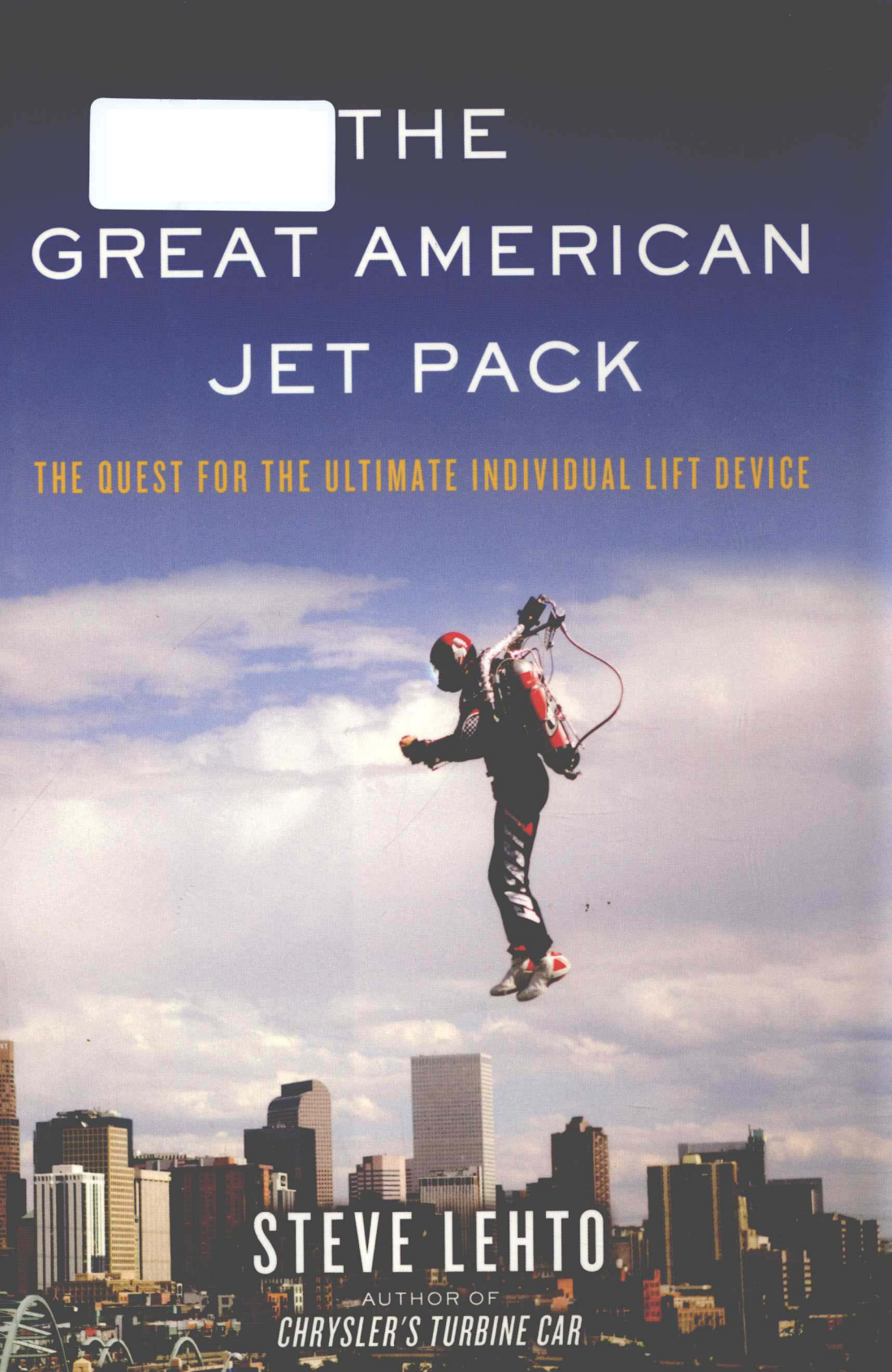
THE GREAT AMERICAN JET PACK

THE QUEST FOR THE ULTIMATE INDIVIDUAL LIFT DEVICE



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INTRODUCTION

In his 1887 book *The Clipper of the Clouds*, Jules Verne described a fictional meeting of scientific gentlemen debating whether man might fly, and if so, how. A stranger appeared before them and announced that lighter-than-air contraptions such as hot air balloons were impractical. The bigger they were, the harder they were to maneuver. No, the answer lay in heavier-than-air flight. Over the clamorous objections of his learned audience, the man boldly predicted:

> Yes, the future is for the flying-machine. The air affords a solid fulcrum. If you will give a column of air an ascensional movement of forty-five metres a second, a man can support himself on the top of it if the soles of his boots have a superficies of only the eighth of a square metre. And if the speed be increased to ninety metres, he can walk on it with naked feet. Or if, by means of a screw, you drive a mass of air at this speed, you get the same result.[1]

A man walking in the sky? In August 1928, the science fiction magazine *Amazing Stories* featured a cover with a colorful drawing of the Skylark of Space, a futuristic character hovering a few feet off the ground, held in the air by a small device on his back.[2] The image was the product of the artist Frank R. Paul, who often illustrated stories of flying saucers from outer space and battles that raged on the surfaces of other planets.[3]

The Skylark of Space has been largely forgotten but inventors did build a working model of the device on his back. It would eventually creep into the consciousness of America, and people across the United States saw men flying in the same manner as the Skylark of Space, zooming around effortlessly in the sky as if gravity had finally been made obsolete. The men, wearing what most people would mistakenly call jet packs, became ubiquitous in the 1960s and 1970s. The devices were featured in movies and television shows and hovered over Super Bowl halftimes and Olympic opening ceremonies. They became known worldwide. But then they seemingly vanished from the landscape. Only a few isolated stories would pop up from time to time of inventors reviving the technology, or diehard enthusiasts working to keep the technology alive, flying the devices in demonstrations and at public events.

The story of the jet pack is really the story of man's dream of flying. Not in the manner of the Wright Brothers, who built a huge flying machine that could take off and fly with more than a little bit of effort. The jet pack—or the individual lift devices, as they were blandly labeled by the government men who financed much of their development—answered man's desire to simply step outside and take flight. No runways, no wings, no pilot's license required. Soaring through the air with the wind in your face and landing anywhere there was room to stand. Could it be done? Yes, it could be done, and it was.

A vehicle that takes off vertically, like a helicopter, is described as vertical take-off and landing, or VTOL. The personal flight devices covered in this work are, for the most part, vertical take-off and landing devices. This attribute separates them from small airplanes and gliders, and makes them closer to the notion that one could simply step outside and take flight. VTOL vehicles do not require landing strips or airports. They just need a place to land and a view of the sky.

To the average person, the term *jet pack* is often used to describe any individual lift device, regardless of its means of propulsion. To a purist, the first such device that flew safely and practically was called a rocket belt. It was powered by a chemical reaction that created thrust and it flew for less than half a minute. Later models powered by small jet engines flew longer and were real jet packs, but they were deemed jet belts to keep in line with the belt terminology.

Although early developments in the field showed promise, the technology stalled. The practical jet pack seemed tantalizingly close but always just out of reach. When one problem was solved, another would replace it. The only constant was the promise—the promise that jet packs would soon be here, available for everyone. But soon never came.

The story of individual lift technology truly started with the advent of flying platforms in the 1940s. Shortly after the platforms came the rocket belts, and then the jet belts. Innovation in these designs followed an interesting trajectory. The individual lift devices morphed from carrying a passenger to being worn by the passenger. Later they came full circle, returning to something a passenger stood on to be lifted skyward. Innovations in the twenty-first century even allowed a man to fly across the English Channel wearing a descendant of the jet belt.

A common thread among these devices is that the pilot and the machine were usually connected, often attached, to each other. Further, these flying machines were controlled to a large extent by the movements of the pilot, something called *kinesthetic control*. While airplanes and helicopters required trained pilots to work levers, pedals, joysticks, and yokes, the individual lift devices often had nothing more than a handle or two—the pilot simply leaned or twisted in the direction he wanted to travel. It was this last point—the ease with which an untrained pilot could take to flight—that was often the major selling point made by the promoters of this technology.*

This promise of ease in operation resulted in eventual disappointment for the people who hoped to fly like this someday. The jet pack was perhaps the most overpromised technology of all time. Creators of the flying platforms, rocket and jet belts, and the later flying devices and the men who flew them audaciously promised that one day, we would all have them.[4] They would be available for everyone, affordable, and they would be as commonplace as automobiles. They would not only fulfill humankind's dream of flying, they would allow us a magnitude of freedom hith-

*This is an admittedly artificial distinction being made by the author. There were also one-person helicopters and hovercraft that could be considered similar to the devices being written about here. However, for the purposes of this work, the author is sticking to what appears to be a logical class of devices: those that appeared simplest to operate and offered the average man the ability to fly "without wings."

erto unknown to modern man or woman. No more traffic jams; no need to rely on mass transit. Soon, it was promised, you would be able to simply strap on your jet pack or step onto your own flying platform and zoom to wherever you wanted to go.*

And then, in the twenty-first century, the largest strides were made in the development of these devices. While engineers and hobbyists revisited the technology of the rocket belts, doing what they could to tweak more than a half minute of flying time from units modeled on the 1950s versions of the rocket belt, a Swiss pilot and inventor named Yves Rossy built a flying apparatus that came perhaps the closest yet to man's dream of free flight. His creation was a small wing fitted with miniature turbine engines, technology that did not exist in the 1950s. "Jetman" Rossy crossed the English Channel and flew over the Alps with his jet pack using nothing more than his body movements to steer. Perhaps the dream of individual flight is within human reach after all.

*The term jet pack has become synonymous with an unkept promise of a better future through science. There is even a book entitled *Where's My Jetpack? A Guide to the Amazing Science Fiction Future That Never Arrived*, by Daniel H. Wilson (2007). That question has been asked by many. Another writer from the *New York Times* asked "Where Are Our Jetpacks?" in "Canceled Flight," *New York Times Magazine*, June 11, 2000.

1

FLYING SHOES AND HOVERING PLATFORMS

In the fall of 1942, a thirty-four-year-old engineer named Charles Horton Zimmerman was thinking about flight and what it would take to make it available to everyone. He had been working at Chance-Vought, a manufacturer of military aircraft, as well as at the laboratory of the National Advisory Committee for Aeronautics. For an aeronautical engineer, he held an unorthodox belief: he thought airplanes were too difficult to fly. He knew that trained pilots could fly them, but he hoped aviation could be pushed to a point where anyone could fly. "I couldn't see any future for personal aviation. There seemed to be no prospect of a plane *I'd* want to fly." Zimmerman wondered how to simplify the flying machine. What was necessary to lift a man into the air? Reduced to its components, it wasn't much. An upward force pressed against his feet would lift a man if the force was greater than that of gravity. Could an individual, simply being lifted, remain stable in "flight" like this? If so, it was simple. There it was: lift and control. Two problems Zimmerman hoped to overcome to allow the average person to fly.

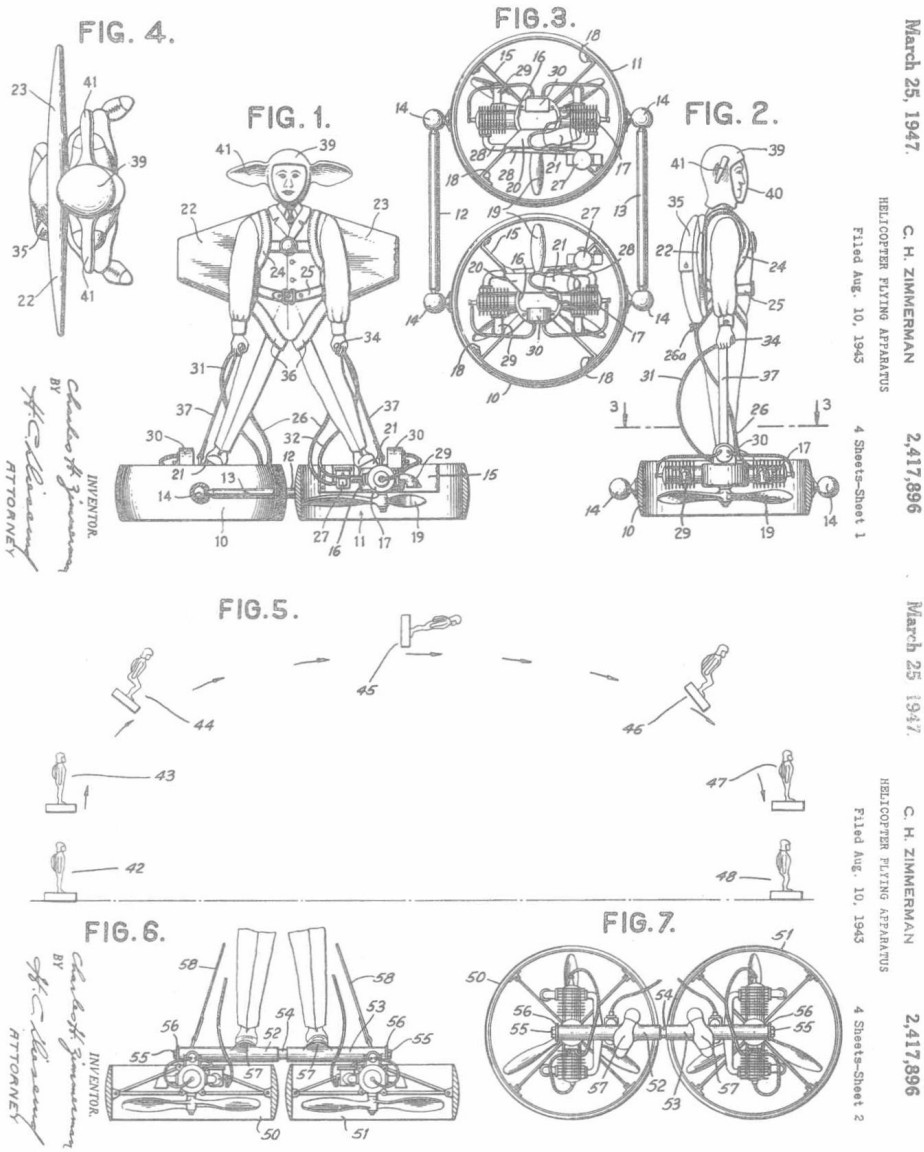
Zimmerman knew that stability in the air was the real problem. He had been working on airplane stability in wind tunnels for more than a decade and was an expert on the subject. Like so many inventors, he opted to work out of his garage while attacking the problems of personal flight. He hung ropes from the rafters and placed a board between them.

He put a stick under the board and then stood on it to see how hard it was to keep his balance when perched on such a small platform. He found it was much easier to keep his balance than he had expected. Could he balance on a platform if it was lifting him into the air? He thought so. He set out building a device he called his "Flying Shoes."[1]

Zimmerman thought it might be possible to get the lift he needed using miniature helicopter blades.[2] The device he built consisted of a small platform on a framework of tubing that stood just a few inches off the ground. Zimmerman, as the pilot, would stand between two small four-cylinder engines powering two-bladed propellers that faced upward. The spinning blades were about knee-high to Zimmerman and controlled by a throttle handle extending upward from the base.

As he worked on developing the Flying Shoes Zimmerman became convinced that he could not only balance on the device when it was aloft, but that he could also maneuver it with kinesthetic control.[3] That is, he believed he could stand on the Flying Shoes and simply lean in the direction he wanted to go. If he leaned forward, it would tip the device and the change in the angle of the propellers would move the platform forward. To stop, he thought he could just lean backward. If true, this meant that an operator would not need special training to pilot the Flying Shoes. The flight controls were intuitive. This would be the flying machine he had dreamed of, the one that could be flown by anyone.

Zimmerman filed for a patent on the Flying Shoes in 1943. The patent was granted in 1947, and it is clear Zimmerman had some great aspirations for his invention. Patent filings often contain quite broad and general descriptions of an invention and sometimes appear primitive when compared to the products that follow. Zimmerman's patent for a Helicopter Flying Apparatus covered the Flying Shoes, but it was outlandishly different from what he had built. In his patent, Zimmerman imagined the flyer attaching himself to the machine, which had blades surrounded by rings. The pilot stood directly on top of the propeller housings, which—when compared with the open-bladed Flying Shoes prototype—seemed a much safer design. The drawings in the patent show that Zimmerman did not simply intend for his device to hover. He drew small wings on the back of the pilot and even smaller wings on the side of the operator's head.



Charles Zimmerman's Flying Shoes allowed a man to hover, although Zimmerman imagined that the pilot would be able to fly horizontally as well. While the machine never fulfilled that dream, it did demonstrate kinesthetic control.

An accompanying illustration showed a typical flight: the flyer would lift off the ground, tip forward, and then fly in the manner of an airplane, using the wings on the flyer's back and head. When he wanted to land, he would slow down and swing his legs beneath him and then land vertically. Zimmerman had never gotten his shoes to do any such thing, and

he never would. The claims he made in his patent for the device were likewise impossible. He said the device "should be able" to travel 350 miles at speeds approaching two hundred miles per hour.

Notwithstanding the outlandish performance claims, Zimmerman's patent contained real elements that made it groundbreaking. He proposed a device to be worn by its pilot, with vertical take-off and landing, that would be controlled kinesthetically. The only mechanical control for the pilot was the throttle. Zimmermann went so far as to suggest his device could be powered someday by a turbine engine.[4]

Even though Zimmerman worked in an aeronautical laboratory, he chose to build the Flying Shoes in his garage using his own money. The engines cost him $500 each and the propellers were $100 for the pair. Zimmerman, like many other inventors, insisted on testing the device himself. A magazine reporter remarked on Zimmerman's bravery, standing on the Flying Shoes with the wooden propellers whipping by just four inches away from his knees.

While Zimmerman was fine-tuning his Flying Shoes, he met Stanley Hiller Jr., a twenty-one-year-old businessman and inventor who built and flew his own helicopters and had, at the age of seventeen, established Hiller Industries in Palo Alto, California. Hiller's company, later known as Hiller Aircraft and then Hiller Helicopters, developed helicopters for the military and civilian markets.[5] Hiller was always looking for new developments and inventions. While he was traveling on the East Coast in 1946, Hiller heard about an inventor working on a "crazy machine" nearby.[6] The man telling Hiller the story thought Hiller would get a kick out of it since the machine contained elements of a helicopter. Hiller went and visited Zimmerman to see what he had created. He was intrigued.

Hiller brought the Flying Shoes to California for testing.[7] It didn't go well. It was hard to keep the two engines running at the same speed and, as a result, the device proved unstable. Plus, what would happen if one of the engines failed in flight?[8] Worse, how safe was it for the operator to be standing so close to two propellers spinning at full speed? And the machine never got far off the ground; it hovered at an altitude of a few inches.[9] Hiller sent the Flying Shoes back to Zimmerman but remained intrigued by the idea.

Meanwhile, Zimmerman remained fixated on the idea of kinesthetic control, convinced that a person could balance and control a hovering device using nothing more than body movement. But how could this be proven? The National Advisory Committee for Aeronautics agreed to let Zimmerman work on the problem using its facilities. The scientists and engineers there routinely used large quantities of compressed air stored in giant tanks. Zimmerman thought he might be able to build a rig where a small platform would be blasted upward using nothing more than the compressed air. On February 2, 1951, under his direction, Zimmerman's engineers attached air hoses to a piece of plywood with a small nozzle in its center. The hoses fed air through the nozzle at several hundred pounds per square inch, and Zimmerman's feet were strapped to the board. They connected safety tethers to him, in case it didn't work. Then, they let the air loose.

The air shrieked through the nozzle and Zimmerman waited to see what would happen. Nothing. Then he looked around and realized that his safety lines were no longer taut. He later said he was hovering off the floor but hadn't felt the board move. He stood motionless for a minute and then signaled for the air supply to be cut off. He had proven he could remain stable on a column of air, but could he maneuver? Zimmerman and another man named Paul Hill took turns flying the board and studying the limits of hovering flight. They realized that Zimmerman had been correct: they could move about on the column of air by simply leaning in the direction they wanted to go. "Paul Hill became adept at sashaying around the 15-foot circle to which the dragging lines limited him." Soon others were riding the board on a cushion of compressed air.[10]

Paul Hill liked the idea so much he built a contraption that looked like a double-bladed, upside-down helicopter. It weighed 140 pounds, but it flew. The blades were powered by compressed air. Its seven-foot propellers were on the same axis but spun in opposite directions. It responded to the pilot's body movements, even if it wasn't as responsive as the flying board. Word of these NACA experiments found their way to Hiller, who had not forgotten the Flying Shoes.[11] Hiller was so convinced the idea was viable that he began looking for a government sponsor.

2

THE HILLER AND DE LACKNER FLYING PLATFORMS

In 1953, the Office of Naval Research–Naval Sciences Division heard about the NACA work and Stanley Hiller's desire to create a practical individual lift device. It offered Hiller a contract to develop a ducted-fan flying platform, suggested by a government scientist named Alexander Satin who had followed the work of Charles Zimmerman and Paul Hill.[1] Zimmerman reportedly waived any patent rights he might have in whatever Hiller developed.[2] The proposed device consisted of two large propellers that spun, one in each direction, inside a round fiberglass housing that was a foot or so tall. On top of the housing was a small spot for the pilot to stand, surrounded by a frame of aluminum tubing to keep the pilot from falling off the device. In essence, the device was a huge fan pointed at the ground. The pilot would stand on top of the platform and when it lifted itself, it would lift the pilot with it. The flying platform would be controlled kinesthetically.[3] In many respects, it was a larger version of the Flying Shoes, slightly reconfigured. An advantage of this new design was that the duct—the circular shroud that surrounded the propellers—concentrated the air more efficiently than a non-shrouded propeller. Hill and Zimmerman consulted with Hiller on the design, and the project was developed and built under strict secrecy.[4] While Hiller Helicopters employed nine hundred people, only fifteen knew about the flying platform before it was unveiled publicly, according to Hiller.[5] The work began in January 1954

and Hiller had a working prototype before the end of the year.[6] The device was five feet across and two men could lift and carry it. It became the "first ducted fan VTO vehicle to fly successfully." It has also been claimed that it was the "first heavier-than-air aircraft capable of being flown from the outset by someone without flight training," although it is unclear if anyone who was not a pilot ever actually flew the Hiller Flying Platform.* While the flights were not spectacular, they highlighted the simplicity of kinesthetic control. The VZ-1 Flying Platform made its first free flight January 27, 1955.[7]

By April 1955, Hiller was ready to let the world know about its new flying machine. Hiller reported it to *Flight* magazine, an aerospace periodical that acted as a sort of yearbook for the aviation industry. Although the magazine covered all manner of aircraft, the editors found the flying platform unusual. "Retrospectively, the past twelve months seem to have introduced—albeit in rudimentary forms—an unprecedented number of curious types of flying machine. One of the strangest of all is [the Hiller Flying Platform]."[8] *Flight* cautioned readers not to expect to see the flying platforms in widespread use just yet; the flying platform was a "research tool," and "further research and development will be necessary."[9]

Hiller publicized the new invention in the mainstream press also, and as would become commonplace, the new individual lift device was introduced to the general public with overblown superlatives, setting it up to almost certainly disappoint. It could never live up to the hype. Reporters from *Collier's* were given a demonstration of the VZ-1 and could barely contain themselves, gushing about the platform and the impact it was sure to have on society. "A radically different one-man aircraft, it hovers, climbs and darts sideways, 'riding a column of air.' It's probably the simplest flying machine ever created—and it may revolutionize aeronautics."[10]

Hiller touted the machine as being equally valuable to the civilian market as it might be to the military. "It is not inconceivable that it might become the long-awaited 'airplane in every garage,' which never became a reality because of the high cost of planes and helicopters. Simplicity is

*Keep in mind that there is a distinction made by using the term "aircraft." The rocket belts were powered by rockets and were not considered aircraft. Later, jet belts would be considered aircraft.

the keynote of the Hiller-ONR machine, and simplicity means lower cost. Anyone with a sense of balance can learn to fly such a vehicle. If you've ever ridden a bicycle you're a platform pilot prospect." A project engineer gave the reporter an even better standard: "A trained bear could fly this machine."[11] Further, it would work wonders for the American fighting man. It could be used to assault beaches, cross rivers, or patrol "otherwise inaccessible areas."[12]

Stanley Hiller Jr., the president of Hiller Helicopters, was asked to explain to the readers of *Collier's* how kinesthetic control worked. He did his best while overselling the idea in the process. "In essence the pilot is standing on, and riding, a column of air. Stepping into this machine is like stepping into your shoes. As you walk with your shoes, you can fly with this platform. Since the early gliders, prior to the flight of the Wright Brothers, there has never been a flying device which depended on the natural reflexes of the body for its control. Now we've reached instinctive flight. We're *putting on* the machine, instead of getting into it. In the future, if you can stand, you can fly."[13] Although he was exaggerating how easily the flying platform could be flown, he was onto something: kinesthetic control was revolutionary and it was possible.

Although Hiller claimed that the flying platform did not require pilot training to fly, Hiller only demonstrated it being flown by their test pilot, Phil Johnston, who was a World War II fighter pilot before coming to Hiller Helicopters. He said that the device was simple to fly and easy to master and that it only took fifteen minutes of training. It was so easy to fly, "a child could control it."[14] Hiller Helicopters never mentioned whether they had ever actually let someone untrained try to fly the device. If it was as simple as putting on one's shoes, why hadn't they tried it?

Buried deep within the article were details that revealed some of the flaws in the device. So far, the longest flight of the VZ-1 had lasted just three minutes. The engineers conceded weaknesses in the machine's design. The propellers were belt-driven. If the belts snapped or came off, the platform would fall. The device had two engines and each drove one of the propellers. If one engine stopped, the device would spin out of control due to the unbalanced torque of the remaining propeller. The fear of losing power in flight would haunt the field of individual lift. Airplanes

and helicopters can, to varying degrees, land safely if they lose power from a complete engine failure. The flying platform, much like the other individual lift devices that followed it, could not safely land from any considerable height after loss of power. This problem was euphemistically called "lift degradation" by engineers; others might characterize it simply as falling out of the sky, or "crashing."[15]

The flying platform was still being refined, but Hiller didn't want any of these caveats to scare off future purchasers. He said the vehicle was "as safe as the family automobile." Reporters were told the machines would start out priced in the range of $1,000 to $2,500 each, but with mass-production techniques, they could be churned out "like washing machines," at only $500 apiece.[16]

Hiller mentioned one more detail that was probably the real reason he decided to unveil the previously top secret project to the press in the first place: these devices could not become available to the public without continued financial support from the military. The platform was still experimental, but with further funding Hiller hoped to refine it and make it available to consumers. Hiller also told the reporters about other possible evolutions of the ducted fan method of propulsion. He could build bigger devices and even aircraft that could take off like helicopters but fly like airplanes. It was all a matter of funding. Still, "anything that man can think of, man can do."[17]

Flight magazine published an updated synopsis of the Hiller Flying Platform program in its November 1956 issue. They, too, were impressed by the concept of kinesthetic control. The platform "is almost literally a flying carpet which the pilot controls by body balance instead of using manual or mechanical flight controls. Directional flight is achieved merely by leaning in the direction one wishes to go."[18]

Although the Office of Naval Research had funded the initial development of the flying platform, they decided not to order any more of the devices from Hiller. However, the army liked the idea of the VZ-1 enough to order three flying platforms in 1956. They asked for the platforms to be modified a bit. Worried about the dangers associated with losing an engine in flight, they asked Hiller to add a third engine. The additional engine added power but also increased the weight of the platform. To lift