Air and Space this Week

Item of the Week

Skipping Stones, Sinking Ships, Busting Dams

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May 16/17 is the anniversary of one of the most unusual bombing attacks of World War II, the destruction of two large dams in Germany by the use of large, spinning bombs that would skip across the dam's reservoir, strike the top of the dam, and spin down its face to the optimum detonation point. Skipping flat stones across the water is a familiar activity for many children (including Ronnie Howard), and the concept had been applied earlier in the War with conventional bombs, but busting dams with bombs that bounce was another story. This one.

Skipping Stones

I grew up in the Finger Lakes region of western New York. It was a wonderful place and time to be a child there, with lots of woods, creeks, glens, and other interesting places to explore. The weather wasn't all that great, and the geology (except for the post-glacial stuff) was pretty ho-hum, with lots of flat-lying Devonian sandstones and shales. I was in college before I saw metamorphic or igneous rocks *in situ*! But fissile shale and quiet lakes provided the perfect opportunity to skip ideally-shaped rocks spectacularly. My friends and I became quite adept and getting 15 or more skips, and an ending glide, with most of our skipping attempts. To make things more challenging, we sought out rounder rocks to showcase our skipping prowess, and we found that, with the proper throw, we could make a near-spherical rock skip satisfactorily, especially if we threw it on a very flat trajectory with reverse spin. Bad golfers (like me) know that trick, too. A skulled shot over a pond would sometimes skip upon hitting the water, often more than once, even all the way to the other side, saving a few strokes to be wasted later in the round.

Sinking Ships

Dive bombers face a difficult three-dimensional problem when they try to sink a moving ship: down-range, cross-range, and time. Bombs from high altitude allow fast-moving ships to take effective evasive action starting when the bomb drop is observed. One way to simplify the problem is to dive to very low altitude before releasing the bomb; another is to reduce the three variables to two by using a torpedo (when it worked right) instead of a bomb. In that case, the two factors are azimuth and time. Evasive action could still be effective in those cases where the torpedo run is long enough to allow the target ship to turn directly toward or directly

away, “combing the wakes” by presenting their narrow width rather than their length to the oncoming torps.

Torpedoes are heavy, and at least early in the War, they were not reliable. Bombs, on the other hand, almost always went “boom” when they were supposed to; the problem was getting them on target.

Some RAF pilots must have had a boyhood experience with skipped stones that I had, and they began experimenting with flying low and fast when releasing bombs. If their speed and height were favorable, the bombs would skip along several times before sinking out of sight. They spread the word to their brothers-in-arms in the Southwest Pacific (SWP). The results were amazing. Unsuccessful conventional bombing attacks had been carried out twice against two invasion ships heading toward Gasmata (a small copra town on the southern coast of New Britain Island, the *Kinryu Maru* and the *Kozui Maru*. Three Hudson bombers tried the skip-bombing technique on February 11, 1942, and hit them both. One of the Hudsons was lost. Neither ship sank, but both were damaged. The *Kinyru Maru* would later be sunk by dive-bomber Christian “Never Miss ‘Em” Fink during the Battle of the Eastern Solomons. The *Kozui Maru* was torpedoed and sunk by the submarine *U.S.S. Grayback* (SS-208) on October 15, 1943.

General George Kenney was in charge of the U.S. air forces in the SWP at that time. He had a number of early model B-25 Marauder medium bombers available, and he had a real “ace-in-the-hole,” Major Paul Gunn, a most-capable innovator. Kenney had the good sense to run interference for “Pappy” Gunn, rather than cause it (Gunn, like Gregory Boyington, was a bit older than the rest of the men in the command, hence, the nickname – although I might have opted for “Pop” in his case!).

The Japanese were using relatively small (and hard to hit) freighters to support their advances in the SWP. One of Gunn’s most effective experiments was converting B-25s from bombers to strafers. He pulled the bombsite and bombardier’s position out of the nose of some the B-25s and replaced them with a bank of .50 caliber machine guns, and added additional gun pods aside the cockpit. With the top turret aiming forward, a strafer B-25 would have a dozen fifties firing in the direction the plane was flying. Flying such a strafer against a heavily armed and armored ship would have been suicide, but against smaller warships and cargo ships without as many anti-aircraft guns, the concentrated fire was devastating (a .50 round could easily penetrate a half-inch steel hull plate and a bunch of them coming in at once could really tear up a smaller ship’s superstructure and defensive gunners). The other effective experiment was skip-bombing.

The Japanese were no strangers to low-level torpedo attack, and they were quite good at evading by turning toward/away, presenting a much narrower, and more difficult, target. But this skill would betray them when Pappy’s newest creation, and the eagerly-adopted skip bombing tactics, were tried for the first time on a larger scale.

Here’s the dilemma. Turning toward or away from a *torpedo* bomber was an excellent evasive maneuver. But that maneuver was **exactly the wrong thing** to do against a strafer or skip bomber (some of Gunn’s creation had both capabilities). Presenting one’s stern or bow to a

strafer/skipper allowed their entire deck to be hit during one strafing run. One of the problems faced by the skip bomber was having their bomb actually skip over the target, but with the full length of the target ship presented to them, that problem was diminished.

One of the first times skip-bombing and strafing B-25s was used on a larger scale was at the Battle of the Bismarck Sea. The Japanese tried to send in eight cargo ships with men and supplies to reenforce beleaguered garrisons on New Guinea from their big base at Rabaul, on New Britain Island. They were escorted by eight destroyers. Thei convoy's destination was the port of Lae in northwestern New Guinea (its airstrip was the one from which Amelia Earhart made her last-ever take-off). The trip would take three days, March 2-4, 1942. The first part of the trip was covered by bad weather, but a reconnaissance aircraft spotted the ships, setting the stage for a large attack. The B-25 strafers were ready, and they had other aircraft and P-38 fighters for support.

The result was a major debacle for the Japanese. By the time it was over, four of the destroyers were sunk, as were all eight of the cargo ships (some accounts list nine). Most of the troops were lost (some had been sunk, rescued, then sunk again). The only ones who weren't were on the few cargo ships sunk the first day; destroyers rescued a number of them and took them to safety (not their destination), and themselves out of the battle. The battle scenes were pretty chaotic, and there was a lot of duplication of ship damage/sinking reports; General McArthur insisted for long afterward that the attack was even more successful than it actually was – in spite of codebreaking and other evidence to the contrary. But it was devastating enough! The skip bombing, and the strafing, had produced spectacular results, so much so that an escort carrier was named the "U.S.S. Bismarck Sea" later in the War (CVE-95). The carrier supported the U.S. invasion of the Philippines and was sunk off Iwo Jima by a concentrated *kamikaze* attack on February 21, 1945. She would be the last U.S. carrier lost to the Japanese.

Busting Dams

The idea of skip bombing was not confined to the SWP, and Pappy Gunn wasn't the only innovator in coming up with effective bombing/strafing tactics. An even more-impressive display of both cropped up in the ETO.

Barnes Neville Wallis was born on September 26, 1887, in Ripley, Derbyshire. He left school at 17 and took an entry-level position at the Thames Engineering Works in southeast London, but later shifted over to a shipbuilding firm on the Isle of Wight. Along the way he had learned a great deal about engineering, especially marine applications, and obtained a degree in engineering from the University of London External Programme in 1922.

While at his shipbuilding gig, Barnes met H.B. Pratt, formerly of the Vickers armaments company. The Admiralty, looking ahead to the impending War to End All Wars, became very interested in rigid-frame airships, inspired by the German successes with zeppelins. Pratt was tabbed to start planning, and, impressed with Barnes' design work, had him come along. As a capable team, they designed HMA 9 and the R.26 class of dirigibles.

After WWI, Britain formed the Imperial Airship Service in 1924 and designed and built two second-generation airships, capable of 70 knots airspeed, carrying 100 passengers, and with a range of 3,000 miles. The IAS built one, the R.100, and Vickers build the other, with Wallis as chief designer. He had become an expert in geodetic (geodesic) design, foreshadowing Buckminster Fuller, and his dirigible was lighter and could carry more hydrogen than could the R.101. The R.101 crashed and burned (in that order) with great loss of life, and the R.100, even though more successful, was scrapped.

Wallis moved over to aircraft design, and his knowledge of geodetics allowed significant advances in aircraft construction. He scored a major interwar success with the design of a monoplane with geodetic construction of both wings and fuselage. It was very light, and very, very strong, so much so that when load tested, the test machine broke but his aircraft did not! It would eventually become the Vickers Wellesley, which entered service in 1937. It's designed allowed for a much larger than normal fuel supply, and it set endurance/distance records not broken until the much-larger B-29 came on line.

After his success with the Wellesley, Wallis designed the Vickers Wellington bomber, capable of carrying a two (long) ton bomb load for 2,500 miles, a radical improvement over contemporary bombers. It would remain the mainstay long-range bomber in the RAF throughout WWII; well over 11, 000 were built.

When Hitler came to power, the Air Ministry began collecting intelligence on possible military/industrial targets in Germany. Many of them were dispersible or movable, small and difficult to hit. Wallis was deeply concerned, too, and began thinking about those strategic targets that could not be concealed or moved, such as power plants, oil refineries, etc. He was particularly interested in the large dams in the Ruhr Valley, built to supply hydroelectric power and water for industrial, agricultural, and transportation purposes. If those dams could be breached, the resulting flood would destroy factories, mines, farms, and workers, and the loss of power/water would severely hamper the infrastructure the dams supported.

But no weapon existed that could bust the dams.

Wallis calculated that at least some of the Ruhr dams design made them vulnerable to a ten-ton bomb, but the largest bomb in the RAF arsenal was a half-tonner, and no bomber could begin to carry a bomb twenty times that large. For those reasons, the Air Ministry rejected Wallis' plans and calculations.

The attractiveness of the Ruhr dams as a target, however, caused the Air Ministry to study just how big a bomb would be needed to knock them down. They ran a series of calculations, based in part on scale model testing, and concluded that a 13-ton bomb was needed if it exploded near the dam, but only a 3-ton bomb was necessary if it could be placed against the base of the dam on the reservoir side.

The Germans were not asleep at the switch while this was going on, and they realized that aerial torpedoes might be able to damage, if not bust, the Ruhr dams. They placed anti-

torpedo nets in the reservoirs above the dams, and installed a lot of anti-aircraft weapons around each one.

Barnes Wallis was undaunted by his initial rejection. He must have had an episode or two in his youth, as I did, with rock skipping. He realized that if a large bomb could be made to skip across the dam's reservoir, it would bounce over any torpedo net and, if dropped from a very precise altitude at a very precise speed, it would lose speed as it skipped, hit the inside face of the dam, and roll into the ideal position for the dam's destruction. The key to the skip and roll was putting a lot of backspin on it before its release.

His first trials were with a spherical bomb, but his tests showed that it would not bounce as straight as desired. Then he tested a spinning cylinder. Its torque would keep it bouncing in a straight line. He acquired and modified one of the new Lancaster bombers, and demonstrated the basic success of his concept. He was able to secure permission to proceed.

On February 26, 1943, the 617th bombardment squadron was assigned the mission to bomb three dams in the Ruhr valley. Twenty-five Lancasters were modified for the mission (the bomb Wallis designed was much too large for any bomber's bomb bay), so the bomb bay doors were removed, the opening revealed was enlarged, and a mechanism for spinning the bombs was designed and installed. An accelerated training schedule was imposed; flying a bomber with the bomb spun up was a serious challenge! The planes with the Wallis bomb aboard looked quite odd, like that of a steam-powered roller, and since their base was RAF Scampton, they became known as the "Steamrollers of Scampton."

The bombs had to be released at a height of 60 feet while flying at 240 MPH, exactly the correct distance from the target dam. Two ingenious devices were used to make sure the bomb was released at the proper height and distance. A spotlight was installed on each wing, aimed down and inward. The two spots of light on the ground(water) would merge only if the aircraft were at the correct height. Similarly, a Y-shaped device was created for the bombardier, who would sight along the upright of the Y until the two tips at the top of the Y just covered the two parapets on each dam; then and only then would the range be exact. Fuses with a short delay would ensure that the bomb had enough time to sink to the optimum depth (and not blow up directly below its bomber!).

The Ruhr dams were at their fullest in the springtime, when they held the winter snow runoff. The Moon was full on May 16/17; its light would be needed to see the dam well enough for the Y-shaped device to work. Three dams would be targeted, the Móhne, the Eder, and the Sorpe.

The raid, "Operation Chastise," would be led by Wing Commander Guy Gibson, an already-famous aviator.

Gibson's nine-plane group would attack the Móhne Dam. If the dam broke before all nine planes dropped their bomb, they would proceed on to the Eder Dam. Five other planes would attack the Sorpe Dam, and five more were held in reserve for use as needed.

Three of the attacking planes were shot down *en route* to the Ruhr; none from Gibson's nine.

Gibson's group got to the Möhne and prepared to attack. His Lancaster, of course, went first. The Germans were briefly perplexed as to why a large plane was approaching at very low altitude with its "landing lights" on. But they rallied quickly, and poured out a torrent of 20mm cannon fire. Gibson's bomb detonated, but to no effect (he may have hit the anti-torpedo net). The pilot of the second to attack, and several of his crew, had been wounded on the way to target. His bomber was hit just as it was dropping its bomb, which sailed over the dam and destroyed the power station beyond. Two of his crew survived to become POWs. The third bomber to attack was also hit on its bombing run, and its bomb exploded before getting to the dam. The next bomb hit one of the parapets, causing superficial damage. Gibson and the third bomber flew alongside the fifth to attack, to divide the defensive fire. Their courageous actions worked; the fifth bomb dropped breached the dam, creating a 100-meter-wide gap.

The Eder Dam was a tough target. The shape of its reservoir required a long, winding approach and had hills partially blocking the exit route. Several approaches were necessary to get into position for the drop. One bomb hit a parapet, and one exploded ineffectively, before the last bomber scored, and the dam collapsed.

The Sorpe Dam raid was a failure. Four of the five bombers assigned were lost long before they got to the dam, brought down by flak or collisions with power lines. Several others (from the reserved five) aborted due to plane/equipment malfunctions. Only two bombers managed to attack the Sorpe Dam.

The design of the Sorpe Dam was different than the other two targets that night. It was a concrete-cored masonry structure, not an all-masonry dam, which made it almost invulnerable to the Wallis bomb. The design difference was known at the time, but Wallis hoped that multiple hits would cause the dam to weaken and fail. Two bombs were not enough.

Ten bombers survived the attacks, and one was lost to flak on the way home. Fighter planes were not effective in defending the dams.

The damage to Germany's war infrastructure was much as hoped for. Many factories were destroyed, power stations and transmission lines were swept away, coal mines and airfields were flooded out. Several canals were bereft of water, the barges stranded high and dry. Armaments czar Albert Speer predicted a serious loss of production for months to come; if the Sorpe Dam had fallen, Ruhr production would have been crippled for many months.

Hitler ordered 27,000 workers and slaves to clean up and repair the damage. Worse, much worse, he also meddled with Speer's plans and ordered another 10,000 workers, busy building up the "Atlantic Wall" defenses at that time, to be diverted to repairing the Ruhr dams. At the Nuremberg Trials, Speer testified that the diversion of labor from the Atlantic defenses was a "catastrophe" that greatly aided the D-Day invasion.

Afterward

The survivors of the raid were hailed as heroes upon their return. Gibson was awarded the Victoria Cross, the British equivalent of the U.S. Congressional Medal of Honor. Thirty-three

other major decorations were awarded. Gibson went on a book/bond tour in the U.S., where he was received most warmly. Gibson returned to combat when he got home, over the objections of RAF command. He was the master bomber on a raid to Munich laid on by Mosquito bombers on September 19, 1944. His plane crashed in Holland on the way home, to causes never fully determined. The Dutch buried him there, and named a street after him.

The 617th continued on after the raid, recognized as experts on specialty bombing missions. Not all of their subsequent actions were as successful as the Dam Buster raids. The mounted a very costly, unsuccessful raid on the Dortmund Ems Canal in September, 1943, using another of Wallis' creations.

Germany had a number of targets that could not be damaged by one-ton bombs, no matter how accurately dropped. Bombers had gotten bigger and could carry heavier bomb loads later in the War, and Wallis obliged them by creating two giant bombs, the twelve-ton "Grand Slam" and the six-ton "Tall Boy." The Grand Slam was difficult to carry and aim, so most of the subsequent specialty use was for the Tall Boy, until July, 1944, when the Grand Slams came into more general use.

The Tall Boy was designed to penetrate thick layers of concrete before exploding. This required an extremely strong, aerodynamic casing, which limited the explosive charge carried to a "mere" 5,200 pounds of high explosive. Maximum penetration depended on the bomb landing vertically; Wallis cannily canted the tail fins slightly to produce a stabilizing spin on the way down. Like the Wallis bomb, the Tall Boy was larger than the Lancaster's bomb bay could accommodate, but only by a relatively small amount, requiring the bomb bay doors to have a bulge outward.

Over 700 Tall Boys were used in combat, most of them delivered by the 617th. They were essential in destroying key railroad tunnels, viaducts, submarine pens, and V-1 and V-2 launch sites. They also played a key role in the sinking of the German cruisers *Tirpitz* and *Lützow*. The 617th was slated for the Pacific Theater in mid-late 1945, but that deployment was cancelled after early August, when bombs that dwarfed the explosive effect of the Grand Slams made their appearance.

Wallis continued his research in aeronautics after the War, independently proposing the "flying wing" and "variable geometry" concepts, which reached fruition in the U.S. Air Force with the F-102 "Delta Dagger", the F-111 "Aardvark" bomber, and the B-2 "Spirit" bomber, and with the civilian Concorde. He also conducted useful research into the design and construction of large radio telescopes, such as the Parkes Telescope still in use in Australia (it was the ground station that received the TV transmission of Neil Armstrong's "small step!"), submarine design, and bridge construction.

Wallis was given a £10,000 award by the Royal Commission on Awards to Inventors after the War. He had been greatly disturbed by the number of Dam Buster aviators that were killed on May 16/17 while delivering his best-known invention (so much so that his post-War work in aircraft design was somewhat inhibited because he couldn't countenance the possibility that a test pilot might die in the development of his new designs). He donated the entire sum (serious

coin!) to the Christ's Hospital School in 1951 for the setting up of a fund that would support the children of RAF KIAs to attend school. [The original foundation that established this school was set up by Henry VIII, confirmed by Edward VI in 1553, and renovated after the Great Plague and Great Fire with the assistance of Christopher Wren.]

Sir Barnes' wartime work was recognized when he became a Fellow of the Royal Society in 1945, his knighthood in 1968, and his being awarded an honorary Ph.D. from Heriot-Watt University in 1969. He passed away on October 30, 1979.

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Finger Lakes Stone Skipping even has its own FaceBook page!

Not only can you skip stones on the shores of Keuka Lake, there is a more-direct link to aviation there. Hammondsport, at the bottom of the upright of the Y-shaped lake was the home of aviation pioneer, Glenn Hammond Curtis. He conducted the first seaplane tests there, too. The area is most definitely worth a visit, and don't miss the Glenn H. Curtis Aviation Museum there: https://glennhcurtissmuseum.org/site-map.php!

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RAF Scampton still exists and is the home of the Red Arrows RAF Demonstration Team (the equivalent of the USA's Thunderbirds). See also: http://www.dambusters.org.uk/airfields/scampton

The 70th anniversary of the Dam Buster mission in 2013 was commemorated by a series of events, including a low pass by a Lancaster bomber, with a Spitfire and Hurricane flying escort, over the Derwent Dam in Lincolnshire, one of the reservoirs used to train the Dam Busters. The Dambusters Inn (pub) in Scampton has a collection of photos of every person, all 133, who flew the mission, and copies of the decorations they were awarded. A few of the original DBers were in attendance, and the whole affair had considerable publicity, especially since no further such observances were planned (the surviving members were by then in poor health). See:

https://www.globalaviationresource.com/v2/2013/05/17/news-dambusters-70th-anniversary-commemorations

https://www.youtube.com/watch?v=Olg3Md79Ntc&ab_channel=NorthfieldFilms

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https://dambustersblog.com/category/raf-scampton (see the entry for August 30, 2013 for a good view of the Dambusters Inn's mural being signed by mission veteran Les Munro)

Another useful resource: https://dambustersblog.com/category/dambusters-70th-anniversary

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