Air and Space this Week

Item of the Week

Aircraft Carrier Development: Two Key January Moments

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KEY WORDS: Aircraft Carrier Eugene Ely Curtiss Angled Deck Buell

"A tailhooker fresh out of tech,
Asked God to help save his neck.
The Lord heard his plea
From far out at sea,
And sent him the first angled deck"

By Harold L. Buell, in "Dauntless Helldivers,"
New York: Orion Books, 1991, page 270

This week's Item is tied to these anniversaries of two January events critical in the creation and evolution of the modern aircraft carrier:

January 18, 1911: Eugene Ely, flying a Curtiss "Pusher" biplane, made the first aircraft landing on a ship (*U.S.S. Pennsylvania*, ACR/CS-4), using a primitive arresting-gear setup.

January 12, 1953: The Navy's first carrier landing on an angled deck was made by the CO of the *USS Antietam*, Capt. S.G. Mitchell, who landed aboard in an SNJ.

The adoption of the airplane by the U.S. Army for military purposes came less than a decade after Kittyhawk. The use of the new invention for naval purposes was recognized at the same time, but was more difficult to implement with the prevailing technology.

The airplanes of the day did not require a long runway to get airborne; a decked-over part of a large, slow ship would be enough. But landing a pre-WWI airplane on a moving ship at sea posed a tremendous challenge. Even though the landing speed was relatively low, there was a problem with the length of the landing runout. A large, flat deck would be required.

What was needed was a way to shorten the landing zone on a yet-to-be-built/converted ship. But first, could a plane actually take off from, and land on, a ship?

Eugene Ely was a colorful guy. After graduating 8th grade, he knocked around a bit and ended up as a chauffeur to the local priest. Both had a love for speed, and the priest had a very fast car. Ely ended up in San Francisco in time for the Earthquake, and was involved in automobile sales and racing. Ely married and ended up in Oregon, selling cars. His boss bought a Curtiss 4-cylinder biplane for kicks. He couldn't handle flying it, so Ely stepped forward – and crashed the plane. He bought the pieces from his boss, fixed it up, and learned to fly it. He got his pilot's license in 1910, and went to work for Glenn Curtiss as an exhibition flyer.

During the Taft administration, the Secretary of the Navy was not a proponent of the use of airplanes by the Navy. But he appointed Capt. Washington Chambers to be in charge of the development of naval aviation in the Navy's Bureau of Ordinance. This was a great choice!

Ely and Curtiss met with Capt. Chambers and discussed the use of planes aboard naval warships. Chambers liked what he heard, and set up two experiments that would show the practicality of ship-based launching and landing of airplanes, both to be flown by Ely (a civilian).

The Navy provided the use of the light cruiser *USS Birmingham*. A temporary wooden platform was built over its bow, and on November 14, 1910, Ely took off in a Curtiss Pusher aircraft. The platform was 83 feet above the water in Hampton Roads, and Ely needed all 83. The Pusher was below stalling speed when Ely cleared the bow, and barely gained enough speed while going down to pull level, wheels dragging the water. But it did prove that a taking off from a ship was possible. Also of note, the *Birmingham* was not under way for the test. Had it been, the airflow over the deck platform would have helped Ely get aloft (of course, if he had crashed on take-off, the *Birmingham* would have run over him….).

Taking off from a ship was relatively easy compared to landing on one. Something had to be done in order to reduce the length of deck necessary for the landing, and to protect planes/personnel on the deck forward if there was a problem on landing. But how to do it?

Ely and Curtiss were helped by Curtiss' Chief Engineer, Hugh Robinson, a future circus performer and all-round daredevil. They came up with the idea of affixing a hook to the landing aircraft and placing a set of ropes weighted with sandbags at their ends across the landing area. The pilot would snag one of the ropes with the hook just as he neared touchdown, and the weight of the rope and sandbags would arrest the plane's forward motion. [BTW: Curtiss was a daredevil, too, loving speed in any vehicle. He managed to mount a V-8 engine on a heavy-duty bicycle, and set a land speed record with it at Ormand Beach, Florida, on January 23, 1907. He got the thing up to 136 MPH (!!!), with open bevel gears inches from the rider's ankles. There is a coda to this aside; see the Didja Know? section.]

The *Birmingham* was not suitable for the landing test, so Ely took his Pusher out to California, where the armored cruiser *USS Pennsylvania* was anchored in San Francisco Bay. A temporary wooden deck platform and the new arresting rope system had been installed, and on January 18, 1911, he used it to land successfully on the *Pennsylvania*.

The Navy was now convinced that the airplane had value, but it took a few years to get the ball rolling. In 1920, the naval collier *USS Jupiter* was highly modified to include a large flight deck and hangar area beneath. It already was the first Navy ship with a turbo-electric drive, and now it was the first Navy aircraft carrier, renamed the *USS Langley* (CV-1; although she was affectionately called the "Covered Wagon").

The ensuing decades would see advances in propulsion, plane-handling, arresting technology, and more. By WWII, aircraft carriers, designed from the keel-up as carriers of aircraft, were coming off the ways in large numbers. Their flight decks ran the length of the ship, and planes took off under their own power, unassisted.

Combat operations in WWII revealed some deficiencies of the prevailing carrier design. The planes were getting much faster and heavier, and hence required more room for their take-off run and heavier arresting gear for their landings. Having both takeoff and landing functions on the same deck was a problem, too. Planes missing their arresting wires would likely crash into planes and personnel involved in launching operations. There was a barrier that was used between the two areas, but there were a number of cases where it was not sufficient, and any plane running into the barrier would be seriously damaged, and personnel would be hurt, or even killed. There were times, too, when a plane faltered at takeoff and the rapidly-moving carrier would run over the plane and pilot, to the detriment of all concerned.

After the War, the problems became even more acute as the world's major navies moved to jet propulsion. Jet engines, especially the early ones, spooled up too slowly to allow for a safe takeoff, even if the full length of a WWII-era flight deck was available. Some sort of catapulting process was required. Low-power catapults used to launch float planes from cruisers had been in use for more than a decade; a much heavier-duty catapult was becoming progressively necessary.

The jet's higher landing speed also was causing safety problems. If the plane slowed down enough for the arresting gear to work well and missed the arresting wires, it couldn't regain flight speed fast enough to avoid going into the ocean in front of the carrier.

The solution was one of those things that engenders a "Why didn't I think of that?" response.

Royal Navy Captain Dennis Campbell came up with a novel idea, one he called the "skewed deck." The idea was to separate the landing and takeoff areas on a carrier's deck. Planes would be catapulted off the front of the carrier, and they would land aft, but on a flight deck angled away from the ship's centerline, so that landing wouldn't interfere with launch operations. Such an arrangement would also allow the plane to land at a higher speed, so that a "bolter," a landing plane that misses the arresting wires, had a fighting chance to touch-and-go and try again.

The Royal Navy conducted tests of the skewed-deck concept in 1952. They painted angled lines denoting the skewed deck on the conventional decks of the *HMS Triumph* and *HMS Midway*. The carriers retained their arresting gear and barriers, aligned with the original landing direction, but in spite of that, the tests showed the superiority of the skewed-deck concept.

The U.S. Navy was watching Campbell's brainchild closely. They arranged a test more realistic than skewed lines on a conventional flight deck. They took the *USS Antietam*, an Essex-class carrier that entered service at the very end of WWII and was then supporting military operations off Korea, built a sponson (deck overhang) on its portside, and set up a true angled landing deck, complete with arresting gear perpendicular to the landing direction.

The results were a resounding success, and the pilots, not just famed dive bomber Buell, loved the safety factor the angled deck provided. The brass loved the angled deck, too; it greatly improved the efficiency of flight operations.

The remaining in-service Essex-class carriers received the alteration to an angled flight deck as part of the SCB-125 general upgrade of the mid-1950s, along with the steam catapult and landing mirror. Every carrier built for the last half-century have angled flight decks, too.

Other links/references:

USS Antietam report: http://www.ussantietam.com/files/canted_deck_evaluation.doc

The Naval Officers Club of Australia: https://www.navalofficer.com.au/angled-deck

Aviation Boatswain's Mates Association: https://www.abma-usn.org/carrierlife

Defense Media Network: https://www.defensemedianetwork.com/stories/naval-aviation-centennial-from-props-to-jets-and-angled-decks

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