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Credit: Lilium

The New Spark in Aviation

By Joe Martin

“Sophie, get me an air taxi to the Megabank Building on Central Avenue South.” A familiar female voice responds, “Sure, let me see what’s available.” Your Intelliphone screen pops up a satellite map image. A fluorescent green dot blinks over a building a few blocks away. “This one is available in about two minutes. Is that OK?” You reply in the affirmative. The

voice quotes a price, which you accept. “Thank you. Your taxi is on the way, license is NV1435.”

The green dot, now revolving like a tiny slow-motion pinwheel, heads toward the red circle marking your location. It stops momentarily, changes course slightly, then heads your way again. Not bad, you think to yourself. A lot of traffic today.

Three minutes 27 seconds after placing the call, the vehicle approaches the Vertiport, so quiet it cannot be heard over the street noise below. The rotors quickly wind down and the waiting area gate slides open. You walk over and strap in. This one holds three passengers, but you have it to yourself. The electric motors hum again, and you’re off to your cross-town appointment, ETA about 5 minutes from now—at least a half-hour sooner than you’d make it by the fastest ground transportation available.

Sci-Fi scenario, or soon to be reality? In *Flightline* #202, we wondered

what spot space tourism may someday occupy in the history of human flight. In this issue, we look at some electrically powered aircraft designs. A few have already flown; some are awaiting takeoff. Others will likely remain digital dreams or non-flying mockups. Tough questions remain, but 2022 should provide answers.

The idea of electrically powered flying machines isn’t new. In 1884, the nonrigid airship *La France*, its massive propeller turned by a battery powered 8.5 hp electric motor, became the first aircraft of any kind to make a free flight and return to its starting point. The 23 minute flight covered about five miles. The airship managed to repeat the trick in five of its seven flights but as the internal combustion engine matured, electrical power was shelved. A century and a half later, is it poised to make a comeback as the prime mover in the drive towards Advanced Air Mobility?

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At least for now, Rolls Royce's sleek Spirit of Innovation is the fastest electrically powered aircraft in the skies. (Credit: Rolls Royce.)

Plenty of aspiring entrepreneurs think so. “There is no addressable market right now. We’re creating it,” says Kyle Clark, founder and CEO of Beta Technologies, one of the leaders in the flock of Advanced Air Mobility (AAM) startups. Directly or indirectly, several big names are also in the game, among them Airbus, Embraer, and United Airlines.

AAM and its virtually independent subset, Urban Air Mobility (UAM), are not precisely defined, but NASA describes AAM as an “air transportation system that moves people and cargo between places previously not served or underserved by aviation – local, regional, intraregional, urban – using revolutionary new aircraft that are only just now becoming possible.”

Ah, but how to determine exactly what is just now becoming possible? Players come and go, and flight and financial statuses change daily. The internet abounds with exquisitely done photographic renderings of AAM aircraft that exist only in cyberspace—some examples of which accompany this article. SMG Consulting, “a boutique management consulting firm” with offices in Arizona and California, has devised a tool to help sort through it all. The aptly named Advanced Air Mobility Reality Index, “based on a proprietary formula that uses publicly available information as well as expert knowledge.”



Harbour Air intends to convert its entire fleet of DeHavilland Beaver floatplanes to electric propulsion, like the test aircraft shown here. (Credit: Harbour Air)

rates companies on a scale of 0 to 10, expressed to one decimal place. Zero represents a company just considering the market. Ten would be “a company with a commercial product that is produced in thousands of units per year.”

The AAM Reality Index may be aviation’s equivalent of the NFL’s passer rating algorithm, and just as apt to change game-to-game, but it’s an interesting look at the outfits that hope to make AAM a paying proposition. A couple dozen companies are currently ranked. A quarter of these are pursuing autonomous vehicles

which, given the hurdles that must be surmounted in that arena, would seem to be at least a decade away from carrying passengers, although cargo-toting versions may be in the air sooner. There are no tens in the mix, obviously, and less than half have put a test vehicle—even of the subscale or tethered variety—into the air. Several of that select group only reached the first flight milestone in 2021, so it’s clearly a long road ahead.

Challenges—Technical and otherwise

The drawback today, just as it was in 1884, is the relatively puny amount of energy a battery can deliver per unit of weight. Top end battery-powered motor packs can deliver upwards of 500 hp, but only for 15 or 20 minutes. The battery/motor

AAHS ANNUAL MEETING

SAVE THE DATE!

EARLY
REGISTRATION
\$160!

June 10-11-12

in Sonoma Valley!



Mark out these dates for the relaxing aviation filled weekend we've all been waiting for! AAHS is proud to offer a vintage aviation weekend you won't want to miss. Come visit old friends and make new ones while enjoying the beautiful vineyards of Sonoma!

REGISTRATION

\$160 Members Early Bird
\$175 After April 30
\$80 Sat Only

PLANNED ACTIVITIES INCLUDE*

- Tour of Nut Tree Museum and Hangar BBQ
 - Rare P51 H Model, J. Doolittle Collection
 - First Aircraft built in San Francisco
 - Outdoor hangar BBQ and wine tasting

Walkabout of North Bay Air Museum

Vineyard flights w Vintage Aircraft Co.**

Hangar Luncheon w featured Speaker

Afternoon vineyard tour **

Coffee and donuts at the private Ala Dobles Ranch, home of Walt Bowes flying collection, including a rare Luscombe, Fleetwing Seabird, Waco and many more!

See AAHS [website](#) for most current schedule

Questions? call the AAHS office 714-549-4818



HOTEL INFORMATION

Fairfield Marriott
\$129/Night rate (2 night min.)
(707) 469-0300
370 Orange Drive Vacaville, CA 95687
Group rate available, see hotel [website](#)



*Subject to change

** Not included in price



Pipistrel's Velis Electro production line in Slovenia. Textron, Inc., has recently made an agreement to purchase Pipistrel. (Credit: Pipistrel)



Florida Institute of Technology is among the US operators awaiting FAA type certification of the Velis Electro. (Credit: Brian Kish, Florida Institute of Technology)

combination on *La France* weighed on the order of half a ton—about the same as the 6,000-cell lithium-ion battery pack in Rolls Royce's *Spirit of Innovation* which, although not included in the AAM Index, is certainly real.

In November 2021, *Spirit* (UK registration G-NXTE) clocked a record 345 mph over a 3-kilometer course, followed by an average 330 mph run over a 15 km course at the famed Boscombe Down aircraft testing facility. The maximum speed reached throughout all the trials was 387 mph. (As a point of reference, in April 1939 Messerschmitt test pilot Fritz Wendel gunned the Me-209 to a then-world's record 469 mph.)

Aside from significant battery technology challenges, there's the matter of airworthiness certification. Light Sport Aircraft (LSA) is a case in point. At least one electrically powered LSA type is in production and routinely flying today—but not in the US. Slovenia-based Pipistrel Aircraft's Velis Electro was certified by the European Union Aviation Safety Agency (EUASA) in 2020, but FAA certification is still pending. Pipistrel got a major boost when Textron, parent company of Beech and Cessna, recently (March 2022) announced an agreement to purchase the company. The handful of Electros in the U.S. are essentially operating as demonstrators in the Experimental category. Even with type certification in place, LSA is not general aviation. The two-seat Electro is apt to be limited to a training role, and only in visual meteorological conditions (VMC).

In Canada, meanwhile, Harbour Air Seaplanes isn't looking to set or break any speed records. Instead, the Vancouver, British Columbia, short haul/charter service intends to convert its fleet of DeHavilland DHC-2 floatplanes to Electric Propulsion Unit (EPU) systems manufactured by MagniX. A proof-of-concept example (C-FJOS) has been performing data-gathering flights since 2019. A second Beaver (C-FIFQ) is being readied as the certification validation aircraft for the series. Mating a certified MagniX



Joby Aviation's S4 demonstrator, which chalked up a 115-mile flight on one battery charge, transitions from vertical takeoff to horizontal flight. This aircraft recently suffered major damage in a remotely-piloted crash. (Credit: Joby Aviation)

EPU with a long-since-certified airframe such as the Beaver should make for a quicker Supplementary Type Certification (STC) issuance. A Cessna Grand Caravan 208B (N32EL) powered by a MagniX magni500 EPU has also been flown successfully, with STC expected in 2023.

Urban Air Mobility aircraft

Of the 13 AAM Reality Index entries that intend to launch 100% electrically powered, piloted aircraft, 11 are in the air taxi category portrayed in our hypothetical opening scene.

The current UAM contenders are electrical Vertical Takeoff and Landing (eVTOL) types. These are not simply electrically powered helicopters. Some resemble the V-22 Osprey, while others use rotors for liftoff combined with horizontally aligned props for cruise.



A front view shows the arrangement of the S4's six electric powerplants in horizontal flight. Backed by over a billion US dollars, Joby may be the safest bet in the AAM sweepstakes. (Credit: Joby Aviation)



Beta Technology is flying the Alia prototype in conventional takeoff/landing mode. Fairings are visible, but the VTOL rotors are not installed. In production configuration, these stop once in horizontal flight, then align with the booms to reduce drag. Wheels replace skids. (Credit: Beta Technologies)



Beta's innovative charging stations/VTOL pads are built around standard shipping containers. (Credit: Beta Technologies)

In the UAM race, California based Joby Aviation, Inc., backed by deals with Toyota as well as NASA and the US Air Force, holds the early lead (8.4 rating) as its model JAS4-2 demonstrator (N542AJ) continues flight testing after completing eleven laps (155 miles) around its Big Sur test facility in mid-2021. The 1 hour, 17 minutes flight was made on a single battery charge. However, on February 16, 2022, N542AJ, remotely piloted at the time, crashed at Joby's test facility in Monterey County, California. Details are sketchy, but one report describes damage to the aircraft as "substantial." The NTSB is investigating.

Close behind Joby is Beta Technologies (7.8), with headquarters and factory at Burlington, Vermont, International Airport. CEO Kyle Clark's philosophy is to keep things as simple as possible. "The number of requirements that you impose on an aircraft will define your path to certification," he says. Beta's Alia design has "no articulating nacelles, no variable-pitch rotors, and no gearboxes"—reducing the number of things which must be accounted for in the certification process. As development continues, Alia has been flown in conventional mode for some time.

Beta is also deploying its "airport in a box" infrastructure. The modular "box," designed around standard shipping containers, contains an elevated landing platform, basic crew rest quarters, and a charging station. The production version of the Alia-250 aircraft will gross 7,000 lbs. and carry a pilot and five passengers or an equivalent weight of cargo 250 nm at 145 mph, and do it on a single charge. Recharge will take about an hour.

Archer Aviation (7.2 rating), another California based startup, has gone public by merging with a Special Purpose Acquisition Company (SPAC)—essentially an all or nothing bet by the SPAC investors that initial losses (\$177 million in Q3/2021) will translate into future profits. United Airlines is among Archer's backers hoping that the first flight of their Maker demonstrator (N301AX) in December 2021 does indeed herald big things to come. In the UK, Vertical Aerospace, Ltd., is betting on its four passenger VA-X4 air taxi, slated to fly in 2022. Several other AUM enterprises score in the seven range on the AAM Reality scale, and at least a couple of these should put prototypes in the air next year.

Advanced Air Mobility—The Regionals

Unlike the UAM types, which are mostly on-call VTOL vehicles intended to flit above city traffic, aircraft in the AAM category will be larger types capable of operating on regularly scheduled routes—the domain of the regional airline.

In this field, only Germany's Lilium scores above 5.0 on the Reality scale. The company touts its six-passenger (plus pilot) eVTOL demonstrator, nicknamed Jet, as a pre-production example of the type that will start commercial operations in 2024. Jet relies on 36 ducted electric vectored thrust motors, which resemble miniature jet engines, thrust being generated by electrically driven fans and augmented by variable nozzles. The engines are integrated in the wing flaps that tilt downward for vertical takeoff then transition to normal position for cruise.

Conspicuously absent from the Reality Index is Eviation Aircraft, whose Alice prototype, first exhibited at the 2019



Archer's 12-motor Maker made its first flight in late 2021. For takeoff and landing, the forward six pivot up as shown, then rotate forward for horizontal flight. The rear six are VTOL rotors only, which feather then align fore-and-aft to reduce drag while in flight. (Credit: Archer Aviation)



German AAM entry Lilium features the 6-seat "Jet." Thirty-six ducted jets rotate downward to hover. (Credit Lilium)

Paris Air Show, is certainly among the most aesthetically pleasing offerings in the AAM field. Figuratively at least, Alice got off to a flying start, but a fire in Eviation's hanger at the Prescott, Ariz., Regional Airport in January 2020, coupled with other issues, essentially set the program back to square one. Operations have moved to Arlington, Washington. Alice, now with T-tail, repositioned motors, and tricycle gear, is essentially a redesigned aircraft. In mid-February, Eviation founder and CEO Omer Bar-Yohay unexpectedly stepped down, just a little over a month after Eviation's chairman, Roei Ganzarski, who also headed MagniX, left the company.

Likewise, work on NASA's X-57 progresses at a pre-climate-change glacial pace. Named after James Clerk Maxwell, the Scottish physicist who first advanced the theory of electromagnetism, the X-57 is a modified Italian Tecnam P2006T four-seat twin. NASA is in the midst of a four-stage modification process on the vehicle, starting with systems ground tests and replacement of the avgas-powered engines with electric motors. Subsequent

mods will move the motors to the tips of a new, higher aspect ratio wing, and place pods under the leading edge, simulating smaller electric motors in those positions. In the X-57's final Mod 4 form, prop wash from these 12 small motors will "blow" over the airfoil, increasing lift at STOL airspeeds. At cruising speed, the small propellers will fold backwards to reduce drag.

Back to the future?

Among the more interesting AAM deals announced in the past year is Mesa Air Group's option to purchase 100 ES-19 all-electric commuter aircraft from Sweden's Heart Aerospace. Operating as American Eagle and United Express, Mesa is a regional partner of those mainline carriers.

As a 2021 digital article in simpleflying.com notes, while flying has now become routine for almost all Americans, service to more isolated rural areas has in fact regressed. As one example, Farmington, New Mexico's Four Corners Regional Airport once boasted 30 daily departures to seven destinations. Today, Farmington has no scheduled passenger service. Operating costs of the ubiquitous 50-seat RJs have made locations like Farmington unprofitable, even with Essential Air Service (ESA) subsidies from the Federal government.



Eviation has redesigned Alice's engine and empennage arrangements. The original tail-dragger, V-tail pusher became a tricycle gear twin (L). Mt. Rainier, backdrop of many a Boeing publicity shot, looms in distance behind this rendering (R) of the most recent proposed configuration. (Credit: Eviation)



Among the most ambitious AAM undertakings is Swedish contender Heart Aerospace's ES-19. Mesa Airlines believes the 19-seater, represented here in United Express livery, will enable the reopening of many now abandoned small market destinations. (Credit: Heart Aerospace)



NASA's X-57 Maxwell pictured over Edwards AFB—something that won't really happen for several more years. (Credit: NASA)

Although it now operates those very Bombardier and Embraer regional jets exclusively, Mesa has a long history of passenger operations with smaller aircraft in out-of-the way markets. Mesa CEO Jonathan Ornstein elaborates: “Mesa operated over 200 19-seat airplanes at one point, and now there are, literally, no 19-seat aircraft being operated in the United States when there was once, literally, in the thousands.” Harking back to his days at now-defunct Air LA, Ornstein sees the ES-19, so named because of its number of seats, as the low-cost solution to reopening those unserved markets.

The ES-19 is scheduled to become operational in 2026, but to this point only a 1/5th scale demonstrator has actually flown. In any case, one nagging question remains. Even if the ES-19 and similar types are FAA certified, will the convenience of closer and more frequent air service be sufficient to overcome the flying public's general aversion to propeller-driven aircraft?

The bottom line

As the old joke has it, the way to make a small fortune in aviation is to start with a large one. At least some of the names on the AAM Reality Index, backed by Special Purpose Acquisition Companies, seem to be in that position. Joby Aviation reportedly can tap a cash reserve of nearly two billion dollars. Lillium rings in at \$930 million, with Archer not far behind. Beta Technologies, which appears to have as good a chance as any at early FAA certification, comes in at \$500 million. All are presently operating at tremendous losses, and while options and tentative agreements amounting to billions of dollars are on record, no money has yet changed hands. AAM wannabe Zunum went bust back in 2019. Others may be on life support.

Four of the companies briefly examined in this article—Joby, Archer, Lillium, and Vertical Aerospace—are traded on the NY Stock exchange or NASDAQ. The stock market may or may not be a sound indicator of public confidence or of things to come, but as 2022 began all four offerings were trading in the \$6 to \$8 range, around 20 to 40 percent lower than where their values stood in early 2020.

Graham Warwick, Technology Editor at *Aviation Week & Space Technology*, may have summed it all up as well as anyone can: “Which is the winning business model in advanced air mobility? Urban or regional; passenger or cargo; piloted or autonomous; vertical, short, or conventional takeoff and landing? All of them or none? It is a question that cannot yet be answered. There are players pursuing all of these ideas, individually or in combination, and they all want a piece of a market that is projected to be worth trillions of dollars but which in reality does not yet exist.” (Quote from AW&ST, 13-26 Sept 2021)



AAHS Needs YOU at 2022 AIRVENTURE

AAHS has reserved a display booth at this year's EAA AirVenture, and we need your help! We're looking for AirVenture attendees to volunteer at our booth, sharing AAHS's mission and membership opportunities with other aviation enthusiasts. We also need a Booth Manager, who will attend AirVenture for the full week and can oversee the volunteer schedule, supplies, and setup of the booth. AAHS will provide the Booth Manager free entry to AirVenture for the whole week, a vehicle pass, and a discount on housing.

AAHS has rented a home in Oshkosh for this epic event, with three private rooms and one shared room, for members wanting to enjoy a week of full aviation immersion! Rates for the rooms/beds are set on a weekly rate, averaging \$100-\$150 per night. Priority will be given to members who volunteer at the booth. Those same members who commit a few hours each day of the event may also receive a week pass (limited availability).

Will you accept the challenge? Help AAHS reach more members at the EAA AirVenture Oshkosh Airshow! For more information about volunteering and housing availability, contact us at membership@aahs-online.org or (714) 549-7818. See you there!



Bill Allen, John Lyon, and Jerri Bergen at 2017 AirVenture



Two days prior to 2017 AirVenture, on downwind leg in the Stinson L-5

Book Reports

From Kites to Cold War. The Evolution of Manned Airborne Reconnaissance, by Tyler Morton. Naval Institute Press, 291 Wood Road, Annapolis, Maryland 21402. <https://www.usni.org/press/books>. ISBN 9781682474655, 2019, Hardbound, 9" x 6", 304 pages, 22 B&W photos, 1 map. List price: \$51.95. Also available in digital format.



The genesis of this work appears to be a 2012 article by then-Major Morton for *Air & Space Power Journal*. Promotion to Lt. Col. followed, coupled with a PhD dissertation which, revised and repackaged as part of the Naval Institute Press's History of Military Aviation series, emerged as the book reviewed here. In a narrative of less than 210 pages, Morton sets out to present "a unique account spanning two millennia of manned airborne reconnaissance history,"

something not heretofore found in a single volume.

That's a tall order, as he admits, but one he aims to fulfill by selecting "lesser known narratives at the expense of retelling well-worn histories." That approach works surprisingly well, although plenty of well-worn history is repeated, and some of the lesser-known episodes are heavily condensed.

The book is divided into six chapters, plus an introduction and epilogue. At the end of each chapter a few paragraphs summarize the conclusions reached. The first half of the book looks at the history of aeronautics from the Montgolfier brothers first flight in 1783 through the end of WWI. A lot of aviation history is summarized in the first three chapters, much of which will be unfamiliar to readers whose interests lie in the time beyond balloons and biplanes.

Among many "firsts," WWII ushered in the collection of Electronic Intelligence (ELINT) and Communications Intelligence (COMINT) from airborne platforms, which chapter four covers in some detail. Together these "ints" make up Signal Intelligence, or SIGINT, which is a central theme throughout the remainder of the book.

Chapter five introduces Strategic Reconnaissance, Cold War style. The U-2 and the A-12/SR-71 "Blackbirds" are of course covered, but the greater part of the narrative lays out a concise but thorough history of the long-running Peacetime Aerial Reconnaissance Program (PARPRO) and its antecedents. (The author's SIGINT focus may relate to his experience as an enlisted linguist and 2,500 flight hours logged aboard RC-135

Rivet Joint and other ISR platforms.)

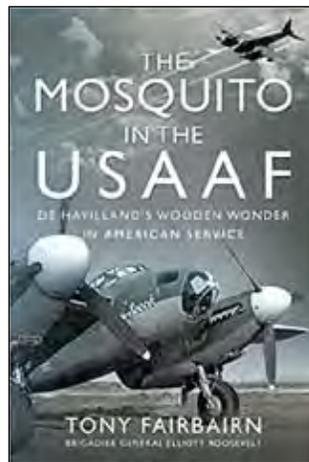
Chapter six outlines American Tac Recon in Korea, the Cuban Missile Crisis, and Southeast Asia. Because much of the more recent activity remains classified, the story ends around 1972 as the U.S. looked to exit the Vietnam War. As in the previous chapter, there is considerable discussion of SIGINT along with the more traditional facets of aerial reconnaissance.

From Kites to Cold War reads easily enough, but its appeal will vary depending on the reader's interests and accumulated knowledge. For the aviation buff who has long studied combat histories or specific aircraft types, a sweeping survey such as this won't offer much that's new. On the other hand, discussions of applied SIGINT such as Project TEABALL and its Korean War predecessors will likely be something of a revelation to almost anyone.

The author's secondary objective, "to fill a considerable historiographical gap," is well met. For those seeking a deeper understanding of the many subjects touched upon, 1,247 footnotes are backed by a 25-page bibliography. The PhD dissertation which is the basis for the book can be found online at <https://apps.dtic.mil/sti/pdfs/AD1030466.pdf>.

Joe Martin

The Mosquito in the USAAF, by Tony Fairbairn. Casemate Publishers, 1950 Lawrence Road, Havertown PA 19083. <https://www.casematepublishers.com> Hardbound, ISBN: 9781399017336, 2021. 9.25" x 6", 304 pages, including appendices and index. 278 black and white illustrations. \$42.95. Also available in digital format.



Tony Fairbairn has done a very neat job of capturing the use of the famed de Havilland Mosquito, or "Mossie," by the United States Army Air Forces (USAAF) in World War II. His coverage of the American Mosquitos mission sets revealed some, to this author anyway, surprising usages, namely that of clandestine operative radio relay and intelligence collector. In addition, the more familiar roles of weather reconnaissance, radar chaff dropper, bomber operations

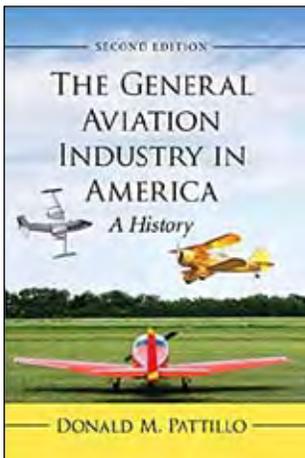
command ship, and night fighter are covered as well.

He touches, briefly, on how the Mosquito was acquired by the USAAF. Remarkably, in a book published in late 2021, he has first-person interviews with many American personnel who flew or worked on the Mosquito, including one with retired Brig. Gen. Elliott Roosevelt, probably the driving force for there having been American Mosquitos. This book has been decades in the making as the Roosevelt interview, and a forward written by him, date from the 1970s, when many of the Mossie veterans still walked among us.

By working chronologically with each American unit that operated the Mosquito, Fairbairn keeps the complex intertwining of such a unique aircraft in various roles complete and easily understandable. The research and interviews conducted make this, in my opinion, probably THE book on American Mosquito operations. It also features a remarkably large collection of Mosquitos in American markings from every unit. Researchers, historians, and families seeking information on this topic will find this a very useful book. I enjoyed reading it and recommend it to any fans of the Mosquito or other aviation enthusiasts.

Brick Eisel, Lt Col, USAF (ret) and author of *Beaufacturers in the Night: The 417th Night Fighter Squadron USAAF*

The General Aviation Industry in America, A History, by Donald M. Pattillo. McFarland & Company, Inc., PO Box 611, Jefferson, NC 28640-0611. <https://mcfarlandbooks.com> ISBN: 978-1-4766-7721-7, 2020. Softcover, 6" x 9", 257 pages, 43 photos. \$39.95, also available in digital format.



Don Patillo has updated and expanded his general aviation history *Pushing the Envelope* (McFarland & Company, Inc., 1998.) In this second edition, retitled *The General Aviation Industry in America: A History*, he includes the significant technological advances of the last three decades in general aviation, and the political and economic environment that has shaped the industry. This edition covers significant world events such as terrorism, and its impact

on aviation and the global community, and game-changing regulatory updates that significantly affected the viability of general aviation aircraft ownership in recent years.

Pattillo keeps his focus on the industry of general aviation, i.e., the manufacturers and their products that served the individual aviator or business venture, as opposed to military or commercial aviation. To best describe the ongoing development and shaping of the aviation industry that served the individual market, Pattillo necessarily limits his conversations to the significant aviation designers and producers that most significantly affected the general aviation market. Thus readers shouldn't be disappointed if they do not see mentioned their favorite kit plane developer or prototype aircraft model.

The book is organized chronologically, from the inception of general aviation following WWI to present times. The initial read is daunting; as he describes (with footnotes and index references) in long paragraphs the inception of the most important general aviation companies, their owners, their financial backers, and aviation designers. Piper and Cessna, both early aviation entrepreneurs, as well as other household aviation names such as Beech and Taylor all show up with

in the first 25 pages of the book. One of the book's defining features is that it does not devote pages to the career of each aircraft manufacturer, rather it highlights the endeavors of major aviation individuals and their firms at significant points of time in the aviation industry development.

If you're interested in learning of the history of Ed Porterfield, for example, you would see a mention of him starting the American Eagle Aircraft Co. in 1926, as one of the many small aircraft designers of the 1920s, on page 23, but it leaves off after a paragraph when Porterfield leaves the company in 1932. Porterfield is mentioned again later on page 32, when he establishes his own aircraft company, Porterfield Aircraft Corp., in 1934, in which he produces a series of light tandem trainers before being taken over for war production in 1942.

The index is not just a nice-to-have feature with this book, it's a necessity if you're seeking to follow a single thread of an aircraft manufacturer among the dense background of the industry's history. Each chapter begins with an overview that effectively frames the economic climate of the time, and gives the reader a broad brush of what is to come. This helped this reviewer set the expectation for what would be found in the coming pages. For example, under the section 'Business Jets' within Chapter 5, "General Aviation Matures, 1954-1967," Pattillo outlines the overall reasons for the success of business jets in this timeframe, and then goes on to describe the startup of Learjet, by William P. Lear, as an example of how the business jet market was evolving.

Jerri Bergen

Wants & Disposals

DISPOSAL: Historical Materials for Sale

OAG'S 1930's -; First flight covers 1926- , 1000's of airliner/airport postcards; Flight covers of first transatlantic/transpacific flights 1939; Complete collection of all Enroute Low and High-Altitude Routes with Instrument Approach Procedure plates, Standard Terminal Arrival (STAR) diagrams 1987; Many VFR maps sectional and terminal; Jeppesen maps going back to 1958; Nat. Geographic magazines with aviation pictures, maps and articles; Commercial Airport histories, terminal diagrams and airport runway maps. For more details on the entire collection, contact Paul Marzell paul@marzellcompany.com.

DISPOSAL: Must downsize my aviation book and magazine collection. Janes, Windsock, AAHS Journals, Air International, lots more books and mags. Priced to move. Write for a listing. Please specify in subject line, "Book List".

Axel Kornfuehrer, AAHS #10476
130 15th Ave North, Hopkins, MN 55343

President's Message

Are you, like me, looking to the months ahead, blocking out dates for the must-do events on your calendar (getting the Porterfield annual completed, the foot surgery I put off) and then fantasizing about what other fun things you can get to this year with what's left?

Here in the AAHS office our calendar is filling up with events we are hosting, activities we are supporting, and you're invited to participate in them all! You'll see in this issue our official 2022 Annual Meeting Invite for June 10-12, in the wonderful wine country of Sonoma Valley. We'll have three days of vintage airports and airplanes, good food, and good company. It's just one low price for a weekend of outdoor, masks-optional, aviation fun. Sign up now for an early bird discount! We'll be adding more details, such as attendee gifts, speakers, and aircraft rides on the [AAHS website](#) and in upcoming issues of the Journal.

Soon after our Annual Meeting, AAHS will be going to Oshkosh! At EAA AirVenture, July 25-31, AAHS will have an official booth staffed by AAHS volunteers for the week. We are arranging group lodgings via a rented home, with costs shared by the renters. We're also investigating speaking about our PLANESPOTTER app as a presenter at AirVenture. If you plan to attend AirVenture 2022, why not schedule a few hours to chat with visitors, and get to know your fellow AAHS members and history buffs? As we know them, more details will be posted on the website and in the upcoming AAHS Journal. Think about adding this event to your calendar, too.

We are making a commitment to become a valued partner at historic Flabob Airport, and we're starting that partnership with the publication of a small airport newsletter, the *Flabob Flyer* that will provide some regular news of airport happenings to tenants and local neighbors. This will be published quarterly. If you're a Flabob local, and have some time to share a story or news update, drop by AAHS headquarters and give us the scoop!

A longer-term commitment to both Flabob Airport and our mission includes teaming with the Tom Wathen Center at Flabob to design an aviation library that will house the AAHS book collection, as well as other aviation book collections already on the field. AAHS has this year initiated activities to help the project team in identifying books (currently about 14,000 volumes) to be included in this shared library and creating a general cataloging system that all the collections at Flabob will eventually use. Later in the year, AAHS will support the Flabob Airport Veterans Day Celebration, where we'll help vend food, do traffic control, sell books, and give tours of AAHS headquarters.

You can help AAHS with any of these activities with your time, or with a donation to the Society. Your volunteer time and financial support are the wings that give this organization lift, and we can't see this mission through without you. So plan to have some fun this year with AAHS!

Jerri Bergen
AAHS President



AAHS FlightLine

American Aviation Historical Society

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The Ithaca Aviation Heritage Foundation's beautifully restored S-4B, Signal Corps No. 4366, takes flight in September 2018. It has since been retired to a museum. (Photo by Mike Brown)

Restorations and Reproductions

The Thomas-Morse S-4 Scout

It wouldn't be an outrageous stretch to say that the two most important elements in aviation history are people and planes. When it comes to planes, there's nothing like being able to experience the real deal. Be it a flying warbird or a static museum example painstakingly restored—or replicated from original factory drawings—down to the last rib and rivet, these are the most tangible connections to the story of human

flight. One of the objectives of *Flightline* is to share information and updates about these historical artifacts. In this issue, we look at two restored examples of the Thomas-Morse S-4 Scout, familiarly known as the "Tommy."

While it's not exactly unknown, the S-4 won't get any votes as one of the outstanding aircraft of the WWI era. In 1916, Thomas-Morse, along with several other manufacturers, began



The Ithaca "Tommy" knocked down to begin restoration. It took years to rehabilitate this basket case. (Credit IAHF)



This 1918 photo shows S-4 Scout fuselages bottom side up on the production line. The distinctive longeron curvature is evident. (National Archives)



This photo of the Thomas-Morse production line helped establish the likely identity of the Ithaca Tommy. What are believed to be constructor's numbers 129 and 130 are in the foreground. (National Archives)

design work on pursuit aircraft that could be used to defend the homeland against enemy air attacks. The pursuit never took shape, but the original contract was modified to call for four “speed scout” types, about which the Navy also expressed interest.

After the U.S. entered the war, it became evident that the much-hyped program to train thousands of aviators in the States for service in the American Expeditionary Force was overly ambitious. The several Curtiss “Jenny” variants and the oft-maligned Standard J-1 were adequate as primary trainers, but there was no American equivalent of rotary-engine combat types like the Sopwith Camel and the Nieuport pursuits. So it was that the Thomas-Morse speed scout design was reimagined as the Tommy. The S-4 was a single-seater, but it represents the first advanced trainer designed and built (in any appreciable quantities) in the U.S.

Robert Casari covers all this and more in his encyclopedic

American Military Aircraft, 1908-1917. The story of Thomas-Morse, beginning as the Thomas Brothers Aeroplane Co., is chronicled in one of the Putnam Aeronautical Books series, *General Dynamics Aircraft and Their Predecessors*, which also contains info, photos, and specs on the individual aircraft types. (In 1929 Thomas-Morse was absorbed by Consolidated Aircraft that, as Convair, became part of General Dynamics decades later.) Although it was published more than 50 years ago, the Profile Publications Ltd monograph (No. 68) on the S-4C still contains much useful information.

Since the 1950s, a dozen or so S-4s are known to have been in the hands of private owners, and it is from this pool that today’s survivors have come. The two examples featured here have been restored as closely as possible to their original states. In fact, these birds are no doubt more pristine than any 1917 or 1918 production article ever was!



These hand-painted numerals, thought to be Thomas-Morse constructor's numbers, provide a clue to the original identities of pieced-together airframes. (World War 1 Aero)



This shot of the still incomplete Ithaca Tommy clearly shows the elliptical form of the aileron and elevator trailing edges of the S-4B. (IHAF Facebook)



The finished product. S-4B No. 4366 ready for pre-flight. (IHAF)



Resplendent in its restored state, the NMUSAF's S-4C poses outside the museum. (NMUSAF)



The Dayton Tommy before restoration. Barely noticeable here, years of dripping castor oil finally caused a huge rent in the fabric under the cockpit. (NMUSAF)



In addition to restorative work, modifications made by previous owners (circled) had to be brought back to original condition. Castor oil was still dripping! NMUSAF)



NMUSAF restoration technician Brian Lindamood works his sheet metal magic on the Tommy's cowl, correcting those snipped away portions. (YouTube via NMUSAF)



Fine overhead shot of S-4C No. 38994. Note the straight-edged ailerons and the late or post-war placement of the wing insignia. (NMUSAF)

Bringing Tommy Home

Condition issues aside, a major undertaking in the complete and accurate restoration of an aircraft more than 100 years old, made mostly of wood, wire, and cloth, is to determine its original configuration then sort out the undocumented modifications subsequent owners may have made. Neither of those tasks is easy. Manufacturer's data placards are lost or swapped, and pieces of two or more airframes and even different models may have been cobbled together to make one hybrid airplane.

The first S-4 restoration we'll look at is a tribute to the perseverance of the Ithaca [NY] Aviation Heritage Foundation, abbreviated hereafter as IAHF. In September 2018, after years of hard work and some diligent research, the group put a Tommy back in the air a century after it left the factory in Ithaca. Some of the restoration and replication work was done in the very buildings that once housed the Thomas-Morse factory.

When the "Bring Tommy Home" team delved into the airframe they'd finally convinced the former owner to donate, they found that it had begun life as an S-4B. Somewhere along the line, the original 100 hp Gnome engine had been replaced by a 80 hp LeRhône, and C model wings and elevators had been grafted onto the fuselage. The engine swap was fairly common "in the day," but B-style wings and elevators had to be fabricated as replacements, along with some less visible components. The only other S-4B known to exist is at the Old Rhinebeck Aerodrome, also in New York. The Ithaca group was able to glean valuable information from that Tommy.

As received, the IAHF airplane was marked with a Navy serial number (A-4358) which, while legitimate, proved not to be accurate for this airplane. The data placard was long gone, and no Army serial number could be found on any airframe components. But there was a clue. A hand-painted "191" was discovered on a

metal panel behind the cockpit. A period photograph of the Thomas-Morse production line shows a lineup of fuselages with engines and cowlings in various stages of installation. Tags attached to each airframe are marked with consecutive 3-digit numbers. Knowing that Thomas-Morse began its in-house numbering for the S-4B at 101, the IAHF team concluded that their aircraft was the 191st in the series. Aligning that piece of data with the government-assigned serial numbers on the S-4B contract (4276-4375) means that in all likelihood the airplane is 4366. Marked as such, the Tommy now stands as the centerpiece of The History Center in Tompkins County, a few miles from where it was rolled out of the Thomas Morse factory back in 1918.

In an interesting sidelight to this story, the Old Rhinebeck Tommy has "192" painted in the same position as the 191 on the Ithaca S-4B. But it seems there are always complications. Affixed to the instrument panel of the Old Rhinebeck machine is an original

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Thomas-Morse placard stamped with contractor's number 153, equating to S/N 4328, which is how the aircraft is now marked. Given the mixing and matching that has occurred in virtually every surviving S-4, it's impossible to say with certainty, but there's a very good chance that these two airplanes were originally built side-by-side as S/N 4366 and 4367. Interestingly, the IAHF volunteers believe that the cowling on 4366 as it was originally received came from the S-4 prototype. Since the restored version was to be airworthy, a replacement cowl was fabricated. The original has been preserved as a separate artifact.

As the restoration progressed, the Ithaca team described their efforts and results in *World War I Aero* magazine. Excerpts from these articles, along with a gallery containing hundreds of photos, may be accessed at <https://www.tommycomehome.org/> It's well worth a look.

The Air Force's Tommy

The second Tommy restoration we explore is the job done on the S-4C that until recently perched in the Early Years gallery of the National Museum of the U.S. Air Force (NMUSAF, in Dayton, Ohio). The S-4B now at Old Rhinebeck was displayed at the museum from about 1963-1973, but the newly restored S-4C is another bird entirely. It was donated to the Air Force Museum by Mr. R.W. Duff of Miami, Fl., but like the Ithaca example, its pedigree is somewhat uncertain.

In the News & Comment section of the Winter 1973 AAHS Journal, Frank Strnad, who also authored Profile No. 68, noted that "Upon seeing the Tommy unassembled in Florida in 1963, I attempted to identify it. We later found "38944," a Signal Corps serial, stamped in the wood on the lower ends of two wing and two cabane struts. Other struts were of a lighter color, and were apparently replacements." That was enough for the museum—38944 she remains, although the Thomas-Morse placard in the restored cockpit is stamped 562, which by the calculus previously explained should equate to S/N 38953.

Be that as it may, the museum's relic badly needed of repair and restoration. Most noticeably, castor oil dripping for decades caused the fabric along the entire bottom of the fuselage to split

open. As the restoration crew began disassembly, they realized that the cowling had been moved backwards a few inches from its original position. Half-circles were cut from the cowl rim in order to squeeze it past the front edges of the cabane and landing gear struts. Restoring the cowling to its original form required patching these cutouts and filling the excess rivet holes punched during the modification. The finished product is a marvel of sheet metal craftsmanship. The restoration was completed in October 2021. Photographs taken throughout the restoration process are posted on the museum's website, along with an excellent 13-minute video at <https://www.youtube.com/watch?v=z-UGL-iKm0c>

Other S-4 Scouts in Museums

Besides the examples already examined mentioned, there are a handful of Tommies in other museums around the country. The National Museum of the Marine Corps has a hybrid ship, a combination of restored S-4B wings and empennage mated with a fuselage scratch-built by Century Aviation, using parts from what is believed to have been a spare prototype fuselage. The finished product is marked as an S-4B from the Marine Corps flying school at Miami, Fla., ca. 1918-19.

The well-travelled S-4C S/N 38899 (N3991) now resides in the Experimental Aircraft Association Museum in Oshkosh, Wisc. At one time, it had been re-engined with a 120 hp Ken-Royce radial. Can readers fill us in on its current configuration? The Eagles Mere (Pennsylvania) Air Museum has a near-twin sister ship, S/N 38898. The Cradle of Aviation Museum (Long Island, NY) website shows S-4C No. 38394, pictured in Profile No. 68, evidently unchanged over the past 75 years or so. The Yanks Museum (Chino, Calif.) displays an almost identically marked Tommy, reported to be S/N 39734.

The Navy also employed the Scout. The S-5 was essentially an S-4B mounted on floats. According to Joe Bauer's serial number listings, the National Museum of Naval Aviation Tommy (BuNo. A5858) was delivered as C model, which means the aircraft displayed is actually a land-based S-4C on floats—not an S-5.

Joe Martin

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