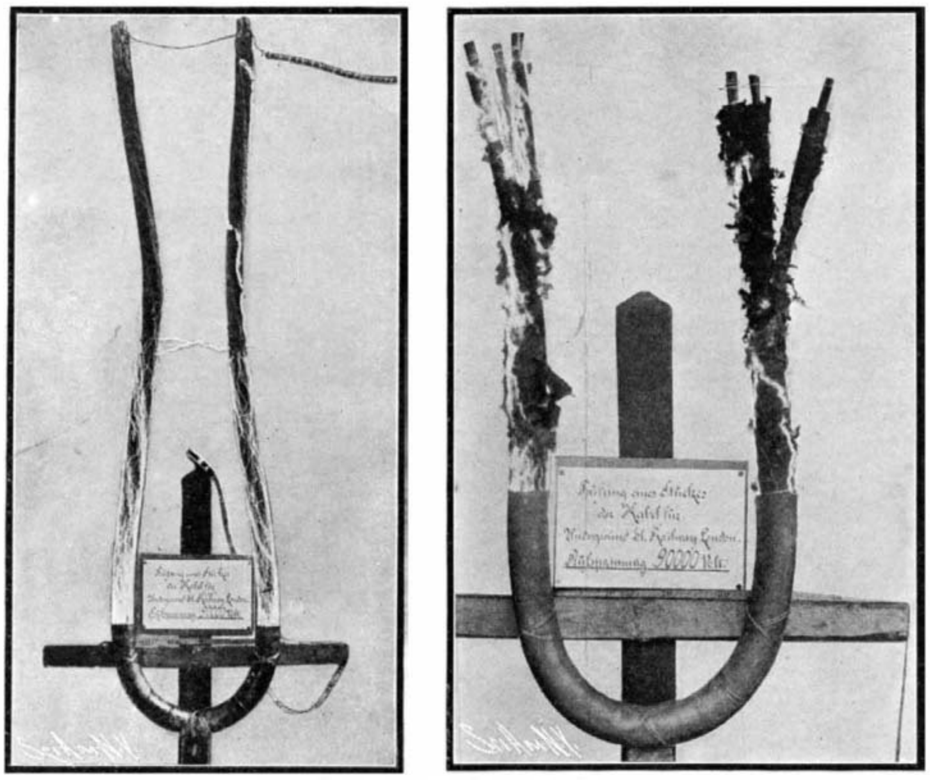
CABLES THAT WITHSTAND 90,000 VOLTS.

The distances to which the electric current is transmitted are continually increasing, and, with the distance, increases the tension of the current; but, with the tension, the insulating properties of conductors, and especially of cables, must also increase. Marked progress has been made in recent years in such insulation, and the best proof of this is the fact that some cables have recently resisted tensions of 90,000 volts. Such cables have been furnished by the Allgemeine Electricitäts Gesellschaft, of Berlin, to the Underground Railway Company of London. The cables are composed of three conductors, each having a cross section of 195 square millimeters. Each conductor is insulated by a layer of paper 11 millimeters (0.433 inch) in thickness, and the three conductors collectively are covered with a layer of paper 11 millimeters in thickness and an outer casing of lead. The diameter of the cable thus becomes 72 millimeters (2.834 inches). A cable of such length and thickness bent into a loop not exceeding five times the external diameter of the cable, should resist 33,000 volts. For testing the cables, the three conductors were placed under tension and the lead casing was grounded. The insulating material was not pierced at 90,000 volts. Some previous experiments showed that the upper layer of the insulator becomes heated so strongly and so instantaneously that the surface of the paper that covers the cores is torn, and that the tension does not pierce the insulation between the lead and the conductors. Paper is therefore an excellent insulator, but has the drawback of causing a loss of flexibility in the cable when the insulating layers have to be thick. This trouble has been remedied by adding to the material with which the paper is saturated a larger quantity of thick oil. The cable thereby becomes more flexible and the insulation still more efficient.



CABLE SUBJECTED TO 90,000 VOLTS TENSION.

THE PROGRESS OF AVIATION SINCE 1891.

Since 1891, when Lilienthal, after twenty years of calculation, experiment, and observation of soaring birds, made his first flight of 15 meters, aviators have been in possession of a method. The main difficulty is to start, as the aeroplane cannot be floated without considerable initial relative velocity. This Lilienthal acquired by running down hill against the wind. Between 1891 and 1896 he made more than two thousand flights, some of which exceeded 100 meters. If the wind freshened during the flight he was lifted, sometimes higher than his starting point, and could prolong his flight. He landed easily by raising his wings, as birds do, to check his forward motion. He omitted the motor as useless at the first stage, for he adopted the process of evolution and chose as his first model, not the intricate flight of the most adept fliers but the soaring of species like the flying-fish and the grasshopper, which are learning to fly.

Lilienthal proved that a slightly convex surface of 20 square meters, inclined from 7 deg. to 10 deg. to the wind and moving against it with a relative speed of 10 meters per second would sustain a total weight of 100 kilogrammes. He showed, too, that the problem of equilibrium is more difficult than that of motive power. The aviator, like a bicyclist or a soaring bird, is constantly engaged in regaining his lost equilibrium. Lilienthal did this by thrusting out his legs forward and laterally. In this unnatural exercise he acquired great skill which, however, did not prevent his falling to his death in 1896.*

The first of his followers, the Englishman Pilcher, used a similar apparatus, but raised it like a kite by means of a rope to which swift horses were attached. When high enough he gradually bent forward, loosed the rope and swooped down like a crow alighting in a meadow. He was killed in an attempt made in a storm in 1899.

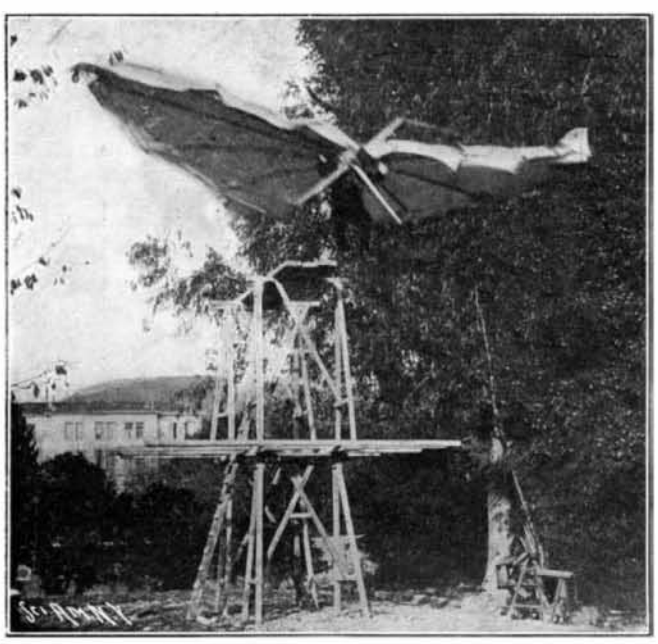
In 1896 Chanute, of Chicago, who had studied the theory of aviation and published an exhaustive history of the subject, made, with his assistants, Herring and Avery, a practical trial of the Lilienthal type of machine, but soon abandoned it on account of its instability and returned to his own plan of making equilibrium automatic by the use of several surfaces. In such an arrangement inclination forward causes increased pressure on the upper while inclination backward has a similar effect on the lower wings, the result in either case being to right the vessel. At first Chanute used five pairs of wings, but his final model contained only two parallel surfaces and resembled a Hargrave† kite moving sidewise. An elastic tail‡ favored equilibrium by increasing the moment of inertia and keeping the head to the wind.

(*Continued on page 262.*)

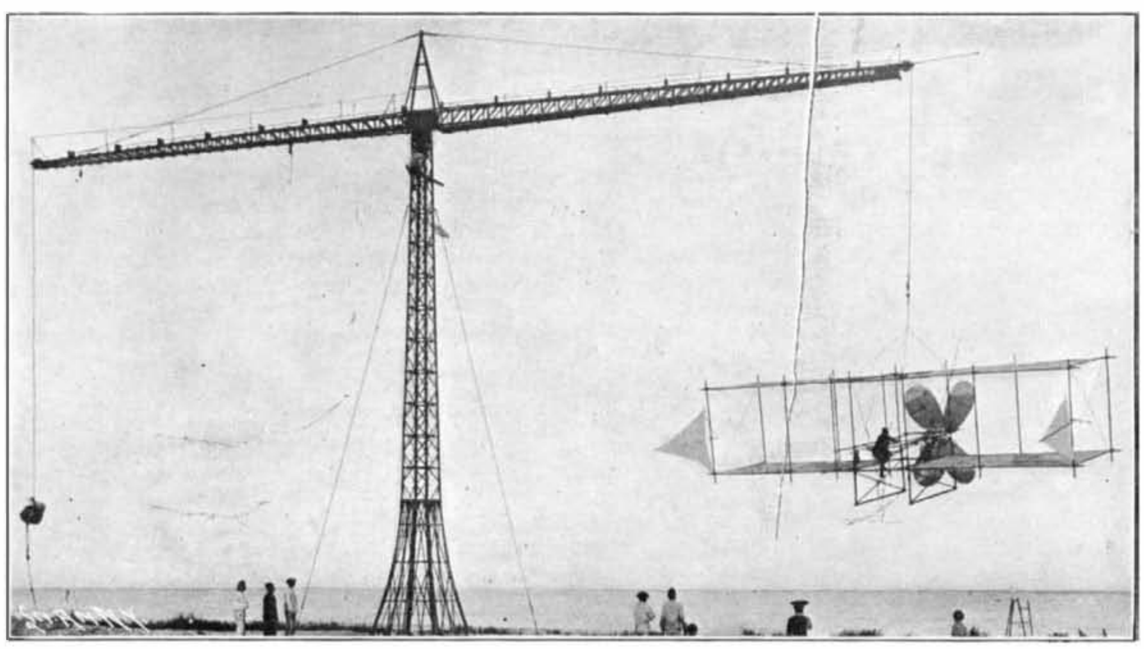
* Le Bris, a French sailor, derived from his observations of the albatross an idea identical with Lilienthal's. Adopting Pilcher's kite method of starting, he made some attempts in 1867, but poor success, accidents and lack of money forced him soon to abandon his experiments.

† L. Hargrave, of Sydney, Australia, inventor of the cellular kite and more than a score of successful aeroplane models.

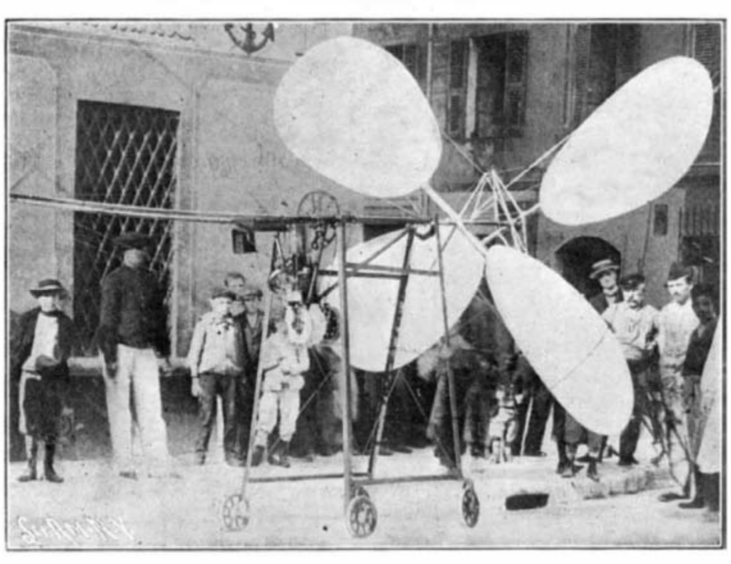
‡ Pénaud, in 1871, invented the first successful aeroplane with a flexible tail. He died in 1880 at the age of 30.



Capt. Ferber's Aeroplane No. 4.



Capt. Ferber's Aeroplane No. 6 Undergoing a Test.



The Motor and Propeller of Aeroplane No. 6, designed by Capt. Ferber.

A Flight That Ended in a Fall Because the Wind's Direction Had Not Been Considered.

THE PROGRESS OF AVIATION SINCE 1891.—CAPT. FERBER'S EXPERIMENTS.

note that the tire is mounted on what appears to be the usual steel clincher rim. As far as the bottom and inside edge of the rim is concerned, this is correct, though the flat face of the rim has a small groove in it near its outside edge. The outside clincher ring is entirely separate from the rim, and it too contains a groove on its outer edge that matches the groove in the rim, being nearly opposite it when the tire and clincher ring are in place. As soon as this is accomplished, all that is necessary to secure the tire is to crowd it against the inner clincher ring sufficiently to allow of inserting the light locking ring in the rim (see Fig. 2). This ring is of the special cross-section shown in Fig. 1, and when the tire is inflated, it takes all the side pressure exerted by the inner tube and casing upon the outer clincher ring. If the tire is deflated, the weight upon it will, it is claimed, still keep the ring in place. The outer surface of the locking ring is flush with that of the clincher ring, there being no projections to come in contact with the curb, nor any crevices or openings through which dirt or water can penetrate. Rims of this type can be fitted to any wood wheel and can also be adapted to any style of clincher tire. Besides being extremely simple in construction, this form of attachment offers the great additional advantage that no tools whatever are required to remove an inner tube. This of course can be done in a minimum of time and with practically no exertion, by pressing in on the deflated tire and removing the split locking ring (Fig. 2), whereupon the clincher ring will come off and the tube can be removed (Fig. 4) or the complete tire be taken off (Fig. 3) if necessary.

The new rim has been tested by the inventor on a heavy touring car throughout the past year, and has been found to work satisfactorily. That it will be a boon to automobilists, to whom the repair of tires by the roadside is one of the greatest drawbacks of the new locomotion, is obvious to all.

THE PROGRESS OF AVIATION SINCE 1891.

(*Continued from page 260.*)

Hundreds of "gliding experiments" were made without accident in 1896-7, the longest flight being 109 meters with a descent of 10 deg. The equilibrium was so nearly automatic that the aviator never had to move more than 60 millimeters.

In 1900, on the dunes of Kittyhawk, N. C., the brothers Orville and Wilbur Wright began their experiments with a Chanute or two-surface aeroplane, but replaced the long and awkward tail by a horizontal rudder at the bow,* and lay on their faces to lessen air resistance. Two assistants ran with the apparatus against the wind unless the latter exceeded 8 meters per second, when a standing start could be made. The machine rose, recoiled a little, then, answering the helm, set itself parallel to the slope and glided forward. On reaching the bottom of the dune it rose slightly in obedience to the rudder and, its speed being thus checked, alighted like a bird. In 1901-2 the Wrights made hundreds of flights, some of 300 meters. In 1902 they added a vertical rudder at the stern and flew in curves. Finally, in 1903 they succeeded in hovering over one spot by rising with a brisk and variable wind, gliding forward when it lulled and drifting backward and upward with each gust. They hovered for 72 seconds without advancing more than 30 meters.

This result rehabilitates the scattered minority that for forty years has contended that certain birds remain aloft without exertion. It is now certain that this occurs with ascending air currents. Such currents are common in the mountains, and so are soaring birds, but neither is found on the plains. There is a certain analogy between a sailing vessel and an aeroplane. The former tends to approach a definite vertical, the latter a horizontal plane. These skillful experimenters sailed within 6 deg. of the horizontal—doing almost as well as vultures—and they hold in their hands prompt and complete realization of flight.

In December, 1903, they began to experiment with a machine of 50 square meters surface and 12 meters breadth, weighing 338 kilogrammes and having astern two screws driven by a 16-horse-power motor. Starting on level ground from an inclined monorail they made four flights, the longest of 59 seconds at a speed of 16 kilometers per hour relatively to the ground. December 17, 1903, marks the date of the first real flight of a manned flying machine and the honor of this memorable achievement belongs to the Wrights.

The French newspapers having spoken of Lilienthal's apparatus as a "parachute," it was not until 1898 that I learned its real nature from an old copy of the Illustrirte Zeitung. Convinced that Lilienthal had discovered, if not the art of perfect flight, at least the way to learn to fly, I determined to follow his method. My first model, whose length exceeded its breadth,† was dashed to pieces at the first trial. The second, flown as a kite, proved unstable. No. 3, with 15 square meters surface, 7 meters wide, and weighing 30 kilogrammes, proved unable to sustain my weight. No. 4, of the same weight and area, but 8 meters wide, was launched in 1901 from a scaffold 5 meters high. It landed gently after a flight of 15 meters, which occupied two seconds. Similar results were obtained from further experiments, but the stabilty was still unsatisfactory.

Then I entered into communication with Mr. Chanute and finally adopted his two surfaces, chiefly because they double the sail area for a given weight and allow the frame to be stiffened like a truss bridge.

My aeroplane No. 5 was of the Chanute-Wright type (weight 50 kilogrammes, width 9.5 meters, length 1.8 meters, sail area 33 square meters). Its first flight, in 1902, was 25 meters, its second 50 meters. Its chief defects, marked lateral deviation and sudden landing due to insufficiency of the rudder, were avoided in 1903 in a slightly smaller machine with two lateral horizontal rudders acting as a keel. This machine, when flown as a kite, exerted a horizontal pull of 20 kilogrammes, whence it was inferred that a screw traction of this amount would keep it afloat.

Then I bought the lightest motor then obtainable, a 6-horse-power Buchet, weighing 39 kilogrammes alone and 90 kilogrammes with its accessories and the twin screws—the last made necessary by the dangerous torque introduced by a single screw. To favor equilibrium by increasing moment of inertia I put all the machinery at the bow and balanced it by the weight of the aviator at the stern. At the rate of 1 horsepower for 50 kilogrammes,* which has been found sufficient for the Chanute type, my motor should drive an aeroplane weighing 300 kilogrammes which, again, should have a sail area of 50 square meters to agree with the ratio of surface to weight observed in large birds. This area was divided into two surfaces 10 meters broad, 2.5 meters long, and 2.5 meters apart. The total weight of the aeroplane (No. 6), allowing 75 kilogrammes for the aviator, was 230 kilogrammes.

Though this marks a record of lightness it is still too great for the methods of starting previously employed. Every aviator has been confronted by this problem of starting. Lilienthal used an artificial hill 15 meters high, Pilcher a kite cord, Langley a catapult, Eiffel proposes to stretch an inclined wire from the first story of his tower, Goupil suggests a circular railway, Bazin has patented an aerial merry-go-round. Though the last introduces centrifugal force, it permits the safe study of continued flight.

So I constructed a 30-meter cantilever pivoted on a pillar 18 meters high and hung the aeroplane over it by a cable having a counterpoise at the other end. I found the maximum traction of the screws, 20 kilogrammes, insufficient for flotation, but military duties postponed the construction of new screws until 1904.

Prof. Langley is not of the school of Lilienthal. After some remarkable experiments on air resistance he proceeded at once, like Maxim and Ader, to construct a complete aeroplane. In 1896 he made the record for unpiloted models with a flight of three quarters of a mile (1,200 meters).†

In 1903 he built a machine large enough to sustain a man's weight which, with Prof. Manley aboard, was projected by springs from a barge and fell into the Potomac after a flight of 30 meters. According to the Scientific American this failure was caused by starting at a wrong angle owing to a defect in the catapult. But why did not the machine right itself? Either because the rudders were insufficient or because Prof. Manley, untrained by previous experience, did not operate them promptly. Here again we see the genius of Lilienthal in mastering equilibrium before attempting propulsion. But the failure is only temporary. Prof. Langley, aided by the government, will correct defects. Prof. Manley will acquire dexterity, and the aeroplane will fly.

In conclusion, I will mention the machine recently constructed at Chalais-Meudon for M. Archdeacon. It is of the Wright type with planes 7.5 meters broad, 1.44 meters long, and 1.4 meters apart, a total surface of 22 square meters, and a weight of 34 kilogrammes. It has a horizontal rudder in front and a vertical one behind. Experiments made with it on the aerodrome by M. Voisin and myself are herewith illustrated.—Abstract of a paper by Capt. F. Ferber in the Revue d'Artillerie.

* Birds use their heads as rudders for small and sudden changes, their tails for large ones only.

† Experience proves that a rectangle moving parallel to its shorter side has more sustaining power than a square of the same area, probably because it meets a greater number of fluid filaments. The rear element of the surface seems to have little effect except to increase friction.

* Wright has increased this to 75 kilogrammes. This is a good sign.

† In the same year MM. Latin and Richet launched, near London, a very remarkable model driven by steam which made a flight of 200 meters.

Several minerals contain thoria. The mineral supposed to be uraninite or pitch-blende proves on complete analysis to be a new mineral, which it is proposed to name thorianite. This mineral is one of the richest known in the rare earth thoria, of which it contains more than 75 per cent, uncombined with silica, and is of very considerable value and commercial importance.

Correspondence.

Some Weather Observations.

To the Editor of the Scientific American:

The article "Grandfather's Barometer," in issue of March 4 contains much truth.

These signs and omens originated when the people lived in the country; their observations covered great distances and it was almost obligatory on them to watch the weather. Those who live in the city are unable to note these signs and are therefore inclined to ridicule them.

Having left the city for the country many years ago, I have observed closely the weather and have noted the following. No. 1 I have found almost always correct, and were one situated so as to be hourly cognizant of the temperature and the force and direction of the wind over a large territory, as is the Washington weather bureau, I believe it would prove invariably so. It applies in this locality from about October 1 to May 1.

1. Double the hours or days from the clearing of a storm to the next calm period; the result will enable one to foretell very closely the coming of the next storm. The sooner the calm, the sooner the storm.

2. When the sun sets between dark banks of clouds with a yellowish red cast, and appearing (to me) like an evil eye, there will be a heavy southeast storm the following day.

3. The same general appearance when the sun rises, but with a reddish yellow cast, is shortly followed by a heavy easterly storm.

4. Long and narrow clouds in the west late in the day, having the appearance of condensed fog and below dark banks of clouds, is an almost sure sign of storm the following day.

5. When the electric lights of the city, viewed from an elevation in the suburbs, scintillate with a peculiar diamond-like brilliancy, a storm shortly follows.

There are other indefinable signs, whereby, like a sixth sense, one can foretell the approach of a storm or the clearing away of a present storm.

I trust these observations will be of value. L.

Worcester, Mass., March 8, 1905.

Astronomical Anomalies.

To the Editor of the Scientific American:

In the English Mechanic of Nov. 4, 1904, under the heading "Astronomical Anomalies," Mr. Fred G. Taylor (letter 345, page 299) presents four queries, with the request that he be helped in his "difficulties"; and as I now have in preparation a book to be entitled "Facts and Fallacies of Astronomy," containing numerous questions for astronomers to answer, and illustrating the errors to be found in various textbooks on the subject, I was much interested in his communication, having given considerable attention to the "contradictions" mentioned by him. Well may we exclaim with the late and lamented Prof. Proctor: "It may well be questioned how far it is just that those who have still so much to learn should undertake to write textbooks of science."

The exact time of the earth's rotation as given in Lockyer's "Elements of Astronomy," to which the above-named writer refers, is of course wrong, and should be 23 hours, 56 minutes, 4.09 seconds. But Lockyer's book, a copy of which I have had in my library for many years, contains other errors equally glaring and surprising, coming as they do from one who is supposed to be an authority on the subject, and in my forthcoming volume I refer to many of his statements which I have corrected and explained. All the queries included by the writer mentioned are important and deserving of attention, but I was particularly interested in query No. 4, in which he says: "Sir Robert Ball, in 'Starland' and elsewhere, says that by looking up a vertical shaft—that of a coal pit for example—the stars may be seen during the day. Maunder, in 'Astronomy Without a Telescope,' chapter 8, treats the statement as an unproved tradition. Again, which is correct? The above are samples of the contradictions frequently met with. If astronomy be an exact science, why in the books mentioned do we find such contradictory statements?"

The belief seems to be widespread, and generally accepted by the public, that the stars may be seen in the daytime from a deep well, shaft, or pit, and it is mentioned as a fact by many popular writers, while others equally well known and eminent treat the belief as a fallacy. In many textbooks and other writings on astronomy the statement is made that stars are visible even at midday from such localities, some going so far as to claim that they may be seen in the tube of any large telescope from which the lenses or mirrors have been removed. As I have never had an opportunity to view the heavens under the conditions mentioned, I am not able to verify the statements from personal observation, and cannot, so far as my own knowledge is concerned, say whether they are true or