

The Fallacy of a Camouflaged Iceberg

by Samuel Halpern

There were two lookouts high up in *Titanic's* crow's nest between the hours of 10pm and midnight on the night of April 14th 1912. They were Frederick Fleet and Reginald Lee. Both survived the disaster and later testified before the British Wreck Commission as to the conditions they saw just before the fatal iceberg appeared ahead. Both mentioned seeing haze on the horizon, but neither of them would agree on the extent and severity of that haze. Lee said it appeared all around the horizon, and stated that at one point in time he told Fleet, "if we can see through that we will be lucky." Fleet, however, testified that the only haze he saw was about 10 to 15 minutes before the iceberg encounter, and that it extended about two points (about 22 degrees) to either side of dead ahead. He also claimed that it was nothing to really talk about. More importantly, Fleet emphatically denied being told by Lee that they would be lucky to get through it. In other words, one or both of them was lying about what they claimed they saw or said.¹

There are some people that have suggested that Fleet's description of seeing "a sort of slight haze" directly in front of the ship may actually have been starlight reflecting off of this vast expanse of pack ice that lay directly ahead of *Titanic*. From the height of *Titanic's* crow's nest, about 90 feet above the water, the distance to the visual horizon would have been about 11 nautical miles. Around 11:30pm, *Titanic* would have been about 4 miles away from the unseen iceberg that lay ahead, and 2 or 3 miles beyond the iceberg was the eastern edge of this vast field of pack ice that ran from north to south across their path; a field of ice that was about 5 to 6 miles wide in the direction they were headed.

Could a field of pack ice be seen from a distance of 6 or 7 miles away on a very clear but dark and moonless night? Was there enough reflective starlight for it to present itself as some "sort of slight haze" near the horizon to someone with a height of eye of about 90 feet above the sea?

At 10:15pm, *Californian* time, Captain Stanley Lord noticed what he described as "a brightening along the western horizon" as seen from the upper bridge of his vessel, a height of eye that was about 45 feet above the water. It then took him about six minutes more to realize that what was broadening ahead of him was a field of ice. At 10:21pm he took evasive action to avoid crashing his ship into this field of pack ice, and ended up only about 1/4 mile from its eastern edge, having turned his ship around in the process.

At 11 knots, *Californian* would cover a distance of about one nautical mile every six minutes. Thus, we see that this north-to-south trending field of pack ice was not seen from *Californian* until she was almost a mile away from it. It was simply too dark to be seen from very far off. With *Titanic* 6 to 7 miles away from this same field at 11:30pm, it is highly unlikely that it could have been the "haze" that Fleet described.

Could the haze reported by Fleet have been a low-lying bank of fog hanging over this icefield that was directly ahead of *Titanic*?

For fog to form above a sheet of ice there needs to be a relatively warm layer of moist air hanging over the cold surface of the ice. Those conditions simply did not exist anywhere near *Titanic* that night. The reported air temperature at midnight where

Californian had stopped, which was not that far away from where *Titanic* came to a stop, was measured at 27°F, and the temperature of the water was measured at 28°F. There simply was not enough of a temperature differential for any fog to form, let alone enough light for it to be seen.

If there was some form of haze, fog or reflected starlight coming off the icefield directly in the path of *Titanic* that somehow became noticeable to Fleet just ten or fifteen minutes before the ship struck the iceberg, then why was this icefield not seen by anyone after *Titanic* came to a stop following the impact with the iceberg, when *Titanic* came much closer? That vast field of pack ice, only 2 to 3 miles away and about 5 to 6 miles across from where *Titanic* stopped, was apparently not seen by anyone on *Titanic* after she came to a stop, by anyone in the lifeboats afterward, or by anyone on the rescue ship *Carpathia* until after the sun came up in the morning.

So what was this so called “haze” that Fleet and Lee had mentioned? And were there others that reported seeing haze that night?

The problem about seeing what is a true haze is that you cannot actually see it. Haze causes an obscuration, and makes objects within it appear indistinct. By most accounts, the visual conditions that night were extraordinarily clear. When *Carpathia*’s Captain Rostron was asked, “Was there anything, so far as you know, peculiar in the atmospheric conditions that night?” his response was, “No, I never saw a clearer night. It was a beautiful night.”

Titanic’s Second Officer Lightoller was asked about the environmental conditions that existed when he came on deck after the accident had occurred. His response was:

“The weather was perfectly clear when I came on deck after the accident, and the slightest degree of haze on the surface of the water would have been very noticeable, or, rather, I might put it the other way; it is proved that there was no haze by some of the boats noticing from the waterline this vessel’s lights. [This mysterious vessel that appeared to be about 5 miles away off *Titanic*’s port bow.] I think that has been mentioned, and if there had been the slightest degree of haze they would not have seen them.”

Lightoller also remarked that it was well understood by all watch officers that Captain Smith was to be called “if there were the slightest degree of haze to arise, the slightest haze whatever, if that were to any degree noticeable.”

In his book, *The Loss of the SS Titanic*, second-class passenger Lawrence Beesley described the extraordinarily clear conditions that existed that night as seen from the lifeboats:

“The night was one of the most beautiful I have ever seen: the sky without a single cloud to mar the perfect brilliance of the stars, clustered so thickly together that in places there seemed almost more dazzling points of light set in the black sky than background of sky itself; and each star seemed, in the keen atmosphere, free from any haze, to have increased its brilliance tenfold and to twinkle and glitter with a staccato flash that

made the sky seem nothing but a setting made for them in which to display their wonder...

The complete absence of haze produced a phenomenon I had never seen before: where the sky met the sea the line was as clear and definite as the edge of a knife, so that the water and the air never merged gradually into each other and blended to a softened rounded horizon, but each element was so exclusively separate that where a star came low down in the sky near the clear-cut edge of the waterline, it still lost none of its brilliance. As the earth revolved and the water edge came up and covered partially the star, as it were, it simply cut the star in two, the upper half continuing to sparkle as long as it was not entirely hidden, and throwing a long beam of light along the sea to us.”

Beesley’s description of a star being cut in two seems somewhat of an exaggeration. You cannot cut a single point source of light such as a star in two, even if it is blocked using a device with a sharp knife edge.² However, the sea has been described as flat as a sheet of glass that night, and the horizon as seen from someone seated in a 30-foot lifeboat with a height of eye at just over 4 feet above the water would only be about 2½ nautical miles away. A setting star could easily create what looked like a reflected beam of light across a flat reflecting surface just before it gets extinguished.³ However, what is more relevant was Beesley’s claim that he could make out a clear dividing line between sea and sky from the lifeboat on that dark, moonless night. This was just the opposite of what was observed from a higher level above the surface of the sea.

Charles Groves, third officer on the SS *Californian*, described the seeing conditions that night from the bridge of his vessel from a height of eye of about 45 feet above the water:

“The night was dark and brilliantly clear with not a breath of wind, and the sea showed no sign of movement, with the horizon only discernible by the fact that the stars could be seen disappearing below it.”

Californian’s Captain Stanley Lord also described the seeing conditions that night:

“I told them [at the US investigation] it was a very strange night; it was hard to define where the sky ended and the water commenced. There was what you call a soft horizon. I was sometimes mistaking the stars low down on the horizon for steamer’s lights... We could not distinguish where the sky ended and where the water commenced. You understand, it was a flat calm.”

Both Charles Groves and Stanley Lord were specifically asked if they saw anything that could be called “haze” that night. Groves’ answer was, “No, nothing whatsoever. None.” Lord’s answer was, “No, I did not. In my opinion there was not.”

The seeing conditions from *Californian*’s upper bridge as described by Third Officer Groves and Captain Lord were not much different from what the seeing conditions were from *Titanic*’s navigating bridge as described by Second Officer

Lightoller, who was the Officer of the Watch between 6 and 10pm that night. According to Lightoller, when Captain Smith arrived on the bridge of *Titanic* about 8:55pm that night:

“We remarked on the weather, about its being calm, clear. We remarked the distance we could see. We seemed to be able to see a long distance. Everything was very clear. We could see the stars setting down to the horizon.”

In a book that Lightoller wrote in 1935, he added:⁴

“We [Captain Smith and I] also commented on the lack of definition between the horizon and the sky – which would make an iceberg all the more difficult to see – particularly if it had a black side, and that should be, by bad luck, turned our way.”

As in the case of *Californian*, stars could be seen setting right down toward the horizon, but the line of the horizon itself could not be discerned from the bridge of *Titanic* or the bridge of *Californian*.

As noted before, on *Californian*, the height of eye for someone on her upper bridge was about 45 feet above the water. From that height, the line of the horizon would be about 8 nautical miles away if it was visible at all. On *Titanic*, the height of eye for someone on her navigating bridge was about 70 feet above the water. From that height, the line of the horizon would be almost 10 nautical miles away if visible. However, it is also quite understandable why someone looking out from the height of a vessel’s bridge, or a little higher up in the crow’s nest, might attribute the lack of some sharp visual demarcation line between the sea and sky, a “soft horizon” as Captain Stanley Lord called it, as caused by some form of haze obscuring the visual horizon.

For example, *Titanic*’s Lookout George Symons, who was on duty up in the crow’s nest along with Archie Jewell between 8 and 10pm, told the British Wreck Commission that the night was: “Pretty clear, Sir, a fine night, rather hazy; if anything a little hazy *on the horizon*, but nothing to speak of.” At the Ryan trial in 1913, Symons said that he “thought the haze was extending all round the horizon within a certain locality.” However, he also said that when he was in the lifeboat he could “see a further distance,” implying the absence of any haze. Once again we see how a hard demarcation line between sea and sky was indiscernible that night from a height well above the waterline. However, when in the boats, just a few feet off the surface of the water, such was not the case.

Could there have been a localized haze just surrounding the fatal iceberg that *Titanic* struck?

Another possibility that could cause an object to be partially obscured is the phenomenon of sea smoke, or what is sometimes called steam fog. It is formed when very cold air moves over a body of relatively warmer water; just the opposite affect of what is commonly referred to as fog, which is what you get when relatively warm air moves over a body of cold water. According to Second Officer Lightoller:

“If we were coming on a large berg there might be a haze, as there frequently is in that position, where warm and cold streams are intermixing. You will very frequently get a little low-lying haze, smoke we call it, lying on the water perhaps a couple of feet.”

Was any sea smoke seen by people that night?

Alfred Shiers was a 24-year old fireman on board *Titanic*. At the time of the accident he was off duty reading in his bunk which was located on the starboard side of D deck forward of No. 1 hatch under the forecastle. (See Figure 1.) As soon as the impact occurred, Shiers jumped out of bed and went aft to the companion ladder, located just aft of his quarters on the starboard side near the spiral staircase [1], and then up to C deck just outside the firemen’s mess [2]. From there he went “towards the window underneath the forecastle-head to see if there was anything there.”[3] Not seeing anything, he then went further aft and came out on the starboard side of the Forward Well Deck where: “I saw the ice then [in the well deck], and then the berg when I looked over the side [4]...It was very dim then; I could just see it...I saw the berg that was going away...on the starboard quarter, off the stern.”

According to Shiers it was “about four or five minutes” after the crash that he came out on deck and saw the iceberg disappearing off the starboard quarter. He also looked over the side and noticed that the ship had “a slight way on her; she was moving, but not much,” the same observation that Second Officer Lightoller made when he got up a few minutes after the collision to have a look around. Shiers was also asked if he got a good view of the iceberg, to which he relied, “No, only dim...It was hazy. When I saw that berg it was hazy. The berg was in a haze.”

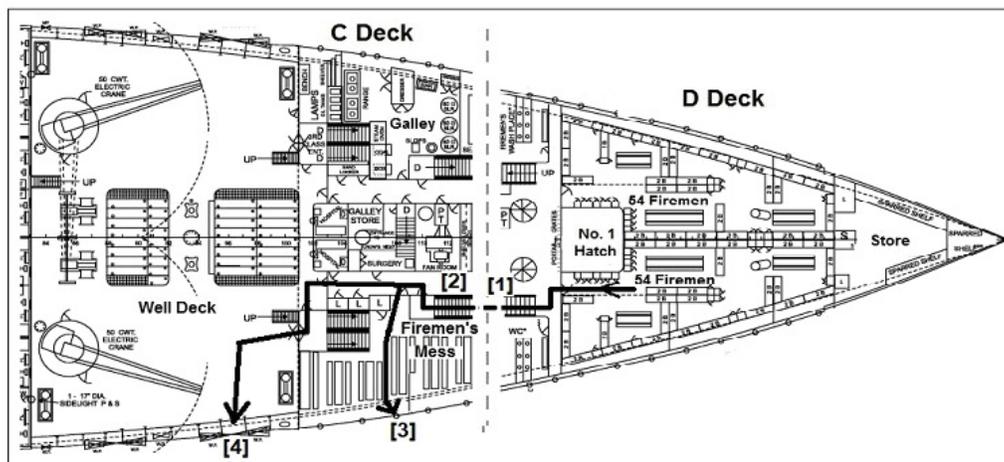


Fig. 1 – Path taken by Fireman Alfred Shiers to get to the Forward Well Deck.

Shiers was questioned more extensively at the Limitation of Liability Hearings in New York in 1913 about this haze that he saw when came up on deck that night and saw an iceberg off the ship’s starboard quarter. He had this to say:

“It seemed like a mist. I could just see the dim outline of it [the iceberg]. That is all I could see of it. It was hazy. I could only just see the outline of

it...I never took any notice how far around [the haze extended]...Yes, it was astern of the ship when I saw it where the berg was...In the distance where the berg was I could just see the outline of it. I did not look any farther around. The haze was both sides of it [the iceberg]...It was just a thick haze. I could only just discern the shape of the berg...I could not see how high it [the haze] went...Yes, it [the iceberg] was dim. I could not see whether it was any colour or anything. There was only just the outline of it which seemed to be in a bit of a haze.”

From what Shiers was able to describe in his deposition, he saw the dim outline of an iceberg astern of the ship that seemed to be in some sort of haze or mist. He did not take notice as to how far around the haze extended, only that it seemed to be on both sides of the iceberg. He was not able to notice any color to the berg or say how high the haze went. His description seems to describe a localized, patch of sea smoke extending around the base of the iceberg.⁵

It should also be noted that when Lookout Reginald Lee was called to testify at the Ryan trial in 1913, he described the lower part of the iceberg as being in haze, not the upper part. As summarized in the trial report:

“A portion of the berg was above the haze. When he [Lee] saw the berg he did not think he could see the lower part of it below the haze. If the whole berg had been covered with haze he would not have seen it so soon.”

This description also would tend to describe a patch of localized sea smoke hanging around the base of the iceberg. Yet, Lee also maintained at the Ryan trial that when he went into the crow’s nest at 10pm, “the sky was clear; the sea was not. There was a haze, as seen when one looked for the horizon.” At the time of the Ryan trial in 1913, Reginald Lee was no longer employed by the White Star Line.

Frederick Fleet was also called to testify at the Ryan trial in 1913. Fleet also mentioned the existence of a slight haze on the horizon prior to spotting the iceberg. This was essentially the same claim that he made the year before when questioned before the British Wreck Commission. As summarized in the Ryan trial report:

“There was a very slight haze on the horizon, but it did not hinder them [Fleet and Lee] in performing their duties. Shortly before the collision he [Fleet] saw a black object right ahead...He saw the haze about a quarter of an hour before the accident. It was right ahead of him, and so was the ice. He had no glasses that night. If he had had them he could have picked up the object soon enough to have given notice in time to avoid the accident.”

When Fleet and Lee came down from the nest after the accident around midnight, they were replaced by lookouts George Hogg and Alfred Evans. At the Ryan trial George Hogg said that from 6 to 8pm, the previous time when he and Evans were up in the nest, “the weather was clear.” When he went back up to the nest at midnight, he “saw a black object on the starboard quarter,” and “the weather was still clear.” The inference is that he was able to see the fatal iceberg that *Titanic* struck off *Titanic*’s starboard quarter in

clear weather from the crow's nest after he went up to replace Fleet and Lee following the collision. This would have been after the ship had already come to a complete stop. It would have been at least 15 minutes or more after it was seen by Shiers who, as we have noted, described seeing only the outline of the berg through "a bit of a haze" when he was on deck about 5 or 6 minutes after the collision, while *Titanic* was still moving away from the iceberg.

Figure 2 is a rendering of what the iceberg may have looked like off *Titanic*'s starboard quarter as it faded back into the night as *Titanic* was slowly moving away from it following the collision. It was created by taking a photograph of a real iceberg and reducing its size and reducing its brightness to show what it would look like at night as it slipped further and further away from the ship. The iceberg picture seen in the frame on the far right would be at a distance twice as far away (half the size) as the one seen in the frame on the far left. In addition, the brightness of a starlit object would tend to decrease as the square of the distance from an observer, thus the berg in the frame on the far right would appear to be one-fourth as bright as the one in the frame on the far left. Notice also how the lower part of the berg seems to disappear as the berg fades further away into the night giving the impression that the lower part may be obscured by some low-lying haze.



Fig. 2 – Iceberg disappearing off the starboard quarter.

Could Fleet have seen a phenomenon called ice blink? The answer is no. Ice blink is caused by the reflection of light from a distant wide body of ice onto the underside of low-lying clouds. On that Sunday night the sky was dark and cloudless.

Could the reported haze on the horizon have been a case of a Fata Bromosa, or what is sometimes referred to as a "fairy fog," caused by a temperature inversion? (See Figure 3.)

In his book, *Titanic: A Very Deceiving Night* (March 2012), author Tim Maltin claimed that both the collision with the iceberg and the failure between *Titanic* and *Californian* to communicate with each other using Morse signaling lamps were caused by a mirage. He also went on to say that abnormal refraction caused *Titanic*'s distress rockets to appear to burst only as high as half the height of her masthead light when seen from the bridge of the *SS Californian*. He also claimed that the iceberg that *Titanic* struck may have been camouflaged by a wall of "fairy fog" on the horizon, thereby preventing the lookouts from seeing the iceberg sooner than they actually did.

In the introduction to his book, Maltin wrote that "the true cause of the *Titanic* disaster has never been revealed, until now," and that his book "proves the presence of abnormal refraction – or mirage – at *Titanic*'s crash site and reveals its previously unseen but crucial role, shedding new light on the tragedy."

Tim's book was well written and referenced. He came up with some new and interesting thoughts that tried to explain some of things that were seen that night that otherwise appeared to be unexplainable. There were a number of things that he wrote in his book that I did not agree with, and I told Tim what they were before his book was published. But overall, I liked the fresh approach that was taken at the time, his consultation with experts such as Andrew Young (Department of Astronomy, San Diego State University), his extensive research and collection of pertinent data from the log books of several vessels that were in or near the area, and his willingness to take constructive feedback from others without feeling insulted. He brought a different perspective to a complex subject, and for that reason I thought it was worth being published.



Fig. 3 – Fata Bromosa on the horizon seen in daylight.

Nevertheless, it is one thing to show that conditions for abnormal refraction may have been present in regions near the area where *Titanic* sank, but quite another thing to prove that abnormal refraction caused confusion with Morse signaling, or caused rockets to be seen to go no higher than half the height of a vessel's masthead light, or caused the fatal iceberg that sank *Titanic* to be camouflaged by a false horizon.

Maltin claimed that the heavily stratified air in a thermal inversion was rendering the Morse code signaling between *Titanic* and *Californian* to be "incomprehensible, even to the point where *Titanic*'s steady electric lights appeared to be the flickering oil lamps of a much smaller vessel." Flickering lights can certainly cause confusion with Morse signaling, but the reality is that flickering lights from a far off vessel have nothing to do with thermal inversions. What appeared to be the light of a vessel flickering was caused by normal undulations in the atmosphere, with moments of calm lasting several seconds in between. It is the same phenomenon that causes stars in the sky to twinkle. It is a phenomenon known as scintillation, and is due to some turbulence in the atmosphere.

What about those low-lying rockets that were seen from *Californian*? What is interesting is that the claim of low-lying rockets came from only one person, *Californian*'s Second Officer Herbert Stone. When testifying before the British Wreck

Commission, Stone said, “I have remarked at different times that these rockets did not appear to go very high; they were very low lying; they were only about half the height of the steamer’s masthead light and I thought rockets would go higher than that.” Then, Stone said, “But that I could not understand why if the rockets came from a steamer beyond this one, when the steamer altered her bearing the rockets should also alter their bearings.”

It was quite clear to those who were questioning Herbert Stone that if the rockets came from some steamer that was far beyond the steamer that was being observed, a steamer that was judged to be about 5 miles away, then the bearing to those rockets could not change as the nearby observed steamer allegedly steamed away from the south-southeast to the southwest.

As shown in Figure 4, if there was a tramp steamer about the size of *Californian* only 5 miles away, and taking its masthead light to be about 90-100 feet above the water, then the angular height of the masthead light as seen from the bridge of *Californian* would only be about 0.2° [12 arcminutes] above the vessel’s waterline, and a rocket bursting at half that height would appear to be only 0.1° [6 arcminutes] above the waterline.⁶ (As a point of reference shown in Figure 4, the average angular diameter of a full moon is about 0.5° [30 arcminutes].)

If the rockets went only as high as Stone claimed they did, then they would have had to come from some vessel that was more than about 27 nautical miles away.⁷ However, when this steamer allegedly started to move away, the bearing to those rockets remained right over the steamer, something that could only happen if the rockets originated from the observed steamer, not from some far off vessel.

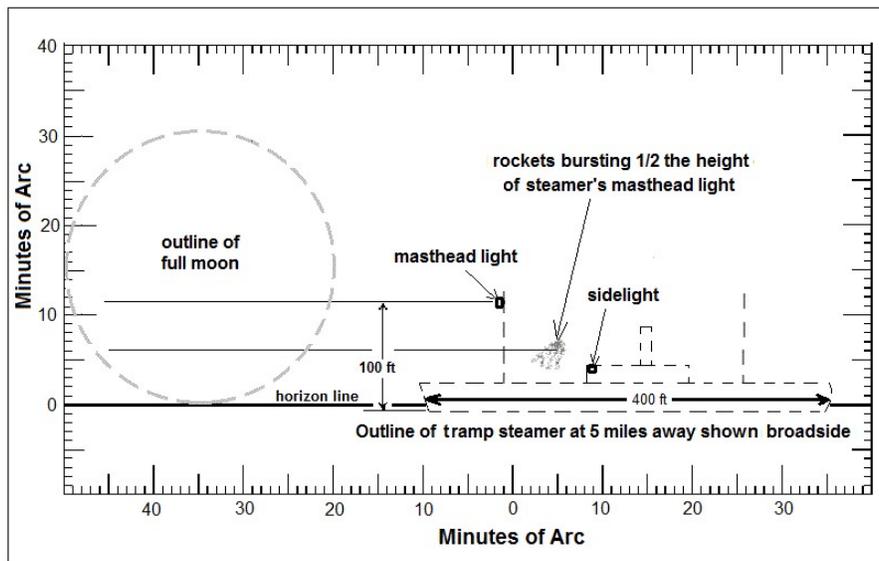


Fig. 4 – Angular height of Herbert Stone’s low-lying rockets.

The reader should note that *Californian*’s Apprentice James Gibson, who also was an eyewitness to the rockets that were seen from *Californian*’s upper bridge that night, never described these rockets as low lying compared to the lights of the steamer. In fact, in his April 18th report to Captain Lord, which was withheld from the 1912 inquiries, Gibson wrote:

“I then got the binoculars and had just got them focused on the vessel when I observed a white flash apparently on her deck, followed by a faint streak towards the sky which then burst into white stars.”

Here we see that Gibson, looking through binoculars, was able to trace the path of a rocket from the moment it was fired from the vessel’s deck, as it ascended “towards the sky” above the steamer, to when it had burst into white stars.

A rendering of what James Gibson described is shown in Figure 5.

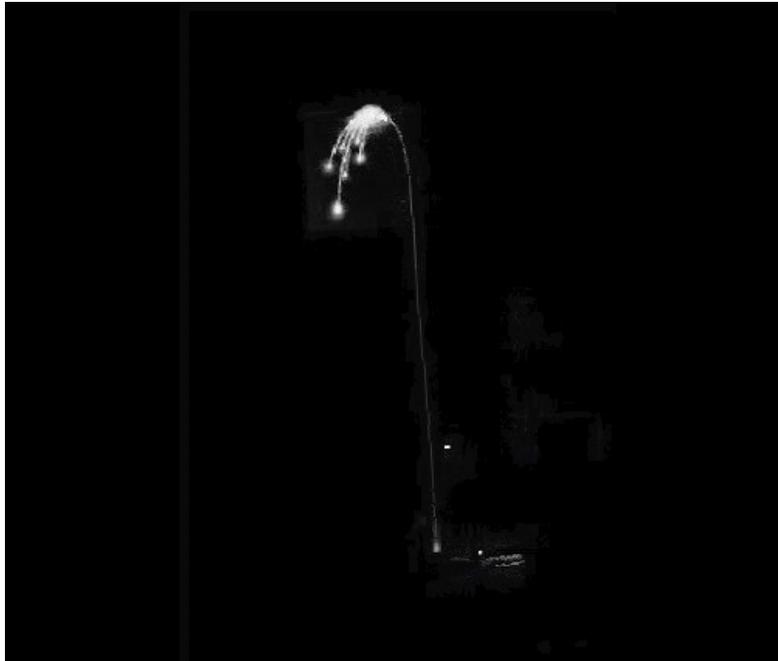


Fig. 5 – What Gibson described seeing.

In my opinion, *Californian*’s Second Officer Herbert Stone was not a very truthful or careful observer. Besides claiming to see low-lying rockets burst over the steamer as she was steaming away, Stone also claimed that he saw the stern light of this vessel from about 1 o’clock, as she was altering her bearings toward the southwest, up until the time she disappeared out of sight, sometime after 2 o’clock.⁸ Furthermore, he claimed that this steamer, only the lights of which could be seen, started to steam away after the 2nd of a total of 8 white rockets was seen. The problem however with Stone’s account is that you cannot have a stern light showing from a vessel moving away while its red sidelight and masthead light were also showing. According to Apprentice James Gibson, the vessel’s red sidelight and masthead light were showing when he arrived back on the bridge shortly after the 5th of 8 white rockets was seen by Stone. According to Gibson, the vessel’s red sidelight did not disappear from view until sometime after the 7th rocket was seen. In addition, Gibson was also asked if he ever saw what looked to him to be a vessel’s stern light, or if he ever saw the vessel turn around, and he replied “No” to both.

It was highly unlikely that Herbert Stone ever saw rockets going only as high as half the masthead light. If that were true, it would have been, or should have been,

obvious to both Stone and Gibson that they came from some far off vessel from the very beginning, not from the vessel that they had under observation, a vessel which Second Officer Stone at one point remarked to Gibson, "Look at her now; she looks very queer out of the water; her lights look queer." It never occurred to them, or never admitted by them, that what they were seeing were the lights of a vessel in distress that was slowly sinking beneath the Atlantic.

In short, *Californin*'s Second Officer Herbert Stone was someone who was clearly not a very good observer. He also failed to see the approach of a vessel with 2 masthead lights and carrying "a lot of light amidships" that Chief Officer George Stewart had to point out to him around 4 o'clock in the morning, the time when *Carpathia* had stopped to pick up the first lifeboat from *Titanic*. This is the same person who reported seeing what we now know to be rockets from *Carpathia* in the south-southwest around 3:20am when *Carpathia* was actually coming up from the southeast. This was the same and only person who claimed that he saw rockets go only as high as half the masthead light of a steamer, but also said that the bearing to those rockets stayed on the same bearing as the steamer as it allegedly steamed away from the south-southeast toward the southwest.

What seems to be transparent reasons, Stone's account of low-lying rockets was accepted as the truth by Maltin, rather than Gibson's account of seeing rockets ascend skyward. The explanation that Tim Maltin came up with for Stone's low-lying rockets is that these distress signals, which we know came from *Titanic*, exploded into stars high above an inversion layer, and therefore were not subjected to any increased atmospheric refraction. However, Maltin then claimed that the lights of *Titanic*, which originated below the inversion layer, were raised higher than usual due to abnormal refraction with the result that the bursting rockets appeared below the level of her masthead light.

What was described by Maltin is simply impossible even if there was strong atmospheric refraction in the vicinity of *Titanic* to cause some looming or towering of *Titanic*'s lights that night. You cannot have an object (e.g., an exploding rocket) that is actually well above another object (e.g., a vessel's masthead light) to appear to a far away observer to be below it in such a situation. The rays of light from two different objects, one high above the other, could not cross each other on the way to an observer under looming conditions to make the higher object appear below the lower one. Furthermore, nobody reported seeing any inverted images that night which would have been indicative of a superior mirage. And certainly, strong atmospheric refraction could never cause a stopped vessel, as we know *Titanic* was, to appear to change her bearings during the time that she was firing distress rockets as reported by *Californian*'s second officer.

What about the claim that a temperature inversion created the appearance of a luminous fog bank on the horizon that camouflaged the iceberg from being seen earlier in time?

As for a temperature inversion causing the creation of a luminous fog bank hovering just above the sea on the horizon, one must first ask if there was enough light for such a sight to be seen at all that night? The phenomenon of a Fata Bromosa, in which the relatively flat and uniformly illuminated surface of the sea beyond the horizon appears as a vertical or slightly overhanging wall of fog, is very well documented. It occurs when cold air bends light abnormally downwards, around the curvature of the earth, revealing much more of the earth's surface beyond the visible horizon than can be normally seen. During daylight or moonlight conditions, it appears as a wall on the

horizon as previously shown in Figure 3. However, for that “overhanging wall of fog” to be seen at all, there must be sufficient light reflecting off the surface of the sea that is *beyond* the normal horizon. If the sea between a vessel and the horizon itself cannot be seen because of the lack of sufficient light at night, then too there would be insufficient light to form a wall of apparent fog caused by abnormal refraction. The Fata Bromosa would be there if conditions were right, but it would not be visible as depicted in some books and documentaries trying to expound a causation theory as to why the iceberg was not seen sooner. In addition, it should also be pointed out that some more recent meteorological studies suggest that at the time and in the area where *Titanic* collided with an iceberg, super-refractive atmospheric conditions did not exist.⁹

The distance at which an iceberg can first be seen visually depends upon the existing meteorological visibility, the height and cross-sectional area of the iceberg, the source and condition of lighting, and the location of the observer. In 1912 it was generally *believed* that on a dark, clear night, icebergs can be seen at distances from 1 to 3 miles, appearing either as white or dark objects with occasional light spots where waves break against it.¹⁰ Under such conditions of visibility, growlers (small icebergs less than 14 feet in height and 46 feet in length) are considered an even greater menace to vessels, and we know that the lookouts were warned to keep a sharp lookout for them.¹¹

Belief is one thing but fact is another. Data on iceberg visibility distances was systematically collected in 1925 by Lt. Commander Fred Zeusler of the United States Coast Guard who was the Ice Observation Officer for the International Ice Patrol that season. That data showed that an averaged sized iceberg can be expected to first be spotted at a distance of about one-half nautical mile on a clear, dark, and moonless night.¹²

Sir James Bisset, former Commodore of the Cunard Line and second officer of the rescue ship *Carpathia* at the time of the *Titanic* disaster, wrote in 1988 that on dark, moonless nights with clear visibility, icebergs are first visible by starlight at a distance of about one-half mile.¹³ It should also be pointed out that during the rescue operation, *Carpathia* had come to within one-quarter mile of a 30 foot high iceberg before it was spotted and successfully dodged on the way to picking up the first lifeboat from *Titanic*.¹⁴

In *Knight's Modern Seamanship* (18th Edition, John Wiley & Sons, 1989), in the chapter on Ice Seamanship (Ch. 13), it states: “On a clear, dark, starlit night, a lookout will not pick up a berg at a greater distance than one-fourth of a mile, but if its bearing is known, an occasional light spot, caused by the swell breaking against it, is discernible with binoculars at a distance of a mile.” Nonetheless, on the night of April 14, 1912, the only light coming off an iceberg was reflected starlight, and with the total absence of wind or swell, there were no breaking of waves at the base of a berg to help spot them earlier.

When the fatal iceberg that sank *Titanic* was first spotted, it was well below the level of where the horizon would have been if it were visible. As pointed out before, the lookouts could not tell where the sky ended and the sea began. There was no clear dividing line between water and sky as seen from the bridge or the crow's nest. From several eyewitness accounts, the height of the iceberg that *Titanic* struck was about 70-75 ft above the water, or about 15-20 ft below the level of the crow's nest. Its peak was described as being just a little higher than the boat deck. At the level of the crow's nest, the visible horizon (if it were visible) would be about 0.15° below the horizontal. This is

known as dip and is accounted for when taking celestial sights. The iceberg *Titanic* struck would have been about one nautical mile in front of *Titanic* when its peak would have dropped below the horizon. It would have been completely camouflaged by the black, cold sea that surrounded it.

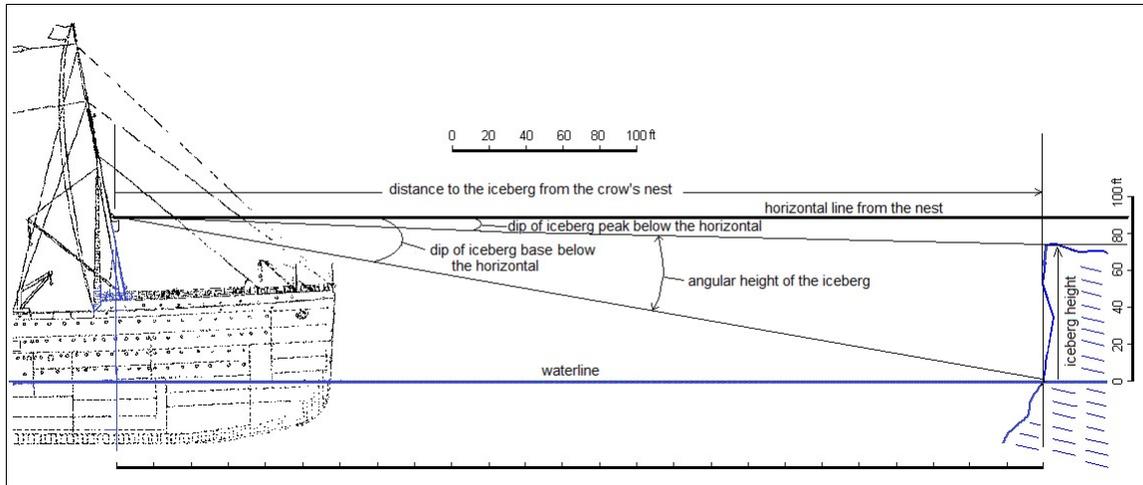


Fig. 6 – Angular height of the iceberg when 500 ft in front of *Titanic*'s crow's nest.

The iceberg that *Titanic* struck would not have become visible until it was about 1/2 mile away, and was more likely first spotted when only about a 1/3 mile away. It would have been virtually impossible for it to have been seen earlier because there simply was not enough light to make it visible against the background of a very black sea. Its angular size when it was more than a mile ahead of the ship, when its peak would have been above the horizon, was just too small for it to be spotted against the black sky, and too small for it to block out any recognizable grouping of stars that were ahead.

The lesson in all of this is that one must not fall into a serious trap by taking a theory and then presenting only selective evidence to support it without exploring, understanding or presenting some realistic alternatives.

There have been many attempts to show the encounter between *Titanic* and the iceberg that occurred at 11:40pm ATS on April 14th 1912. Most of these do not take into account the actual seeing conditions that existed that night, usually showing a much brighter scene than what there really was, and using an artist rendering of a giant iceberg towering well above the vessel. What we will try to do here is to be as accurate as we can to show what the lookouts would have seen when they first spotted the iceberg and struck the lookout bell three times to warn the bridge that something was ahead.

The distance to the berg when those three bells were struck was based on the documented movements of standby Quartermaster Alfred Olliver. QM Olliver said that he left *Titanic*'s standard compass platform for the bridge as soon as he heard 3 bells strike from the lookouts in the nest, and was just entering the bridge when the ship struck the iceberg. Based on the distance of the path from the compass platform to the bridge that he had to take, and assuming a brisk walking speed, and allowing for some reaction time as well, it is estimated that it took Olliver about 50 seconds to get to the bridge after leaving the 3-bell warning. Based on this timing, and a speed of 22½ knots for the ship, it is estimated that the iceberg was about 2000 feet (1/3 nautical mile) ahead of the vessel

when those three bells were struck in the nest.

The view from the nest that was created spans a width of 4 points (45°) to either side of dead ahead centered on an azimuth angle of 266° true, the ship's known course heading just before the fatal encounter. The vertical field in the viewing frame is taken from 24° above to 24° below the horizontal as seen from the nest.

To make things as realistic as possible an actual photo of the forecandle head from *Titanic's* sister ship *Olympic* was photographically darkened and adjusted so that the view corresponded to that which would have been seen at night from the crow's nest in the chosen field of view that is presented. The height of eye from the crow's nest, which was located on the foremast, was about 90 feet above the waterline, or 40 feet above the level of the ship's forecandle head, and about 125 feet aft of the vessel's stem head. From the crow's nest, the stem head of the vessel appears at an angle of about 18° down from the horizontal.

For the iceberg, an actual photograph of the one taken on April 20th from the German steamer *Bremen* was used. That iceberg matched very closely with descriptions given by several *Titanic* eyewitnesses, including AB Joseph Scarrott and QM Alfred Olliver, who actually saw the iceberg that *Titanic* struck at the time of the encounter. This photograph was then photographically darkened accordingly and adjusted in angular size to match the view from the nest as it approached the ship in the time leading up to the collision. The peak height of this medium sized iceberg was taken as 70 feet above the waterline, or about 20 feet below the level of the lookouts in the crow's nest. This would place the peak of the berg just slightly higher than the level of the boat deck to match what several eyewitnesses described seeing as it went aft along the ship's starboard side during the encounter. As previously mentioned, the iceberg was always below the level of the horizon as seen from the nest from the very first instant that it was spotted. There were no background star fields or a visible overhanging wall of fog, apparent or otherwise, for it to block out.

To recreate the scene in the sky as the ship approached the iceberg, we used planetarium software to reproduce the sky scene for the ship's position (about $41^\circ 46'N$, $49^\circ 57'W$) and time (02:58 15 April 1912 GMT) of the encounter. In the recreated scene, shown in Figure 7, the bright star that can be seen almost directly ahead of the ship at a height of about 12° above the horizon is Procyon, the brightest star in the constellation Canis Minor, the little dog. About 27° to the right of Procyon, and about the same height above the horizon, is the red planet Mars. (It should be noted that there were a number of other bright stars in the sky that night, but they were located outside the field of view that is being presented. They were the bright star Regulus in the constellation Leo the lion in the west-southwest at a height of about 43° above the horizon, the Gemini twins Castor and Pollux in the west-northwest at respective heights of about 27° and 28° above the horizon, and the bright star Capella in the northwest at a height of about 15° above the horizon in the constellation Auriga, the charioteer.)

The recreated scene from the nest at the time the iceberg was first sighted, about 50 seconds before the collision, is shown below in Figure 7. The distance of the ship from the iceberg was about 2000 feet, and the berg appeared just below the level of where the horizon would be. Notice the lack of a clear demarcation line between sky and sea.



Fig. 7 – Recreated scene from the nest when the iceberg was first sighted.

¹ For Reginald Lee, this thick haze of his seemed to be a shadowy cover in a failed attempt to disguise reality by casting a small cloud of doubt. It was seemingly part of a defensive reaction that was created over concern of being blamed for not seeing the iceberg in time to avoid. For he and his mate, Frederic Fleet, were the two men who were charged with the responsibility of signaling a warning to the Officer of the Watch in sufficient time for him to take action to avoid what was ahead of them. Yet despite the warning that they gave, the ship still managed to somehow collide with an iceberg, and almost 1,500 people perished.

² What would happen is that you would get what is called the knife-edge effect, or edge diffraction. It is a redirection of a portion of the incident light that strikes a well-defined obstacle, such as a mountain range or the edge of a building, that is caused by wave diffraction.

³ For a star about to set on the horizon, the angle of incidence (the angle between a ray incident on a surface and the line perpendicular to the surface at the point of incidence) would approach a right angle. That is where the reflectivity off the water would approach 100%. (Reference: David Lynch, William Livingston, *Color and Light in Nature*, 2001, Section 3.5.) This could easily produce a reflected image of a bright star setting near the horizon as a beam of light on the water to an observer in a lifeboat.

⁴ Commander Charles Lightoller, *Titanic and Other Ships*, Ivor Nicholson and Watson, 1935.

⁵ According to Mila Zinkova, “Low patches of sea smoke might be hard to detect at night, but sometimes the glowing plankton that is common in these waters can enhance their appearance. The plankton glows when disturbed by the movement of waves or by predators. Shiers (1913) testified that he observed phosphorous that was coming up in the water right after the collision. Reflected starlight also could have made sea smoke more evident. The effect could have been greater over the ice field. Sea smoke could appear as localized fog (or haze) around the icebergs: the United States Coast Guard (1922) describes an instance in which vapor from the melting ice was clinging to the berg as steam. That localized, patchy appearance might provide some justification as to why most witnesses saw no haze and account for Fleet’s, Lee’s and Thayer’s haze and Jessop’s mist.” (Reference: Mila Zinkova, “Titanic’s Mirage, Part 2: Did a mysterious mirage-associated haze camouflage the iceberg?,” Royal Meteorological Society.)

⁶ At 5 nautical miles, the ship’s waterline would appear to be almost on the horizon as seen from *Californian*’s upper bridge. (Bowditch, Table 16.)

⁷ Distress socket signals, as used by *Titanic* and other vessels in 1912, ascended to heights of about 500-600 feet above firing point before they burst into stars. There are tables (e.g., Bowditch, Table 15) and formulas that give distance by vertical angle measured between the sea horizon and the top of an object located beyond the sea horizon after correcting for sextant index error and dip of the horizon as seen from

an observer. An angle of 6 arcminutes (6.0') above the horizon happens to be close to the value for the dip of the horizon (6.5') for a height of eye of 45 feet, the height of eye above the sea for someone standing on the upper bridge of *Californian*. Therefore, using a corrected angle value of -0.5 arcminutes (-0.008°), and using a difference in height between the rocket burst and height of eye of 550 feet, the calculated distance to a vessel firing those distress rockets is 27.3 nautical miles.

⁸ British inquiry, 8100.

⁹ Sukanta Basu, Christopher G. Nunalee, Ping He, Steven T. Fiorino, Mikhail A. Vorontsov, "Reconstructing the Prevailing Meteorological and Optical Environment During the Time of the *Titanic* Disaster," Proc. SPIE 9224, Laser Communication and Propagation through the Atmosphere and Oceans III, 92240Y (7 October 2014).

¹⁰ Lightoller, BI 13560-13569, BI 13648-13652. What you have back in 1912 were a lot of opinions, not all of which agreed with each other.

¹¹ Lightoller, BI 13615-13622.

¹² Leo Shubow, *Iceberg Dead Ahead!*, Bruce Humphries, Inc., 1959.

¹³ James Bisset and P. R. Stephensen, *Tramps & Ladies*, Angus & Robertson, 1988.

¹⁴ The only background to the berg would be a very black sea. The same was true for the 30-ft iceberg sighted from the bridge of *Carpathia* shortly before reaching the first lifeboat. (Rostron, BI 25405-25413, BI 25425-25432.) That iceberg would have presented a typical cross-sectional area of 0.16 of that of a typical 75-ft berg, and would have needed to have come 40% closer to present the same amount of reflected starlight that a 75-ft berg would present. If that 30-ft berg was first seen at ¼ mile as Rostron claimed, then a 75-ft high berg should present about the same amount of reflected starlight when 2.5 times further away, or just over ½ mile. One is a check that validates the other.