Sinking the Myths

A Review of the Evidence
The May 22, 1968 Loss of the USS Scorpion
By Stephen Johnson

Author of: *Silent Steel: The Mysterious Death of the Nuclear* Attack *Sub USS Scorpion*
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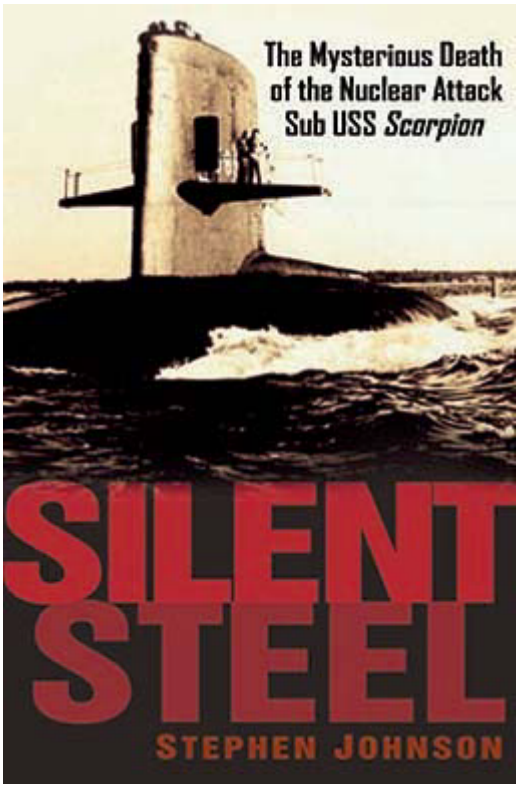

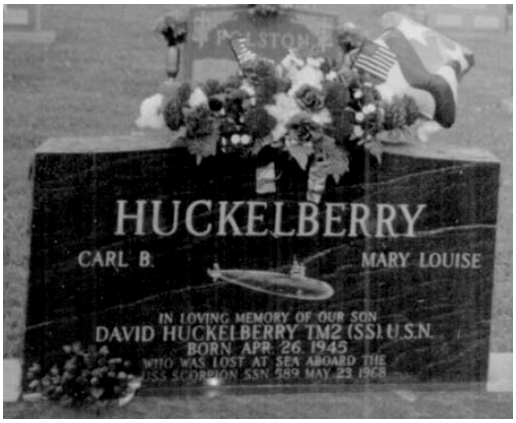

USS Scorpion torpedoman David Huckleberry's headstone marks an empty grave

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A Note from the Author

This overview of the established evidence regarding the loss of the fast attack submarine USS Scorpion was originally prepared for relatives of the Scorpion crew confused by conspiracy theories and fictional claims about what killed their loved ones.

Although a detailed account of the circumstances surrounding the Scorpion's loss can be found in my book, this synopsis addresses some of the most ridiculous allegations made regarding the loss of the submarine.

Silent Steel: The Mysterious Death of the Nuclear Attack Sub USS Scorpion is recommended for those interested in understanding what actually happened to the nuclear attack submarine USS Scorpion and the 99 men who died with her. For those obsessed with conspiracy theories, or disinterested in the complex realities of what actually befell the Scorpion, ***Silent Steel*** may not be for you.

It is also recommended reading for those who want to know the crucial, inside story of submarine operations plagued by parts shortages, Cold War pressures and the morale issues of 1960s submarine operations that sometimes burned out officers and men as rapidly as equipment.

Silent Steel is a work of painstakingly researched nonfiction made refreshing by taut and descriptive writing. It is a sad story that is also a tribute to the 99 who died aboard Scorpion, alone, in the depths of the Mid-Atlantic.

My book does not contain contrived dramatic elements designed to manipulate the reader's emotions. It is the gritty, hard-edged story of submarine sailors and the unforgiving world in which they live and sometimes die. While fictional scenarios blame the Soviets and ignore complex problems within the Submarine Force, ***Silent Steel*** takes the less commercial path of explaining how an effort to make American submarines

safer actually robbed the Scorpion of maintenance work and repairs of malfunctioning safety systems while its demoralized crew and officers struggled to accomplish their missions.

Therefore, for those reflexively defensive of the U.S. Navy's justifiably famed Submarine Force who would take offense at an unflinching examination of official mistakes and failures, this book may not be your cup of tea either.

Silent Steel was not written to prove any theory as to why the Scorpion sank with all hands, because no theory is provable by the evidence at hand. This is a critical point that those who wish to study this disaster must understand.

However, the evidence does provide conclusive proof of one thing that did not happen to the Scorpion: enemy attack. The rumor of this nonexistent event has hovered over the loss of Scorpion since it the day it failed to return.

And, despite easily-disproven claims by those who profess to know what happened to the Scorpion in ridiculously minute detail, no final conclusion can be reached without the development of new evidence.

My book is a based upon newly-declassified secret documents – some the Navy sought to deny me – letters from Scorpion crew members, reports and official scientific studies conducted by a baffled Navy. Even the Navy's official "findings" are guesses based upon evidence the Navy admitted was inadequate to explain the actual cause of the Scorpion's loss.

The Navy's poor performance in explaining the depth and scope its diligent efforts to understand the disaster, combined with its own present-day confusion over a series of contradictory official investigations, has fueled commonly accepted, but erroneous beliefs about the tragedy.

The actual facts surrounding the Scorpion's death are far more disturbing than fictional scenarios that lurked for decades. These groundless suspicions have been harnessed by writers to form the core of so-called "true stories" redolent with plot twists and every sort of imagined Cold War scheme.

On the other hand, ***Silent Steel*** respects the reader by equipping each to be his or her own judge of the facts. By unveiling the details of the official inquiry into the disaster, and subsequent scientific investigations sponsored by the Navy, ***Silent Steel*** gives the public more information than was available to the original Court of Inquiry.

Silent Steel challenges every commonly-accepted belief regarding the Scorpion disaster while holding official theories up to careful inspection. It is an even-handed review of the evidence that unearthed the behind-the-scenes activities of the Submarine Force during the apex of the Cold War, revealing shocking circumstances that may have caused the loss of the Scorpion. ***Silent Steel*** relies not only on official documents, but interviews with those who were at the heart of two major but inconclusive investigations. These Cold War officers and scientists spoke freely of the Scorpion investigations knowing their true version of events might be erased not only by their own mortality but a wave of myth and fiction.

Silent Steel has been widely praised by Submarine Force officers and enlisted men who served aboard the Scorpion. In an age when conspiracy theories seem to command more attention than facts, **Silent Steel** has become known as "the real book" on the loss of the Scorpion among naval historians, submariners and others familiar with the realities of Cold War naval operations of the 1960s.

For the first time in nearly forty years, ***Silent Steel*** introduces America to the doomed men of the Scorpion, the troubling circumstances that affected their boat, and their final weeks at sea in the words of the sailors themselves. It has been called "highly literate" and a "fitting tribute" to the men who died. More importantly, it attempts to place the death of the Scorpion's crew in context with the realities they faced. It would be unjust to remember these men through the distorted lens of baseless rumor and unfounded speculation.

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The Facts Behind the May 22, 1968 Loss of USS Scorpion

By Stephen Johnson

Mythology vs. Hard Facts

Though unsupported by physical evidence, the claim of enemy attack as the cause of Scorpion's loss is attractive to those unfamiliar with the established facts. The shocking and captivating aspects of such sensational myths regarding the loss of Scorpion –combined with the Navy's inability to conclude precisely what caused the fast attack boat to plunge to its doom – are why unfounded rumors have persisted for nearly 40 years.

Psychologists have long understood that people are inclined to believe dramatic events have dramatic triggers, even when mundane causes are to blame.

The lunatic conspiracy claims about a U.S. government plot to destroy the World Trade Center's twin towers on 9/11 are based upon delusional thinking and a wholesale perversion of simple scientific principles. This is the latest example of this type of collective self-delusion. However, at the core of these theories is a deeply rooted desire to believe in false causes at the expense of logic because they serve an emotional need. The side effect of this is the necessity to then mount a quixotic campaign against what, in most cases, is actually the truth.

An example of the willingness to believe the flimsiest conspiracy theory regarding a transportation disaster occurred five years before the 9/11 terror attacks and more closely parallels the conspiracy thinking that has been applied to the loss of the USS Scorpion.

The confusion and controversy surrounding the July 17, 1996 explosion aboard TWA Flight 800 off Long Island is worth noting. The fiery catastrophe and the deaths of all aboard was surrounded by allegations of terrorism and even a U.S. Navy "attack" on the airliner. The FBI obstinately pursued terrorism as the cause of the crash sidetracking the investigation to the dismay of the National Transportation Safety Board that knew the explosion was most likely triggered by an electrical spark in the Boeing 747's center fuel tank. The NTSB's seemingly mundane theory ultimately prevailed as the most likely cause, though unfounded conspiracy theories still compete with this finding.

It's worthwhile to take note of the belief system that enables conspiratorial thinking:

A.) The belief the government is covering up the facts
B.) The belief that the facts can be hidden even though most so-called secret programs are eventually revealed
C.) The belief that the government somehow caused the disaster
D.) A willingness to believe unsubstantiated falsehoods that are often self-evidently incorrect is essential. This maintains the illusion of an emotionally satisfying crusade in which participants, driven by internal emotional needs, can see truths that are invisible to people of lesser talents.

Even President John F. Kennedy's former press secretary Pierre Salinger announced his discovery of "evidence" that the U.S. Navy launched a missile that struck TWA Flight 800. Salinger later admitted he had been hoodwinked by a bogus document on the Internet. As we have seen, Mr. Salinger, a former White House official and national television news correspondent, was not immune to this type of emotionally-based, but pointless, speculation.

The truth is always more complicated, less mysterious and therefore less satisfying emotionally. Arriving at a factual conclusion is often frustrating, difficult and painstaking – if the evidence even allows a provable resolution. For this reason, the term "most likely" is often attached to the findings of accident investigations.

Like TWA Flight 800, the loss of the nuclear-powered attack submarine Scorpion was a transportation disaster, a high-tech mishap that is notoriously hard to unravel without surviving witnesses. In recent times, such events have been exploited by fictional conspiracy theories that invariably provide the desired "dramatic cause." This predilection for conspiracy theories has gripped the American psyche since the early 1960s and coincided with a growing distrust of government during the Vietnam War.

Although the actual causes of disasters seem mundane when fully explained, these seemingly small problems are, in actuality, deeply scandalous. We live in an age when the safety of large numbers of people is increasingly dependent on exotic technologies that, by necessity, must be remarkably reliable. These malfunctions often begin long before the tragic event. The seeds of disaster are planted during design, fabrication, maintenance, policy development, personnel training and the operation of a ship or aircraft. The technical malfunctions that caused the fiery destruction of American space shuttles in 1986 and 2003 are potent reminders of how a bureaucratic culture can become fatally flawed.

The death of the Scorpion, despite unfounded claims of enemy action and a number of other conspiratorial scenarios, was preceded by complex and subtle events that had nothing to do with enemy attack, sabotage or the ever-handy Bermuda Triangle myth. The actual background events – issues that have long plagued submariners and their machines – are explained in **Silent Steel**. They have never before been

brought to light because they have been hidden not only beneath layers of secrecy but the camouflage of their own subtlety.

And, because these issues didn't fit the preconceived matrix of a conspiracy that many people are emotionally motivated to believe, they failed to gain a purchase in the public's consciousness.

Evidence

The fundamental thing to remember is that Scorpion's wreckage exhibits massive and obvious evidence of hydrostatic collapse damage, also called "implosion" damage. Such damage is obvious on two different locations fore and aft on Scorpion's hull, and occurs when an intact submarine, unmarred by blast damage from an undersea weapon, descends below its "crush depth".

Submarines struck by depth charges or torpedoes are almost always found intact on the seafloor, save for the presence of a highly distinctive hole blown into the hull of the boat. Such penetrations rapidly fill submarines with water. When sea pressure inside its hull is equal to that of the surrounding sea, a submarine cannot suffer catastrophic implosion damage as did the USS Thresher in 1963 or the USS Scorpion in 1968. (The condition of the shattered Thresher, which suffered implosion damage when it descended below its crush depth, is, with some minor differences, similar to that of the Scorpion. Even Thresher's fairwater sail, like that of the Scorpion, was detached following the implosion of its air-filled hull. See the photograph below.)

What is almost humorous about persistent claims that Scorpion was struck by a torpedo, is the recognition by experts that had the Scorpion been sunk by such a weapon, the damage would have been so obvious and unmistakable as to ensure that there would be no disagreement or controversy. The very obvious evidence of implosion damage to Scorpion proves that the one thing that didn't happen to the Scorpion was torpedo attack. And yet, a controversy persists, mostly because some, for their own purposes, desire one.

The Scorpion is dismembered into four main pieces and scattered across a broad debris field. This is a far different arrangement than one would see with a submarine struck by a torpedo. It is common to find submarines sunk by depth charges, mines or torpedoes mostly intact on the seafloor without any sign of implosion damage.

It should be noted that massive implosion damage is obvious on the Israeli Defense Force submarine INS Dakar lost mysteriously on January 25, 1968 in the Mediterranean. When it was finally located May 28, 1999 the horrific and unlimited force of implosion damage was fully documented. The Israeli government does not believe Dakar was sunk by a torpedo.

The hazards of operating submarines is underscored by the sinking of at least four submarines during 1968 including two lost in the Mediterranean, the Israeli Dakar and the French submarine Minerve. The Soviet submarine K-129 was lost in the Pacific two months prior to the Scorpion's fatal accident.

Collapse Mechanism

It was explained by the Structural Analysis Group report, as part of what is known officially as the Phase II Investigation that analyzed the loss of the Scorpion following the 1968 Court of Inquiry, that the operations compartment was obliterated and a portion of the stern was drawn forward into the hull. It was determined that Scorpion's hull had likely imploded at 2,000 feet of depth. (Due to a lack of safety systems, Scorpion was restricted to 500 feet of operating depth, 200 feet below its normal maximum operating depth. According to Court of Inquiry testimony, the Scorpion may have been operating no deeper than 350 feet when it first experienced the problem that caused its loss.)

In the aft section was a cone cylinder juncture. This is funnel-like segment reduced the diameter of the Scorpion's hull to allow the circumferential placement of ballast tanks around the auxiliary machine space located forward of the engine room and aft of the reactor compartment. Photographs and eyewitness accounts of the Scorpion's wreck indicate the hull also collapsed at reinforcing frame 67 in the aft area of the submarine. When this occurred, 50 feet of the stern was pulled forward like a massive cylindrical cookie cutter at the speed of sound, pushing machinery and bulkheads toward the reactor compartment.

The amount of energy required to hurl the stern into the forward part of the submarine's hull is immense and not the result of a torpedo blast which would actually preclude this type of implosion damage by filling the Scorpion with water.

The juncture at frame 67 was known as a "hard point" that would not deform to absorb stresses. Because it was also a discontinuity deviating from the pure tubular shape of the hull, it was considered the weakest segment of the pressure envelope. It was upon this juncture -- it's "weakest" -- that the submarine's collapse depth was calculated. (Obviously, a perfect sphere or tube in a continuous shape is more structurally sound.) It should be noted that the cone cylinder juncture was reinforced during a "ship alteration" several years before Scorpion was lost. This likely boosted the Scorpion's original estimated crush depth beyond 1,400 feet. This is why her hull is believed to have endured pressures 600 feet deeper than anticipated.

It was the opinion of Peter Palermo (chief of Submarine Structures Division of Naval Ships System Command who testified at the original Scorpion inquiry and who headed the subsequent Phase II investigation) that the modern design of Scorpion's "teardrop" hull was calculated to be more uniformly strong. This was different than older submarine hulls which tended to deform and collapse at different depths and at different locations in a less uniform fashion. The INS Dakar is a fine example of this

with a long line of implosion damage running from its stern forward to its fairwater sail, in a process known as “venting”. The Scorpion suffered simultaneous, catastrophic implosion damage at two different locations while the Thresher, with an even more modern hull design, suffered even more obliteration during its own singular moment of collapse.

The Scorpion and Thresher, therefore, would collapse in an instantaneous process that could be termed an "eggshell" effect, meaning they would simply collapse in a single moment across its entire surface rather than buckle and bend before fully giving way. Older submarines often displayed “venting” or collapse damage in one segment of the boat that caused catastrophic flooding while leaving much of the rest of the boat intact except for the site of the implosion damage.

It was apparent to Navy scientists and engineers that Scorpion actually suffered implosion effects at the operations compartment (forward) and at the engine room (aft) simultaneously, or within a millisecond of each other. Had one segment of the hull flooded first, the inrush of water would have fully flooded the submarine by collapsing its bulkheads which were far weaker than the pressure hull. This would have prevented other compartments from collapsing. Instead, the Scorpion suffered collapse at two different segments of its hull indicating simultaneous events.

The very clear hydroacoustic recordings of Scorpion's destruction reveal that the so-called "explosion" that some claim killed Scorpion is, in reality, the significant acoustic energy produced by the collapse of its massively-strong, two-inch-thick hull. This is hardly surprising.

Because the Scorpion did suffer catastrophic implosion damage fore and aft -- something that would be impossible had the boat been filled with water by a torpedo strike -- the possibility of a torpedo blast can be eliminated based upon this very obvious evidence alone. The lack of acoustic evidence of a high-explosive blast on the recording of the Scorpion's destruction is a second piece of evidence that argues decisively against an undersea weapon as the culprit in the Scorpion’s loss.

The only "evidence" supporting the destruction of the Scorpion by a torpedo blast is the unproven and unsubstantiated claim that this happened without causing blast damage or the usual accompanying acoustic fingerprint. For those who have reviewed the evidence, the fatal weaknesses in this claim are obvious.

Those who denounce all the hard-won evidence gathered at great financial cost and at the risk of men’s lives, are simply wearing blinders so they can choose to believe in an unsubstantiated government conspiracy and perfidious enemy action – a farfetched formula for fiction rather than a rational inquiry. This does not serve the memory of the men of the Scorpion, or the needs of the present-day submarine force which continues to experience maintenance and safety problems.

Nearly 45 years after the assassination of President John F. Kennedy, and an avalanche of films and conspiracy books, we find ourselves finally confronting the fact that Kennedy was indeed shot by a lone assassin named Lee Harvey Oswald. Shall the Scorpion disaster follow the same trajectory? About the only thing that is known about the loss of Scorpion is that it was not damaged by a torpedo explosion. Nonetheless, the myth of a torpedo attack on Scorpion lives on.

It is the "dramatic cause" that fills an emotional need. It is also far more exciting to discuss a torpedo blast or an enemy attack than an inadequate weld on a seawater piping joint or a momentary hydraulic malfunction or an inglorious but potential catastrophic fire in the toilet paper storage locker.

It has also been claimed that the Scorpion destroyed itself by launching a malfunctioning torpedo. Once again, this theory is negated by evidence that shows there is neither torpedo damage nor the acoustic signature of a torpedo blast. In addition, the safety features on the Scorpion's own acoustic homing torpedoes would render self-destruction essentially impossible.

Aside from the lack of evidence that would support torpedo attack theories, few experts believe the Scorpion could be outclassed by Soviet submarines of the period. The Soviet Echo II class submarine -- one of their most capable during the 1960s -- was nonetheless too noisy and slow to effectively engage the Scorpion. Furthermore, officers that served on Scorpion during the 1960s insist the Soviet undersea weapons of the period would have been ineffective in striking the Scorpion which was capable of eluding the weapons. Scorpion crew members have claimed a Soviet attempt to sink the Scorpion with a Soviet torpedo in 1966 was defeated by the submarine's ability to hear the approaching weapon and to outdistance it with great underwater speed.

Did a Torpedo Explode Inside the Scorpion? Even the Doomed Russian Submarine Kursk Evidence Says "No".

As usual, this hypothesis is easily defeated by a complete lack of torpedo blast damage on Scorpion and the lack of acoustic evidence of a torpedo explosion, but the claim that an internal torpedo detonation sank Scorpion is also contradicted by the evidence of just such an event on a Russian submarine in 2000.

On the Scorpion's detached torpedo room, photos reveal "shell-yielding" or a scalloping effect between the frames on the port side of this still-intact section of hull. This occurred as that segment of hull was being squeezed by sea pressure while the submarine approached crush depth. As the hull was squeezed, it began to deform into a banana shape, something that would not occur due to an internal torpedo explosion which would likely rip compartment open to allow massive flooding. The pressure hull eventually imploded under this immense pressure.

The intact condition of the Scorpion's torpedo compartment is ample evidence that an internal explosion did not occur when one of the Scorpion's torpedoes detonated, as some have claimed.

However, a real-world example of an internal explosion of a submarine provides ample evidence of the effects of such an event.

The destruction of the Russian submarine Kursk's weapons compartment stands as eloquent and obvious testimony as to what happens when an internal, high-explosive blast takes place inside a submarine. In August 12, 2000 the Kursk sank following two internal explosions with the second being far larger than the first. (It should be noted that ranking Russian Navy officers initially made the self-serving claim that a United States submarine collided with Kursk precipitating its loss – an outright lie the Russian government later repudiated.)

The final blast inside the Kursk is estimated to have been caused by the detonation of nearly five tons of high explosives. This is equal to the amount of high explosives in the torpedo compartment of the Scorpion that would have detonated had there been an internal, high-order explosion. The bow of the Kursk remained attached to the hull of the submarine, unlike the Scorpion's which was completely sheared off by hydrostatic forces where it joined the operations compartment.

In addition, the operations compartment of the Scorpion just behind the disembodied torpedo room and forward of the nuclear reactor compartment has been totally obliterated. This would not have happened had the submarine filled with water following a massive internal explosion, or, once again, if it were struck from the outside by a torpedo. The Scorpion's hull steel is folded inward circumferentially behind the intact torpedo room and at the nuclear reactor compartment by implosion forces. It is not blown outward as it would be by an internal explosion.

In short, the Kursk blast caused massive and obvious damage to the forward weapons compartment whereas Scorpion's torpedo room, sheared as it is from the hull and rumpled by hydrostatic implosion damage, is essentially pristine.

The crushing of the Scorpion's operations compartment by sea pressure obliterated 30 feet of the pressure hull and framing. It's believed by Submarine Structures Director Peter Palermo, who helped investigate the Scorpion disaster, that the hull steel was most likely peeled back inside the remaining halves of the hull like a paper bag being folded inside its opening. For all practical purposes, the hull that once surrounded the Scorpion's massive operations compartment is gone.

Locating the USS Scorpion and Myths about the SOSUS system

When Gordon Hamilton of Columbia University discovered that his La Palma Island (Canary Islands) listening station recorded the loss of Scorpion, the data provided numerous details including the time of the event and the location of the Scorpion's

wreckage by triangulating the signal arrival times using mathematics. (This method was an everyday task for Hamilton who perfected methods of calculating splashdown locations of ballistic missiles during accuracy tests.)

These sounds were carried through the Deep Sound Channel thousands of feet beneath the water which allowed them to travel great distances with little loss of signal energy. This phenomenon was discovered by geophysicist William Maurice Ewing just prior to World War II and served as the basis of the Sound Surveillance System (SOSUS) that located and identified Soviet submarines traveling through specific choke points during the Cold War. In fact, Hamilton was a protégé of Ewing's who gave Hamilton the job of running the acoustics station in Bermuda.

It is a myth that the Navy's SOSUS system played an early, central role in locating Scorpion. The fact is that the Scorpion's hull collapse signals were not readily apparent on the Low Frequency and Analysis Recording Diagrams (LOFARGRAMS) gathered by SOSUS hydrophones. It was Gordon Hamilton's hydrophones in the Canary Islands that solved the riddle of the time and location of Scorpion's loss. This is because of the placement of his hydrophones which used the massive, sloping edge of La Palma Island as a giant underwater ear.

Hamilton's signals then allowed experts to pinpoint Scorpion's death sounds amid the jumble of ocean sounds gathered by the super-secret Air Force Technical Applications Center hydroacoustic listening system -- hydrophones designed for detecting Soviet nuclear blast tests. SOSUS data is said to have been studied carefully following the analysis of the La Palma and AFTAC signals and may have played some role in refining Hamilton's calculations. SOSUS, however, was not a critical element in locating Scorpion's wreckage.

What was also learned following a one-year study by Robert Price and Ermine America Christian of the Naval Ordnance Laboratory, both of whom studied torpedo blast damage on submarines since the 1940s, was that the Scorpion's acoustic signal was the sound of the submarine imploding at 2,000 feet of depth. (I successfully obtained a declassified version of this Naval Ordnance Laboratory Report which explains all this is dizzying, mathematical detail. The actual pages of that section of the report can be found below the image section of this document.)

No High-Explosive Blast

Since the acoustic signal does not contain a bubble pulse -- the highly distinctive micro-second cycling of an explosion's steam bubble expanding and contracting as it rises -- and since there is no shock wave spectra contained in the hydroacoustic signal, it was determined by Price/Christian that no high-explosive blast occurred. (Dr. John Craven, head of the Technical Analysis Group directing scientific studies on behalf of the Scorpion Court of Inquiry, once argued the bubble pulse was swallowed by the Scorpion in an effort to explain why his self-destruction theory was viable in the absence of any acoustic or physical evidence. Craven was unable to

convince the Court of Inquiry of his theory which announced it lacked sufficient evidence to precisely determine the cause of Scorpion's loss.) It should be pointed out that "Meri" Christian of the Naval Ordnance Laboratory was a recognized authority of bubble pulse phenomena and often presented professional papers on the subject. Ms. Christian's findings are still quoted by present-day hydroacoustic researchers.

When the massively large Russian submarine Kursk – with twice the hull volume of Scorpion -- had two internal weapon explosions in 2000, both blasts threw bubble pulses into the ocean which were recorded by geophones across Northern Europe. It's doubtful the Scorpion could have suffered a similar high-explosive blast without transmitting a similar signal to the hydroacoustic listening station at La Palma, Canary Islands.

Some have accused Robert Price of attempting to cover up a torpedo explosion as the cause of Scorpion's loss. Price, an exceedingly decent man who was singularly confident in his calculations and conclusions, laughed at the accusation before his death in spring 2006.

Given the fact that during the mid-1970s Price helped to conclusively prove that the Navy erred in claiming the 1898 destruction of the USS Maine in Havana Harbor was caused by a Spanish mine, it seems doubtful that Price would taint his scientific principles to hide an ugly truth on any subject.

Collision Damage

There is no collision damage visible on the hull, sail or control planes of the Scorpion. Collision damage would be extremely obvious since it can't be mistaken for weapons damage or implosion damage. Again, there is no visible torpedo damage or depth charge damage on the hull of Scorpion.

There is only implosion damage.

The hull was photographed thousands of times with still cameras and it has been filmed on several occasions. The wreckage has been observed in person by several teams of qualified U.S. Navy submariners serving as pilots aboard deep submergence vehicles. I have not found a single person who has observed the Scorpion's wreckage in person who believes it was struck by a torpedo or suffered an internal explosion.

The Investigators

Those who inspected the hull in person include the submariners who were the pilots of the Trieste II bathyscaphe as well as Capt. Harry Jackson, a naval architect who began his career in wartime submarine maintenance. Jackson later helped design some of America's most notable submarines including the experimental USS Albacore

-- the forerunner of the Scorpion, the USS Thresher and others. One of the Trieste pilots who inspected Scorpion was Ross Saxon who was familiar with torpedo damage from conducting salvage dives on ships struck by such weapons.

Saxon, like the others who have observed the Scorpion up close during the 1969 dives to Scorpion, has remained adamant that the Scorpion suffered no torpedo blast damage.

Among those who inspected the photographic evidence included Peter Palermo, chief of the Submarine Structures Division of Naval Ships Systems Command who later oversaw the Structural Analysis Group study of the Scorpion disaster following the Court of Inquiry. Palermo was not a naval officer. His military service consisted of serving as a Marine Corps rifleman during the Korean War. Palermo was always convinced that Scorpion ***did not*** suffer torpedo damage and that it imploded upon reaching crush depth due to some undetermined event.

(THE FINDINGS OF PALERMO'S ONCE-SECRET STRUCTURAL ANALYSIS GROUP REPORT IS CONTAINED BENEATH THE IMAGE SECTION OF THIS DOCUMENT.)

Another person asked to review Scorpion's damage by Palermo was Naval Research Laboratory researcher William S. Pellini, a member of the prestigious National Academy of Sciences, and one of the world's leading experts on brittle fracture and catastrophic failure of hull steel. Pellini is considered a pioneer in the science of fracture mechanics. Pellini's research was critical in providing solutions to numerous high-priority engineering problems such as nuclear reactor component embrittlement and making chemical transport tanks on trains and trucks resistant to cracking, adding immeasurably to public safety.

Below is an excerpt from Mr. Pellini's biography from the National Academy of Sciences Press. Pellini is an example of the highly-qualified individuals who earnestly worked to unravel the Scorpion mystery, and whose role in this effort has been forgotten by those making outrageous and ludicrous claims about the Scorpion disaster:

> "He was known to his friends, colleagues and professional associates as one of the most astute and competent investigators of complex phenomena in the fields of materials and service performance. During his long and distinguished career, he made significant contributions to the design of highly stressed steel structures, to the design and inspection of nuclear containment vessels, to the failure analysis of railroad equipment, to the development of programs for research on methods of controlling aerodynamic heating, and to many other fields.

> From 1942 to 1946, he served at the Naval Proving Ground, Dahlgren, which was a center of research and study related to light and heavy armor and projectiles. The work done at the Armor and Projectiles laboratory at (Dahlgren) vastly improved the capability of both naval ships and aircraft to operate and survive in the combat environment.
>
> He was considered a guide for years on directing work on ablative materials such as the tiles currently used in the space shuttle."

Pellini was no stranger to the hull material of the Scorpion and played a critical role in establishing the use of HY-80 steel on the ill-fated submarine. This excerpt is from the Encyclopedia of Chemical Processing and Design; Volume 67:

> "In the late 1950s, Pellini conducted the critical experiment that led to the decision to use HY-80 steel in pressure hull submarine construction, when he demonstrated that the fracture safety of HY-80 was superior to that of T-1 steel. Using explosives to deform a 2-inch-thick sample consisting of two steels welded together, he showed that the T-1 had a tendency to fracture in the heat-affected zone near the weld. The impact was entirely visual. No analysis was necessary."

(Later, when improper welding techniques were found to cause cracking in HY-80 pressure hulls prior to the Scorpion's construction, it was Pellini who successfully stood up against Naval Reactors' Hyman Rickover to successfully argue that HY-80's welding problems could be overcome. The Scorpion's hull was repeatedly found to be found in excellent condition prior to the boat's sinking.)

And, a final note for those who remember the mysterious cracking and failure of World War II Liberty ships: It was Pellini with fellow Naval Research Laboratory scientist P.P. Puzak who spent 15 years unraveling why these ships suffered massive and inexplicable hull cracking. Both determined that inadequate hull steels could lose half their strength in colder water that transitioned the steel from a ductile (flexible state to one of embrittlement. (An indirect benefit of their work was that it explained how the Titanic's hull shattered rather than bent when it struck an iceberg – another maritime disaster confused by numerous false claims.)

There is not an iota of evidence that this world-renowned scientist and the dozens of others who investigated its loss would be party to a cover-up regarding the Scorpion disaster.

And, it should be said, Pellini -- who conducted ground-breaking work in understanding the effects of explosions on warship hulls known as the "explosive bulge test" -- saw no evidence of a torpedo blast on Scorpion. Had Pellini stated that he saw earmarks of a torpedo explosion on Scorpion, such a claim could have even been self-serving since it would have exonerated the HY-80 hull steel he favored for submarine pressure hulls. (Given that the acoustics analysis indicated Scorpion's hull did not collapse until a depth of 2,000 feet, Pellini's faith in HY-80 steel needed no defense.)

Many capable and dedicated scientists worked on the puzzle that was the Scorpion disaster and each did their best in providing what answers they could. By referring to Price, Jackson, Palermo, Pellini and Saxon, I simply wanted to reveal background information about those who officially studied this mystery.

Soviet Warships

Anti-Submarine Warfare Forces Atlantic Fleet officers gave testimony that they were operating in the same vicinity as the Scorpion at the time of its loss. Although ASWFORLANT did not detect Scorpion or know of its location in the Atlantic, sworn testimony held that no Soviet forces were within 200 miles of the Scorpion's path of intended movement at the time of Scorpion's loss.

Again, one must ask: How could the Soviets, with their slow, loud submarines of the period, stalk and destroy the Scorpion in the middle of the Atlantic when they were unable to destroy it inside their own coastal waters, even if they somehow knew its approximate location?

Ultimately, one must ask why no Soviet-era sailors or officers have admitted to this "dastardly deed" even after the fall of the Soviet Union and the defection of numerous officials and KGB officers. One must also ask for a valid reason as to why the U.S. government would be obliged to cover this up when Scorpion was operating in international waters at the time of its loss. Did the U.S. government conceal a Soviet attack to avoid a war?

This seems a somewhat odd claim since there would be no war if the U.S. chose to not pursue one. Covering up an alleged criminal act by the Soviet government seems only to serve Soviet interest.

Although the Soviets were well known for shooting down U.S. aircraft in their airspace, creating a reason for a Soviet attack on an American warship on the high seas seems like a tall order. This is a particularly suspicious claim since attacking an American warship of any type in international waters could be, at worst, an act of war, and at best, an incomprehensibly stupid act. This is particularly true since an unwarranted military attack could irreparably damage the Soviet Union's already-tattered reputation as it desperately sought to extend its influence with a world community already leery of an untrustworthy, totalitarian regime.

None of these scenarios of enemy attack passes the acid test of scientific analysis or even the less formal "smell test" of common sense. Such claims are not backed up by any evidence of any sort. In addition, highly-placed U.S. naval intelligence officers have repeatedly insisted there is no validity to rumors of Soviet attack. These denials are given the hardness of iron because they are backed up by ample and obvious physical evidence.

The Myth of a Secret Search for the Scorpion

The claim has been made that Scorpion was known to be lost before it failed to arrive as scheduled on May 27, 1968 supposedly prompting Vice-Admiral Arnold Schade, commander of Submarine Fleet Atlantic (SUBLANT), to mount a secret search for the boat.

Although it has been claimed that Schade admitted during the 1980s to launching a search, this claim is soundly contradicted by Schade's sworn testimony to the Court of Inquiry just days after Scorpion was lost. Schade stated flatly that Scorpion's orders to practice radio silence during its return to Norfolk meant that no one believed Scorpion was in distress. Hearing nothing meant all was normal. This is covered in detail in ***Silent Steel***.

In fact, Schade was hundreds of miles away from Naval Base Norfolk at the time Scorpion failed to arrive which seems odd for an officer who, it is claimed, was supposedly searching for a submarine he believed to be in distress. In hundreds of interviews, I failed to find a single sailor or officer in the Atlantic Fleet who recalls being ordered to search for the Scorpion prior to May 27, 1968, the day it failed to arrive.

What did happen is a matter of record. Upon learning that Scorpion was overdue on May 27, Schade did order an initial search for the Scorpion around 1 p.m. but did not issue a formal declaration of “SUBMISS” (Submarine Missing) for another hour or so. The only advantage of the SUBMISS declaration was to rush ships to Scorpion’s last known position which was five days old and nearly 2,000 miles away, something of a fool’s errand. Schade eventually did order a “SUBMISS” alert, which did activate a massive but fruitless search of the Scorpion’s last known position.

Given these circumstances, it’s easy to see how Schade’s actions may have been misinterpreted.

(A word of caution to researchers on the subject of the Scorpion: I did find dozens of former Navy personnel who swore they saw Scorpion in places where it was not and even heard from sailors who claimed to have seen the submarine ***after*** it was lost. They were vehement about their recollections. I only used recollections that could be reliably verified by other witnesses and by official documentation. Gossip and sea stories, embroidered by years of retelling, do not serve the purpose of history.

Eventually, all such claims were contradicted by fellow sailors who said the Scorpion was not where others erroneously claimed it was.)

Bolstering Schade's testimony regarding his belief that Scorpion was making a routine return to base is the sworn testimony of the commanders of the Scorpion's Division and its Squadron. Both men testified they believed nothing was amiss with Scorpion since it was under orders not to transmit except in case of emergency. Neither officer had reason to mount a search nor did they ask that Schade do so. And, neither mentioned any effort to locate the Scorpion prior to its failure to arrive.

Oddly enough, since Schade was several levels above the Scorpion's direct commanders, these officers would have been the ones to request a search for Scorpion if they believed anything was amiss since several signals were sent to Scorpion while it was under radio silence. When no responses were received, the assumption was made that Scorpion was merely adhering to its orders to not break radio silence.

The Mundane vs. the Dramatic

Schade, who testified several times before the Court of Inquiry and never mentioned any worries he harbored about the Scorpion before the day it failed to arrive, was indeed very concerned about several controversial aspects of submarine operations and safe operating procedures.

Schade diligently lobbied the court to more fully investigate issues of stern plane reliability and hydraulic system reliability on deep-diving, high-speed submarines. These problems worried Schade since a submarine traveling at high speed thrown into a sudden dive by a stern plane failure could quickly exceed its crush depth. He even offered the court an unsolicited letter annunciating these concerns in lengthy detail.

In addition, Schade attempted to convince the Inquiry's board to consider the possibility of flooding in the forward part of the Scorpion through the trash disposal unit ball valve as a suspect worthy of closer consideration. During his testimony, Schade never expressed the belief that the Scorpion was a victim of enemy action.

Given Schade's long history of service in the Submarine Force and his wartime performance as a submariner of great skill and daring -- he remains the only American submarine commander known to have engaged in combat with pirates -- it is highly doubtful Schade was a ringleader of a cover-up involving the loss of submariners under his command. It also seems doubtful that he would commit perjury during a Court of Inquiry convened at his own request.

Schade was suffering from Alzheimer's disease at the time of his death in 2003 at the age of 91. Because of this, I was unable to interview the retired vice-admiral for ***Silent Steel***.

The Myth of a Secret Discovery of the Scorpion's wreck with Soviet Help

Given that the Soviets were unable to locate their own ruined Golf-class submarine, known as the K-129, which likely suffered a rocket fuel explosion roughly 700 miles from Oahu two months before the loss of the Scorpion, the claim that the Soviets were somehow able to pinpoint Scorpion's wreckage is somewhat absurd.

The subtext of this lurid claim is that the Soviets knew where Scorpion was because they sank it. As ridiculous claim is piled upon fictional scenario, one enduring rumor is that the U.S. Navy caused the March 1968 loss of the K-129 which resulted in a "revenge killing" of the Scorpion. The absurdity of this claim is repellant to American naval officers who spent years successfully outwitting their Soviet adversaries.

Forgetting for the moment that the Scorpion exhibits no signs of torpedo or depth charge damage, it seems far fetched that the Soviets would immediately rush to the Americans and tell them they had attacked and sunk a nuclear-armed and nuclear-powered submarine.

The claim has been made that the Scorpion's wreck was located immediately after it was lost by the Navy oceanographic survey ship Compass Island rather than five months later by the USNS Mizar, a Naval Research Laboratory ship which indeed located the Scorpion's wreck because it was specially equipped for the task.

This odd scenario flies in the face of the Compass Island's capabilities which were focused upon navigational missions and seafloor mapping. This wild claim also contradicts Capt. Joseph Bonds, 84, who commanded the Compass Island at the time it supposedly discovered the Scorpion. The Compass Island, says Bonds, did not locate the wreckage of the Scorpion. It was found, he said, months after by the Mizar after the Compass Island departed the scene.

This claim also contradicts the realities of deep ocean search capabilities of the period. Even fairly accurate coordinates would mean months of searching would be necessary to finally locate wreckage two miles beneath the surface, not a matter of hours or days. In fact, the Navy had solid coordinates for the location of the Scorpion's wreckage and it still took nearly half a year of searching to locate the boat's shattered hull.

Bonds has confirmed that Compass Island did not locate Scorpion and was unequipped to do so. His comment on author Ed Offley's claim in "Scorpion Down." a book that purports the Scorpion was sunk by a Soviet submarine, that Compass Island located the Scorpion with Soviet help is, in a word, "fiction." Bonds also says he was never interviewed by Offley.

Bond's however, did recount Compass Island's well-established role in supporting the Mizar's efforts to locate the Scorpion: After hydroacoustic recordings of the

Scorpion's death sounds allowed the establishment of an initial, 144-square-mile search box southwest of the Azores, the Compass Island sailed to the location. Once there, it dropped a series of SUS (sound, underwater signal) charges to reconfirm that the Scorpion's hull collapse sounds originated from the search box established by Gordon Hamilton's La Palma Island signals. The Compass Island then conducted mapping runs of the seafloor two miles beneath the search box. These maps were needed by the Mizar so it could safely pull its sensor-equipped sled in a glider-like fashion at the end of three miles of cable a few dozen feet from the seafloor.

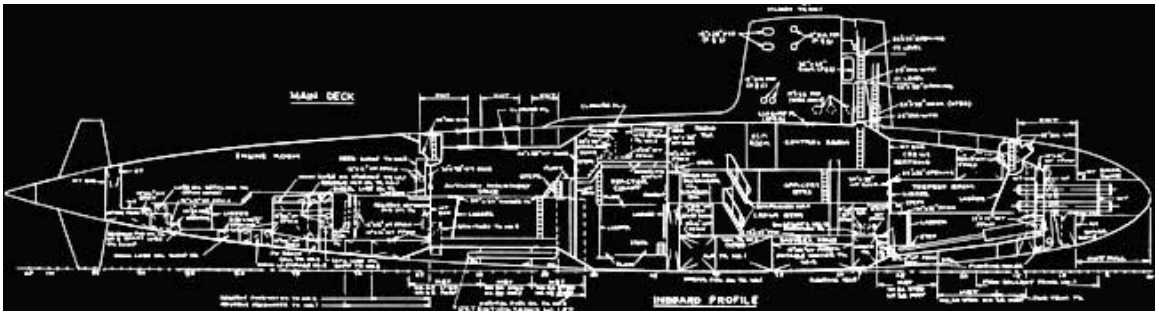
What the Compass Island did discover was, by itself, quite extraordinary.

The sinking Scorpion had apparently descended into a massive volcanic crater, or caldera, a formation geologists were disinclined to believe existed in the deep ocean. (It was once the scientific consensus that intense sea pressure would suppress the volcanic explosion of the lava dome that creates such massive holes.)

A seafloor contour map created by the Compass Island's Sonar Array Sounding System was personally given to Chester "Buck" Buchanan by Bonds who was astonished at the rugged terrain. Buchanan then ordered the construction of a three-dimensional model of the caldera in which the wreck of the Scorpion was believed to lay. A photograph of this model is included in the image section of this document.

Photos and Images Related to the USS Scorpion

(Below are images and photographs that will illustrate what is actually known about the loss of the USS Scorpion. These images alone dispel many prevailing myths such as claims that collision, torpedo attack or an internal explosion caused the loss of Scorpion.)



A blueprint of a Skipjack-class hull identical to the Scorpion's

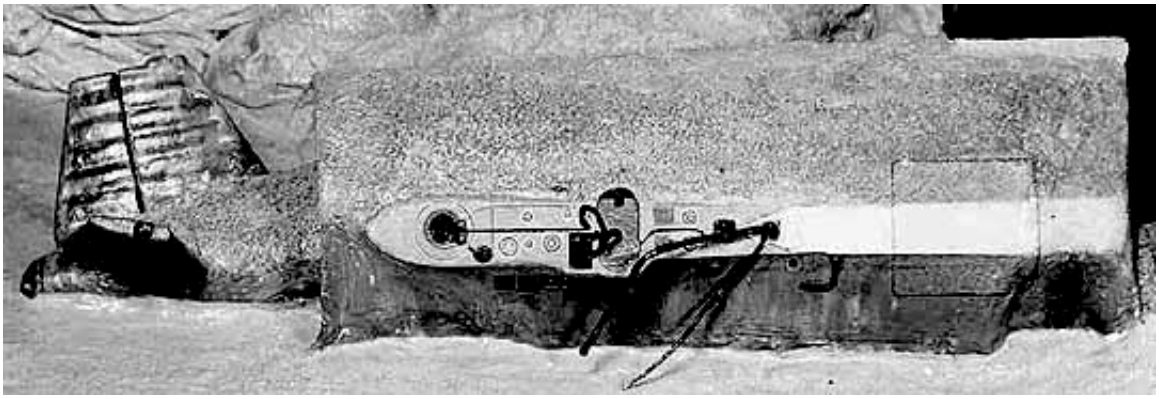
The torpedo compartment bulkhead is directly below the forward edge of the fairwater sail (conning tower). The operations compartment below the sail obliterated upon reaching collapse depth which is why the sail was detached and now lies separated in the debris field. Just behind and below the raised turtleback exhaust manifold extending aft of the sail is the cone cylinder juncture that reduces the size of the hull for the allowance of ballast tanks around the auxiliary machine

space. Frame 67 collapsed just aft of the machine space and drew the engine room (stern) 50 feet forward around the auxiliary machine space like a huge cookie cutter.

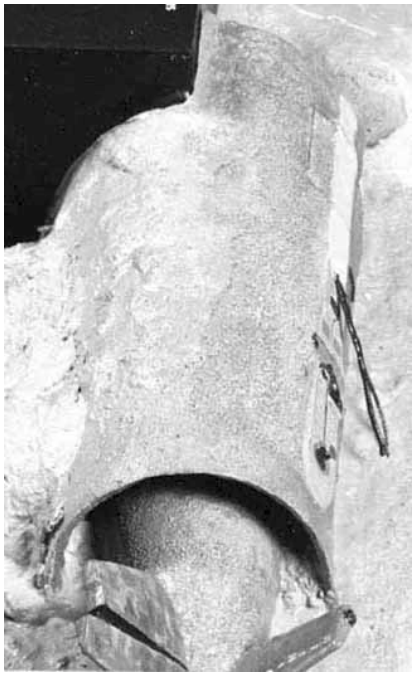
The only force in the world that could cause such colossal damage is the illimitable, cumulative power of the oceans in the form of hydrostatic pressure pressing against an air-filled pressure hull. One scientist called this the television tube effect when old TVs propelled their electron gun forward when the vacuum tube screen imploded.

It must be remembered that flooding in one compartment below 300 feet of depth would not be contained by the four bulkheads separating the five compartments. This is because the bulkheads could only sustain 300-500 feet of sea pressure. Flooding would cause the bulkheads to collapse one after another which means a single torpedo strike would fully flood the boat with water as it sank deeper and deeper. Compromising one segment of the hull with a blast means there would be no implosion damage anywhere on the Scorpion's hull.

Dr. John Craven, who directed the scientific effort during the original inquiry into the Scorpion's Court of Inquiry, originally testified he expected to find Scorpion on the seafloor fully intact with imploded internal bulkheads, most likely after receiving a torpedo strike. Needless to say, the Scorpion was found in a shattered state with its hull imploded and separated.



This is a model of the aft segment of the Scorpion's hull with the stern imploded 50 feet into the hull upon reaching crush depth. The top of the hull, or weather deck, is facing the camera and is turned 90 degrees with the keel of the submarine facing away from the viewer. Please note the white stripe where the "turtleback" or the exhaust fairing that extended from the rear of the fairwater sail was once seated. The S5W pressurized water reactor was contained beneath the square hull "patch". Note the clean, annular break at frame 67 where the stern has been driven forward into the hull. This is where the cone cylinder juncture failed at crush depth. To the right, implosion forces have cleanly sheared the hull when the operations compartment was obliterated by sea pressure. The torpedo room and fairwater sail were detached at that moment. Even the untrained eye can determine that no collision damage or torpedo blast damage is visible.



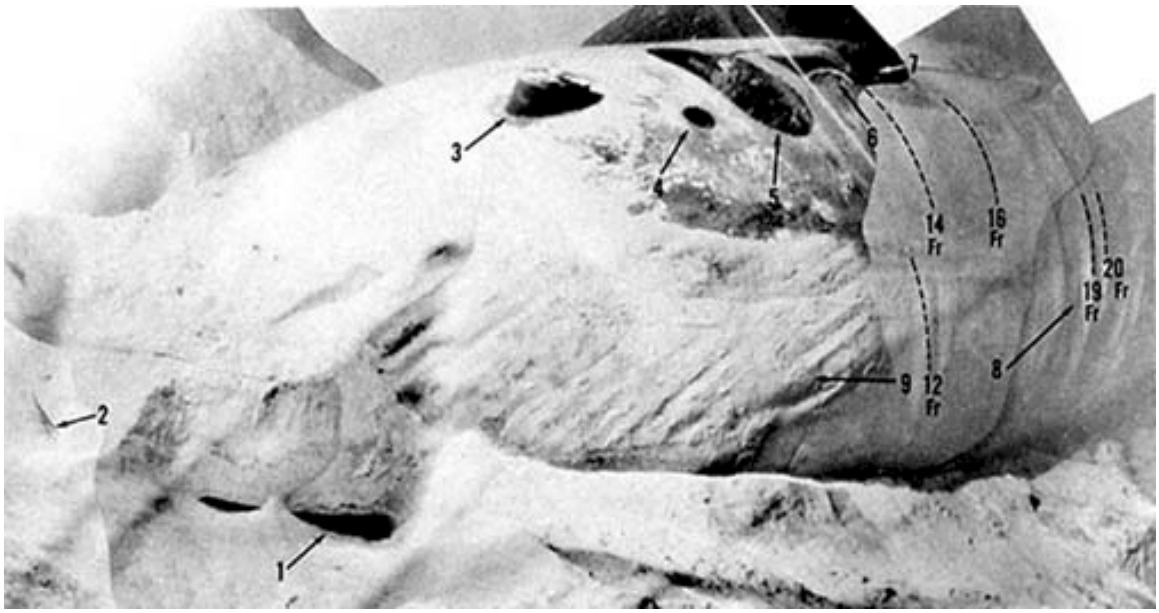
Above is a stern view of the same model. Once again, no torpedo blast damage is visible. This segment of the wreckage skidded laterally shoving seafloor ooze against its keel. The stern jutting from the hull is tilted nearly 90 degrees to the left of its original configuration. Note the clean break of the pressure hull steel at reinforcing frame 67. It is important to note that this damage would not happen had Scorpion been flooded with water by a torpedo attack. In addition, this precise collapse mechanism occurred to scale models of the Scorpion's pressure hull when subjected to implosion pressures inside a test tank.

Above is a model of the torpedo compartment which includes the fairing (non-pressure hull covering) enclosing the torpedo tubes. The breech ends enter the pressure hull through a reinforced bulkhead at the forward end of the torpedo room with their muzzles extending to the bow through what is termed a free-flood area. Note the sea pressure's effects on the bow that was bent like a banana as its structure fell victim to implosion forces, once again proving Scorpion was still filled with air at the time it reached crush depth.

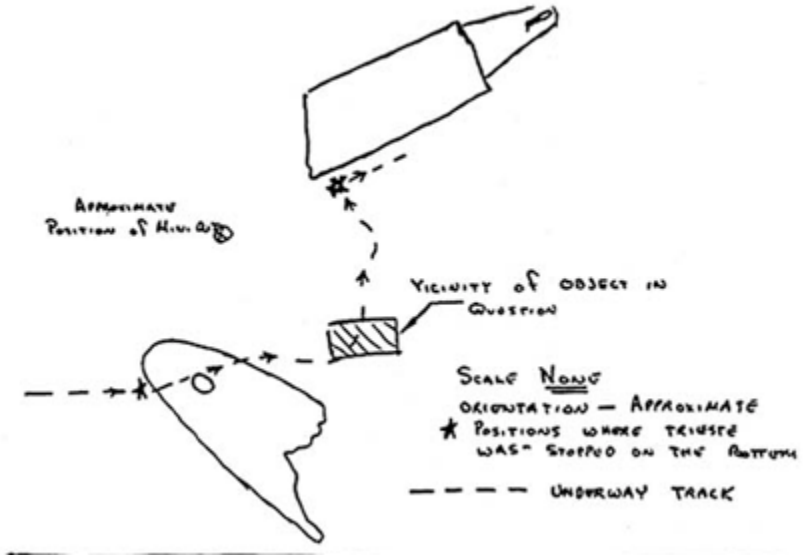
Some claim it was deformed upon collision with the seafloor, but the soft globigerina ooze would have cushioned the impact and it's doubtful this remarkably strong structure would have been deformed by impact in this fashion. For example: the bow of the submarine, which is a relatively weak segment of hollow fairing, appears unscathed, while the immensely strong pressure hull aft of the bow is bent and crumpled.

Note the wrinkling of the two-inch steel which covers massively strong reinforcement rings positioned every 20 inches inside the hull. The forces required to do this type of damage are almost inestimable. There is no torpedo blast damage visible inside or outside this section of hull which is sheared from the obliterated operations compartment at the bottom of this image.

This photograph of the aft end of the torpedo room was taken by a towed camera sled deployed from the USNS Mizar in October 1968. It shows the bending of the Scorpion's hull steel inward and downward by implosion forces. The operations compartment directly behind the torpedo room has been obliterated. None of this damage bears the earmarks of a torpedo blast. The piping is the remnants of one of the submarine's periscopes. The forward edge of the fairwater sail, or conning tower, ended where the pointed outline ends forward of the collapse damage.

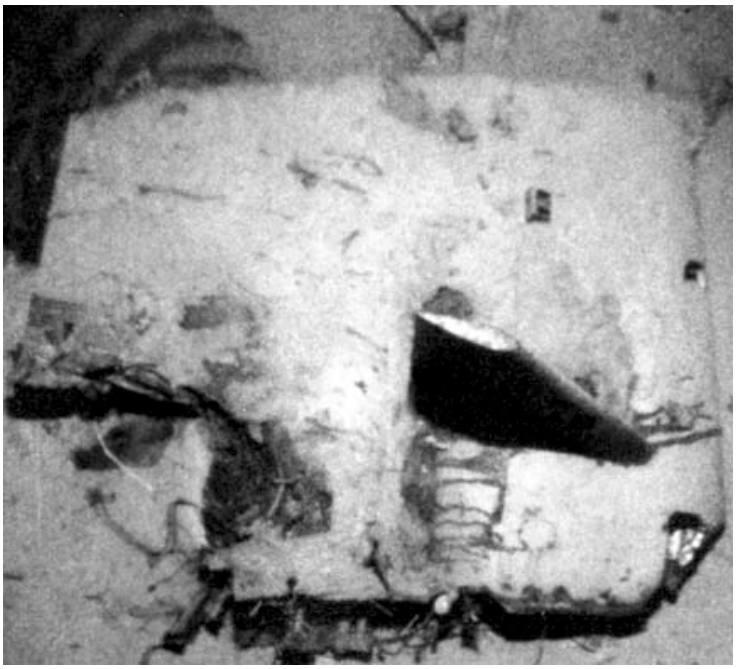


Above is a composite image from the cameras of the Trieste II submersible taken in 1969. The forward edge of the bow is to the left with the small slits being the torpedo tube shutters jarred slightly open upon impact with the seafloor. These are marked by the numbers "1" and "2". An upward-looking sonar fathometer is protruding from the nose (3) and the large oval opening is where the submarine rescue buoy was stored. Both fore and aft buoys imploded and are lost. What is most important about this image is the shell yielding/bending caused by implosion damage due to hydrostatic pressure which is seen at the right and marked by dotted lines. This would not occur if Scorpion had been filled with water and its internal pressure had been equalized with the surrounding sea pressure.

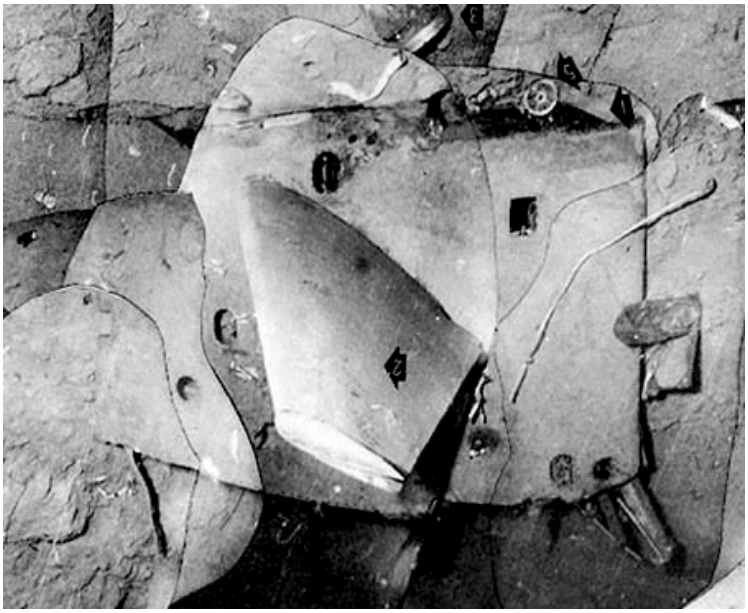


This sketch was made by one of the Trieste II pilots Lt. Brynes who, along with other members of the crew spotted the body of a sailor wearing a life preserver on the sea

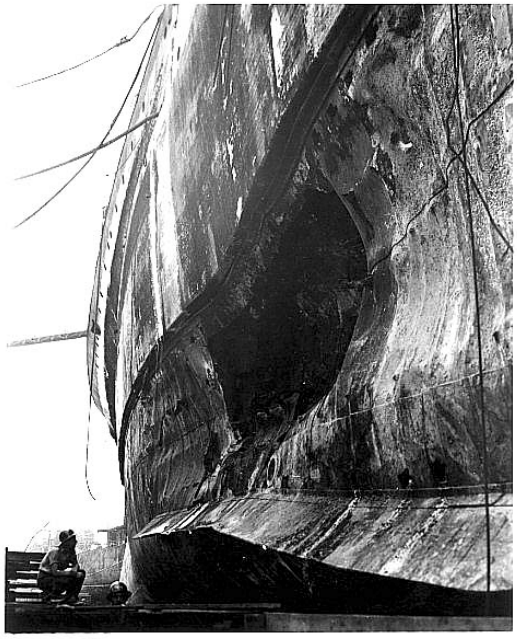
floor. This location is marked by the box filled with diagonal slashes. The bow/torpedo compartment is to the right facing northwest and the midsection with the stern collapsed 50 feet inside of it is facing southwest. Note the attitude of the hull segments which broke apart at 2,000 feet after suffering implosion damage before falling the remaining 9,000 feet into the volcanic caldera – the collapsed lava dome of an ancient volcano. Some have claimed the Scorpion's wreckage indicates it was heading back toward Europe. This is foolishness all around, since the segments are pointed back toward the United States. (However, no one can draw a reliable conclusion of the Scorpion's direction of travel by the disposition of its wreckage following a two-mile freefall. Keep in mind that dozens of feet of the operations compartment are simply gone or peeled back. This compartment once existed between the reactor compartment and the torpedo room. Only implosion damage from sea pressure against an intact, undamaged hull could cause this sort of damage.



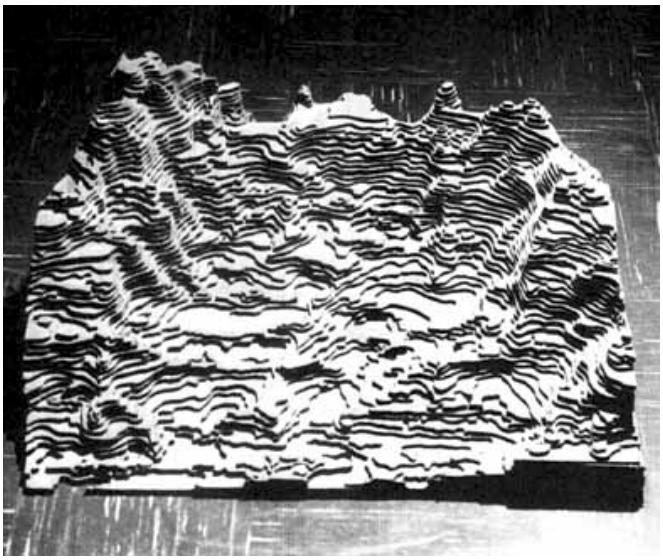
This image of Scorpion's fairwater sail, commonly called a "conning tower" was taken during the 1980s. The sail was detached when the operations compartment was obliterated by implosion damage after the submarine descended to crush depth. (Its perch was atop the operations compartment which disintegrated at crush depth.) The damage notched into the rear of the sail was caused when it was torn from the exhaust housing known as the "turtleback" that ran from the rear of the sail along the aft portion of the submarine. This fairing carried diesel exhaust when it was necessary to run the Scorpion's diesel engines. Once again, the clean lines along the top and its edges fore and aft reveal neither torpedo blast damage nor collision marks.



This composite image, made from a series of smaller images, shows the detached fairwater sail of the USS Thresher which also sank below crush depth and imploded in 1963 during an ill-fated test-depth dive. The Thresher's sail has also been torn from its perch atop the operations compartment. The similarities to the condition of Scorpion's sail are striking, though no work of fiction has yet attempted to claim Thresher was sunk by the Soviets. Although the submarine rescue ship Skylark was nearby at the time of the disaster and was able to provide approximate coordinates for the Thresher's location, it still took nearly a year for NRL scientist Buck Buchanan to locate the wreckage with a towed camera sled behind the specially-equipped research ship USNS Mizar. Claims that the Scorpion was found almost instantly in a secret operation with Soviet help, are proven false by the well-known difficulty of locating deep ocean shipwrecks with the technology available during the 1960s. It should be noted that Thresher lies in water roughly 2,000 feet shallower than Scorpion on a relatively smooth seabed. Scorpion lies inside a volcanic caldera surrounded by craggy spires.



Above is an example of torpedo damage on the "soft" portion of the USS West Virginia during World War II. The torpedo struck just below the "armored belt" or the "torpedo belt" of the warship which is the thicker band of steel just above the torpedo blast hole. Torpedoes create unmistakable damage on the hull of a ship or a submarine. No damage even approximating this torpedo hole is visible anywhere on the Scorpion's wreckage. The HY-80 hull steel of Scorpion, a version of the famed Krupp Armor, was originally developed as protection for aircraft carrier hulls during and after World War II. Its high-strength and high-ductility characteristics made it ideal as hull steel in a new class of deep-diving submarines including the Scorpion.



This is the cardboard sheet and plaster model of the volcanic caldera that contained the wreck of the Scorpion. It was ordered constructed by Naval Research Laboratory scientist Chester "Buck" Buchanan, the chief scientist aboard the USNS Mizar. The

model is based upon mapping created by the Navy survey ship Compass Island. Mizar's personnel used this map to help it thread its towed camera sled into this rugged terrain feature caused by the collapse of an ancient lava dome. The Compass Island did not locate the Scorpion since it did not have an instrumented sled like the ones carried by Mizar which was equipped specifically for deep ocean research. Despite the maps and the model, one sled was damaged and another lost completely as Mizar attempted to maneuver the sleds inside the crater. I'm told Scorpion's wreckage lies halfway up the wall of this caldera on a large, gently sloping ledge. The map provides graphic evidence of the challenge Buchanan's towed sled pilots faced while trying to locate Scorpion from two miles above. The effort to locate Scorpion lasted five months under often-difficult conditions. The provably false claim that Scorpion was found immediately by the survey ship Compass Island and that the search that actually located the Scorpion's remains was some sort of charade is ludicrous. Buck Buchanan, 91, who was under intense pressure to locate the Scorpion's wreckage, is chagrined at the patently false claims that his mission was part of a cover-up. The commander of Compass Island at the time, Joseph Bonds, also calls the claim "fiction."

Official Investigative Documents of the Phase II Investigation
Conducted in the aftermath of the original Court of Inquiry investigating the loss of the USS Scorpion

(Although the full reports are fairly lengthy and contain supporting documents and statements, these are the actual pages containing the conclusions reached by both studies.)

The Conclusions of the Structural Analysis Group Report
1970
Chaired by Peter Palermo,
Submarine Structures Division
Naval Ships Systems Command

8.0 CONCLUSIONS

1. The hulk of USS SCORPION (SSN589) was located and photographed by USNS MIZAR (T-AGOR 11) in October 1968 and again in July and August 1969 by TRIESTE II.

2. During her loss about 15 acoustic emissions occurring over a 192 second period were detected; and an emission detected 22 minutes earlier was possibly from SCORPION.

3. Analysis of the acoustic emissions established the location of the hulk.

4. The hull of SCORPION is in two major sections on the bottom.

   a. The bow section from approximately Frame 35 to the Forward Perpendicular, and

   b. The stern section from approximately Frame 40 to the tail appendages.

5. Analysis of the structural damage indicates the following:

   a. Torpedo Room intact and flooded.

   b. Operations Compartment imploded due to external pressure.

   c. Reactor Compartment - considerable secondary damage due to a combination of hydrostatic pressure, the effects of Engine Room telescoping and implosion of the Operations Compartment and mechanical damage.

   d. Auxiliary Machinery Space - intact and flooded.

   e. Engine Room - imploded due to external pressure and telescoped into the AMS.

6. Based on the acoustic evidence, collapse of the Engine Room and the Operations Compartment occurred almost simultaneously at a depth of approximately [redacted] feet.

7. All available evidence indicates that the material condition of the pressure hull was good, and that premature hull failure did not occur.

8. There is no positive evidence of a large external explosion.

9. There is no positive evidence of internal (weapons) explosion.

10. There is no evidence of massive fire.

11. There is considerable circumstantial evidence that at some time during the loss of SCORPION, the submarine achieved periscope depth. This is based on the position of communicating masts and the evidence of an apparent escape attempt.

12. A plausible contributing cause of the loss of SCORPION is a battery casualty. The high velocity impingement of pieces of the flash arrestor into the recovered piece of plastisol indicate that the casualty occurred prior to complete flooding of the battery compartment.

13. Other plausible contributing causes, as discussed in the text, are massive flooding, stern plane casualty, collision, sabotage and human error.

14. Based on the evidence examined and the conclusions arrived at during the deliberations of the SAG, it is the opinion of the SAG that there is no reason to change design criteria, or operating procedures and regulations, only that existing regulations and procedures be diligently followed.

Conclusions of the Study of the Scorpion Hydroacoustic Signals 1969

Principal Authors: Robert S. Price, Meri Christian, Peter Sherman, Naval Ordnance Laboratory

CHAPTER 5

RESULTS OF SPECTRAL ANALYSIS (U)

5.1 (U) Appendix C contains a detailed discussion of the digital spectral analyses and shows the frequency spectra of all submarine signals and calibration shots examined. Here only a brief summary of spectral characteristics is included.

5.2 [redacted] All comments apply to records from the high-gain channel of Hydrophone A at the [redacted] station; comparative analysis of data from several recording channels showed the same spectral characteristics on all channels for both Events and SUBMISS shots, so effort was concentrated on this particular channel which had by far the greatest signal/noise ratio. The background noise was examined at a number of points during the sequence of SCORPION hydroacoustic Events. This noise analysis played an important part in our interpretation of the data. Since spectra for the background noise showed high energy levels for frequencies below [redacted]--due to real noise components along the propagation channel, to equipment, to processing errors, or to some combination of these factors--we did not consider frequencies below [redacted] in our interpretation of data except in the case of Event 1.

5.3 [redacted] In general, the SCORPION Events spectra can be grouped into three categories, viz, (a) those with spectral energy distribution essentially the same as that of the noise background, (b) those having clearly-defined harmonic patterns of regularly-spaced peaks and nulls, and (c) one having a very large energy content at very low frequency. The internal spectral patterns (though not the spectral envelopes) of group (b) are similar to those of an explosion or implosion, and undoubtedly contributed to the belief that a number of the SCORPION signals arose from such sources. We do not believe this to be the case, however, for the reasons given in paragraph 5.5 and in Section C.3 of Appendix C.

5.4 [redacted] In Table 3 spectral characteristics are summarized for all of the SCORPION Events. Here the arrival time of the signal, relative to Event 1, is shown in the second column. The third column, headed "Probable Type of Signal" identifies the signal in terms of the categories noted in paragraph 5.3 above. The comment [redacted] indicates that the frequency spectrum of the Event looked essentially like that of the background noise, shifted to a significantly higher signal level. The comment "repeated impulses" identifies the spectrum as one with a sharp harmonic pattern. The reason for this designation and the significance of entries in the last column of Table 3 are given in the following paragraph.

5.5 [redacted] In Reference 2, the discussion of spectral characteristics is couched in terms of a "bubble pulse fundamental frequency, **BPF**". This terminology derives from the fact that underwater explosion spectra contain regularly-spaced peaks and nulls which do, indeed, correspond to the bubble fundamental frequency, or inverse of the first bubble period of the explosion. One also finds such harmonics in the spectra of numerous other types of pressure waves, however--e.g., short lengths of sinusoids, single pulses, and pairs of impulses. And the frequency spacing of the nulls is not necessarily the fundamental frequency of the wave; for example, the sine wave analysis of Appendix C shows the relationship between null spacing and length of pressure record for a sinusoid. Since we do not know the nature of the pressure waves in the SCORPION Events, we have avoided use of the term "BPF", which might carry an unfortunate and misleading implication. For these spectra we have called the probable pressure wave form "repeated impulses", which overall considerations

lead us to believe the signals probably were. The last column of Table 3 shows the time separation (Δt) between two pulses (or a sequence of equally-spaced pulses) of a pressure signal that would, in the frequency domain, show the observed pattern; the fundamental frequency, $f_f = 1/\Delta t$, is also listed. These values of f_f agree well with Hamilton's measurements (Reference 2) of line structure on sound spectrographs.

5.6 [redacted] For convenient comparison of the various Events individual frequency spectra shown in Appendix C are repeated here, reduced in size, in Figures 3 and 4. Figure 5 shows Events 6, 7, and 8, the triplet of high-amplitude signals from which the SCORPION sequence was identified. To obviate computer plotting problems the spectra are shown starting at about [redacted], rather than [redacted].

5.7 [redacted] The spectrum of Event 1 is unique among the SCORPION signals in that it contains an extremely large amount of low-frequency energy. The spectrum level at [redacted] is some [redacted] above the low-frequency noise spike. For frequencies above [redacted] the level decays rapidly at a rate of about [redacted], until it reaches an essentially constant value at [redacted]. Based on the sine wave analysis and our data from the STERLET test, we conclude that the pressure wave in this case was probably roughly sinusoidal, with dominant frequencies in the neighborhood of [redacted]. The spectral envelope of this signal differed significantly from those of all explosions examined in the SUBMISS and STERLET series (see C3.2) and, consequently, we do not believe Event 1 is an explosion. We believe this signal was the sound of the hull collapsing at about [redacted] depth.

5.8 [redacted] We think that Events 2-14 were noises generated by structural failures, mechanical vibrations, and impacts of pieces of the hull and/or large machinery masses. Despite the evidence of strong harmonics in some of these events, we do not think they were explosions or implosions. The shapes of the spectral envelopes and the decrease, rather than increase, in fundamental frequencies during the Events sequence point to mechanical, rather than explosive, sources.

5.9 [redacted] Event 15, the last of the significant signals of the sequence, may be another mechanical sound, such as Events 2-14, or it may be the noise of the hull impacting the bottom. Since this signal is a low amplitude one just above the background noise level, we incline towards bottom impact as its source.

5.10 [redacted] Our efforts at conjecturing pressure wave forms (for which we might, in turn, be able to conjecture the sources) from the spectra point up two types of missing information needed for such an exercise. First of all, there is the question of what types of noises are produced by mechanical impacts underwater. Secondly, we need to know how sounds are modified by the oceanic channel between the site of the SCORPION disaster and the recording station in the [redacted]. Although we have tried to weight probable source and channel characteristics reasonably, on the basis of general long-range acoustic propagation knowledge, there is little hope of determining how well we succeeded in the case of the SCORPION signals. For a research problem, however, additional work along both of these lines could very profitably be keyed to the SCORPION location.

5.11 [redacted] Studies that could be conducted, we believe at modest cost, are:

(a) Attempt to record at the [redacted] station the sound of a nuclear submarine blowing all ballast tanks as it transits the site of the SCORPION disaster. Presumably ballast tanks would be blown as a first recovery attempt in the event of

CONJECTURED NATURE OF HULL FAILURE AND SOURCES OF NOISE (S)

[redacted] Piecing together all of the information (or suggestions) we can glean from analysis of the hydroacoustic data, the photographs of the wreckage of SCORPION and THRESHER, and the results of the STERLET acoustic measurements, we believe that the sequence of occurrences outlined below is a plausible description of what might have happened when the SCORPION sank.

6.1 [redacted] SOME UNKNOWN INCIDENT OR CHAIN OF INCIDENTS CAUSED THE SCORPION TO SINK OUT OF CONTROL.

The February 1969 USS CHOPPER (SS342) mishap is an example of loss of electric power in a submarine. It was followed by corrective action, initiation of which was delayed almost to the fatal limit by a combination of failures. Fortunately the plunge of the ship towards the bottom was halted [redacted] just before the hull reached collapse depth and the ship was able to surface, though not under control and with some damage caused by excessive pressure.

In 1959 the USS STICKLEBACK popped out of the water because of a power failure and was lost in collision with a destroyer. There have been other mishaps, also.

6.2 [redacted] WHEN THE BOAT REACHED ABOUT [redacted] FT DEPTH THERE WERE CATASTROPHIC, ESSENTIALLY SIMULTANEOUS, HYDROSTATIC FAILURES OF THE PRESSURE HULL.

The envelope characteristics of the pressure signal point to a source depth of about [redacted] ft for Event 1 of the SCORPION Hydroacoustic records; see Appendix B and Chapter 4 of this report. Although SCORPION'S rated hull collapse depth was [redacted] ft [redacted] operation depth), the CHOPPER incident showed that a hull may survive to greater than rated depth. The STERLET hull (with an operating depth of [redacted] ft, Ref 9) or bulkhead failed at [redacted] ft although the calculated torpedo room hull collapse depth is [redacted] ft and similar bulkheads have failed at [redacted] to [redacted] ft depths.

6.3 [redacted] THE COLLAPSING HULL EMITTED A LOUD NOISE, THE HYDROACOUSTIC SIGNAL IDENTIFIED AS "EVENT 1". THIS WAS A ROUGHLY SINUSOIDAL PRESSURE PULSE WITH DOMINANT FREQUENCIES IN THE NEIGHBORHOOD OF [redacted] OR LOWER.

The STERLET hull collapsing under hydrostatic pressure emitted a roughly sinusoidal pressure wave with dominant frequencies in the neighborhood of [redacted], see Appendix A. Calculations of the fundamental frequency assuming the STERLET torpedo room volume to be equivalent to a sphere of gas agreed well with the observed fundamental frequency.

The same assumed relationships, viz,

$$(U)\ f_f = \frac{3.11\ (D + 33)^{1/2}}{r} \quad \text{(REF 2, 10)} \qquad (6.1)$$

where f_f is the fundamental frequency (Hz)
D is the depth of bubble (ft)
r is the equivalent spherical radius (ft)

applied to SCORPION dimensions at [redacted] ft depth give fundamental frequencies of [redacted] for the total hull volume and [redacted] for the control room section. The telescoping action would generate a pressure wave or waves of much lower frequency. Thus, any of these calculations leads one to expect that the bulk of the acoustic energy radiated at the time of hull collapse would be primarily very low-frequency energy.

The power spectrum of the STERLET collapse (signal S-2 of Appendix A) recorded [redacted] distant has a peak spectrum level at [redacted]. No other signals in the STERLET series peaked at such a low frequency, see Appendix C.

Event 1 of the SCORPION series was the only signal having a high signal/noise ratio for frequencies below [redacted]. The maximum spectrum level occurred at [redacted] and was about [redacted] above background. The spectrum envelope decayed rapidly for higher frequencies, as does the spectral envelope of a pressure wave comprising several cycles of a sinusoidal wave, see Appendix C.

6.4 [redacted] THE HULL FAILED RAPIDLY IN TWO MAJOR MODES - COLLAPSE IN THE REGION OF THE CONTROL ROOM AND TELESCOPING OF THE ENGINE ROOM INTO THE AUXILIARY MACHINERY SPACE (AMS).

According to the booklet of general plans, bulkheads in the SCORPION may be much weaker than the pressure hull. If either of the two main failures had occurred separately the hull would have filled through either hole, quickly bursting all interior bulkheads. Thus the second main hull failure at a later time would have been prevented by the flooded condition of the remaining hull.

The SCORPION hull failures show some resemblance to those of the THRESHER (Reference 11). In both cases there was a sharp break in the pressure hull plating at the after edge of the transition ring between the AMS and engine room. On the SCORPION the ring, which is thicker than the hull plating and heavily stiffened, was located at frame 67. The mode of failure was probably crumpling of the hull plating aft of the ring, tearing at the weld joint and, for the SCORPION, telescoping of the after section of hull into the AMS. This telescoping action

apparently did not occur on THRESHER as evidenced by the photographs (Reference 11). The proportions of the transition section "funnel" and hull were proper on SCORPION and telescoping did occur.

The amount of intrusion of the engine room into the AMS shown in the pictures (Reference 4) is about 50 feet. This figure is confirmed by the lack of radioactivity around the wreck which indicates that the reactors, located in the forward portion of the reactor compartment, were not breached. The failure in the control room appears to be simple hydrostatic failure limited longitudinally by the transition sections into the torpedo room and into the AMS.

Which of the two failures occurred first is unknown but either could have triggered the other by imposing additional transient stresses on a hull already loaded to the breaking point at one place. If the ship were plunging downward at a 45 to 60° angle one would expect the control room to fail before the engine room, if they were of equal strength.

6.5 [redacted] AFTER DESTRUCTION OF THE CONTROL ROOM THE VESSEL BROKE APART BY FOLDING THE BOW TO PORT OR UPWARDS.

This could have occurred when the control room collapsed or the actual break could have been delayed. Exactly when is difficult to determine but acoustic event 2, about 30 seconds after the main collapse could be attributed to the breaking. During failure of the control room the sail, turtle back, etc, could have started and perhaps completed their separation from the hull.

6.6 [redacted] DURING THE TELESCOPING ACTION THE PROPELLER SHAFT WAS EXTRUDED FROM THE HULL.

Since the propeller and shaft are found together on the bottom well to starboard and somewhat forward of the stern of the vessel they must have had considerable time to fall separately from the main hull. The propeller fell rapidly because it is well embedded in the bottom.

6.7 [redacted] AS THE SCORPION'S ENGINE ROOM - AMS SECTIONS FELL THEY BEGAN TO ROCK, OSCILLATE, AND/OR SPIN UNDER THE INFLUENCE OF HYDRODYNAMIC FORCES.

6.8 [redacted] IMPACTS OF THE AMS AND ENGINE ROOM, AMS AND BOW SECTIONS, OR OF HEAVY EQUIPMENT WITH THE WALLS OF THE INTERLOCKING HULL SECTIONS WERE THE SOURCE OF ALL OR MOST OF THE ACOUSTIC EVENTS 3 THROUGH 14.

The engine room, though trapped in the AMS, might still be loose enough to shift somewhat and produce an impact noise; each piece weighed over 500 tons. Heavy machinery such as diesel generators, reduction gear boxes, condensers, etc could fall from place to place in the devastated machinery spaces if the hull motion were violent enough. Missile hazard is recognized even in fairly well ordered submarines; in a ship that is literally torn to pieces it

should be extremely high. The unique configuration of the engine room telescoped into the AMS provides both a closed chamber in which loose equipment is trapped and, if they are not tightly locked, a noise source. The THRESHER did not have this configuration and perhaps did not emit a series of noises; the STERLET could not have this configuration and did not emit a series of noises with the acoustic characteristics typical of Events 3 through 14.

6.9 (S) THERE WERE NO CLEAR IMPLOSION SIGNALS FROM THE ESCAPE TRUNKS.

The after escape trunk of the SCORPION was probably sheared off inside the hull by the intruding engine room. The forward escape trunk outer hatch is open (Reference 5). Probably neither imploded as a result of hydrostatic pressure; they were opened by the initial catastrophe.

If there were two SCORPION signals from collapsing escape trunks, as was the case for the STERLET, it is not possible to identify them. One might expect such a signal to contain harmonics of the sort attributed to "multiple impact" signals, see Chapter 5. The fundamental frequencies, however, would be too high for a clear spectral interference pattern to be seen within the limited bandwidth [redacted] of the recording equipment. The two STERLET deep signals were a complex combination of repeated impulses with periods that agreed well with those calculated as in Comment 6.3 above (also see Appendix A). Similar calculations for SCORPION dimensions and probable depths give frequencies greater than [redacted] for the collapse wave that would be generated by these chambers.

6.10 (S) THE LAST SCORPION NOISES WHICH WERE RELATIVELY LOW IN AMPLITUDE, PROBABLY WERE CAUSED BY MAJOR DEBRIS STRIKING THE BOTTOM.

The nested SCORPION hull sections would have a density perhaps four times greater than the STERLET. The SCORPION hull would fall more rapidly than the STERLET hull since the speed is controlled by the weight to drag ratio. The STERLET sank at approximately 22 ft/second; it is therefore reasonable that the much denser SCORPION hull could easily sink at 50 ft/second. At 50 ft/second the time for a 9000 foot drop (starting at 2000 feet and ending on the bottom) is about 3 minutes--total duration of the SCORPION noises.

It is probable that neither the STERLET nor the SCORPION made a loud noise when they struck the bottom. The last SCORPION noises may have originated at the bottom, but they are relatively low in amplitude. If they did originate at bottom impact, their strength (relative to the STERLET's lack of noise) may be due to the higher velocity of fall and the presence of the telescoped sections. The two wrecks were consistent; neither seems to have produced a large bottom impact noise.

6.11 [redacted] THE ENGINE ROOM-AMS SECTIONS STRUCK THE BOTTOM WITH SOME ROTARY OR TRANSVERSE MOTION.

There is some evidence of a post-impact roll to starboard of the telescoped sections. In the pictures the port side of the ship is covered with heaped up bottom material which extends as a thin covering well over the deck area.

Whether the material was dragged over the hull by post-impact roll or was thrown across by transverse motion at time of impact has not been established.

6.12 [redacted] THE MINOR DEBRIS SCATTERED OVER THE BOTTOM.

Most small debris and structures such as the sail and turtle back appear to lie right on the surface. A few small objects have left tracks after impacting, an indication of some motion other than vertical fallings. Most debris appears to have been violently separated from its normal position in the hull; many pipes appear flattened by hydrostatic pressure. The area of the debris field is comparable to that from the THRESHER. The disposition of SCORPION debris as evidenced by the photographs (References 3, 4) is consistent with complete hull destruction far above the bottom.