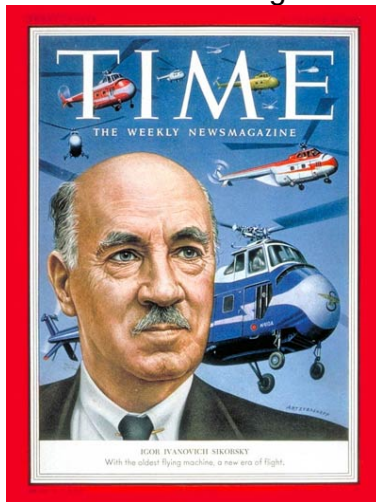


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Russian-born Igor Ivanovich Sikorsky, the eminent early birdman and aircraft designer, has never forgotten a monumental nosebleed he suffered as a boy of ten in the Czarist city of Kiev. As he sat with cold compresses on his neck and waited miserably for his veins to close, he fell prey to an alarming thought: if his condition became chronic, he might never be able to become a flyer. One night a little later he dreamed of coursing the skies in the softly lit, walnut-paneled cabin of an enormous flying machine—a cabin he recognized with a start 30 years later when he went aboard one of his own four-engine Sikorsky Clippers to inspect a job of interior decoration done by Pan American Airways.

Both the nosebleed and the dream occurred before the airplane had been invented, and although he is an extremely modest and practical man, Sikorsky cannot help but brood about them. There are times, in fact, when he experiences an uneasy amazement at his own mental processes—particularly at a sense of intuition that has nudged him to many a successful engineering conclusion that neither he nor the science of aerodynamics could explain rationally until years afterward.

The Earthbound Greeks. Sikorsky the man allows his mind to range widely when he meditates upon these mysteries inherent in Sikorsky the designer and inventor. He cannot understand, for instance, why man's conquest of the air was not begun by the early Greeks or Romans. Both, he feels, were perfectly capable of inventing and flying gliders; both, to his way of thinking, produced minds which could have grasped the scientific conquests involved; both had carpenters and artisans capable of building such machines, and both made the fabrics, paints and materials needed for their construction. "But they didn't," he sadly concludes, "even invent the hot-air balloon."

Why, on the other hand, he asks, did Otto Lilienthal, the Wright Brothers, Santos-Dumont, and a hatful of other pioneer airmen—among them, Igor Sikorsky—come into a wingless world lusting to fly and apparently equipped with some kind of built-in mental equipment which helped them do so? Sikorsky never goes so far as to conclude that he is an instrument of Divine

Providence, but neither can he, as a deeply religious man, avoid-wondering how else to explain some of his own rarer moments of intuition.

This curiosity about his own brain, and his grave sense of responsibility and hope for its products, would be understandable enough if only for its most recent series of convolutions—the experiments in which he planned, built and flew the world's first really workable helicopter,* and more recent work in which he has helped bring the device to its present state of windmilling efficiency. Today, at 64, he is not only an honored pioneer of the brave, oil-spattered world of pre-Sarajevo aviation but also the paramount prophet of a completely new era of flight.

Way, Hay & Up She Rises. The helicopter—by virtue of its ability to rise straight up, to hover motionless in midair, to fly sideways, backward and forward, to feel its way through fog or snow at five miles an hour if necessary, to stop quicker than an automobile, and to lower itself vertically into clearings hardly bigger than the circle described by its rotor blades—began proving itself a priceless beast of aerial burden in the early days of the Korean war. In the last 36 months it has altered the whole world's concepts of transport, and has made itself a unique, irreplaceable and increasingly commonplace part of U.S. life.

There are still fewer than 3,000 helicopters in the world (virtually all U.S.-built) and, in many ways, the inspired contraption is still in its infancy. But few machines have so caught the national imagination. The Marine Corps has long since adopted the helicopter as its answer to the atomic bomb, and proposes to send rotor-topped whirlybirds hurrying inland from carriers far at sea, to establish the beachheads of the future. The Army has begun supplementing trucks with helicopters, and, in so doing, is regaining a disregard for rough terrain it has not been able to afford since the day of the mule. And today no naval aviator leaves a carrier deck without knowing that a helicopter is hovering near by, ready to swoop and pluck him from the sea if he is forced down.

Rotor-lifted aircraft, able to take off and land from rooftops, parks or squares in the heart of the biggest cities, are already eliminating that most exasperating aspect of fixed-wing air transport, the long surface trip to outlying airports. The Belgian airline, Sabena, is operating a helicopter service between Brussels, Bonn, Lille, Maastricht and Rotterdam. Helicopter services are carrying passengers and mail in and around New York, Chicago and Los Angeles. City councils all over the U.S. have accepted the theory that the helicopter will not only replace the DC-3 on air feeder lines but may augment the suburban bus as well, and they are dutifully planning heliports to accommodate the new airborne traffic.

Cameras in the Sky. Meanwhile, the helicopters of 1953 are finding new and increasingly fantastic employment with every passing day. They string power lines across peaks of the high Rockies, and thresh slowly over northern Canada doing mineral surveys from the air. They have landed yellow-fever vaccine in Costa Rican jungle clearings, and have plucked sick, wounded or stranded men from mountain ledges, deep canyons, flood areas and sinking ships all over the world.

Crop-dusting, hazardous when performed with low-flying, fixed-wing aircraft, is as safe as surrey-riding when done with helicopters. The owner of a big Texas pecan grove no longer sends

Mexican laborers clambering into his trees—he simply flies a helicopter over the grove when the nuts get ripe, and the rotor blows the crop to the ground before lunchtime on harvest day. The whirlybird is proving a heaven-sent device for motion-picture directors; a camera fixed in a helicopter can hang motionless high in the sky over battle scenes, or follow the U.S. Cavalry to the rescue through the steepest canyons. Four Bell helicopters, two dressed like boys and the others like girls, do square dances above the crowds at aviation shows.

But these outward manifestations of the rotor age seem positively undramatic when compared to the fevered turmoil amidst which the helicopter itself is currently being brooded, hatched, crossbred and re-hatched by fanciers intent on improving the breed. A new and fiercely competitive race of engineers and manufacturers has sprung up in the wake of Sikorsky's success, and whirlybird hatcheries have bloomed all over the U.S. Some of these firms have big plants and big contracts (the leaders: Sikorsky, Bell, Piasecki, Killer and Kaman), and some have little except blueprints, dreams and stock certificates. But helicopters of every conceivable configuration are evolving from all their drawing boards.

In the struggle to produce the definitive helicopter type, the industry has spawned single-rotor helicopters, coaxial (two rotors on one shaft) helicopters, biaxial (two rotors on separate shafts) helicopters, biaxial machines with intermeshing rotors, experimental helicopters powered by turbojet engines, and a snarling line of machines with ramjet or pulse-jet engines mounted at their rotor tips. There is scarcely a helicopter engineer who does not harbor some guarded gimmick for improving rotor life or rotor control, and every manufacturer seems supremely confident that his machine is the only helicopter worthy of the name.

Tractors & Telescopes. Gentle Igor Sikorsky seems almost out of place in his position of eminence amidst this uproar. He is an erect, balding man with a scraggle of grey hair at his collar, a bland face, a clipped mustache, and a polite, faintly accented voice. His position at the big Bridgeport helicopter factory of the United Aircraft Corp.'s Sikorsky division is difficult to describe: he is a sort of resident genius and after-dinner speaker combined, and reigns not through any formal authority but through the sheer logic and soundness of his engineering opinions.

He talks with a professorial air, greets everyone from workmen to Marine generals with a slight, stiff-backed Old World bow, and has never been known to lose his temper or, for that matter, even raise his voice. He wears dark business suits, often with blue, rubber-soled yachting shoes and a variety of individualistic headgear—a long-billed khaki airman's cap, a narrow-brimmed fedora turned up sharply fore & aft, or a black-&-white-checked cloth cap of a type worn in deck chairs before the great Titanic went down.

All his life Sikorsky has been a highly publicized figure, but he keeps the outside world rigidly partitioned from his family life and his quiet social life. He has a grown daughter (by an earlier marriage) and four sons. Serge, 28, works in Europe for the United Aircraft Export Corp.; Nicholas, 26, and George, 22, are at home; and Igor Jr., 24, is a student at Yale. He maintains a fond, paternal relationship with them, as he does also with a band of old Russian friends, some of them Sikorsky employees of many years standing.

Sikorsky was largely instrumental in building an Orthodox church near Bridgeport as a place of worship for the area's Russian colony. The designer's wife, Elizabeth, usually cooks and serves dinner herself when the Sikorskys entertain at the modest Easton, Conn. farmhouse: the guests are almost always limited to old Russian friends and old acquaintances from the aircraft world, among them Charles A. Lindbergh and his wife, Anne.

Sikorsky is a stargazer (five-inch-telescope class) and a writer of religious and philosophical books (*The Message of the Lord's Prayer*, *The Invisible Encounter*). Tractors of any type fascinate him and he currently has three ("they are like pets"). But one hobby takes him far from home. He is wild about volcanoes and will fly thousands of miles to watch one fume and throw lava into the air. When Mexico's famed Paricutin was erupting, Sikorsky traveled twice to the craterside to admire the effect.

The Wood-Breakers. The faint aura of unworldliness that clings to him, however, is mostly illusion; the Sikorsky imagination may soar, but he is a practical, enduring, even stubborn man. Though his colleagues call him "Uncle Igor" behind his back, nearly all United Aircraft officials call him Mr. Sikorsky to his face. His career has spanned virtually the entire history of flight.

Sikorsky was just 19 when he set out, in 1909, on a pilgrimage from Kiev to Paris, then the mecca of aviation. The early aeronauts who had hived there were mostly grease-stained motorcycle or automobile racers who flew—or tried to fly—out of the sheer love of risking their necks in public. Sikorsky was a young gentleman and an embryo intellectual; his father, a physician, was famed in Russia as a psychologist, and Igor had put in three years at the Imperial Naval College in St. Petersburg, and two more at the Institute of Technology at Kiev. He was not abashed, however, as he walked through the long grass at the edge of Juvisy airfield, outside Paris, and took his first look into the temple of the flying machine.

It was a strange place. Few of the airplanes which went quivering and coughing across the pasture land ever got into the air. One that would rise to an altitude of ten feet was watched with respect, and a man who got high enough to "break wood" (i.e., have an actual crash) was a hero. Paris rang with theories on planes and flight, almost all of them completely false. One Captain Ferber, however, gave the youth a piece of advice he never forgot: "To invent a flying machine is nothing; to build it is little; to make it fly is everything."

Sikorsky asked one French aviator to name the best aircraft engine of the day. "They are all bad!" the Frenchman cried. Sikorsky modified the question. "Which is the least bad?" The Frenchman meditated and answered: "The one with the smallest number of parts, for the parts are all bad, too." Sikorsky forthwith bought a 25-h.p., three-cylinder Anzani engine, took it back to Kiev, and began building a flying machine himself in his father's backyard summerhouse. It was a rude helicopter. It snorted, flapped, and vibrated, but stayed stubbornly on the ground. To Sikorsky's delight, however, it lifted 357 lbs., only 100 lbs. less than its own weight, when attached to a scale.

After that, month after month, Sikorsky toiled, sketched, planned and studied in his personal struggle to conquer the air. He built another helicopter. He built a frail little fixed-wing airplane.

They refused to fly, too. He built still another airplane, the 52, and after days of taxiing and trying the controls he got its flimsy, bicycle-wheel undercarriage off the ground, and began trying to learn to fly. After eight minutes in the air he tried a turn; the S-2 crashed from a height of 80 feet and was completely ruined. Sikorsky limped away from the wreck to try again.

"The Grand." A new burden of worry assailed him as he toiled on. His father, apparently a man of inexhaustible faith, put much of his small fortune into Igor's experiments, and in the end resolutely mortgaged the family home to keep them going. Igor's sixth plane won the highest award at a Moscow aircraft exhibition in 1912. A huge manufacturing combine, the Society of Russian Baltic Railroad Car Factories, financed him, and with consummate confidence he set out to build the biggest flying machine the world had ever seen. It was "the Grand," the first four-engine transport plane in history—a magnificent affair with a glassed-in cabin, a dining table and an outside observation platform from which Sikorsky liked to admire the clouds as his creation lumbered through the air at 60 miles an hour.

The Czar himself came to see the aerial behemoth and presented Sikorsky with a gold watch bearing the two-headed eagle of Imperial Russia. Igor was 24, one of the world's leading aircraft designers and a famous man. In a few years he was worth half a million dollars. During World War I he shuttled tirelessly between his factory, which built four-engine bombers, and the front, at times taking cover from showers of steel arrows which German bomber pilots dumped on Russian airdromes. Then came the Revolution. Sikorsky left Russia with one suitcase and a thin sheaf of English pound notes.

He ended up in a small furnished room in Manhattan, scratching for a living by giving lectures on mathematics to other emigres. By 1923, however, he was back in business; aided by a handful of long-suffering fellow Russians, he built a clean-lined two-engine transport plane in a Long Island farm yard. Sikorsky was too polite to order his workmen out when they scrambled in for the test hop, and the overloaded plane crashed.

He nevertheless proved himself an impressively facile designer, and eventually United Aircraft & Transport Corp. assimilated his Sikorsky Aviation Corp. By 1937 he had made his mark all over again. The Sikorsky amphibian was a famous plane, and Sikorsky's four-engine Clippers were blazing Pan American's transoceanic routes on both the Atlantic and the Pacific. Sikorsky did not rest on his laurels. He rose at a meeting of United's operating committee, bowed and calmly announced that the time had come to perfect the helicopter.

Feathers & Corks. If he had suggested, instead, that United begin work on a perpetual-motion machine or a cure for baldness he could hardly have startled his colleagues more. The helicopter is the oldest flying machine. The Chinese top, a toy propeller that flies when its shaft is spun between the palms, was conceived in the Orient a thousand years ago. Leonardo da Vinci designed a spiral airscrew in the hope of achieving perpendicular flight. In 1784 two Frenchmen, Launoy and Bienvenu, made a spring-powered model coaxial helicopter with corks for hubs and bird's feathers for rotors. It flew beautifully. An Italian named Enrico Forlanini built a successful seven-lb. steam-driven model in the 1870s.

But men intent on developing the principle behind these simple toys ran into awesome problems. As it sweeps forward into the wind, a whirling rotor blade has more lift than it has on its backward journey. Early models tended to roll over sideways like dying ducks. When the rotor begins turning, torque tends to whirl the body of the helicopter itself in the opposite direction. Furthermore, a spinning rotor is, in effect, a gyroscope—which reacts lustily against any movement from its original position. On top of all this the whirling blades are subject to vibrations—"resonances," as helicopter engineers call them—and early experimental machines had a nasty habit of flailing themselves into suicidal collapse. Anyone who conquered all these difficulties still faced another—ships and planes are steered by rudders. But a rudder obviously could not be used to control a machine intended to go straight up, as well as forward, back and sideways.

The Flying Rat Trap. The world did not lack men who felt confident of hauling themselves into the air with the Chinese top. Over the years they built some of the strangest contraptions ever seen outside an opium dream. They also solved some of the weird problems inherent in helicopters, and a few got into the air. In 1922, an American named Henry Berliner flew a tri-winged tri-rotor "gyrocopter" at an altitude of 15 feet for one minute and 35 seconds. In the same year, a scholarly, short-tempered Russian named George de Bothezat built something that resembled a huge rat trap with four lifting rotors and two steering rotors; it flew at a height of six feet for a minute and 42 seconds at McCook (now Wright) Field.

A wealthy Spaniard, Juan de la Cierva y Cordonnia, discovered that hinged rotor blades would adjust to differences in lift all around their circular path. He incorporated the principle into the Autogiro, a machine that depended on a free spinning, unpowered rotor for lift, and on a conventional propeller for forward motion. The Cierva Autogiro, which was built in the U.S. by Pittsburgh Plate Glass heir Harold F. Pitcairn, was the first, practical departure from the fixed-wing plane. Though it could not ascend vertically, it could take off with a short run, climb rapidly and land in tight fields.

Even so, it was little more than an aerial curio—a compromise between an airplane and a true helicopter. Conventional-aircraft engineers felt that the long, painful struggle to produce a direct-lift machine was simply proof that the practical helicopter was an impossibility. Sikorsky did not agree. He had never ceased thinking about rotor-machines in all the 30 years since building his first. While workmen at the Sikorsky plant goggled and shook their heads, Sikorsky began flailing the air with a stationary test device made from the transmission of an old Ford, a motorcycle engine, and a single rotor blade.

One Woman in the Kitchen. Stranger developments followed. United Aircraft, caught between its doubt of helicopters and its respect for Sikorsky's genius, financed an experimental direct-lift machine. Sikorsky was obligingly frugal; all his years of helicopter research cost United less than \$300,000. His Vought-Sikorsky 300 was simply a framework of welded pipes with a 75-h.p. aircraft engine and a big flywheel that was linked by automobile fan belting to the transmission of a single, three-bladed rotor. Nevertheless, it incorporated most of the principles of today's Sikorsky machines.

In building it, the inventor drew heavily on the theories of others, but putting them together mechanically with some of his own and making them practical was an awesome task. Most earlier helicopter builders (like some today) killed torque by using sets of two or more rotors which revolved in opposite directions. But Sikorsky put his faith in one rotor. "One woman in the kitchen is fine," he says. "Two women in the kitchen get in each other's way." He decided to keep his fuselage from spinning simply by hanging a vertical fan on an outrigger at the tail.

To make his helicopter go up or down he incorporated the idea of the variable-pitch propeller; by increasing the rotor blades' bite on the air (and simultaneously opening the throttle), he increased their lifting power. But to steer the machine forward, backward or sideways he made the blades subject, also, to something much more complicated, called cyclical pitch. This forced the bite of each individual blade to lessen as it swung toward the direction in which the control stick was moved—and then to gradually increase back to maximum pitch as it traveled through the next 180 degrees of its circle. Thus, if the stick was pushed forward, the helicopter would move ahead because the blades pushed harder at the rear of the rotor "disk" than at the front.

An Engineer's Nightmare. All this was harder to do than to plan. He had to build a hub that would contain all the gear necessary for these subtle and complicated changes of altitude and still let the blades ride free (to kill gyroscopic effect and preserve a balance of lift), supported horizontally only by centrifugal force. The hub was an engineer's nightmare. There was only one way to ferret out its many early imperfections. Sikorsky had the VS-300 tied down with stout ropes to keep it from rising more than a few feet. Then he climbed into the seat in his dark business suit and upturned fedora, started the engine and began—as he had in a Russian pasture 30 years before—trying to learn to fly a strange, new and hideously uncertain machine.

It took weeks, months, years. On the first "flight" in which the VS-300 left the ground it immediately lurched sideways "like a frightened horse." Sikorsky had no way of knowing whether the fault was his or the helicopter's. For a while he had the machine fastened to a post in a nearby field, and "flew" it there every day simply in an attempt to keep its wheels precisely six inches off the ground. Meanwhile the VS-300 was rebuilt and rebuilt again—in all, it went through 19 major alterations, accumulating and shedding tail rotors in the process.

Gradually it improved. So did its control system—pilots originally complained that it would take a man with nine arms to fly it. So did Sikorsky's ability to handle it. In 1941 he set a record for endurance—the VS-300 stayed in the air at treetop height for one hour and 42 minutes. By the time of Pearl Harbor the burden of Sikorsky's experimental work was done. The VS-300 would do amazing stunts—hover motionless with ease, sit down in backyards, lower a bag of eggs to the ground without cracking a shell. The Sikorsky plant turned to building bigger and more powerful helicopters, which were put to use in rescue, patrol and communications work during World War II.

Man with a Thousand Lives. Igor Sikorsky's real moment of triumph came when the U.S. Marines pressed helicopters into service in Korea—and not simply because the Bridgeport plant (soon to be doubled in size) fairly vibrated to the rush of new business. He kept meticulous track of rescue work done by helicopters all through the war. "We have," he would announce to friends with satisfaction, "now saved 7,642 lives. We are saving more every week."

Helicopters are still growing bigger and bigger. Sikorsky is soon to unveil a two-engine, single-rotor machine capable of carrying 26 fully equipped marines or 35 short-haul passengers. The Piasecki Transporter, a new 40-place biaxial helicopter, is undergoing tests at Philadelphia. Meanwhile, the more fervent of the new disciples of vertical flight dream of mass-producing small helicopters by the hundreds of thousands, of eliminating metropolitan airports with "convertiplanes" capable of rising with rotors and then undergoing a mid-air metamorphosis and becoming speedy jet airplanes. Some even wonder if fixed-wing aircraft themselves cannot be flown straight up simply by blowing a lifting wind across their wings with jet engines instead of with a take-off run. Even to Igor Sikorsky a lot of this sounds like wild talk—wild talk such as he has not heard since Paris in 1909, when the world of flight was new and nothing was impossible.

* The word helicopter stems from two Greek words, helix, meaning spiral, and pteron, meaning wing. Correct pronunciation: hell-icopter.