he could get it closed again he had valved so much gas that the balloon was coming down like a rock.

Harris did a little rapid metal calculation and decided that if he could throw out about 150 pounds of ballast the balloon would come down slow enough to prevent injury. But he didn't have any ballast. Taking his sweetheart in his arms he pressed a farewell kiss on her cheek and jumped out of the basket. He was dashed to pieces on the ground below but with his weight out of the balloon it came down at a normal speed and the lady was uninjured although she promptly fainted when she reached the ground.

As early as 1785 Blanchard and Dr. Jeffries, his companion in many of his aeronautic exploits, drifted across the English channel. The fame they obtained on the strength of this was equal to that obtained by certain members of the feminine sex who swam across 150 years later.

Charles Green, a resident of London, did for balloons what Ford did for automobiles. He made them cheap. It was in 1814 that he discovered coal gas would do equally as well as the more expensive hydrogen.

An artist with a pen who made a specialty of forgery and spent most of his life in solitary confinement has saved more aviators' lives than any other man in the history of the world. This man is M. Lavin, a French gentleman, who didn't use his abilities to the best advantage.

In the early part of his career he attracted attention by a marvelous ability in imitating other people's hand writing. He could look at a man's signature and copy it so well the man would swear he had written it himself.

Lavin was an honest forger at first. But temptation was too much for him. That was how he happened to invent the parachute.

He got into difficulty when he started copying treasury certificates. So long as he merely copied them and threw the copies in the fire it was all right. But one day he bought some goods with his copies and the next thing he knew he was in prison.

Prison was an uninteresting place for so accomplished a gentleman and he longed to get out. In his efforts to win favor of the men in power he made pens out of straws and copied their signatures. But the officials thought they would rather have him copying their signatures where they could watch him than to turn him out to do it.

He next took his straw pens and started drawing their pictures. But that didn't win any more favor than the first method.

One day while looking through the window at the water below his prison tower he decided to take a high dive into the stream and escape. But he was more of an expert at writing than swimming and was afraid to try so high a jump.

It happened to be a rainy day and he watched the women carrying umbrellas. That gave him an idea. He started gathering material to make an umbrella of his own. He wanted a big one, the bigger the better. Finally the big umbrella was completed and he went to the edge of the tower and jumped off. It arrested his fall and he lit in the water and swam to the shore without being hurt. So far as the parachute was concerned the scheme worked perfectly. But getting away was another matter. He was caught and spent the rest of his life in confinement, a sad ending for one of the most useful inventors the human race has produced.

There were others about the same time who tried the same idea in different forms. The next one of which there seems to be a record is Sebastian Lenormand, a resident of Montpellier. In his first experiment he used two umbrellas, one for each hand. He jumped from a high tower and came down safely.

This exhibition came to the attention of Abbe Berthelon, professor of natural history at Montpellier, and he sent for Lenormand. They decided to conduct the experiment on a more scientific basis. Obtaining a large umbrella, about 30 inches in diameter, they called on animals for the dangerous part of the work. Tyeing some pigs to the umbrella they were pleased to see them descend safely to earth.

Next they made mathematical calculations to see how large an umbrella was necessary to hold a man. They decided one 14 feet in diameter was about right, including the heavy framework which must be strong to prevent it from breaking.

Using these specifications Lenormand built a parachute and jumped from the tower without injury. These two were the first to use the word parachute for the contrivance. It is a French word meaning something equivalent to the English counterfall.

One of the spectators at this exhibition was Etienne Montgolfer. He was much impressed with the idea and believed he could use it as a means of getting out of his balloon. Blanchard was also present and at once adopted the plan. He preferred to drop dogs, hens and rabbits rather than jump out himself. Lenormand was fortunate in the large number of important visitors he attracted to see his show. This is probably one explanation of the reason why he is usually given credit for the invention of the parachute rather than Lavin. One of Lenormand's noted visitors was Jacques Garnerin.

Garnerin liked the idea and stored it away in the back of his head while he went to war. In 1797 he was made a prisoner and held in Hungary. He may never have heard of Lavin's experience but he decided on about the same course. He employed some companions to bring him material for a parachute but they betrayed him to the prison guard and the plan was nipped in the bud.

At the same time another man named Drouet was held captive in a castle in Spielberg in Moravia. He took the curtains from his bed and made a parachute and in jumping from his window broke his leg when he hit the ground. He was captured so his efforts brought him nothing. Later the two were released.

In the first year after his release from prison, 1797, Garnerin, gave the first public parachute exhibition from a balloon. He went up about 3000 feet and cut loose. Attached to the parachute was a spacious cage and the man expected to float down to the ground as comfortably as he ahd gone up.

But the minute he cut loose the cage began swinging back and forth like a pendulum. It jerked and bucked and Garnerin lost the high silk hat he had provided for the occasion and the long tailed coat was almost shaken from his back. Long tailed coats and high silk hats were the proper dress for the aeronaut in those days.

Several times it looked like it would be the end of Garnerin before he hit the ground but he managed to hang on. He later gave many exhibitions and finally cut a hole in the center of his parachute for greater stability. He was government aeronaut for France for many years.

As the savage looked upon birds flying through the air with admiration, civilized man looked upon them with scientific interest and tried to figure out how they did it. But many scientists have produced very unscientific results when they approached a new subject. This was particularly true of those who studied the flight of birds.

When Hiram S. Maxim became interested in the subject about 1889 there were a lot of theories about how hard a goose had to work to keep up in the air. Maxim believed that most of these theories were so much foolishness.

Men who were otherwise good mathematicians told him that a goose exerted 100 horse power in its flight. Others, more conservative in their calculations, put the figure at 50 horse power. Still others, timid souls perhaps, who were afraid to venture into the full possibilities of mathematics, said a goose exerted less than one horse power.

But Maxim as he watched these birds couldn't convince himself that one goose was equal to as much as half of one horse. It doesn't matter so much how the men who figured a goose was equal to 100 horses came to their conclusions. History does not record a single instance of a scientist or philosopher who so much as expressed a willingness to trade 100 horses for a goose so there is some indication that the men who advanced the theory were not sure of themselves.

Those who were trying to convince Maxim that the power of a goose was but little less than that of the conventional horse power of 550 foot pounds per second had a very definite formula by which they reached their conclusions. If a goose fell, they said, he would fall at the rate of 38 feet per second. If the goose weighs 12 pounds this fall would equal 12 times 38 or 456 foot pounds of work per second. This is the amount of work that would be necessary to force a column of air against the bird's wings with sufficient power to hold him up. Therefore this was the amount of work any goose had to do to remain in the air. Dividing 456 by 550, the number of foot pounds per second for one horse power, they found that a goose exerts .83 horse power.

"But," retorted Maxim, "suppose your goose were sitting on a limb. No one would contend that it would take anything like that amount of power to hold him up."

As the goose moves from one section of air to another he is doing something very similar to sitting on a limb. He does not exert sufficient downward pressure on any one column of air to set up any great amount of motion in that air. Just as a skater can keep on top of thin ice by skating fast so the bird keeps on top of the air by moving through it quickly.

Maxim was inclined to agree with Professor Richard Procter, who advanced the theory that it doesn't take much more energy for a bird to fly than it does for an animal of equal size to run. Wings of a bird serve as an airplane to keep the creature in the air amd as a propeller to give it motion through the air.

Because birds flap their wings scientists of the latter part of the 19th century said any flying machine which was successful would have to do likewise. They contended that no flying machine could weigh more than 50 pounds because there is no bird which weighs more than that.

"If you made locomotives after the same theory as horses you would have machines weighing five tons which would go only five miles an hour," Maxim declared. "If we take advantage of mechanical possibilites in the locomotive why not do it in the airplane?" he asked.

He also scorned the idea that only wing flapping machines could be successful. In defense of the screw propeller he declared that it has a high degree of efficiency and affords an opportunity to use a large amount of force in a continuous manner without vibration or unsteadiness.

At the same time Langley was testing the action of air forces on planes and propellers at the Smithsonian Institution Maxim was building a testing device on his experimental grounds near London. This apparatus consisted of a revolving tower with an arm 31 feet 9.9 inches long, the radius of a circle 200 feet in circumference.

Planes to be tested were placed at the end of this arm which could be moved about the 200 foot circle at any speed up to 90 miles an hour. In these experiments he found that a wing of thin wood, 12 feet 10 inches long and 26 inches wide with the under side curved one-fourth inch, when placed at an angle of one to 13 and moved at a speed of 3500 feet per minute lifted 53 pounds. At the same time the push on the screw necessary to drive the apparatus was eight pounds while the push necessary to drive it without the plane was threee and theee-fourths pounds, showing that it required four and one-fourth pounds to drive the plane.

Maxim learned from these experiments that the best results are obtained when the angle is flat and the speed high. The maximum lifting power he was able to obtain was 250 pounds per horse power. He found that the planes worked at a speed greater than 30 miles an hour and apparently were most efficient at about 60 miles per hour. At this speed the best inclination seemed to be one in 14. He could carry 14 pounds for each pound of push on the propeller.

In 1892 Maxim wrote as follows: "If a thin pine board 20 feet long and two feet wide with the edges well sharpened, the bottom side being slightly concave and the top side slightly convex, be suspended in the air with the front edge one inch higher than the back edge and be driven with a two bladed wooden propeller 28 inches in diameter at a rate of 50 miles an hour we should find that it would carry approximately a load of 240 pounds and the power required would be 1.33 horse power, to which 20 per cent must be added for propeller slip." No man could visit any airport today and come away and write a better description of an airplane.

But scientific men thought that because birds flapped their wings flying machines must do likewise. Any other kind of a machine was regarded as visionary and foolish. In fact any one who thought a flying machine could be built was regarded as a little foolish. Consequently it was 11 years later before the first actual flight was made with a man-carrying airplane.

The thing that puzzled Maxim was the kind of a motor to use in such a machine. In those days the gasoline motor was in its infancy and could not be regarded seriously as a factor for an airplane. Also the electric motor was a thing subject to experiment and with its source of power carried too much weight, to be practical in an airplane. Consequently Maxim and his assistants returned to the steam engine. And the things they did with steam were worthy of notice.

They built an engine which weighed 640 pounds and developed 362 horse power or 1.76 horse power for each pound of weight. It had cast steel cylinders and a steam pressure of 320 pounds to the square inch. Steam to operate it came from a water tube, oil-fired boiler which weighed about 1000 pounds, so that the entire power plant weighed about three pounds for each horse power.

Maxim was determined to produce the best engine available for the construction of a flying machine. He was able to obtain backing to the extent of $100,000 and immediately set to work.

The machine he built had horizontal rudders forward and aft of the main plane. Inclined lateral planes could be attached to either side or left off as the occasion demanded. It was to be driven by 18 foot tractor screw propellers connected to the engine by a chain drive.

Weight of this gigantic airplane was 7500 pounds. It had a lifting surface of 4000 square feet and a propeller thrust of 2100 pounds. It was intended to make a speed of 38 miles an hour.

In order to test the lifting power without loss of control a circular track was built. This consisted of rails above and rails below. The plane was to run on the rails on the ground until it developed flying speed when the rails above would keep it from raising more than a few inches. By means of an elaborate set of scales and springs Maxim was to determine if the machine was properly balanced.

But when the three and one half ton of machinery started around the track it had so much lifting power that the axle on one of the wheels which was to hold it down was bent. With a crash the mighty flying machine , perhaps the first one actually built which was capable of getting off the ground, toppled over and was wrecked. Maxim estimated that it exerted a lifting power of approximately 10,000 pounds. But the men who had furnished the $100,000 had had enough of flying machines and Maxim was never able to make a second attempt.

Another of his contributions to the science of flight came through his work with wind tunnels. He built a square box of pipe through which wind was driven at a high velocity and this was used to determine the lifting power and resistance of model planes.

Little virtue was seen in the balloon by Maxim. He contended that very little had been achieved since the days of the Montgolfers and that very little was likely to be done. At that time the maximum speed obtained by power driven balloons was about five miles per hour and as the wind was usually blowing faster than that the balloon merely traveled with the wind.

Tremendous head resistance and great bulk looked to Maxim like difficulties too great to overcome. He felt that if a lighter than air machine was driven at a speed greater than that likely to be encountered in the wind it would be wrecked by pressure of the air.

Crushed in spirit and broken in body, Samuel Pierpont Langley, inventor and manufacturer of the world's first successful flying machine, gave up to the hoots and jeers of the mob and died February 27, 1906. Langley never lived to see it proven that his "airdrome" nicknamed "Langley's Folly" was actually capable of carrying its pilot in sustained flight, but he never doubted that it was.

While a boy he used to lie on the ground back of his home in Roxbury, Mass., where he was born August 22, 1834, and as the gathering twilight changed the day into night, contemplate on the stars above him. His first study was in the realm of astronomy and much of his contributions to science were made in this field.

From his early study of astronomy he turned to civil engineering and later entered architecture, a profession which he followed for seven years. But his interest in astronomy returned and he went to Europe for a brief period before accepting a place in the observatory at Cambridge. This position was followed by one at Pittsburgh which he accepted in 1867.

Lack of money seemed to be the great drawback of the Pittsburg institution and it was up to Langley to find a way to provide that money if his job as a director of the institution was to amount to much. As a result he started the system of time control now used on all American railways and familiar all over the country. Twice daily he sent out time signals by telegraph from the clock in the observatory and was able to make lucrative contracts with the railroads.

By 1873 he had completed a study of the sun's disk and invented the bolomoter, an instrument to accurately measure small amounts of heat. His experiments in connection with the spectrum upset the previous conclusions of scientists and showed new things about how the heat of the sun comes to the world and the effect of the atmosphere.

Like many other experimenters his first interest in the theory of sustained flight came from watching birds. His two papers, "Experiments in Aerodynamics," and "Internal Work of the Winds" give the results of his early research.

From 1887 until his death he was secretary of the Smithsonian Institution at Washington D. C. His first model was started in 1893 and made a successful flight of about three-fourths of a mile in 1896.

This machine was 16 feet long and weighed 30 pounds. Its tandem wings, set at a dihedral angle, were respectively 10 and 13 feet long. The model remained in the air for one minute and a half.

Two things were accomplished by the inventor by the success of this model plane. It inspired him to build a man-carrying machine and brought him $50,000 from Congress with which to carry on the work.

President McKinley at this time was interested in the possibilities of mechanical flight from a military point of view. Through the war department he induced congress to make the necessary appropriations for the experiment.

With the assistance of Charles M. Manley, the man who produced the airdrome steam engine, a machine which weighed complete with boiler and all, about two pounds to the horsepower, Langley started work. By the fall of 1903 he was ready to conduct his experiment.

Realizing that water offers a safer medium on which to light in case of accident Langley decided to launch the machine over water. But in preparing a launching device, a mechanical problem in no way related to the principles of flight, the genius of the inventor seemed to fail him. The device which he finally produced, might with some stretch of the imagination, be regarded as the forerunner of hhe airplane carrier at sea.

But to the onlookers along the Potomac river the houseboat, from which the airdrome was to take to the air, was the last word in comedy. They thought the houseboat itself was supposed to fly.

It was a tremendous production 40 by 60 feet in size. On it was a hanger for the plane, sleeping quarters for the crew and a workshop. On top was a turntable weighing over 15 tons. This held the plane and from it the machine could be launched in any direction so as to head into the wind without turning the entire boat around.

Langley chose one of the most remote parts of the Potomac and expected to conduct his experiments in secret. But in this he reckoned without the newspaper men. No sooner had he arrived at the place for the tests with his houseboat than hundreds of reporters and others curious to see the show swarmed around in small boats. Preparing for the flight was slow work and the newspaper men waited around for days during which it appeared there was nothing happening.

Then one day the airdrome was wheeled out of its shed and Manley mounted the seat and braced himself for the jar of the catapault which was to hurl the craft into the air. Many onlookers lined the shore at Liverpool landing and the reporters were busy with their notebooks.

With the propellers turning and engines purring the big machine was thrown forward. At first it looked as though it would take the air, but just as it was about to clear the deck something caught in a guy rope. The machine nosed down into the river and sank with a rapidity that was mistifying.

This was all the more amusing to the newspapers. Cartoonists and jokesters made great sport with "Langley's folly." Congress began to hear from the taxpayers for wasting $50,000 on such"foolishness."

Langley felt that he must make haste and justify himself or it would be too late. He made another attempt in December, with the same result. Manley was rescued from the river with great difficulty. It was too late. The money was gone and congress wouldn't give any more. The humor of the American people was aroused too much for that.

So one of the greatest of American inventors found himself classed with those who work on perpetual motion machines and identify themselves with Napeleon. His health failed rapidly until his death.

But over in Kitty Hawk, N. C., two young men were busy who didn't regard Langley as a fit subject of an insane asylum. A few days after the wreck of the airdrome they were in the air with a machine patterned on vastly different lines, but employing the same principles.

Wilbur and Orville Wright made a close study of Langley's work and declared it was a great help to them. Later when patent rights were involved they had some unkind things to say about the keeper of the Smithsonian museum who permitted another test of the airdrome, but they never denied the valuable work of its builder.

It was on May 28, 1914, that the airdrome was shipped to Glenn H. Curtis at Lake Keuka. He placed it on Pontoons and with the same old steam engine which had been in the museum for 11 years succeeded in making short flights over the water. With a more powerful engine the plane made a still more creditable showing. Langley's principles and construction were correct.

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