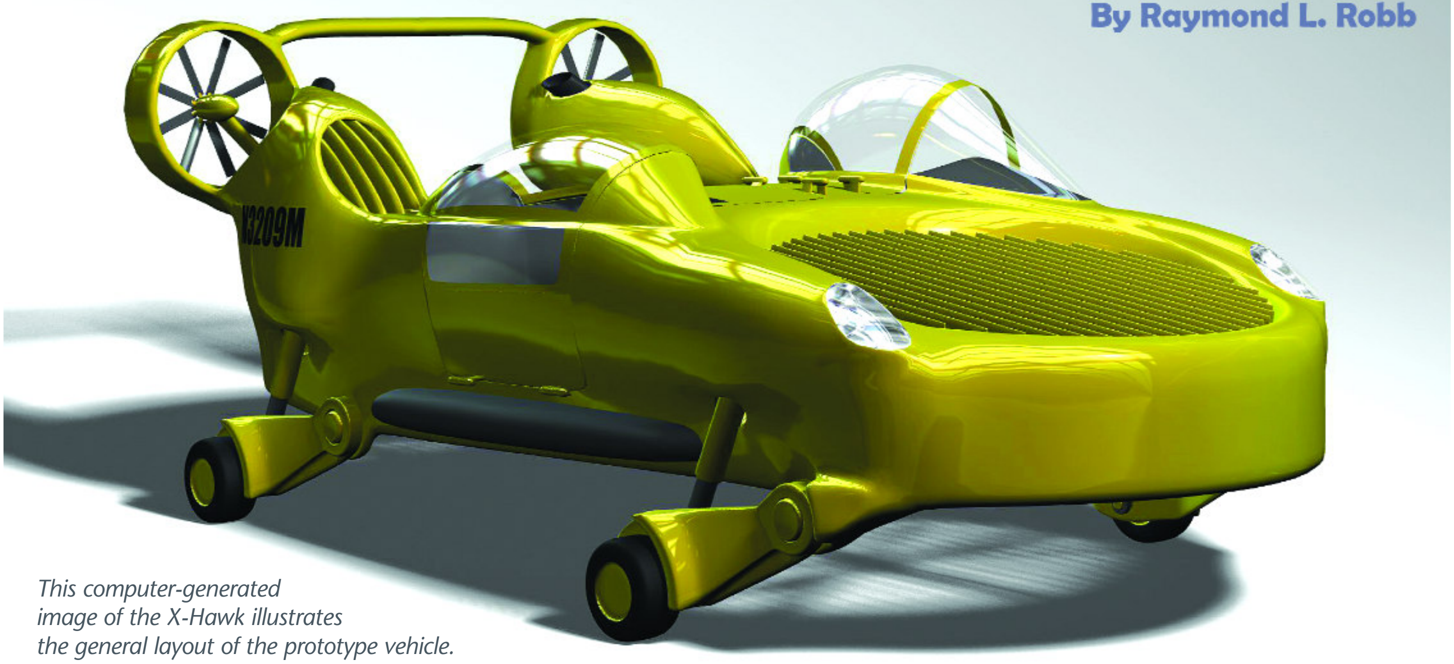
Driving on Air: 20th Century Flying Carpets

By Raymond L. Robb



This computer-generated image of the X-Hawk illustrates the general layout of the prototype vehicle. UrbanAero hopes to fly it in about two years.

Flight has always held a certain appeal to man, particularly in ancient times, when he dreamed of soaring like a bird, gliding effortlessly above the trees and hilltops. Legends abound with tales of magical chariots, flying thrones, and flying carpets which whisked their riders away on incredible flights of fancy. As is often cited by Sergei Sikorsky when quoting the words of his famous father, it is interesting to note that all of these ancient tales held one thing in common: pure vertical flight. To early man, this idea was only logical since birds did not require an extended takeoff run and the idea of runway-hungry fixed-wing aircraft had not yet been conceived. As modern-day technology has progressively transformed the "impossible" into reality, many of the ideas dreamed up by both ancient and modern-day man have eventually materialized in one form or another. One such idea is the so-called "flying car," a concept that combines man's fascination with automobiles and flying machines. The term flying car has been applied to countless designs, both built and unbuilt, which have appeared over the years. As such, it would be impossible to cover all of these designs within the scope of this article. Therefore, we will focus on variations of the so-called tandem fan arrangement (with the exception of the VZ-7AP) which evolved as a direct spin-off of the one-man flying platforms successfully tested by the United States military during the 1950s and 1960s [see "Walking on Air: Flying Platforms of the Past, Present...and Future?" *Vertiflite*, Summer 2004]. Bearing an uncanny resemblance to the "flying carpets" of Asian and Middle Eastern lore, these flying cars first appeared a mere half-century after Orville and Wilbur Wright struggled into the air with their Wright Flyer. The basic design proved to be fairly successful, but it was not adopted for use by the military for various reasons. However, some ambitious designers in the civilian industry are hard at work today in an attempt to resurrect the tandem fan configuration for use by the commercial industry as well as by the general public. In the following pages, we will explore past designs tested by the military, and take a look at similar designs which may yet find their niche in tomorrow's market for affordable vertical flight.

The Flying Car in Uniform

History shows that some of the most innovative technological advancements are born as a result of roles and requirements identified and defined by the military. As stated earlier, the tandem fan flying car has its roots in the armed forces. After the Korean

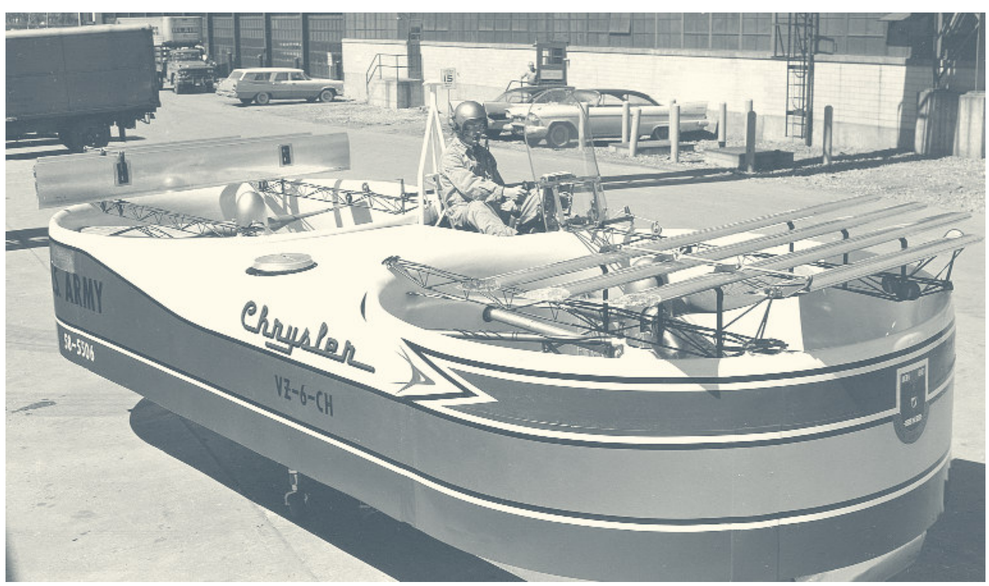
War, U.S. military strategists and tacticians were seeking ways to increase the mobility of combat personnel on the battlefield. As a result, several one-man flying platforms were built and tested, all of which showed promising results. However, since the flying platform was designed to carry only a single soldier and his individual equipment, the Army sought to develop this idea further and field a larger version of these machines. What the military needed was a craft capable of carrying a more substantial load, a sort of "airborne truck" which could successfully negotiate almost any type of terrain, including water. The military's primary utility vehicle at the time was the 4-wheel-drive ¼-ton Willys MB and Ford GPW, which were both universally known as the "jeep" (from "GP"). The jeep had proved its value as an extremely versatile workhorse on the battlefield, readily adaptable to a multitude of tasks, many for which it had not even been designed. Having served admirably throughout World War II and Korea, the jeep served as a basis for the concept of a sort of "flying jeep" and military planners in 1956 began to solidify their requirement for such a vehicle.

In order to fulfill the role envisioned by military leaders, the Army Transportation Research Command (TRECOM) issued a Request for Proposals (RFP) in 1957 on behalf of the U.S. Army Transportation Corps, inviting ideas from industry. The RFP outlined a Vertical Takeoff and Landing (VTOL) utility vehicle capable of operating at extremely low altitudes and at forward speeds up to 70 mph with a payload capacity of 1,000 lb. Cruising altitude was to be a mere 5-12 feet with an endurance of "several hours" at maximum payload capacity. Missions envisioned for this new machine included forward observation, liaison duties, and even direct combat as a weapons platform. Various companies in both the aviation and automotive industries responded to the Army's RFP, as the concept of a flying jeep did not seem to fit neatly in either category, three of which received Army contracts for prototype development and testing. These companies were the Chrysler Corporation, the Aerophysics Development Corporation (which was subsequently purchased by the Curtiss-Wright Corporation), and the Piasecki Aircraft Corporation.

The Chrysler VZ-6CH

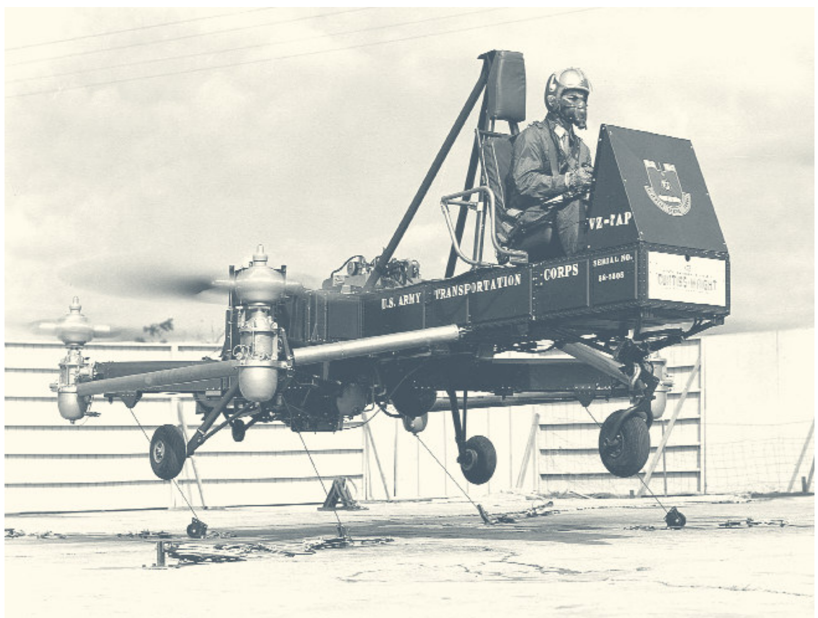
Venturing out of its more traditional role as an automotive giant, the Chrysler Corporation's submission for this new concept in military transportation was designated the VZ-6CH by the Army. In competing for the TRECOM contract, Chrysler was tasked to build two prototypes, which were assigned the military serial numbers 58-5506 and 58-5507. The VZ-6CH had a very unusual appearance for a flying machine. Unlike conventional fixed-wing aircraft or helicopters, there were no wings or rotors. Lift was gained solely from the thrust produced by twin fixed-pitch ducted propellers made of laminated wood, each measuring 8.5 ft in diameter, mounted horizontally and arranged in tandem. With removable side panels fitted, the vehicle had a flat, slab-sided rectangular fuselage with rounded ends. The pilot was seated to the left of center between the propeller ducts. The machine had a length of 21.5 ft and a height of 5.2 ft to the top of the pilot's seat. Gross weight was approximately 2,400 lb. Both three-bladed propellers were driven by a single 360 shp Lycoming six-cylinder GSO 480 piston engine, mounted to the right of the pilot's seat. Each propeller had its own gearbox at the hub. The pilot flew the machine through the use of a conventional control column, collective lever, and foot pedals. The control column and foot pedals were linked by a series of cables to two sets of hinged control vanes mounted directly under each propeller. These vanes, by way of being mounted directly in the slipstream of the propellers, were used to produce roll. When rotated differentially, they produced yaw. Pitch control was achieved by closing either set of inlet vanes mounted directly above the propellers at each end of the craft, reducing airflow and forcing the appropriate end downward. Altitude was controlled with the collective lever by varying propeller rpm. While on the ground, the VZ-6CH rested upon a set of four fixed landing legs equipped with castoring wheels and arranged in a diamond pattern.

Despite Chrysler's optimism in the projected performance of the VZ-6CH, the machine never managed to live up to its potential. Although tether tests demonstrated ample thrust to lift the machine vertically into



The VZ-6CH was Chrysler's submission for the proposed Flying Jeep concept. Only one was ever flown.

the air, the very first attempts at free-flight resulted in a crash which severely damaged the first prototype. This occurred due to a number of factors, but mostly due to the lack of provision for controlling horizontal translation. When the VZ-6CH was untethered for the first time, the pilot attempted to lift off and the vehicle began to drift laterally across the tarmac before the wheels even left the ground. Since the castoring wheels offered no resistance, it was decided to chock one of the four wheels in place. On the next attempt, as the machine started to tilt forward, it then rolled rapidly 270 degrees and fell onto its right side, resulting in extensive damage to the machine. Fortunately, the pilot walked away from the scene with only a scraped elbow, having been protected in the roll by the crane tether attachment point mounted on top of the craft. After the crash, discussions were held concerning rebuild and modification. However, the VZ-6CH was deemed to be beyond economical repair and the Army simply chose to terminate development funding, effectively ending the VZ-6CH program altogether. Sadly, no examples of the machine exist today. Information on the VZ-6CH is scarce, more so than either of its competitors, possibly due to the crash occurring so early in the test program, resulting in much more limited testing than that of its rivals.



The Curtiss-Wright VZ-7AP, shown during tethered flight tests with the ring guards removed.

The Aerophysics Development Corporation/Curtiss-Wright VZ-7AP

The Aerophysics Development Corporation was another manufacturer selected in 1957 to develop a machine to fulfill the Army's unique requirements. However, the company was subsequently purchased by the Curtiss-Wright Corporation that same year, under which development of its proposal continued uninterrupted. This machine received the military designation VZ-7AP and, like its competitors, had a very unusual configuration. The VZ-7AP, two of which were built and assigned the military serial numbers 58-5508 and 58-5509, was of a fairly simplistic and straightforward construction. Its "fuselage" consisted of a long rectangular box-like structure with four short arms extending diagonally fore and aft from the sides, each of them fitted with a vertically-mounted variable-pitch propeller. Each arm had additional tubular braces firmly affixing it to the fuselage to prevent hub movement. The two-bladed propellers were of laminated wood construction, and were initially surrounded horizontally by protective tubular rings. However, these ring guards were removed soon after testing began, primarily to reduce weight. All four propellers were powered through a system of extension shafts and gearboxes by a single 425 shp Turbomeca Artouste IIB turboshaft engine mounted toward the aft end of the fuselage. The pilot, positioned at the front end of the boxy structure, was seated behind a simple instrument panel and provided with conventional helicopter-type flight controls. Directly behind his seat was a protective roll bar. Further back, the fuselage was slightly wider to serve as a platform for cargo, a passenger, or a combination of both. Overall, the VZ-7AP measured 17 ft in length, 16 ft wide to the tips of the propeller blades on each side, and 9.25 ft to the top of the pilot's headrest/roll bar. Empty weight of the machine was 1,260 lb and loaded weight was approximately 1,700 lb, which included a payload exceeding 400 lb. In at least one flight though, lift-off was made at 2,400 lbs gross weight. The machine rested on landing gear comprised of three non-retractable wheels. With regard to flight control, the pilot increased or decreased altitude through use of his collective lever, and exercised pitch and roll control by differential inputs to the propellers using the control column. Yaw control was initially attempted by a control vane mounted at the end of the turbine exhaust pipe and controlled by the foot pedals. However, this was soon found to be woefully ineffective and was later replaced by wooden control vanes positioned vertically in the slipstream of the aft propellers.

Tie-down testing of the VZ-7AP commenced on April 7, 1959. However, violent oscillations in the propellers prior to reaching full rotational speed necessitated an immediate halt until the problem could be isolated and rectified. By blocking the lead-lag hinges installed on each propeller, the problem was resolved and successful tie-down tests resumed in October 1959. Free-flight was achieved after only a few hours of operation, and the performance of the VZ-7AP was explored. Although the cruising speed of the VZ-7AP was established at 25 mph, one flight test demonstrated a maximum speed of 55 mph. A ceiling of 200 ft was achieved in tests, but altitudes of 25 ft or less were more likely in an operational scenario. During testing, a number of modifications were made, including a reversal in the direction of propeller rotation in relation to one another and a redesign of the control column linkages to reduce roll control sensitivity. These modifications, along with others, made the VZ-7AP easy to fly without any stability augmentation whatsoever. Numerous demonstration flights were made for military dignitaries, including one at Fort Ord, California. On at least one occasion, a 76 mm recoilless rifle was mounted on the cargo deck to demonstrate the potential of the VZ-7AP to serve as a weapons platform. Despite a mostly trouble-free flight test program, cancellation of the flying jeep program by the Army in December 1959 resulted in the testing of the VZ-7AP being discontinued. The last flight occurred in January 1960. Today, only one example of the VZ-7AP still exists, resting peacefully in the collection of the Army Aviation Museum at Fort Rucker, Alabama.

The Piasecki VZ-8P and VZ-8P(B)

Of the three types of flying jeeps built for the Army, Piasecki Aircraft Corporation's AirGeep was the most thoroughly tested, making it probably the best remembered of the three. Frank Piasecki had established himself as a leader in the field of military rotary-wing aircraft, having produced such notable designs as the tandem rotor HUP-1/2/3 for the U.S. Navy and the larger H-21 Shawnee/Workhorse for the Army and Air Force respectively, before starting Piasecki Aircraft. In response to the TRECOM contract, Piasecki built a prototype designated the Model PA-59K Sky Car. The Sky Car made a series of tethered test flights and made its initial free-flight on September 22, 1958, piloted by Frank Piasecki himself. Prior to delivery of the first prototype to the Army, Piasecki renamed it the AirGeep as a direct reference to the utility vehicle it was intended to replace. Using horizontally-mounted, counter-rotating twin ducted rotors arranged in tandem, the AirGeep was similar in appearance to the Chrysler VZ-6CH. Rotor diameter was 7.4 ft. The AirGeep's "fuselage" consisted of an aluminum alloy chassis that housed the rotor ducts. It had a length of 26.1 ft, a width of 9.4 ft, and a height of 6.7 ft to the top of the roll bar behind the pilot's seat. Each three-bladed rotor was driven independently by two separate 180 hp Lycoming 0-360-A2A piston engines. However, both engines were connected to a single central gearbox, allowing power to be directed to both rotors from a single engine in the event that one of the engines failed. Two seats were provided between the fore and aft rotor ducts, with the pilot occupying the one on the right hand side. The seat on the left could be occupied by a passenger or simply removed to allow room for cargo. Flight controls were of the conventional helicopter-type, with a cyclic stick and foot pedals for directional control and a collective pitch lever for controlling altitude. The cyclic stick and foot pedals provided inputs to a series of hinged vanes mounted beneath each rotor duct, directing the air blowing downward through the ducts to achieve directional control. Changes in altitude were effected by simply increasing the power to each rotor. A set of three non-retractable wheels was arranged in a "taildragger" pattern, which facilitated ground handling. The AirGeep's performance was noteworthy for such an ungainly machine, with a cruising speed of 50 mph, while maximum speeds of 65 mph were achieved in tests. Range was approximately 25 miles, though this was subject to variation depending upon the heights and conditions under which the craft was flown. Probably the most impressive performance feature was the AirGeep's altitude capability, which was demonstrated to be as high as an astounding 3,000 ft. However, such ceilings were unlikely to be flown on a routine basis as

An early version of the Piasecki VZ-8P AirGeep, armed with a 106mm recoilless rifle.

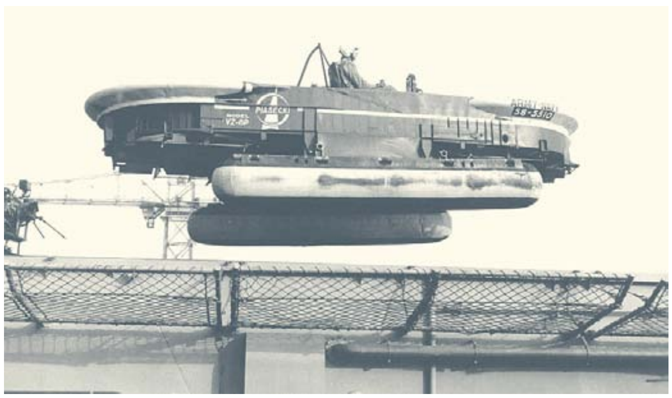
The VZ-8P(B) AirGeep II, shown here during hover tests, was a much improved version of Piasecki's original design.

the AirGeep was primarily envisioned to operate only a few feet above the ground. Empty weight of the AirGeep at this time was 1,848 lb, with a maximum takeoff weight of 2,350 lb.

Only five months after its first untethered flight, the first AirGeep was delivered to the Army. In accordance with standard practice, the Army then assigned a military serial number (58-5510) to the AirGeep along with an alphanumeric designation, calling it the VZ-8P. In order to reduce weight and increase reliability, performance, and payload capability, the Army chose to replace the two Lycoming engines with a single French-built 425 shp Turbomeca Artouste IIB turboshaft engine. The VZ-8P flew for the first time with this new engine on April 22, 1959. In this configuration, the AirGeep had a payload capacity of 1,200 lb, including the pilot. As testing progressed, the powerplant was again replaced, this time by a lighter and more powerful 550 shp AiResearch 331-6 turbine engine.

Having taken an interest in ongoing Army tests, the Navy engaged in a contract with Piasecki in June 1961 to conduct its own tests to determine suitability of the AirGeep for waterborne operations. The VZ-8P was briefly loaned to the Navy and referred to as the Model PA-59N. In naval configuration, the wheeled landing gear was temporarily replaced by large elongated floats on either side, permitting testing from open water under mild sea conditions. First flight in this configuration occurred on November 8, 1961. Testing took place primarily at the Philadelphia Navy Yard in Pennsylvania and at the Naval Air Test Center, Patuxent River, Maryland. During these trials, the Navy assigned the quite appropriate name SeaGeep to the machine, but the military alphanumeric designation was unchanged. During testing, the SeaGeep was fitted with a number of different side shields to vary the water spray patterns around the ducts and to increase lift in ground effect (IGE), while not reducing lift out of ground effect (OGE). It was found that water spray patterns were negligible since the spray was forced strongly away from the craft rather than recirculated, allowing clean air to enter the ducts. Altitudes up to 220 ft above the water were attained. Film footage taken during Navy tests of the SeaGeep at various altitudes above the water recorded flow patterns that were subsequently found useful in later VTOL downwash studies. Successful open water landings by the SeaGeep were demonstrated alongside ships, while landings aboard ships were easily accomplished on the first attempt. Safety of deck personnel was felt to be superior to that of the other flying jeeps, since the rotors were enclosed in the fuselage. Potential missions suggested for the SeaGeep included ship-based rescue, Anti-Submarine Warfare (ASW), and ship-to-ship resupply. After a brief but successful test period, the Navy returned the Model PA-59N to the Army, at which time it was converted back to its original wheeled configuration.

About the same time as the Navy was testing the SeaGeep, Piasecki began ground and flight testing an improved version of the Model PA-59K for the Army. This machine, known as the Model PA-59H and named the AirGeep II, made its first free-flight on February 15, 1962. The Army assigned it a military serial number of 58-5511 and the designation VZ-8P(B). It was fitted with two 530 shp Turbomeca Artouste IIC shaft turbine engines, providing nearly triple the power available in the original AirGeep, while adding multi-engine reliability. Cruising speed in flight was increased to 70 mph with an attainable maximum speed of 85 mph. Range was estimated to be 35 miles, depending on operating conditions, and the maximum flying weight was increased to 4,800 lb. The wheeled landing gear was retained, but reconfigured in a traditional tricycle pattern. The most obvious external difference in the AirGeep II was a sharply-angled rear rotor duct which lowered induced drag and allowed increased forward speeds. Like the original Lycoming-powered AirGeep, the VZ-8P(B) was designed so that either engine could drive both rotors through a central gearbox in the event of a single engine failure. One of the most novel features added to the AirGeep II was the ability to travel as a regular wheeled vehicle on roads and other types of level terrain, drastically reducing fuel consumption and extending its maximum range even further. This was made possible by use of a hydrostatic transmission connecting one of the engines to the main wheels, allowing a top speed of 35 mph. In addition to these changes, seating for a co-pilot and three passengers was added. The pilot and co-pilot were provided with zero-altitude/zero-speed ejection seats.



The Navy tested a maritime version of the VZ-8P called the SeaGeep, which was fitted with large elongated floats.

Unlike its competitors, both versions of the VZ-8 were tested extensively under field conditions. Flights were made beneath trees, between buildings, and over obstacles of all kinds. Crew-served weapons were fitted during some tests to explore the practicality of mounting armament on the craft, though no live ordnance was fired. Still, the VZ-8 was destined never to enter service with the military. After more than a year of successful testing during which a wealth of knowledge was gained, particularly regarding ducted fans, the quest to find a flying jeep was abandoned and flight tests of the VZ-8 were discontinued. Ultimately, both versions of the AirGeep ended up as museum pieces. The VZ-8P is currently on display at the American Helicopter Museum and Education Center in West Chester, Pennsylvania, while the VZ-8P(B) can be seen at the U.S. Army Transportation Museum at Fort Eustis, Virginia.

Ahead of Their Time?

Despite the high degree of success achieved in testing and the vast amount of knowledge gained, not to mention the amount of funding and resources expended, the military chose to discontinue development and abandon the concept of the flying jeep altogether in December 1959. The reasons for cancellation of the program are multifaceted. Although the concept was proven to be technically sound, the impracticality of it as a military utility vehicle became apparent as the program progressed. Relatively small-diameter fans were the key feature of the whole flying jeep concept. However, a small disc area equates to high disc loading which, in turn, consumes greater quantities of fuel than machines with larger diameter rotors, such as the helicopter, when lifting a comparable payload. More importantly, the inherent operational limitations of the flying jeep were recognized by the military, particularly in regards to a low maximum flight speed, instability in windy conditions, and relatively limited range. One of the biggest factors in the military's decision to scuttle the project was the predicted difficulty in maintaining the machine under actual field conditions. As a military vehicle, the flying jeep would have been expected to operate in virtually any climate and be robust enough to endure the harshest weather, while being easy to maintain in the field.

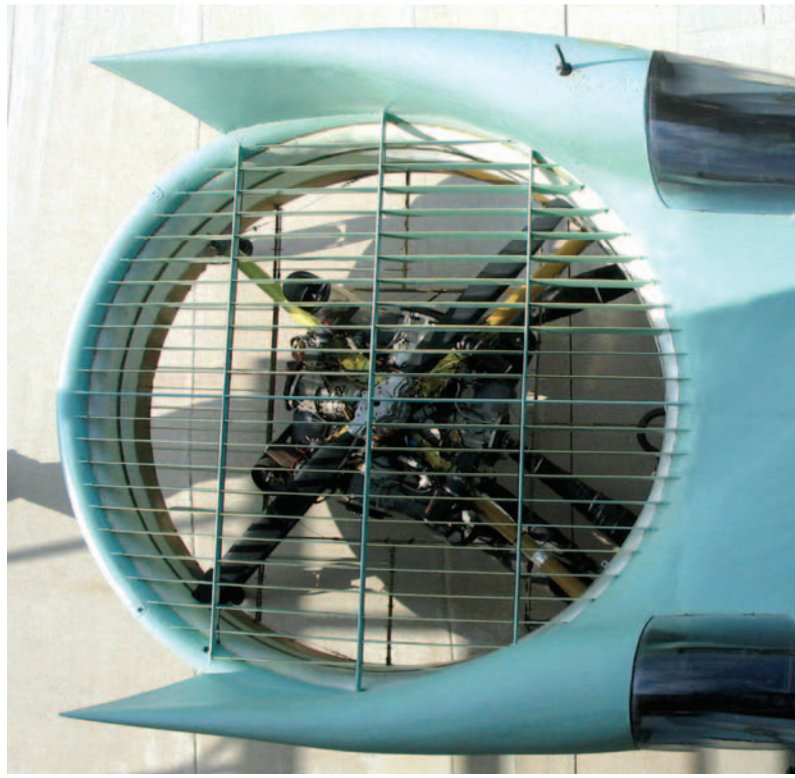
On the positive side, the flying jeeps exhibited several favorable attributes. With some exceptions, they proved to be relatively stable in calm weather and easy to operate. By their very nature, they were capable of extreme nap-of-the-earth (NOE) flight, able to hover or fly beneath trees or other obstacles and maneuver between buildings. Most significantly, they demonstrated the ability to traverse extremely difficult terrain that was completely off-limits to conventional wheeled or tracked vehicles, including water. As an added benefit, the flying jeep would have been hard to detect by enemy forces on the battlefield due to its low profile. Seen from the front, the rear, or from any side, the ducted rotors/propellers were hidden from view, both visually and on radar. Their tandem position would allow the pilot to engage targets with any onboard weapons while the majority of the machine remained hidden behind whatever cover was available, further reducing the chances of detection by the enemy.

In the end, with only a limited payload capability and modest flight performance, the flying jeep was ultimately deemed by military planners to have very limited potential. This view was further enforced by the rapidly growing success of the military helicopter, which offered much greater performance and better fuel economy. Like the flying platforms before them, the flying jeeps were relegated to the category of "what might have been" in the annals of military research and development. But, even though the military abandoned the flying jeep concept over 40 years ago, the dream continues to exist in the minds of ambitious engineers around the world, some of whom believe the concept was simply ahead of its time.

The Urban Aeronautics X-Hawk

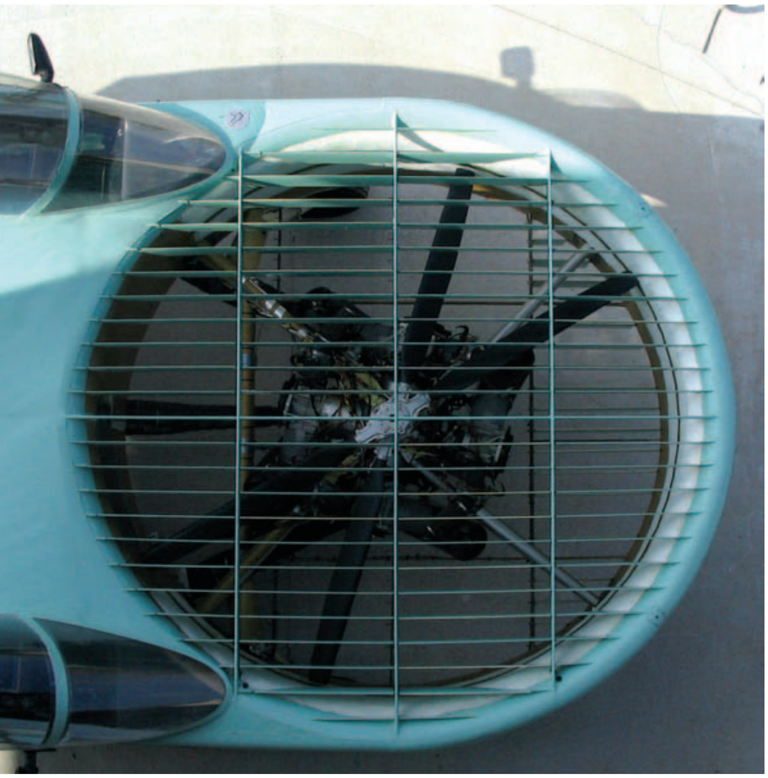
In a concentrated effort to introduce a practical contemporary version of the military's flying jeep, the Israeli-based company Urban Aeronautics Limited is developing such a machine for civilian and possibly military use. Citing the many technological advances that have been introduced since the flying jeeps were first flown, the company's president, Rafi Yoeli, believes it is time to "dust off" the flying jeep data and rethink the concept in terms of innovative flight control, advanced composite materials, modern construction techniques, and more powerful, fuel efficient turbine engines. In doing so, UrbanAero has completed preliminary design work on a modern-day version of the flying jeep known as the X-Hawk, a powered-lift VTOL vehicle designed specifically for operation in complex urban environments.

As with the VZ-6CH and VZ-8P, the X-Hawk is configured as a tandem fan, turbine-powered vehicle with a center section to house the crew compartment and payload bay. The vehicle currently exists only on paper, but detailed calculations and computer modeling have validated the predicted operation of the system. The lift fans will operate using variable pitch rotors and a system of vanes much more complex than that of the flying jeeps. This U.S.-patented multiple-vane control system will consists of four separate layers of independently movable vanes in each duct; two layers at the top and two layers at the bottom. Each layer will have some 100 vanes installed which, when deflected even slightly, will each produce approximately 4 lb of side force. When applied in concert with the same amount of force produced by the other vanes in the same duct, the total combined side forces will be considerable. The effectiveness of producing side forces by the vanes on the top side of the duct will be essentially equivalent to those produced on the bottom (and vice versa) since air will pass through the duct at a relatively constant velocity. Because all four layers of vanes will move independently of one another, it is easy to understand how deflecting top and bottom layers in opposing directions will produce significant rolling moments, possibly as high as 2,000 ft-lb. Conversely, when all four sets of vanes are moved in unison, they will create a powerful side force with no rotation of the vehicle. Forward propulsion will be provided by a pair of ducted variable-pitch pusher propellers connected to the main transmission system and mounted at the rear of the craft on either side. These will allow the X-Hawk to fly forward or backward in level flight without tilting the machine. The pilot will operate the X-Hawk with a fly-by-wire multi-channel flight control system and the entire lift and propulsion system will be equipped with an auto-stabilization feature. This system will simplify the pilot's workload considerably, allowing him to concentrate on the task at hand, particularly when it requires very precise piloting such as during high-rise rescue missions. Initial production versions of the X-Hawk will be powered by two Pratt & Whitney Canada PW-207K or equivalent turbine engines. UrbanAero is very optimistic about the estimated performance of the X-Hawk, boasting a maximum speed of 92 – 115 mph and a ceiling of 8,000 ft. Empty weight will be 2,550 lb with a useful payload of 1,700 lb, bringing the maximum takeoff weight to 4,250 lb. In order to operate in an increasingly noise-conscious urban environment, the X-Hawk's ducts will be acoustically treated to reduce their noise level. Multiblade, slow-turning rotors will further reduce the noise level to a degree significantly lower than that produced by present-day helicopters. From a flight safety standpoint, the X-Hawk is designed to be fully certified by the Federal Aviation Administration (FAA) and able to hover OGE at maximum takeoff weight. It will be able to descend to a safe landing even after failure of one of its turbine engines.



The CityHawk, seen here from above, is UrbanAero's manned proof-of-concept vehicle for their forthcoming X-Hawk.

The primary function of the X-Hawk, at least in the initial model, will be as an airborne ambulance in the Medevac role. However, the basic model is designed from the outset to facilitate modification of its payload bay to various configurations. This high degree of adaptability will allow the X-Hawk to fulfill a number of roles from high-rise rescue to police duties and power line maintenance to bridge inspection. The modular payload bay can be configured to serve not only as a medical rescue cabin, but also as a multi-seat passenger compartment seating up to seven people at a time. With all the seats removed, the compartment could serve as a cargo area for up to 1,700 lb. On a typical Medevac mission, the X-Hawk will have an endurance of 1.5 hours while carrying three people, 220 lb of medical equipment, and 950 lb of fuel. Compared with a ground-based ambulance, the X-Hawk's performance will result in a considerably reduced on-scene response time. Most



notably, the X-Hawk's lack of an exposed rotor will make it much more flexible than present-day helicopters, allowing it to enter more confined areas safely or even make physical contact with buildings while hovering if necessary.

Although the X-Hawk has yet to be built, UrbanAero has conducted extensive testing using scale models and a manned proof-of-concept vehicle known as the CityHawk. The CityHawk is essentially very similar to the X-Hawk, but is approximately 30% smaller and powered by eight Zanzottera two-stroke fuel-injected engines, providing a combined power output of 250 horsepower. As a pure research vehicle, it is equipped with only two seats, and does not have a payload bay. The machine's landing gear consists of two fixed wheels in the front and two castored wheels in the rear. The CityHawk is capable of flights up to 45 minutes in duration, and is equipped with a fly-by-wire control system and some 300 movable vanes in the two ducts. There are no pusher propellers installed, so forward and backward motion is achieved simply by tilting the fuselage in the desired direction of travel. Engine run-ups of the CityHawk began in mid-2002, which soon progressed to tail liftoffs. The first four-wheel liftoff occurred on January 23, 2003, proving the basic functionality of the multi-vane control system as predicted. During testing, the X-hawk was free to hover and maneuver under its own power, but kept at a safe "not to exceed" height from the ground by two safety cables. After ten hover tests, the CityHawk successfully concluded flight testing in December 2003, providing valuable data and further substantiating initial estimates of the X-Hawk's performance.

UrbanAero has now signed agreements with two other companies as risk-sharing partners. Bet Shemesh Engines in Israel will provide the engines for the first of two forthcoming X-Hawk prototypes, which will be powered by two refurbished 650 shp Honeywell LTS-101-750B-2 turboshaft engines. The Purdy Corporation in Manchester, Connecticut will develop and produce the mechanical power distribution systems. UrbanAero is currently raising funds to begin development and construction of the prototypes. The first prototype is expected to take to the air in two years, followed by the second prototype approximately 6 months later. Herzliya Medical Center, a leading private hospital in Israel, recently placed the first purchase order for the X-Hawk. In addition, UrbanAero has partnered with the U.S.-based STAT/MedEvac and the University of Pittsburgh Medical Center to help promote the idea of the X-Hawk as a serious contender for the Medevac mission. Both organizations will play a key part in defining requirements and making design recommendations for the initial version of the X-Hawk. Eventually, UrbanAero hopes to catch the attention of other medical facilities around the world and further extol the inherent virtues of the X-Hawk in a vital life-saving MedEvac role.

In addition to the MedEvac version of the X-Hawk, UrbanAero hopes to develop another version for law enforcement duties. This new "police cruiser", dubbed the X-Hawk LE, will be more powerful, allowing it to carry three police officers in addition to the pilot and all their necessary equipment. The extra power will come from either Turbomeca Arriel 2C2 turbine engines or LHTEC CTS800-4N turboshaft engines, both in the 1,000 shp class. It will have an endurance exceeding 3 hours and a maximum speed of 155 mph. As with the Medevac version, the X-Hawk LE will be able to avoid ground-based traffic congestion and enjoy virtually unimpeded movement among busy urban areas, all the way from ground level to its maximum ceiling of several thousand feet. Although the X-Hawk LE was originally conceived with law enforcement duties in mind, variants of it will be produced for other missions that require high-altitude flight capability or increased load-carrying capacity.

Tests with the CityHawk have been very successful in proving the validity of the X-Hawk concept. In some aspects, performance test results have even exceeded initial expectations, particularly those concerning the degree of controllability manifested in the multi-vane control system. One noteworthy aspect in all of UrbanAero's design work is the attention paid from the outset to safety, redundancy, and full compliance with FAA standards and guidelines. All of UrbanAero's planned X-Hawk variants are designed to be FAA-certified in the 'Normal' category, with subsequent single pilot Instrument Flight Rules (IFR) capabilities implemented in all of its vehicles. Certifying the X-Hawk as a single pilot IFR machine makes sense, especially due to its predicted ability to operate freely in very gusty wind, as well as in icing conditions, a capability that is an added bonus to the reliance on standard propeller blades, rather than the traditional overhead rotor found on conventional helicopters.

The primary goal of UrbanAero is to develop an alternative VTOL machine that does not have the inherent limitations of exposed rotors as used on conventional helicopters. Recognizing that the price to be paid in doing so is fuel efficiency, UrbanAero believes that the benefits far outweigh the disadvantages in the short-range missions for which the X-Hawk was conceived. As envisioned, the X-Hawk and its multiple variants will be used mostly for public service and commercial utility tasks. However, once the concept has been proven to work reliably and production variants of the X-Hawk have earned a successful service record, UrbanAero may expand its horizons toward the civilian market. Indeed, the technology used in the X-Hawk and its variants may eventually spawn a revolution, making the dream of "a flying car in every garage" a reality.

Reflecting on the significant interest in the concept expressed by the military during the 1950s, it is possible that a modern incarnation of the flying jeep might yet find its way into service.

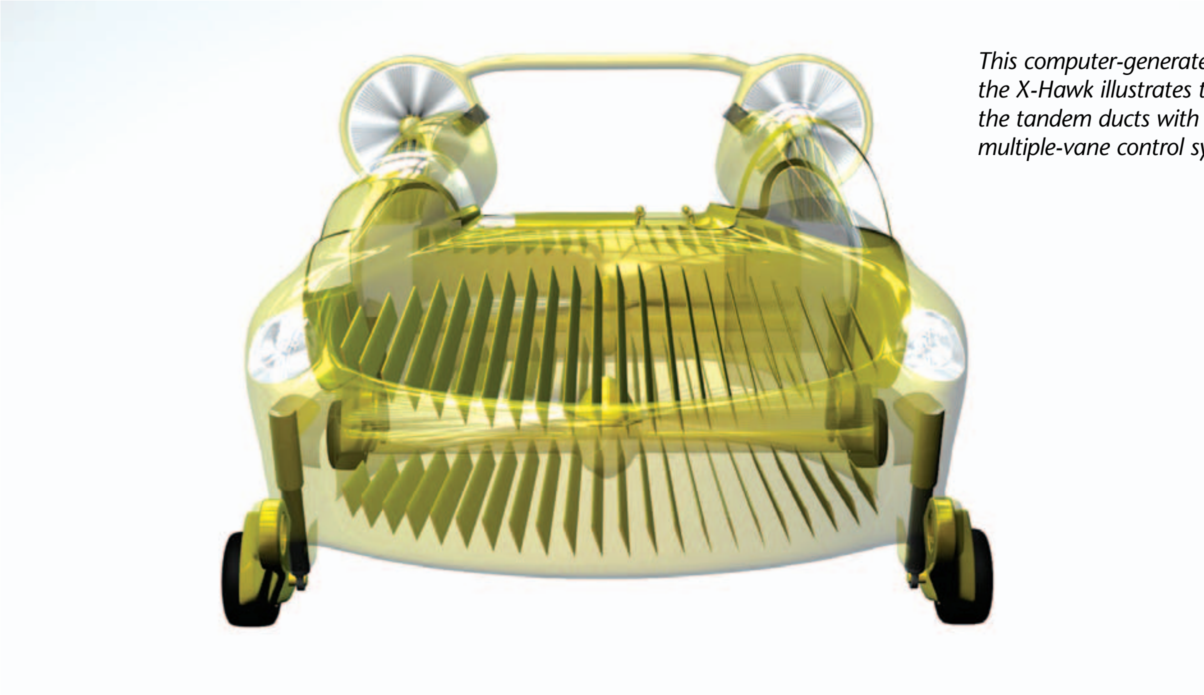
The "New" Piasecki Sky Car

Although the AirGeep never entered service, Piasecki did not let go of the idea. In fact, the company still considers the PA-59 to be an active project and research continues today. Having retained the extensive amount of data gathered during tests of the PA-59 over 40 years ago, Piasecki seeks to one day revive interest in the flying car concept, this time aimed squarely at the civilian market. As such, the company has resurrected the name "Sky Car" and applied it to their vision of tomorrow's preferred mode of transport. A modern artist's concept of the Sky Car released by the company bears a resemblance to the PA-59 in its basic layout, retaining the tandem fan configuration but adding a pair of vertical fins to the rear. However, certain features of the average family car have been added such as a full windshield, a roof, side windows, and headlights. Seating for a pilot and three passengers is provided. Essentially, the same basic principles of operation used in the AirGeep will be applied, this time incorporated into a craft that takes full advantage of modern advances in construction, materials, and lightweight turbine engines. Details of the new Sky Car have not been released, but basic performance figures in terms of speed, altitude, controllability, and ease of operation are expected to meet or exceed those achieved by previous Piasecki designs.

Conclusion

The idea of flying cars roaming the skies in significant numbers is not new. However, there are a number of obstacles and logistical issues that will need to be overcome before such a vision can ever be realized, particularly regarding civilian versions. Enforcing traffic rules for ground-based vehicles can be difficult enough, whereas airborne traffic presents a whole new set of dilemmas in traffic management, particularly when the majority of those operating the vehicles are not pilots in the usual sense. Inevitably, very strict rules imposed by the FAA will need to be adhered to (and rightfully so, for safety's sake) prior to the entry of the flying car into modern society. Nevertheless, various ideas and innovative designs continue to surface today as ambitious companies in the civilian sector attempt to crack the market for an affordable VTOL machine capable of carrying people and cargo aloft at speeds comparable to or exceeding those routinely achieved by the family car. Given their way, these determined dreamers will one day make the flying car almost as commonplace as the automobile is today.

Reflecting on the significant interest in the concept expressed by the military during the 1950s, it is possible that a modern incarnation of the flying jeep might yet find its way into service. Considering the increasingly prominent role of Special Operations Forces in today's environment, a military version of the flying jeep could conceivably be used quite effectively by small teams of covert operators to increase their mobility on the battlefield. In an urban warfare scenario, the extreme maneuverability of such a machine could prove very beneficial to military troops operating in densely populated areas and complex environments. Since ducted fans are typically quieter than conventional helicopters, a flying jeep would provide the element of surprise for military forces in a tactical arena. Likewise, civilian police forces would benefit greatly from the flying jeep's ability to



This computer-generated cutaway image of the X-Hawk illustrates the internal layout of the tandem ducts with their patented multiple-vane control system.

operate in a very demanding environment, providing law enforcement agencies with VTOL capability but without the complexity and inherent safety risks of exposed rotors.

There is a perception among many that the idea of a flying car is impractical, an idea enforced by the fact that no such machine has ever reached production. As a result, those involved in present-day research tend to disassociate their work from past efforts as much as possible by emphasizing their use of composite materials, modern construction techniques, more efficient engines, and advanced flight controls. Despite the many advances in technology since the 1950s, the data obtained over the last half-century still provides the basis for today's research in ducted fan VTOL flight. Furthermore, the limited but tangible successes enjoyed during testing of the flying jeep designs continue to provide the strongest motivation of all for those who seek to bring the concept from the drawing board to the production line. It is for all these reasons that the flying car concept continues to thrive. Indeed, the modern-day "flying carpet" may yet become a reality.

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