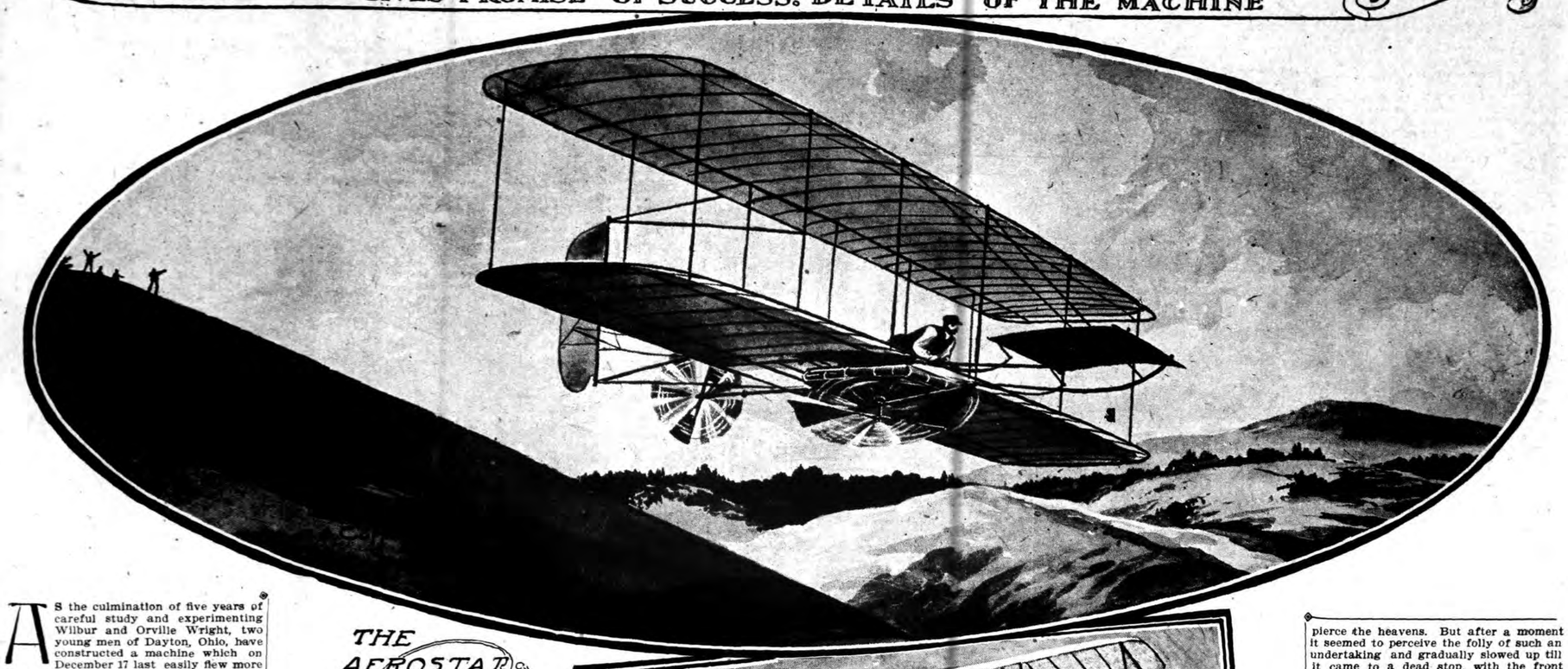
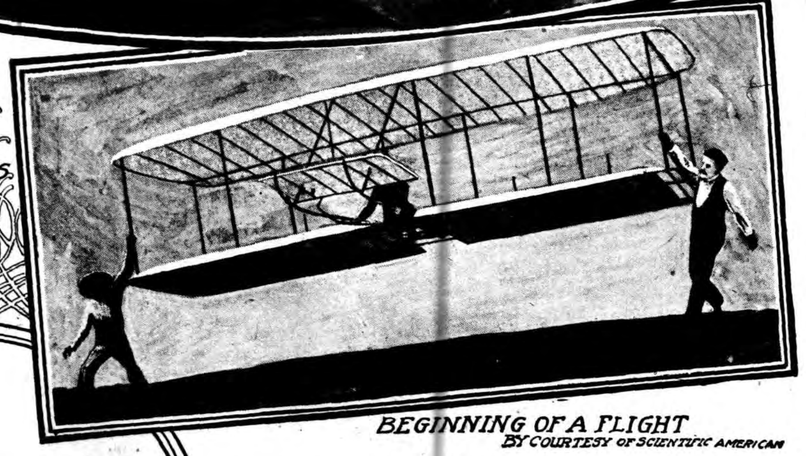
THE MACHINE THAT FLIES

PERFORMANCE OF THE WRIGHT BROTHERS' AEROSTAT GIVES PROMISE OF SUCCESS. DETAILS OF THE MACHINE



THE AEROSTAT IN FLIGHT SHOWING POSITION OF MOTOR AND PROPELLERS. G.A.COFFIN



BEGINNING OF A FLIGHT
BY COURTESY OF SCIENTIFIC AMERICAN

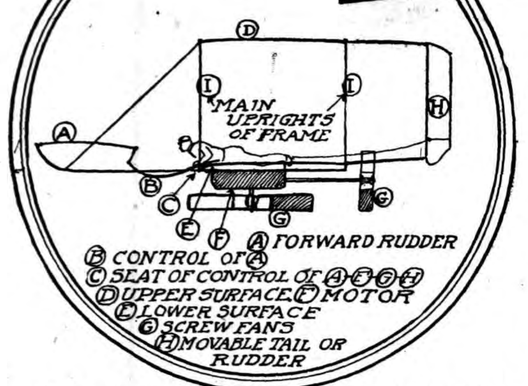


DIAGRAM SHOWING CONSTRUCTION AND OPERATION OF AEROSTAT.

AS the culmination of five years of careful study and experimenting Wilbur and Orville Wright, two young men of Dayton, Ohio, have constructed a machine which on December 17 last easily flew more than three miles in the face of a wind blowing twenty-one miles an hour. The affair was dirigible at all times.

This is the first successful flying machine which has ever been constructed, and the eyes of the entire scientific world have been turned on the experimenting grounds at Kitty Hawk, N. C., an isolated locality among the sand dunes of the Atlantic coast.

What they have built is not an airship supported by a gas bag and driven by a motor, but a scientific adaptation of the principles in a soaring eagle's flight, only that two motor driven screw fans, one with a horizontal resistance and the other with a perpendicular resistance, make the machine's flight something surpassing that of a soaring bird, for the machine can navigate the air in any direction, and the soaring bird is confined to currents of air that oppose his wings in available fashion.

Having known of them and their earlier work with the intimacy of school fellowship and neighborly friendship, and having followed their later endeavors with the interest begot of old times, it is more than a pleasure to tell, now that they have triumphed where so many, many others have failed, of the prefatory things and of their small beginnings.

The brothers are the sons of Bishop Wright, of the conservative division of the United Brethren Church, and are natives of the city of their present residence. Orville, the younger, is nearly thirty and Wilbur is a few years older. Their total scientific training was got under Professor William Werthner in the old Central High School, in Dayton, and, oddly enough, boys who were schoolmates with them and have since distinguished themselves in the public eye include Ernest Blumenschien, one of the country's foremost illustrators; Earl Kiser, twice America's champion professional bicyclist; Harry Lydenberg, with a row of Harvard records and the librarianship of the Astor Library in New York, and Paul Laurence Dunbar, the negro poet and novelist.

Printer Inventors.

Both boys excelled in mathematical, electrical and chemical studies and were honor men. On graduation they established a tiny job printing office on the west side and published a suburban paper with success. Ere long Orville began making a fine showing in bicycle racing, and both entered into the manufacture of bicycles, which is their business to-day, they being the designers and makers of the Van Cleve wheel.

It was in 1896 that Professor Langley's attempts at aerial navigation attracted their attention to the subject and in 1898 they took up the matter actively. Their spare time for many months was spent in the observation of the flights of birds, kites, &c., and paralleling this line of study was their experimental study with gasolene and electrical motors.

They were so successful in the latter that the attention of Western engineers was attracted to them. Their designs in gas engines were of a most advanced type, and so careful were their calculations and so clear their imaginative construction—the great inventive faculty—that success attended all they did.

At last, when satisfied that they had a motor which could produce as much power per pound of weight and foot of space as could the natural navigators of the air, they turned their attention to the construction of a winged machine which should afford enough resistance to the air to support its own weight and that of one man.

If Orville Wright led in the motor construction Wilbur Wright was foremost in the working out of the soaring or gliding theory, and so this story of their progress shall be for the most part told in the words of the older brother:—

Difficulties Overcome

"The difficulties which we faced were to be classed in three groups—(1) those which relate to the construction of the sustaining wings, (2) those relating to the generation and application of the power required to drive the machine through the air, and (3) those which relate to the balancing and steering of the machine after it is actually in flight.

"As long ago as 1893 a machine weighing 8,000 pounds demonstrated its power to lift itself from the ground and to maintain a speed of from thirty to forty miles per hour, but came to grief in an accidental free flight owing to the inability of the operators to balance and steer properly.

"Herr Otto Lilienthal seems to have been the first man who really comprehended that balancing was the first instead of the last in importance of the problems. He built a pair of wings of size suitable to sustain his own weight and used gravity as a motor—a very cheap experimental motor.

"Herr Lilienthal was followed by Mr. Pilcher, a young English engineer, and by Mr. Chanute, president of the Society of Western Engineers. A few others have built machines, but nearly all that is of real value is due to the experiments conducted under the direction of the three men mentioned. The first two gave their lives.

"My own active interest in aeronautical problems dates back to the death of Lilienthal, in 1896. The brief notice of his death which appeared in the telegraphic news at the time aroused a passive interest which had existed since childhood and led me to take down from the shelves of my father's library a book on 'Animal Mechanism,' by Professor Marey, which I had already read several times. It seemed to us that the main reason why the problem had remained so long unsolved was that no one had been able to maintain any adequate practice.

Lessons from Lilienthal

"We figured that Lilienthal had in five years' time spent only five hours in the air, yet Lilienthal, with this brief practice, was remarkably successful in meeting the fluctuations and eddies of wind gusts. It seemed feasible to practise by the hour instead of the second by building a machine which would be sustained at a speed of eighteen miles an hour and then finding a locality where winds of this velocity were common. With these conditions a rope attached to the machine to keep it from floating back with the wind would give us the same results as if we had a machine driven forward by a motor in a calm.

"We found, according to the accepted Lilienthal tables of air pressure on curved surfaces, that we would need a machine spreading two hundred square feet and that winds of the sort we wished were common along the Atlantic coast. When the winds were low it was our plan to glide from the sand hills.

"After much study we concluded that tails of size were an impediment. Also it seemed reasonable that if the body of the operator could be placed horizontally only one square foot instead of five would be exposed to the wind. Pilcher, Lilienthal and Chanute had been upright.

"Then the method of control used by Lilienthal, which consisted in shifting the body, did not seem quick or effective enough, so after long study we contrived a system consisting of two large surfaces on the Chanute double decked plan and a smaller surface placed directly in front at a short distance in such a position that the action of the wind upon it would counterbalance the effect of the travel of the centre pressure on the main surface.

"Thus, changes in the direction and velocity of the wind would have little disturbing effect and the operator would be required to attend only to the steering of the machine, which was to be effected by the curving of the forward surface, up or down. At that time the lateral equilibrium and the steering to right or left was to be attained by a peculiar torsion of the main surfaces, equivalent to presenting the wings of one end to the wind at a greater angle than the others.

Trial as a Kite.

"With these plans we proceeded, in the summer of 1900, to Kitty Hawk, North Carolina, a little settlement located on the strip of land that separates Albemarle Sound from the Atlantic Ocean. Owing to the impossibility of obtaining suitable material for a two hundred square foot machine, we were compelled to make it only one hundred and sixty-five square feet, which, according to Lilienthal's tables, would be supported at an angle of three degrees in a wind of about twenty-one miles per hour. On the very day that our machine was completed the wind blew from twenty-five to thirty miles per hour and we took it out for a trial as a kite.

"We found that while it was supported with a man on it in a twenty-five mile wind the angle was nearer twenty degrees than three, so we turned our attention to measuring the lift and drift of the machine under various loads. The results obtained were most astonishing. It appeared that the total horizontal pull of the machine while sustaining a weight of fifty-two pounds was only 8.5 pounds, which was less than had previously been estimated for the resistance of the head framing alone, fifty per cent less than Chanute's final estimate.

"On the other hand it appeared deficient in lifting power. This deficiency we supposed might be due to one or more of the following causes:—(1) That the depth of the curvature of our surfaces was insufficient, being only one in twenty-two, instead of one in twelve; (2) that the cloth used in our wings was not sufficiently airtight; (3) that the Lilienthal tables might themselves be in error. We decided to arrange our machine for the next year so that the depth of curvature of its surfaces could be varied at will and its covering airproofed.

"We then turned our attention to gliding from the top of Kill Devil hill, a sand dune about one hundred feet high. Although landings were made while moving at speeds of more than twenty miles per hour, neither machine nor operator suffered injury. The control of the machine proved even better than we had expected, responding quickly to the slightest motion of the forward rudder. With these glides our experiments for the year 1900 closed.

The Machine of 1901

"When it came to building our machine for 1901 we decided to make it like the previous machine in theory, but we increased the size from 165 square feet to 308 square feet. The curvature of the surfaces was increased to one in twelve. The machine was completed on July 27 and tried in a wind blowing thirteen miles per hour. An attempt to glide was made, but the machine went a short distance and turned into the ground without injury. The operator took a position further in the rear to set back the centre of gravity and the machine sailed three hundred yards easily.

"After a long series of successful glides and experiments, we returned from Kitty Hawk and took up experiments in our laboratory to ascertain the amount of pressure on curved surfaces, with a view to approximating the motor power necessary. It was calculated that at a speed of twenty-four miles per hour the total horizontal resistance of our machine, when bearing the operator, amounted to forty pounds, which is equivalent to two and one-third horse power. It must not be thought that we believed a motor of such horse power would drive the machine. We knew that one of six horse power, weighing about one hundred pounds, would be required. Of course, one of less weight and the same power is practicable.

Culmination of All Experiments

"In August of 1902 we repaired again to Kitty Hawk. There were three sand dunes on our experimental grounds worthy of the names of hills—Kill Devil, West and Little Hill. Our 1902 pattern, which was practically the culmination of all our experiments, was the same double decked pattern we had used, and it was used in our last successful trial with a motor a few weeks ago.

"There were two surfaces, 32 feet from tip to tip, made of straight grained spruce, for frame, and cloth, airproofed, for covering, with a spread of 305 square feet, a front rudder with a spread of 15 square feet and a vertical tail 12 feet square, at that time fixed, but since reduced in size and made mobile. The total weight, to which the motor and gear must now be added, was then 116½ pounds, to which must also be added the weight of the operator, from 150 to 160 pounds.

"On the second day the machine was taken to the big hill and regular gliding was commenced. The wind was somewhat brisk. In one flight the wind struck the machine from the left and began lifting the left wing in a decidedly alarming fashion. Owing to the fact that in the new machine changes had been made in the mechanisms operating the rudders, so that the movements were exactly reversed, it was necessary to think a moment before proceeding to make the proper adjustment.

"Meanwhile the left wing was rising higher and higher. I therefore decided to bring the machine to the ground as quickly as possible, but in my confusion forgot the change that had been made in the front rudder and instinctively turned it the wrong way. Almost instantly it reared up, as though bent on a mad attempt to pierce the heavens. But after a moment it seemed to perceive the folly of such an undertaking and gradually slowed up till it came to a dead stop, with the front pointing skyward.

Making a Lancing

"By this time I had recovered myself and reversed the rudder to its fullest extent, at the same time climbing upward toward the front, so as to bring my weight to bear on the part that was too high. Under this heroic treatment the machine turned downward and soon began to gather headway again. By the time the ground was reached it was under full control, but as one wing touched first it swung around in landing and came to rest with the wing blowing in from the rear. There was no unusual shock in landing and no damage at all resulted. As a result of this we drew the tips of the wings down some six inches lower than the centre.

"After several days' rain we had another opportunity for trial. On this occasion my brother Orville did most of the gliding. After a few preliminary flights to accustom himself to the new method of operating the front rudder he felt himself ready to undertake the management of the lateral control also.

"Shortly afterward he started on a flight with one wing slightly higher than the other. This caused the machine to veer to the left. He waited a moment to see whether it would right itself, but finding that it did not he decided to apply the control. At the very instant he did this, however, the right wing unexpectedly rose much worse than before and led him to think that possibly he had made a mistake.

"A moment of thought was required to assure himself he had made the right motion and another to increase the movement. Meanwhile he had neglected the front rudder, by which the fore and aft balance was maintained. The machine turned up in front more and more till it assumed a most dangerous attitude. We who were on the ground noticed this in advance of the aviator, who was thoroughly absorbed in his efforts to restore the lateral balance, but our shouts were drowned by the howling of the wind. It was only when the machine came to a stop and started backward that he realized his true situation. From the height of nearly thirty feet the machine sailed diagonally backward till it struck the ground. The unlucky aeronaut had time only for one hasty glance behind him and the next instant found himself the centre of a mass of fluttering wreckage. How he escaped injury is more than I know, but he was unable to show a scratch or bruise anywhere.

Affixing the Tail

"It was now that we fixed on a single movable six square foot tail. The majority of the glides had been made in winds approximating twenty miles an hour. One day we worked in a thirty-seven mile an hour wind. We had concluded that we needed at least an eighteen mile an hour wind for gliding. In this wind we found the horse power consumed to be one and a half, and in a twenty-five mile wind two. At eighteen miles an hour 166 pounds was sustained per horse power; at a higher speed 125 per horse power, and we found that at between eighteen and twenty-five miles the ratio of speed and power was about equal, but above or below varied sharply.

"Much time was spent in measuring the winds about us and the flights of our neighbor birds in them. We had many sorts of soaring birds in the vicinity, including bald eagles, hawks, buzzards and ospreys. Maxim's machine supported to one horse power twenty-eight pounds, Langley's 1896 machine thirty-one pounds—ours carried 165 pounds.

"Chanute's best degree of gliding descent was seven and a half to eleven degrees. We attained five to seven degrees. If it be desired to fly horizontally through the air by mechanical means the best angle of incidence would be from five to seven degrees.

"We were now approaching the point of introduction of power into our machine, and in the earlier portion of 1903 made many interesting experiments, culminating in the construction of a motor which we placed under the operator sufficiently to the rear to retain the centre of gravity in its proper position according to our previous designs. A screw fan propeller was geared on a line to the rear and a second one placed underneath the motor to serve to lift the machine, as the first propeller was meant to drive it.

"The motor was our own gasolene type, and anything new that was introduced had already been suggested by our previous experiments. Early in December we began to look forward to the day of trial. The weather was not propitious, but on Thursday the wind was blowing about twenty-one miles an hour, and I took my place in the machine for a trial from the big hill.

"First, the lifting propeller was started, and facing the wind the machine rose easily and gracefully to the height of about sixty feet, and when the rear propeller began to hum and the lifting propeller to slow down the first flying machine sailed into the wind and traversed easily a distance of three miles down the dunes.

"Our experiments are not yet completed, but we feel confident of delivering to the world in no great stretch of time a completely practical flying machine for everyday use."

Sixtieth Anniversary of the Brewing of Lager Beer in America.

THIS is the sixtieth anniversary of the brewing of lager beer in the United States. Everybody knows that beer and ale have been brewed in New York ever since the Dutchmen came over from Holland and founded the colony of New Netherlands, but it is not so well known that the brewing of lager beer in the United States is so recent that at least ten of the original brewers are still living.

The first brewery in New York was established more than two hundred and fifty years ago, when old Governor Van Twiller built a brewery on the West Indies Company's farm, which was on the west side of town, near Hudson street. Another brewery was started in Albany about the same time, which has continued brewing ever since. These breweries and others ran along for two hundred years before lager beer was made. They brewed ale, table beer—or small beer—and what is now known as barley wine, but they did not brew lager beer, or hopped malt beer, which is the kind of beer now commonly used. It is pretty well settled that the brewing of lager beer in the United States began in 1843, and about the same time in New York and Philadelphia. The Philadelphia brewery was a small building in the suburbs, while the New York brewery was at Broadway and Nineteenth street, opposite the old Goelet house, where a big carpet store stands now.

The books of this original New York lager beer brewery are still in existence, and they tell a number of interesting things about the early methods and sales of beer. Sebastian Sommers used to own the brewery, where he made ale and small beer, but not lager beer. He sold the brewery before lager beer was brewed. J. F. Luther was the first customer, on September 3, 1843. He bought five gallons of beer and paid fifty cents for it, at a rate of ten cents a gallon. At that time a brewery did a retail business, and the customer would call for his beer and take it home with him in a pail or tub. Peter Stoltz was the second customer. He bought a dollar's worth, or ten gallons. Daniel F. Tiemann and William F. Havemeyer, each of them afterward Mayor of New York City, were among the first customers. Lager beer was a novelty, and it soon became a fashionable drink, as the names on the books of the old brewery show. The swell families would bring a bucketful to serve with their Sunday dinner on state occasions.

It was not the cheap and popular drink that it is now. Whiskey sold at so low a price then that it and other hard liquors were more in common use.

It took some time for lager beer to become popular, and the early sales of the brewery were not large. The owners worked with their two or three men to turn out $10 or $15 worth of beer a day, which was sold to customers who called for it. In a few years the business grew and the brewery moved over to Seventh avenue, near Seventeenth street, where the first lager beer saloon was opened in connection with the brewery. Seventh avenue and Seventeenth street were in the suburbs then, and there was no other saloon for some distance. People would make an excursion there to taste the new drink.

Lager beer did not become popular until the introduction of ice to keep it cool. Before the use of ice the beer was kept in vaults under ground until it was sold. More brewing was done in the winter, and more beer was sold then than in the summer. The use of ice caused the abandonment of the old vaults and enabled the brewing of a big summer supply, which has been growing rapidly every year. The American taste demands a beer colder than the German taste. In Germany the beer is rarely put on ice, and it is drunk at the temperature at which it comes from the vaults.

The old account books, besides telling about the beer and its sale, gave the wages of the laborers. The foreman of the brewery got thirty dollars a month. The wages ran down from his to four dollars a month. The average pay of a workman seems to have been about nine dollars a month, which he would draw in instalments of fifty cents and one dollar as he needed the money. Accounts were kept with every laborer separately, crediting him with his wages and charging against him the sums drawn from time to time.

In this practical school several of the big brewers of to-day learned their trade. Even in California one of the most successful brewers is a man who worked in his first lager beer brewery in New York city.

It was not for years after the brewing of lager beer in the United States that putting it up in barrels and kegs as now became customary. The present kinds of export beer and the different qualities were not made then as now.