The Break-up of the Titanic:

Viewpoints and Evidence

Titanic Research

by

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Tuesday, 09 July 2002

A detailed discussion of structural failure as the Titanic sank.

http://www.encyclopedia-titanica.org/breakup-of-titanic.html

We would like to thank Mr David Gleicher for this outstanding piece of research.

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Introduction

From very early on in the history of the Titanic, the ship's final moments have been a subject of lively debate. Did the ship break apart? Did it explode? Did its stern rise out of the sea at an extreme angle before it plunged into the Atlantic? Or did it, as in some of the early films, go down quietly and sedately, the doomed people on the ship gathering to sing together as it gently sank?

Ballard's historic discovery in 1985 of the wreckage of the Titanic, and the scientific work over a number of subsequent expeditions to the site, has opened up anew the question of what exactly happened to the Titanic in its final moments. Certain key issues have been resolved by these expeditions. The claim by several witnesses (e.g., Osman, A: 541, quoted below) that the ship's boilers exploded, has been disproved, said boilers being found largely undamaged. It is also clear now, that the ship did break apart, previously a point of great contention as well. The wreckage was found in two distinct pieces, the stern, fragmented virtually beyond recognition, on the one hand, and the bow of the ship, remarkably intact, on the other, the two separated by approximately 2000 feet (Wells, 1997: 118-9), with a large chunk of the mid-section left unaccounted for.

The consensus that the ship broke up in the course of sinking, in turn, however, has led to a division of opinion as to the nature of the break-up itself. The thrust of this piece is to sort out the main current theories of the break-up, and to evaluate what support there is for each, both with respect to the scientific evidence and to the testimony before the American and British investigative inquiries of those on the scene.

Three main theories of the break-up will be discussed: the 'popular conjecture' (as it has been called), which is in its rough outline the break-up theory that pre-dated the Ballard discovery, but was elaborated in greater detail after it. It is expressed graphically in an early scene in Cameron's film, Titanic (1997), in the guise of an explanation to the elderly Rose. A second theory has been advanced by Roy Mengot (1997), subsequent to a 1996 expedition to the wreckage. And lastly a new theory has emerged subsequent to a 1998 expedition and is presented in the Discovery Channel documentary, Titanic: Answers from the Abyss (1999).

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Mengot's analysis of the 'break-up' of the Titanic, relies heavily on data derived from the 1996 expedition to the wreckage (Wells, 1997), presented in the Discovery Channel documentary, Titanic; Anatomy of a Disaster (1997). Mengot supports his theory by reference to computer simulations reported in the paper, "The sinking of S.S. Titanic--investigated by modern techniques," Hackett and Bedford (1996), a stress analysis conducted by naval engineers at Cobbs & Gibbs Inc. in 1996, as well as a forensic analysis of the Titanic wreck in William Garzke, et. al. (1997). Mengot's most important conclusion is that the Titanic broke apart from forces in great measure acting on the keel of the ship, just aft of Boiler 4, causing the mid-section of the ship to be compressed and crushed from the bottom.

More recent data has come from a 1998 research expedition to the wreckage of the ship; these are reported in a second Discovery Channel documentary, Titanic: Answers from the Abyss (1999), and in Garzke, et. al. (2000). Their findings are based largely on a new stress analysis by Cox & Gibbs based on a new forensic analysis by Garzke. These indicate that at the time of the break-up there had been greater stress on the after expansion joint at the upper part of the ship's structure than estimated in 1996, and not as much on the keel aft of the site of the accident, as previously estimated in Cox & Gibbs in 1996. The latter had been, of course, a piece of evidence cited by Mengot for his theory of the break-up.

The chief difference in the estimates of stress between the two models derives from new tests of steel that had been located near where the break-up occurred and was found by the 1998 expedition (Garzke, et. al., 2000: 10-11). These indicate the steel was stronger than previously believed in 1996. The inference drawn from the 1999 Discovery documentary is that the ship broke apart from the top down, contradicting Mengot's bottom-up thesis.

This new theory (like the popular conjecture) is open to a broad attack on purely conceptual grounds. The after expansion joint, which was found in the wreckage to have separated by a number of feet, nonetheless did not enter into the fundamental hull structure of the Titanic, whereas the keel did. The break-up of the ship as a whole therefore still would seem to have depended on the keel separating (though not necessarily completely) and with it the structure collapsing.

As Mengot (1997) writes in this regard:

A top-down break requires a number of single point failures working together and plays into the strength of the ship's design. A bottom-up break works against the strengths of the ship's design.

And elsewhere, he asserts of the area in the keel:

Of note, the inch thick steel sides of Titanic are the strength of the ship's design. The lower ship's structure of the keel, the watertight bulkheads, the decks between them, and the interior pillar system also make for a strong structure. This structure provides the current stern with most of it's form and appears relatively intact aft of the engine room. The decks above the watertight bulkheads show far more movement and damage.

This general point is made more forcefully by Parks Stephenson, a member of the Marine Forensics Panel of the Society of Naval Architects and Marine Engineers, in the following communication published on the Encyclopedia Titanica Message Board:

I hear a lot of talk on this and other lists about the opening of the expansion joints affecting the structural integrity of Titanic's hull girder; so much so, I was beginning to think that H&W developed a special kind of expansion joint that I have never before encountered. Evidently, though, there appears to be a common misconception about the role expansion joints played in the failure of Titanic's longitudinal strength members. Which is to say, they played no role at all. If anything, they were merely a symptom, an indicator, of the bending stresses acting on the hull girder below.

I have reviewed the finite element model constructed by Gibbs & Cox engineers that show stresses accumulating in the region of the aft expansion joint. That computer model was constructed by architects who assumed that the superstructure was part of the hull structure (based on their more

modern experience). I discussed this at length with Bill Garzke, Chief Architect at G&C and Chairman of the Marine Forensics Panel. The result is that you won't see that model anymore, except on re-runs on the Discovery Channel. I also was invited to join the Marine Forensics Panel, where I am now a contributing member (I say this to provide some credentials for what I have claimed above; otherwise, I don't expect many people will believe me). The failure of Titanic's hull girder had to do with the extreme negative bending moment acting on the part of the ship that had a large number of discontinuities in the structure, like large public and engineering spaces, shell plating openings, etc.

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The new 1998 stress analysis does not alter, but indeed depends upon, the reliability of the computer simulation reported in Hackett and Bedford (1996). This important paper maps the changes in the angle of the ship in the water over time, and related information, up to the point of the break-up and hence is a valuable resource. Both the 1996 and 1998 stress analyses are based on the 'flooding scenarios' found in the Hackett and Bedford paper (Garzke, et. al. 2000: 12; 16). It should also be noted that the most novel of the 1998 findings, and the most speculative as well, concern what happened to the ship once it was completely under water. These go well beyond the Hackett and Bedford simulations, and will not be of much concern to us here.

According to Hackett and Bedford (1996: 193) between 2:10AM and 2:15AM--by which time water had filled the six forward watertight compartments and half-filled Boiler Room 4--the weight of the forward bow of the ship became such that the angle of the ship's trim to the surface of the water increased sharply (Hackett and Bedford, 1996: 194). From 1:40AM to 2:10AM this angle had been already increasing at an increasing rate and had doubled from almost 5 degrees (roughly the angle it had been since about 12:20AM) to almost 10 degrees, an average rate roughly of .18 degrees per minute. From 2:10AM to 2:15AM, a mere five minutes, the angle of the trim to the water surface then increased to more than 17 degrees. The rear three compartments of the stern were now out of the water, the extreme rear of the stern having first cleared the surface of the water at 2:00AM (cf., Quinn, 1997: 21)

Mengot (1997) writes, describing the situation at 2:15AM:

#1 funnel was inundated and the collapsible boats [A and B: DG] were floated off the bridge area. Water [was] moving up the corridors and beginning to flood the compartments for #2 and #3 boiler rooms" (also see Hackett and Bedford, 1996: 193).

He argues that the relevant physics broadly speaking, is:

The weight of the bow section [was] pulling perpendicularly downward. Buoyant forces [were] pushing up on the broad bottom of the ship, trying to right the stern. The sides [tried] to remain rectangular.

In other words, the ship's lower structure was under increasing stress from opposite and increasing forces. Its bow, from the water it had been and still was taking in, was being pulling down by its own weight, while that portion of its keel that was still under water was being pushed up by the force of buoyancy, and there was an increasing force of the stern out of the water at the extreme rear s well.

Mengot's theory is that these opposing forces had the effect of compressing the mid-section of the ship, crushing it, particularly just aft of the accident, until the structure failed, the ship coming apart. This accounts for the missing midsection of the ship's wreckage, it having been left in such small particles that it has effectively disappeared. Mengot emphasizes that the Titanic was a relatively hollow vessel once its basic structure was breached. He uses the metaphor of the folding of a hollow cylinder, as opposed to the snapping of a stick, the forces ultimately crushing the ship at the bottom. Once this happened, the forward part of the ship. heavy with water and suddenly freed from much of the weight of the stern, detached afore the third funnel, and pulled away, at some point separating completely from the stern.

In one respect Mengot seems to be in agreement with the popular conjecture discussed below. Once the stern became completely severed from the rest of the ship by the initial break-up, it first fell back onto the ocean, in Mengot's view from a 10 to 15 degree angle out of the water. Then, like a bobbing cork finding temporary equilibria, its Poop Deck briefly rose up out of the water again, after which this last remnant of the Titanic went under, sinking until at some two hundred feet below the surface it imploded.

The 1998 analysis offers an alternative view. It refers to new evidence from the severed keel gathered during the 1998 expedition, indicating that there was excessive wear and tear of the keel. This leads to the conclusion that the keel remained attached to the stern, which was dragged down by the bow before being led down under the ocean, still loosely attached. The stern implodes, causing explosions

some 200 feet below the surface. It is then said to detach completely from the keel some 500 feet below the water surface.

Both the 1996 and 1998 analyses of the break-up differ in key respects from that originally put forward after the 1985 discovery of the Titanic; what we have followed Mengot (1997) in referring to as 'popular conjecture.' The latter is the basis of the very influential delineation, graphic and otherwise, of the break-up in Ballard's Discovery of the Titanic (1989), Lynch and Marschall's Titanic: An Illustrated History (1992), Cameron's film Titanic (1997), and Quinn's Titanic at Two (1997: 87).

The physics of the break-up according to this theory lies primarily in the force pulling down on the stern as it putatively rose at an extremely steep angle out of the water. This is said to have opposed the force pulling down the sinking bow, until like a stick snapping, the ship cracked along the after expansion joint at the top of the ship. Key to this view is that the break-up did not occur until the stern was out of the water at an angle on the order of some 45 to 50 degrees ahead (Quinn, 1997: 93-4), so that the ship broke apart from stress placed on the upper deck. To quote Quinn:

The stern began to lift out of the water…This much weight rising out of the water created a terrible strain on the Titanic which was first felt on the upper decks as the ship tried to bend itself back down into the water (1997: 87)

Mengot (1997) points to the analysis of Cox & Gibbs in 1996, according to which at 2:15AM--the time the structure failed--the greatest stress was on the keel, well below the water-line, in the area just abaft the site of the accident. While there was stress as well on the after expansion joint it covered a much smaller region. This is what one would expect if it was the push upward on the keel from buoyant forces opposing the downward pull on the bow and the stern that caused the break-up; i.e., Mengot's hypothesis.

This argument, of course, has lost some of its power due to the 1998 stress analysis, which points in the other direction. However, as already noted, even the 1998 analysis indicates some extreme stress in the keel, and secondly, the keel and not the after expansion joint was fundamental to the ship's larger structure. The possibility of the ship cracking at the expansion joint as it was breaking apart at the keel therefore cannot at all be ruled out (Wells, 1997: 144-45).

In one important respect the findings reported from the 1998 expedition parallel Mengot's theory, in relation to the popular conjecture. Both rely on the Hackett and Bedford simulations suggesting that the angle of the stern was only 10 to 15 degrees at the time of the break-up.

As mentioned above, a new speculation made in the 1999 Discovery documentary, based on an examination of the large section of the keel found by the 1998 expedition, is that the two parts of the ship did not fully detach immediately, but remained loosely connected at the keel until the ship was well below the water; the bow dragging the dangling stern behind it as it descended. It is not clear however, given this conjecture, how the documentary traces the sinking of the stern immediately after the break-up, as seen from above the water. As just discussed, Mengot's view is that after the break-up the stern gently fell back onto the surface of the water, and then went forward on its nose, its afterend rising up (like a cork) to an almost perpendicular position, from which it made its final dive under.

The documentary does not address what the course of the stern would have been, instead, if it were being dragged down by the bow. This lacuna makes it difficult to evaluate the 1999 Discovery documentary's claims in terms of eyewitness testimony. The latter[1] is clearly the basis for what Mengot and the popular conjecture put forward as to what happened to the stern once the break-up occurred, and before it was completely under water. One is left to wonder, then, how the new theory takes into account this testimony.

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When we look to eyewitness testimony of the final moments of the Titanic we find that there is evidence confirming, in various of its aspects, the Mengot's bottom's up theory of the break-up, as against either the popular conjecture or that of the 1999 Discovery documentary. Most notably, there is no direct eyewitness testimony from someone who was on the ship and directly saw the ship breaking up. This lends credence to Mengot's account in particular, since where he posits the main damage occurred was extremely remote; the boiler rooms amidships, at the bottom of the ship. If there were anyone in this area at that late time, a fireman or two perhaps, they surely would not have survived. Mengot's theory also leaves open the possibility that the final break-up of the ship occurred just below the surface, so that the ultimate coming apart of the upper decks was not visible to observers.

The top down theory of the break-up, by contrast, in both its versions implies that the top decks were coming apart well out of the water, between the third and fourth funnel. Indeed, this is explicitly simulated in the 1999 documentary. But this would mean the break-up of the Titanic would have been observed by at least one of the several survivors who were specifically on the ship at the time of the sinking, or in nearby lifeboats.

Moreover, with respect to the popular view, as is portrayed for instance in Cameron's Titanic, once having detached, the stern would have fallen from a great height, crashing back into the ocean. There is fairly detailed testimony by three survivors who were on the after Boat Deck and whom we will quote directly in due course (Abelseth, A: 1038-9; Dillon, B: 3848-85; and Joughin, B: 6040-76). No mention is made by any of them of seeing the ship break-up (except for the falling of funnels), or of the ship crashing back into the ocean, or of there being a huge wave as a consequence of such a fall.

The latter point is made by Mengot in the context of the following detailed hypothesis as to what the break-up consisted of:

Condition 11 [the ship at 2:10AM to 2:15 AM: DG] shows stress on the shell plate at a critical point where they begin to break-up. The #1 boiler room is forced upward into the falling upper decks and the center section of the ship grinds itself up, spilling out the single ended boilers. The rapid flooding of the turbine room smashed the condensers and allows us to find interior sections of the condensers in the debris field. The stern is left low in the water at the head as the bow begins the trip to the bottom. With the watertight compartments compromised back to the dynamo room, it fills in only minutes to allow the stern to settle and tip up so quickly that many survivors didn't notice an interruption in the sinking process.

This process also allows the stern to be more gradually lowered into the water. In a top down break, all models and simulations show the stern flopping down into the water, as seen in the Cameron movie. The splash and wave produced would have been enormous, but survivor accounts don't indicate this (1997).

Interestingly, Quinn, having recited the popular conjecture, is compelled to try to explain, in the case of Abelseth, why, if his testimony is to be believed, he didn't see the break-up, though he did hear it, on the far-fetched grounds that it was too dark:

Abelseth was very fortunate that he chose not to jump into the water only a minute earlier. He was lucky he chose to wait with his cousin and brother-in-law at the empty davits lifeboat No. 15--the further one back, instead of the davits of lifeboat number 9. Had he chosen either of the alternatives, he would have been caught in the catastrophic break-up of the ship. Because the lights had gone out, he could not see that the ship tore apart a hundred feet ahead of him. he describes the break-up only through the sense of hearing and apparently did not realize himself that he heard the ship tearing in two (1997: 100).

Mengot's theory provides us a simpler account of Abelseth's testimony. The latter, like many others heard the ship coming apart, but saw nothing, because the initial break-up was occurring well below the water, in the keel, out of sight and somewhat more forward than Quinn imagines here.

Mengot's location of the break-up at the ship's bottom, conjoined to the considerably more gentle angle of the stern when it occurred, also helps explain certain seeming peculiarities of eyewitness accounts. In this context, we will refer primarily to the testimony of the few survivors who were on the ship when the break up was occurring, as well as those in the water near the ship at that time. The most reliable of the witnesses in the lifeboats, who on occasion we will make reference to as well, generally were those that had left the ship some time after 2:05AM, and were within as little as a hundred feet of the break-up. Most lifeboats that were from a quarter of a mile up to a few miles away, and, particularly given the darkness of the night, observations by most individuals in them lack the necessary specificity to be of much value.

One of the most common observations made by eyewitnesses of the sinking of the Titanic bears some scrutiny. This is that the sound heard was that of an explosion. It bears repeating that while many witnesses use the term 'explosion' to describe what they heard,[2] none actually testified to seeing the ship explode. Without visual aid the compression of the ship at the bottom--Mengot's theory--was essentially the crushing into bits the keel and the boiler rooms amidships, and it might be mistaken for a detonation. The sound of small particles of matter making contact with one another is common to both, and is quite distinct from the cracking of a structure.

In some cases, as well, the term explosion is seemingly used by people who were in lifeboats, and were hearing the stern imploding 200 feet or so below the surface, after the ship had completely sunk, and hence well after the actual break-up. There is convincing evidence from the wreckage that such an implosion of the stern did take place. Prime examples of such witnesses (also see Pitman, A: 281) are steward Frederick Crowe (A: 621) who was in Lifeboat 14 within a mile of the ship, and testified to 'hearing several explosions' which he describes as "a kind of muffled explosion….at a very great distance…"; and Frederick Lee, better known for being a lookout when the accident occurred, who testified to hearing "explosions…after [the ship] had gone down" that were "like a gun-cotton explosion under water at a distance" (B: 2562-3). We confine our comments here, therefore, to witnesses who make it reasonably clear that the stern was still visible above the water when the noise they heard occurred, and therefore are not referring to the sound of the stern exploding 200 or so feet below the water, after the Titanic had completely disappeared from view.

It is equally significant that there is--with one or two possible exceptions whom we will discuss--no testimony of anyone hearing a snapping of a joint, or the sharp sound of the upper decks cracking, as one would infer from the a top down theory of the break-up, whether it be the popular theory or that of the 1999 Discovery documentary.

An angle from which one can approach the common (though by no means universal) interpretation of the sound as an explosion--knowing with some certainty from the wreckage that no significant explosion actually took place until the stern was some distance below the water--is that this interpretation only makes sense in the context of the boilers being the source of the explosion, as most of those who use the term thought had been the case. The finding by the 1998 expedition that the forward boilers were basically intact dispelled that theory. After all, there was nothing on the upper decks that was capable of a detonation of any great magnitude. The belief by so many that there was an explosion before the ship had sunk may therefore be partially explained by the fact that the eyewitnesses sensed the noise was indeed coming from below, and associated it, in one way or another, with the boilers.

An extreme example of this is the somewhat fanciful observations of the AB Frank Osman, who was on Lifeboat 2, which was just astern the ship when it broke up. His testimony before the American inquiry, in an exchange with Senator Burton, is as follows:

OSMAN: …After she got to a certain angle she exploded, broke in halves, and it seemed to me as if all the engines and everything that was in the after part slid out into the forward part, and the after part came up right again, and as soon as it came up right down it went again.

SENATOR BURTON. What do you think those explosions were?

Mr. OSMAN. The boilers bursting.

SENATOR BURTON. What makes you think that?

Mr. OSMAN. The cold water coming under the red-hot boilers caused the explosions.

SENATOR BURTON. You reasoned that out?

Mr. OSMAN. Yes; but you could see the explosions by the smoke coming right up the funnels.

SENATOR BURTON. Did you see any steam and smoke coming?

Mr. OSMAN. Yes.

SENATOR BURTON. Did you see any sparks?

Mr. OSMAN. It was all black; looked like as if it was lumps of coal, and all that.

SENATOR BURTON. Coming up through the funnels?

Mr. OSMAN. Through the funnels.

SENATOR BURTON. That is, there was a great amount of black smoke coming up through the funnels just after this explosion?

Mr. OSMAN. Just after the explosion.

SENATOR BURTON. And there were lumps of coat, etc., coming up?

Mr. OSMAN. Yes; pretty big lumps. I do not know what is was.

SENATOR BURTON. Did any water come up?

Mr. OSMAN. I never seen no water; only the steam and very black smoke (A: 541).

It is also the case that there are many credible witnesses who explicitly rejected in their testimony the term explosion, or qualified it to indicate a sound of something being ‘smashed’; that is, crushed, but not a cracking noise. Several analogize the sounds they heard to ‘rumbling noises,’ a few to a ‘rattling chain,’ one calls it a ‘volley of musketry’ (but explicitly not an explosion).[3]

One of the most nuanced descriptions is that of Jack Thayer, a First Class passenger who was on the forward Boat Deck at the time of the break-up:

Occasionally there had been a muffled thud or deadened explosion within the ship. Now, without warning she seemed to start forward, moving forward and into the water at an angle of about fifteen degrees. This movement with the water rushing up toward us was accompanied by a rumbling roar, mixed with more muffled explosions. It was like standing under a steel railway bridge while an express train passes overhead mingled with the noise of a pressed steel factory and wholesale breakage of china (1940: 344).

Thayer vividly suggests that the ship was being compressed--‘the noise of a pressed steel factory and wholesale breakage of china.’ He also confirms that the angle of the ship out of the stern was in the range of 10 to 20 degrees when the ship broke up, since the bow was sinking at about a 15 degree angle. Thayer’s estimation of a 15 degree angle is about the same as Hackett and Bedford’s estimate at the time of the break-up.

Archibald Gracie provides a very similar description to Thayer’s (to whom he was nearby, on the Forward Boat Deck) of what he heard. It also gives the impression of something being crushed, not cracked. Gracie writes:

[T]here came a noise which many people wrongly, I think have described as an explosion. It has always seemed to me that it was nothing but the engines and machinery coming loose from their place and bearings and falling through the compartments, smashing everything in their way. it was

partly a roar, partly a groan, partly a rattle, and partly a smash, and it was not a sudden roar as an explosion would be; it went on successively for some seconds, possibly fifteen or twenty, as the machinery dropped down to the bottom (now the bows) of the ship; I suppose it fell through the end and sank first before the ship (Gracie, 1913: 142).

Gracie's statement is some indication that whether or not one heard an 'explosion' depended to a large extent on what was in the mind of the observer's as to the source of the noise. Since Gracie thought it was the boilers dislodging that he heard, he did not hear an explosion, Osman on the other hand, based on dubious chemistry, did. What is perhaps more significant, however, both these witnesses and virtually all the others implicitly locate the break-up at the bottom of the ship, and in the cases where the sound is described in some detail, the eyewitness accounts seem fairly consistent with one another, whether one calls the thing an 'explosion' or not. There is considerable evidence in the testimony of witnesses, then, pointing to Mengot's theory, and away from a top down theory of the break-up, including that of the 1999 Discovery documentary.

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We alluded to two possible anomalies in the view just expressed. They appear in the testimony, indeed, of two key eyewitnesses--both having been on the ship at the time of the break-up--and each seems superficially to give some support to a top down theory of the break-up.

One is the testimony of Charles Joughin, the chief baker, who was likely as close to the break-up as anyone that testified, being at around 2:10AM-2:15AM, on A Deck in the deck panty. He testified to the sound he heard in the following exchange with the Solicitor General at the American inquiry:

SOLICITOR-GENERAL: Tell us what happened?

JOUGHIN: I went to the deck pantry, and while I was in there I thought I would take a drink of water, and while I was getting the drink of water I heard a kind of a crash as if something had buckled, as if part of the ship had buckled, and then I heard a rush overhead. . . .

SOLICITOR-GENERAL: You say that you heard this sound of buckling or crackling. Was it loud; could anybody in the ship hear it?

JOUGHIN: You could have heard it, but you did not really know what it was. It was not an explosion or anything like that. It was like as if the iron was parting.

SOLICITOR-GENERAL: Like the breaking of metal?

JOUGHIN: Yes (B: 6040; 6049-50)

It is tempting to conclude that this confirms the top down theories of the break-up--particularly the phrases "crackling" and "the breaking of metal." However, the latter are words actually spoken by the Solicitor General. In Joughin's own words the sound he heard was like 'buckling' and 'iron parting.' As such it corresponds rather precisely to the dynamics of what happened according Mengot, and which is supported in some measure by the evidence of the wreckage:

The single point failure of the hull, namely the buckling of the keel near the current tear, relieves much of the compression stress on the keel and transfers it to the sides. The [starboard] side shell plate is compelled to bow outward as the keel length shortens (1997).

Joughin, in other words, may have been the sole survivor close enough to the break-up that he could actually hear far below, the keel buckling and the starboard plate shell separating from it. Rather than pointing away from Mengot's theory, the baker's testimony then, points to it. More importantly, perhaps, Joughin implies that the noise came from below, given that he was on Deck A and he does not indicate that the noise came from right above him, only that he heard a rush of people overhead. More than any other testimony, perhaps, this seems to directly contradict the top down theories of the break-up.

The more problematic testimony with regard to Mengot's view is that of Olaus Abelseth. The latter testified that he'd moved forward from the after Well Deck to the after Boat Deck, around 2:00AM it would seem, with his brother-in-law and cousin, and was still there when the breakup occurred.

Like Daniel Buckley, one of the other two Third Class passengers who testified at the American inquiry--there were none who testified at the British inquiry--Abelseth was examined on the thirteenth day of the sixteen day inquiry (the only other Third Class passenger to testify, Berk Pickard, did so the next day). Abelseth's testimony, and Buckley's as well, not surprisingly incorporate in Zellig-like fashion some of the more popular stories emanating from the press in response, to some degree, to the hearings themselves. The reader may note the gratuitous reference to the story of the Strausses in the quotation from Abelseth cited below, just as Buckley gratuitously told a story of an encounter with Mrs. Astor. That Abelseth's testimony conforms to what was already a popular view of the break-up, of the stern rising at an extremely steep angle out of the water, by the time he testified makes what he says open to a healthy skepticism.

Abelseth's testimony is unusual, as well, in that it was before only Senator Smith, and Abelseth was allowed at various points to speak at some length without any actual examination taking place. For these reasons also, what he testified to needs to be taken with a grain of salt. The following is a long section of an even longer statement of this sort. It covers Abelseth's experiences from roughly 2:00AM:

Then we stayed there [the after Boat Deck: DG], and we were just standing still there. We did not talk very much. Just a little ways from us I saw there was an old couple standing there on the deck, and I heard this man say to the lady, "Go into the lifeboat and get saved." He put his hand on her shoulder and I think he said: "Please get into the lifeboat and get saved." She replied: "No; let me stay with you." I could not say who it was, but I saw that he was an old man. I did not pay much attention to him, because I did not know him.

I was standing there, and I asked my brother-in-law if he could swim and he said no. I asked my cousin if he could swim and he said no. So we could see the water coming up, the bow of the ship was going down, and there was a kind of an explosion. We could hear the popping and cracking, and the deck raised up and got so steep that the people could not stand on their feet on the deck. So they fell down and slid on the deck into the water right on the ship. Then we hung onto a rope in one of the davits. We were pretty far back at the top deck.

My brother-in-law said to me, "We had better jump off or the suction will take us down." I said, "No. We won't jump yet. We ain't got much show anyhow, so we might as well stay as long as we can." So he stated again, "We must jump off.," But I said, "No; not yet." So, then, it was only about 5 feet down to the water when we jumped off. It was not much of a jump. Before that we could see the people were jumping over. There was water coming onto the deck, and they were jumping over, then, out in the water.

My brother-in-law took my hand just as we jumped off; and my cousin jumped at the same time. When we came into the water, I think it was from the suction - or anyway we went under, and I swallowed some water. I got a rope tangled around me, and I let loose of my brother-in-law's hand to get away from the rope. I thought then, "I am a goner." That is what I thought when I got tangled up in this rope. But I came on top again, and I was trying to swim, and there was a man - lots of them were floating around - and he got me on the neck like that [illustrating] and pressed me under, trying to get on top of me. I said to him, "Let go." Of course, he did not pay any attention to that, but I got away from him. Then there was another man, and he hung on to me for a while, but he let go. Then I swam; I could not say, but it must have been about 15 or 20 minutes. It could not have been over that. Then I saw something dark ahead of me. I did not know what it was, but I swam toward that, and it was one of those collapsible boats (A: 1038).

What Abelseth asserts here certainly fits the popular theory of the break-up. The sinking sequences in Cameron's Titanic may well in fact have been based directly or indirectly on what Abelseth had to say here. The 'popping' and 'cracking' rather than a 'rumbling roar' is what one can infer from a top down theory of the break-up, and there is as well the clear intimation that the stern rose out of the water at a very steep angle before the actual break-up occurred; causing people to '[slide] on the deck into the water.'

The credibility of Abelseth's testimony is, however, in some doubt, and more importantly there is far too little detail provided by him to bear the weight of the entire issue of the break-up. When it comes down to it, we have from him here no more than a few suggestive and unsubstantiated phrases. As we shall see momentarily, the assistant cook John Collins, the chief baker, Charles Joughin, and steward, Thomas Dillon, each provide much more detailed testimony as to what was happening in the general vicinity of Abelseth, and about the break-up itself.

Indeed, reading Abelseth's account, in relation to Gracie's, for example, one is struck by the absence of any reference on his part to what these others on the ship at that time describe as sudden waves that swept large numbers of people off the Boat Deck, or crowds of Third Class passengers who'd come up to the Boat Deck and were racing aft (presumably past where Abelseth was standing) toward the after Poop Deck. Even more tellingly, perhaps, there is an absence of any reference in Abelseth testimony to the stern crashing back down into the ocean, were it to have risen so steeply out of the water, precipitating the break-up as Abelseth suggests is the case. It strains credulity that

Abelseth, given his location, would not have been aware of such an event, had it happened, and would not have mentioned it.

Concerning specifically Abelseth's description of the sound he heard as 'cracking' and 'popping', a reasonable explanation is that in much the same way that Joughin on A Deck alone could hear the specific noise of the keel buckling, Abelseth may be the one survivor who was close enough to the break-up to have heard the cracking of the ship around the expansion joint, signaling not the root of the break-up but the stress on the top decks. By the Hackett and Bedford simulation (1996: 189), and the eyewitness accounts, it is not impossible that the major break occurred just under the surface of the water (owing to the gentleness of the angle of the stern out of the water and the plunging bow), and hence was otherwise, except for its immediate effects, invisible to observers. Hence the impression left on some, e.g., Osman, A: 541; Collins, A: 630, that the ship 'exploded in the water.'

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It is instructive now to examine, in relation to the different theories of the break-up, the detailed testimony of the witnesses, Collins, Dillon and Joughin, the latter two of whom were, like Abelseth, on the afterend of the Boat Deck when the break-up occurred.

Collins was on the forward end of the Boat Deck at 2:10AM or so, and like Gracie (1913), Lightoller (1935) and others who had also been in that vicinity, he testified to being swept into the water by a high wave which he attributed to the sudden plunge of the bow. On the whole, Collins' testimony before the American inquiry--he was examined by Senator Bourne--if viewed in the light of Mengot's theory, is particularly helpful in understanding how the illusion might have been cast that the ship's stern rising at a steep angle out of the water was what caused the break-up:

BOURNE: Was the ship sinking when you were swept off [from the Boat Deck: DG]?

Collins: She was, sir.

BOURNE: When you came up from the water and got on this collapsible boat, did you see any evidence of the ship as she sunk, then? Collins: I did, sir; I saw her stern end. BOURNE: [Where were] you on the boat at the time that you were washed off the ship?

Collins: Amidships, sir.

BOURNE: You say you saw the stern end after you got on the collapsible boat?

Collins: Yes, sir.

BOURNE: Did you see the bow?

Collins: No, sir.

BOURNE: How far were you from the stern end of the ship when you came up and got into the collapsible boat, would you judge?

Collins: We were about - I could not exactly state how far I was from the Titanic when I come up to the surface. I was not far, because her lights went out then. Her lights went out until the water almost got to amidships on her.

BOURNE: As I understand, you were amidships on the bow as the ship sank?

Collins: Yes, sir.

BOURNE: You were washed off by a wave. You were under water, as you think, for two or three minutes (sic), and then swam 5 or 6 yards to the collapsible boat and got aboard - and got into the boat. The stern of the ship was still afloat?

Collins: The stern of the ship was still afloat.

BOURNE: The lights were burning?

Collins: I came to the surface, sir, and I happened to look around and I just saw the lights and nothing more, and I looked in front of me and I saw the collapsible boat and I made for it. BOURNE: After you got in the boat, did you see any lights on the Titanic? Collins: No, sir.

BOURNE: When you were in the water, after you came up above the surface of the water, you saw the lights on the Titanic?

Collins: Just as I came up to the surface, sir. Her bow was in the water. She had not exploded then. Her bow was in the water, and I just looked around and saw the lights.

BOURNE: Had she broken in two?

Collins: Her bow was in the water and her stern was up y

BOURNE: But you did not see any break? You did not think she had parted and broken in two?

Collins: Her bow was in the water. She exploded in the water. She exploded once in the water, and her stern end was up out of the water; and with the explosion out of the water it blew her stern up.

BOURNE: You saw it while it was up?

Collins: Yes, sir; saw her stern up.

BOURNE: How long?

Collins: I am sure it floated for at least a minute.

BOURNE: The lights were still burning?

Collins: No, sir; the lights was out.

BOURNE: How could you see it?

Collins: I was on the collapsible boat at the time.

BOURNE: If it was dark, how could you see?

Collins: We were not too far off. I saw the white of the funnel. Then she turned over again, and down she went. Collins: I got on to the raft. I could see when I got on to the raft. I saw the stern of the boat, and I saw a mass of people and wreckage, and heard cries (A: 631).

Collins' testimony can be understood in the framework of Mengot's theory so long as one interprets his reference to an 'explosion under water' as an observation of the immediate effects of the ship being crushed just under the surface of the water. Osman's testimony cited above might also be seen this way. Collins then reports another 'explosion' which he says was 'out of the water'. This, we can surmise, was the detachment of the stern that immediately followed the break-up. and which we can easily imagine to have appeared to someone that close to the ship, especially one so predisposed, as an explosion above the water surface.

This illusion is revealed in how Collins specifically explained to Bourne (and to himself) the effect of the two 'explosions': '"Her bow was in the water. She exploded in the water. She exploded once in the water, and her stern end was up out of the water; and with the explosion out of the water it blew her stern up."

Based on his premise that there was an explosion (and not seeing what was taking place below the water line), Collins seems to 'see' the sharp rise in the stern as the effect of the second explosion (and believes the ship is still in one piece). In short, he hasn't realized that the stern had detached from the bow when he testified, "I am sure it [i.e., the Titanic as a whole] floated for at least a minute." There are other witnesses (Bright., A: 841; Dillon, (B: 3859-85).) who also testified that the ship 'righted itself' after its initial plunge.

Collins' testimony also confirms the notion that the angle of the stern out of the water was on the order of 10 to 20 degrees when the break-up occurred --as indicated also by the Hackett and Bedford simulation and the writing cited of Jack Thayer (1940)--and along with this, that the initial break-up of the stern was not directly visible even to those within a hundred feet or less of it on the upper decks, because it occurred just beneath the surface of the water. Collins also does not refer to any precipitous fall of the stern back down to the water consequent to the break-up; one of the key implications of the popular theory. Indeed we can speculate that it is because nothing like this was observed that Collins, and others, did not realize that the ship had broken apart at all.

Let us turn to the second eyewitness, Steward Dillon, who, like Abelseth, was on the after Well Deck in the period roughly from 1:40AM to 2:05AM. Unlike Abelseth, who went forward to the Boat Deck, Dillon testified to moving back to the after Poop Deck at some point after 1:40AM (when the angle of the ship to the water was accelerating) and to remaining there, going down with the ship.

In the following testimony before the British inquiry, he describes his final ten minutes or so aboard the Titanic:

ASQUITH: Before the ship actually went down did you see her make any movements?

DILLON: Yes, she took one final plunge and righted herself again.

ASQUITH: She gave a plunge and righted herself again?

DILLON: Yes.

ASQUITH: Did you notice anything about the funnel?

DILLON: Not then.

ASQUITH: Did you afterwards notice something about the funnel?

DILLON: Yes.

ASQUITH: What?

DILLON: When she went down.

ASQUITH: Was that after you had left the ship?

DILLON: Before I left the ship.

ASQUITH: What did you notice?

DILLON: Well, the funnel seemed to cant up towards me.

ASQUITH: It seemed to fall aft?

DILLON: Yes; it seemed to fall up this way.

ASQUITH: Was that the aftermost funnel?

DILLON: Yes.

ASQUITH: Did you get the idea that the ship was breaking in two?

DILLON: No.

ASQUITH: Did the funnel seem to fall towards you?

DILLON: Yes.

COMMISSIONER: That is the after funnel?

DILLON: Yes, my Lord.

ASQUITH: Then you say the ship plunged and righted herself again; and was it then that you dived into the water?

DILLON: I did not dive into the water.

ASQUITH: How did you get off the ship into the water?

DILLON: I went down with the ship, and shoved myself away from her into the water.

ASQUITH: Were you sucked down at all?

DILLON: About two fathoms.

ASQUITH: And did you then come up again to the surface?

DILLON: I seemed to get lifted up to the surface.

ASQUITH: You got lifted up to the surface?

DILLON: Yes.

ASQUITH: Were you picked up by one of the boats?

DILLON: Yes.

ASQUITH: Do you know which one?

DILLON: Afterwards I found out; it was No. 4 boat.

ASQUITH When you came up again, after you were sucked down - you told us you were sucked down and came up again - was the ship still floating then?

DILLON: No.

ASQUITH: She had sunk when you came up again?

DILLON: Well, I saw what I thought would be the afterpart of her coming up and going down again, final.

ASQUITH: Then she had not sunk?

DILLON: She came up and went down again.

ASQUITH: You saw what you thought was the afterpart coming up again?

DILLON: I thought it was the ship coming up again. She came up and went down again - finish (B: 3859-85).

Even more than Collins perhaps, Dillon's testimony fits with Mengot's theory, in contradiction to the popular view, though it does not necessarily gainsay the 1999 Discovery documentary scenario either. We see that, like Collins, Dillon too had an illusory impression that the ship 'righted itself' before finally sinking.

Not perceiving the break-up, as such, according to his testimony, Dillon felt the sudden plunge of the bow which we know occurred around 2:15AM, and then experienced the stern falling back into the water. The latter, he interprets as the ship temporarily regaining its balance in the water. It is at that point it would seem he entered the water and when he came to the surface he saw the stern rising up out of the water at a severe angle and finally sinking into the ocean. Like Collins (also see Lightoller, 1935: 300) he believed that this was the Titanic altogether that was sinking, not just its afterpart.

Thus, while Dillon's testimony might appear to support the popular theory concerning the angle of the ship when it sank, it does not necessarily do so. What he seems to be referring to, without knowing it-- but which Raymond Asquith, his examiner, does seem to have comprehended-- is the angle of the stern to the water after the break-up had already occurred, and the stern had detached from the bow

of the ship. Like Collins, Dillon makes no reference to the stern crashing down into the ocean from a great height, and indeed the mildness of the phrase ‘the ship righted itself’ to describe what was likely the detaching stern falling back into the water, is an indication that the angle of the ship to the water could not have been on the order of 45 degrees or more.

Finally, there is the testimony before the British inquiry of Charles Joughin. The following is Joughin’s description of his experiences after his hearing the sound of the break-up (cited above) from the deck pantry on A Deck.

SOLICITOR-GENERAL: Was it immediately after that sound that you heard this rushing of people and saw them climbing up?

JOUGHIN: Yes.

SOLICITOR-GENERAL: What did you do?

JOUGHIN: I kept out of the crush as much as I possibly could, and I followed down - followed down getting towards the well of the deck, and just as I got down towards the well she gave a great list over to port and threw everybody in a bunch except myself. I did not see anybody else besides myself out of the bunch.

SOLICITOR-GENERAL: That was when you were in the well, was it?

JOUGHIN: I was not exactly in the well, I was on the side, practically on the side then. She threw them over. At last I clambered on the side when she chucked them.

SOLICITOR-GENERAL: You mean the starboard side?

JOUGHIN: The starboard side.

SOLICITOR-GENERAL: The starboard was going up and she took a lurch to port?

JOUGHIN: It was not going up, but the other side was going down.

SOLICITOR-GENERAL: It is very difficult to say how many, I daresay, but could you give me some idea, of how many people there were in this crush?

JOUGHIN: I have no idea, Sir; I know they were piled up.

SOLICITOR-GENERAL: What do you mean when you say, "No idea." Were there hundreds?

JOUGHIN: Yes, there were more than that - many hundreds, I should say.

SOLICITOR-GENERAL: You said this vessel took a lurch to port and threw them in a heap. Did she come back; did she right herself at all? -

JOUGHIN: No, Sir.

SOLICITOR-GENERAL: She took a lurch and she did not return?

JOUGHIN: She did not return.

SOLICITOR-GENERAL: Can you tell us what happened to you?

JOUGHIN: Yes, I eventually got on to the starboard side of the poop. . . .

SOLICITOR-GENERAL: On the side of the ship?

JOUGHIN: Yes.

SOLICITOR-GENERAL: Is that on the bulwark itself?

JOUGHIN: I do not know what you call it, Sir. It is the side. . . .

SOLICITOR-GENERAL: You see on the model that part of it is painted black and part of it is painted white. Do you mean you were on the part that is painted black or the part that is painted white?

JOUGHIN: I got along here (Showing.), and eventually got hold of the rails here…

. . .

SOLICITOR-GENERAL: Did you find anybody else holding that rail there on, the poop?

JOUGHIN: No.

SOLICITOR-GENERAL: You were the only one?

JOUGHIN: I did not see anybody else..

SOLICITOR-GENERAL: Were you holding the rail so that you were inside the ship, or were you holding the rail so that you were on the outside of the ship?

JOUGHIN: On the outside.

SOLICITOR-GENERAL: So that the rail was between you and the deck?

JOUGHIN: Yes.

SOLICITOR-GENERAL: Then what happened?

JOUGHIN: Well, I was just wondering what next to do. I had tightened my belt and I had transferred some things out of this pocket into my stern pocket. I was just wondering what next to do when she went.

SOLICITOR-GENERAL: And did you find yourself in the water?

JOUGHIN: Yes.

SOLICITOR-GENERAL: Did you feel that you were dragged under or did you keep on the top of the water?

JOUGHIN: I do not believe my head went under the water at all. It may have been wetted but no more (B.: 6040-76).

There are several things remarkable about this testimony. By the time Joughin reached the Boat Deck and was making his way to the after Well Deck, it appears that the stern had already sufficiently detached that it had fallen back into the water, because he makes no reference to the angle of the stern out of the water. If this is so, however, it also means the ship did not fall back into the water from an angle anywhere near 45 degrees. Aside from the timing of the events (having heard the break-up Joughin then went from A Deck up to the Boat Deck in the midst of many others doing the same), it is noteworthy that Joughin evinces no awareness of the break-up when he is on the Boat Deck. This might be accounted for by the fact that he was in among a large crowd fleeing aft, or perhaps it is one more confirmation that the detachment of the stern took place beneath the surface of the water and hence was not visible even to those on the Boat Deck.

By the time Joughin reached the after Well Deck, both Collins and Dillon were already in the water. The former observed the detachment of the stern from the water nearby, having been swept off the forward end of the Boat Deck literally a minute or so earlier, while the latter seems to have gone into the water just after Collins and immediately prior to Joughin reaching the after Well Deck, as the stern fell back to the ocean. This may account for his testimony of being sucked down underneath the water.

Abelseth’s testimony is too vague and at odds with the others to intelligently say where he was at any particular stage. As mentioned previously, it is strange as well that Abelseth did not testify to Joughin’s ‘crush of people’ rushing to the afterend of the ship.

Joughin was likely the survivor who remained on the ship the longest. His singular testimony, as such, is that when he reached the after Well Deck the stern listed sharply to port, catapulting virtually all the remaining people on the deck into the water. The stern then remained rotated on an angle approaching 180 degrees as it came up again out of the water and then dived into the water for the last time.

This is in line with, and may be in part the basis of the following speculation on the part of Mengot (1997) as to what happened to the stern during and after its separation from the bow:[4]

The stern is left low in the water at the head as the bow begins the trip to the bottom. With the watertight compartments compromised back to the dynamo room, it fills in only minutes to allow the stern to settle and tip up so quickly that many survivors didn't notice an interruption in the sinking process.

This process also allows the stern to be more gradually lowered into the water. In a top down break, all models and simulations show the stern flopping down into the water, as seen in the Cameron movie. The splash and wave produced would have been enormous, but survivor accounts don't indicate this.

As the stern nosed in, it rotated nearly 180 degrees to starboard. If the starboard shell plate broke-up after the port side, an extra pull from the sinking bow may have started the turn. Separating the shell plate farther on the starboard side may have caused more rapid flooding on that side, producing a list which is translated into a roll as the ship tips up.

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Conclusion

The exact nature of the break-up of the Titanic cannot be conclusively characterized as yet, but the weight of the evidence favors something along the lines of Mengot's theory. In particular, there is much to confirm the dual thesis that: 1) the ship broke apart from the bottom up, and 2) that the stern of the ship never rose out of the water by more than a 10 to 15 degree angle. The 'popular conjecture,' which rejects each of these assertions, seems for that reason the least likely of the three theories to be borne out by further evidence.

The new theory, presented in the 1999 Discovery Channel documentary, argues against Mengot's first assertion, but is in agreement with him as far as the second is concerned. The argument put forward revolves exclusively on issues of the physics of the break-up, and the structural nature of the ship. And virtually the single piece of evidence adduced is the revision of the stress analysis by Cox & Gibbs. Even within the realm of physics this is not entirely convincing, because of the centrality placed on the after expansion joint as the source of the break-up. There is nothing to rule out that there was failure both at the bottom and at the top, but that the structural failure was due to the former and not the latter. When one goes from the physics to the testimony of credible witnesses, I believe there is additional support for Mengot's first assertion. Most witnesses who heard the noise of the ship breaking apart largely locate it toward the bottom of the ship, and there is not one witness on one of the top Decks who literally saw the ship cracking apart.

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Notes

[1] Bright, A: 841; Collins, A: 631; Dillon, B: 3859-85; Lightoller, 1935: 300.

[2] Brown, B: 10551; Collins, A: 630; Lucas, B: 1531-51; Osman, A: 541; Weikman, A: 1099.

[3] Brice, A: 653; Bright, A: 841; Peuchin, A: 338; Rowe, A: 525; Ward, A: 599;. Woolner, A: 889.

[4] The reader will note one discrepancy in the two accounts. Joughin testified the ship listed radically to port, while Mengot on the basis of the wreckage, asserts it listed to starboard. One imagines that Joughin simply made a mistake here; understandable under the circumstances.

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