# Man's Efforts to Fly Straight Up

*Aviation*

**Ever since the time of that versatile Italian, Leonardo da Vinci, many strange craft have been planned and made by inventors bent on becoming complete masters of the atmosphere. Success has been elusive, but the persistent are still building. Here is the story of the efforts of five centuries.**

SCIENTISTS and inventors have always had the flight of birds to give them encouragement in developing the airplane. But those who have tried to make a heavier-than-air flying machine that would rise straight up and remain stationary in the air have gotten no encouragement from birds. For there is no bird that can fly vertically and only one that can stay still in mid-air. It is the humming bird.

Even without an analogy in nature to encourage them, inventors of helicopters, who have been at work as long as those who flew airplanes a quarter of a century ago, seem nearer their goal than ever before. The latest helicopter, as vertically rising aircraft are known among technical men, is being tested. It is the combined product of the ingenuity of a 27-year-old inventor and the research organization of a $70,000,000 aviation corporation.

This newest helicopter is very much unlike any individual machine of the past. It seems to have taken points from numbers of older helicopters; and its makers should know before long whether these points have been wisely chosen, and also whether new features are correctly designed. Its builders, the Curtiss-Wright Corporation, make no fantastic predictions. They call it "a step toward controlled vertical ascent and descent."

What a helicopter must do has been well defined by the makers of the new machine. "The true helicopter," they say, "is a flying machine that will be able to lift itself vertically off the ground, to hover indefinitely over a given spot, to descend vertically under its own power, and to achieve safe descent in the event of engine failure. In addition, it must be able to move horizontally at satisfactory speed and to be controllable and satisfactorily stable under all flight conditions."

A lot of performance is packed in those two sentences, and engineers have not yet made a machine that will do everything specified. They are, however, learning daily more about the aerodynamic laws the new craft must obey, and how to design helicopters so that least effort will be expended in making these laws work for them.

The first helicopter was a product of the brain of the versatile Leonardo da Vinci. Its aerodynamic principles were carefully thought out and a sketch, which is still in existence, was made of the proposed craft before the inventor's death in 1519. The need of an engine for flying had already been discussed by Roger Bacon as far back as 1250.

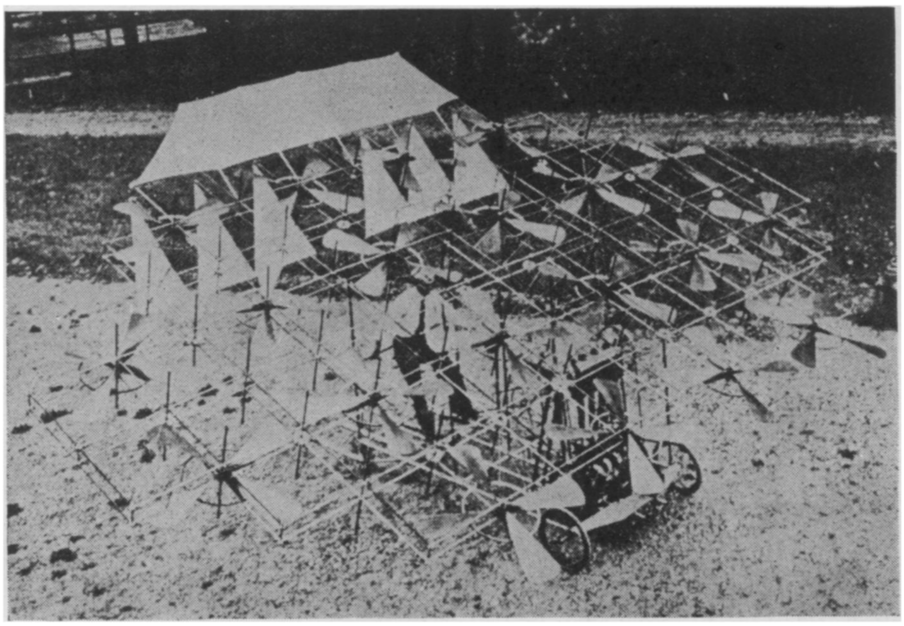
## Early Models

By 1843 helicopter design was well in the model-making stage. Encouraged by the new steam engine, inventors were trying to use it as a power plant for aircraft. Sir George Cayley made a model which shows appreciation for the same aerodynamic principles present-day inventors are finding they must follow. He used two lifting propellers or airscrews which turned in opposite directions to provide stability, and smaller airscrews to drive the craft horizontally.

This was just one of the many helicopters that have been designed, modeled or actually built.

To invent helicopters that would not fly successfully seems to have been a weakness, even of great men of science. Thomas A. Edison has long been a believer in this form of craft as the best means of air transportation. He holds a patent on a machine whose revolving wings are in reality box kites held down by piano wire. Some of the most important contributions to helicopter design and invention in America have been made by Peter Cooper Hewitt, inventor of the mercury arc lamp, and by Emile Berliner, who was originally responsible for the disc talking machine.

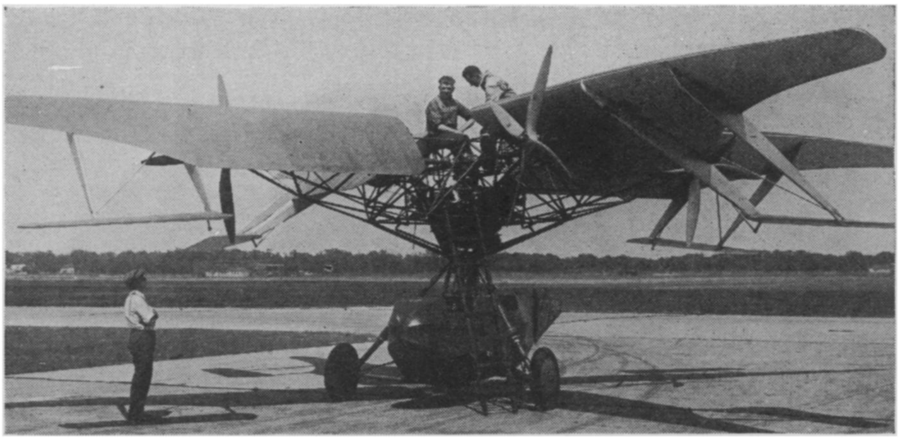
These scientists were doubtless encouraged by the inspiring performance of models, for model helicopters, powered by rubber bands or blockwork, will readily lift themselves from the ground and easily climb to great heights. But when such craft are made large enough to lift real peo-

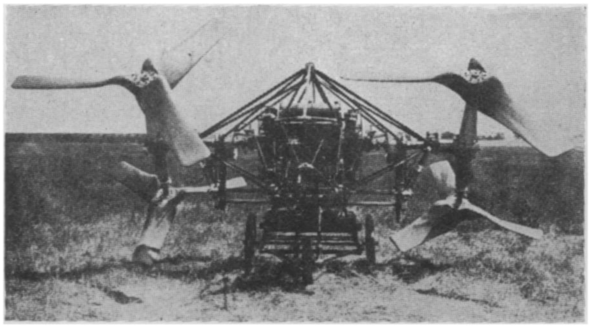


**Twenty small, rapidly turning propellers were designed to make this machine rise vertically. It was built in 1909 by Wilbur R. Kimball, of the New York Aeronautical Society.**

ple instead of minature humans, there arise many unforeseen difficulties of construction which do not affect the building of models.

Lifting ratios greater than 100 pounds per horsepower are frequently achieved in models, Dr. H. L. Dryden, authority on aerodynamics at the U. S. Bureau of Standards, says but only a fraction of a horsepower is applied to these models and very little weight is lifted. If such ratios held for man-sized craft, a wonder world of air transportation would be opened up. However, difficulties of mechanical construction multiply and laws of aerodynamics become more severe as the size of vertically rising craft is increased.





**Top—The latest, the Curtiss-Bleecker helicopter, on which preliminary tests have been made.**

**Side — Another odd form of vertically rising craft, built by the Leinweber Brothers, of Chicago.**

The rotating wings of models can be made very light and do not require the structural bracing necessary in real machines. It is very difficult to design this bracing to combine both strength and light weight.

The wings of models can also be turned much faster than those of big machines because ability to rise depends more on circumferential speed at the wing tip than on revolutions per minute. Hence, to attain the same circumferential speed, a small propeller must make more revolutions than a large one. This speed is easily reached in models by means of elastics or clockwork, but it is very difficult to gear high speed aircraft motors down to about 130 revolutions per minute for the big machines. A heavy, clumsy system of gearing is necessary and much power is lost.

### Not So Clumsy

In spite of the fact that the large rotating wings seem awkward and clumsy, they have been found the only solution to the problem of how to rise vertically, Dr. Dryden explains. The first machines attempted were built years ago and used one or more small propellers which turned as fast as those that drive airplanes today. These ships were entirely unsuccessful.

As propeller speed is increased, the power required rises much faster than the force pulling upward. Expressed by the aerodynamic law, power is proportional to the cube of the speed, and thrust, or upward driving force, to the square of the speed.

The rotating surfaces must be large because they take the place of wings of the usual airplane. Their linear speed must compare with airplane speed and yet is limited by fast increasing power.

### Some Curious Craft

Some of the first helicopters, whose failure helped to find aerodynamic laws applying to them, were curious craft. One early machine represented a combination between a bicycle and a parachute, and was to be operated by manpower. Safety in descent after the operator got tired pedaling was apparently uppermost in the mind of its inventor.

Twenty propellers were used to operate another, which was built in 1908 and 1909 by Wilbur R. Kimball, of the Aeronautic Society of New York. It had too much gearing and framework and too much weight per horsepower.

As the gasoline motor was improved and more power was concentrated into less space, and as inventors learned that they must use a few large slow rotating surfaces rather than many fast turning propellers, their problem changed, or rather it was half solved. They found that it was comparatively easy to rise up in the air; but, once up, they could not control their machine and bring it slowly and safely back to earth. Many helicopters had a tendency to soar upward, swing over in a great arc and come diving back to the ground head first.

### Observation Helicopter

Probably the first successful vertically rising flying machine was the Petroczy-Karman helicopter developed in Austria during the World War. But it could rise straight up and do nothing else. It was tethered to the ground by three cables and as long as these cables were kept taut it could not tip over. It could not be controlled well enough to permit it to sink to earth gradually under a lessening of its own power, but it had to be pulled in by the cables. During one test it was fitted with an electric motor and operated successfully for a few minutes on current supplied from the ground.

The French have sought stability in the Oehmichen helicopter by swinging the whole craft beneath a small balloon. The balloon is by no means large enough to lift the entire weight but its buoyancy helps to keep the craft right side up.

Compressed air was tried by the Leinweber Brothers of Chicago as the stabilizing agent for their machine. The craft was designed so that the least tilt out of balance would swing a pendulum to set in motion a compressed air motor. This in turn was to open valves which would allow air to enter the motor and right the machine instantly. (*Turn to page* 190)

in plant pathology is the development of disease control methods based on scientific research," he continued. Most of these methods have been developed within the last 50 years, many within 25 years. These include spraying and dusting with fungicides, disinfection, eradication, control of the carriers, sanitation, cultural and handling methods, breeding and selection of resistant species and varieties, and quarantines. Spraying has become one of the leading methods in spite of the expense and trouble which it entails. The practice of quarantine regulations makes it reasonably certain that new plant material may be introduced into a country without introducing diseases.

The loss through insects and plant diseases in the United States each year amounts to $3,000,000,000, Lee A. Strong of the Plant Quarantine and Control Administration, U. S. Department of Agriculture, reported to the Conference.

"Fully 50 per cent. of the important pests responsible for this enormous loss are of foreign origin, practically all of them having been introduced prior to the passage of the Plant Quarantine Act of 1912," he said. He explained the authority under which these quarantines are carried out and how they operate.

Comparatively little is known of the insect problems of South America, Dr. W. Dwight Pierce, entomologist, formerly of the U. S. Department of Agriculture, said. It would take a long time and many men to make a complete survey of the insect life of the Americas. Consequently he suggested that the Pan-American Union or the Tropical Plant Research Foundation maintain a small staff of specialists in the various branches of agriculture, including entomology, who will be constantly available to the various countries to make surveys of the more important economic problems and to give practical advice.

### Death to Weeds

No short cuts or easy methods exist for controlling the weeds which cost farmers of the United States several hundred million dollars each year, M. W. Talbott of the U. S. Bureau of Plant Industry told the delegates.

"In the main, the old doctrine of hard work and plenty of it must be observed," he said. "The three main methods of weed control are: prevent weeds from maturing seed; prevent the introduction of weed seeds; and prevent perennial weeds from making top growth."

For the first method he advised tillage, mowing and pasturing with livestock. The second is more difficult and often requires comunity action to keep down the introduction of weed seeds. For keeping down the top growth of perennials, he recommended clean cultivation, smother crops, pasturing, frequent cutting and the application of chemicals. This last must be done with care, however.

### Successful Tick War

The success of a 24-year war against the cattle tick, cause of the costly animal disease known as southern Texas or tick fever, was reported by W. W. MacKellar of the U. S. Bureau of Animal Industry. "It is possible and practicable to eradicate the cattle tick permanently from any section," Mr. MacKellar declared.

When this eradication project was started in 1906, 983 counties with a total area of 728,565 square miles were under Federal quarantine because of tick infestation. At the close of 1929 the quarantined area had been reduced to 184 counties containing 151,198 square miles.

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## Man's Efforts to Fly Straight Up—*Continued*

Since the World War there has been no want of helicopter inventors and trial machines. They are found in nearly every country. Even if such craft must be tied down with a rope, it has been learned that they are often better for observation purposes in war than captive balloons. They cannot be seen from a great distance, are small targets and require few men in their ground crews.

Among other helicopters which have been the subject of extensive research during the past decade is one developed by Louis Brennan for the British government. Great secrecy surrounded its building and tests.

In America both the de Bothezat and the Berliner helicopters are said to have made short flights. The de Bothezat machine had four propellers arranged radially on the same level over a framework to which the engine was fixed.

Dr. Berliner and his son, Emory A., of Washington, built a machine which made use of an airplane fusilage. But instead of wings there were two propellers which turned in opposite directions to lift the machine vertically. Horizontal motion was gotten by means of a three-foot propeller near the tail of the ship to tilt the entire machine by raising and lowering the tail.

Marquis Pateras Pescara has used two propellers, one above the other, rotating in opposite directions. He is reported to have remained in the air more than eight minutes and to have flown over 3,000 feet in Paris early in 1924.

A German engineer, Englebert Zaschka, has designed a helicopter in which a gyroscope is used to increase stability. It also serves as an energy accumulater for a gliding flight. Gliding flight is this case means a straight descent.

While many engineers were seeking vertical flight directly, Juan de la Cierva, a young Spanish scientist and former member of parliament, decided to make a cross between a true airplane and a true helicopter. In effect, he stripped the wings from an ordinary biplane and erected above the ship four windmill blades which turn in a horizontal plane and are free to move at will, being connected to no source of power.

When he tested his machine in 1923 he found he had a ship that would not remain stationary in the air, but it would travel very slowly indeed. He could throttle it down to 20 or 30 miles an hour. It would not climb straight up but it would rise at a very sharp angle, much sharper than that at which airplanes ascend.

In Italy Signor M. Isacco has apparently attempted to convert the autogiro into a helicopter. He calls his machine the helicogyre. A casual examination shows it to be an autogiro with small motors built in the revolving wing tips. This makes the rotating wings independent of the backwash of the propeller for their motion.

The newest helicopter, the Curtiss-Bleecker machine, is the invention of Maitland B. Bleecker, who began to plan his machine when a student at the University of Michigan.

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