

## Thirty Seconds Lost?

by Samuel Halpern

In our commemorative book, *Report Into the Loss of the SS Titanic – A Centennial Reappraisal*,<sup>1</sup> it was stated that about half a minute went by between the 3-bell warning from the lookouts and the issuing of a hard-astarboard helm order (left full rudder by modern standards) by First Officer William Murdoch. The rationale for this interval lies primarily in the mutually supporting testimony of two key eyewitnesses who were on the scene that night, Lookout Frederick Fleet, who was up in the crow's nest, and Quartermaster Robert Hichens, who was at the wheel. Additional supporting evidence also comes from Standby Quartermaster Alfred Olliver who was at the standard compass platform amidships when the 3-bell warning from the lookouts was sounded.

To summarize the evidence, we have the following subjective estimate from Fleet:

Senator Fletcher: When you gave the three bells did you immediately turn to the telephone?

Frederick Fleet: Yes, sir.

Senator Fletcher: How long were you at the telephone?

Frederick Fleet: I suppose *half a minute*.

Senator Fletcher: When you turned from the telephone and observed the course of the ship, you saw she had turned to port?

Frederick Fleet: Yes, sir.

Senator Fletcher: Did she turn immediately and suddenly, or gradually, to port?

Frederick Fleet: Just started to go as I looked up.

and the following subjective estimate from Hichens:

The Attorney-General: What was the first notice to you that there was something ahead?

Robert Hichens: Three gongs from the crow's-nest, Sir.

The Attorney-General: That you would hear in the wheelhouse, would you?

Robert Hichens: Certainly.

The Attorney-General: And you knew what that meant?

Robert Hichens: Certainly, Sir.

The Attorney-General: That meant something ahead?

Robert Hichens: Yes.

The Attorney-General: How long was that before the order came "Hard-a-starboard"?

Robert Hichens: Well, as near as I can tell you, *about half a minute*.

Both mutually supporting answers to direct questions that suggest that about ½ minute elapsed from the time that Fleet struck the signal bell three times signaling that an object was sighted ahead to when Murdoch issued the order to put the helm hard over.

But we also know that it takes some finite amount of time for the ship to turn after the helm order was given before she struck the iceberg along her starboard side. According to Robert Hichens, "she just swung about two points when she struck," and according to Frederick Fleet, she change her course from a direct line "a little over a point, or two points" when she struck. Once again, we have mutually supporting evidence that the ship turned to port some measurable amount before striking the iceberg.

Hichens was in an enclosed wheelhouse when all this happened. His knowledge of how far the ship had turned after receiving the helm order came from looking at the steering compass directly in front of him. As he said, “The vessel veered off two points; she went to the southward of west.” Her course before the helm order was given was “N 71° W” (289°) on the steering compass.<sup>2</sup> That course was also marked on the dimly lit course-board in front of him in the enclosed wheelhouse. It was the same course handed over to him when he took the wheel at 10 p.m.

Fleet was just going back to his place on the port side of the crow’s nest after leaving the loud-speaking telephone, located on the aft starboard side of the nest, when he saw the ship veering to port. He had just finished calling down to Sixth Officer James Moody in the wheelhouse to report seeing an iceberg ahead. This call came a few moments after he struck the bell three times to warn the bridge that some object was sighted ahead. As soon as he recognized that the object was an iceberg, he went to the loud-speaking telephone and rang them up:

I asked them were they there, and they said yes. Then they said, ‘What do you see?’ I said, ‘Iceberg right ahead.’ They said, ‘Thank you.’

Fleet then went from the phone to his place on the port side of the nest when, according to Fleet, “My mate [Reginald Lee] saw it and told me. He told me he could see the bow coming around.” This has led Fleet to believe that the ship started to turn to port while he was at the telephone. However, according to his lookout mate Reginald Lee:

As soon as the reply came back ‘Thank you,’ the helm must have been put either hard-astarboard or very close to it, because she veered to port, and it seemed almost as if she might clear it, but I suppose there was ice under water.

Clearly, Lee was saying that the helm must have been put hard-astarboard soon after Moody’s reply of “thank you” was given to Fleet, not before. And we know from Hichens that Moody repeated what Fleet had just reported on the phone to First Officer William Murdoch who then gave the order to put the helm hard-astarboard and then rushed to the engine telegraphs to ring down orders to the engine room.

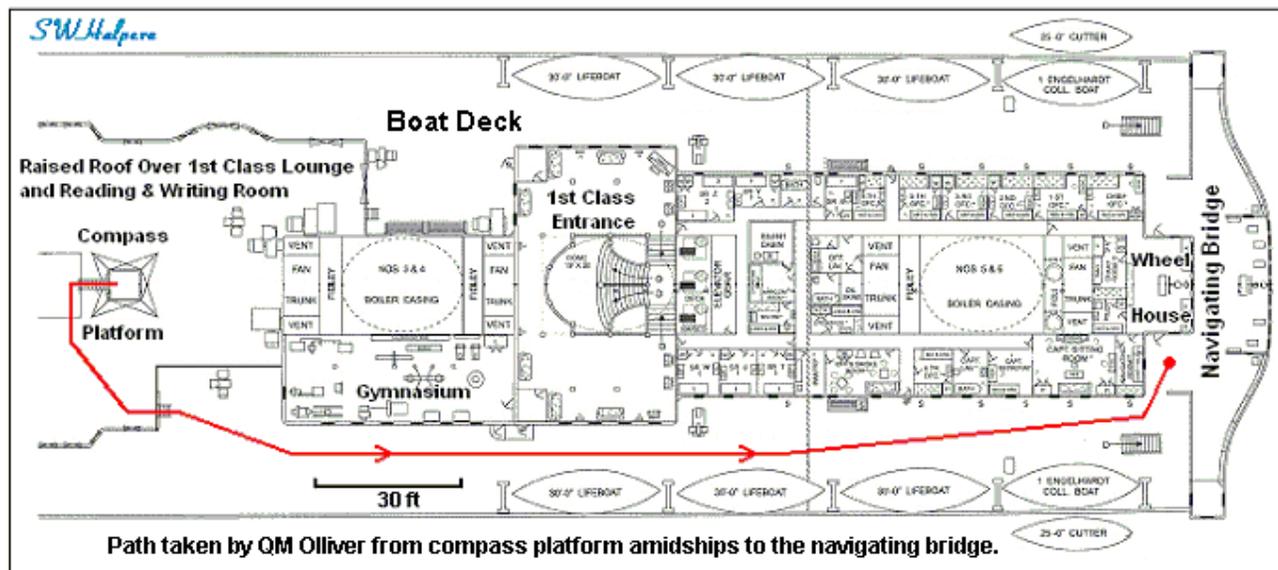
From their vantage point high up in the crow’s nest, Fleet and Lee watched as the ship veered to port “a little over a point, or two points...until the iceberg was alongside of her.” The iceberg then seemed to strike “just about in front of the foremast” on the starboard side.

According to Lee, the berg “might have been half a mile or more; it might have been less” when it was first spotted. Making a reported 22½ knots (38 feet per second) through the water at the time, it would take *Titanic* about 80 seconds to cover a distance of half a nautical mile. According to both lookouts, the signal bell was struck as soon as this dark object was sighted ahead.

At that moment, Standby Quartermaster Alfred Olliver was busy tending to the lights in the standard compass located on a platform amidships. According to Olliver:

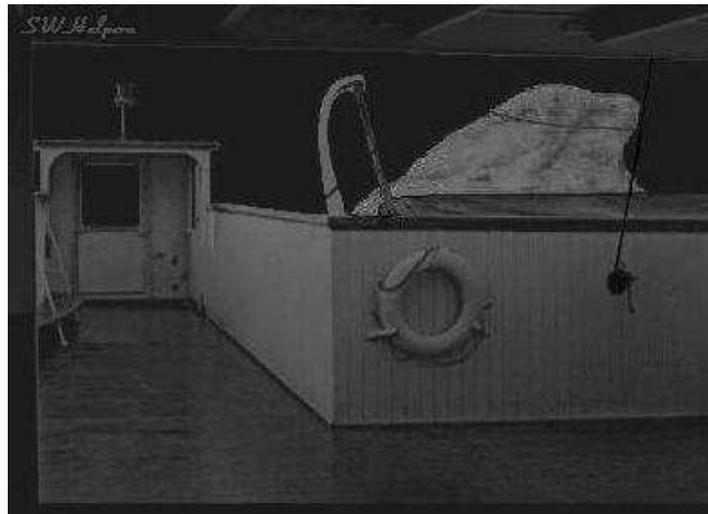
When I was doing this bit of duty I heard three bells rung up in the crow’s nest, which I knew that it was something ahead; so I looked, but I did not see anything. I happened to be looking at the lights in the standing compass at the time. That was my duty, to look at the lights in the standing compass, and I was trimming them so that they would burn properly. When I heard the report, I looked, but could not see anything, and I left that and was just entering on the bridge just as the shock came. I knew we had touched something.

Of course Olliver was not able to see anything directly ahead of him since his view would be blocked by the ship's second funnel, but his instinctive reaction was quite understandable upon hearing those 3 bells. His actions that followed, however, are very revealing. He immediately leaves the compass platform and goes forward to the navigating bridge "and was entering the bridge when the collision occurred" in time to hear "a long grinding sound" that "did not last many seconds." He also saw First Officer Murdoch about the lever that was close to the wheel on the navigating bridge that closed the watertight doors down in the machinery spaces.



As Olliver went on to explain:

I found out we had struck an iceberg...The iceberg was about the height of the boat deck; if anything, just a little higher. It was almost alongside of the boat, sir. The top did not touch the side of the boat, but it was almost alongside of the boat...[It was] just abaft the bridge when I saw it.



What QM Olliver saw.

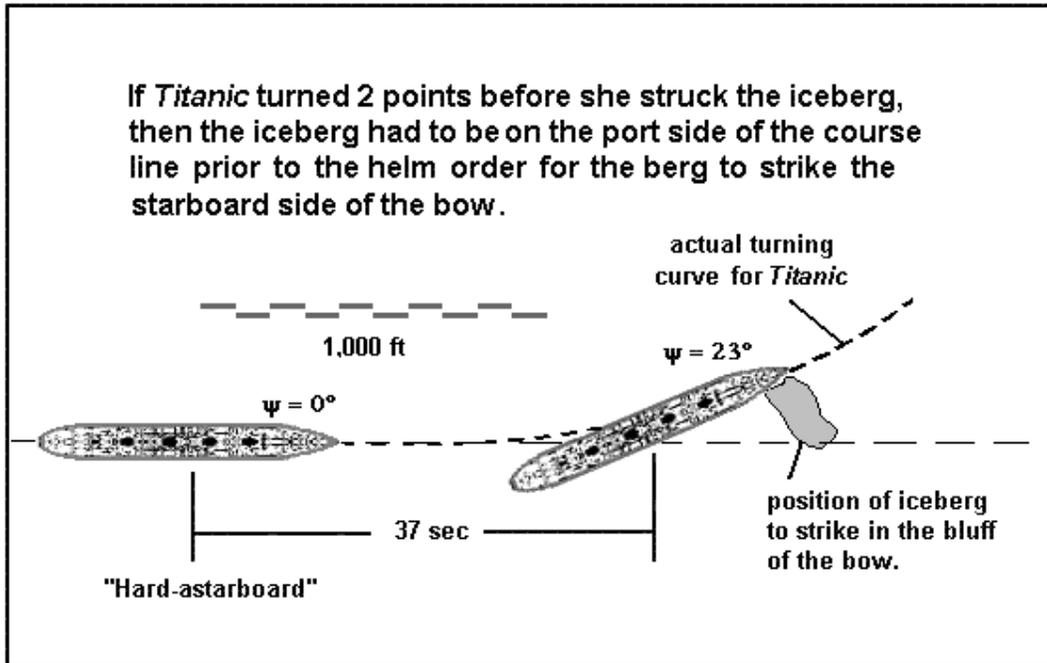
The walking distance from the compass platform to the bridge is about 250 feet. Assuming Olliver walked at a typical pace reported for people hurrying to cross a busy intersection, and allowing for a few seconds of reaction time, it is estimated that it would have taken him about 50 seconds to reach the bridge after hearing those 3 bells. At a sustained 22½ knots, *Titanic* would cover a distance of 1,900 feet (about 1/3 nautical mile) during that interval.

If the helm order was indeed given about half a minute (30 seconds) after the 3-bell signal, as told to us by both Fleet and Hichens, then that leaves about 20 seconds from the time the helm order was given to the time when the ship struck the iceberg. Based on a detailed study of the turning characteristics for these *Olympic* class vessels,<sup>3</sup> it would take almost 25 seconds for the ship to turn about one compass point, and about 37 seconds for it to turn two compass points. This suggests that the interval from the 3-bell lookout signal to when the helm order was given was actually less than half a minute.

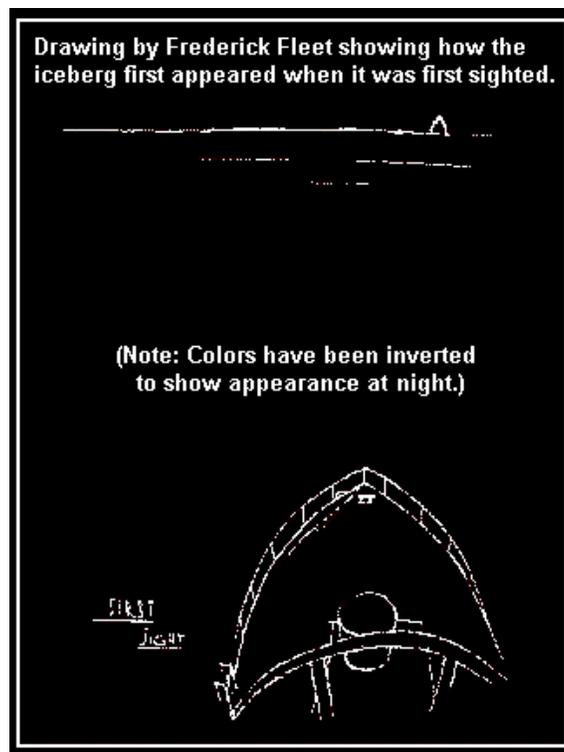
<b>Time (sec)</b>	<b>Relative Heading (degrees)</b>	<b>Speed (knots)</b>	<b>Forward movement (ft)</b>	<b>Lateral movement (ft)</b>
0	0.0	22.5	0	0
2.5	0.0	22.5	95	-1
5	0.2	22.3	189	-2
7.5	0.7	22.1	283	-5
10	1.6	21.9	376	-9
12.5	2.8	21.7	467	-12
15	4.3	21.4	558	-15
17.5	6.1	21.2	648	-17
20	8.0	20.9	736	-16
22.5	10.0	20.7	824	-14
25	12.1	20.4	911	-9
27.5	14.2	20.2	996	-1
30	16.4	20.0	1081	9
32.5	18.6	19.8	1164	22
35	20.8	19.6	1246	37
37.5	23.0	19.4	1327	55

But what about Hichens' observation on the steering compass that the ship turned about two points (22½°) when she struck?

If we examine the details of the ship's turning circle, and plot what the results would be to achieve a two-point turn at 37 seconds, we get the picture shown below for the ship striking an iceberg in the bluff of the bow on the starboard side in the vicinity of the peak tank as we know it did. What it shows is that the iceberg, reported as a medium sized berg with a peak that reached a little higher than *Titanic*'s boat deck,<sup>4</sup> would have had to be over on the port side of the ship's course line when the helm order was first given.<sup>5</sup> It is highly unlikely that Murdoch would have given an order to turn the ship's head to port (hard-starboard helm) if that was truly the case.



When Frederick Fleet was asked to sketch a picture of what he saw when the iceberg was first sighted, he placed the peak of the berg slightly off *Titanic*'s starboard bow, not over on the port side. He said that they swung the ship's bow away from the object "because we were making straight for it."



What Fleet saw at time of first sighting.

This leads us to believe that ship would have turned a little more than a point when she first struck the iceberg, not two points as concluded by the British Wreck Commission back in 1912 based on what Hichens reported.<sup>6</sup> Hichens' observation that the ship went south of west on the steering compass was most likely the maximum amount that the ship veered to port after striking the iceberg before the ship started to turn back to starboard under port helm (right rudder by modern standards).

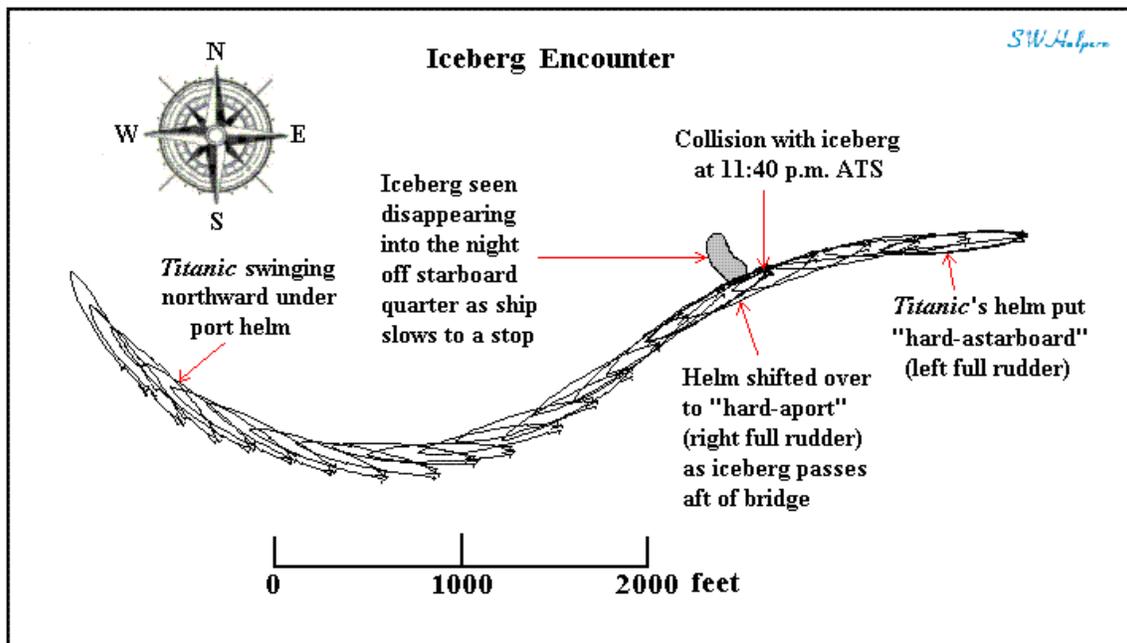
We know that the ship was placed under port helm after striking the iceberg from multiple sources, including standby QM Alfred Olliver:

I know the orders I heard when I was on the bridge was after we had struck the iceberg. I heard hard aport, and there was the man at the wheel [Hichens] and the officer [Moody]. The officer was seeing it was carried out right.

The purpose of this order was obviously to mitigate further damage to the starboard side of the ship. It was not part of a maneuver to avoid contact. Contact had already taken place. That the helm had been shifted is confirmed from observations of crewmen such as AB Joseph Scarrott and Fireman Alfred Shiers who came topside within minutes of the ship striking and saw the iceberg disappearing into the night off the ship's starboard quarter. As Scarrott noted:

[She was] under port helm. Her stern was slewing off the iceberg. Her starboard quarter was going off the iceberg, and the starboard bow was going as if to make a circle round it.

When *Titanic* finally came to a stop, she was facing northward. As later witnessed by Quartermaster George Rowe when he came onto the navigating bridge carrying extra distress rockets, "[Her stern was] practically dead south...her head was facing north."



But the real issue in all of this is the apparent delay that occurred between the 3-bell lookout signal and the order to put the helm hard-astarboard.<sup>7</sup> Why would Murdoch wait to take decisive action? Furthermore, was the delay as long as 30 seconds or was it shorter than that?

To answer these questions we have to create a realistic scenario of the events that took place from the time that the iceberg was sighted. For this we can utilize some of the footage from James Cameron's 1997 epic film which realistically depicted events on the bridge during the early part of the iceberg encounter. These scenes were created on a full scale recreation which added a degree of realism to the movements of the individuals involved. Except for a few minor points in the recreated scenes, which will be noted, we find that a realistic time duration taken from the 3-bell signal to when the hard-astarboard order was given is about 20 seconds of elapsed time, not 30 seconds.

The recreation of events in the film has the starboard-side lookout striking the bell three times and then calling down on a phone in front of him to the wheelhouse. In reality, it was Frederick Fleet, over on the port side of the nest, that struck the lookout bell three times and then went behind his mate Reginald Lee, who was on the starboard side of the nest, to get to a loud-speaking telephone, the same type that was used in the wheelhouse, to call down. The film also shows Sixth Officer James Moody coming out of the chart room carrying a cup of tea when the call came down from the nest. We have no way of knowing exactly where Moody really was when the call came, but we know from Fleet's initial words on the loud-speaking phone, "Are you there?" that there was a few seconds delay before Moody answered the phone. It is just as likely that that when Moody, normally stationed close to the helmsman, heard 3-bells strike from the nest, instinctively would have walked over toward the wheelhouse door in anticipation that Murdoch would have seen what was sighted ahead and may soon issue orders. When the phone signal from the crow's nest came down a few seconds after the 3 bells were struck, Moody would have turned from the door to go to the back wall of the wheelhouse where four loud-speaking telephones were located to answer the one from the nest.<sup>8</sup> When he did answer, his response to Fleet's "Are you there?" question was, "Yes, what do you see?" Fleet then said, "Iceberg right ahead," to which Moody calmly replied, "Thank you." Moody then would have run to the wheelhouse door to report to Murdoch, "Iceberg right ahead." By the time he reached the door, just seconds after leaving the phone, Murdoch had arrived from his position out on the starboard bridge wing and gave the order "Hard-astarboard."

As discussed in chapter 5 of *Report Into the Loss of the SS Titanic*, the most likely reason that Murdoch did not respond as soon as the 3-bell signal was heard was his need to assess the situation that was fast unfolding in front of him. It was argued that Murdoch probably saw the berg within seconds from the time the bells were struck and quickly assessed its relative bearing. More importantly, he needed to estimate the distance to the object to decide exactly what to do. If the object appeared to be too close at hand, trying to turn the ship away may very well cause a collision as the ship's stern initially would swing to the outside of the turn while the ship would continue to move straight ahead. In that situation, the best action might be to hold her steady if it appeared that the ship might actually have a chance of clearing the object if it was slightly off to the side. As all ship handlers know well, if the bearing to an object is opening up, you are *not* on a collision course. If it remains the same, or doesn't change much, you are on a collision course. Given enough distance, he might even try to swing the ship around the object by first swinging her head away to one side of the object, and then swing her in the opposite direction to clear the stern.

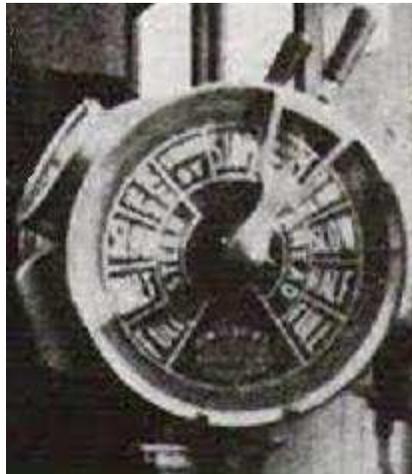
All this takes some finite amount of time to assess. When Murdoch finally decided on what needed to be done, he ran from where he was on the starboard-side bridge wing to the nearby wheelhouse door and got there just in time to hear Moody relay to him the lookout report, "Iceberg right ahead." Murdoch then called out "Hard-astarboard!"

During those 20 seconds, between the 3-bell signal and when the hard-astarboard order was given, we have the following events taking place (where T is the time just at the end of the listed event):

<u>Time (sec)</u>	<u>Events taking place</u>
0	Fleet strikes 3 bells up in the nest.
4	Fleet picks up phone in back of nest and signals the wheelhouse. QM Olliver leaves the amidships compass platform for the bridge.
9	Receiving no reply, Fleet calls out on the loud-speaking telephone: “Are you there?”
10	Phone answered by Moody: “Yes, what do you see?”
13	Fleet replies: “Iceberg right ahead!”
15	Moody acknowledges: “Thank you.”
19	“Iceberg right ahead!” reported by Moody.
20	“Hard-astarboard!” ordered by Murdoch.

As soon as Murdoch gave the helm order he ran over to the nearby engine-order telegraphs located on the right side of the navigating bridge to ring down orders to the engine room. In the film they showed him pulling the telegraph handles back from Full Ahead, to Stop, then forward again, and then all the way back to Full Astern. Based on testimony from those that were down in the engine rooms at the time, it seems that Murdoch actually rang down a Stop order, not a Full Astern order. (The only witness who reported that Full Astern was rung down on the telegraphs was Fourth Officer Joseph Boxhall, an order that is not supported by any other evidence and inconsistent with other reported actions taken at the time.)

After ringing down Stop on the regular engine-order telegraphs, Murdoch ran to the emergency engine-order telegraphs and rang down Stop on those as well. From an eyewitness account down in the engine room, the Stop order that came down on both sets of telegraphs were answered by two greasers who were working nearby.<sup>9</sup>



**Engine-order telegraphs used on *Titanic*.**

After ringing down those engine orders, Murdoch went over to the watertight door (WTD) control switch and pressed a button that rang a warning bell that was located next to each drop-down watertight door on the tank top in the machinery spaces. The written notice next to the WTD control switch read:

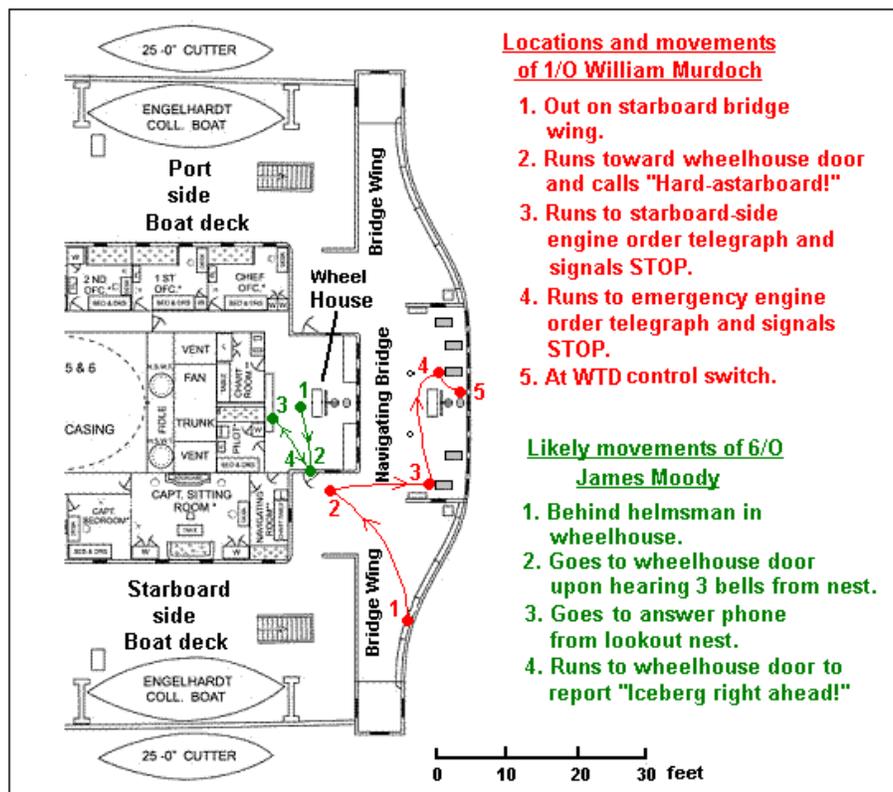
“In case of emergency, to close watertight doors on tank top, press bell; push for 10 seconds to give alarm; then move switch to ‘on’ position and keep it there. Note: Doors cannot, however, be operated mechanically whilst switch is on.”

According to Third Officer Herbert Pitman, *Titanic's* WTD control switch was located "close to the wheel" on the navigating bridge.

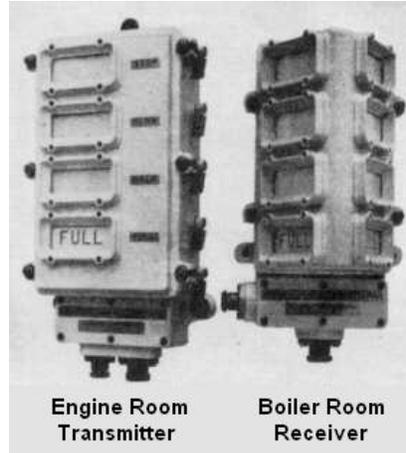
The events just described are listed in the continued timeline that we started from the 3-bell signal:

<u>Time (sec)</u>	<u>Events taking place</u>
24	Murdoch at engine order telegraph.
26	Telegraph set to STOP.
28	Moody reports: "Helm hard-astarboard."
31	Murdoch at emergency engine telegraph.
33	Telegraph set to STOP.
36	Response bells rung back from Engine Room. Murdoch at WTD switch; pushes warning button.

The described movements of First Officer William Murdoch and Sixth Officer James Moody are shown in the diagram below.



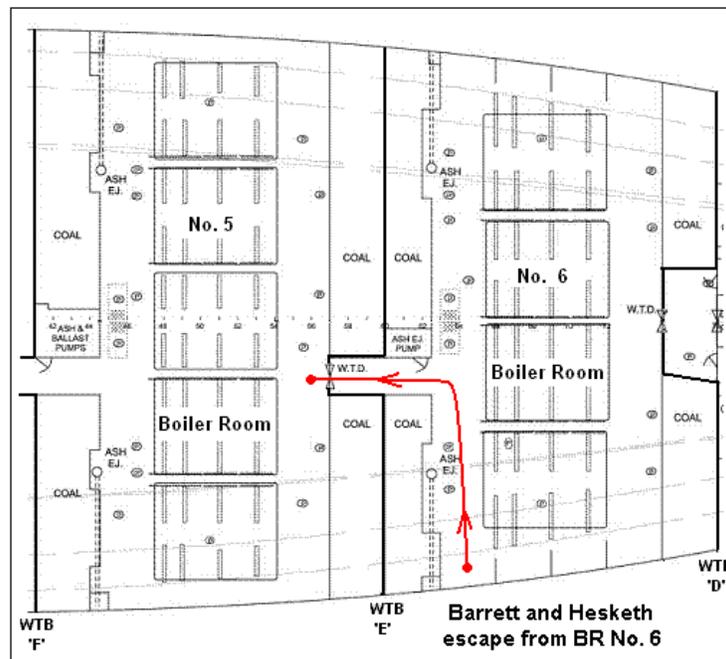
Down in the engine room the engineers on duty scrambled to obey the unexpected orders that were sent down by the mechanical telegraphs. The immediate thing that had to be done was to close the stop valves feeding the two reciprocating engines. In addition to that, an order had to be sent to all the stokeholds to stop feeding the fires and shut the dampers to limit the buildup of steam pressure. Within a few seconds of receiving the stop order, someone in the engine room managed to get to the boiler room telegraph transmitter to switch the order from Full to Stop. When this was done, a white light on the bottom of the indicator marked "FULL" went off while a red light on the top of the indicator marked "STOP" went on in all six boiler room compartments.



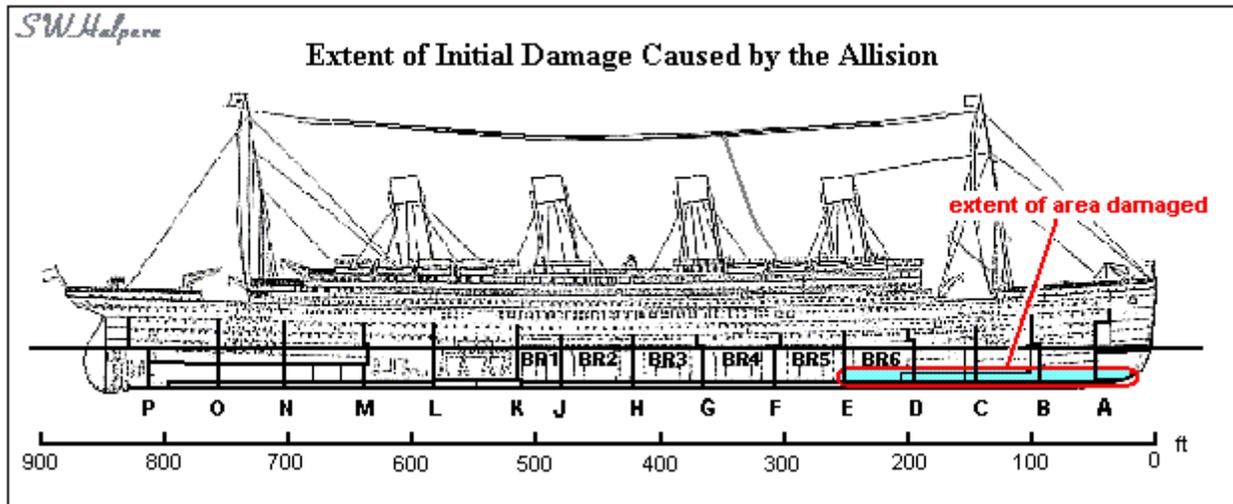
In Boiler Room No. 6, Leading Fireman Fredrick Barrett was busy talking to Junior Second Engineer John Hesketh when the boiler room telegraph went to Stop and bells were heard. Immediately Barrett called out to the firemen working the furnaces to “shut all dampers.” However, before they could get all the dampers shut, the ship struck ice. As Barrett described it:

Water came pouring in two feet above the stokehold plate; the ship’s side was torn from the third stokehold [aft] to the forward end.

Barrett was standing near the starboard side of Stokehold No. 10 on the aft side of Boiler Room No. 6. which was located about 250 feet aft of the ship’s bow. When the side of the ship next to him opened up about 2 feet above the plates that he was standing on, a stream of water swept through knocking him off his feet. He picked himself up and, along with Second Engineer Hesketh, sprang for the watertight door that separated Boiler Room No. 6 from Boiler Room No. 5. He and Hesketh managed to get through the door just as it came down behind him “like a knife” as he was to say later.<sup>10</sup>



Knowing the extent of damaged caused by the allision with the iceberg as well as the speed of the vessel as it enters a hard turn, we find that it would take about 7 to 8 second for the berg to get from the area of the peak tank in the bow to as far back as watertight bulkhead E that separated Boiler Room 5 from 6. According to Barrett, the empty bunker on the fore starboard side of Boiler Room 5 was penetrated to about 2 feet aft of the watertight bulkhead which caused the empty bunker space to flood.



Our continued timeline of events from the 3-bell signal shows the following:

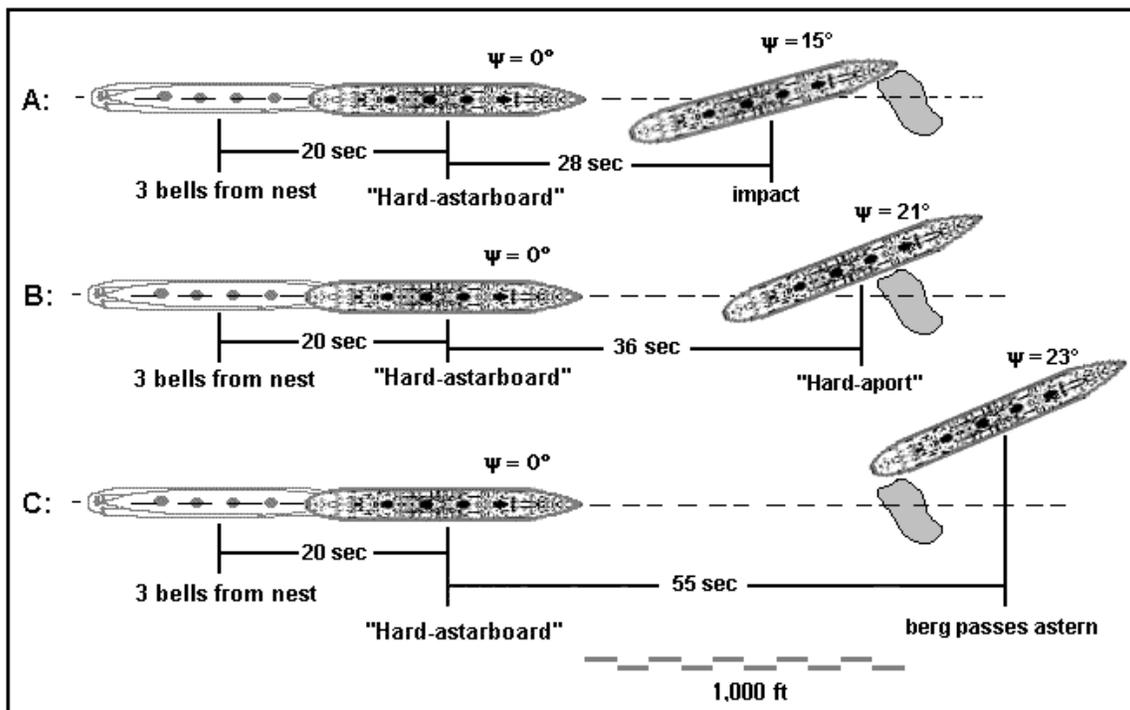
<u>Time (sec)</u>	<u>Events taking place</u>
42	"Shut all dampers!" called out by Barrett.
46	Murdoch closes the WTD switch.
48	Allision with iceberg begins in the area of the peak tank in the bow.
50	QM Olliver enters bridge and sees Murdoch about the WTD control switch.
55	Allision with iceberg ends. Olliver sees the peak of the iceberg passing aft of the starboard bridge wing.

Based on the timing shown in the developed timeline, as well as the derived turning characteristics of these *Olympic*-class vessels, we find that the ship would have turned about 15 degrees (1.33 points) from time the hard-astarboard order was first given to the time that it struck the iceberg. This is in good agreement with what Frederick Fleet said he observed from the lookout's nest. From QM Olliver we also know that First Officer Murdoch called "hard-astarboard" after the peak of the iceberg went aft of the bridge in an apparent attempt to minimize damage along the starboard side of the vessel. This was just after the sound of the allision had ceased. We also know that it would take about 15 seconds for Hichens to get the wheel all the way over from one side to the other shifting the rudder from 40° left of center to 40° right of center, and that Sixth Officer Moody sang out "Helm hard-astarboard" when the helm was hard over. Furthermore, we also know from our derived turning curves that it would have taken about 27 seconds for the iceberg to reach the stern of the vessel from the time it first struck as the ship was slowly losing speed, and that it takes from 25 to 30 seconds for all the drop-down watertight doors down on the tank top to completely close from the time the switch on the bridge was first thrown. In addition we were told that Captain Smith came through the wheelhouse from his quarters onto the bridge within about one minute from the time of the collision and asked his first officer "What have we struck?"<sup>11</sup>

Based on all of this, we are thus able to complete the events timeline that we started from the 3-bell signal as shown below. (See Appendix – A for the complete timeline of events that was developed.)

<u>Time (sec)</u>	<u>Events taking place</u>
56	Murdoch calls out: "Hard-aport!"
71	Moody confirms "Helm Hard-aport."
74	Murdoch orders Olliver to take the time and Moody to make a note of the incident in the logbook.
75	Capt. Smith enters wheelhouse from his quarters as QM Rowe sees the iceberg pass aft of the stern. Barrett sees WTD slam shut behind him.
78	Capt. Smith steps onto the bridge and asks Murdoch, "What have we struck?"

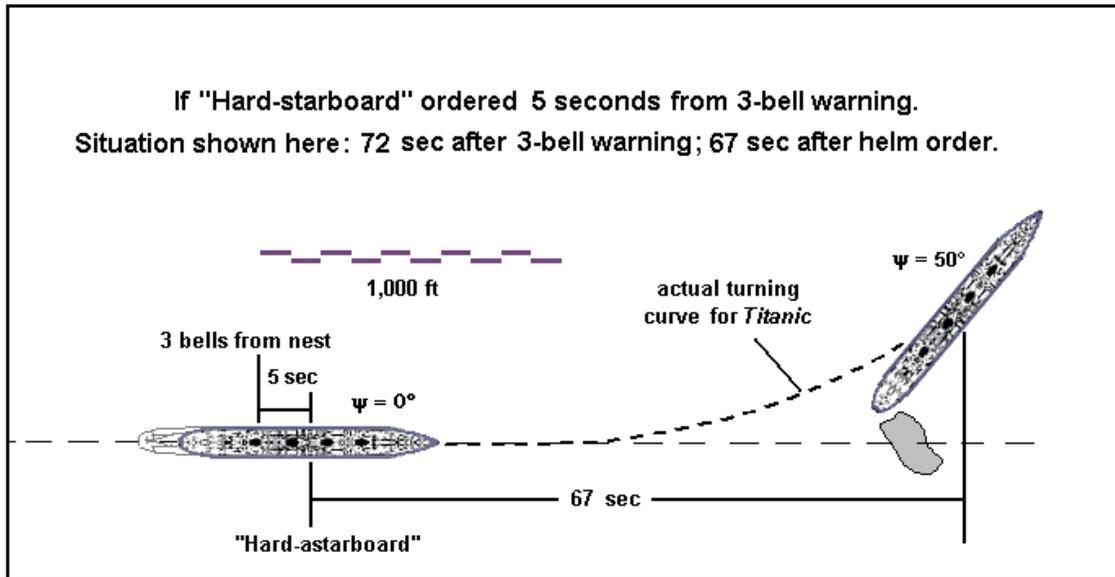
The diagram below shows the advance of the vessel: a) to the initial contact with the iceberg 28 seconds after the hard-astarboard order was given, b) to the time of the hard-aport order 36 seconds after the hard-astarboard order was given, c) to the time that the stern of the vessel passed the berg 55 seconds after the hard-astarboard order was given; all assuming the hard-astarboard order came 20 seconds after the 3-bell lookout signal took place.



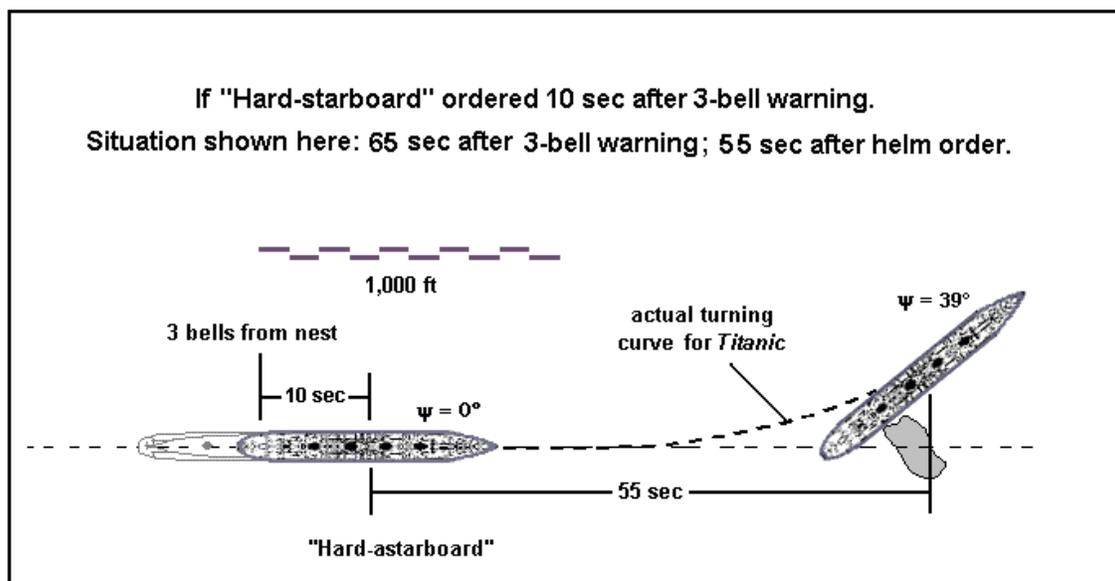
It is believed that the above scenario represents a realistic view of the detailed events leading up to and shortly after the encounter with the iceberg. However, we still must ask why did it take First Officer Murdoch about 20 seconds before calling out the hard-astarboard order? Why not sooner?

To give us some insight into the answers to these question, we have used derived turning curves for *Titanic* to see what would have happened if Murdoch would have called for the helm to be put hard-astarboard T seconds after the 3-bell lookout warning. The different times considered are: T = 5, 10, 15, 20, 25 and 30 seconds. The results are shown in the following set of diagrams:

1. A hard-astarboard order given within 5 seconds of the 3-bell signal. The ship's stern would have cleared the iceberg about 67 seconds later (72 seconds from the 3-bell signal) without the need for any other maneuvering as shown below:

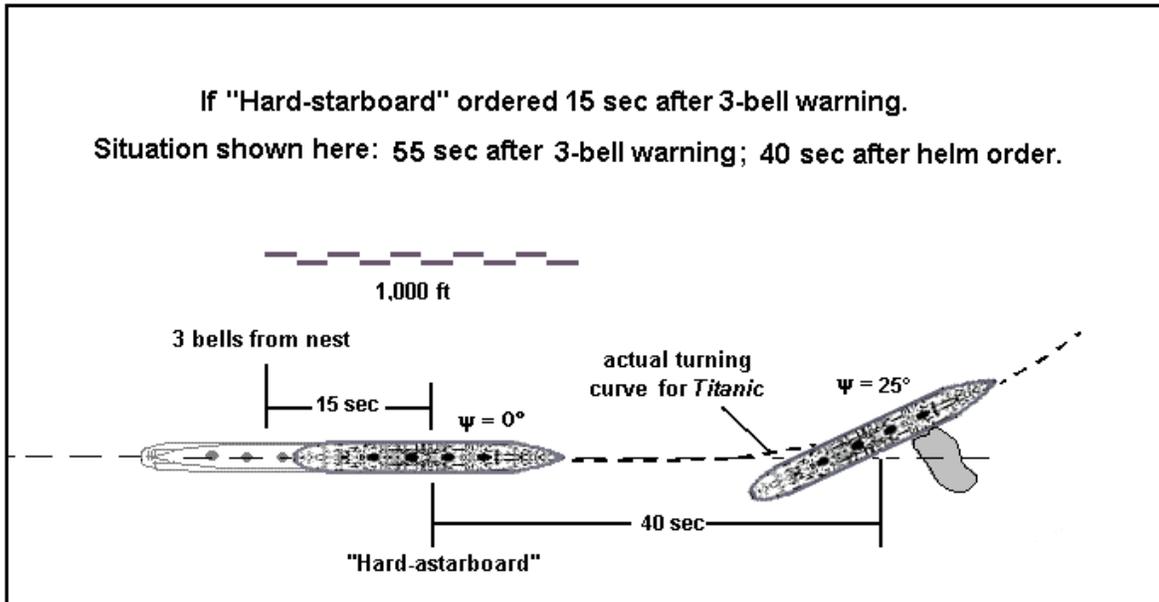


2. If the hard-astarboard order was given only 10 seconds after the 3-bell signal, and no other orders given afterward, the ship would have struck the berg in the vicinity of the turbine engine and electric dynamo compartments 55 seconds later (65 seconds from the 3-bell signal) as shown in the next diagram. Damage caused by the collision would likely have extended further aft opening up four or perhaps five compartments to the sea. In that condition, the ship could not stay afloat.

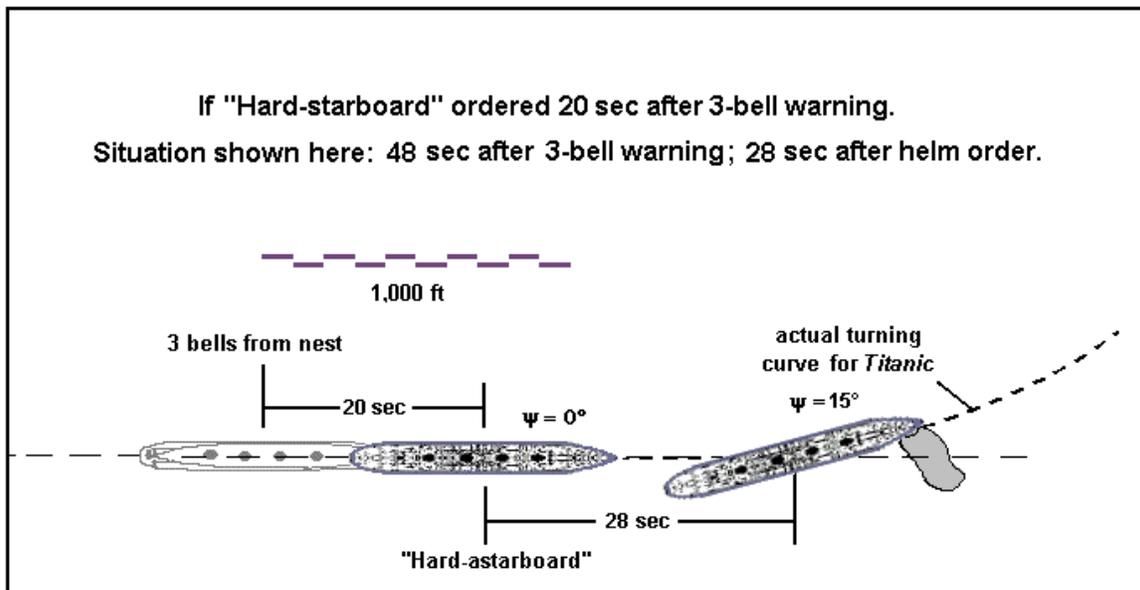


3. If the hard-astarboard order was given 15 seconds after the 3-bell signal, and no other orders given afterward, the ship would have struck the berg 40 seconds later (55 seconds from the 3-bell signal) in the

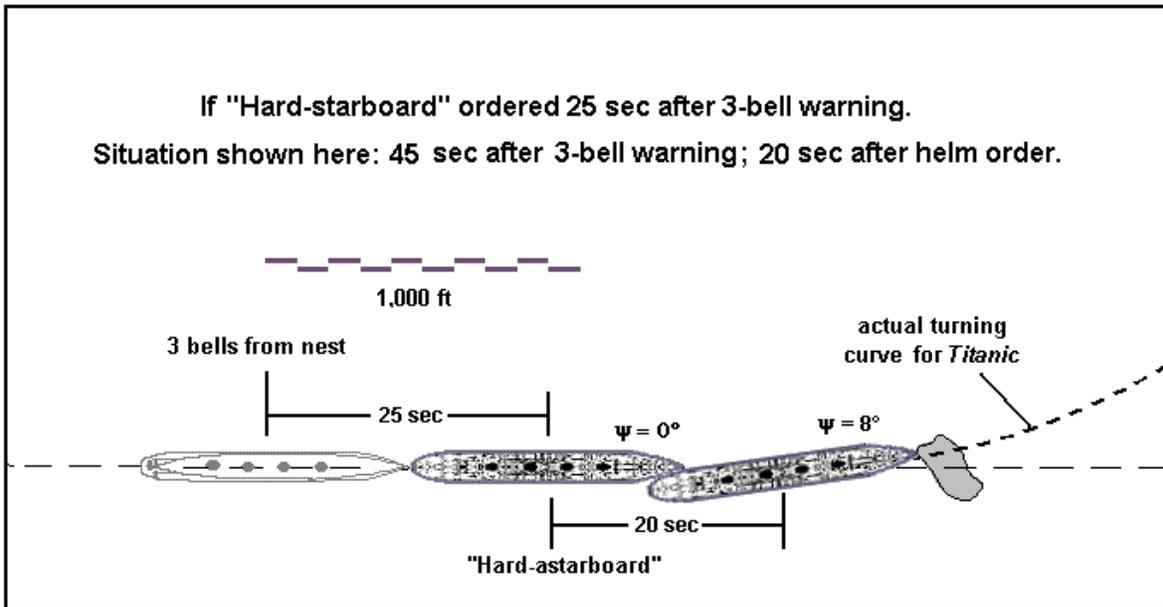
vicinity of boiler rooms No. 5 and 6 as shown below. Damage would have extended further aft to include several other compartments. More than likely, the ship would have lost transverse stability and capsize, which is what happened in the relatively recent *Costa Concordia* grounding accident.



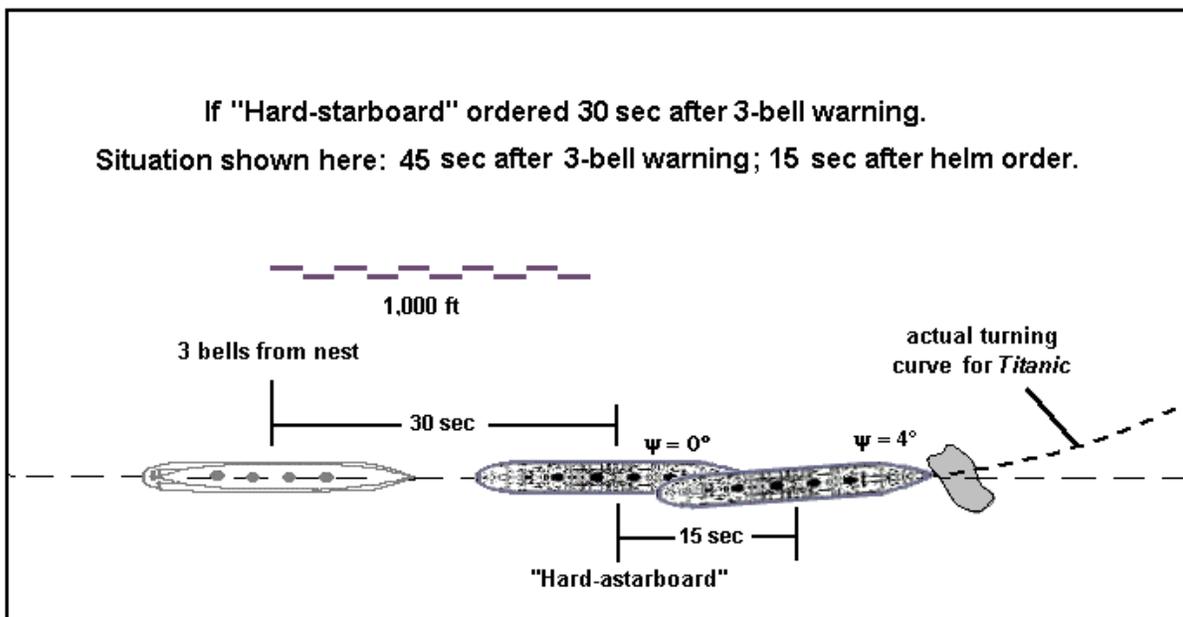
4. With a delay of 20 seconds from the 3-bell signal, the ship would have struck the iceberg in the vicinity of the peak tank and cargo hold No. 1 just 28 seconds after the helm order was given (48 seconds from the 3-bell signal) as shown below. This would result in an allision with the iceberg causing damage that would extend aft to include holds No. 2 and 3 and boiler room No. 6. This is what seemed to have happened to *Titanic* leading to the foundering of the vessel after 2 hours and 40 minutes.



5. If the helm order was given 25 seconds after the 3-bell signal, the ship would strike the berg in the bow 20 seconds after the helm order was given, or 45 seconds from the 3-bell signal. Most likely the ship would have been saved with damage confined to the first two or three compartments. This situation is shown in the diagram below.

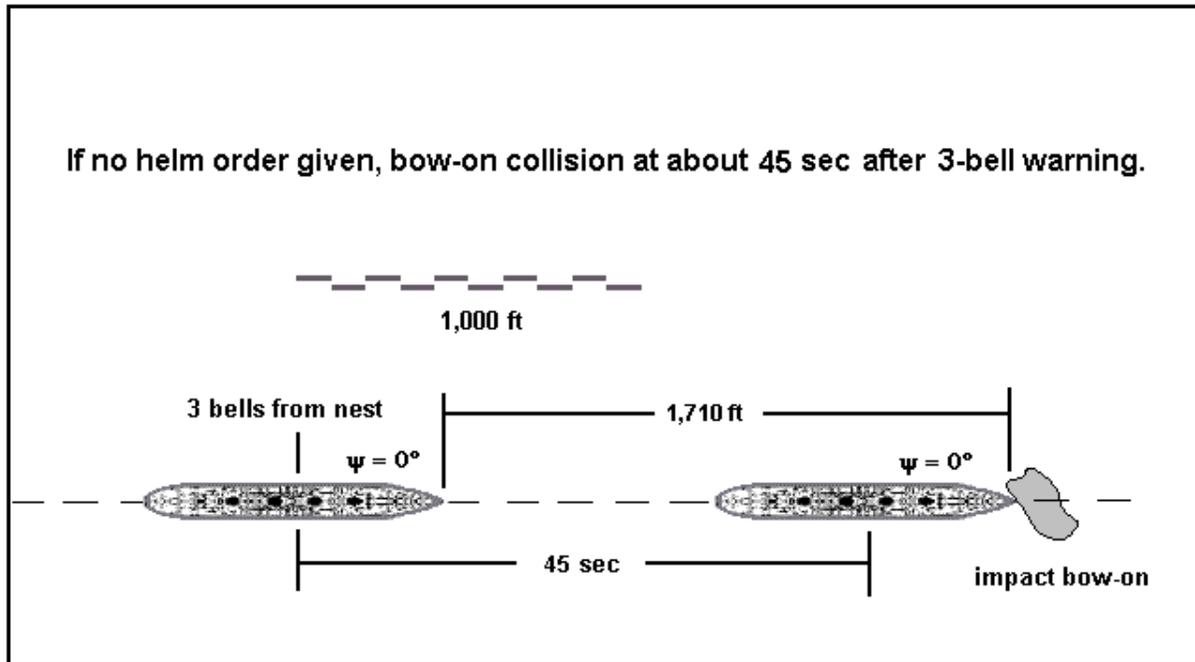


6. The same would happen if the helm order was given 30 seconds after the 3-bell signal with the ship striking the berg in the bow 15 seconds later, or 45 seconds from the 3-bell signal as shown below.



Finally, if *Titanic's* first officer had elected not to turn at all, the ship would have struck the berg square-on about 45 seconds after the lookout signal was given as shown below. Naval architect Edward

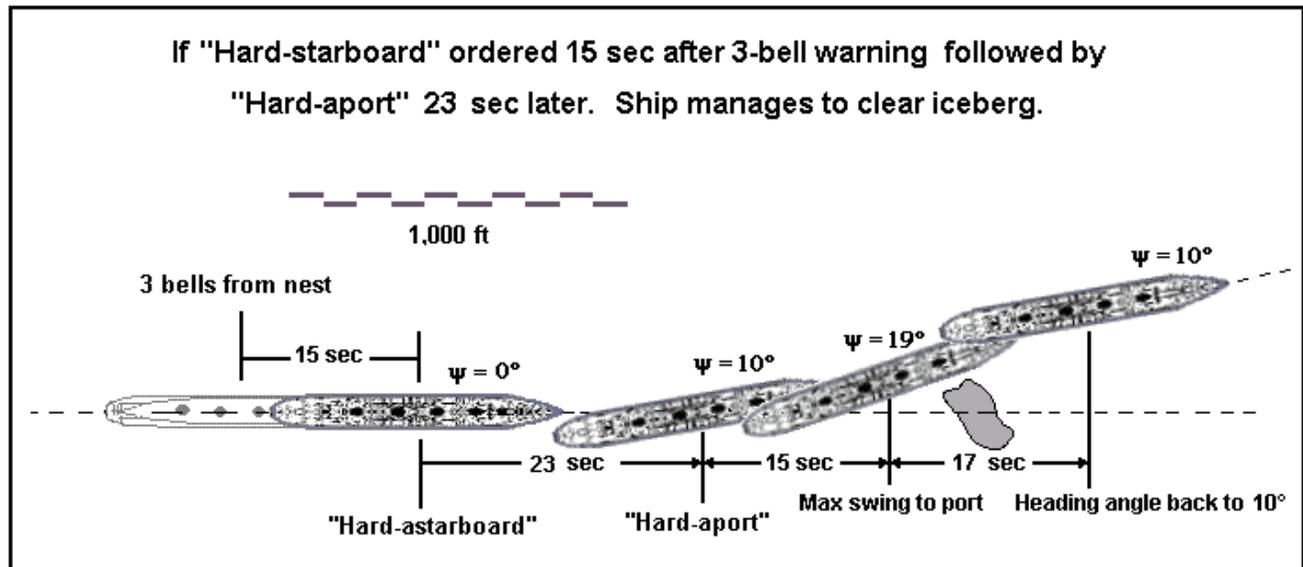
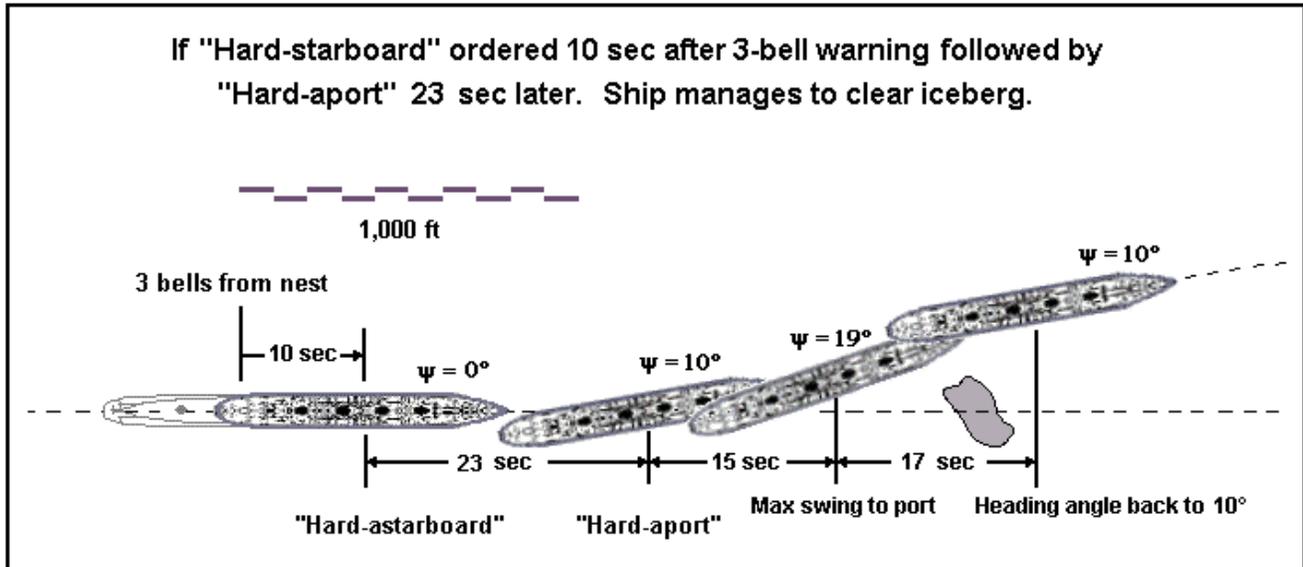
Wilding from Harland & Wolff estimated that if the ship had hit the berg bow-on, then “the momentum of the ship would have crushed in the bows for 80 or perhaps 100 feet” crushing in the first two watertight compartment within about 5 seconds of initial contact. The ship would have stayed afloat despite many casualties among the firemen, trimmers and greaser who were stationed in that part of the ship.



As can be seen in the scenarios considered above, for *Titanic* to have missed striking the iceberg, the hard-astarboard helm order would have to have come within the first 5 seconds following the 3-bell lookout signal. However, there was one other option that could have been taken to avoid contact with the iceberg. That option is called a “port-around maneuver” which was mentioned by *Titanic*’s fourth officer Joseph Boxhall during the enquiries. According to Boxhall, after the first officer told Captain Smith that the ship hit an iceberg he also told Smith: “I intended to port around it, but she hit before I could do any more.”<sup>12</sup>

Given enough distance, the intent of such a maneuver is to first swing the ship’s head to port away from the iceberg to clear the bow by ordering the helm hard-astarboard, and then swing the ship’s stern away from the object by shifting the helm to the opposite side by ordering the helm hard-aport. If executed properly, the ship would first swing to the left and then swing to the right as it goes around the approaching danger. Basically, it is a side-step maneuver to avoid an object that is directly ahead of the vessel, but requires very precise timing on the part of the ship handler.

Using the derived turning characteristics of the vessel under zigzag movements, we were able to determine the conditions under which such a maneuver could have been executed successfully. We already knew from our previous results that the ship would clear the iceberg if the hard-astarboard order came within the first 5 seconds following the lookout signal, even if no other order was given. So we looked at two other possibilities. The first possibility assumes that Murdoch calls hard-astarboard 10 seconds after the 3-bell lookout signal, and then calls hard-aport 23 seconds later. The second assumes that Murdoch calls hard-astarboard 15 seconds after the 3-bell lookout signal, and then calls hard-aport 23 seconds after that. These are both shown in the diagrams below:



In both these situations, it is seen that the port-around maneuver would likely have been successful. In the second case, with a 15 second delay between the 3-bell signal and the first helm order, the ship would just clear the iceberg off its starboard side. However, with a 20 second delay between the 3-bell signal and the first helm order, there simply would not be enough distance to execute the maneuver successfully, and the ship would strike the berg in the bluff of the bow on her starboard side which is what actually happened. Unfortunately, those last 5 seconds before ordering the helm be put hard-astarboard proved to be fatal.

Although it is interesting to consider these alternative "what if" scenarios with the information that we now have available, it still comes down to the actual events that took place that fateful night when a dark object was sighted ahead at twenty minutes to midnight. It is easy with hindsight to suggest that William Murdoch should have acted immediately and ordered the ship to turn away as soon as the 3-bells were sounded, or at least within the first 15 seconds. However, we can only say this knowing what we know now, not having to face the conditions that actually confronted Murdoch that night; conditions

where some dark mass, lit only by reflected starlight and outlined against a pure black sea, was sighted with very little time to fully assess a very fast unfolding situation.

The actions taken by Murdoch, once he realized that there were few options left, seems to be one where he hoped to minimize damage to the ship by trying to take a glancing blow in the fore part of the ship along its starboard side, and further minimize any damage by swinging her stern away in the opposite direction soon afterward. Ideally, taking a glancing blow in the fore part of the ship would have dissipated the energy of collision over an area that is generally believed to be less vulnerable than, for example, the area of the machinery spaces. Unfortunately, the ship's first five compartments were opened to the sea, and *Titanic* was not designed to sustain that degree of damage. However, the overall result may have been much worse if the primary damage was sustained further aft, with the ship possibly foundering in a shorter interval of time, or worse yet, capsizing before many of the boats could be launched.

## APPENDIX – A

### Complete Timeline of Events

<u>Time (sec)</u>	<u>Events taking place</u>
0	Fleet strikes 3 bells up in the nest.
4	Fleet picks up phone in back of nest and signals the wheelhouse. QM Olliver leaves the amidships compass platform for the bridge.
9	Receiving no reply, Fleet calls out on the loud-speaking telephone: “Are you there?”
10	Phone answered by Moody: “Yes, what do you see?”
13	Fleet replies: “Iceberg right ahead!”
15	Moody acknowledges: “Thank you.”
19	“Iceberg right ahead!” reported by Moody.
20	“Hard-astarboard!” ordered by Murdoch.
24	Murdoch at engine order telegraph.
26	Telegraph set to STOP.
28	Moody reports: “Helm hard-astarboard.”
31	Murdoch at emergency engine telegraph.
33	Telegraph set to STOP.
36	Response bells rung back from Engine Room. Murdoch at WTD switch; pushes warning button.
42	“Shut all dampers!” called out by Barrett.
46	Murdoch closes the WTD switch.
48	Allision with iceberg begins in the area of the peak tank in the bow.
50	QM Olliver enters bridge and sees Murdoch about the WTD control switch.
55	Allision with iceberg ends. Olliver sees the peak of the iceberg passing aft of the starboard bridge wing.
56	Murdoch calls out: “Hard-aport!”
71	Moody confirms “Helm Hard-aport.”
74	Murdoch orders Olliver to take the time and Moody to make a note of the incident in the logbook.
75	Capt. Smith enters wheelhouse from his quarters as QM Rowe sees the iceberg pass aft of the stern. Barrett sees WTD slam shut behind him.
78	Capt. Smith steps onto the bridge and asks Murdoch, “What have we struck?”

<sup>1</sup> Samuel Halpern, et. al., *Report Into the Loss of the SS Titanic – A Centennial Reappraisal*, The History Press, 2011.

<sup>2</sup> There was a 23° difference between the ship’s true heading (reported to be 266° true) and the heading seen on her steering compass (289°) due to magnetic variation and compass deviation error.

<sup>3</sup> Samuel Halpern, “She Turned Two Points in 37 Seconds,” [http://titanic-model.com/articles/Two Points in Thirty Seven Seconds/Two%20Points%20in%20Thirty-Seven%20Seconds.pdf](http://titanic-model.com/articles/Two%20Points%20in%20Thirty-Seven%20Seconds.pdf). The table shown gives the ship’s relative heading and speed and the forward and lateral movement of the amidships point for various times following a hard-astarboard helm order.

<sup>4</sup> The IIP describes a medium sized iceberg as having a height from 50 to 150 feet and a length from 200 to 400 feet.

<sup>5</sup> At the Thomas Ryan Vs. Oceanic Steam Navigation Company trial in 1913, Harland & Wolff’s Edward Wilding testified that they found from experiments done to *Olympic* at full speed that she traveled 440 yards forward and 100 yards laterally in turning two points in 37 seconds. It seems that the forward distance is correct, but the lateral distance appear to be about three times greater than the turning circle data shows. It is likely that Wilding meant a lateral distance of about 100 feet, not 100

yards, unless he was specifically talking about measurements taken from a location at the bow of the ship and not at its amidships point. Either way, it points to the berg being over to the port side of the course line if indeed the ship had turned two points when she first struck.

<sup>6</sup> Some of what Hichens reported at the inquiries was problematic regarding how long he took to turn the wheel hard over. [BI 948-958, 1006-1016.] At first he said she struck just as he received the order hard-astarboard. Then he said that he did not have time to get the wheel over before the ship struck. Then he said he just got the wheel over when she struck. And finally he said that the ship struck just as Moody reported to Murdoch that the wheel was over hard. It would take about four full turns of the wheel to get it over all the way over to one side from its amidships position. So we may be talking about 7 or 8 seconds at most to put the wheel hard over. In that amount of time the ship would turn no more than about 1 degree off her course line, an almost imperceptible amount. At the American inquiry Hichens said, "But, during the time, she was crushing the ice, or we could hear the grinding noise along the ship's bottom." He also said that the standby quartermaster [Olliver] was standing at his left side when Moody reported to Murdoch that the wheel was over hard. But we know from Olliver that he witnessed hearing a hard-aport order being given and acknowledged, not the hard-astarboard order. It seems that Hichens' recollection of when the ship struck to when he got the wheel hard over after receiving the hard-astarboard order may have been confused with his receiving an order to put the helm hard-aport. Although Hichens never admitted at the inquiries to receiving a hard-aport order, Howard Chapin, a passenger on the rescue vessel *Carpathia*, who interviewed several survivors from *Titanic*, wrote in his *Account of the Disaster as Told by the Quartermaster at the Wheel*: "The first officer tried to clear the ship's bow by putting the helm to starboard and then clear the stern by putting the helm to port, but the iceberg extended far out under the water, and there was no chance of not hitting it." (See George M. Behe, *The Carpathia and the Titanic – Rescue at Sea*, Lulu.com, 2011, p. 36.)

<sup>7</sup> The other person to give extensive evidence in 1912 as to what happened moments before and after the allision with the iceberg was Fourth Officer Joseph Boxhall. However, as pointed out in some detail in my article "She Turned Two Points in 37 Seconds," Boxhall's evidence is also highly problematic and inconsistent on several accounts with the evidence presented by others. It was also inconsistent with an account he gave in a BBC broadcast in 1962. It seems that Boxhall's motivation at the time was to convey the impression that there was absolutely nothing any crew member could have done to avoid the accident that befell *Titanic*. According to Boxhall, he was coming out of the officer's quarters on the starboard side of the ship when he heard 3 bells being struck from the nest. He also said that he heard the Murdoch give the order "hard-astarboard" and heard telegraph bells ring. When he got only as far as the captain's quarters on his way to the bridge, the ship struck the berg. The distance from the entrance to the officer's quarters and the bridge is only about 60 feet, a distance that can easily be covered in 10 to 12 seconds walking a normal pace. Within that short time span, there would not have been sufficient time for the lookouts to call down on the phone to the wheelhouse, or for the vessel to turn any real perceptible amount before striking the iceberg. A time span that short would also imply that the iceberg was not sighted until it was only about one-half a ship's length (about 440 feet) ahead of the vessel which, on a perfectly clear night, is highly unlikely.

<sup>8</sup> The other three phones in the wheelhouse connected the wheelhouse directly to the forecandle head, the engine room, and the poop deck.

<sup>9</sup> Greaser Frederick Scott (BI 5523-5535). From several other accounts (including Dillon, Stengel, Lightoller and Beesley), it was two or three minutes after the collision when most people noticed that the ship's engines came to a stop. This should not come as a surprise since none of the engine room staff were put on standby beforehand.

<sup>10</sup> This account was given by Frederick Barrett to second class passenger Lawrence Beesley when the two of them were in lifeboat No. 13. (See Beesley, *The Loss of the SS Titanic*, Houghton Mifflin Co., 1912.) The closing of the watertight doors was checked by a set of cataracts that allowed them to drop slowly until they reached the last foot of travel. Then they slammed down tight shut. The total closing time of these drop-down watertight doors took from 25 to 30 seconds from the time the switch on the bridge was thrown.

<sup>11</sup> According to Hichens, it was "just about a minute, I suppose, after the collision, the Captain rushed out of his room" and passed through the wheelhouse to get onto the bridge.

<sup>12</sup> AI p. 230. When asked at the British inquiry (BI 15355) what did the first officer tell Capt. Smith after the ship struck the iceberg, Boxhall replied that Murdoch told Smith: "An iceberg, Sir. I hard-a-starboarded and reversed the engines, and I was going to hard-a-port round it but she was too close. I could not do any more. I have closed the watertight doors." The problem with this story is that there was no other corroborating evidence from any other eyewitness. Both Hichens and Olliver, who were on the bridge at the time, talked about Murdoch telling Smith that the ship hit an iceberg and that he had closed the watertight doors. But neither said anything about him telling Smith that he reversed the engines, or that he intended to port-around the berg. If Murdoch was going to port-around the berg he would not have ordered the engines full-speed astern as Boxhall claimed he did. Reversing the engines would almost certainly kill the effectiveness of his rudder, and a port-around maneuver would have been unsuccessful even if there was enough distance for it to be carried out.