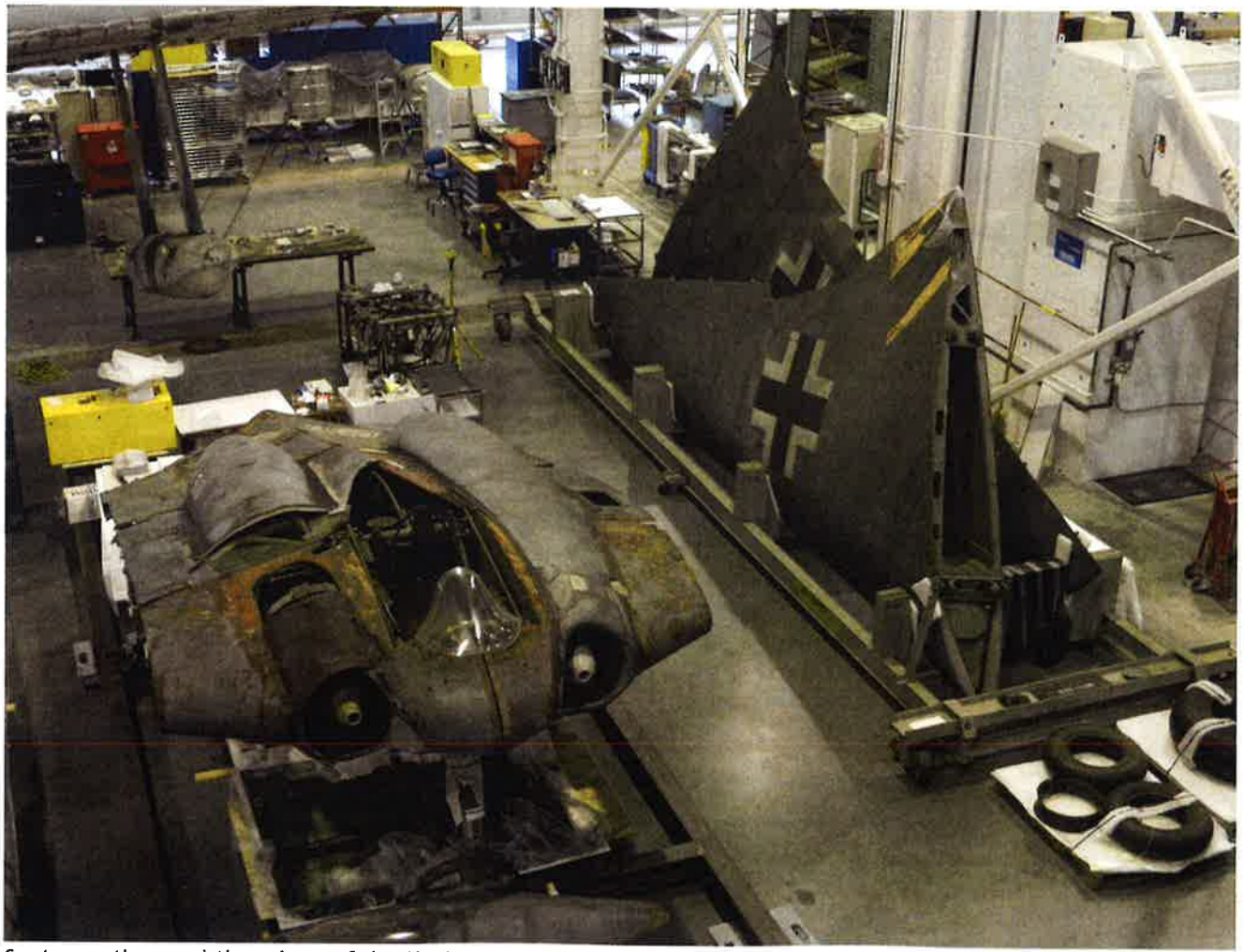
Out in the Open

The Horten 229 'Bat-Wing' Emerging From Its Cave

by Terry Coakley



Center section and the wings of the Horten 229 now in the restoration hangar of the Smithsonian National Air and Space Museum's Steven F. Udvar-Hazy Center after the move of the center section in January 2015, as photographed from the second-floor observation windows in the summer of 2015.

RICHARD KIRK JR., USED WITH PERMISSION

The Horten 229 V3 with its wings attached after its 1946 move just outside of Chicago.

COURTESY OF THE NATIONAL AIR AND SPACE MUSEUM

The center section being made ready for the move to Udvar-Hazy in 2015.

Somewhere between rumors of German wonder weapons at the end of World War II and the reality of jet aircraft that actually became operational, like the Me 262 and the Me 163, lies the Horten 229, also known as the Horten IX or the Gotha 229. While so many of the German Luftwaffe's so-called "secret weapons," such as the Amerika Bomber (which the Horten brothers also designed), never advanced beyond the drawing board, the Horten 229 actually flew, although not in combat.

While the second prototype, V2, crashed during its third test flight in 1944 when one of its engines failed, the nearly completed third prototype, V3, was captured by the Americans at the end of the war. American and British journalists at the time called the newly discovered aircraft the "Bat-Wing." Now, 70 years after its capture in 1945, it is emerging from its years in storage.

The futuristic, flying-wing design of the Horten 229 — with the jet engines embedded in the aircraft, the lack of a vertical stabilizer, and its exhaust centered on its pointed, trailing end — looks more like something from the very end of the last century than something that flew in the 1940s. It is historically significant as it was the world's first jet-powered, all-wing aircraft. For years, people had to be content with playing historical simulation games to glimpse the completed aircraft and experience its performance compared to that of other WWII aircraft. For those of us who were ambitious enough to venture — as I did in 2002 — to the more than 30 metal buildings that made up the National Air and Space Museum's Paul E. Garber Restoration and Storage Facility in Suitland, Maryland, to see the center section and wings stored there, just as the pictures in various books depicted, it still remained unclear how long it would take for this aircraft to be publicly displayed for everyone to see.

Many of us saw the 2009 National Geographic Channel program in which a full-size mock-up of the Horten 229 was constructed by Northrop Grumman and put up on a pole to test the stealth characteristics of the plane, giving a preview of what the real thing might look like someday with the wings attached. The full-size model of the Horten 229 is now on display at the San Diego Air & Space Museum.

When the Udvar-Hazy Center annex of the Smithsonian's National Air and Space Museum opened in late 2003 near Washington Dulles International Airport, I was disappointed to see that the Horten 229 was not listed among the exhibits, even in its then-current state. When I finally went to Udvar-Hazy in December of 2012 to see the *Enola Gay*, the space shuttle Discovery, and other aircraft displayed there, I looked through the glass at the back of the building and was shocked to see that the wings for the Horten 229, which I recognized immediately, had been moved to the new restoration facility in the rear of the center. I tracked down docent Scott Wiley, who explained to me that it would be a while before the center section of the Horten 229 could be brought there to be joined with the wings for display. The wings were actually there when phase II of the facility opened on March 15, 2011, but

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2013 photo (taken just before the start of work and the move to Udvar-Hazy) of the center section, from the rear, showing the "Bat-Wing" tail, as well as the markings added by the Americans.

the aircraft was not mentioned on the list of aircraft on display, as just the wings were in the restoration hangar at that point. The day was coming, though, when this aircraft could finally be seen!

History of the Aircraft

Aircraft designer Reimar Horten and his brother, Walter, a fighter pilot, had developed winged gliders and propeller-powered wings in Germany since the 1930s. The Udvar-Hazy Center currently displays a full Horten III and Horten VI, up high, and a center section of a Horten III at ground level, all of which were developed before the Horten 229.

In 1942, Germany responded to Jack Northrop's flying-wing work in the United States by giving the Horten brothers the resources to construct the Horten VII by 1943 and the Horten VI in 1944. By 1943, Reimar's vision had led him to begin work on his first jet-powered wing, the Horten IX, or Horten 229 as it is now known.

According to British intelligence reports from after the war, the Hortens started working on the Horten 229 — without official authority — as a "private venture"/outgrowth of their earlier projects. This aircraft would have a larger wingspan than planes such as the American P-51 (37 feet) or the Me 262 (41 feet). When displayed at the Udvar-Hazy Center, the Horten 229 V3 (third prototype) will be 24.6 feet long, stand 9.3 feet tall, and have a 55.4-foot wingspan. What is amazing is that the Horten 229 is sheathed with a plywood skin. Steel pieces cover the plywood where exhaust from the two Junkers Jumo 004B engines exit the aircraft. While the center section is built around a steel tubular framework, the wings are built around a wooden structure.

In August 1943, Hermann Göring gave the Hortens his approval to complete work on the Horten 229 as part of his 1,000 x 1,000 x 1,000 requirement that all future German aircraft be capable of 1,000 kph (620 mph), be able to carry a 1,000-kilogram (2,210-pound) bomb load, and be able to "penetrate" (defined as one-third the range) 1,000 kilometers (620 miles) into Allied territory, although the aircraft may not have met all the criteria.

The Horten 229 V1 (first prototype) was built at Göttingen as a glider to be towed to flight. It should be noted that the Hortens had no wind tunnel. Their concepts were developed almost entirely through flight experiment, building on earlier successes. So the Horten 229 V1 glider was a true proof of concept. The Horten 229 V1 took its first flight on March 1, 1944. In the months that followed, it was flown about 10 hours by Walter Horten, 10 hours by Lt. Erwin Ziller, and 30 hours by Heinz Scheidhauer. V1 seems to have undergone more testing than was usual to determine its stability as a gun platform. Other than these tests, most of the flight research seems to have come from test-pilot reports. Damaged in a hard landing at the end of the war, V1 survived the war, but the U.S. 9th Armored Division found it in Brandis on May 6, 1945, and burned in a "cleaning action."

During the construction of the Horten 229 V2 — the powered second version — at Göttingen in 1944, BMW 003 engines were considered but rejected for two of the more powerful Jumo 004Bs used on the Me 262. The Junkers engine was larger, but poor communication with Junkers regarding the size of the 004B led to a redesign of the area around the engines, causing a three- to four-month delay. The aircraft was assembled in a three-bay maintenance garage to avoid detection. Interestingly, the nose wheel was made of a tail wheel from an He 177 bomber, and the main undercarriage was the same kind used on a Bf 109 fighter. Employees worked 90 hours a week to complete the aircraft. The Horten brothers continued to work on this and other designs at the same time.

When the first official V2 test flight was made on February 2, 1945, from Oranienburg, Lt. Ziller was the pilot. He had flown the Me 262 five times in December 1944, so he was familiar with the characteristics of the Jumo 004B engines that powered the Me 262 and now the Horten 229 V2. He did not use the pressure suit shown in pictures from that time during his actual flight tests. The first flight lasted about 30 minutes. Reimar Horten later said he was present for the first flight, apparently in the control tower. At the end of the second test flight the next day, Ziller deployed the braking parachute too soon on his landing approach, resulting in a hard landing that bent one or more landing-gear struts. As a result, the third test flight was delayed until February 18, 1945. Neither Horten brother was present for the second test flight.

Better Performance Than the Me 262, but Time Runs Out

The Horten 229 carried 22 percent more fuel than an Me 262. While the Me 262 required a concrete runway, the Horten 229 was designed to operate from shorter grass runways. The Horten 229's engines sat high enough that the raised intakes should have protected the engines from ground debris. It was designed to have a high operating ceiling (39,000 feet, and it was believed the engines would not work much above that level as the burners would go out). This compared to the Me 262's 37,500- to 38,000-foot operating ceiling. It also had a faster climb rate than an

Me 262, as Ziller reported after the second flight. Specific results from flight tests did not survive the war, and much of the information about the aircraft comes from the recollections of Reimar Horten, who was interviewed after the war.

Forty-five minutes into the third flight, the right engine went out and Ziller apparently tried to relight the engine but was unsuccessful. The Jumo 004Bs had a very short operational life of 12 to 20 hours. Ziller did not radio any message and continued to fight to save the aircraft. He also did not use his ejection seat or jettison the canopy, but he did deploy the landing gear.

He ran out of altitude and the plane was destroyed on impact, but there was no fire. Ziller was killed. British intelligence reports state that after the engine failure "the pilot undershot, tried to stretch the glide and stalled." In all, Ziller had flown V2 about two hours in the three test flights. Though it was never confirmed, a demonstration was reportedly done before the crash that pitted the V2 against an Me 262, and Reimar Horten said V2 was faster and more maneuverable, with a steeper and faster climb. In the test against the Me 262, speeds of 400 to 430 mph were reported to have been achieved at two-thirds throttle. The maximum speed for an Me 262 was 541 mph, or about 25 percent more than the demonstration speed achieved by the Horten 229, but the Horten 229 should have been able to go another one-third faster than it did during the demonstration flight, even with the same engines as an Me 262 — perhaps as fast as 600 mph. Reimar Horten thought that V2 had performed satisfactorily on a single engine, despite the eventual crash, because of the proximity of the engines to the centerline of the aircraft. However, it does appear that neither Horten brother was present for the final flight.

The aircraft manufacturer, Gotha, had been chosen to produce 20 of the aircraft, and it exerted greater control over the project after the V2 was tested, as the Hortens were beginning work on the Amerika Bomber, a six-engine flying-wing design that looked like a larger Horten 229. Because Gotha had been selected to produce the Horten 229, the aircraft is often referred to as the Gotha 229. Gotha had to work on V3 away from its main factory because the U.S. 8th Air Force destroyed about 80 percent of it in a July 20, 1944, raid.

Gotha engineers made modifications to the design, making V3 different than V2. V3 was redesigned to accept the Jumo 004Bs from the start, with the entire engine installation shifted slightly forward. The landing gear and hydraulics were also beefed up. The center section of V3 was still uncompleted when the American 3rd Army VII Corps captured it at the Gotha facility at Friedrichroda on April 14, 1945. Like V2, it was still a test aircraft that lacked cannons for combat. The aircraft was assigned number FE-490, and 70 years of American control began. Along with V3, the Americans found the center sections of V4, with the engines installed, and the steel frame of V5. Pictures of each do exist. These two were constructed similar to V3 to provide sufficient aircraft for test flights.

The V6 mock-up was also found, apparently in a shed, away from the other frames. V4, V5, and V6 were all uncovered center frames. V6 was to include all the required Gotha modifications, as well as more armor protection than other German jets. The pilot was to be protected from the front by armored glass. An armored "bathtub" was to replace the frame structure of the cockpit, and a model was built. V6 was also designed to accommodate four 30 mm MK 108 cannons or two long-barreled 30 mm MK 103 cannons (originally planned for V3). Two 500-kilogram bombs might also have been included.

In the end, V6, with the engines moved outbound, didn't have enough space for all the weapons, so V6, V7, and V8 were probably going to end up as prototypes for reconnaissance aircraft, with V7 and V8 being two-seat versions, probably with vertical stabilizers. The Hortens referred to the two-seat design as H IXb (and also H IX V6, although in Gotha production the two-seat versions began with V7). V4, V5, and V6 were in various stages of completion at the same facility as V3, and like V1, V4, V5, and V6 were burned, leaving only the partially completed V3 to be sent back to the United States. The 9th Air Force Disarmament Division found a set of mostly completed wings about 75 miles away from Friedrichroda that appear to have been intended for V3. Gotha did not have the wing order, which had instead gone to a large furniture factory, May GmbH, in Stuttgart-Tamn because of their wooden content. The wings may have been found at the Robert Hartwig Co., which had made at least one wing for static-load testing in January 1945.

In the end, the delays caused by the fitting of the engines in V2, etc., and then the crash of V2, had pushed the work on V3, V4, V5, and the modified V6 to close to the end of the war. Why work on a reconnaissance version or two-seat variants with longer, pointed noses with the war coming to a conclusion when the single-seat version with cannons had not been perfected and the order for combat aircraft had not yet been filled? It appears the Horten brothers, and even Gotha, were striving for perfection and at some point may have been content to

keep hundreds of men working on their designs throughout the war — and especially at the end — rather than have them go off to fight and be killed.

In late summer 1944, there was an unsuccessful push to send Horten workers to the Eastern Front. Reimar Horten admitted after the war that he preferred building sailplanes and that managing staff in larger projects seemed like a waste of time. A British intelligence report from right after the war states, "In reviewing the Horten achievements one cannot help being impressed with the speed of their work and the utter irrelevance of much of it to the German war effort."

While this sounds a lot like Wernher von Braun, who claimed to be more concerned with research and getting people into space from an early age than with the V rockets that were actually produced, an operational version of the Horten 229, with any cannons, could have proved deadly for Allied aircrews because of its advanced performance capabilities. Without a tail, would the Horten 229 have been a sufficient gun platform? Once the project was turned over to Gotha for production, the Hortens were no longer as involved, which may have reduced the overall focus on the aircraft, as the Hortens were then working on the Amerika Bomber. Gotha's desire to make its own design changes also slowed production of an aircraft that, while not perfect, could have flown operationally and then been further refined. Fortunately, Allied pilots never had to face this advanced jet in combat, even in limited numbers.

The Whole Truth

Those involved with the 2009 replica reported finding that the aircraft had a 20 percent improvement in radar detection versus the radar of the time, which would not make it the German "stealth fighter" some refer to it as. In a 1983 book, Reimar Horten said that he had intended to add charcoal to the adhesive between the layers of plywood on the production model to help it evade radar detection. There is no record of Reimar having ever done any testing on what is now known as stealth technology — unlike the Japanese, who were more focused on research in the area. Although no production model of the Horten 229 ever existed, a 2014 publication by Horelick, et al., provides the results of testing done on the V3 by the Smithsonian team to determine whether charcoal was present in the adhesive layers of the V3 test version. The team hoped to fully characterize all of the original material so that any materials chosen to stabilize the fragile plywood would not alter or compromise the analysis of the adhesive layers. A stabilization method was needed so that the aircraft could be safely transported from the Garber facility in Maryland to the Mary Baker Engen Restoration Hangar at the Steven F. Udvar-Hazy Center in Virginia. No charcoal was found in the adhesive layers between the plywood during the analysis. So while the Horten 229 V3 was built without a true effort to make the aircraft stealthy, engineers from Northrop Grumman did observe the Horten 229 in the early 1980s in one of the Suitland, Maryland, storage buildings when they were developing America's B-2 stealth bomber, and although it is difficult (for me) to directly draw the heritage line from the Horten 229 to the B-2 bomber, there are certainly similarities.

A drawing released in December 2015 of a "sixth-generation" fighter concept by Northrop Grumman even more closely resembles the Horten 229. While the Horten 229 was not a stealth aircraft, it was very efficient, and clearly ahead of its time. The truth is that its stealthy look resulted from the evolution of the Hortens' aerodynamic designs and not from any attempt to deliberately reduce radar detection through reducing the reflection of radar waves.

Beginning and Ending 70 Years in the Dark

The wreckage of the crashed V2 was found in a barn after the war and flown to England, where discussions of fitting it with Rolls-Royce jet engines never got off the ground. It was presumably destroyed after being displayed at Farnborough. The nearly complete Horten 229 V3 arrived in America on board the USS Richard J. Gatling on July 12, 1945, after departing Cherbourg, France, as part of Operation Seahorse. Plans to bring V3 to flight status never materialized because of budget cuts and the amount of work that would have been required.

A picture of the aircraft after its arrival at Freeman Field in Indiana shows at least one wing with part of its covering missing. The Americans finished it with plywood before it was painted. The aircraft was redesignated at that time T2-490 (T2 for "technical intelligence"), and as part of Gen. "Hap" Arnold's planned Air Force Technical Museum, it was stored/displayed starting in 1946 at the former Douglas factory just outside of Chicago at Orchard Field (now O'Hare International Airport). Interestingly, the *Enola Gay* was also stored for a time at Orchard Field.

In painting the Horten 229 V3 in its current scheme, the Americans also painted swastikas on the trailing surface and put the T2-490 numbering on the top of the engine covers. (This can be seen in the picture included in this article that shows the aircraft at the Udvar-Hazy Center restoration hangar.)

The full-size model of the Horten 229, the building of which was chronicled for a National Geographic program in the late 2000s, is now on display at the San Diego Air and Space Museum.

During my 2014 visit, it was interesting to see the word "Alclad" stenciled on some of the aluminum panels that had been removed from behind the canopy, indicating the aluminum had been added by the Americans in 1946 at Orchard Field. It was at Orchard Field where Richard Kirk Jr. took the picture of the aircraft included in this article that shows the wings attached.

In 1947, V3 was saved from destruction by curator Paul E. Garber of the National Air Museum division of the Smithsonian, which became the National Air and Space Museum in 1966. Garber had Arnold's collection moved in 1952 to the Silver Hill storage facility in Suitland, Maryland. Because of a lack of space, it sat outside in wooden crates from 1952 to 1974. This was the root cause of most of the deterioration that the museum has had to confront and stabilize. But most importantly, the aircraft was saved from destruction. Malcolm Collum, chief conservator for the museum, spoke with Russ Lee, the curator of the aircraft, in 2011 and asked what he thought about getting the Horten 229 out of storage. Needless to say, Lee was excited to take up the challenge, but as curator of the aircraft, he knew that the museum had a long task in front of it. Work on the project began in 2011.

In a 2014 article from the Smithsonian team titled "Technical Study of the Bat Wing Ship (The Horten Ho 229 V3)," published by the American Institute for Conservation of Historic and Artistic Works, Horelick, et al., reported what they had found. They noted that the plane "has suffered from water damage and fungal attack causing ... structural failure [and] extensive plywood veneer delamination, material loss, biological growth, and coating delamination ... evident throughout the aircraft." It was in this fragile condition that I saw it at the Garber facility in Suitland in 2002, where it sat inside, uncrated, with the wings next to the center section. The 2014 article describes in detail the start of the work, which began with the disassembly of the plywood panels and analysis performed to understand the plywood, veneers, paint layers, and adhesives used in the construction of the aircraft. Some of this work was done using intelligence reports from the war that described German plywood technology of the time.

The Current Project

V3 was not stored under conditions befitting a historic, one-of-a-kind aircraft, let alone one that was sheathed in plywood. The aircraft was mostly completed when captured by the Americans, and they "finished" it for display purposes in 1945-46, including adding its current paint scheme.

Lee told me that the decision has been made to maintain the aircraft in this paint scheme (as shown in the first picture in this article), as it is part of the story of the aircraft. Lee and conservator Lauren Horelick have decided to exhibit the aircraft "in an unrestored, but stabilized state, and allowing it to show its age, history, and character." Therefore, it might need to be displayed using a stand to help support the wings. I believed this was the correct approach before my in-person interview and was relieved that this was the National Air and Space Museum's plan.

After seeing that the three control surfaces of the wings do not appear to be movable, I was more convinced. I arrived at my opinion after looking at old photos of the aircraft over the years and seeing the aircraft in storage; materially changing the aircraft after all this time would seem too extreme. To put this in terms that others might appreciate — in the classic car world the "patina" of original paint is now often preferable to a shiny new paint job on a restored classic car, assuming the old paint can be reasonably maintained. If this one-of-a-kind aircraft were restored and painted over, it would not be the same aircraft, and since it will not be flown, it is not necessary to bring it closer to operational.

While Lee admits that other enthusiasts might have another opinion, he acknowledges the

TERRY COAKLEY PHOTOS

Three detailed views of the restoration project using plywood to fill in the gaps left behind by deterioration.

growing trend to exhibit unrestored aircraft. This enthusiast hopes he speaks for the majority in saying that this is the correct approach.

Conservation, Not Restoration

Lauren Horelick, the conservator working with Russ Lee, has decided that the conservation approach will be one of materials stabilization. She worked from 2013 to 2014 with a team of conservators to create the same four- or five-ply beech plywood of a similar thickness to that originally used on the aircraft in order to fill in places where the material was lost due to deterioration. See the three photos on this page that I took during my behind-the-scenes tour. On two of the photos, I included two "before" shots (A and B) at the bottom of the frame (next to the sections being worked on) that show the missing areas before the new plywood was added. These necessary plywood "patches," now a light wood color, will be painted just a shade lighter than the existing paint so that they are not confused with anything that is original to the aircraft.

With Horelick I observed a small, blackened section on the interior of a lower, green-painted panel where a small, cut-in hole existed. Could this have been from the heat of a V3 engine test? The darkened area near the hole was small, but would anyone really expect to see large burn marks within the aircraft? It was interesting to observe, but in my opinion it was probably just an area that was not cleaned as well as the flat surface surrounding it.

The bright green paint on the interior of the wood panels was noted in the 2014 technical study article by Horelick, et al., which reported that it was found "selectively" on the exterior of the wood panels as well as under the paint applied by the U.S. Army in 1946. The green paint was also found under metal parts. Their research speculates that the green paint may be a kind of fireproof coating, given its extremely high chlorine content and its location in the areas that would have had the most heat. Indeed, after the second V2 test flight, Ziller had reported to Reimar Horten that special paint behind the engines had tolerated the heat.

Final Thoughts From My Return Visit to Udvar-Hazy in December 2014, Two Years After Spotting the Wings There

In order to gather materials for this article, I was given access to the floor of the Mary Baker Engen Restoration Hangar at the Udvar-Hazy Center in December 2014. The next month, the center section of the aircraft was moved to the Udvar-Hazy Center in a covered container (pictured in this article) and is currently displayed as shown in the cover photo. Visitors can peer in from the windows on the second-floor observation deck, where the view is the same one shown in the cover photo for this article. I was lucky enough to receive a tour from Russ Lee. The aviation community is fortunate to have Lee — a Horten flying-wings expert who authored *Only the Wing*, a 300-page book on the subject — curating the aircraft throughout this process.

Lee told me that the current plan is to display the Horten 229 near the *Enola Gay*, across from the German section at Udvar-Hazy. That would also put it near Jack Northrop's yellow NIM Fly-

ing Wing, with its dual pusher propellers. Observing the aircraft from the raised walkways at Udvar-Hazy will highlight the aircraft's "Bat-Wing" appearance from above. As I said, the Horten 229 might need to be displayed on a stand to help support its wings, but that shouldn't take anything away from the presentation. No work has been done on the wings as of yet.

The Future

When will the aircraft be displayed outside of the restoration glass? The timetable is uncertain because there's another project ahead of it: the Martin B-26B-25-MA Marauder *Flak Bait*, which lies next to it in the restoration hangar. In addition, the museum is heavily focused on the revitalization now underway at the National Air and Space Museum on the National Mall in Washington, D.C.

A wealth of information, including technical data on the project, has recently been made available at the National Air and Space Museum's website, and specifically at *https://AirAndSpace.SI.edu/collections/horten-ho-229-v3/*. The public display of this aircraft will spur others to think about its place in history and what type of performance it was capable of. The Horten 229 Restoration Project maintains its website, where a group has an interest in constructing a flying replica — and although they have not responded to my inquiries regarding the status of their project, they claim on their website to have come close to receiving some funding recently. Given that the Horten 229 V3 was a test aircraft, if a flying example is ever built it may make sense to include some of the modifications that were planned for V6, including adding protection for the pilot from the engines, if not with an armor "bathtub," then with some other shielding.

Storage of the Horten 229 V3, so much of it plywood, after the war and in some of the intervening years was less than ideal. Lee acknowledges this and would like the warbirds community to know that "we are taking care of the airplane; we are giving it the highest level of care that we can give." Having witnessed firsthand the work now taking place on the project, the care involved, and the technical data they have released, I can confirm that this is 100 percent accurate.

Update: The Horten 229 is now scheduled to be publicly displayed on the floor with the rest of the aircraft at Udvar-Hazy, although with the wings unattached for now, starting later this fall after additional work was completed in the summer of 2017 on the center section.

WARBIRD TOONS

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