

The TIGHAR Hypothesis



In the course of twelve years of research, our impression of what happened to Amelia Earhart, Fred Noonan, and the Lockheed Electra in which they disappeared has changed and evolved many times as new information has been uncovered and old theories have been laid to rest. We fully expect that process to continue, but here is how the picture looks at this time.

1.

At 08:43, twenty hours and thirteen minutes into the flight, and with somewhere between three and four hours of fuel remaining, Earhart and Noonan have been unable to make visual or two-way radio contact with Howland Island. They implement the only procedure available to them which will minimize the chance of having to land the aircraft in the sea – they proceed southeastward on a heading of 157°.

2.

Shortly before noon, the aircraft is landed successfully on the reef-flat at Gardner Island at low tide on the smooth stretch of coral just north of the S.S. *Norwich City*, the ship that ran aground there eight years earlier.

3.

That evening, the aircraft's radio is used to send distress calls. Transmissions continue for a few days.

4.

By a week later, rougher seas and increased surf on the reef have forced Earhart and Noonan to abandon the aircraft which is now obscured from view at high tide. The castaways seek shelter from the sun in the dense bush inland and come upon a cache of provisions left behind by the rescuers of the *Norwich City* survivors eight years earlier. When search planes from the USS *Colorado* are heard overhead on the morning of July 9th Earhart and Noonan are unable to reach the open beach in time to be seen. If anything of the airplane was visible through the surf, its proximity to the *Norwich City* led the searchers to dismiss it as debris from the shipwreck.

5.

Literally marooned on a desert island, Earhart and Noonan survive for a time but eventually succumb to any of a number of possible causes including injury and infection, food poisoning (some local fish are highly toxic), or simply thirst. Noonan dies not far from the site of their landing. His bones are later found and buried by the island's first settlers. Earhart dies at a small makeshift campsite near the lagoon shore on the island's southeastern portion. Her remains are discovered there in 1940 by British authorities.

6.

The airplane on the reef is destroyed by surf action and the debris is scattered "downstream" across the reef-flat, along the shoreline, and into the lagoon. During the island's period of habitation (1938 – 1963) the colonists encounter, and in some cases recover and use, various bits of wreckage, but most of the debris is eventually swept through the main lagoon passage and deposited in the large sandy shoal just inside the passage. Those components recovered by the colonists are mostly consumed in local uses such as fishing tackle and decorative items.

Today

Whatever now survives of NR16020 is either on the lagoon bottom or buried in the sandy shoal just inside the main passage. Some wreckage may have been pulled seaward from the original landing site and may rest on an offshore coral shelf. The apparent absence of wreckage in the shoreline vegetation at the west end of the island (as indicated by TIGHAR's 1999 search) is probably due to earlier salvage activity by the colonists and the scouring action of significant weather events in subsequent years. Buoyant bits of wreckage may have washed up anywhere along the lagoon shore and may still survive deep in the dense shoreline vegetation. More scraps of salvaged material used by the islanders almost certainly survives in the abandoned and overgrown village.

The portions of Earhart's skeleton that were found on the island in 1940 (a skull and several arm and leg bones) and taken to Fiji for examination in 1941 may still exist. The bones that were not found (primarily the spine, ribs, half of the pelvis, hands and feet, one arm, and one lower leg) have probably now been consumed by the forces of nature. The bones that were recovered and examined may still exist but search efforts to date have been unsuccessful. Noonan's remains may be buried in one of the graves found on the western end of the island.



The Evidence

Here are the puzzle pieces that make up the picture described above.

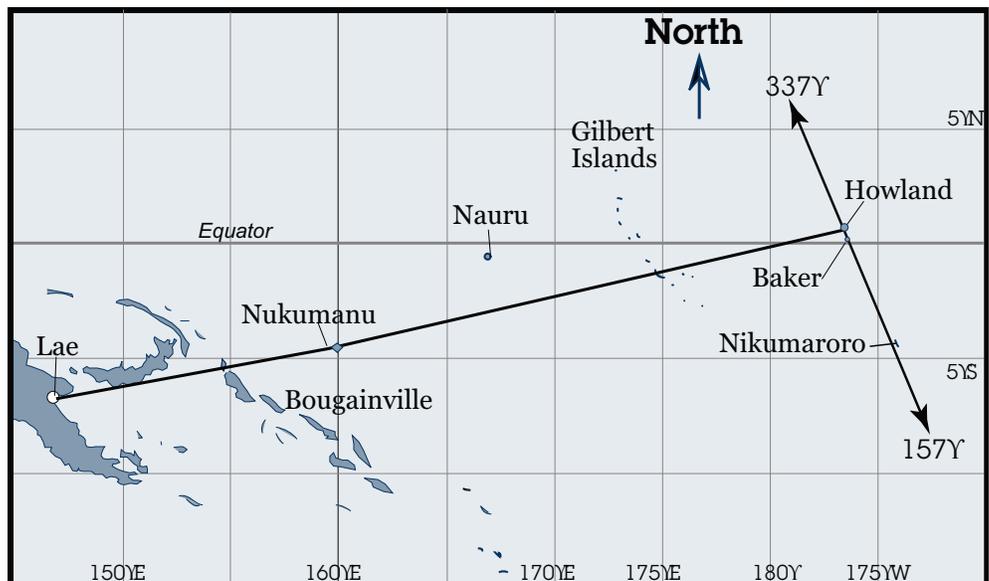
July 2, 1937
08:43 Local time

HYPOTHESIS 1

Twenty hours and thirteen minutes into the flight, and with somewhere between three and four hours of fuel remaining, Earhart and Noonan have been unable to make visual or two-way radio contact with Howland Island. They implement the only procedure available to them which will minimize the chance of having to land the aircraft in the sea—they proceed southeastward on a heading of 157°.

SUPPORTING EVIDENCE

- The aircraft's known fuel load at departure and the power/fuel management recommendations given to Earhart by Lockheed engineer Clarence "Kelly" Johnson, indicate that the aircraft should have had a maximum endurance of roughly 24 hours. (Report by Guinea Airways Manager Eric Chater dated 25 July 1937 and telegrams from Johnson to Earhart dated March 11 & 13, 1937.)
- When last heard from at 08:43 (20 hours and 13 minutes into the flight) Earhart said she was flying on a "157/337" line. (*Radio Log USCG Itasca, 2 July 1937.*) She was not understood to say which direction she was flying but U.S. Navy authorities in 1937, Earhart's husband George Putnam, and her technical advisor Paul Mantz all agreed that the flight probably proceeded southeastward on the line in the hope of reaching land. (*Report of Capt. W.L. Friedell, commanding officer USS Colorado, date 13 July 1937.*)
- Such a line passing through Howland Island also passes within visual range of Gardner Island (see map below, Nikumaroro).



July 2, 1937
Late Morning

HYPOTHESIS 2

The aircraft is landed successfully on the reef-flat at Gardner Island at low tide on the smooth stretch of coral just north of the S.S. Norwich City, the ship that ran aground there eight years earlier.

SUPPORTING EVIDENCE

- Early settlers on Gardner Island (Nikumaroro) tell of an airplane wreck seen in 1940,, long before any possibility of WWII activity. The wreckage is said to have been located on the reef near “where the waves break” and just north of the shipwreck. (*Interviews with former residents Emily Sikuli and Otiria O’Brian in Fiji in July 1999.*)
- Photographic evidence confirms the presence of anomalous material in that location as early as October 1937. (*Photographs taken by Eric Bevington in October 1937 and by New Zealand Pacific Aviation Expedition in 1938/39.*)

July 2, 1937
Evening

HYPOTHESIS 3

The aircraft’s radio is used to send distress calls. Transmissions continue for a few days.

SUPPORTING EVIDENCE

- On the evening of July 2nd, the radio station on the island of Nauru (which had heard Earhart’s in-flight transmissions the night before) hears “Fairly strong signals, speech not intelligible, no hum of plane in background, but voice similar to that emitted from plane in flight last night.” (*Telegram dated 3 July 1937 addressed to U.S.*

Secretary of State, Washington, D.C., reporting transmission heard on Nauru.)

- The signals are heard on 6210 kilocycles, the frequency to which Earhart said she was switching in her 08:43 transmission. (*Radio log USCG Itasca.*)
- The unintelligibility of the voice message is attributed to “bad modulation or speaker shouting into microphone.” (*Message received by USCG Itasca July 3, 1937.*)
- While in Lae, New Guinea Earhart was advised to “pitch her voice higher to overcome distortion caused by rough carrier wave” when using 6210 Kilocycles. (*Report by Guinea Airways Manager Eric Chater dated 25 July 1937.*)
- Experts at the time agree that for the airplane to be sending radio transmissions it must be on land and able to operate the starboard generator-equipped engine to recharge its batteries. (*Message received by USCG Itasca on July 5, 1937.*)
- Over the next few days further transmissions heard by a variety of stations cause the Navy to concentrate its search on the islands of the Phoenix Group. (*Official U.S. government message traffic July 2- 9, 1937.*)
- Analysis of the alleged post-loss messages using modern radio propagation software reveals many to be effectively impossible but some, such as the transmission described above, appear to be highly credible. (*Report by Robert Brandenburg, LCDR, USN [Ret.].*)

(cont.)

July 9, 1937
Morning

HYPOTHESIS 4

Rougher seas and increased surf on the reef have forced Earhart and Noonan to abandon the aircraft which is now obscured from view at high tide. The castaways seek shelter from the sun in the dense bush inland and come upon a cache of provisions left behind by the rescuers of the *Norwich City* survivors eight years earlier. When search planes from the USS *Colorado* are heard overhead on the morning of July 9th Earhart and Noonan are unable to reach the open beach in time to be seen. If anything of the airplane was visible through the surf, its proximity to the *Norwich City* led the searchers to dismiss it as debris from the shipwreck.

SUPPORTING EVIDENCE

- The captain of the S.S. *Norwich City*, rescued from the island with the surviving members of his crew in 1929, wrote that: "Before leaving camp all provisions, etc., were placed in the shelter, but I sincerely hope that no one will ever be so unfortunate as to need them." (*Undated written statement by Capt. Daniel Hamer, master, S.S. Norwich City.*)
- A photograph of the *Norwich City* survivors' camp taken in 1938, shows the site to be in considerable disarray and may be an indication of later use. (*Photo of "Wreck survivors' camp" taken by New Zealand Pacific Aviation Survey, December 1983/February 1939.*)
- A photograph taken during the July 9, 1937 aerial search for the Earhart plane shows that the tide was high and there was significant surf running on the reef at the time of the Navy overflight. (*Aerial photograph of Gardner Island dated July 9, 1937.*)
- The description of the search by the Senior Aviator notes that "Here, signs of recent habitation were clearly evident but repeated circling and zooming failed to elicit any answering wave from possible inhabitants and it was finally taken for granted that none were there." (*Article entitled "Aircraft Search for Earhart Plane" written for U.S. Navy Bureau of Aeronautics Weekly Newsletter by Lt. John O. Lambrecht, Senior Aviator, USS Colorado.*)
- The only documented inhabitation of Gardner island prior to 1937 was a brief stay by perhaps 20 laborers who planted coconut trees in 1892 for a few months. (Lambrecht did not know the island was uninhabited.) (*British government report "History of Gardner Island", H.E. Maude.*)

1937/1938

HYPOTHESIS 5

Literally marooned on a desert island, Earhart and Noonan survive for a time but eventually succumb to any of a number of possible causes including injury and infection, food poisoning (some local fish are highly toxic), or simply thirst. Noonan dies not far from the site of their landing. His bones are later found and buried by the island's first settlers. Earhart dies at a small makeshift campsite near the lagoon shore on the island's southeastern side. Her remains are discovered there in 1940 by British authorities.

SUPPORTING EVIDENCE

- In October 1937 a small British expedition to Gardner Island noted unexplained "signs of previous habitation" along the southeastern lagoon shore. The site was later described as looking "like someone had bivouacked for the night." (*Diary of Eric R. Bevington, entry for October 13, 1937 and interview with Bevington in 1991.*)

- Anecdotal accounts by former residents and an American serviceman tell of the remains of a man and a woman discovered on the island and, in some cases, associated with the purported airplane wreck. (*San Diego Union interview with Coast Guard veteran Floyd Kilts in 1960; TIGHAR interviews with Dr. Teinamati Mereki and Reverend Aberaam Abera in the Solomon Islands in 1995; with Tapania Taeke on Funafuti in 1997; with Emily Sikuli and Otiria O'Brian in Fiji in 1999.*)
- Extensive official British government records confirm the discovery in 1940 of the partial skeleton of a castaway who perished while attempting to survive on Nikumaroro sometime prior to the island's settlement in 1939. The remains of a fire, dead birds and a turtle were present. With the bones were found a sextant box bearing a stencilled number that is similar to a number written on a sextant box known to have belonged to Fred Noonan, and the remains of a woman's shoe and a man's shoe. Also at the site were "corks with brass chains" thought to have been from a small cask and may have come from the *Norwich City* supply cache. Similarly, a Benedictine bottle found with the remains may have been part of the cache. Although at first suspected of being the remains of Amelia Earhart, the possibility is later discounted by British authorities after a doctor (with no forensic training) pronounces them to be the bones of a short, stocky male. (*Records of the Western Pacific High Commission.*)
- Although, so far, the present location of the bones themselves is not known, evaluation by modern forensic anthropologists of measurements taken in 1941 indicate that the individual who died on Nikumaroro was most likely a white female of northern European extraction who stood

approximately 5 feet, 7 inches tall (not a bad description of Amelia Earhart). (*Paper prepared by Dr. Karen Ramey Burns, Dr. Richard Jantz, and Dr. Thomas F. King for the annual meeting of the American Anthropological Association in 1998.*)

- The remains of a shoe found on Nikumaroro by TIGHAR in 1991, in the same part of the island where tradition holds that the bones were found in 1940, has been judged to be of the same vintage, style and size as the shoes worn by Earhart on her final flight. (*Analysis by the BiltRite Corporation in 1992.*)

Other bones are said to have been found near the shipwreck by the island's first settlers in 1939. TIGHAR has identified at least one, and possibly two, graves in that area. (*Correspondence with Bauro Tikana in Tarawa in 1991; interview with Emily Sikuli in Fiji in 1999; search operation conducted in 1999.*)

1938-1963

HYPOTHESIS 6

The airplane on the reef is destroyed by surf action and the debris is scattered "downstream" across the reef-flat, along the shoreline, and into the lagoon. During the island's period of habitation (1938 – 1963) the colonists encounter, and in some cases recover and use, various bits of wreckage, but most of the debris is eventually swept through the main lagoon passage and deposited in the large sand shoal just inside the passage. Those components recovered by the colonists are mostly consumed in local uses such as fishing tackle and decorative items.

SUPPORTING EVIDENCE

All of the anecdotal and photographic evidence is chronologically and sequentially consistent.

- The earliest accounts and photos depict a large body of wreckage on the reef-flat near the ocean. (*Interview with former resident Emily Sikuli in Fiji in July 1999. Photographs of anomalous material in the alleged aircraft wreck location taken by Eric R. Bevington in 1937 and the New Zealand Pacific Aviation Survey in 1938.*)
- The anomalous material visible in the 1937 and 1938 photos is no longer apparent in photos taken after December 1940 when severe weather is known to have damaged the western end of the island. (*Photographs taken by the U.S. Navy in 1941 and the U.S. Army Air Corps in 1942; Phoenix Islands Settlement Scheme Quarterly Report for fourth quarter 1940 by Gerald B. Gallagher, Officer in Charge.*)
- An anecdotal account describes an aircraft control cable used as a heavy-duty fishing line leader and a large fishhook fashioned from aluminum by residents of Nikumaroro in 1944. When queried, the locals said the material came from “an airplane that was here when our people first came.” When asked where the airplane is now they just shrugged. Small wooden boxes made on the island are decorated with inlaid 24ST aircraft aluminum. (*Interview with former USN PBYPilot Dr. John Mims in 1995; souvenir boxes owned by Dr. Mims.*)
- Two 1953 aerial photos indicate the presence of light colored metal debris on the reef-flat near the main lagoon passage “downstream” of the location of the anomalous material seen in the 1937 and 1938 photos. The *Norwich City* debris is uniformly dark in color. (*Forensic imaging of 1953 aerial mapping photo.*)
- Anecdotal accounts of former residents describe aircraft debris seen on the reef near the main lagoon passage, in the shoreline vegetation, and along the lagoon shore just opposite the passage in the late 1950s. (*Interviews with Pulekai Songivalu and Tapania Taeke on Funafuti in 1997.*)
- Aircraft debris consistent with the Lockheed Model 10 and, to date, not identified as consistent with any other aircraft type known or suspected to have been in the region, has been found in and near the abandoned village on the island. (*Results of TIGHAR expeditions in 1989, 1991, and 1996.*)



Today

HYPOTHESIS 6

Whatever now survives of NR16020 is either on the lagoon bottom or buried in the sandy shoal just inside the main passage. Some wreckage may have been pulled seaward from the original landing site and may rest on an offshore coral shelf. The apparent absence of wreckage in the shoreline vegetation at the west end of the island (as indicated by TIGHAR’s 1999 search) is probably due to earlier salvage activity by the colonists and the scouring action of significant weather events in subsequent years. Buoyant bits of wreckage may have washed up anywhere along the lagoon shore and may still survive deep in the dense shoreline vegetation. More scraps of salvaged material used by the islanders almost certainly survives in the abandoned and overgrown village.

The portions of Earhart’s skeleton that were found on the island in 1940 (a skull and several arm and leg bones) and taken to Fiji for examination in 1941 may still exist. The bones that were not found in 1940 (primarily the spine, ribs, half of the pelvis, hands and feet, one arm, and one lower leg) have probably

now been consumed by the forces of nature. The bones that were recovered and examined may still exist but search efforts to date have

been unsuccessful. Noonan's remains may be buried in one of the graves found on the western end of the island.

Testing the Hypothesis

Pre-Expedition Research

Before returning to Nikumaroro, several research projects need to be completed so that we can further validate (or, if need be, modify) the working hypothesis to maximize the expedition's chances for success.

- **Re-evaluation of the aircraft's range and endurance.**

New information has made possible a much more detailed evaluation of the aircraft's performance on its final flight. Especially in the light of recently published speculation that the aircraft ran out of fuel at the time of the final radio transmission heard by the *Itasca*, it is important to establish what can and can not be said about the flight's capabilities. TIGHAR is presently assembling a blue ribbon panel of independent experts to perform a new evaluation.

- **Propagation analysis of the post-loss radio signals.**

Recent software advances make possible a detailed computer analysis of the various transmissions suspected at the time as emanating from the lost aircraft. A team of TIGHAR volunteers has compiled a comprehensive list of the recorded incidents which will be databased and evaluated. It should be possible to know which alleged post-loss transmissions are almost certainly bogus and which are more credible. This technique has already shown the transmission heard by

Nauru on the evening of July 2nd to be highly credible.

- **Forensic imaging of historical photos.**

This hi-tech project has the potential for producing a photographic "smoking gun." If the anomalous material visible on the reef at Nikumaroro in the 1937 and 1938 photos can be shown to be aircraft wreckage, there is only one aircraft that it could be. Air traffic in the region prior to World War Two is easy to document and only one aircraft is missing – Earhart's.

- **Verification and further analysis of how the western end of Nikumaroro "works."**

Only recently have we come to have an understanding of how the shape of the main lagoon passage and the force of major weather events out of the west and northwest seem to create a venturi effect that greatly influences the distribution of any material caught up in it. We need to consult with experts in this field to learn more about where we should look.

- **Continued analysis of artifacts recovered.**

We still have many avenues of research to follow in learning more from the artifacts we've recovered from the island. Only a few of the dozens of items collected have been conclusively identified.

- **Examination of archival records and interview of former island residents in Tarawa.**

We know that there are official records in Tarawa that we've never seen, and we've heard of former residents of Nikumaroro living in Tarawa who have interesting stories to

tell (like the woman who says she was shown "the grave of a pilot").

- **Further efforts to find the bones in Fiji.**

There is much more that could be done to try to find a paper trail that could lead us to Earhart's bones.

The Niku IIII Expedition

Assuming that on-going research continues to support the current hypothesis, the following search operations are contemplated for NIKU IIII.

- A side-scan sonar and visual scuba search of the lagoon bottom just inside the main lagoon passage.
- A sub-bottom profiling sonar search of the sandy shoal.
- Excavation of sonar "hits" in the sandy shoal using an underwater archaeological suction dredge.
- A hand-held metal detector and visual scuba search of the offshore ledge north of the shipwreck.

- A detailed examination of *Norwich City* wreckage on the reef-flat in search of aircraft components that may have become hung up in the shipwreck debris.

- Ground Penetrating Radar examination of the known grave and suspected grave on the island's western end and excavation of the features if warranted.

- Further archaeological survey of the abandoned village.

- Detailed examination of the 1996 Site.

At this time, the NIKU IIII expedition is scheduled for the summer of 2001.

