

The Sands of War: Full Version

You might not know this, but during World War II six lives were lost on the American mainland as a direct result of enemy action. In one of the lesser-known tales of World War II, forensic geoscience, and the identification and sourcing of sand, played an important role.

The catalyst for this story was the Doolittle Raid, the first air raid by the United States on the Japanese home islands, on April 18, 1942. The attack engendered a very strong desire for revenge and initially convinced the Japanese that the Americans had developed new, extremely long-range aircraft. In reality, the 16 planes used in the raid were modified Army Air Forces B-25 bombers that took off from a Navy aircraft carrier on what the pilots knew was likely to be a one-way trip. Following the strike on Tokyo, the Japanese feared further attacks on the home islands, and wanted to find some method to retaliate against the American mainland. One of the results was a program to develop balloon bombs, or *fusen bakudan*.

The idea of a balloon bomb apparently dated back to a 1933 Japanese Military Scientific Laboratory program to develop new war weapons. It was only one of several ideas that were under development. The program was formally stopped in 1935, though they continued to explore other military uses for balloons. Following the Doolittle Raid, a joint Army/Navy research project began to develop balloon bombs that could be launched from submarines. Two submarines were adapted for this purpose, but the program was discontinued in August 1943, when the submarines were suddenly redeployed to Guadalcanal. Thus arose the necessity to develop a balloon that could launch from the Japanese homeland.

The Japanese had been studying the powerful air currents in the upper atmosphere, especially the ones we now called *jet streams*, since the 1920s. The polar-front jet stream that flows from Asia, across Japan, to North America is thousands of kilometers long, a few hundred kilometers wide, and is typically located somewhere between about 9 and 15 kilometers above the Earth's surface. The jet stream usually moves between 250 and 500 km per hour, though speeds of over 700 km per hour have been recorded. The Central Meteorological Observatory in Tokyo worked from 1942 to 1944 collecting detailed observations, and some 200 of the balloons created for the submarine program were launched during the winter of 1943/44 to collect additional meteorological data and test project feasibility. These balloons were never intended to reach the United States. Based on the data they collected, the meteorologists estimated that the jet stream would be capable of carrying a balloon across the Pacific from Japan to North America in an average time of 60 hours, or roughly three days.

Armed with this knowledge, the Imperial Japanese Navy and the Imperial Japanese Army began separate projects to design balloons capable of surviving the trip to the American mainland to deploy an explosive payload. By the spring of 1944, two different balloons had been developed. The Navy created a rubberized-silk balloon meant to travel at a constant elevation, but it was slow to ascend and could only carry a limited payload. Researchers experimented by launching two or three of these balloons each day, all carrying radio transmitters that allowed engineers to track their speed, altitude, and course. After the creation of some 340 of these balloons, only around 34 were launched and production was halted.

The bulk of the balloons launched were based on the design developed by the Army. They were constructed of tissue paper made from fibers of the *kozo* bush (a member of the mulberry family) and sealed together in layers using paste called

konnyaku-nori made from Japanese potatoes. Thousands of Japanese schoolchildren performed much of the construction of the airtight balloon envelopes, each of which consisted of 600 individual pieces of paper (http://www.onawindandaprayer.com/content_insight.htm). Each balloon was about 10 m in diameter, had a four-spoke aluminum wheel that held the cargo, and was filled with hydrogen. To manage the flight, engineers developed a battery-operated control system that was programmed to release helium when a balloon ascended to over 11.6 km (38,000 feet) and to drop ballast (sandbags) when it descended below approximately 9 km (30,000 feet).

After three days, by which point a balloon would presumably be over the United States mainland and the ballast gone, the control system would fire a charge to release the bombs. Each of these balloons was equipped with between three and five explosives, typically including one 15-kg fragmentation antipersonnel bomb and four 5-kg incendiary devices. There also were small picric acid blocks and packets of magnesium flash powder meant to destroy the balloons after they delivered their payload. The intention was to start huge wildfires, cause casualties, divert American resources, and provoke civilian panic.

The balloon attack formally began on November 3, 1944, the birthday of former ruler Emperor Meiji. The jet stream is strongest from November to March, which would help to ensure that the balloons reached the States, but a winter launch missed the fire season of the western United States and limited the possible scope of damage that the balloons could inflict. From November on until the cancellation of the project, balloons were launched on every clear day. The total number of balloons launched is unclear, but numbers between 6,000 to over 9,000 are often quoted. They expected at least 10% to reach North America.

Though some were spotted earlier, the first published report of a balloon bomb reaching land was from Kalispell, Montana in early December 1944. It was described as “a huge paper balloon bearing Japanese ideographs and armed with an incendiary bomb capable of starting a major conflagration” (Christian Science Monitor, 1944). According to the FBI, the balloon had “characters indicating that it was completed on Oct. 31, 1944 [and] was painted red and yellow with a rising sun emblem” (Los Angeles Times, 1944). Other discoveries quickly followed in Oregon and Washington. There also had been earlier news reports of a “phantom plane,” a parachute in the air and several explosions near Thermopolis, Wyoming, which was in reality almost certainly a balloon bomb.

There were actually several short newspaper stories published about the balloons in 1944, and in some areas their existence was common knowledge, but there is no evidence of associated widespread panic. The major concerns initially appeared to be determining where the balloons were coming from, and if they carried any passengers. “That they were made in Japan there was no doubt but it was found highly improbable [that] the balloons started their flights in Japan because of their limited gas capacity” (Washington Post, 1945). *Newsweek* even suggested, “the best conclusion, therefore, is that any saboteurs [carried by the balloons] probably would be Germans” (Newsweek, 1945).

Sometime in January 1945, the Government Office of Censorship requested a news blackout on all stories about the balloon bombs to keep the Japanese from getting any information about the fate of their balloons, and possibly to keep the public from wild speculation about what the balloons might be carrying. Meanwhile, the materials recovered from the balloons that landed were examined for clues as to the balloons’ origins. The Japanese had done their best to ensure

that there were no markings or stamps on any of the parts or materials used to construct the balloons that could be used to trace their places of manufacture, thus denying the Americans military targets (though a few items with location information did make their way into some of the balloons). Initially, American Military Intelligence did not believe that the balloons could be coming over directly from Japan. Instead, they thought that the balloons could possibly be coming from North American beaches launched by landing parties from enemy submarines, from German prisoner-of-war camps, from Japanese-American internment camps, or possibly even from some small Pacific Islands.

This is where geology enters the story. The Military Geology Unit (MGU) of the United States Geological Survey (USGS) had been formally established in June 1942 with the intention of providing the US military with geologic information that could help invading armies, such as detailed terrain descriptions, as well as the locations of water supplies, important mineral reserves, and sources of construction materials. When sand from some of the ballast bags was recovered from the balloon bombs, it was delivered to the USGS, and the men and women working with the MGU. There, the geologists used stereomicroscopes and polarized light microscopes to perform a detailed examination of the few handfuls of sand that they had been provided with.

Ballast sand samples from the balloons that had landed in Holy Cross, Alaska, and Glendo, Wyoming were delivered to Clarence S. Ross, a mineralogist-petrologist with the USGS. He could tell almost immediately that the sand was beach sand and that it was not from North America. He found nothing in the sand, such as mica, to indicate a granitic (i.e. continental landmass) source. Instead, the sand contained around 52% hypersthene, and lesser percentages of augite, hornblende, garnet, high-titanium magnetite, and high-temperature quartz. Both the hypersthene and the augite were of volcanic origin, while the garnet and the hornblende were of metamorphic origin. Hypersthene (which would more technically be referred to as *ferroan-enstatite* these days) is an uncommon mineral, so to find such a high percentage of it concentrated in the sand was quite unusual. Based on the mineral composition, the geologists knew that they were looking for a beach that had both volcanic and metamorphic rocks located in-land, but no in-land granite. This composition also eliminated the Pacific Islands, which are mostly the result of basaltic volcanism, so their beach sands would contain neither the high-temperature quartz nor the metamorphic minerals.

Julia Gardner, a paleontologist, examined the sand for coral and mollusks. She found that there was, in fact, no coral at all. In modern oceans, most coral is confined to water that is greater than 18 °C, which tends to keep them located in tropical and subtropical waters between 30° north and 30° south latitudes. Most coral also requires highly saline water that is clear enough to permit high light penetration. This meant that the ballast sand was from a beach located in a cold-water region, which eliminated almost all of the beaches south of Tokyo Bay as potential sources.

Kenneth E. Lohman, an MGU specialist in *diatoms* (a form of microscopic photosynthetic algae that has a silicate shell) recovered more than a hundred different species of recent and fossil diatoms. The fossil diatoms were all Pliocene in age, which helped to limit the age of the parent rock. Kathryn Lohman searched for *foraminifera*, a microscopic form of single-celled life that produces calcium carbonate shells. These organisms are almost entirely marine in origin and have a wide variety of forms, which can be used to help determine their source. The

diatoms and foraminifera that the Lohmans found all pointed to Japan. In fact, they located an 1889 paper that described diatoms and foraminifera that matched the species found in the ballast samples and that came from an area around Sendai, on the northeast coast of Honshu. This narrowed the source area down to the eastern coastline of Honshu, somewhere north of Tokyo. More specifically, they identified Shiogama beach, eight miles northeast of Sendai, and another possible source zone called the Ninety-nine League Beach at Ichinomiya, forty miles southeast of Tokyo.

Given this intelligence, orders were dispatched for aerial reconnaissance of selected areas of the eastern coastal areas of Honshu. Some of the photos showed what might have been partly inflated balloons and possible launch areas. According to one newspaper, "an analysis of the sand ballast of the balloons revealed their launching points and these, too were bombed" (Seattle Times, 1945). This is an oversimplification of events. The balloon attacks had already ceased as a result of the press blackout and redirection of the Japanese war effort.

Due to the self-censorship of the American press, the Japanese only learned of one landing. The Chinese newspaper *Takungpao* had picked up a story from American sources that a balloon reached Thermopolis, Wyoming and reported it in late December 1945. Strangely enough, most of the American papers did not have information about this incident because it had mistakenly been reported as a "phantom plane," and instead they all listed the Kalispell, Montana landing as the first incident. According to later newspaper reports, the Japanese also thought that the Thermopolis balloon bomb had not exploded.

The news of six deaths in Oregon never reached them either. The only casualties of the balloon attacks occurred on May 5, 1945, near Bly, Oregon. The Reverend Archie Mitchell and his pregnant wife had taken five children from their Sunday school on a fishing trip/picnic. The minister was at the car, or walking some distance behind the group, when he heard his wife call out that they had found something. Moments later, there was an explosion, apparently caused by someone trying to move the balloon. Mrs Elsie Mitchell, 26, and all five of the children, ranging in age from 11 to 14, were killed in the explosion.

The press blackout was officially ended with a single press release on May 22, 1945, when the Army and Navy disclosed information about the attacks "so that the public may be aware of the possible danger and to reassure the nation that these attacks are so scattered and aimless that they constitute no military threat" (Chicago Daily Tribune, 1945). Basically, spring had started, the school year was ending, and the military wanted to prevent any additional accidents like what had happened in Oregon.

In all, over 345 balloon fragments were discovered during the war, but due to the news blackout and low-key response, the Japanese had no idea where their balloons were going or what effect they were having. In April 1945, the project was declared a failure and the attacks were abandoned. Plus, American B-29s destroyed two of the three helium plants supplying the balloon project, as well as several of the factories supplying parts, which contributed to the decision to abandon the project. Thus, the balloon bombs were halted before the fire season started again. According to Kiyoshi Tanaka, one of the engineers leading the project, if the Japanese General Staff had learned that even one death had resulted from the balloon attack, 10,000 more would have been launched.

While the intelligence from the MGU did not directly result in the destruction of the Japanese balloon bomb program, it was still vital to the American war effort.

For one thing, it kept American war efforts from being diverted to look for a fictitious Pacific Island launch site or for saboteurs lurking on American soil. And the MGU had successfully identified one of the launch sites. If the program had not already been abandoned as fruitless, this information probably would have resulted in bombings of the suspected launch sites.

There were actually three balloon-launching sites: Ichinomiya Prefecture, Nakoso in Fukushima Prefecture, and Otsu in Ibaraki Prefecture. The latter two were only a few miles apart, and about 100 miles up the coast from Ichinomiya, in an area that the USGS had not considered likely. All of the sand examined by the MGU came from the same beach, which turned out to be the Ichinomiya site. Additional bombs would have eventually supplied more ballast material for examination.

As dismissive as the newspaper reports were about the balloon bomb incidents, they were actually a very serious potential threat. Some recently revealed evidence has disclosed a high-level debate about the possibility of using the balloons to deploy biological weapons (New York Times, 1995). If the program had continued into the fire season, massive wildfires could have done serious damage to the western coast. Just look at what has been happening in California the past few years. In response to this threat, a total of 12 companies of ground troops, 200 paratroopers, some L-5 patrol planes, and C-17 troop carriers were assigned to protect the western coast of the United States and fight any resulting forest fires. There were also some serious near misses by the balloons.

A few landed near the Hanford atomic bomb plant, but failed to explode, and one struck a power line running from the Bonneville Dam to the Hanford plant, temporarily halting work. A balloon with one bomb still attached landed on a runway at the Paine army airfield. Another of the balloons came within a few miles of Detroit, near the Chrysler tank arsenal, a Ford plant, and other large war plants. Apparently, a boy in Washington State carried around a live anti-personnel bomb for a few days before authorities managed to take it away, averting what could have been a very nasty accident. Balloon shrouds and other fragments were found as far east as Michigan (3 incidents), as far south as Mexico (3 incidents), and as far north as the Northwest Territories, Canada (4 incidents). The majority of the balloons were found in British Columbia, Canada (57), Oregon (45), Alaska (37), and Montana (32), all numbers not including post-war discoveries.

One final note of caution, while over 6,000 balloons and possibly as many as 9,000 were launched, to date only 361 or so have been found. This means that there might be several more hiding out there in the less accessible areas of the western United States. The most recent reports of balloon fragments being found were in 1987 in North Dakota and in Oregon in 1992. The bulk of this story was based on newspaper and magazine articles from the 1940s and on John McPhee's "The Gravel Page" article from the January 29, 1996 issue of *The New Yorker*.

Further Reading

McPhee, J. (1998) *Irons in the Fire*. The Noonday Press, Farrar, Straus and Giroux: New York. [This book includes "The Gravel Page" article mentioned.]

Webber, B. (1992) *Silent Siege III: Japanese Attacks on North America in World War II: Ships Sunk, Air Raids, Bombs Dropped, Civilians Killed*. Webb Research Group Publishers, Oregon. [Book that has the most detailed information.]

And as I wrote this, I saw that the American Public Broadcasting System (www.shoppbs.org) has released a DVD of *On a Wind and a Prayer*, a 2005 documentary by Michael White Films about the Balloon Bombs (www.onawindandaprayer.com).

References

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