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Palomares*

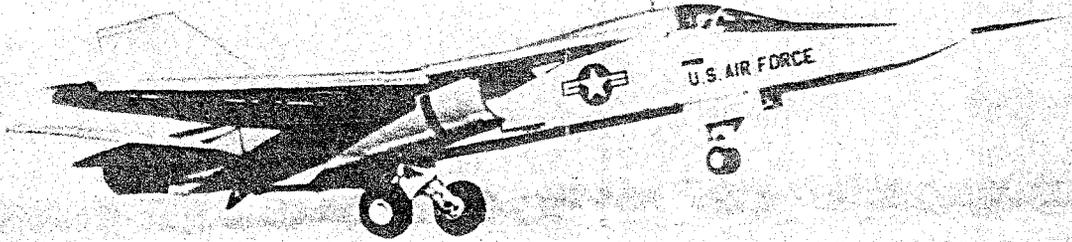
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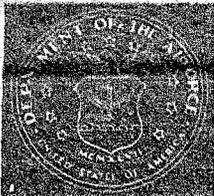
# USAF Nuclear Safety

AFRP 122-1 APRIL/MAY/JUNE 1969 NO. 2

VOLUME 63 (PART 2)



PITOT-STATIC INSTRUMENT RESPONSE  
TO NUCLEAR BLAST WAVES PAGE 2



# USAF Nuclear Safety

AFRP 122-1 APR/MAY/JUN 1969 NO. 63

VOLUME 2

## DEPARTMENT OF THE AIR FORCE THE INSPECTOR GENERAL USAF

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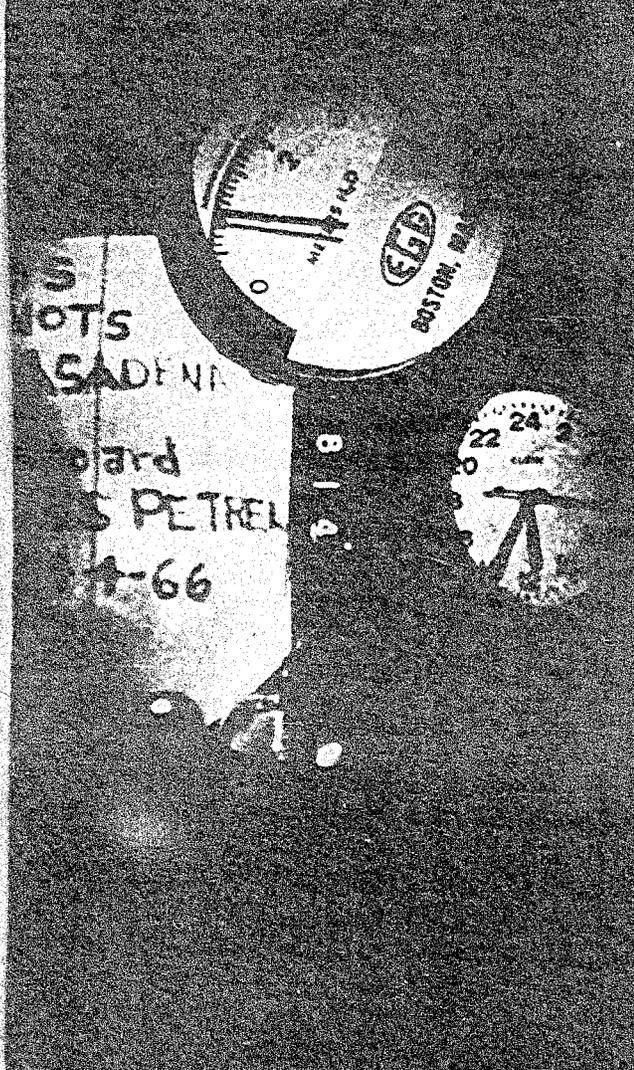
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When the first attempt to retrieve the weapon failed, the unmanned, tethered vehicle CURV from Naval Ordnance Test Station, Pasadena, was flown to the site. Lowered from the USS Petrel on 4 April, CURV photographed the parachute-shrouded weapon at 2,900 feet.

## Contact 261

by Captain Lewis B. Melson,  
U. S. Navy



A graduate of Oregon State University in 1940, Captain Melson became a naval architect in 1942 and served as Drydocking Officer and Hull Repair Superintendent at the Charleston Naval Shipyard, from 1944 to 1946. His subsequent duties include two tours with BuShips, the first (1952-1953) as Director, Engineer Applications; the second (1953-1954) as Director, Applied Science Division; three years (1957 to 1960) at Norfolk Naval Shipyard; command of Ship Repair Facility, Guam, from 1961 to 1963; and, since October 1965, duty as Assistant Chief of Research, Office of Naval Research.

ON the morning of 17 January 1966, a B-52 bomber collided with a KC-135 tanker aircraft while refueling over the southeast coast of Spain. The two planes exploded and the wreckage fell in a fiery fury in the vicinity of the seacoast town of Palomares. Four members of the B-52 crew were able to parachute to earth, three of the crew coming down at sea and the other landing ashore. None of the personnel in the KC-135 survived. Fortunately, the survivors who landed in the water were rescued by Spanish fishermen trawling in the area.

Advised of the crash through the report of a second KC-135 which had been on the scene, the Commanding General, 16th Air Force, Torrejon, Spain, Major General Delmar E. Wilson, U. S. Air Force, organized a rescue team and flew to Palomares to assume charge of the recovery operations.

The B-52 that crashed was known to have carried four nuclear weapons. Search teams were able to locate three of these weapons within the first 24 hours of search. The only portion of the fourth weapon located was the tail plate to the parachute compartment, which was discovered in the bed of Rio Almanazora near the Coast Guard Tower at Villaviecos. On 22 January 1966, the U. S. Navy was requested to assist in locating the missing weapon, which might have fallen into the sea. This request set into motion the largest deep sea search and recovery operation ever conducted by the Navy. Locating and recovering the missing weapon from a depth of 2,800 feet, 5½ miles offshore, was a significant achievement which confirmed the ability of the U. S. Navy to operate deep submergence vehicles under difficult situations.

The Secretary of the Navy and the Chief of Naval Operations, after receiving the request for assistance, took two immediate steps to provide the required assistance. A Washington Technical Advisory Group, under Rear Admiral L. V. Swanson, U. S. Navy, was organized to act for the Chief of Naval Operations and to provide equipment and experienced technical personnel. The Commander in Chief, U. S. Naval Forces Europe, was directed to order the Commander, Sixth Fleet, to assume operational control of the search and to designate an on-scene commander. Commander, Sixth Fleet, designated Rear Admiral W. S. Guest, U. S. Navy, to assume this duty as Commander, Task Force Sixty-Five, directing him to report to the Commanding General, 16th Air Force, with the mission of conducting co-ordinated surface and sub-surface operations in the vicinity of Palomares, Spain. Rear Admiral Guest proceeded immediately to Torrejon Air Force Base for briefing and arrived at Palomares the next day. The Commander, Sixth Fleet, ordered units of the Sixth Fleet to report to Commander, Task Force Sixty-Five, for the operations and Rear Admiral Guest broke his flag from the USS *Macedonough* (DLG-8).

On 24 January, an Advisory Group meeting arranged for the best submersibles and bottom search equipment to be made available to Commander, Task Force Sixty-Five. Two deep submersibles with a depth of 6,000 feet—*Alvin* and *Aluminaut* were available. The *Alvin*, a research vehicle operated by the Woods Hole Oceanographic Institution (WHOI) for the Office of Naval Research, was completing an overhaul at Otis Air Force Base, Massachusetts, and the *Aluminaut* was operational at Miami, Florida. Both vehicles were alerted for deployment. A third vehicle of more limited capability, the *Deep Jeep*, from Naval Ordnance Test Station, China Lake, was ordered shipped immediately to the scene to assist until the larger vehicles arrived. The *Deep Jeep* could dive to 2,000 feet for four hours. A fourth submersible, PC 3B, built by Perry Submarine Builders, Inc., and owned by Ocean Systems, Inc. was ordered shipped for use in the shallower depths. Its operating depth is 600 feet.

Other major search equipment deployed included:

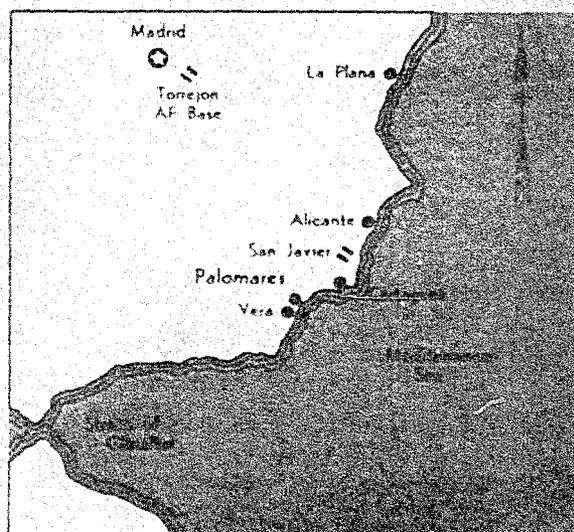
- Westinghouse Corporation Ocean Bottom Scanning Sonar (OBSS)
- Honeywell Sea Scanner and Bottom Profiler Decca Hi-Fix Navigation
- NOTS Pasadena OCE Underwater Television Cameras (2)
- NRI's Oceanographic Ship, USNS *Mizar*
- EODU-2 with Underwater Object Locating Units
- NavOcean's Survey Ship, USNS *Dutton*
- AN/SQS-19 Mine Hunting Sonar

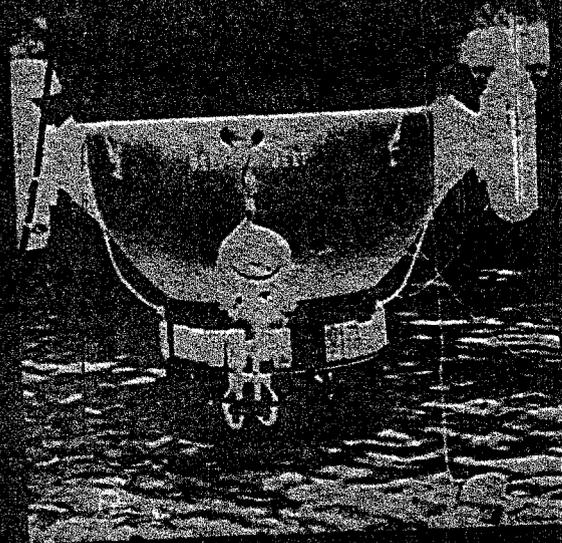
The site of the operation off Palomares was 45 miles south of Cartagena. At Cartagena the U. S. Navy maintains

a naval magazine and a fuel depot. These facilities were used to transship equipment and material arriving by air through the Spanish Air Force Academy's field at San Javier, 20 miles to the north. Material could also be shipped directly to Palomares by road from Cartagena or lifted by helicopter from San Javier. At Palomares, the 16th Air Force had established an advanced contingent which supported 750 men during the height of the search.

The Sixth Fleet was on the scene before Task Force Sixty-Five was organized. On 17 January, the USS *Kiowa* (ATF-12) was ordered to the scene by Commander, Sixth Fleet, at the request of Commander, 16th Air Force. The *Kiowa* was released on 19 January, when it became obvious no floating wreckage existed. Later, on that same day, the Air Force asked for ships that could search the sea area inshore of the 100-fathom curve. The proximity of the major portion of the wreckage to the beach indicated the possibility that some portion might have fallen into the sea. The USS *Sagacity* (MSO-469) and USS *Pinnacle* (MSO-462) and an Explosive Ordnance Disposal (EOD) Team from Barcelona were diverted from their normal operations and arrived off Palomares on 21 January. The MSOs began a reconnaissance of the coastal waters with their minesweeping sonars, while the EOD team searched the shallow waters along the shore adjacent to the aircraft debris area.

The Air Force investigating team at Palomares, while collecting information from witnesses of the crash, interviewed Senor Francisco Simo-Orts, the master of the fishing trawler, *Manuela Orts Simo*. Senor Simo related to the interviewing officers his experience, which eventually proved to be the leading clue to the recovery of the weapon. On the morning of the crash, Senor Simo was





Aerial view of a large, flat, open landscape, possibly a field or a construction site, with some structures visible in the distance.

THE ADULTER SAID IT

and after completing his trawl, returned to port, notifying the *Guardia Civil* of what he had seen. On 22 January, the *Pinnacle* took Senor Simo to sea to determine if he could relocate the position from which he had observed the two parachutes land. When the *Pinnacle* reached the site where Senor Simo said he had been, the ship's sonarman informed the bridge there was a contact on the bottom in 2,000 feet of water. Not believing this coincidence, the Commanding Officer of the *Pinnacle* left the scene and returned again, carefully ensuring that neither Senor Simo nor the sonarman knew the ship's exact position. Senor Simo again indicated his position, which checked reasonably well with his first fix and the sonarman again reported a contact. Ordinarily a contact with a UQS-1 in this depth would be considered improbable. A BT cast revealed that isothermal conditions existed and the contact was charted. The *Sagacity* was then vectored to the area and acquired a bottom contact, again at 2,000 feet. Both contacts were considered interesting but improbable in a depth too great for any immediate identification. The description of the two parachutes by Senor Simo could not be verified by the Air Force or Navy personnel at that time, and their identity remained questionable. Later, additional information concerning the number and types of parachutes that might have been released from the aircraft or weapons became known and the largest chute described by Senor Simo was assessed as being all or a portion of the weapon. The splash area was then designated as a High Probability Area.

Commander, Sixth Fleet, assigned additional ships to Rear Admiral Guest: Commander, Mine Division 84 with the USS *Skill* (MSO-471) and the USS *Nimble* (MSO-459); the USS *Nespeken* (AOG-55), the USS *Macdonough* (DLG-8), the USS *Fort Snelling* (LSD-30) and the USNS *Dutton* (TAGS-22). The *Macdonough* served as flagship for Rear Admiral Guest until the USS *Boston* (CAG-1) relieved on 30 January 1966. These ships were the nucleus of the Task Force. By the evening of 24 January, Rear Admiral Guest had reviewed all available information and had established as the primary area for search a triangle enclosing all observed aircraft debris. The location of Senor Simo's boat was within this triangle. By the 25th, a general plan for the search was approved. The EOD and UDT divers were to search the shallow waters along the beach for debris, with the MSOs conducting UQS-1 sweeps in the waters beyond the swimmers' capabilities. The *Dutton* began a bottom survey and the preparation of charts for the Task Force. The *Pinnacle* was sent to Cartagena to install the OBSS equipment which had been shipped from CONUS by air. On 26 January, the *Kiowa* was reassigned to the Task Force and proceeded to Cartagena to install the underwater television and to transport the Decca Hi-Fix navigation equipment and the Honeywell Sea Scanner and Bottom Profiler to the search site.

When the *Pinnacle* returned to the search area, she was assigned to sweep the Simo location. When this position was reached, the contact previously noted was reacquired with the sonar and OBSS streamed. Within two days, OBSS had located 28 contacts. During the early phases of the search, a contact was defined as any object that differed significantly from the surrounding bottom terrain and which could not be immediately identified. Until 3 March, the consensus of the joint search teams was that the missing weapon would be located ashore, or that it had burst apart in the air and fragments might have been blown out to sea by the prevailing wind from 300° at 25 knots. The search ships reported all contacts that appeared to differ from the bottom. These contacts were plotted in the flagship. As rapidly as possible, they were reacquired and identified visually by swimmer, underwater television or a submersible.

The *Deep Jeep* arrived at Cartagena on 29 January and loaded on board the *Kiowa*. Its first dive was made on 31 January, with negative results. Between 31 January and 8 February, when its services were terminated by grounded electrical wiring, the *Deep Jeep* made eight dives in areas where the depths were from 300 to 1,500 feet. Although it only classified one contact during its dives, it was available as an interim stand-by until the larger submersibles arrived.

The Decca equipment was set up ashore by engineers from the company and the LORAC Team from Commander, Service Squadron, Eight. The master station was located nearby, and the slave stations were placed about 15 miles north and south of the master, giving an excellent area of coverage. Four receivers were available when the transmitter came on the air and the principal search ships were equipped with them. Although all fixes had to be relative until the master navigation charts for the area were provided through the U.S. Naval Oceanographic Office on 28 February, they were extremely valuable in pinpointing the location of contacts with an error of less than 30 feet.

There were no accurate charts of the area when the search began. The best hydrographic chart frankly admitted a possibility of errors of more than one-half mile. A Spanish chart SPN-108, was used by the Air Force and similar errors were found. Before the Decca fixes could be tied into an accurate world system, the entire region was resurveyed by teams from the Air Force, Army, and Navy. Positions obtained from radar, visual landmarks, console, and radio beacons were inaccurate within themselves, and when used in conjunction with questionable charts made the problem of relocating reported contacts tedious and time-consuming. The bathymetry charts provided by the *Dutton* were invaluable in planning daily operations and correlating search information.

The naval search area extended seaward from the debris pattern ashore. The bomber and the tanker aircraft,

at the time of the collision, were at 30,500 feet, IAS 283 knots, on a course of 256°, with the wind from 300°. The estimated point of the collision was almost directly above the Villaricos Tower, which was on the north side of the mouth of Rio Almanazora, a dry bed stream. The falling wreckage covered an area along the flight path towards the village of Vera for a distance of 2.5 miles. The influence of the wind carried some debris south of the flight path along the beach and out to sea. The naval search area thus extended approximately 5 miles along the beach and 12 miles seaward. Grids were drawn paralleling the beach. The grid chart divided the search area into 1- by 2-mile grids. Later on, these grids were subdivided into 1,000-yard squares. Search assignments were given by grid area number, i.e., G5, D23, etc. For microsearch near the end of the operation, the grids were redivided into 1,000 squares for closer control of the search vehicle.

A series of bottom current measurements were taken by U. S. Naval Oceanographic Office personnel from the *Nespelen*. These readings indicated the general set of the currents near the beach was erratic but tended toward the south, while those offshore were usually 0.2-0.7 knots to the southwest. Sediment samples of the bottom showed a hard clay material overladen with up to 14 inches of loose silt. The bathymetric charts showed a gradual slope from the beachline to the 50-fathom curve about 2.5 miles offshore. Beyond this depth, the southern half of the search area was in an extension of the Rio Almanazora canyon with precipitous slopes. The northern half was more gradual with a fairly uniform slope extending to the 600-fathom curve at 10 miles. Ironically, the position of Senor Simo's sighting of the parachute that passed overhead was almost directly above the north rim of the extension of the Rio Almanazora canyon.

A 2-mile diameter circle, encompassing the position of the two chutes observed by Senor Simo, was drawn by Rear Admiral Guest, and OBSS surveys were concentrated within the circle until the deep submersibles arrived. The *Aluminaut* was lifted from Miami by the USS *Plymouth Rock* (LSD-29). The *Alvin* was disassembled for the flight by air to Rota, where she was reassembled, tested, and then lifted to Palomares by the *Plymouth Rock*. The submersibles arrived on 10 February. The *Fort Snelling* was designated the support ship for the submersibles. To free her basin for them, her amphibious load was transferred to the *Plymouth Rock*. During transfer operations, the submersibles were placed at buoys until the *Fort Snelling's* basin was available. One hour after the transfer began, a mistral blew in without warning from the west with winds of 70 knots. The submersibles had to remain at the buoys in 12- to 14-foot seas until the morning of the 11th. The *Alvin* was returned to the *Plymouth Rock* and remained there until the 12th, at which time both submersibles were

docked in the *Fort Snelling*. The *Alvin* incurred some damage to its plastic body which was easily corrected. The mistral blew until 14 February, precluding all search operations. That morning, the *Alvin* and the *Aluminaut* commenced diving operations. Commander, Task Force Sixty-Five, assigned the *Alvin* to the southern half of the primary area, and the *Aluminaut* to the northern half. The maneuvering characteristics of the *Alvin* were better for rugged terrain, while the *Aluminaut*, with a greater endurance, could search the gradual slopes in a shorter period of time.

A fourth submersible, the Ocean Systems, Inc., PC-3B, arrived on the 14th. This craft, built by Perry, was assigned to depths greater than the swimmers and divers could monitor. Operating between 200 and 600 feet, the PC-3B was assigned the contact identification in the intermediate waters. Cruising along the bottom under the control of an MSO, the PC-3B was vectored to the reported contacts. When the contact was closed and identified as aircraft wreckage, PC-3B would release a float and line, permitting a diver to descend and retrieve the wreckage. Easy to control and maintain, the PC-3B rapidly eliminated all contacts in the areas assigned to it.

While the *Alvin* and the *Aluminaut* were concentrating their search in the main area, the waters from the shoreline outwards were combed by other teams to ensure that no region was overlooked. The swimming teams originally ordered to the site had been augmented. More than 150 qualified divers and the USS *Petrel* (ASR-14), the USS *Tringa* (ASR-16) and the USS *Hoist* (ARS-40) were made available to Task Force Sixty-Five. The three methods of diving used during the operations were compressed air diving to a depth of 120 feet, mixed gas from 120 to 210 feet, and hard-hat rigs to 350 feet. Inshore, the divers jackstayed all waters out to 120 feet and thoroughly cleared the area. More than 50 tons of aircraft wreckage were located and removed by these teams. In the waters deeper than 120 feet, the Honeywell Sea Scanner and Bottom Profiler equipment was employed. This system was first mounted in an LSL and later on in a 40-foot utility boat. Divers accompanied the utility boat, and when a contact was observed, the divers would buoy and dive to the bottom to identify the object. An AN/SQS-19 was mounted on the *Petrel* for a trial. Its erratic performance precluded its continued use and the equipment was returned to the United States.

When the *Petrel* and the *Tringa* reported for duty, the underwater television systems were transferred to them. It had been determined that using the TV from an unmoored ship was unprofitable. The ASRs adopted the method of a two- or four-point moor and would walk along the legs inspecting the bottom with the camera. When a contact was observed, a hard-hat diver would descend for retrieval. This

system was partially successful, but the amount of area covered per day was very low and it was not used as a major search technique.

The MSOs swept the waters beyond the swimmer/diver zone with UQS-1 and OBSS. The UQS-1 was limited to 600 feet or less, but could cover large areas daily. The OBSS was streamed from an MSO and lowered until the sonar was about 30 feet above the bottom. Towed at 0.5 knot, the OBSS would transmit a signal which, when recorded, gave a rudimentary picture of the bottom for 200 feet on each side of the OBSS. By interpretation, the shadow-like markings on the recording would be designated a probable contact or not. It was a difficult device to handle in rugged terrain and two OBSS systems were lost during the operations. Not equipped to sense changes in topography directly ahead, they frequently nudged the bottom and were damaged. A later version was sent to Palomares and operated at 225 KC, which gave a resolution discrimination of 6 inches. Most of the 455 contacts listed for investigation were made with the OBSS system.

The USNS *Mizar*, with the Naval Research Laboratory Oceanographic Team on board, arrived on 19 February. Equipped with computerized Underwater Tracking Equipment (UTE) and a camera/TV sled, the *Mizar* was the best equipped oceanographic research ship available. Her versatility had been demonstrated during the two *Thresher* searches. Dr. Chester Buchanan was prepared to photograph the bottom, tracking his camera sled with the UTE. The *Mizar* was assigned the northeast section of the primary search area and photographed a major portion of it.

It soon became obvious that the *Alvin* and the *Aluminant* could dive to the bottom and search, but it was difficult to track the submersibles and to know exactly where they had been. The submersibles were fitted with pingers and transponders to enable the MSOs to track them, but the operation was erratic. Transponders placed on the bottom for the submersibles to use as beacons, either failed to operate or were blanked by the rough terrain. It became evident that the *Mizar* tracking system was the only one that would track the submersibles below 1,600 feet successfully. The *Mizar* was then assigned to track the *Alvin*, which was working in the canyon. The *Alvin* would dive and remain below for at least 7.5 hours. After surfacing, the *Alvin* would return to the *Fort Snelling* for battery recharging and the *Mizar* would devote the free time to photography.

From 14 February to 3 March, the *Alvin* and *Aluminant* continued searching assigned areas. The search patterns were plotted and analyzed for predicted coverage. The search procedures were to take the vehicles to their areas shortly after sunrise when the wind and sea were calm. After diving, they retained contact by underwater telephone with a surface ship. Rather than attempt individ-

ual searches for contacts in the areas, they made a methodical search, covering as much bottom as possible, with the *Alvin* following contours along the steep canyon walls. The optimum search speed was one knot, with varying visibility, usually ranging from 15 to 50 feet. Objects believed to be reported contacts were investigated and photographed. Two contacts made by the *Pinnacle* and the *Sagacity* were never verified, but the area contained many rocks and small hummocks and it is possible these were contacts made by the MSOs. The slow search speed and the limited visibility meant the maximum area covered during a normal dive of 7½ to 10 hours was less than 0.10 square mile, discounting holidays and overlaps. The statistical analysis indicated that at least six sweeps would have to be made through the same area to ensure that all of the bottom had been covered. This meant a minimum of 60 days would be required for each square mile to be covered.

The *Aluminant* experienced an unusual situation on the 22nd. After submerging in grid C4, the submersible touched bottom at 1,800 feet to check the set and speed of the current. The bottom slipped under the weight of the craft and the *Aluminant* slid down the side of the canyon with the mud for 800 feet. When the subsidence ended, the *Aluminant*, by dumping all shot ballast, surfaced with more than 4,000 pounds of mud in her tanks.

The Air Force search teams continued combing the region ashore for the missing weapon. The area between Villarcos and Vera was traversed by search parties walking arm to arm. Along the north and east sides of the area, steep mountains required the search teams to be lifted to the tops of the mountains by helicopter. They descended the sides on ropes. More than 800 abandoned mine shafts, cisterns, wells, caves, and other openings had to be examined to eliminate the possibility that the missing weapon had fallen into one of them. Teams from Sandia Base analyzed the debris pattern and computed the probable trajectories of the weapon. Based on the known speed of the aircraft and the relative wind, the first assumption was that the weapon had followed a path similar to that of the other three which landed ashore. Two weapons fell without their chutes deploying, and were found two miles inland along the flight path of the aircraft. They sustained high-explosive, single-point detonations upon impact and caused some minor contamination of the surrounding area. The third weapon streamed a chute and landed in a field close to the beach. All of these weapons were intact.

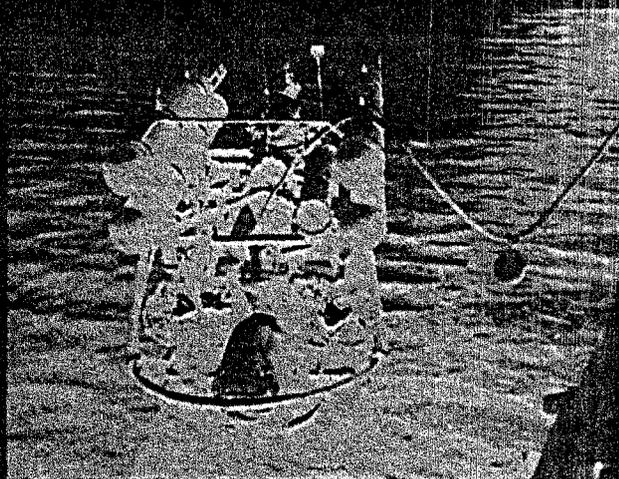
On 5 February, the Sandia team presented its analysis of the situation to Major General Wilson and Rear Admiral Guest. No change was recommended in conducting the search. A possibility existed that the missing weapon had been struck during its fall and might have suffered a minor

explosion. If this had happened, a portion of the weapon and a parachute might have been carried to sea by the wind. They recommended that the Navy continue an aggressive search in the area indicated by the visual sighting of Senior Simo.

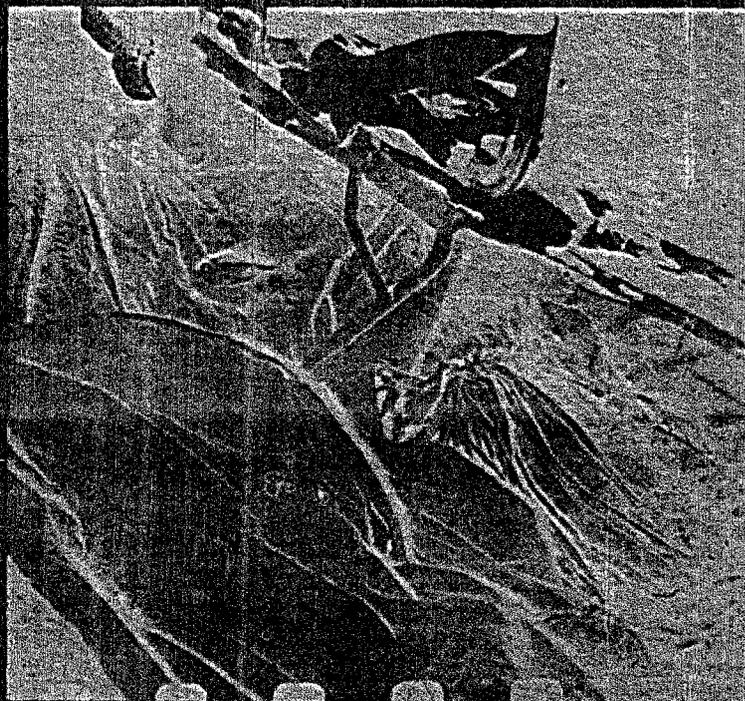
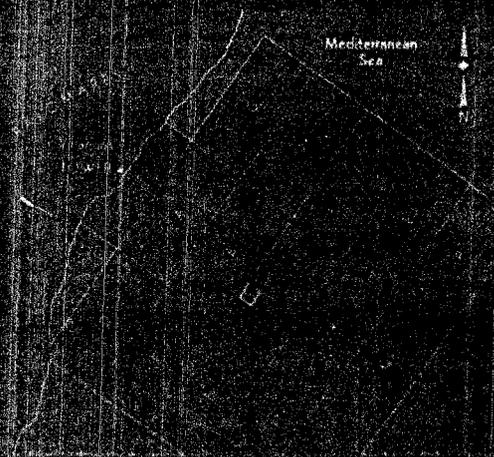
A computer analysis of the debris that fell in the water was prepared by Sandia after its first report on 5 February. Three areas of descending order of probability

for search were designated A, B, and C. Rear Admiral Guest modified this analysis by redesignating A as A-2 and reserving A-1 for the circle around Senior Simo's position.

A second and more important review of the data was held on 8 March. Further information indicated that the pilot who had been picked up at sea farthest offshore had really landed closer to the location of Senior Simo's splinter. This reduced the possible area to be searched by



CURV, seen from the stern with her buoy attached to the *Petrel*, could find, photograph—and would eventually retrieve—the bomb. But the key to the systematic search was the dividing of the search area into one-by-two-mile grids, which were later divided into 1,000-yard squares and ultimately, in one, C-3, the weapon was located by the *Alvin*'s two pilots.



one-half. The Sandia team then decided the first chute reported by Senor Simo was a small parachute from the missing weapon with an attached chute bag. The bag itself was what Senor Simo had described as the half-body of a man with its entrails hanging out. The chute that passed over him and sank, and which he had reported as being reddish in color, was most likely the largest of the parachutes in the weapon's case, which was white. However, Senor Simo had to look into the sun to see it as it landed on the water and the glare of the sun through the parachute gave it the reddish color. The team concluded that the weapon had not landed ashore and had sunk at sea. The loss of the tail plate was believed due to a blow against the weapon's case when the plane broke up, which blow drove out the tail plate, allowing parachutes to stream. They recommended that the Air Force reduce their search efforts and that the Navy continue.

The second Sandia report reversed all previous concepts of the location of the weapon and stated it was the firm belief that the missing weapon had deployed its parachute and was on the sea floor, probably near the position reported by Senor Simo. It suggested the paramount responsibility for locating the weapon had shifted from the Air Force team to the Naval Task Force. This report reinforced the possibility that the weapon was at sea near Senor Simo's sighting. This confirmed a Task Force Sixty-Five conclusion which was based on a report from the *Alvin*'s tenth dive on 1 March. During contour searching at 2,400 feet in grid C4, a furrow was sighted in the bottom resembling a torpedo track. This track was vertical to the slope, and was about 18 inches in width. The *Alvin* attempted to follow the track but had to surface before the lower end could be located. Tracks from trawling operations had been observed by OBSS and the submersibles previously but never in the steep section nor with the same contours.

Two additional assignments were then given Task Force Sixty-Five in addition to the search for the missing weapon and the removal of all debris from waters along the beach. The Task Force was asked to remove all aircraft wreckage from the Spanish mainland. The *Kiowa*, the USS *Luiseno* (ATF-156) and the USS *Everglades* (AD 24) were assigned to this task. The wreckage had been piled near the 16th Air Force Base Camp. A jetty was bulldozed out into the sea, permitting barges to be brought alongside and the wreckage loaded. The barges were taken in tow by the *Luiseno*, with the other ships acting as escorts. All material was taken into the Atlantic to be dumped. The other additional task was to remove from the area all soil that contained radioactive particles. The Air Force barreled the dirt and the USNS *Lt. George W. Bove* loaded more than 3,500 drums for transshipment at Charleston, South Carolina, for burial at the Atomic Energy Commission

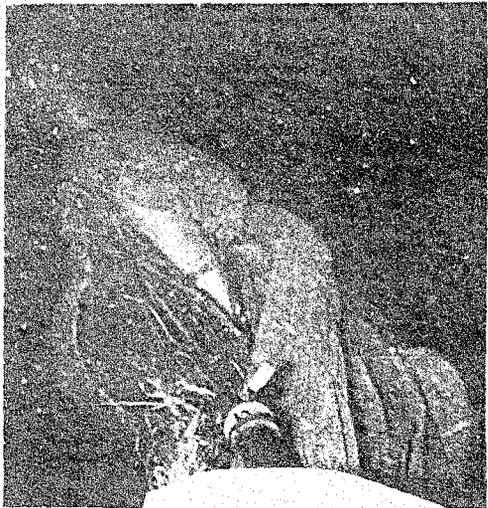
(AEC) site near the Savannah River Project.

The *Alvin* made four more dives in the same area through the 7th of March without reacquiring the track. She was then assigned an area in 400 feet of water in an attempt to reduce the number of contacts reported along the seaward end of Area A-2. On 12 March, the *Alvin* was reassigned to C4 and sighted the torpedo-like track for the second time. On the next day, at 2,550 feet, Contact 261, the missing weapon, was sighted by WHOI pilots, M. J. McCamas and V. Wilson. Quoting from the WHOI report on the *Alvin* operations, "The reasons it took so much longer to find the weapon than should be expected was due partly to the errors in tracking the submarine on the bottom from the surface. Even though the *Mizar* was the tracking ship on the first track discovery, her navigation system at that point had unknown but suspected errors in it that were fortunately isolated and corrected by the *Mizar* prior to the discovery. For example, we believed we were in the southwest corner of the 1,000 x 1,000-yard square, C-4, the first time; when the bomb was actually found it was in the southeast corner of C-4, about 800 yards away.

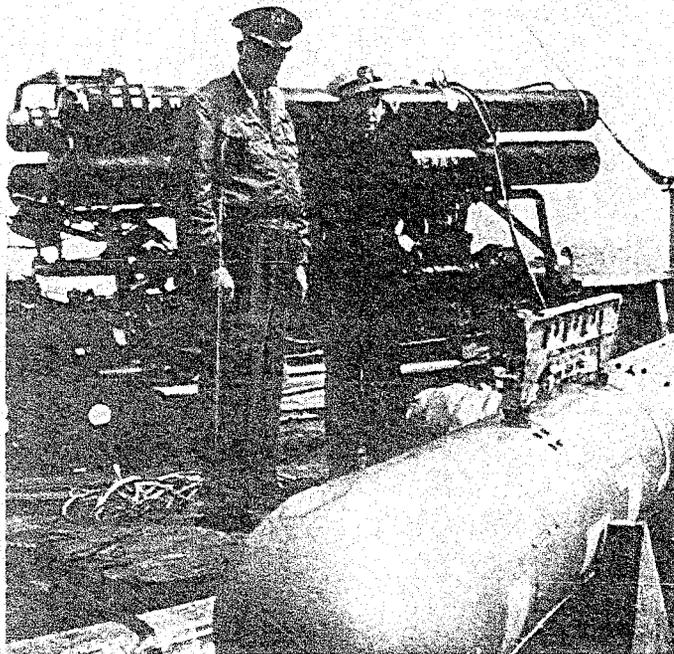
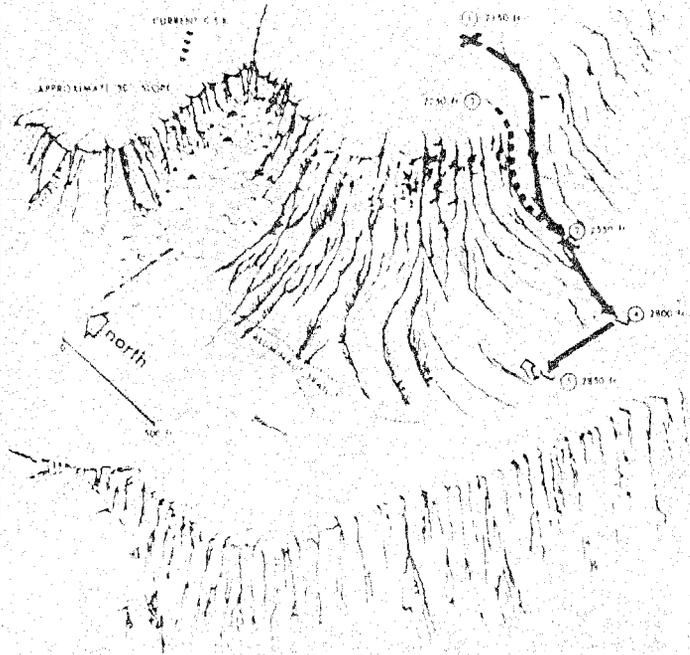
"The terrain also played a major role in delaying the findings. The slope was very steep at the point where the weapon finally hung up and was found. On the first two track-following dives, the submarine apparently passed very close to the weapon without sighting it, because the bottom fell away so sharply the track could not be followed visually and was lost. On the third dive down the track, McCamas and Wilson, very wisely (and bravely) backed down the slope and thereby discovered the parachute-shrouded weapon."

When the *Alvin* sighted the weapon, the information was passed to the *Ability*. Commander Task Force Sixty-Five instructed the *Aluminant* to rendezvous with the *Alvin*, using the *Mizar*'s tracking equipment to vector the *Aluminant* to the site. The *Aluminant* took a *Mizar* transponder with her and landed within visual distance of the *Alvin* on the scene. She remained there for 24 hours while the *Alvin* surfaced for recharging batteries and to mount her mechanical arm. The *Mizar* fixed the location so she was able to vector either of the submersibles to the position without delay. The next four dives by the *Alvin* were to attempt to secure the weapon.

Wedged in "vee" on a 70-degree slope, the parachute-covered object posed a difficult recovery problem. It was assumed the object was the missing weapon, but whether it was intact or in fragments was not known. Any attempt at lifting would require the bottom of the parachute to be kept closed to prevent the object from slipping out and being lost. The plan devised was for the *Alvin* to mount her mechanical arm (which was left off for easier searching) and to plant an anchor or similar device on the slope above the object. A messenger line could then be slid down the



The weapon, photographed during its ascent and while being inspected by Rear Admiral Guest and Major General Wilson on the deck of the *Petrel*, was almost as difficult to retrieve as to locate. As reconstructed by an artist, (1) is the original resting point; (2) is where *Alvin's* pilots found it; (3) is where it was brought on the first lift attempt; (4) is where weapon rested when first lift attempt failed; and (5) is the point from which the weapon was finally recovered.



anchor line and attached to the chute. Acoustic pingers would be clipped onto the parachute to locate it. A clamp would be devised to encircle the chute and bodily restrain the object from slipping. To the clamp, a 3-inch nylon or

heavier line would be secured for the lift.

The *Alvin* carried down in her claw, on the first attempt, a spear to which a 3/8-inch polypropylene line was bent. The spear was forced into the slope above the

weapon, but it could not be held in place and the messenger line pulled it from the bottom. Two acoustic pingers were then clipped to the chute to act as beacons. The next attempt, on 18 March, was to attach a special clamp around the body of the object, but the billowing chute prevented its being secured. All during the time these attempts were being made, the *Alvin* had to remain neutrally buoyant and was not able to benefit from negative weight gained by landing. The slope was too steep for this to be done. The third attempt employed a special frame rigged by the *Mizar*. Spools of line were placed on a frame, which was nicknamed "Poodle," so the *Alvin* could lift off the line from a spool and attach it to the parachute. The poodle was lowered with a Danforth anchor attached to its base to hold it on the slope. As an alternate device, a grapnel was secured to the anchor with 200 feet of 3-inch nylon line. The *Mizar* placed the poodle within 70 feet of the object on 23 March. The spooled lines could not be handled by *Alvin* and the grapnel was used to snag several chute-shroud lines. The *Alvin* tried again on 24 March to free the poodle lines without success, and then gathered more shroud lines onto the grapnel. Worsening weather dictated that an attempt be made to lift as soon as possible. The *Mizar* began the lift with the *Alvin* leaving the area to avoid becoming entangled in the lines. Sometime after the object was lifted from the bottom, the hoisting line was parted by an anchor fluke and the object, with its chute, fell back to the bottom. None of the transponders attached to the chute were audible and the search began all over again.

The *Aluminaut* dived on 25 March to the area and searched for the weapon unsuccessfully. The *Alvin* dived at 1830 that evening, but the silt clouds and tracks along the bottom from the *Aluminaut*'s search prevented picking up the track. The next morning, the *Alvin* was able to revisit the original site of Contact 261. The track of the weapon being lifted was clear and distinct to the point of lift-off, but no sight of the weapon could be located. The efforts of the *Alvin*, the *Aluminaut*, and the *Mizar* to relocate it continued through 1 April. On 2 April, the *Alvin* relocated the weapon 120 yards south of the original position at a depth of 2,800 feet in grid C3. The *Aluminaut* rendezvoused with the *Alvin* to retain a visual watch on the scene.

The next morning, the *Alvin* submerged and attached two pingers to the parachute and dropped a transducer in the area. Both the pingers and the transducers were audible to the *Mizar*, allowing the submersibles to surface for maintenance before another lift attempt was made.

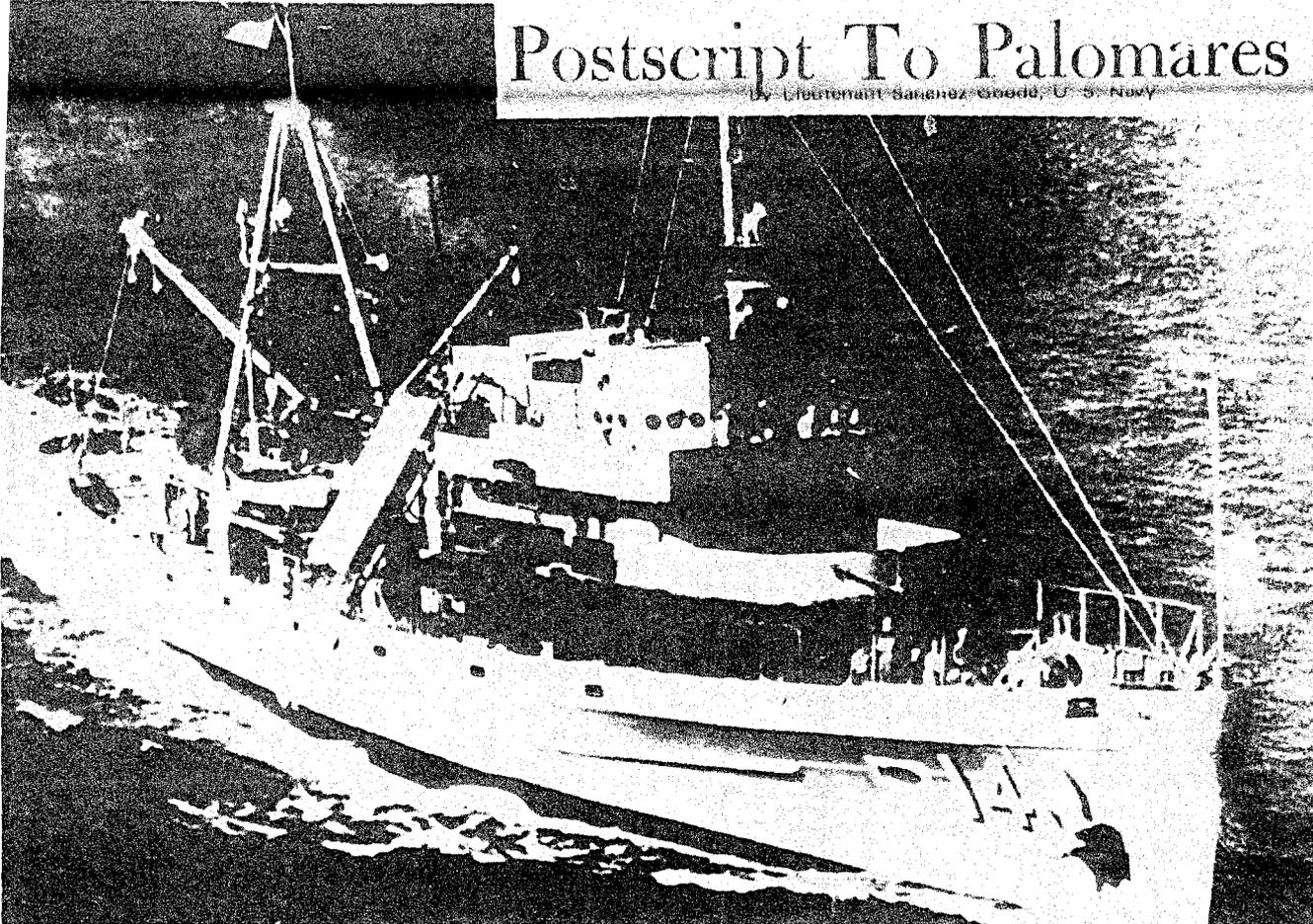
The Washington Advisory Group, when the first attempt to lift was unsuccessful, requested the Naval Ordnance Test Station, Pasadena, to prepare CURV for shipment to Palomares. CURV (Cable Controlled Underwater Recovery Vehicle) had been held in standby at Long Beach for this eventuality. It was flown with its crew to San

Javier and trucked to Cartagena. The *Petrel* stood in to port and the CURV, with its control equipment, was installed. The control cable for the CURV, which connected the sled to the surface ship and allowed control signals to be sent to the sled and television signals to be monitored from the surface, was too short for the 2,900-foot depth and had to be spliced. Four hundred feet of cable were added to the control cable to give a scope of 3,100 feet. On 4 April, while the *Alvin* and the *Aluminaut* were down for maintenance, CURV made a successful test dive to the 2,900-foot depth. It was then planned to attach three lines to the weapon to insure a successful lift. On the 5th, CURV was guided to the weapon by the *Alvin*'s co-pilot, Wilson, and attached a 5/8-inch nylon line to the apex of the parachute. This line was buoyed off. The *Alvin* submerged and inspected the target, reporting the weapon had moved to the west and was now at 2,850 feet. The bottom current was high and the billowing chute made the inspection difficult. On 6 April, CURV attached a second line to six or more parachute shroud lines, then buoyed off this line. On 7 April, while attempting to attach a third and final line to the parachute, CURV became entangled and could not be freed. Commander, Task Force Sixty-Five decided to raise both the weapon and CURV together. The *Petrel* began the lift at 0700, and at 0800 the weapon swung easily beneath the ship. Divers confirmed the weapon was actually within the parachute. Additional straps were placed around it, and at 0845 it was safely on deck. During the lift, the *Alvin* remained on the bottom tracking the pingers clipped to the parachute to maintain positive location. The *Alvin* surfaced when the weapon was on board the *Petrel*, and the search was concluded.

A potential the Navy did not realize it possessed had been demonstrated. Deep submergence vehicles were used in an operational situation off a foreign coastline on an assignment as improbable as any that could possibly be conceived. None of the major search systems employed to locate and recover the weapon had ever been previously assigned to a fleet task force. The *Mizar* Underwater Tracking Equipment had prior limited use with the *Thresher* search, but was rigged to locate a magnetic hull displacing several thousand tons spread out over hundreds of feet of the bottom. Tracking a free submersible operating in an undersea canyon presented a vastly different problem. The location of a non-magnetic object, only a few feet in length, that was lodged on the side of a steep slope, required the combined, dedicated efforts of many people. The success of the Task Force to operate effectively under this adverse situation is revealed in the use of the deep submergence vehicles. The percentage of untried craft used on their first fleet assignment is remarkable and a tribute to the knowledge and skills of the Task Force personnel and the crews of the submersibles.

# Postscript To Palomares

By Lieutenant Sanchez Goode, U.S. Navy



A 1960 OCS graduate, Lieutenant Goode had prior enlisted experience as an electronics technician serving in the submarines USS *Gudgeon* (SS-567) and USS *Sargo* (SSN-583). He has served in the USS *Greenfish* (SS-351) and on the staff of Commander Submarine Division 13. From 1964 to 1966, he was Executive Officer, USS *Petrel* (ASR-14) and, from 1966 to 1967, he commanded NRTC, Salem, Mass., with additional duty as Officer in Charge, Reserve Training Submarine USS *Sea Dog* (AGSS-401). At present, he is the Diver Training Program Manager in the Bureau of Naval Personnel.

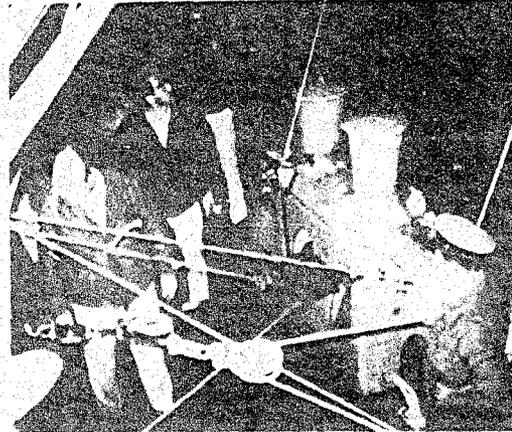
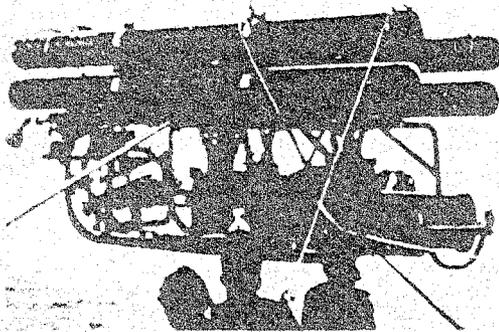
WHEN, on 9 April 1966, Madrid's *El Alcázar* triumphantly announced "*¡He Aquí La Bomba!*" Here is the Bomb! few people in Spain or anywhere else in the civilized world were moved to ask, "Which bomb?" There was only one. Like the Biblical lost sheep, it had been missing; and its recovery was a cause for worldwide rejoicing after months long anxiety.

\*See L. B. Mehan, "Contact 261," U.S. Naval Institute PROCEEDINGS, June, 1967, pp. 26-30, and W. E. Seale, "Palomares, Exercise in Ocean Engineering," *ibid.*, pp. 128-131.

Across the full width of *El Alcázar's* front page was an unprecedented photograph of a U.S. hydrogen bomb. The huge, cigar-shaped weapon was being examined by some 25 American and Spanish military men, on board, the caption said, the USS *Petrel*.

It was my good fortune to be executive officer of the USS *Petrel* (ASR-14), prime recovery ship of Task Force 65, whose afterdeck with the weapon on display became a front-page photograph the world over. How the hydrogen bomb was fished out of the depths and landed on our deck happened about like this.

On 17 January 1966, an Air Force B-52 bomber, with four nuclear weapons on board, collided with a KC-135 tanker aircraft. Some wreckage and the fourth nuclear weapon vanished in the depths of the Mediterranean Sea, although this was not known at the time. Extensive search on land, eyewitness accounts and deductive reasoning suggested there was a possibility the fourth nuclear weapon could be in the water. Task Force 65 was formed with Rear Admiral William S. Guest as commander.



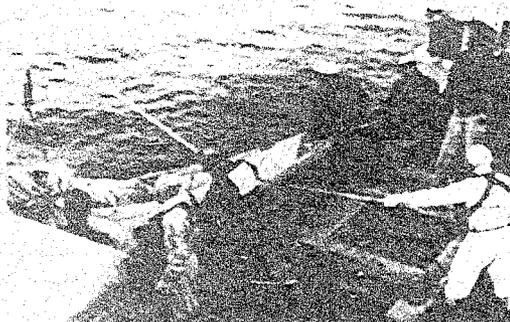
The USS *Petrel*, Lieutenant Commander Max A. Harrell commanding, had departed New London, Connecticut, on 8 January en route to Holy Loch, Scotland, with a YTB in tow. As it had been for the 20 years since her commissioning, the *Petrel's* primary mission was to train and employ deep-sea divers, salvage personnel and equipment for rescue of men entrapped in sunken submarines. But, she could perform, and had acted as target ship, submarine escort, and as a retriever of torpedoes or other weaponry.

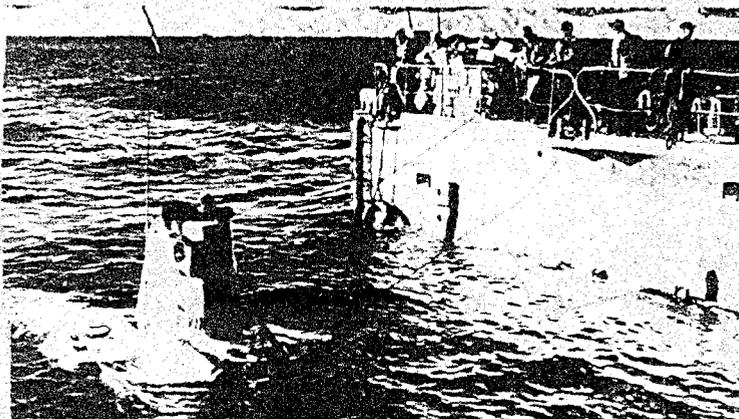
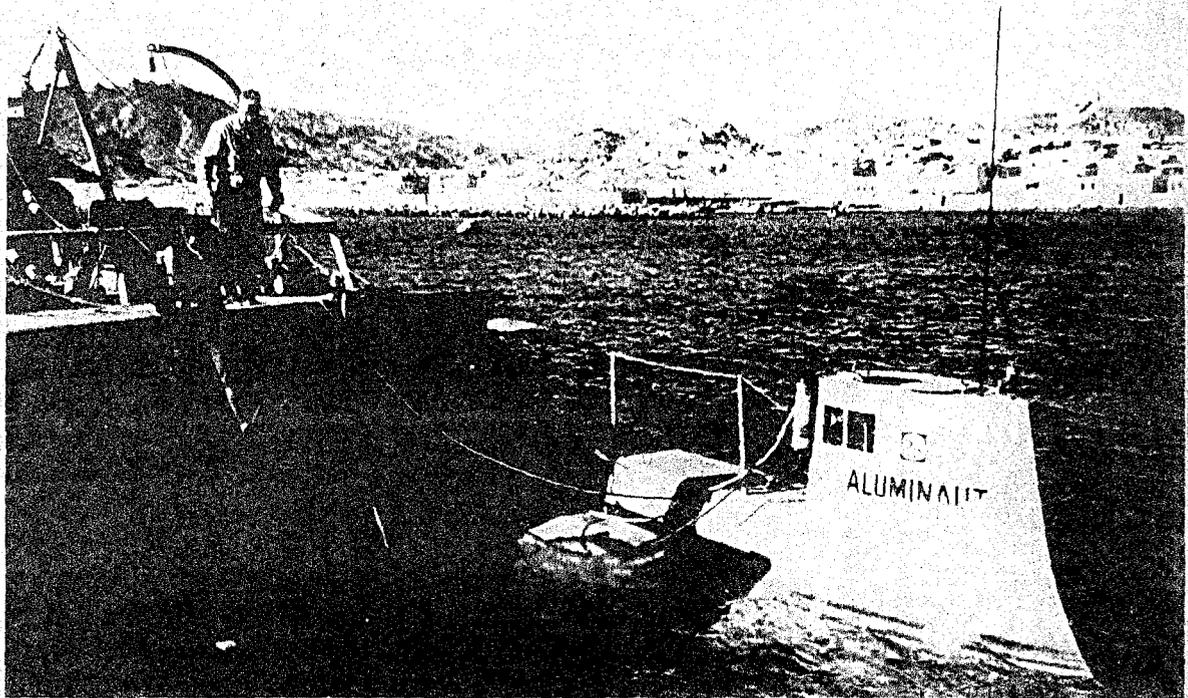
On 25 January 1966, midway in her Atlantic crossing, the *Petrel* was ordered to proceed to Rota, Spain, to participate in the search for the missing nuclear weapon. For Lieutenant Commander Harrell, who had become the ship's eleventh skipper in August 1963, the unexpected was becoming commonplace. The *Petrel's* 1964 cruise, which also had included calls at both Holy Loch and Rota, had been interrupted to help recover the wreckage and personnel killed in a two-plane, midair collision over Bermuda.

Two days were spent at Rota where we transferred the YTB, made voyage repairs, replenished, and loaded additional helium and oxygen in anticipation of extended deep diving operations. The *Petrel* arrived at Palomares and reported for duty to the Commander, Task Force 65, on 1 February 1966.

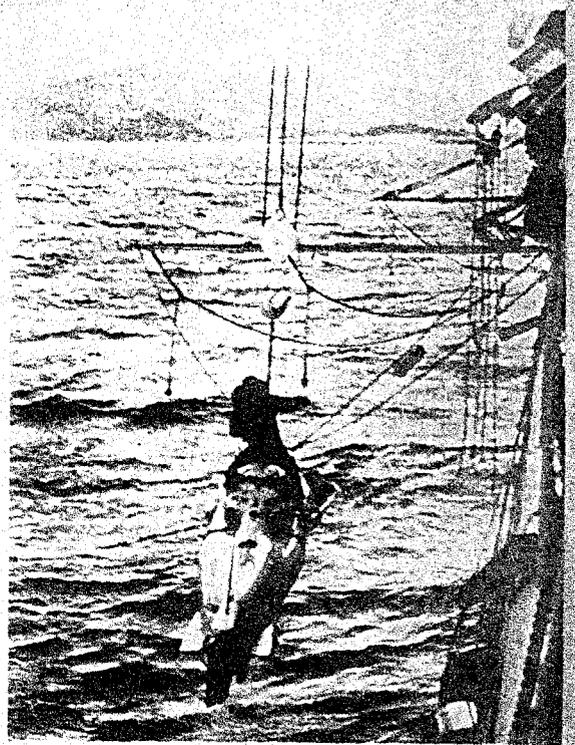
The *Petrel* was assigned to Task Force 65 for 83 days, 79 of these days were in transit or search. The actual recovery covered a period of only four days. These days of search were long and a true test of the American Blue-jacket's capacity for hard work. Some of the tasks included in the search phase were: 220 hours of diving, extensive underwater search using television, providing services to the deep submersibles *Albatross* and *Alvin*, and the planting of moorings and navigational bouys.

The nuclear weapon was first located by the *Alvin* on 15 March. An unsuccessful attempt at recovery by USNS *Mizar* took place on 24 March. The weapon was relocated on 2 April.





As the search intensified, larger, more complex equipment was committed. A diver leaped off the USS *Privateer*, alongside the *Aluminaut*; the *Alvin* entered the well deck of the USS *Fort Snelling*; and the *Perry* submarine, PC-3B, was hoisted on board the USS *Boston* (CAG-1).



In anticipation of a second attempt at recovery, the *Petrel* had been ordered to Cartagena, Spain, for installation of the Naval Ordnance Test Station device CURV (Cable-controlled Underwater Recovery Vehicle).

After the installation of the CURV, an operational test to a depth of 1,050 feet was made to demonstrate its full potential. On 5 April, the first 5/8-inch nylon rope was attached to the weapon parachute shroud lines and buoyed off with 4,700 feet of line. The line load strength of 10,000 lbs. was more than sufficient to lift the weapon. However, because of the position of the weapon on a slope and the previously unsuccessful attempt at recovery, more lines were required to provide a positive assurance of success. Three lift lines were to be used. The second line was attached and buoyed off on 6 April. On the night of 6-7 April, during the attempt to connect the third and last recovery line, CURV became entangled in the weapon parachute. The original plan had been to recover the CURV prior to lifting the weapon. A most challenging problem now had to be faced, i.e., how to lift a load using two lines, 2,800 feet long, attached at virtually the same point with an equal strain on each. This situation was further complicated by the CURV, which for all practical purposes was also attached.

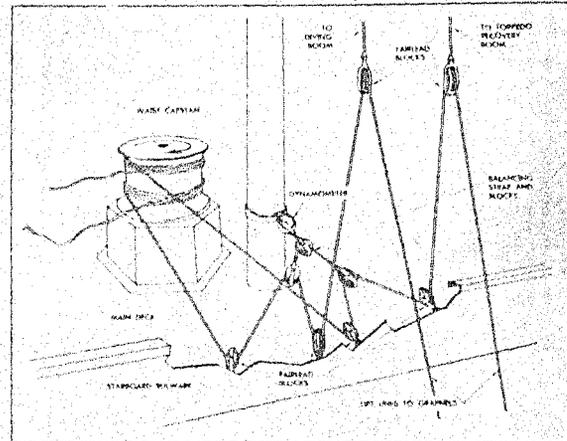
CURV is a neutrally buoyant device and, therefore, was not a lift problem other than the weight of its control cable. It did have to be raised at the same speed as the weapon so that it would represent neither a load nor a lifting force. A unique rigging and control system that had been devised by Lieutenant Commander Harrell was brought into play.

An even strain on each line was maintained by balancing two blocks attached to a short strap reeved through another block attached to a dynamometer. The dynamometer in this situation indicates double the weight being lifted on each line. The lift lines were led to the same waist capstan. Adjustment, to even the strain on each lift line, was made by hand surging the desired line on the rotating capstan. CURV was recovered at the stern, using the fantail capstan.

To ensure positive command control, the deck division personnel had been formed into two teams, each under the control of a chief boatswain's mate.

Chief Boatswain's Mate Thomas Swindler was in charge of the CURV recovery team and Chief Boatswain's Mate William Behymer was in charge of the weapon recovery team. These two teams were both under my direct control.

Lieutenant (jg) J. E. Leamean was assigned the task of being safety officer, to keep a constant check on rigging and the performance of each team. This organization allowed the commanding officer the flexibility and freedom



Lieutenant Commander Harrell's rigging and control system.

required to devote his full attention to keeping the *Petrel* positioned directly over the load being lifted. A sound-powered communications link, from the starboard waist to the bridge, was used to keep the commanding officer informed regarding the direction lines were tending and the distance of the weapon from the surface. Lift lines had been previously marked at 50-foot intervals.

A variance in the load, as indicated on the dynamometer, from the previously determined dynamic load, was used in synchronizing the lifting speed of the weapon and CURV. As the situation dictated, I could direct a speed adjustment to be made by either group. The lift operation was stopped only once to resynchronize the two team efforts. One hour and 40 minutes after commencing the bomb lift, the two grapnels attached to the weapon parachute were at the water's edge. It was then discovered that one of the grapnel's extension, used to connect the grapnel to the CURV control mechanism, had engaged the line attached to the second grapnel, thereby acting as a spreader, preventing rotation of the weapon and causing a twisting of the lift lines. Fortunately, planned corrective action for this problem was never required.

With the weapon at 50 feet, a determination was made that the grapnels had sufficient purchase to provide adequate diver safety. Permission was granted for EOD divers to attach a hoisting line to the weapon itself. Upon completion of this connection, the CURV was disengaged from the parachute and maneuvered astern of the *Petrel*. The weapon's weight was then transferred to the hoisting line, rigged as a single whip to the *Petrel's* main boom. Control was then passed to the First Lieutenant for hoisting and placing the weapon on deck. Emergency weapon safety

procedures were completed by Lieutenant W. Funston, Operations Officer, EODU-2, Charleston. CURV was recovered and secured on deck, completing the operation.

Throughout the recovery operation, including the attaching phase, Lieutenant Commander Harrell controlled the position of his ship to within 50 yards of a point directly over the weapon, using two LCM-8's as tow craft. Experimentation had proven that the most practical method of using these craft was by making them up to the *Petrel's* bow and stern, using 100-foot towlines. LCMs are particularly poor towing craft, as their deck configuration prevents the towline from being connected forward of their rudder. With the tow point aft of the rudder, the rudder has no steering effect. Extensive maneuvering on the part of each boat coxswain was required in order to change direction of tow. During the first line attachment both craft became simultaneously fouled in their own towlines. Quick action on the part of the LCM boat crews and the *Petrel* divers succeeded in freeing the towing lines, thereby preventing disaster, should the *Petrel* have drifted out of position. The *Petrel's* own propulsion could not be used throughout the operation, as the CURV lines were being tended in close proximity to the ship's propeller.

Our skipper's achievement in ship control is a more remarkable feat when considered in the light that, on three separate occasions, he was able to hold the *Petrel's* position within a circle of 50 yards in diameter for totals, respectively, of 31.7 hours, 10.6 hours and 9.9 hours. During the connection phase and 11.2 hours during the recovery.

But feats of seamanship skill were no surprise to those of us who knew Lieutenant Commander Harrell. He had been personally cited for his part in rescue operations of survivors of the sunken yacht *Judy* only three months after assuming the *Petrel's* command. His citation confirmed that he had "... commenced a search pattern during the height of a raging storm. ... Your efforts resulted in locating two survivors and maneuvering your ship to a

position where recovery operations were conducted successfully. ..."

Although 7 April was a beautiful spring day, with little breeze and a calm sea, these ideal weather conditions proved in this situation to be less than optimum from the standpoint of ship control. The absence of a breeze or surface current, to give the ship some force to constantly work against, greatly complicated ship positioning. Every application of force had to be in exactly the required amount or the ship would overshoot the desired position, thereby requiring a repositioning of tow craft and application of force in another direction. Lieutenant Commander Harrell reduced these complicated maneuvers to what might be considered a fine art.

To silence any suggestion that the U. S. Navy was perpetrating a hoax in claiming a recovery of the weapon, an unprecedented display to the world press was arranged. With the submarines *Alvin*, *Aluminant* and *Cubmarine* as a background, the *Petrel*, with the weapon on deck, in full view, passed in review with representatives of the press manning the rail of the USS *Albany* (CG-10). Later, the weapon was packed for shipment and transferred to the USS *Cascade* (AD-16) for its return to the United States.

The *Petrel* was detached from Task Force 65 on 10 April 1966. Following a week in port at Palma, Majorca, she proceeded directly to her home port of Charleston, South Carolina, arriving on 1 May 1966. Coincidentally, this was the same date as had been originally scheduled for return from deployment.

It has not been the intention here to diminish the roles of any of the 16 other ships of Task Force 65, for each ship has its own story to tell.

The success of Aircraft Salvage Operations Mediterranean by Task Force 65 is now a page of naval history and a tribute to the skill and determination of the men of the U. S. Navy. The *Petrel's* part in this tremendous operation, though significant, was only part of an outstanding team effort.

