

Remember the “*MAINE*”

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Abstract

On February 15, 1898 an explosion rocked the Havana harbor in Cuba, then a Spanish Colony. Within minutes, the USS “Maine” sank to the bottom and 266 officers and sailors lost their lives. After a rushed investigation the verdict came in: an exterior mine had been planted under the ship, perhaps by the Spanish. Ten weeks after the sinking, the U.S. and Spain were at war. A second, detailed investigation into the sinking (in 1911) confirmed the official U.S. Government version of the events. Still, the mystery remained.

A detailed analysis of the damage evidence is presented which will solve the mystery. The U.S. battle cry “Remember the *MAINE!* To hell with Spain!” should not have been uttered.

Keywords: USS MAINE, maritime history, mine explosions, coal fires, Spanish American war, forensics, ship wrecks.

1 Historical background: 1898 - the sinking

In the late 1800’s, tensions had been built in Cuba, then a Spanish colony, where Cuban separatists fought the Spanish forces. When riots broke out in the streets of Havana in January of 1898, President McKinley ordered one of his battleships, the USS *MAINE*, to visit Cuba, Figure 1.

The *MAINE* was built in 1895. Originally designed as an armored cruiser, it had been redesignated a second-class battleship. Its primary armament consisted of four 10 inch guns in two turrets in “echelon”, (one forward, to starboard, and the other aft, to port) and six 6 inch guns, as well as various smaller guns. Powder and shells for the guns were stowed in magazines deep within the ship, well below the protective deck. The ship had four coal-fired boilers in each of two separate boiler rooms. Coal was stored in large bunkers around the boiler rooms and magazines. When fully loaded, the ship carried 822 tons of coal.



The visit of the *MAINE* to the port of Havana was meant to be a show of power to the Spanish and to the Cubans that the U.S. government would defend its interests, as the United States had made considerable investments there.

Three weeks later, on February 15, at 9:40 PM, the *MAINE* erupted in a fireball. The three forward ammunition magazines had exploded. Two-hundred and sixty-six men perished.

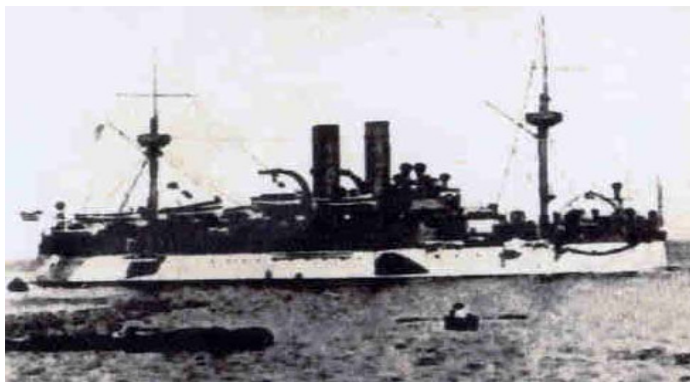


Figure 1: The USS *MAINE*.

Within hours, Captain Sigsbee sent an urgent message to Washington: “*MAINE* blown up in Havana Harbor” and “Public opinion should be suspended until further report. ...”. This advice, however, fell on deaf ears. In large segments of the U.S. press, a mine was hastily blamed as the cause; - specifically a mine planted as “an act of treachery on the part of the Spaniards”, in the words of then Assistant Secretary of the Navy, Theodore Roosevelt.

The U.S. Navy quickly put together a court of inquiry to investigate the disaster. Four naval officers headed by Captain William Sampson undertook the investigation. The Sampson Board was faced with a wreck of a ship mainly under water, Figure 2. The Board was conducting its inquiry on a small ship tied up next to the wreck. Sailors from other ships were drafted as divers. With little knowledge of ship architecture, these men tried to make sense of the underwater wreckage.

Three weeks into the investigation, divers reported a large flap of metal, pushed into the inside of the ship. The fact that it was painted green indicated that it had been part of the outer bottom hull structure, in other words: an outer hull section had been pushed upward/inside.

On March 25, 1898 the official report of the Sampson court concluded that the sinking had been the result of an exterior mine, continuing that “The evidence, however, was insufficient to place blame for the disaster on any person or persons” [1].

By then, most Americans believed they knew who was responsible; the press (Pulitzer and Hearst) saw to that. The sinking, which many others thought of as an accident, became an excuse for war. Voices urging moderation were silenced.

Commodore George W. Melville, the U.S. Navy Chief Engineer reportedly shared the official Spanish position that the sinking was probably the result of an accidental internal explosion.

The US Congress had the ammunition it needed to declare war on Spain. With the rallying cry, “Remember the *MAINE*! To Hell with Spain!” the U.S. went to war, a war that would lead to the end of Spanish colonialism in the New World. It eventually led to the birth of the U.S. as a world power.



Figure 2: USS *MAINE* Wreckage (1898-1911).

2 Recovering the *MAINE* (1911)

Twelve years after the tragedy, the U.S. Congress allocated funds to raise the wreck of the *MAINE* for several reasons: The Navy wanted to remove an obstacle to shipping, - provide a proper burial for the victims, and verify and lay to rest questions about the sinking.

The U.S. Army Corp of Engineers accepted the challenge. A cofferdam was built, surrounding the wreckage, to be able to pump the water out. Eventually, the engineers were successful and sections of the *MAINE* began to emerge, as shown in Figure 3.

As the work progressed, many bodies were recovered from the ship along with numerous personal items. Veteran groups and hundreds of other interested parties requested a piece of the Maine – to remember.

William B. Ferguson, a young naval engineer, was assigned by the U.S. Navy to help the Army identify parts of the ship. Beginning in June of 1911, Ferguson sent weekly reports to Washington with pictures showing both progress and problems encountered.

The aft portion of the ship was found to be nearly intact and showed little damage. The bow section was a different story. Explosions in three different forward magazines had created scrap heaps of metal. As the dewatering progressed, Ferguson was intent on finding the large chunk of hull bent inward, as reported by the divers in 1898. This finding could substantiate evidence of an exterior mine.

On November 7, 1911 Ferguson reported to Washington a very important discovery: The large flap of steel that had once been part of the **outer hull** had been located, - **inside** the hull, as clearly illustrated in Figures 4 and 5. It became

known as “Section 1”. This was viewed as clear evidence that a mine explosion had caused the sinking of the *MAINE*:

The smoking gun had been found!

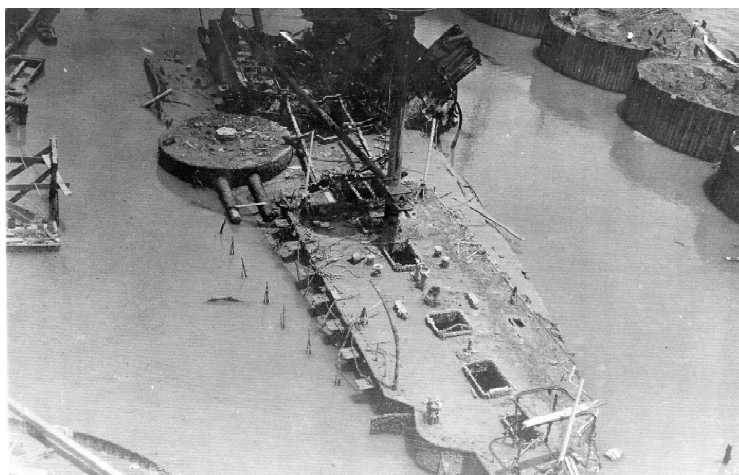


Figure 3: Recovery of the *MAINE* in 1911.

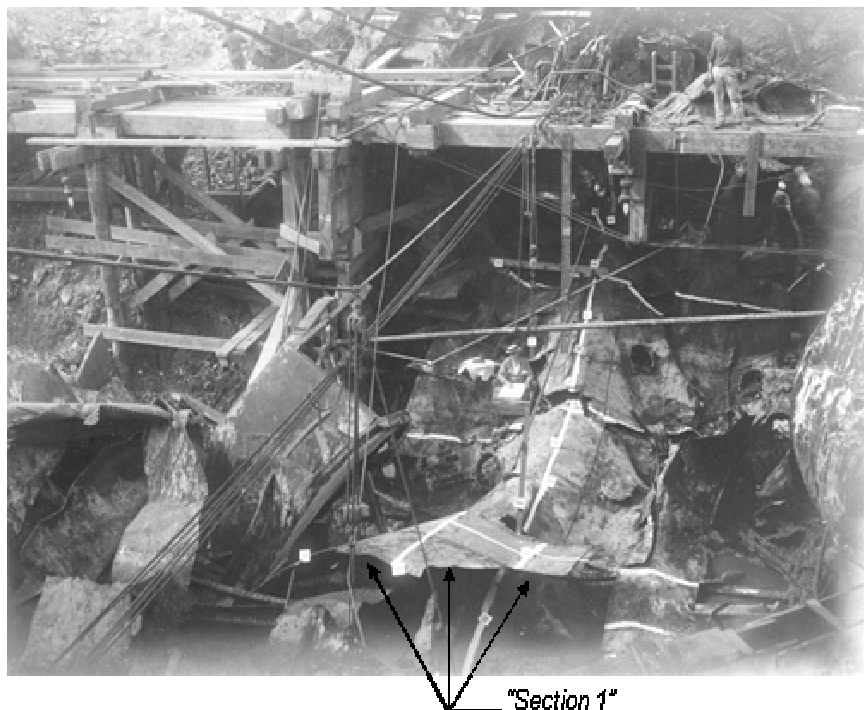


Figure 4: “Section 1” – The Smoking Gun.



Figure 5: “Section 1” - view from a different angle.

In early 1912, a watertight bulkhead was installed to seal off the forward, open part of the hull. It was now possible to re-float the *MAINE* by flooding the space inside the cofferdam and tow her out of Havana harbor with 20,000 spectators lining the shores. The *MAINE* was taken into international waters and sunk a second time with a grand ceremony.

This burial at sea was meant to put an end to the disputes surrounding the destruction of the *MAINE*, - taking with her any remaining physical evidence which might have contained clues for further study by modern forensics. Indeed, to this day, many believe that the inquiry of 1911 solved the issue of what caused the sinking of the *MAINE*. However, questions about the official version of the causes the *MAINE*'s demise lingered and the official findings would be challenged.

3 From the Rickover study to the centennial (1975 to 1998)

In September of 1974, Admiral Hyman G. Rickover, U.S. Navy, read an article in one of the local Washington newspapers, “*Returning to the Riddle of What Happened to The Maine.*” He became intrigued and assembled a team of researchers and engineers to tackle a third investigation of the *MAINE*. Ib Hansen and Robert Price were lead engineers, both with many years experience with riveted hulls, ship explosions and structural metal failure. Mr. Dana Wegner was the lead historian.

Hansen and Price argued that the appearance of “Section 1” was inconsistent with that of a plating structure subjected to a mine blast, i.e., a mine-damaged plate could not possibly look as smooth as the photos show it to be. Their analysis identified spontaneous combustion of coal dust leading to a coal fire as the most likely trigger of explosion of the ship's gun powder magazines. Coal bin fires were a part of life onboard old steam ships. This phenomenon is equivalent to rusting of steel, also an oxidization process. Oxidization generates heat and can lead to a slow-burning, smoldering fire in the bunker.

Rickover's book [3] was re-issued in 1995 with additional arguments supporting the earlier conclusions as well as aiming to answer critics.

In this writer's opinion, the Rickover book should have settled the argument; but with the centennial of the sinking (1998) approaching, interest in the *MAINE* revived and a number of further books and articles were published.

In 1995, Peggy and Harold Samuels published a book "Remembering the *MAINE*" [4], which came to the opposite conclusion. The authors reviewed contemporary press coverage of the disaster, reporting on (a) liaisons between Cuban rebels and newspaper magnates Hearst and Pulitzer and (b) a man who manufactured mines for a group of Spanish extremists. They also scrutinized the findings of the Rickover book and inferred inadequate scientific understanding on the part of its authors.

They emphatically claimed to know who did it: Radical followers of Spanish general Valeriano Weyler, also known as "the butcher", in hopes of engaging the United States in war. These fanatics, according to the Samuels, planted the mine which sank in the *MAINE*. They had the opportunity, the means and the motivation. Case closed!!

In 1998, an article appearing in "National Geographic Magazine" declared that the case of the *MAINE* was still open. It was followed by a related article in the journal "Naval History". These analyses suggested that it was not possible to conclusively prove one side or the other, although a mine was considered more probable than previously thought.

Again, banner headlines appeared: "The Mystery of the *MAINE* Remains...."

4 Interim summary

There is general agreement that the destruction and sinking of the *MAINE* was the result of the explosion of magazines containing gun powder and ammunition. The first magazine to explode was the Forward 6" Reserve Magazine located on the port side between frames 24 and 30. This explosion set off subsequent explosions in the Forward 6" - and the Forward 10" Powder Magazines.

The mystery, then, hinges on the question as to what initiated these magazine explosions. Specifically,

- Did a mine explosion cause the powder in the 6" Magazine to ignite after penetrating the bottom structure? Or:
- Did an internal ignition source set off the explosions?

In the latter case, heat from a coal fire in an adjacent coal bunker, started as the result of spontaneous combustion of coal dust, could have been transmitted through the bulkhead into the magazine raising temperatures to the point of gun powder ignition (at about 450° F).

The explosion that sunk the *MAINE* was an extremely chaotic event, with gun powder and ammunition, located within three different magazines, exploding, rupturing the hull and spewing unexploded shells on the harbor floor. Such a chaotic event can create contradictory damage evidence which, in turn, can lead to expert opinions which are inconclusive (at best) or contradictory (at worst).



It is clear that the combined force of the magazine explosions blew major parts of the ship structure in their path *outward*. One section, the infamous “Section 1”, however, was found bent *inward/upward*. This clue was cited in 1898 in the Sampson Report, and also in 1911 by the Vreeland Board of Inquiry, as clear evidence that only a force acting from the outside, ergo: a mine, could have pushed it inward.

In Rickover's book the Hansen/Price analysis argues that, following the (internal) explosion, the dynamic effect of the water (rushing into the gaping hole) caused this section to be bent inward/upward. Others, non-engineers in particular, had doubts.

Experts in structural damage mechanisms (Hansen, et alii) have pointed out that the appearance of “Section 1” is *not consistent* with that of plating subjected to a mine blast. However, as long as other individuals, whose credentials could not be dismissed off hand, continued to state that the appearance of “Section 1” is *consistent* with mine damage; it is not surprising that the mine theory has been kept alive. In any event, this also keeps alive the intrigue of “who-done-it”.

5 Missed clues solve the mystery

Solving the *MAINE* mystery, at this point, is not a matter of historical research. With apologies to historians, it is a matter of structural engineering and forensics. The actual structural details after the explosion, the physical evidence, was buried with the *MAINE* in 1912. However, Ferguson's photographs have been preserved in U.S. archives. The originals of Figures 4 and 5 are of surprising quality. They reveal details which had been overlooked so far. And we will show that they contain the clues to close the case.

Using terms a non-engineer may be more comfortable with, it involves an “autopsy”, a careful analysis of the “wounds”. This, in turn, requires insight into the “anatomy” of the “victim” as well as pathology, knowing how the “anatomy” responds to stress and trauma.

Looking at the ship's hull from below, “Section 1” is shown in Figure 6 in its original location as part of the outer hull before the sinking, together with an illustration of some details of its “anatomy”, of how it was connected to adjacent structural elements.

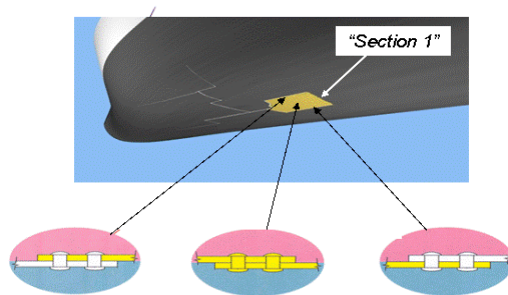


Figure 6: Illustration of “Section 1” in its original location.

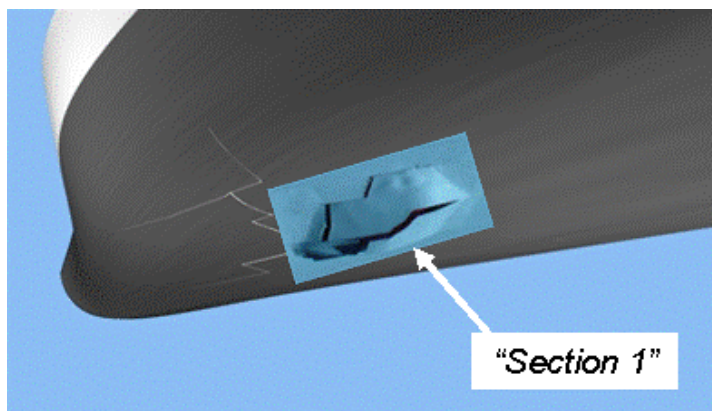


Figure 7 “Section 1” as part of a “blister”.



Figure 8: View of “Section 1” from below.

If an (external) mine explosion had been the triggering event, the blast force would have acted upward, mangling and meshing “Section 1” with its internal support structure.

Instead, it will be shown that it actually was separated from its support structure: A “blister”, as illustrated in Figure 7, had been created when the initial (internal) explosion, pushing downward, separated the plating from its support structure.

Evidence that this actually occurred is presented in a rare photo showing the (now) underside of “Section 1”, i.e., taken from below. This view is shown in Figure 8, above. It reveals that the internal pressure had cleanly detached the plating from the supporting double bottom structure (**Clue 1**).

“Section 1” was just a flap of steel.

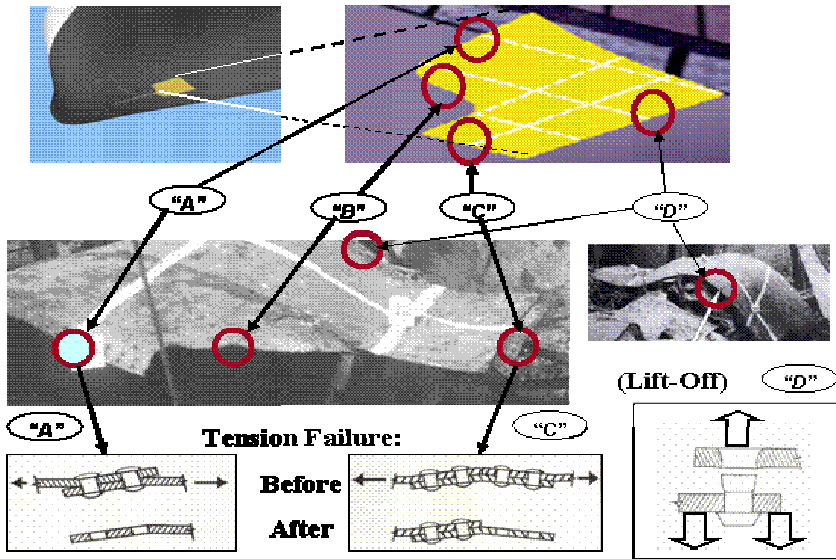


Figure 9: "Section 1" break lines and failure patterns.

Figure 9, upper left, again positions "Section 1" before the explosion (see also Figure 6). In the middle, the two views of "Section 1" are enlargements of Figures 4 and 5, already shown before. We will use this view to focus on the break lines and the associated failure patterns shown in the lower portion of the Figure. They reveal three further clues as follows:

In-Plane Tension (Clue 2): Breaks "A", "B" and "C" show clear evidence of tension failure. Point "B", in particular, reveals tension. It shows a tear, -not at a seam where the rivets might break, but right through the plate without deformation of its edge. Only in-plane tension can produce such a break.

Membrane Tension (Clue 3): All breaks are the result of tension in **different directions**: Break "A" resulted from tension in transverse direction; Break "C" from fore-aft tension; Break "B" from diagonal tension. Omni-directional tension implies membrane tension. Anybody who has ever blown up a **balloon** knows it.

Plate-Separation at Seam (Clue 4): Break "D" shows how plating, formerly at the **underside** of the riveted connection, was simply pushed down by the internal pressure, - a clean "lift-off". In this case, the adjacent plate, which was at the edge of the "blister", was largely outside the thrust of the initial blast and remained attached to the bottom structure.

External/mine blast pressures could not possibly have created this failure pattern. The initial explosion originated inside the ship. Whoever still wants to cling to a conspiracy theory, would have to show how an explosive device could have been smuggled onboard the *MAINE*, a warship in a high state of alert, and then set off in the smallest ammunition magazine, with the largest one just "next door".

6 Summary and conclusion

The sequence of events which led to the sinking of the “*MAINE*” may be summarized as follows:

1. Coal dust in a bunker outboard of the Forward 6” Reserve Magazine experiences spontaneous combustion.

2. Once the ignition temperature of gunpowder, about 450 degrees F, is reached, the ammunition explodes, creating downward pressure which leads to the formation of a membrane/”blister” as illustrated above.

3. At the same time, secondary explosions are triggered in two other forward magazines, destroying the forward part of the ship.

4. “Section 1” is blown outward, as are other bottom sections and the debris from the remaining internal structure.

5. The explosion gas bubble reaches its maximum size before collapsing and venting through the gaping hole above.

6. Water surges into the region of rapidly decreasing pressure, pushing “Section 1” back through the hole, folding it over. It assumes the final position so prominently displayed in dozens of photographs, as water rushed past it into the aft portions of the slowly sinking vessel.

Note that “Section 1” is easily bent: It is merely an un-stiffened plate with a large frontal area (about 100 sq. ft.). The speed of rushing water required to bend this flap of steel can readily be calculated using a simple hydrodynamic equation:

Water rushing at a speed of only 5 ft./sec will bend such a plate!

The temptation will be resisted to speculate about possible motivations of the various actors in these events and investigations. Nevertheless, it is difficult to understand the following:

If a mine explosion had pushed “Section 1” inboard where it was found, it would have been in a location near the blast center of the magazine explosion. Un-reinforced, a mere flap of steel, - how could it possibly not have suffered the massive deformations which other, much stronger structures experienced?

The simple answer is that it was not in that location and position when the magazine exploded. In summary:

- There was no mine, - no “Act of treachery on the part of the Spaniards”!
- The Spanish American war was the result of an overreaction to an accident.

References

- [1] The Report of the Naval Court of Inquiry Upon the Destruction of the United States Battleship *MAINE*, February 15, 1898 (Library of Congress)
- [2] Report on the “Wreck of the *MAINE*”; 14 December 1911, Message from the President of the United States to Congress (Library of Congress)
- [3] Hyman G. Rickover; *How The Battleship Maine Was Destroyed*; Washington D.C.; Department of the Navy, 1976
- [4] Peggy and Harold Samuels; *Remembering the Maine*, Smithsonian Institution Press; 1995

