Fire Down Below

It was known that a small fire was smoldering in one of *Titanic's* coal bunkers at the time she departed Southampton on April 10.[i] It was caused by spontaneous combustion. According to leading firemen Frederick Barrett and Charles Hendrickson, work to dig out the coal to get to the fire did not start until the first watch began after the ship left Southampton.[ii] It was not until sometime on Saturday, April 13, the day before the accident, when the fire was finally put out.[iii] According to Barrett, in addition to digging all the coal out, they also played a hose on it.[iv]

The most effective way to fight a bunker fire is to dig out as much coal as possible to get to where the fire is. The application of water would be to prevent it from spreading further and to extinguish the fire once it could be reached. Even today, "water alone is the most common extinguishing agent for a silo or bunker fire" in coal-fired electric generating power stations.[v] However, water would never be used to wet down coal in a non-burning bunker because wet coal is much more prone to oxidize quickly, generate heat in the process, and eventually ignite spontaneously.

Spontaneous combustion fires in coal bunkers were not unusual occurrences on board steamships of that day. In fact, according to Rule No. 248 of the IMM Company's "Ship Rules and Uniform Regulations" that was in effect at the time:

> ***248.*** *Examination of Coal Bunkers*. – The respective senior engineers of each watch, before going off duty, must go through the coal bunkers, and note their condition on the log-slate, and should there be any signs of spontaneous combustion taking place, they are at once to report same to the Chief Engineer, who is immediately to notify the Commander. All coal should, as often as possible, be worked out of the bunkers.

We also know that the 56/100 inch steel watertight bulkhead that formed part of the bunker wall was slightly distorted from the fire. According to Barrett, "The bottom of the watertight compartment was dinged aft and the other part was dinged forward." And according to Hendrickson, "You could see where it had been red hot; all the paint and everything was off. It was dented a bit…yes, warped…I just brushed it off and got some black oil and rubbed over it." Although Hendrickson talks about the bulkhead being "red hot," he did not actually say that he ever saw it in that condition. But even if the fire never got hot enough for the bulkhead to glow red, it had to have been above the 750°F ignition point of coal for it to smolder, and it had to be close enough to the bulkhead to cause it to expand and distort. Any coal on the other side could easily have been ignited by heat conduction across the bulkhead in the vicinity.

Barrett made it very clear that the bunker space on the starboard side of the ship aft of watertight bulkhead E that separated No. 5 boiler room from No. 6 (the starboard-side bunker space marked 'W' in the diagrams) was emptied out because of the fire.[vi] It was in that space that he saw water entering the ship immediately after the collision at the rate of an ordinary fire hose. When he was asked if there were any other bunkers empty forward, he said "No."[vii] But, what exactly did he mean by that?

When he was being questioned at the British inquiry about the cause of this rush of water that he saw come through the pass between the boilers moments before he

escaped from No. 5 boiler room, Barrett told them that it may have come from the bunker that was at the forward end of the room; the one that had been emptied out. When it was suggested that it may have been a bunker bulkhead that gave way, Barrett said: "It would be possible, because there are watertight compartments inside the bunker. There is a watertight compartment going through the centre of the bunker."[viii] And that answer generated some confusion over *Titanic's* transverse bunker arrangement.

Consider the follow series of questions that were asked of him concerning these coal bunkers:

> 2066. (The Solicitor-General.) I think there are the elements of a little confusion over this. The [watertight] bulkhead runs across the ship from the starboard side to the port side, does it not? - Yes.
> 2067. Is there a coal bunker on either side of the bulkhead on the starboard side? - There is a watertight compartment running right through the centre of the bunker.
> 2068. There is the watertight bulkhead? - Yes.
> 2069. (The Commissioner.) But the bunker is partly on one side of the watertight bulkhead and partly on the other? - Yes.
> 2070. And the watertight bulkhead goes through the middle of the bunker? - Yes.
> 2071. And then across the ship? - Yes.
> 2072. (The Solicitor-General.) If you imagine this box is the bunker and that is the starboard skin of the ship, the watertight bulkhead runs through it like that does it not, down the middle? - Yes.
> 2073. And you were on the after-side of this No. 5? - I was in No. 6 when we shipped it; I was on the after-side of the bulkhead later.

Notice that in his answer to the question as to whether there is a bunker on either side of the watertight bulkhead on the starboard side (2067) he could have simply said, "yes." But instead he tries to explain that the bunker is divided by a watertight bulkhead in the center into two compartments, and agrees that "the bunker is partly on one side of the watertight bulkhead and partly on the other" side. He was not describing it as two separate bunkers that happen to be on opposite sides of a watertight bulkhead, which they were.

The significance of how Barrett viewed things has to do with identifying the bunker space where coal was taken out of when they fought the fire. It seems probable that coal was taken out of the bunker space on both sides of watertight bulkhead E, from the bunker space on the forward side of No. 5 boiler room, and from the bunker space on the aft side of No. 6 boiler room (bunker spaces marked 'W' and 'Y' in the diagrams).

Barrett's answer as to which side of the bulkhead he was on (question 2073 above) is very revealing. He explained that he was in No. 6 boiler room when "we shipped it," and it was later that he was on the after side of that watertight bulkhead, in No. 5 boiler room when that rush of water was seen. In the context of the questioning, the term "when we shipped it" appears to mean when they shipped the coal to empty the bunker out.

Further evidence that coal may have been removed from the bunker space on both sides of the watertight bulkhead is suggested by Fireman George Beauchamp who was also in No. 6 boiler room when the collision happened. His station was stokehold No. 10, at the aft end of the room. Beauchamp heard Barrett and Second Engineer John Hesketh call for the dampers to be shut. He said that when the crash came it was "just like thunder, the roar of thunder." Then the watertight doors dropped and soon someone called out for them to draw the fires. As he explained it:[ix]

> After the order was given to shut up, an order was given to draw fires. I could not say how many minutes, but the order was given to draw fires…Water was coming in on the plates when we were drawing the fires...coming through the bunker door and over the plates...coming through the bunker like.

This picture from Beauchamp suggests that water was flowing out from the bunker onto the plates that the firemen stood on. We know from Barrett that water was also coming in from the starboard side of the hull in that compartment when he ran to escape into No. 5 boiler room just as the doors were closing. But this observation of Beauchamp confirms that the hull was also pierced in the aft bunker space of No. 6 boiler room, ahead of the watertight bulkhead, and suggests that the bunker space was empty enough for water to rise quickly from the tank top at the bottom of the bunker to the level of the bunker doors and spill out onto the stokehold plates that he was standing on.[x]

Fires were also drawn from the furnaces in No. 5 boiler room that night. When that task was completed, the men working there were sent up except for Barrett. As a leading fireman, he was asked to remain below to open a manhole plate on the starboard side so the engineers could get at some valves in the piping system. Being thick with steam from all the water that was thrown onto the fires in the furnaces, Assistant Second Engineer Jonathan Shepherd did not see the open manhole and fell in and broke his leg. Barrett and another engineer, Herbert Harvey, lifted Shepherd out and carried him aft to the pump room where they attended to him as best they could for a while. About 15 minutes later, according to Barrett, "a rush of water came through the pass - the forward end, a space between the boilers where we walk through…I never stopped to look [where the water came from]. I went up the [escape] ladder. Mr. Harvey told me to go up." When Barrett was asked if it could have been a bunker bulkhead at the head of the compartment that gave way, he replied: "I have no idea on that, but that is the bunker that was holding the water back."

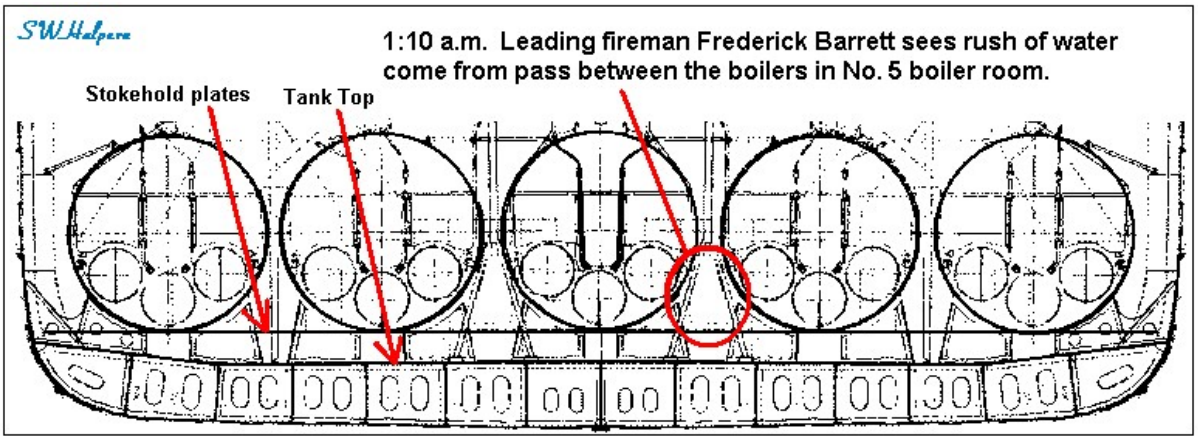

Fig. 6-30 Frederick Barrett sees water coming from pass between boilers.

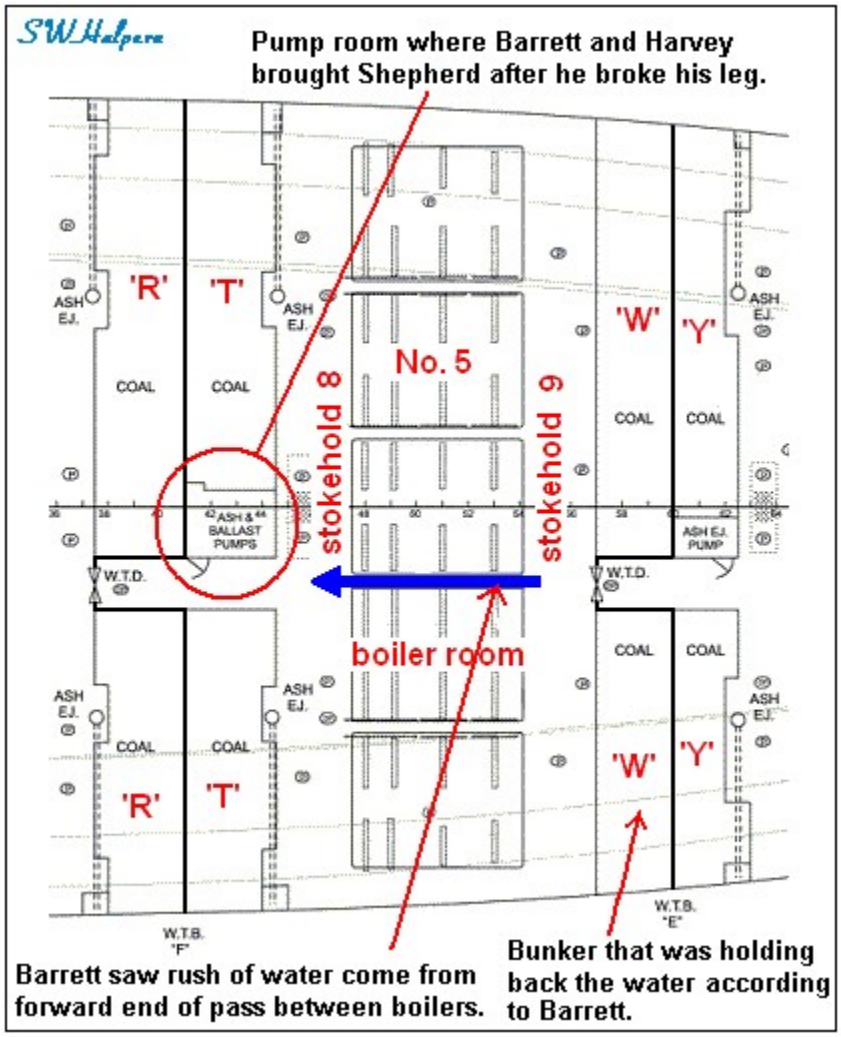

Fig. 6-31 Rush of water between boilers in No. 5 Boiler room.

According to his best recollection, Barrett went up the escape from No. 5 boiler room at about 1:10am. When he came out onto E deck there was water there, "coming down the alleyway from forward."[xi] Prior to that, while they were drawing the fires out of the furnaces, he felt the ship was down by the head and getting noticeably worse.[xii]

There are some people who believed that it was watertight bulkhead E, weakened by the fire in the coal bunker, that gave way which caused that rush of water that Barrett saw. They also believed that this was "the first falling domino in an escalating and ultimately catastrophic chain reaction."[xiii] However, forensic science does not support such a catastrophic event.

Coal burns at a fixed temperature with a given supply of oxygen. Lacking a good draft of air to feed the fire, the coal would only smolder at some relatively low temperature. There would have to had been a good draft of air feeding the fire if it became so hot as to make the steel bulkhead actually glow red. In that case, a lot of coal would have been burnt, and a lot of fumes would have been produced. But this apparently was not the case.

Spontaneous ignition of coal in a bunker usually begins deep down where the coal absorbs oxygen and gives off hydrogen, carbon monoxide, carbon dioxide, and some aerosols under rising temperatures. With no real draft of air in the bunker, coal will ignite and smolder at about 750°F. Since the bulkhead was riveted tight around its edges to angle iron which was riveted to the hull and decks, thermal expansion caused by heat from the fire would cause the bulkhead plate to bulge outward to relieve the stress. After cooling back to room temperatures, it would remain somewhat dented as observed. But to get that bulkhead, which was made of mild steel, to glow red hot, would take a temperature of about 900°F or more from a fire being fed with a good draft of air. Despite the drama that some subsequent newspaper accounts wanted people to believe, it certainly was *not* a raging blaze that was completely out of control.[xiv]

Metallurgical analysis on bulkhead plate similar to that used on *Titanic* was heated to about 1,200°F so that it became red hot. The plate was bounded to other pieces modeling the shell and floor plates by riveting it to angle iron pieces which in turn were riveted to the other pieces. The results showed the bulkhead plate had distorted by about 6 inches, and the rivets holding the plate would only have been stressed to only 10%-20% of their failure load. Even if the bulkhead was first heated red hot and then cooled down by sea water or water from a fire hose, it would not affect the low temperature properties of the bulkhead. The conclusion of modern day forensics is that the bunker fire would *not* have weakened the watertight bulkhead sufficiently to cause it to collapse.[xv]

The most likely cause of that rush of water seen by Barrett was the collapse of a bunker door on the bunker bulkhead at the forward starboard side of No. 5 boiler room. As noted before, water was seen entering that empty bunker space from the time the collision took place. Taking into account the capacity of the transverse bunker space and allowing for some remaining coal, a build up of about 440 tons of sea water could easily have filled that space between the tank top and F deck if gone unchecked. We know that water was seen falling down the first class staircase from E deck onto F deck as early as 12:50am by steward Joseph Wheat; a location that was a good 60 feet aft of where watertight bulkhead E, between No. 5 and 6 boiler rooms, was located. There very well could have been sufficient down-flooding into that forward cross bunker to create a sufficient pressure head even with water draining out of 4 very small drain holes at the

bottom of the bunker bulkhead, especially if any coal or debris still remained in the bunker to impede the flow through those holes onto the plates of the tank top. The bunk doors on the bulkhead were not designed to be watertight, nor designed to hold back a large force pushing against them. If water had reached a height of just 10 feet over the stokehold plate level in the bunker by that time, it would have created a total force against each bunker door of about 3 tons. These bunker doors slid in thin channels that were only ½ inch wide. If a bunker door gave way as a result of a pressure head of about only 10 feet, the velocity of water that would come bursting out of the bunker would be close to 25 feet per second, easily creating "a wave of green foam coming tearing through" into the walk space between the boilers. If it were the main watertight bulkhead between the two boiler rooms that failed, Barrett would not have had time to reach the escape, let alone hear engineer Harvey order him up.

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[i] BI 19630. It was rumored that the fire had started while the ship was in Belfast (BI 5239), but that may not be true. *Titanic* had brought over 1,880 tons of coal from Belfast when she arrived in Southampton. She was loaded with 4,427 additional tons while in Southampton, and burned 415 tons while in port after the loading. It is highly unlikely that they would have added extra coal to a bunker if a fire was known to be smoldering in it. It is more likely that the fire started while the ship was in Southampton after the bunkering, and was discovered on sailing day. It was not a big enough problem to keep the ship from starting her maiden voyage.

[ii] BI 5240 and 2297.

[iii] BI 5243 and 2301.

[iv] BI 2340.

[v] The danger of using water alone is that the surface tension of the water and the heat from the fire may prevent the applied water from penetrating deep into the coal pile. If that happens, gases such as hydrogen sulfide and carbon monoxide, which become explosive at high enough concentrations, may start bubbling out. That is why chemical agents are sometimes added to reduce the surface tension and allow the water to further penetrate the pile. See: Diana Merritt and Randy Rahm, "Managing Silo, Bunker, and Dust Collector Fires," Special Section: Asset Management, *POWER* magazine, November/December, 2000.

[vi] BI 2087-2091.

[vii] BI 2292-2299.

[viii] BI 2064.

[ix] BI 671-674.

[x] There is also some indirect evidence that coal had been removed from the bunker on the opposite side of watertight bulkhead E, between No. 5 and 6 boiler rooms. A story was told to the newspapers by an unnamed fireman that a fire had started in one of the coal bunkers of the vessel shortly after she left her dock at Southampton, which was not extinguished until Saturday afternoon. According to the fireman, "It had been necessary to take the coal out of sections 2 and 3 on the starboard side, forward, and when the water came rushing in after the collision with the ice the bulkheads would not hold because they did not have the supporting weight of the coal." (Marshall Everett, ed., *The Wreck and Sinking of the Titanic*, L. H. Walter, 1912, p. 102.) Despite the obvious exaggerations, what we find consistent with Barrett's and Hendrickson's testimonies about the bunker fire is that it was being fought since the ship left Southampton, and was extinguished on Saturday, the day before the collision. It is likely that the reporter who wrote the article may have misunderstood the location of where that coal was taken out of when he wrote "sections 2 and 3." If the fireman actually spoke of "the second and third stokeholds on the starboard side, forward," that would actually point to the bunkers marked 'Y' and 'W' in Stokeholds No. 10 and 9, respectively, as seen when going aft coming from the firemen's quarters. Although it should be obvious that the presence or absence of coal in a bunker has nothing to do with the strength of a watertight bulkhead, it is easy to see how such a misconception on part of a fireman could come about. The important thing here is that this fireman mentioned that coal was taken out of two apparently adjacent bunker spaces, one on each side of the same watertight bulkhead when fighting the fire. As we have seen, Barrett referred to a bunker as having "a watertight compartment going through the centre of the bunker," one bunker separated by a

watertight bulkhead into two spaces. The other witnesses who testified about fighting the bunker fire, Charles Hendrickson and Thomas Dillon, did not give any location information, and the fire was not considered important enough to have it reported to the Assistant Emigration Officer of the Board of Trade when the ship was docked in Southampton (BI 24118-24121).

[xi] BI 2349-2353.

[xii] BI 2047-2049, 2054-2055. From our own analysis, the ship would have trimmed down about 3.5° by that time.

[xiii] Charles Pellegrino, "Time Line of the Titanic Descent," http://www.charlespellegrino.com/time_line.htm.

[xiv] Marshall Everett, ed., *Wreck and Sinking of the Titanic*, Castle Books, first published in 1912, pp. 100-102.

[xv] Dr. Tim Foecke, *Encyclopedia Titanica Message Board*, July 18, 2003, http://www.encyclopedia-titanica.org/cgi-bin/discus/show.cgi?tpc=5919&post=96005#POST96005; and Jennifer McCarty & Tim Foecke, *What Really Sank The Titanic*, Citadel Press, 2008, pp. 175-180.