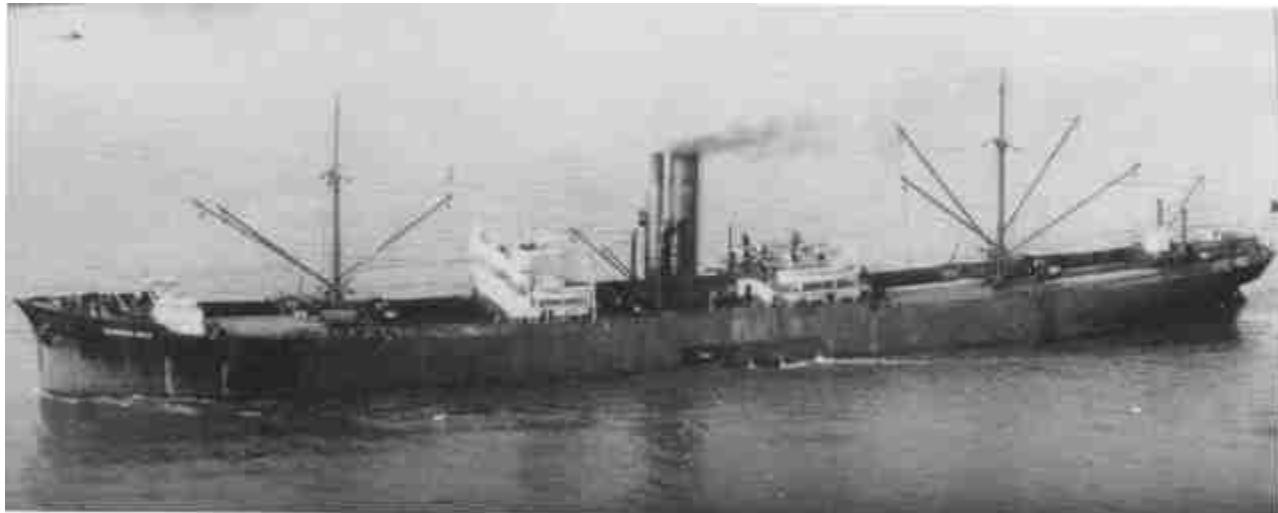


A Lost Sailor or Amelia Earhart?

Lost Norwich City Crewmen: Potential Sources of the Human Remains Discovered on Gardner Island (now Nikumaroro Island) in 1940



SS Norwich City
Image Courtesy of Jane Powell

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<https://ameliaeearhartarchaeology.blogspot.com/2019/01/>

Revisions in this version beyond minor changes are listed in the errata sheet in **Exhibit 8**.

The blog spot is a discussion of research into the Nikumaroro Hypothesis on the 1937 disappearance of Amelia Earhart and Fred Noonan. It is hosted by research archaeologist Tom King, PhD.

Tom King's Preface: NIBBLING AT NIKUMARORO'S NULL HYPOTHESIS

As used in statistics, a “null hypothesis” is the proposition that there’s no relationship between two variables. In the more forgiving vernacular of the social sciences and humanities, the term is often used to mean simply that the hypothesis we’re testing is not correct. Since we hypothesize that Amelia Earhart and Fred Noonan landed and died on Nikumaroro, the null hypothesis is that they didn’t.

A fundamental part of the scientific method is to determine with as much rigor as possible whether the null hypothesis is correct. Ideally – and however little fun it may be – one should try very hard to find evidence that confirms the null hypothesis. If you can’t find it, then with a degree of confidence you can reject the null hypothesis and say that, yes, in all probability your preferred hypothesis is correct.

In the paper that follows, Kenton Spading explores a body of historical evidence that may support the Nikumaroro null hypothesis with reference to the human bones and artifacts reportedly found there in 1940. In simple terms, Spading asks himself, and the data: “If the null hypothesis is correct, and the bones and artifacts do not represent Earhart or Noonan, whose were they?”

An important possibility is offered by the missing crewmen of the SS Norwich City, most of them Yemeni, lost on Nikumaroro’s northwest shore (Nutiran) in 1929. The Norwich City wreck site is about four miles away from the site where the 1940 bones and artifacts were found, at the opposite end of the island, but at least two ways to account for this spring readily to mind:

1. A crew member, thrown off the exploding freighter or abandoning ship, is swept by the storm through Tatiman Passage into the lagoon, and down to its far southeast end. Perhaps he’s unconscious, or disoriented, but if so he comes to and staggers inland, up to the crest of the surge ridge we now call the Seven Site, and there expires – perhaps after living for a time on the local fish, birds, and turtles. His body is then dismembered and its bones scattered by crabs, rats, and birds.

2. A disaffected crew member takes advantage of the opportunity afforded by the shipwreck to get ashore and hightail it. Avoiding detection by his shipmates, he walks to the far end of the island and camps, lying low while the other survivors are rescued. Belatedly realizing that the island lacks water, he eventually succumbs, and is taken apart by the local fauna.

I feel another novel coming on.

I don't personally much like the Nikumaroro null hypothesis. It's messy, and it doesn't easily account for much of our Seven Site archaeological evidence – the [compact](#), the [zipper pull](#), the [freckle crème jar](#), and so on. Our working hypothesis that the Seven Site represents Earhart's campsite is more elegant than the null; it doesn't require us to challenge the immortal words of William of Occam, that "plurality should not be posited without necessity" ([Occam's razor](#)). But, as physicist Richard Muller has recently noted in a very different context: "Occam's razor is often a poor guide to truth" (Muller 2016:140).

I think Kenton Spading has done us all a service by gathering and organizing a plethora of data bearing on the Nikumaroro null hypothesis, on which we can productively chew for quite some time. -TFK

Reference

Muller, Richard A. [Now: The Physics of Time](#). New York: Norton, 2016.

Introduction

In 1940, human bones were reportedly found near the southeast end of Nikumaroro Atoll in the Phoenix Islands.

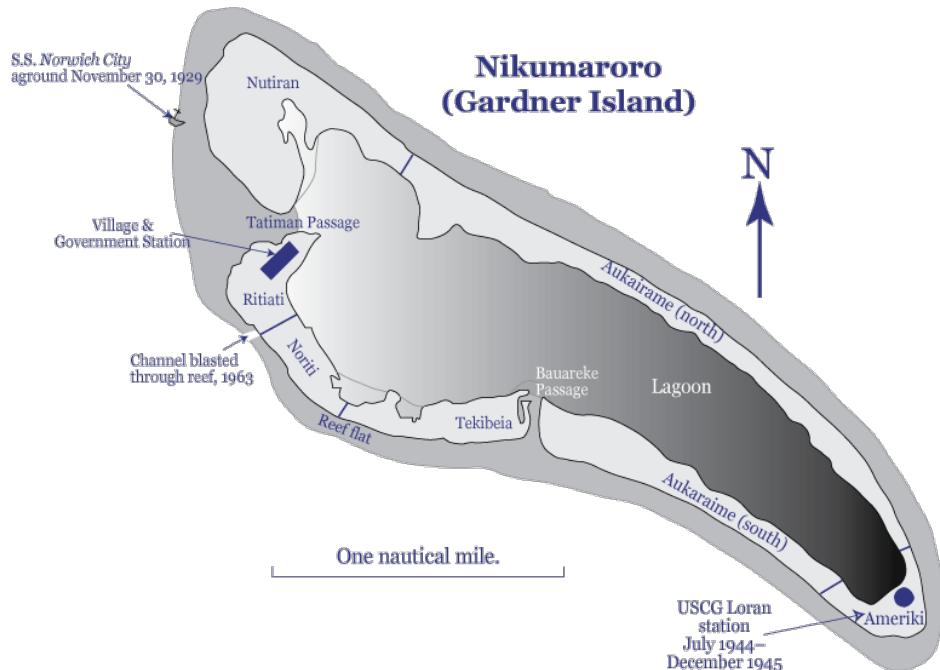


Figure 1

Map From The International Group for Historic Aircraft Recovery, Earhart Project Research Bulletin No. 25, Gallagher of Nikumaroro, The Last Expansion of the British Empire, Thomas F. King, Ph.D., August 1, 2000



Figure 2
Phoenix Islands Map

Map From The International Group for Historic Aircraft Recovery, Finding the Plane, Niku VII Daily Reports, Expedition Purpose & Objective, 2012

For a variety of reasons summarized elsewhere (TIGHAR.org, King 2012, 2018, Jantz 2018, Gillespie 2018) these bones are suspected to be those of Amelia Earhart. The purpose of this paper is to compile and summarize the available data pertaining to the 1940 discovery, with reference to a possible source of the bones other than Earhart – the crewmen lost when the SS *Norwich City* grounded and exploded on the island's northwest reef in 1929.



Photo 1
SS Norwich City aground on Nutiran beach on Nikumaroro in 1938

Photo by Wigram Air Force Base Archives, Royal New Zealand Air Force (RNZAF)



Photo 2
SS Norwich City aground on Nutiran beach on Nikumaroro in 1942

Photo by United States Army Air Force

The 1940 Bones Discovery

Nikumaroro, then known as Gardner Island or Kemin's Island, was inhabited in the 1890s during an effort by John T. Arundel to operate a coconut plantation. When the *Norwich City* ran aground in November 1929, however, the island had been uninhabited since approximately the mid-1890s. It remained uninhabited until December 1938.

From October 13 to October 15, 1937, a British Western Pacific High Commission (WPHC) party explored the island with the intent of assessing its suitability for colonization as a component of the Phoenix Island Settlement Scheme (PISS). One of the colonial officers involved in this assessment visit, Eric Bevington, wrote in his journal that he saw "signs of previous habitation." In 1992 he stated that it looked "like someone had bivouacked" (camped) on the island. [1] His colleague Harry Maude opined that this site represented debris left by Arundel's workers. [2]

On December 20, 1938, a second WPHC expedition, which included Mr. Maude and Cadet Officer Gerald Gallagher dropped off the first Gilbertese [3] colonists on the island (a ten-man working party under government contract). On December 22, Maude and Gallagher departed to deposit workers on other islands in the Phoenix Group. The Nikumaroro (aka Gardner) colonists began preparing a village and coconut plantation.

In April 1940, while clearing land, the colonists discovered a human cranium and buried it. In early September 1940, Gallagher returned to Nikumaroro to set up his headquarters as the WPHC Acting Officer in Charge of the PISS. The colonists informed him that a human skull/cranium had been found and buried. Gallagher stated it was found "on the Southeast end of the island about 100 feet above [the] ordinary high water springs."

Gallagher visited the site, and in a "thorough search" he recovered more bones and various artifacts. He excavated the buried cranium. All the bones and artifacts were eventually shipped to the WPHC headquarters in Fiji. His notes and those of Dr. Kingsley Rupert Steenson, senior medical officer, Gilbert and Ellice Islands Colony in Fiji, can be summarized as follows [4][5]:

1. A total of 13 bones were found "lying under a 'ren' tree." These included the cranium, which had been found and buried before Gallagher arrived in September 1940. "Ren" is the I-Kiribati (Gilbertese) word for *Heliotropium foertherianum*, formerly (until 2003) known as *Tournefortia argentea*. [6]
2. "Remains of [a] fire, turtle and dead birds" were also noted.
3. "Part of" [a shoe] "sole" [that] "appears to have been a stoutish waking shoe or heavy sandal" was found, along with a Benedictine bottle "alleged to have been found near [the] skull." During later discussions of artifacts found with the bones, Dr. Kingsley R. Steenson in Fiji mentioned "corks on brass chains [that] would appear to have belonged to a small cask."

4. “[A] sextant box [with] two numbers on it 3500 (stenciled) and 1542” was located, but “.....no sextant was found. Only part discovered was thrown away by finder but was probably part of an inverting eyepiece.”

Dr. Hoodless Examines the Bones

Gallagher shipped the bones and artifacts from Nikumaroro to the WPHC headquarters in Fiji. There the bones were examined and measured by Dr. D.W. Hoodless, principal of the Central Medical School. The bones, along with all the artifacts collected at the time, were subsequently lost, but Dr. Hoodless' notes have survived, including the measurements and methods he used to estimate the sex, age and stature of the individual whom the bones represented.

Dr. Hoodless estimated the height of the individual using Karl Pearson's formula for stature [7] to be 5 foot 5.5 inches. Pearson's 1898 formula was based on Manouvrier's French sample, consisting of only 50 individuals of each sex. These were individuals whose birth years would likely have been in the early 19th century and who were substantially shorter than modern Americans or even Americans of the late 19th century. Various sources state that subsequent analyses have shown Pearson's formula to underestimate actual stature. [8]

Dr. Hoodless arrived at the estimated height by averaging height extrapolations from the three long bones recovered, namely the humerus, radius and tibia.

Richard Jantz, professor emeritus of the Department of Anthropology at the University of Tennessee, Knoxville and Earhart-Noonan researcher Joe Cerniglia have discovered errors in Hoodless' analysis. These analyses, although worthwhile to note, do not significantly alter Hoodless' height estimate. A further explanation of these errors by Cerniglia may be detailed in a forthcoming report on this blog.

Hoodless opined: "It may be definitely stated that the skeleton is that of a MALE." [emphasis in the original] "...it is probably not that of a pure South Sea Islander - Micronesian or Polynesian. It could be that of a short, stocky, muscular European, or even a half-caste, or person of mixed European descent."

Re-analysis of the Hoodless Measurements

In 1998 the late Karen Burns and Richard Jantz employed the discriminant function program FORDISC 2.0 [9] to analyze Hoodless' cranial/skull measurements to estimate the castaway's race and sex. [10] They concluded the skull was more likely European than Polynesian, although it could not be excluded from any population. The FORDISC analysis indicated the individual was most likely female, but the level of certainty was very low (.65/.35). In the same paper Burns and Jantz estimated stature/height by employing

formulae derived from a modern sample (Ousley 1995) in the forensic anthropology data bank at the University of Tennessee. This analysis determined that the “best estimate” for the individual’s height is:

If female: ca. 5 foot 6 inches to 5 foot 7 inches

If male: ca. 5 foot 7.5 inches to 5 foot 8.5 inches

Confidence Interval (male and female): ca. 5 foot 4 inches (64 in.) to 5 foot 10 inches (70 in.).

These estimates were updated in December 2018 to assist with this paper. See **Table 2**.

Burns and Jantz noted that Amelia Earhart gave her height as 5 foot 8 inches; however, there are indications that she was closer to 5 foot 7 inches. A regression analysis of bone length from stature for women of 5 foot 8 inches and 5 foot 7 inches indicated that the 1940 bones fit Amelia Earhart’s stature very well.

The paper concluded that it is “impossible to know whether the bones inspected by Dr. Hoodless in 1941 were in fact those of a white female and if anything even less possible to be sure that they were those of Amelia Earhart.”

In 2015, Pamela Cross and Richard Wright published a challenge to the Burns, Jantz et al. analysis.[\[11\]](#) In brief, Cross and Wright argue that: “A critical review of both investigations and contextual evidence shows that the original [Hoodless] osteological analyses [Pearson’s formulae] were made by experienced, reliable professionals, while the cranial [FORDISC] analysis is unreliable given the available data. Without access to the missing original bones, it is impossible to be definitive, but on balance, the most robust scientific analysis and conclusions are those of the original [Hoodless] finding indicating that the Nikumaroro bones belonged to a robust, middle-aged man, not Amelia Earhart. Hoodless’s methods were sound and therefore his [male] sex estimate was likely correct.”

In February 2018, Dr. Jantz published a response to Cross and Wright, including a detailed re-analysis of the Hoodless measurements employing FORDISC 3.1 and other data. [\[8\]](#) The first part of Dr. Jantz’s paper, which examined “the methods Hoodless used and which were so vigorously defended by Cross and Wright,” stated:

“Cross and Wright (2015) argue that Pearson’s formulae are still in use today. I am not aware of any contemporary forensic anthropologist that uses Pearson’s formulae. By any reasonable standard, the height of 65.5 inches (5 ft. 5.5 in.) presented by Hoodless and supported by Cross and Wright must be considered an underestimate. I will also show [in this Feb. 2018 paper] that estimating sex from the half subpubic angle supported by Cross/Wright is by no means foolproof.”

The second part of the paper reconstructed Amelia Earhart’s “height, weight, body build and limb lengths and proportions” to “allow explicit evaluation of the bones found in 1940 against Earhart to determine whether or not she can be excluded or included.”

The paper noted that the estimated lengths in millimeters of Earhart's humerus (321.1), radius (243.7) and tibia (372) are very close to the corresponding castaway's bones measured by Hoodless (325, 245, and 372). [\[12\]](#)

Earhart's estimated bone lengths were compared with the 2,776 individuals in the FORDISC 3.1 database. Her ranking numbers were converted to likelihood ratios as described by Gardner and Greiner (2006), resulting in ratios ranging from 84 to 154. Those likelihood ratios, quoting the paper, "would not qualify as a positive identification by the criteria of modern forensic practice where likelihoods are often millions or more." However, the paper stated they do qualify as a "preponderance of evidence" and "if the bones do not belong to Amelia Earhart, then they are from someone very similar to her." Jantz noted certain caveats, however:

"It should be mentioned that a sample of Micronesian or Polynesian bone measurements was unavailable to test against the Nikumaroro bones. I consider it highly unlikely that inclusion of such a sample would have changed anything. As Figure 3 [in the original paper] shows, the Nikumaroro bones are more similar to Euro-Americans than they are Micronesians or Polynesians, which suggests they would produce even fewer nearest neighbors."

"[In the case of the Nikumaroro bones] it is impossible to test any other hypothesis, because ***except for the victims of the Norwich City wreck, about whom we have no data***, no other specific missing persons have been reported. It is not enough merely to say that the remains are most likely those of a stocky male without specifying who this stocky male might have been" (emphasis added).

As discussed below, some data are now available regarding the *Norwich City* wreck victims.

The SS Norwich City

The *Normanby*, later renamed *Norwich City*, was christened and launched on July 12, 1911, by the British shipbuilding company William Gray and Company of West Hartlepool, England. She was assigned yard number 792. She was registered out of London by the London and Northern Steamship Company as **ship number 132596**. The 397-foot bulk carrier had a beam of 53 feet 5.5 inches.

The London and Northern certificate was cancelled on April 24, 1919, when the ship was re-registered at Bideford, England to the St. Just Steamship Company, Limited. Sir Reardon Smith Lines, Limited was assigned to manage the vessel.

On July 2, 1928, nine years to the day before Amelia Earhart and Fred Noonan disappeared in 1937, St. Just was absorbed into the Sir Reardon Smith Lines, Limited. After William Reardon Smith started managing the vessel, her name was changed to the *Norwich City* by the Board of Trade (minutes No. 2544).

Last Voyage: Wrecked on Gardner Island (Nikumaroro)

The *Norwich City* departed the Australian City of Melbourne, in the state of Victoria, with a crew of four (4) officers and thirty-one (31) crewmen (35 total) bound for the City of Vancouver in the Canadian province of British Columbia. She was scheduled to lay over in the City of Honolulu within the United States territory of Hawaii. At approximately the halfway point en route to Honolulu, she encountered a cyclonic weather disturbance with powerful westerly winds and heavy seas. Strong currents threw the ship off its course. Shortly after 11:00 p.m. on the night of November 29, 1929, while facing torrential rain, high winds, and heavy seas, the *Norwich City* ran aground on Nikumaroro's fringing reef. She ended up hard aground north of what would later come to be known as Tatiman (pronounced "TASS-i-mun") passage, the main inlet to the atoll's lagoon.

Abandoning Ship

Captain Daniel Hamer had the bridge watch when the *Norwich City* grounded. He gave the order to don life jackets and prepare the lifeboats. After three hours, radio contact was made with Apia, Western Samoa. Apia Radio attempted to contact vessels in the vicinity of Nikumaroro, but none could be located closer than 850 miles from the atoll. At 4:00 a.m. smoke was streaming from the engine room. The wireless operator reported the fire to Apia. After lowering the starboard boat to the gunwale, Captain Hamer and the chief officer went to the port boat to lower it. At this point a wave slammed into the weather side of the ship carrying the lifeboat away. Captain Hamer was thrown into the sea 40 feet below and given up for lost although he in fact survived and struggled ashore. Chief Officer Thomas was swept inboard but was not seriously injured. At 5:15 a.m., Thomas ordered the starboard lifeboat lowered, which contained the remaining crew. When they let go the lines, the lifeboat was swept away aft and capsized by waves. All of the men were now in the water at the mercy of the seas. The men were repeatedly swept onto the island's reef and then back out to sea.

The Fate of the Crew

Twenty-four of the *Norwich City* crew members, including Captain Hamer and First Officer Thomas, made it to shore and were later rescued. **Exhibit 1** lists their names and titles, extracted from newspaper accounts.

Eleven crewmen were lost, identified as John James Leslie, John Thomas Jones, James William Horne, Thomas Edward Scott, Francis Sumner, Redman Yousef, Saleh Ragee, Said Metanna, Ayed Naif, Ahmed Hassan, and Ali Hassan. All of these were listed in the official records as "deceased, *Norwich City*."

Three of the eleven lost sailors' bodies were recovered and buried on Nikumaroro by the survivors. Two of them were identified in various reports as Mr. Leslie and Mr. Jones; the latter stumbled ashore, collapsed and could not be revived. The third man buried was one of the six Arab crewmen listed in **Table 1**; his name is to date unknown.

Eight crewmen were not recovered by the survivors. Screams were heard from one of the Yemeni seamen, leading to the surmise that he had been attacked by sharks.

Table 1 SS Norwich City Crew Members who Perished After the Shipwreck on Gardner Island, November 29, 1929							
	Name (1)	Sex	Age (1)	Height (2)	Eye Color (2)	Hair Color (2)	Notes
Crew Members Buried on Gardner/Nikumaroro Island							
1	John James Leslie	M	56	(3)			Buried on the Beach on Gardner/Niku Is. (4)
2	John Thomas Jones	M	30 7/24/1899	5 ft 5.25 in.	Blue	Brown	Buried on Gardner Is. Birthplace: Cogan, Wales (4)
3	A Yemeni	M					One of the Arabs Listed Below was also Buried on the Beach (4)
Crew Members who Were Missing After the Shipwreck (4)							
1	James W. Horne	M	31	(3)			Fourth Engineer, Middle Name William
2	Thomas E. Scott	M	27 1902	5 ft. 9 in.+	Brown	Brown	Fourth Engineer, Birthplace: West Hartlepool, England, Middle Name Edward
3	Francis Sumner	M	18 1911	5 ft. 3 in.	Dark	Gray	Ordinary Seaman, Birthplace Hull, England
4	Redman Yousef	M	23 1904	(3)			Fireman and Trimmer, Birthplace: Aden, Yemen, His CR1 Card height and eye color are blank (4)
5	Saleh Ragee	M	22 (1)	5 ft. 6 in.	Brown	Black	Fireman, Birthplace: Aden, Yemen (4), Ragee's CR1 and CR2 cards list his birth year as 1892, age 37
6	Said Metanna	M	29 1899	5 ft. 4 in.			Fireman, Birthplace: Aden, Yemen (4)
7	Ayed Naif	M	30	5 ft. 9 in.	Brown	Black	Fireman & Trimmer (4) (5)
8	Ahmed Hassan	M	27	(3)			(4) (5)
9	Ali Hassan	M	31	(3)			(4) (5)
1. Source of Name, Sex and Age: Public Record Office (PRO), Kew, England, BT 334/89 92813, "Register of Deaths at Sea 1929-1932". Saleh Ragee's birthdate on his CR1+CR2 is 1892 (age 37). See Exhibit 2 . 2. Source of Height, Eye and Hair Color, Birthday, Place of Birth: PRO, Kew, Eng., BT348/349/350/364. "Central Index Register (CR) of Seaman, 1918-1941". See Exhibits 3 and 4 . 3. The search for CR cards, in particular CR1 and/or CR10 cards listing height, for Horne, Ahmed Hassan, Ali Hassan and for good measure Leslie, who was buried, is ongoing. Yousef's CR1 height data field is blank. For Yousef, and the others, the search for additional records, such as CR10 cards and other records is ongoing. 4. In addition to Leslie & Jones one of the six Arabs above was buried on the beach on Gardner Island. Jones' birthdate, height, eye color and hair color were obtained from a CR10 card. Jones' CR10 card is in Exhibit 3 . Naif's height added in March 2024. 5. The crew agreement dated 05 April 1929 lists addresses for 5 of the lost Arabs as: 132 Commercial Road, South Shields, UK (a boarding house since demolished). Ali Hassan is not listed. However, his name and address are in the Feb. 1930 "Register of Deceased Seaman" (Register of Deaths at Sea) Norwich City entry. He is listed as residing at 16 Princes Dock Street, Hull, UK.							

In summary, eleven men were killed in the wreck of the *Norwich City*. Three bodies were recovered and buried near the wreck site – i.e. on the northwest shore of the island about four miles from the location at the southeast end where bones were subsequently found. The remaining eight men were all missing and presumed dead.

After the Wreck: Reports of Bones on Nikumaroro

In addition to the officially reported 1940 discovery and recovery of the thirteen human bones, human bones were reported on the island on several occasions after the *Norwich City* wreck [13]:

1938, USCG *Taney*

The U.S. Coast Guard Cutter *Roger B. Taney* visited Hull Island in the Phoenix Group (now Orona) in 1938. [14] Captain J.W. Jones lived on the island as a coconut plantation manager for Messrs. Burns, Philp, (South Sea) Company Limited. The following passage is from the report written by the U.S. Department of Interior representative aboard the *Taney*:

"Mr. Jones told us of the wreck of the *Norwich City* on Gardner Island. She struck in 1919 [sic: 1929], and the [ship] *Makoa* saw her [*Norwich City*] recently and stated there was much good material aboard her such as anchors, winches, etc. The bodies of nine [sic] men lost in the wreck, drowned or killed by sharks (he said) were buried ashore, but wild pigs dug them up and their skeletons now lie on the beach. The survivors were taken off the island."

Author Notes: *The Norwich City* wreck is on the end of the island opposite to the "South East [sic] corner" where Gallagher describes recovering human bones in 1940. Jones is quoted as saying that someone aboard *Makoa* saw human bones on the beach, presumably near the *Norwich City* wreck. Note the similar references below by Bauro Tikana and Emily (Segalo) Sikuli. There is a picture of the Gardner/Niku Island colonists roasting a pig.

1941, Dr. Kingsley Rupert Steenson

Dr. Steenson, senior medical officer, examined the bones and artifacts after they were delivered to Suva, Fiji. In addition to his aforementioned reference to "corks on brass chains," he noted in the official file: "they appear to be parts of shoes worn by a male person and a female person."

Author Notes: Dr. Steenson is suggesting the castaway site contained two different pairs of shoes demarcated by gender. This is suggestive, but it does not prove there were two castaways. As noted in Table 2, the bones recovered by Gallagher are likely from one person. The potential pitfalls of determining gender based on how a shoe looks are discussed elsewhere in this report.

1960, Floyd Kilts

The U.S. Coast Guard operated Loran Unit 92 on Nikumaroro Island from 1944 to 1946 inclusive. Floyd Kilts was on duty there in 1946. In July 1960, an article written by Lew Skarr appeared in the San Diego Tribune. [15] Skarr quotes a story Kilts said he was told in 1946 through an interpreter by a “native” on the island. Quoting Kilts in the news story: “It seems that in the latter part of 1938 there were 23 island people, all men, and an Irish magistrate planting coconut trees on Gardner....”

“They were about through and the native was walking along one end of the island. There in the brush about five feet from the shoreline he saw a skeleton.”

“What attracted him to it was the shoes. Women’s shoes, American kind. No native wears shoes. Couldn’t if they wanted to—feet too spread out and flat. The shoes were size nine narrow. Beside the body was a cognac bottle with fresh water in it for drinking.

“Farther down the beach he found a man’s skull, but nothing else.”

Author Notes: *Elements of the Kilts story resemble, and presumably reflect, the story documented in the Western Pacific High Commission files. There were 23 colonists on the island at one point in time, and a skull, shoe parts and a bottle were found while preparing to plant coconuts. Gerald Gallagher was of Irish descent and was nicknamed “Irish.” The possibility that the colonists first found a skeleton and then later a skull is a perspective to consider.*

1991, Bauro Tikana

Mr. Tikana was Gerald Gallagher’s clerk and interpreter in 1940. The following is excerpted from a facsimile (fax) dated August 12, 1991 that Mr. Tikana sent to Ric Gillespie, executive director of The International Group for Historic Aircraft Recovery (TIGHAR):

“When we first arrived (in 1940) I saw the [*Norwich City*] shipwreck and asked Mr. Gallagher about it. He told me that it was the *Norwich City*. Later when the laborers were cleaning (clearing the bush) they told me they found bones near the ship. I do not know if Mr. Gallagher knew about the bones as I didn’t tell him about it. The laborers also told me they found bones on the other end of the atoll when they were cleaning the land in that area. I don’t believe Mr. Gallagher knew of these as he was the only white man there and most of the laborers didn’t speak English and were aghast [sic] to talk to him and Mr. Gallagher didn’t speak Gilbertese. I did all the interpreting for Mr. Gallagher and pass on all his instructions to the laborers.”

1999, Emily (Segalo) Sikuli

Mrs. Sikuli was the daughter of the Nikumaroro carpenter. Emily does not claim to be a witness to the finding of bones near the *Norwich City*, but in interviews with TIGHAR personnel [16] she states that bones were found near the *Norwich City* wreck by fishermen. They were turned over to Teng Koata, the Native Magistrate, who then restricted access to the area. She said the bones were turned over to Gallagher and placed

in a box. It may be that Mrs. Sikuli's recollections are not accurate reflections of events in 1940. But it is reasonably clear that bones were discovered somewhere near the *Norwich City*. A 1999 interview with Otiria O'Brian, [17] who lived on Nikumaroro for a short time, corroborates some of Emily's recollection.

Could the Bones Discovered in 1940 Represent One of the Lost Norwich City Crewmen?

In November 1998, while conducting research at the National Archives in Kew, England, the author obtained the heights of two of the Norwich City crewmen — Thomas Scott and Francis Sumner. This information was obtained too late to be considered in the Burns et al. December 1998 paper [18], which was published a few weeks later. In January 2018, the data were forwarded to Jantz, who had not previously seen them, but it was too late to include in his February 2018 paper. [19] In August 2018 the author uncovered the heights for two missing Yemeni/Arab crewmen named Saleh Ragee and Said Metanna; these were also provided to Dr. Jantz. Given that Ragee's height was very close to the "best estimate" for the castaway's height listed in the 1998 paper, Jantz re-employed FORDISC 3.1 and other methodologies. See **Exhibit 5**. During the ensuing years additional data points had been added to the FORDISC database which improved its ability to estimate height from bone length. Jantz re-estimated the castaway's stature based on Hoodless' measurement of the skeleton's humerus, radius and tibia. Francis Sumner's height (5 ft. 3 in.) places him below the 90-percent confidence interval; thus, it is probable that he is not a candidate to have been the Nikumaroro castaway. Said Metanna (5 ft. 4 in.) and Thomas Scott (5 ft. 9 in+) are near the lower and upper 90-percent confidence limits, respectively, and thus are candidates with a low probability to have been the Nikumaroro castaway. Saleh Ragee's height (5 ft. 6 in.) is close to the most likely height range estimate and thus is a good fit for the Nikumaroro bones. See **Table 2**. Ragee and the other five Yemeni/Arabs listed in **Table 1** have a one-in-six chance of having been buried on the beach.

Table 2
FORDISC 3.1, 20th Century Male Forensic Stature Sample
December 2018 Analysis of Hoodless' Bone Measurements

Below the 90-Percent Interval Lower Limit	90-Percent Interval Lower Limit	Most Likely Height Estimate for the Nikumaroro Castaway	90-Percent Interval Upper Limit
	Ca. 5 Ft. 4 In. (64 In.)	ca. 5 Ft. 6 In. to 5 Ft. 8 In. (66 In. to 68 In.)	Ca. 5 Ft. 11 In. (71 In.)
Francis Sumner 5 Ft. 3 In. (63 In.)	Said Metanna 5 Ft. 4 In. (64 In.)	Saleh Ragee 5 Ft. 6 In. (66 In.)	Thomas Scott 5 Ft 9+ In. Ayed Naif 5 Ft. 9 In. (69 In.)

1. **Personal Communication with Richard Jantz:**
 - a. The 90-percent upper and lower confidence limits were determined from a sample of 20th century male forensic statures. See **Exhibits 5 and 7**.
 - b. The most likely height range assumes the castaway was Euro-American. However, it is doubtful that a Yemeni/Arab reference sample would be different enough to exclude Ragee whose height is around the 50th percentile.
 - c. Ragee is close to the most likely height estimate, which means he is a good fit for the castaway.
 - d. From the measurements of the humerus, radius and tibia provided by Dr. Hoodless, it is close to certain they are from the same person.
2. **The source for the heights of Sumner, Metanna, Ragee, Scott and Naif** is listed in **Exhibit 3**. The plus sign (+) appears on Scott's CR1 card.
3. **The 90% confidence interval** (ca. 5 Ft. 4 In. to 5 Ft. 11 In.) is the range within which you can be 90% certain contains the true average height of the population. With large samples, you know the mean with much more precision than you do with a small sample, thus the confidence interval narrows as the size of the population grows.
4. **There is a 1-in-10 chance** (10 percent) that the estimated height falls outside the confidence interval.

Shoe Parts: Did Gallagher Find a Norwich City Arab's Sandal

Gallagher stated the following about the shoe parts he collected in association with the bones:

"[We found] part of [a shoe] sole [that] "appears to have been a stoutish waking shoe or heavy sandal ... My conclusion ... [that the] Shoe was a woman's... [is] based on sole of shoe which is almost certainly a woman's ... probably size 10."

The senior medical officer in Fiji, Dr. Steenson added: "they appear to be parts of shoes worn by a male person and a female person."

Five of the lost *Norwich City* seamen were Arabs from Yemen. Arab seamen, like almost all non-European sailors aboard steamships, were referred to as lascars, **[20]** and often wore sandals and sometimes went barefoot. This was due to economics, Arabic tradition, and the extremely hot conditions below deck in the engine room where they often toiled. Another reason to wear open sandals or to work barefoot was, for example, to provide a better grip on the decks of dhows. **[21]** Lascar sailors hailed from backgrounds and cultures that included Arabic, Cypriot (Cyprus), Chinese, Indian and East African. **[22]** Sandals are common footwear in all of these locales.

Sandals are an essential part of the tradition and lifestyle of Arabic nationals. Sandals, often open-toed, are the preferred footwear of both Arabic men and women in regions such as Yemen, where heat and humidity make this style of "cooler" footwear preferable.

Arabic tradition does not allow for people to wear footwear/sandals on carpets/rugs or in places of worship; footwear is not usually worn in living quarters. Sandals are popular in part because they are easy to take on and off before entering and leaving living quarters or places of worship.

Heavy-soled sandals are commonly worn by men in the Middle East, Asia, North Africa, and surrounding locales. That was true in 1929, and for centuries before that, as it is today. Arabic sandals are worn at work (in office, agricultural, and industrial settings), and in both formal (e.g. weddings) and informal (e.g. relaxing) contexts.

Norwich City seaman/Arabs Redman Yousef, Saleh Ragee, Said Metanna and Ayed Naif worked in the engine room as firemen/stokers, with Yousef and Naif also serving as trimmers. See **Table 1, Exhibits 3 and 4**. Firemen shoveled coal into the *Norwich City*'s boiler to produce superheated steam for propulsion. The trimmers delivered coal to the firemen from the ship's coal bunkers. These engine room jobs were dirty, low-paid and dangerous. It was not uncommon within the shipping industry for a fireman or trimmer to collapse while laboring in the engine room, where temperatures could reach as high as 120 to 160 degrees Fahrenheit. There are recorded instances of engine room workers becoming temporarily insane, rushing to the deck and jumping overboard to escape the heat. **[23]**

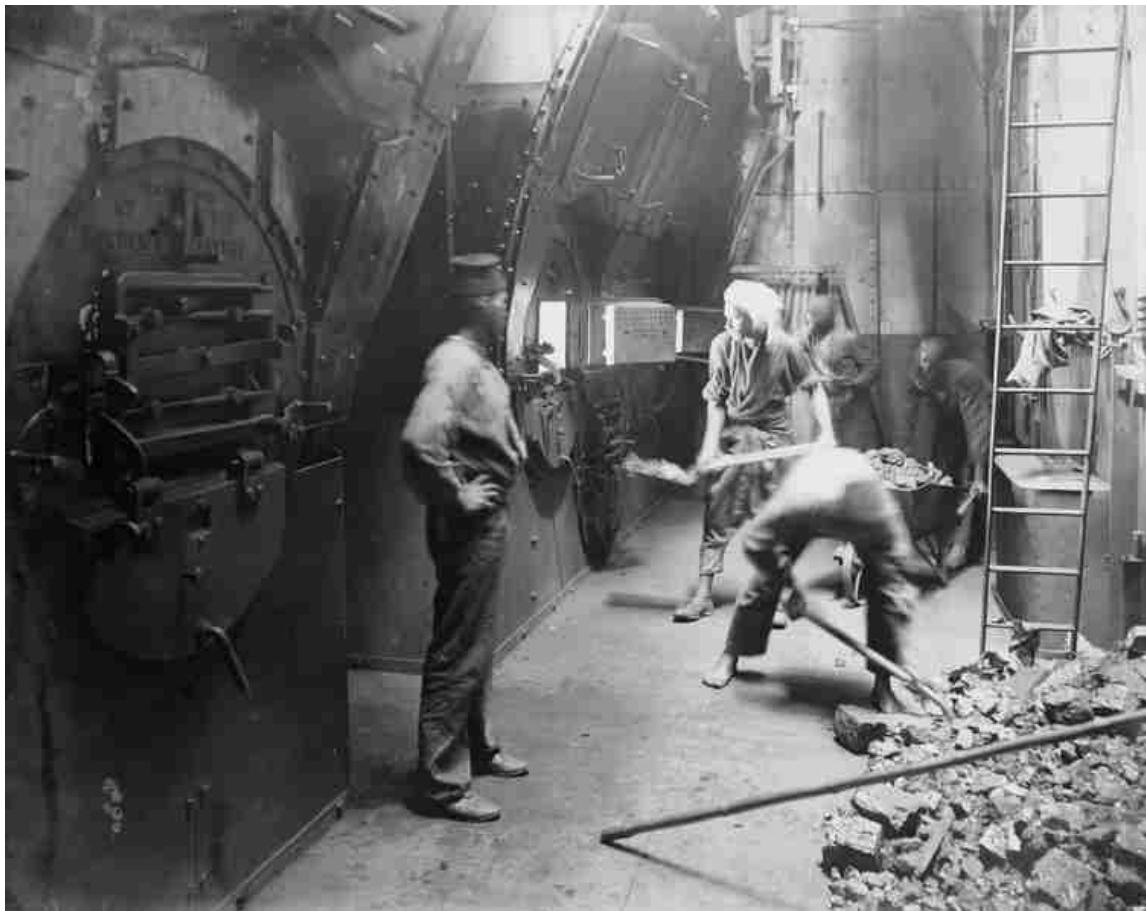


Photo 3

A barefoot fireman (engine department) shoveling coal into the boiler of a British Peninsular and Oriental Steam Navigation Company steamship, ca. 1900

Photo by The Peninsular and Oriental Steam Navigation Company Archive



Photo 4

An assistant electrical officer (engine department) wearing sandals on board a British Peninsular and Oriental Steam Navigation Company steamship, ca. 1900

Photo by The Peninsular and Oriental Steam Navigation Company Archive



Photo 5

The crew of the SS Chybassa, several wearing sandals. The Chybassa was a merchant navy ship of the British India Line, 1917.

Photo by www.iwm.org.uk copyright IWM (Q94607, free to reuse for non-commercial purposes).

Men's Arabic sandals can have a distinctive look that might appear feminine to the eyes of a westerner such as Gallagher or Steenson. The soles of Arabic sandals often have elaborated stitching patterns, as do the uppers. In the Arabic sandals, shown below, note their "feminine" look to the western eye/culture and their thick "heavy" soles. The soles themselves often have intricate designs sewn into them unlike, say, shower sandals or casual sandals worn by men in the western world.



Photo 6
Traditional Arabic men's sandal

Photo by The Desert Boutique Shop



Photo 7
Traditional Arabic men's sandal

Photo by Naal Souq Shop



Photo 8
Vintage sandal relic of the style worn by the Prophet Muhammad

Photo by Topkapi Palace

Corks on Brass Chains: Norwich City Provisions?

The senior medical officer in Fiji, Dr. Steenson, stated after observing the artifacts Gallagher forwarded with the bones: "corks on brass chains would appear to have belonged to a small cask."

Early 20th century ships such as the *Norwich City* used wooden casks to contain water and other liquids; these often-had corks as stoppers, attached by chains. Water casks were often standard issue in lifeboats. The *Norwich City*'s Second Officer, Mr. Lott, reported that there were small water casks (referred to as "breakers") stored aboard the *Norwich City* lifeboats. Lott stated:

"[After swimming ashore] we then gathered what stores we could from the lifeboat. Both boats were washed ashore. ... I found a pool of fresh water on the morning of Saturday. By next morning [it] was turned to salt water and undrinkable. We had the breakers from the lifeboats."



Photo 9
A cork connected by a chain to a cask or breaker

Photo by Andrew McKenna



Photo 10
A cask or breaker with a cork connected to a chain

Photo by Andrew McKenna

Sextant Box, Two Numbers on it, 3500 (stenciled) and 1542

Earhart-Noonan researcher John Kada, with input from fellow researcher Lew Toulmin, published research in October 2018 regarding the aforementioned sextant box Gallagher described. Kada's data indicate that the box, and presumably the reported apparent inverting eye piece, likely belonged to a U.S. Navy survey crew. [24] The USS *Bushnell*'s survey crew camped on the island for seven days, November 28 to December 5, 1939 inclusive. [25] A four-page memo dated November 15, 1938, lists sextant instruments from the *Bushnell*, which were to be sent to the Naval Observatory for maintenance. Item 12 on the list is "Sextant, Brandis N.O. [Naval Observatory] 1542 General Overhaul." The sextant box found on Nikumaroro was marked with the numbers 3500 and 1542. See **Exhibit 6**.

Summary

In 1929, the *SS Norwich City* ran aground on the then-uninhabited Nikumaroro Island within the Phoenix Islands. In 1937, Amelia Earhart and Fred Noonan disappeared in the Pacific presumably somewhere in the region of the Phoenix Islands. In April 1940, colonists supervised by Gerald Gallagher, a British Western Pacific High Commission (WPHC) officer, recovered thirteen human bones on Nikumaroro Island.

Evidence found with the bones (remains of a fire, bird bones) indicated the deceased had lived as a castaway. Artifacts collected with the bones included: parts of shoe(s) that appeared to be a stoutish walking shoe or heavy sandal, a Benedictine bottle, a sextant box and corks attached to brass chains. It was suggested in 1940 that the shoe parts belonged to a woman “based on [the] sole of [the] shoe.” It was suggested the bones might belong to Amelia Earhart. The WPHC had the bones examined by a doctor in Suva, Fiji in 1941. The doctor concluded they belonged to a male about 5 foot 5.5 inches tall. He went on to say the person was “a short, stocky, muscular European, or even a half-caste, or a person of mixed European descent.”

Analyses published in December 1998 and February 2018 posited the bones may have belonged to Earhart. The 1998 analysis presented evidence that Earhart’s height was 5 foot 7 inches to 5 foot 8 inches. A December 2018 analysis, conducted for this paper, of the 1941 bone measurements indicates that the most likely height for the castaway was 5 foot 6 inches to 5 foot 8 inches.

Eight crewmen from the *Norwich City* shipwreck were not located. Heights for five of them have been obtained. Four of them are not likely to have been the castaway; each was either too short or too tall (though none is impossible as a match). The height of the fifth seaman, Saleh Ragee, is listed as 5 foot 6 inches. Ragee is thus a candidate for the skeleton found in 1940. The missing crewmen, including Saleh Ragee, included Arabs from Yemen. Arabs traditionally wear heavy-soled sandals with elaborate stitching, which to a person from a western culture would look feminine. The lifeboats from the *Norwich City* contained wooden casks filled with water that very likely would have had corks on brass chains attached to them. A 2018 paper provided evidence that the sextant box mentioned in the WPHC correspondence was likely from a November to December 1938 U.S. Navy survey of Nikumaroro.

Credits

I am grateful to Dr. Richard Jantz for his prompt replies to inquiries, kind responses and technical expertise. His input, guidance and comments on various drafts are appreciated.

I am also indebted to Tom King. Tom’s suggested edits, expertise and encouragement contributed greatly to the paper. Thank you to Lew Toulmin for commenting on the drafts.

Exhibit 1

Norwich City Crewman Survivors		
1. Captain D. Hamer, Master	2. J. Thomas Chief Officer	3. H.C. Lott, Second Officer
4. C.O. Caldeleugh 3rd Officer	5. W. Willis Chief Engineer	6. D.F. Harkness Apprentice
7. G.B. O'Brien Apprentice	8. D.T. Ross Apprentice	9. T.G. Stephenson, Apprentice
10. P. Stockbridge Cook	11. H. Pearson, Messroom Boy	12. G. Bradshaw Galley Boy
13. J.R. Harrison Boatswain	14. G. Islister Able Bodied	15. A. Walker Able Bodied
16. J.C. Hitchcock Able Bodied	17. A. Leiper Able Bodied	18. H. Rowlands Second Engineer
19. T. Clark Wireless Operator	20. C. Durant Cabin Boy	21. Cassim Hassan, Donkeyman
22. Abdul Hassin, Fireman	23. Mohamed Nassa Fireman	24. Abdul Wahab, Fireman

The SS Norwich City Sailors Signed onto the Ship at Hull, UK on August 27, 1929.

Exhibit 2
BT 334/89 92813
“Register of Deaths at Sea, 1929-1932”
From Microfiche at the Public Record Office, Kew, England

Exhibit 3:

British Merchant Seaman Records: Summary of CR Cards

The Merchant Navy Seamen (see **Exhibit 7**) (1918-1941) records include Central Indexed Register of Seaman Cards which is sometimes referred to as the Fourth Register of Seamen Index Cards. The term “Central Register” is abbreviated CR (i.e. CR cards). The United Kingdom’s (U.K.) Registrar General of Shipping and Seamen used the index between the two world wars to produce a centralized index of merchant seamen serving on British merchant vessels. The U.K.’s Board of Trade issued these cards. This report discusses three types: CR1, CR2 and CR10. There are two or more cards for some individuals. The CR cards are in volumes within the U.K.’s National Archives record series BT 348, BT 349, BT 350 and BT 364.

The originals are held by the Southampton Archives. The Central/Fourth Register was started in 1913; however, the records for 1913 through 1917 were destroyed.

CR1 cards have data fields for, among other things:

Discharge Assigned No. (Dis. A. No.), birthdate/place, sailor’s height and eye/hair color. Each sailor was assigned a unique “discharge assigned” number (Dis. A. No.), similar to a social security number, and a Seaman’s Discharge Book (SDB). The SDB contains a record of the sailor’s sea time, certificates the sailor earned and the ships on which he served.

CR2 cards have data fields for only: Dis. A. No., Certificate of Competency No., birth year/place, rank/rating, ship and date of engagement (no physical characteristics of the sailor). Certificate of Competency is a form of license granted to mariners to work on ships. CR10 cards are similar to CR1 cards. They have data fields for among other things: Dis. A. No., birthdate/place, sailor’s height and eye/hair color, nationality and next of kin information.

The seaman CR1 cards containing height information for “lost” *Norwich City* sailors were located for Scott, Sumner, Ragee, Naif and Metanna. See **Table 1**. “Lost” seaman CR cards for Horne (CR2) and Yousef (CR1 and CR2) were located but those CR cards do not list their heights. The CR cards that have been located to date are below in **Exhibit 4**. Note that John Thomas Jones, who was buried on the beach, is the only sailor so far with a CR10 card. Locating Horne’s, Yousef’s and the two Hassans’ CR1 or CR10 cards, if they exist, may reveal their heights. When this research was started in 1998 the records were accessed on microfiche at the Public Record Office in Kew, England. Many of the CR records are now available at www.findmypast.com.

O.R.

Deceased ^{Dis. A. No.} 918548
esc" ^{for C.R. 160. 1925}
Cert. of Compy. No.

Name of Seaman

Birth: Year

Place

Rank or Rating

J. W. Horne
4th Engr

Name and Official No. of Ship

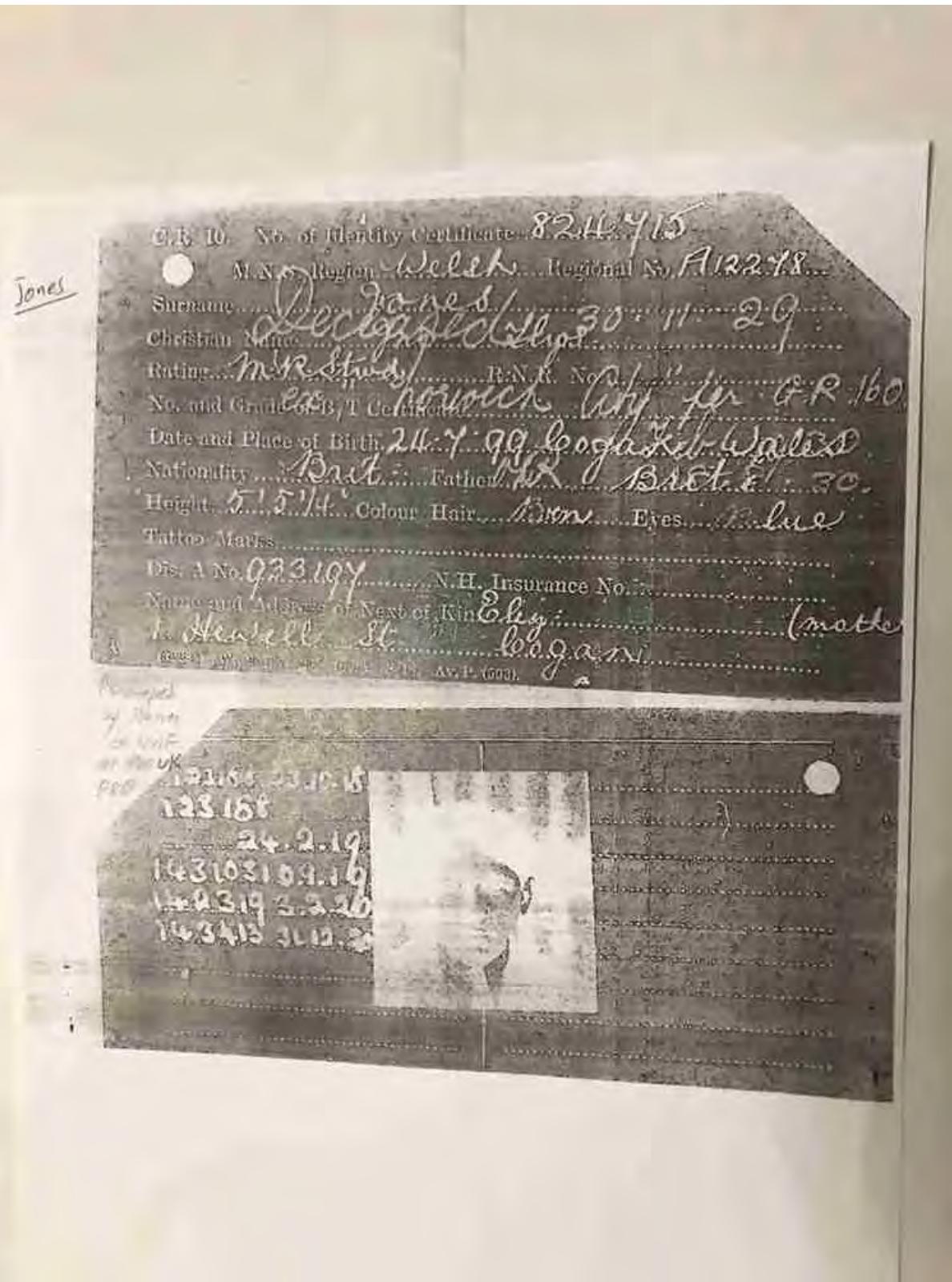
Date of Engagement

Jersey City
140861



[M917] 15423/000 300m 9/22 1937 G & S 151 3

140858 30 4 23
140857 7 12 24
144398 12 8 46
148832 5 5 29
132596 5 4 29



C.R. 1

Deceased 30.11.29 rec "Fowey
by"

Surname METANNA for C.R. 100. Feb. 1930

[in CAPITALS]

Christian Name said 182 39 8 58

Birth : Year 1899 Place Aden

Dis. A. No. R66798 Rating Seaman R.V. 2 No.

Certificate (if any) : Grade No

Health Insce. No. Unemployment Insce. No.

Height 5' 4" Colour Eyes brown Hair black

Complexion Coloured Distinguishing marks scar on

left temple

(9915) 28730/485.60m (4) 5/26 C. & S., Ltd. 188

[TURN OVER]

Fowey City
DECLARATION TO BE MADE IF OCCASION ARISES.

I hereby certify that I am not now in possession of an unfilled
Continuous Certificate of Discharge (Board of Trade, Irish Free State, or
Canadian) for the following reason :—

Dis/ previously

Signature of Seaman

said X Metanna

Dated Stamp of M.M.O.



G.R. 2

Deceased A. No. 30. Rb. 6798.

● ex " norwich city " Cart. of Compy. No. G.R. 162

* Name of Seaman Said Metanna Feb. 1930

Birth: Year 1899 Place Aden 1902 90 8 30

Rank or Rating T'man

Name and Official No. of Ship

Date of Engagement Dis

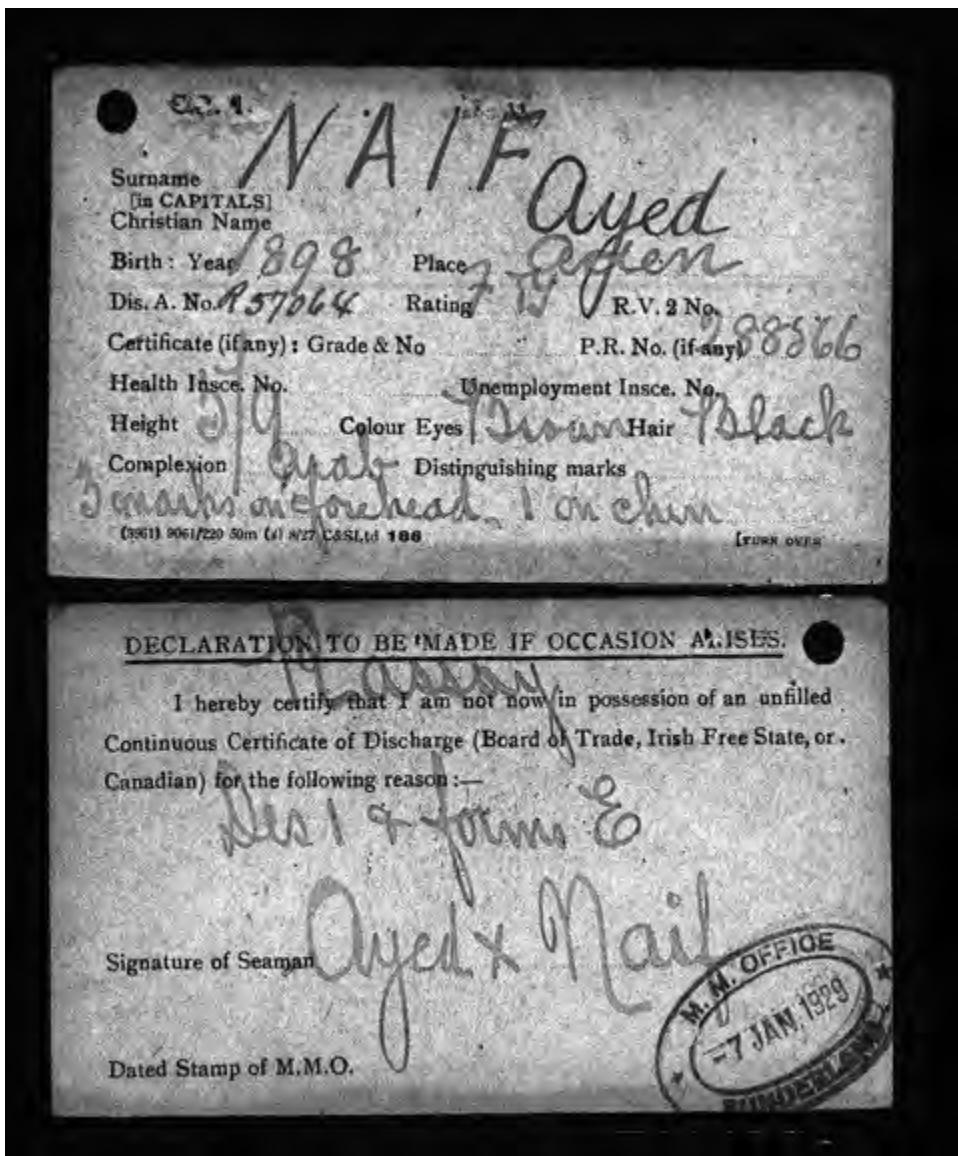
(Stamp of M.M.O.)

Norwich city

23 8 99

* If Dis. A. is not produced, the surname should be in block capitals.

(7401) 26746/71 300m (J8) 5/29 C&SLtd 186





C.R. 2.

Dis. A. No. 107064

Cert. of Compy. No. 1

Name of Seaman Alfred Hart

Birth: Year 1888 Place London

Rank or Rating Fireman 1st class

Name and Official No. of Ship	Date of Engagement
<u>Hornbeam</u> <u>132596</u>	(Stamp of M.M.O.) <u>5-11-29</u> <u>NEWCASTLE-ON-TYNE</u>

[4806] 20690/324 300m (18) 1/28 C.&S.Ltd., 186

Alfred Hart
107064
1-12-29
(C&S)

C.R. 1

Surname RAGEE
[in CAPITALS]
Christian Name Saleh
Birth: Year 1892 Place Aden
Dis.A.No R66809 Rating Seaman R.V.2 No _____
Certificate (if any): Grade _____ No _____
Health Insee. No _____ Unemployment Insee. No _____
Height 5' 6 Colour Eyes Brown Hair Black
Complexion Coloured Distinguishing marks _____

(9915) 28730/485 50m (4).5/26 C. & S., Ltd. 186

[TURN OVER]

Gorwic City

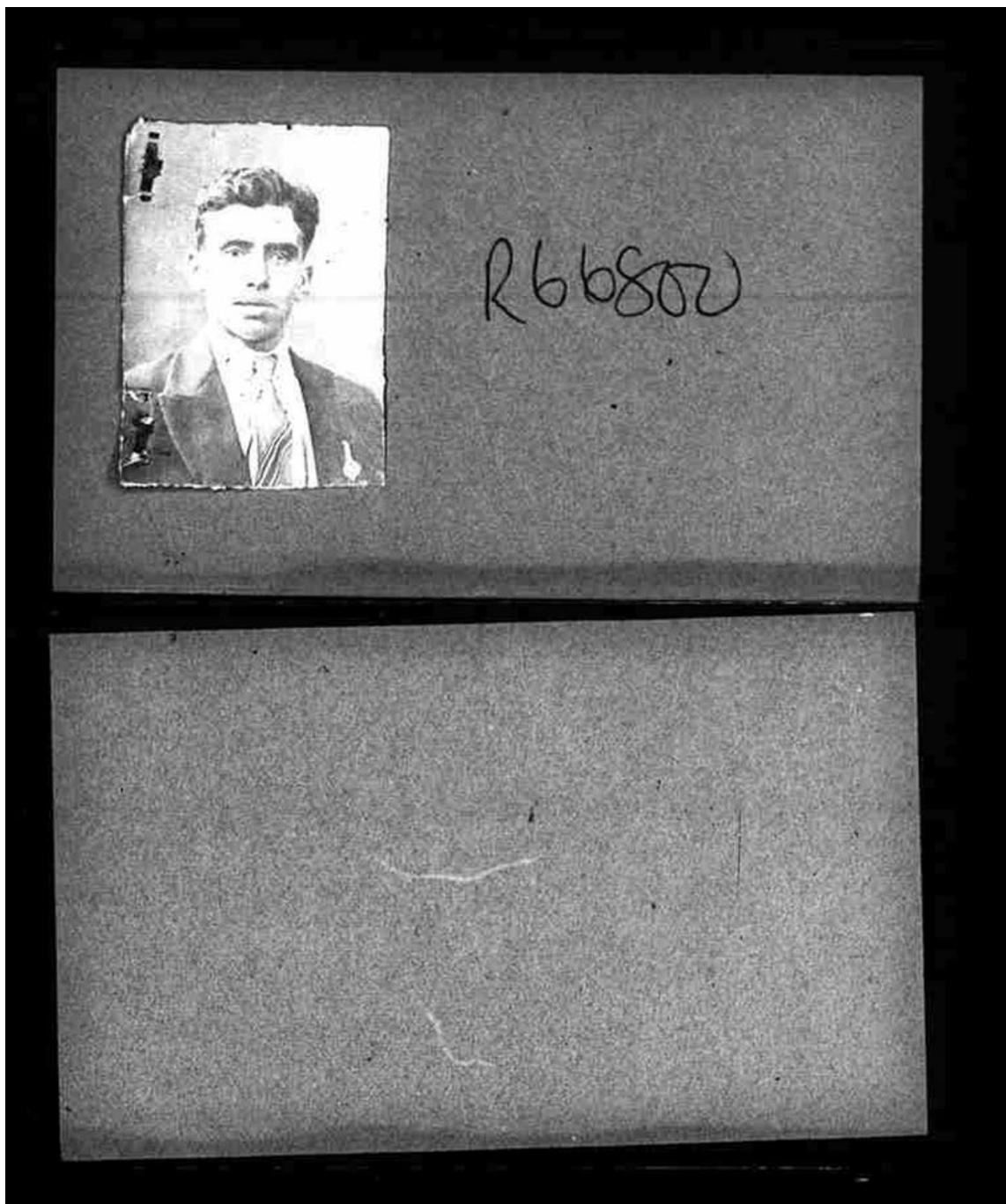
DECLARATION TO BE MADE IF OCCASION ARISES.

I hereby certify that I am not now in possession of an unfilled Continuous Certificate of Discharge (Board of Trade, Irish Free State, or Canadian) for the following reason:—

Signature of Seaman Saleh X Ragee

Dated Stamp of M.M.O.





G.R. 2

Dis. A. No. *Pb6800*

Cert. of Compy. No.

Name of Seaman.....

Saleh Pagee

Birth: Year *1892* Place *Aden*

Rank or Rating.....

T'man

Name and Official No. of Ship

Date of Engagement *Dis*

(Stamp of M.M.O.)

Norwich Lily

23.8.29

*If Dis. A. is not produced, the surname should be in block capitals.

(7401) 26746/71 300m (18) 5/29 C&SLtd 186

C.R. 1. <i>Deceased</i> 30.11.29	
Surname <i>Mc Gregor</i> SC 94 T for GR 160 Feb 1933	
[in CAPITALS] Christian Name <i>Howard Edward</i> RR 4-9-30	
Birth: Year	1902 Place <i>Woolloomooloo</i>
Dis. A. No.	18369 Rating <i>Seaman</i> R.V. 2 No.
Certificate (if any): Grade _____ No. _____	
Health Insee. No. _____ Unemployment Insee. No. _____	
Height <i>5'9 1/4</i>	Colour Eyes <i>Brown</i> Hair <i>Brown</i>
Complexion <i>Medium</i>	Distinguishing marks <i>Signature</i>
[M4200] 11302/122 50m 9/21 1941 G & S 151 2	
TURN OVER	
<u>DECLARATION TO BE MADE IF OCCASION ARISES.</u>	
<p><i>At the present</i> I hereby certify that I have not hitherto received a Continuous Certificate of Discharge for the following reason:— <i>At the present</i> </p>	
Signature of Seaman	<i>J. E. Scott</i>
Dated Stamp of M.M.O. 	

A Lost Sailor or Amelia Earhart?

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C.R. 1.

Deceased 30.11.99'

Surname SUMNER
[in CAPITALS] esc "Norwell City" for £2.100 Feb. 1930.
Christian Name Frank. 1928 8.9.30.

Birth: Year 1911 Place Hull

Dis.A.No 6.33176 Rating OS R.V.2 No —

Certificate (if any): Grade — No —

Health Insce. No. — Unemployment Insce. No. —

Height 5' 3" Colour Eyes grey Hair dark.

Complexion medium Distinguishing marks —

(9915) 28730/485 50m (4) 5/26 C. & S., Ltd. 186

[TURN OVER]

DECLARATION TO BE MADE IF OCCASION ARISES.

Anno 142293
I hereby certify that I am not now in possession of an unfilled
Continuous Certificate of Discharge (Board of Trade, Irish Free State, or
Canadian) for the following reason:—

1st application

Signature of Seaman F. Sumner

HULL
31.OCT.1922

Dated Stamp of M.M.O.

Exhibit 4

SS Norwich City Crew Members Who Were Missing After the Shipwreck Central Register Cards and Birthplace						
	Name (1)	Sex (1)	Age (1)	Height (2)	CR Cards Found	Notes
	See Notes	M				One of the Yemeni/Arabs Listed Below was also Buried on the Beach
1	James W. Horne	M	31	(3)	CR2	CR1 or CR10 cards, if they exist, contain a field for height.
2	Thomas E. Scott	M	27 1902	5 ft. 9 in.+	CR1 CR2	Birthplace: W. Hartlepool, England
3	Francis Sumner	M	18 1911	5 ft. 3 in.	CR1	Birthplace Hull, England
4	Redman Yousef	M	23 1904	(3) (4)	CR1 CR2	Birthplace: Aden, Yemen (4) His CR1 Card height and eye color fields are blank. His CR10 cards, if it exists, contain a data field for height.
5	Saleh Ragee	M	22 (1)	5 ft. 6 in.	CR1 CR2	Birthplace: Aden, Yemen (4), Ragee's CR1+CR2 cards list his birth year as 1892, age 37
6	Said Metanna	M	29 1899	5 ft. 4 in.	CR1 CR2	Birthplace: Aden, Yemen (4)
7	Ayed Naif	M	30	(3)	CR1 CR2	(4)
8	Ahmed Hassan	M	27	(3)		(4)
9	Ali Hassan	M	31	(3)		(4)
1. Source of Name, Sex and Age: Public Record Office (PRO), Kew, England, BT 334/89 92813, "Deaths at Sea 1929-1932." Saleh Ragee's birthdate on his CR1+CR2 is 1892 (age 37) See Exhibits 2 and 3 . 2. Source of Height, Eye and Hair Color, Birthday, Place of Birth: PRO, Kew, England, B348/349/350/364, "Central Index Register (CR) of Seaman, 1918-1941." See Exhibit 3 . 3. The search for CR cards, in particular CR1 and/or CR10 cards listing height, for Horne, Ahmed Hassan, Ali Hassan is ongoing. Yousef's CR1 height data field is blank. For Yousef and the others, the search for additional records, such as CR10 cards is ongoing. 4. In addition to Leslie and Jones who are listed in Table 1 , one of the six Arabs listed in this table was also buried on the beach on Gardner Island. A CR10 card for Jones is in Exhibit 4 .						

Exhibit 5

Statistical Methodology Used for Table 2

(The following exhibit is derived from personal correspondence with Dr. Richard Jantz.)

The *Norwich City* crewmen were male, so male samples were analyzed for this report. Three samples were analyzed for this report: forensic statures for 20th century males, measured statures World War II males (Trotter), and cadaver statures for 19th century males. Three bone lengths (Humerus (H), Radius (R), and Tibia (T)) and four cumulative bone lengths (H+T, H+R, R+T and H+R+T) were plotted on the x-axis versus height on the y-axis (i.e., seven sets of x-y data within each sample, 21 total). A confidence interval with upper and lower limits was calculated for the 21 sets of x-y data.

The bone length values for the Nikumaroro castaway were tabulated: H=324 mm, R=245 mm, T=372 mm, H+T=696 mm, H+R=569 mm, R+T=617 mm and H+R+T=941 mm. The castaway's bone length(s) were marked on the x-axis of the plots that represented that x-axis variable. For example, the castaway's humerus+tibia value of 696 mm was marked on the three x-y plots representing humerus+tibia versus height (one H+T plot for each sample). A vertical line above that bone(s) length (e.g., 696) revealed three points on the sample's x-y plot: i) upper and ii) lower 90-percent confidence limits (CL) and iii) a best height estimate (point estimate) for a person with the castaway's bone length(s). A prediction interval (PI) was then calculated for those three points (i.e. 21 PIs total). The PI equals the absolute value of the difference between the upper and lower CL divided by two, which is the distance between the castaway's best height/point estimate and the CL limit above or below the point estimate. PI is a measure of dispersion. Lower PIs indicate estimates that are less dispersed. These are generally given greater weight than estimates with higher PIs, which are more dispersed.

With PIs obtained from a combination of the x-y sets of data and the castaway's bone length(s) in hand, the lowest PI from the seven possibilities was identified within each of the three samples. Any PI within the sample that shared the lowest PI was also selected. For example, the T and H+T PIs were equal within each sample. This filtering process led to 11 PIs corresponding to CL limits associated with a best height estimate. From this filtration process, a global minimum lower 90-percent confidence interval value and a global maximum upper 90-percent confidence interval value from the 11 choices were selected. These CL values were then adopted as the overall 90-percent confidence interval (64 to 71 inches) for the height of the castaway. In addition, a most likely height estimate range for the castaway, 5 foot 6 inches (66 in.) to 5 foot 8 inches (68 in.), was determined from the aforementioned 21 best height estimates (point estimates) for a person with the castaway's bone length(s). See **Table 2**.

Exhibit #6

Sextant Box Paper Excerpt (with added details)

Derived from John Kada's weblog posting titled "The Probable Origin of the Nikumaroro

Sextant Box" Source: <https://gardnerghost.blogspot.com/2018/10/the-origin-of-nikumaroro-sextant-box.html> with information added by Kenton Spading

Date of original weblog: October 26, 2018

Gallagher stated the sextant box had two numbers on it 3500 (stenciled) and 1542. Sextants (and their boxes) in the early decades of the twentieth century were often marked with two numbers. One is the sextant manufacturer's serial number. The other is a number assigned by the U.S. Naval Observatory, which had the task of inspecting and maintaining sextants to include those used by the U.S. Navy.

From November 28 to December 5, 1939, roughly four months before the castaway's remains were found, the USS *Bushnell*, a U.S. Navy submarine tender, visited Nikumaroro [Gardner] Island. She was outfitted as a hydrographic mapping vessel sent to survey the island, its lagoon and surrounding sea bottom. The *Bushnell* made a short trip to McKean Island during this period leaving the lagoon survey party camped on the island. Maps of the survey illustrate that a network of reference points were established throughout the island. The work included measuring water depths from boats making transects across the lagoon.

Earhart-Noonan researcher John Kada uncovered a hydrographic surveying manual published by the U.S. Coast and Geodetic Survey in 1931. It illustrated that sextants were used to triangulate/determine positions on land-based reference points when making transects of this sort.

In December 2016, Kada visited the National Archives and Record Administration (NARA) in Washington D.C. to view Bushnell records. He confirmed through the Nikumaroro survey notes that sextants were utilized on the island in 1939. The notes did not include sextant numbers.

Kada's second trip to NARA in August 2018 also did not uncover any information on the Bushnell's sextants. The trip was prompted by a sextant box-related paper that fellow researcher Lew Toulmin presented at the May 2018 Earhart-Noonan Symposium during the Archaeology Channel Conference on Cultural Heritage Media in Eugene, Oregon.

Toulmin's research also included an earlier trip to NARA. At NARA Toulmin examined an index card catalog for NARA's holdings of the U.S. Naval Observatory's correspondence for the period 1909-1925. The card catalog was organized by subject and included a card for sextants.

Kada's third visit to NARA in October 2018 revealed a four-page memo from the USS *Bushnell* dated November 15, 1938, listing sextant instruments to be sent to the Naval

Observatory. Item 12 on the list is "Sextant, Brandis N.O. [Naval Observatory] 1542 General Overhaul." A note penciled into the margin indicates that this sextant was returned to the Bushnell on January 17, 1939. This documented that a Brandis sextant with N.O. number 1542 was refurbished by the Naval Observatory in late 1938 and returned to the Bushnell by January 1939, about one year before the Bushnell crew surveyed Nikumaroro. It is probable that the sextant box found on Nikumaroro marked with the numbers 3500 and 1542 was a Brandis sextant box that a Bushnell surveyor lost.

Exhibit 7

Definitions

90-Percent Confidence Interval The upper and lower height values between which 90 percent of the estimated heights of a given sample are expected to fall. It is assumed that an unknown data point, such as the bones discovered on Nikumaroro Island, will fall within these limits, as long as it is drawn from the same or similar population used to estimate the confidence limits.

The term "90-percent" indicates that 90 percent of the experiments, in this case measuring heights of many individuals, include the true mean/average, but 10 percent will not. There is a 1-in-10 chance (10 percent) that the confidence interval does NOT include the true mean. Thus, the interval could shift upwards or downwards over the course of many experiments.

Able-Bodied seamen perform general maintenance, repair, sanitation and upkeep of material, equipment, and superstructure areas in a ship's deck department. Maintenance can include chipping, scraping, cleaning, priming, and painting a ship's metal structures.

Aft is the rear (stern) of a ship as you face forward.

Apprentices typically work in the deck or engineering departments of a ship. Apprentices can advance to be officers or another higher-ranking seaman.

Boatswains are in charge of hull maintenance and related work. The hull is the watertight body of the ship.

Breaker: As a nautical term: A small water cask often used in lifeboats. Credit to Richard Gillespie, executive director, The International Group for Historic Aircraft Recover for reviewing this report and alerting me to Second Officer Lott's quotation regarding breakers.

Cabin Boys wait on the officers of a ship and run errands for the captain.

Chief Engineer is responsible for the engine room and maintenance and other machinery and support systems on a ship, both above and below the ship's deck. The chief sometimes has a rank similar to the master/captain.

Chief Officer is second-in-command after the ship's master/captain.

Confidence Limits: These are the numbers at the upper and lower end of a confidence interval.

Donkey-men are in charge of a donkey-engine, a small steam-engine, usually for subsidiary operations on board ship, as in feeding the boilers of the propelling engines.

Fireman or stoker is a seaman who tends the fire for the boiler to power the steam engine. The British Merchant Navy utilized the term firemen). Much of the job is hard physical labor, such as shoveling fuel, typically coal, into the boiler's firebox.

Forward means toward a ship's bow.

Fourth Engineers work in the engine dept. They are responsible for electrical, lubricating oil, bilge and other tasks. They are sometimes referred to as asst. engineer or 3rd Eng.

Galley Boys assist in the ship's kitchen.

Gunwale: The gunwale is the top edge of the side of a boat or ship.

Master is the highest grade of licensed mariner, qualified to serve as the captain of a merchant ship of any size or type. In the British Merchant Navy a master, who has command of an ocean-going merchant ship, is titled captain.

Merchant Navy is a term given to commercial (civilian) passenger and shipping fleets in the United Kingdom (U.K.). The United States' "Merchant Marine" is equivalent to the U.K.'s Merchant Navy. In the U.K. the military/naval fleet is called the Royal Navy.

Mess Room Boy duties are many and varied. They include coffee, assistant cook, pantry, waiter, dishwasher, bedroom steward, and porter.

Population The broader group of individuals for whom you intend to generalize your height estimates in an analysis of the sample. For example, the population might be all the Arab males living in Yemen. The sample is a subset of the population.

Port is the left side of a ship as you face forward.

Sample A group of individuals for which, for example, heights were recorded. For example, the height of 2,000 male Arabs living in Yemen.

Second Officer is the third-in-command on a merchant vessel.

Starboard is the right side of a ship as you face forward.

Third Officer is customarily the ship's safety officer and fourth-in-command.

Trimmers ensured that the coal was evenly distributed within the holds of the ship as it was fed into the boilers. This ensured that the "trim" or level of the ship was not adversely affected. Trimmers fed coal to the firemen through chutes or often in carts, which were dumped near the boilers.

Wireless Operators operate the radio transmitter on a ship.

Exhibit 8 **Errata**

1. The paper's title was changed from:

Lost Norwich City Crewmen: Potential Sources for the Human Remains Discovered on Gardner Island (now Nikumaroro Island) in 1940

To:

A Lost Sailor or Amelia Earhart? Lost Norwich City Crewmen: Potential Sources for the Human Remains Discovered on Gardner Island (now Nikumaroro Island) in 1940

To better align with the intent of the paper to discuss the lost sailors as a source of the castaway as an alternative to Amelia Earhart

2. Under “Re-analysis of the Hoodless Measurements”:

Changed from:

If female: ca. 5 foot 6.1 inches to 5 foot 7.6 inches

If male: ca. 5 foot 8.0 inches to 5 foot 8.4 inches

Confidence Interval (male and female): ca. 5 foot 4 inches to 5 foot 10 inches.

To:

If female: ca. 5 foot 6 inches to 5 foot 7 inches

If male: ca. 5 foot 7.5 inches to 5 foot 8.5 inches

Confidence Interval (male and female): ca. 5 foot 4 inches (64 in.) to 5 foot 10 inches (70 in.).

To better track with the discussion on page 9 of the 1998 Burns-Jantz paper [10].

3. Under “Re-analysis of the Hoodless Measurements”:

Two references to 1941 were changed to 1940.

The bones were discovered in 1940. Hoodless performed his analysis in 1941.

4. Under “After the Wreck: Reports of Bones on Nikumaroro” “1938, USGC Taney”

Changed from:

There is no historical record of wild pigs living on Nikumaroro prior to its settlement as part of the PISS in 1938-39; Jones' description of the bodies having been excavated by wild pigs appears to be conjecture. Erosion is the more likely culprit followed by the scattering of the bones by coconut crabs.

To:

There is a picture of the Gardner/Niku Island colonists roasting a pig.

Note: A picture was posted on TIGHAR's Earhart forum showing the USCG crew from the Niku Loran station enjoying a pig roast with the islanders.

5. Table 1, Footnote No. 5

Changed from:

A Welsh Newspaper listed the addresses for the 6 Arabs as: 132 Commercial Road, South Fields, which is perhaps a boarding house.

To:

The crew agreement dated 05 April 1929 lists addresses for 5 of the lost Arabs as: 132 Commercial Road, South Shields, UK (a boarding house). Ali Hassan is not listed. However, his name and address are in the Feb. 1930 "Register of Deceased Seaman" (Deaths at Sea) Norwich City entry. He is listed as residing at 16 Princes Dock Street, Hull, UK.

6. Table 1, Ayed Naif

Naif's height (5 ft. 9 in.) was added to **Table 1 and Table 2**. References to Naif were adjusted in the Table 1's footnote, in **Exhibits 3 and 4** and elsewhere as needed.

Naif's CR1 card with a photograph was added to **Exhibit 3**.

7. Exhibit 1, Table of Norwich City Crewman Survivors

No. 14 G. Isbestes

Changed to:

G. Islister

No. 23. Mohamed Noss

Changed to:

Mohamed Nassa

Isbestes is not listed in the 05 April 1929 crew agreement. The adopted spelling is from the The Times of London dated 05 December 1929. Nassa's spelling is adopted from the crew agreement. The agreement is housed at the Memorial University of Newfoundland, Maritime History Archive, St. John's, Newfoundland, Canada.

END

Citations

[1] Richard Gillespie Interview with Eric Bevington, January 22-23, 1992, TIGHAR Tracks, Vol. 8, No. 1/2: p. 6, First on the Scene, March 12, 1992.

https://tighar.org/Publications/TTracks/1992Vol_8/0801_2.pdf

[2] Personal Correspondence between Tom King and Harry Maude.

[3] As they were then referred to; now I-Kiribati

[4] Gerald Gallagher, Kiribati National Archives, Tarawa, KNI 11/I, File 13/9/1, Discovery of Human Remains on Gardner Island, September 23, 1940.

https://tighar.org/Projects/Earhart/Archives/Documents/Bones_Chronology.html

[5] Gallagher, Steenson et al., Western Pacific High Commission Archive, Library and Archives Section of the Foreign and Commonwealth Office, Hanslope Park, England, File No. M.P. 4439 – 1940, Skeleton Human — finding of on Gardner Island.

https://tighar.org/Projects/Earhart/Archives/Documents/Bones_Chronology.html

[6] See https://en.wikipedia.org/wiki/Heliotropium_foertherianum

[7] See https://en.wikipedia.org/wiki/Karl_Pearson, Personal communication from Dr. Richard Jantz: Hoodless made small arithmetic errors or typos in his calculations. His most significant error was using a constant of 89.925 instead of 85.925 as suggested by Pearson for the radius, i.e., 4 cm too large. This resulted from Hoodless not consulting Pearson's original paper. This same error is in the textbook Medical Jurisprudence and Toxicology by Modi, which has persisted through about 16 editions of the text. Whether Hoodless therefore consulted a medical text containing that error, by Modi or another, is unknown.

[8] Richard Jantz, *Forensic Anthropology*, Vol. 1, No. 2: 83-98, Amelia Earhart and the Nikumaroro Bones, A 1941 Analysis versus Modern Quantitative Techniques, February 2018. <http://journals.upress.ufl.edu/fa/article/view/525/519>

[9] https://everipedia.org/wiki/lang_en/FORDISC/

[10] Burns, Jantz, King, Gillespie, *American Anthropological Association Annual Convention*, Amelia Earhart's Bones and Shoes? Current Anthropological Perspectives on an Historical Mystery, December 5, 1998.

https://tighar.org/Publications/TTracks/14_2/14_2bones.pdf

[11] Cross, Wright, *Journal of Archaeological Science*, Vol. 3, 52-59, The Nikumaroro Bones Identification Controversy: First-hand Examination Versus Evaluation by Proxy — Amelia Earhart Found or Still Missing, September 2015.

<https://www.sciencedirect.com/science/article/pii/S2352409X15300109?via%3Dihub>

[12] Personal communication from Richard Jantz: Hoodless wrote 324 in his report. The 1998 paper (Citation 10) erroneously lists 325. This will be corrected in a future paper. The results presented in the 1998 paper will change slightly. The overall conclusions in the 1998 paper stand.

[13] Note that many people were buried on Nikumaroro during the colonial period 1938 to 1963 inclusive, so any reports of human remains post-dating about 1940 are likely to be colonial graves exposed by erosion.

[14] Richard B. Black, Report of Eleventh Cruise of American Equatorial Islands of Jarvis, Baker and Howland and to other islands in the South Seas, p. 7, November 13, 1937, (Saturday) Phoenix Islands, Hull & Sydney. The original is available at the U.S. National Archives and Record Administration, Department of the Interior records.

[15] Lew Skarr, *San Diego Tribune*, San Diegan Bares Clues to Earhart Fate, July 21, 1960. <https://tighar.org/Projects/Earhart/Archives/Documents/KiltsStory.html>

[16] King-Gillespie Interview with Emily Sikuli, July 15 and 27, 1999, TIGHAR Tracks, Vol. 15, 25-30, The Carpenter's Daughter, 1999. https://tighar.org/Publications/TTracks/15_1/carpentersdaugh.html

[17] Tague-Gillespie Interview with Otiria O'Brian, January 19 and 26, 1999, TIGHAR Tracks, Vol. 15, 19-24, Mrs. O'Brian, 1999. https://tighar.org/Publications/TTracks/15_1/mrsobrian.html

[18] Burns, Jantz, King, Gillespie, *American Anthropological Association Annual Convention*, Amelia Earhart's Bones and Shoes? Current Anthropological Perspectives on an Historical Mystery, December 5, 1998. https://tighar.org/Publications/TTracks/14_2/14_2bones.pdf

[19] Richard Jantz, *Forensic Anthropology*, Vol. 1, No. 2: 83-98, Amelia Earhart and the Nikumaroro Bones, A 1941 Analysis versus Modern Quantitative Techniques, February 2018. <http://journals.upress.ufl.edu/fa/article/view/525/519>

[20] Florian Stadtler and Rozina Visram, Arts and Humanities Research Council. (n.d.). The Lascars: Britain's Colonial Sailors. Retrieved from <https://www.ourmigrationstory.org.uk/oms/the-lascars-britains-colonial-era-sailors>. The Persian word lashkar (army) derives from al-askar, the Arabic word for a guard or soldier <https://en.wikipedia.org/wiki/Lascar>

[21] Dionisius A. Agius, *Seafaring in the Arabian Gulf and Oman: The People of the Dhow*: p. 140, Routledge, Taylor and Francis Group, New York and London, ISBN: 0-7103-0939-2, 2005, Digital: 2009.

[22] Florian Stadtler and Rozina Visram, Arts and Humanities Research Council. (n.d.). The Lascars: Britain's Colonial Sailors. Retrieved from
<https://www.ourmigrationstory.org.uk/oms/the-lascars-britains-colonial-era-sailors>.

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<https://www.gjenvick.com/OceanTravel/SteamshipCrew/1900-TheHardLifeAndWorkOfASteamshipStoker.html>

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<https://gardnerghost.blogspot.com/2018/10/the-origin-of-nikumaroro-sextant-box.html>

[25] William B. Coleman, Captain, USS *Bushnell*, Gardner [Nikumaroro] Island Survey Operations, Progress Report - 16 November to 17 December 1939 inclusive, Part I: 5-7, Daily Log of Events, December 19, 1939. Retrieved from
[https://tighar.org/wiki/USS_Bushnell_Survey_\(1939\)](https://tighar.org/wiki/USS_Bushnell_Survey_(1939))