

PYKRETE

WHEN RUBE GOLDBERG MET THE ABOMINABLE SNOWMAN...MAYBE

INTRODUCTION – World War II spawned numerous ‘truth is stranger than fiction’ stories. Including this one about an eccentric who dreamed of building immense ships made of ‘Pykrete’...a mixture of wood pulp and ice...and who also convinced high-ranking British authorities to pursue the improbable concept. Over time, this tale’s authenticity has been compromised during repeated retellings by careless storytellers.

Interest in the concept, however implausible as it now seems, resulted in a small scale prototype being created in 1943, and later abandoned at a remote location in Alberta, Canada. Remains of that sunken prototype are marked by this unusual plaque; located underwater!

That much of the story is indisputably true. Usually, I have little trouble separating fact from fantasy. But in this case what I was initially sure was fantasy turned out to be fact...and vice-versa.



Plaque submerged in Patricia Lake

It reads: A secret WWII project involving the use of ice in ship production. This vessel, built January to April 1943, was a prototype. For more information, contact the Canadian Park Service, Jasper.

Much of what can be found on-line about Pykrete is inconsistent and incomplete. Even authoritative sources are either fragmentary or downright contradictory.

DISCLAIMER – So, in a departure from my norm of only using documented and independently confirmable data, I offer the following tale of innovative engineering, spiced in places by what is likely equally innovative storytelling. I leave it to the reader to ponder what is factual...what is fantasy...while remembering that truth is often stranger than fiction.

Bill Lee

OPERATION HABBAKUK – The British, in particular, love to assign seemingly innocent code names to projects and operations that in actuality hold hidden meaning. For example, ‘Operation Chariot’, was an audacious, but successful World War II operation in which an obsolete destroyer, loaded with explosives rammed and blew up the gate of the largest dry dock in France; thereby denying its use to German occupational forces.

Operation Habbakuk (sic) was a code name employed by the Admiralty’s Directorate of Miscellaneous Weapon Development. It evolved, albeit mis-spelled in the process, from the following biblical quotation found in the Hebrew Bible’s Book of Habakkuk:

“Behold ye among the heathen, and regard and wonder marvelously; for I will work a work in your days, which ye will not believe, though it be told to you.”

Thus was established a fairly prophetic code name for a top secret project to build unimaginably huge aircraft carriers...improbably constructed principally of reinforced ice! Each of these projected vessels was to be between 2,000 and 4,000 feet in length, with a beam of 300 to 600 feet. A calculated hull thickness of 35-40 feet was expected to make them highly resistant to torpedo attack, but would have resulted in a displacement of one to two million tons per ‘berg-ship’.

Their intended use was to create floating air bases sailing slowly in the middle of the Atlantic Ocean that would be invulnerable to enemy attack by virtue of their extreme size. They were expected to support hundreds of British combat aircraft to help protect allied convoys from otherwise largely invulnerable roving packs of German U-boats.



Certainly, words like audacious, outlandish and inconceivable...in the case of this design concept...hardly suffice to describe the imagination of that department's thinkers and dreamers. Some of their other ideas became celebrated flops that are possibly worthy of a future essay. But lest it be thought that all of their ideas were far-fetched, it should be noted that they developed some very practical and useful weapons during World War II.

The most successful of which was the well-known and still used 'hedgehog' weapon, which is a ship-mounted, multiple-barreled mortar that allows a vessel to fire anti-submarine rockets over their bows. Coupled with the dropping of depth charges as a destroyer steamed over a hapless U-boat, the combination was...and is...deadly.

GEOFFERY PYKE – The invention of 'Pykrete' is often attributed to its namesake, although this Brit was neither an inventor nor a scientist...nor even the originator of the Pykrete concept. Rather, he was an eccentric adventurer and opportunist whose wild ideas occasionally caught the fancy of British officials desperate for new weapons of potential.



Geoffrey Nathaniel Pyke was born in 1894. In 1914, just a teenager, he went to Berlin, supposedly as an innocent British correspondent for London's *Daily Chronicle*. But the Germans detained him after World War I began and considering shooting him as a spy. Sent, instead, to an internment camp, he escaped and later wrote extensively (and perhaps imaginatively) of his exploits.

After the 'war to end all wars', he made a small fortune in the stock market, then lost it all in the 1929 crash. To provide his son the kind of education he thought proper, Pyke founded a school for boys where the students were not punished or reprimanded, or forced to learn any specific subject matter. Instead, they were encouraged to learn about things that interested them. After Pyke lost his fortune the school was forced to close.

During the Spanish Civil War, he fitted motorcycles with sidecars designed to carry hot food to the front...and then carry wounded soldiers to treatment stations behind the lines. By 1939, when world war was again imminent, he joined...at his own bold invitation...a British think-tank organization, where he began to propose outlandish ways to influence the outcome of World War II. Most of his ideas were dismissed. But one...involving the use of Pykrete... caught the attention of no less a personage than Winston Churchill.

After that war, Geoffrey Pyke was reportedly briefly involved in the creation of Great Britain's National Health Service. He then produced a series of articles filled with peacetime projects he felt would be beneficial to mankind. His ideas repeatedly rejected, Pyke, at age fifty-four, shaved off his beard, swallowed a bottle full of sleeping pills and bade goodbye to what he considered an unappreciative world in 1948.

PYKRETE INVENTED...AND NAMED – Multiple versions of how the properties of Pykrete were discovered...and by whom...exist. Based on reliable documentation and accounts provided by one of the principals involved in its naming, the benefits of adding wood pulp was the discovery of two American researchers. A report they created was seen, apparently in late 1942, by Geoffrey Pyke, who found it ‘hard to understand’.

He passed it on to Max Perutz, a colleague at the Directorate of Miscellaneous Weapon Development, who later became a Nobel Prize recipient. He provided Pyke with an understanding of the superior properties of augmented ice, According to an account provided years later by Perutz, it was he who named the material ‘Pykrete’.

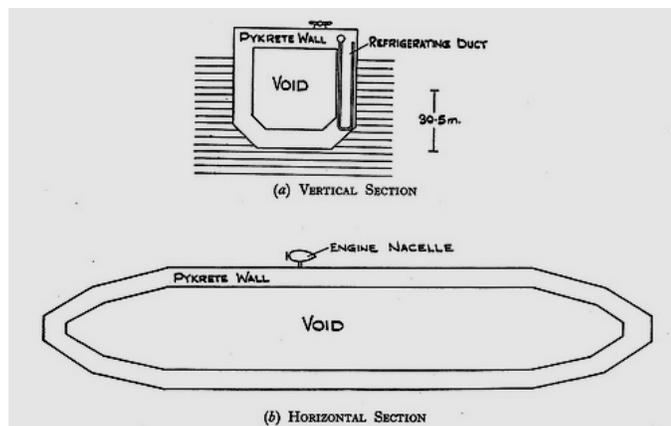
In parallel, Pyke was promoting the idea of creating massive ‘berg-ships’ to the British military hierarchy, although his first writings on this subject simply proposed the use of huge blocks hewn from Arctic ice. Perutz, amongst others, called that idea ‘imaginative, but absurd’, pointing out several flaws in the theory...including thawing and the propensity of pure ice exposed to wave action to fracture under its own weight.

Nevertheless, Pyke’s ‘imaginative, but absurd’ suggestion was seriously considered by high-ranking British officials, including Lord Mountbatten, chief of Britain’s wartime combined military operations. In turn, Mountbatten informed Prime Minister Winston Churchill, who was always receptive to novel ideas that might be beneficial in wartime.

At some juncture, Pyke’s original ‘berg-ships’ became associated with the superior properties of ice reinforced with wood pulp. Obviously, that added information further captured the imagination of Churchill and Mountbatten. That’s when Operation Habbakuk was initiated...on the strength of a supporting memo from the Prime Minister.

PROPERTIES OF PYKRETE – Ice, which is usually quite brittle, will shatter when struck. But when a slurry that contains fourteen percent of wood pulp (or just sawdust) is frozen solid, it becomes ‘super-ice’, with much higher tensile strength. A rifle bullet, fired at a block of pure ice will shatter it. A similar-sized bullet fired at a block of Pykrete will not, but will only penetrate to the same degree as a projectile fired at brickwork.

Slightly denser than pure ice, Pykrete will float but take far longer to melt. Its mechanical properties are far superior to those of pure ice. In theory, a ship’s hull made of Pykrete would be virtually unsinkable. Pipes embedded in the thick sides and bottoms of such a vessel to circulate cold air would supposedly keep the hull frozen.



CONFLICTING ACCOUNTS OF BREAKING THE ICE – There are two unsubstantiated stories associated with how Churchill and others in the British government were introduced to the properties of Pykrete. Both have some documented basis, albeit short on detail. Over time, these tales have become embellished and repeated in several variations. Nevertheless, they are just too entertaining not to repeat.



British records clearly indicate that Lord Mountbatten provided Churchill with information and a sample of Pykrete as part of an effort to elicit the Prime Minister's support. What may have actually been a routine presentation in an office setting has now become legend...as follows.

In late 1942 or early 1943, Mountbatten reportedly visited Churchill at his country home in order to show him a sample of Pykrete. A member of the domestic household staff informed the military man that the Prime Minister was taking a bath. "Good," said Mountbatten as he bounded up the stairs. "That's exactly where I want him to be."

Mountbatten boldly entered a steaming bathroom, where he found the Prime Minister luxuriating in a tub of very hot water. Ignoring the fact that it was not wise to interrupt Sir Winston in his bathtub, Mountbatten opened a parcel he was carrying and indelicately dropped its contents between the Prime Minister's bare legs.

It was a block of Pykrete. It floated. It did not melt, even after being in the steaming bath water for a considerable period of time. The Prime Minister was fascinated. And that was how serious consideration of the use of Pykrete for military purposes supposedly started.

Another story also involves Lord Mountbatten, at least in some versions. Its basis is a conference held in Quebec in 1943, in which British officials were seeking American help with technical problems and the huge cost (\$100 million in 1940's dollars) associated with creating ships made of Pykrete. Here's the most 'popular' version, although the senior British official involved may have been some one else, entirely.

At the conference, the British presented two blocks of frozen material; one made of pure ice, the other of Pykrete for the dubious Americans' inspection. To dramatically demonstrate the superior properties of the ice mixture, Mountbatten (or, more likely, some other British high-ranking military figure) unexpectedly took out a revolver and fired at the block of ice...which shattered immediately.

He then fired a second shot at the block of Pykrete. The bullet barely made a dent as it ricocheted, narrowly missing one of the conference's high-ranking British participants. The Americans were impressed. Not so much, the British chap who was almost wounded.

The end result of that conference was to commit to creating an ice-ship prototype in a remote part of Canada; far from any enemy observation. But was it made of Pykrete?

PATRICIA LAKE PROTOTYPE – The site selected for this unlikely project was near Jasper, Alberta. Suitably cold and remote, this tranquil fresh water lake was adjacent to a military training base, so increased activity there would not have been unusual.



The original plan was to build a 1/10 scale prototype of a ship's hull made of ice. This ambitious plan was soon downsized to create a box-like structure measuring just sixty feet long, thirty feet wide and about 20 feet tall.

Like so many aspects of this story, differing accounts exist about the prototype. Several 'assume' it was built of Pykrete. In fact, it was not. By the time a block of the stuff was unceremoniously dumped into Sir Winston's bath water, he had already authorized further investigation into Pyke's idea of building huge ships from plain ice.

In a memo stamped 'MOST SECRET' and dated December 7, 1942, he wrote: *"I attach greatest importance to the prompt examination of these ideas. The advantages of a floating island or islands, even if only used as refueling depots for aircraft, are so dazzling that they do not need at the moment to be further discussed."*

Construction started in January of 1943. A wooden-framed cabin-like structure was built on frozen Lake Patricia. Ironically, most of the labor was provided by local conscientious objectors, who had no idea that they were potentially contributing to the war effort. Refrigeration equipment and cold-air ducts were installed, and blocks of lake ice were installed in the cabin's walls and atop its flooring.

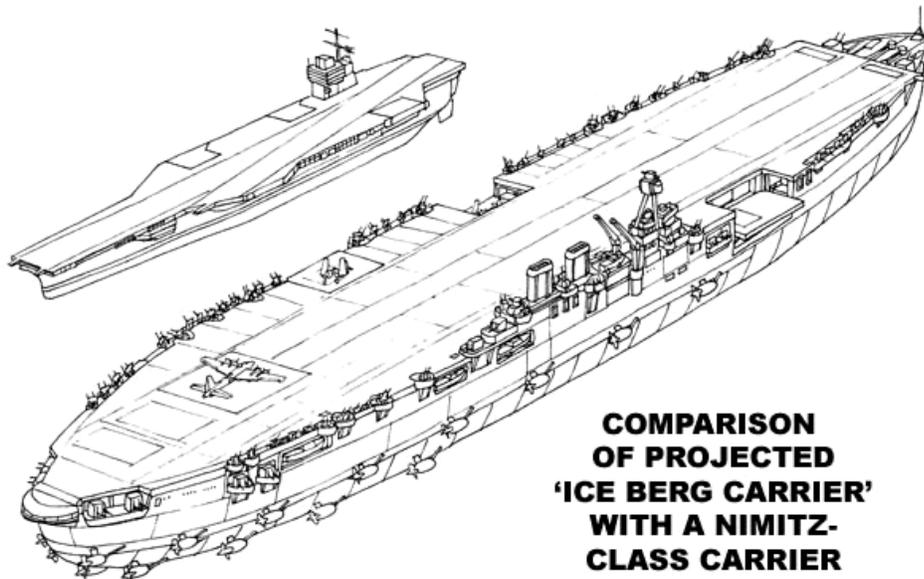




When the structure, topped with a roof to protect the refrigeration equipment was freed by that year's spring thaw, it floated as expected. In June of 1943, the refrigeration equipment was switched off. But the ice-ship prototype took all summer to melt before allowing the prototype's cooling equipment to sink to the bottom of the lake. Where it still remains, greatly deteriorated, but marked by a suitable plaque placed underwater that serves today as a curiosity for recreational divers.

STILL-BORN SHIPS – No large vessels were ever built of Pykrete. By the time the ice-ship prototype was completed, the rapid development of radar, long range aircraft, 'baby flattop' aircraft carriers, and destroyer escorts, augmented by breaking the German naval code had begun to win the Battle of the Atlantic for the Allies. In the Pacific, large conventional American aircraft carriers were rapidly leading the way to victory.

Although some conceptual plans for aircraft carriers built of Pykrete were created, that's as far as Pyke's dream ever got. One can only wonder if...and where...building such outlandishly large vessels might have taken place. The impracticability of this scheme is perhaps best demonstrated by contrasting an artist's perception of such a huge vessel [below, right] with a similar-scaled drawing of a NIMITZ-class aircraft carrier [upper, left].



**COMPARISON
OF PROJECTED
'ICE BERG CARRIER'
WITH A NIMITZ-
CLASS CARRIER**

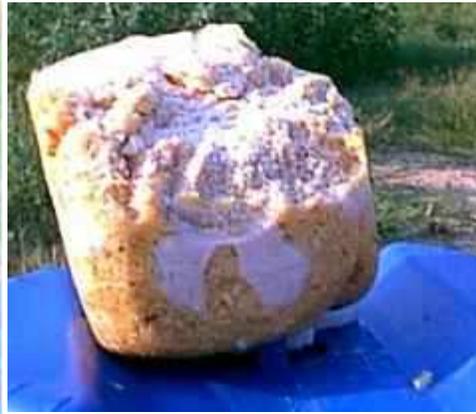
POSTSCRIPT – This odd footnote in history refuses to go away. In recent years, there has been at least one attempt to demonstrate the properties of Pykrete, and another to prove that such a vessel...albeit of much smaller size...could be constructed and used.

In 2000, blocks of Pykrete and pure ice were created, using one-gallon milk jugs. The Pykrete was ten percent sawdust by weight. After being frozen for a week, the plastic containers were stripped away and the bare blocks subjected to rifle fire. The results of that experiment pretty much validates the superior properties claimed for Pykrete.

What happens when you shoot Pykrete?



Pykrete Before



Pykrete After

What happens when you shoot ice?



Ice Before



Ice After

A decade later, the BBC sponsored an attempt to build a small watercraft of Pykrete to demonstrate its superior properties. That effort was a comical failure, as depicted on the next page. Even after being subjected to sub-zero temperatures in an ice house for three weeks, the twenty foot-long boat began to melt immediately after being immersed. Observing engineers noted the boat was too small, with relatively thin sides, and the test was conducted in waters far warmer than an ice-ship would have experienced.



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