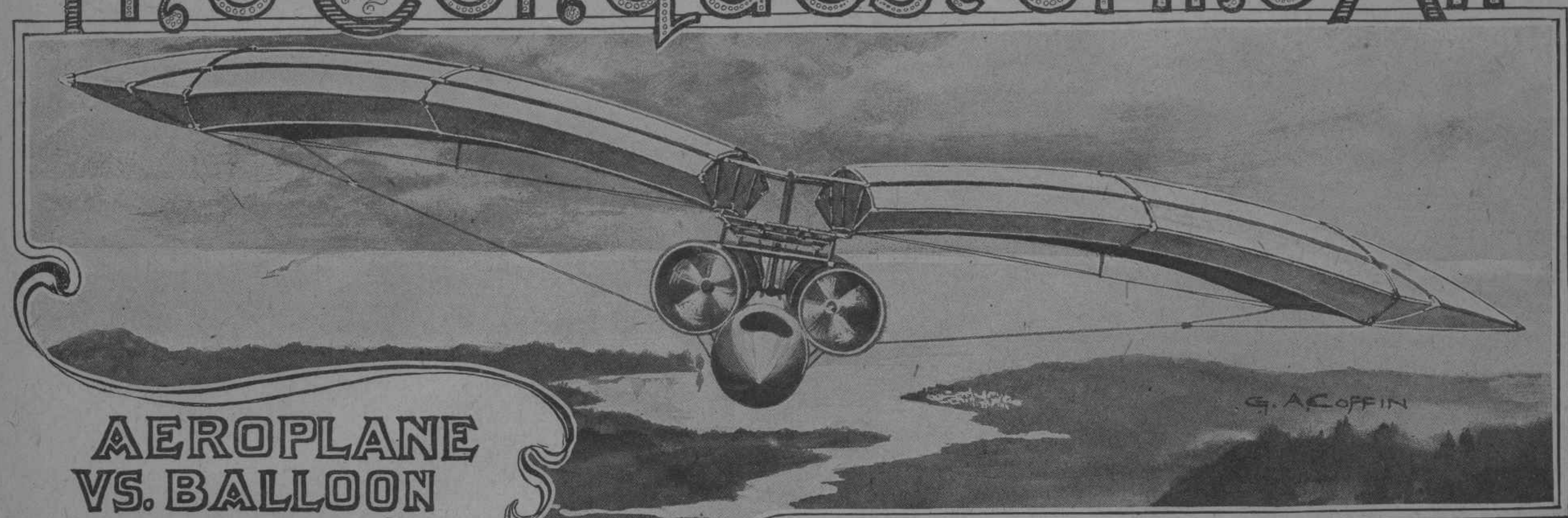
The Conquest of the Air



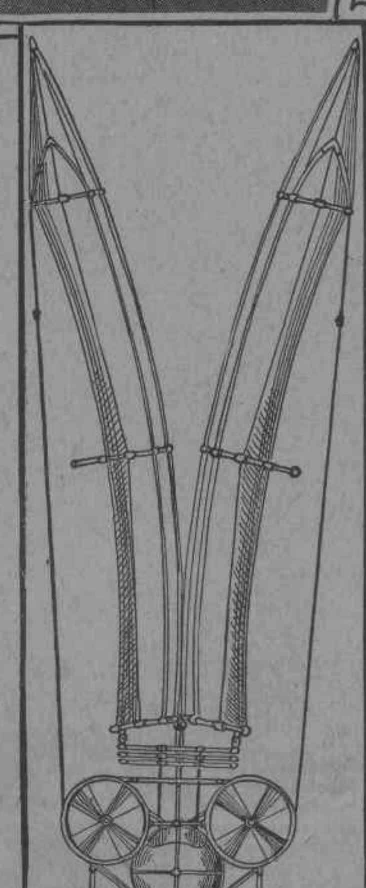
FRONT VIEW OF AIRSHIP IN FLIGHT

AEROPLANE VS. BALLOON

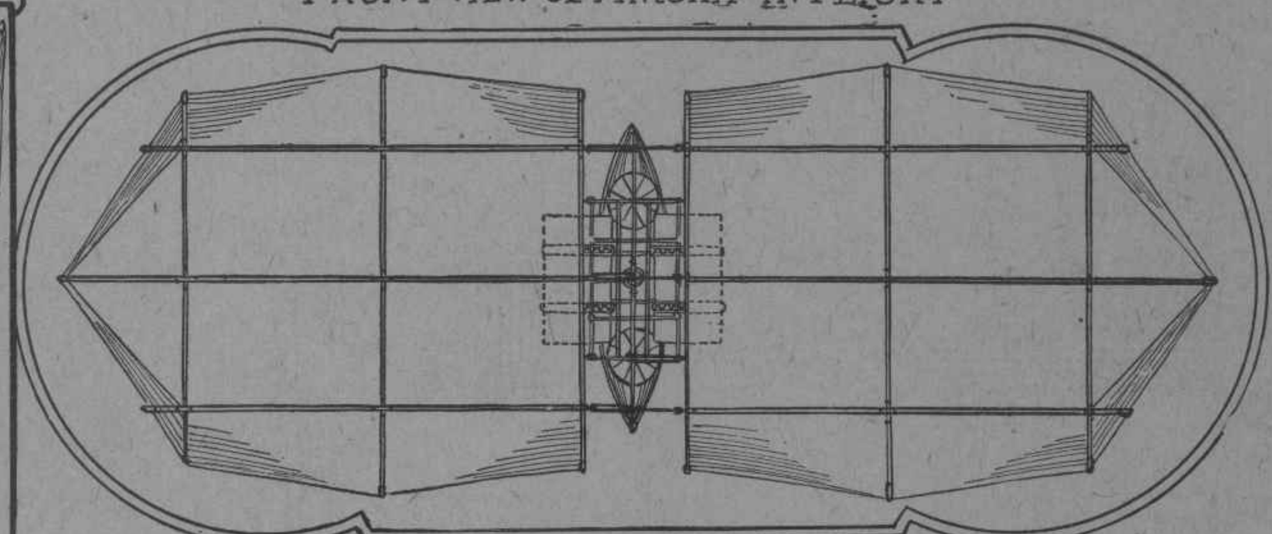
PROFESSOR LANGLEY'S EXPERIMENT

ENGINEER BESKOW'S AIRSHIP

THE LESSON OF THE KITE



FRONT VIEW OF AIRSHIP WITH WINGS ELEVATED



VIEW OF TOP OF AIRSHIP WITH WINGS EXTENDED

THINK of the day you will be able to step from the door of your home in some distant part of Long Island or along the Hudson, strap a pair of wings to your shoulders and a half hour later alight, like a pigeon, upon the window sill of your office, sixteen or more stories from the sidewalk. You will open the window of your office with a key, undisturbed by the rustle of many broad wings, for broker, banker and clerk are pouring from the heavens to the busiest mart of the world. Who shall say that this condition will not exist before the world shall have passed many milestones on its eternal journey?

In the light of recent discoveries in electricity and the development of powerful, yet light, electric and gasolene motors, the spectacle of the skies being swept by countless silken and canvas wings is not beyond the realm of possibility. Governments are experimenting with huge dirigible balloons, with a view to navigating the air, just as they plough through the seas with their machines of war.

In the construction of the airship that will become practical there is yet a decision to be reached. Will the flying machine of the future [illegible] filled with gas and a motor to drive it on its course, or will the theory of generations that if men live above the earth they must do so with the aid of wings, as fly all birds, determine the conclusion of this problem? Must the air car be heavier or lighter than the air?

Scientists of many countries are more active and determined in their experiments to-day to solve the puzzle of aerial locomotion than ever before. The success of Santos-Dumont in Paris with his numerous balloons, which obeyed his will in many trying voyages, has set many minds to working upon this problem, and hardly a week passes in which there is not advanced some new theory.

The possibilities of a navigable vessel of the air, not only as a means of national defence, but to serve commercial interests, cannot be foretold. The evolution of kites has solved many a vexing problem, as W. R. Kimball explains in an accompanying article. There are many active minds engaged along this line.

Next summer at the St. Louis Exposition airship and aeroplane will contest for $100,000 in prizes. The contestants will represent several countries. Many models of these ships, now held in secret in several parts of the world, will be embodied in huge balloons and flying ships.

Professor S. P. Langley, down on the Potomac, has been sending a great winged machine through the air at terrific speed. This scientist has, as yet, failed to divulge the secret of his machine, only meagre reports and less accurate descriptions coming from the isolated section in which the professor and his associates were at work.

A newcomer in the field of airship construction is Bernard Beskow, a civil engineer, residing in New York. From the plans of the invention with which Mr. Beskow intends to compete for the rich prizes at St. Louis, this airship is a distinct departure from models that have been shown.

It is an aeroplane much after the appearance of the machines with which successful flights have been made, but he combines wings and the use of gas in an ingenious manner. Mr. Beskow makes the bold statement that his aeroplane will fly and that he intends to sail it above the housetops of New York before many moons have passed. The inventor does not seek to hide any of the details. He tells the story of his ship in plain words.

My Aeroplane Air Ship Will Fly.

BERNARD BESKOW.

MY ship will fly. I will sail it over New York, and at the St. Louis Exposition I shall make a great endeavor to win the prize. The principal object of this invention is to provide means by which the supporting surface of the aeroplane can be easily varied to suit different purposes, as, for instance, to offer the slightest possible resistance to the air when the ship is in action and to give the largest possible supporting area when the ship is floating in the air.

A further object is to provide the airship with a practical and effective steering apparatus, and means by which to operate the same. The framework for the aeroplane will be strong, and it must be to support the forward impelling and steering apparatus.

I will make one point emphatic before I go any further. The direct ascension of my airship, although "heavier than the air" when under full flight, is accomplished by discharging a certain weight, this making the airship "lighter than the air" at the moment of ascending. The weight discharged is attached to the body of the ship by means of wire ropes, and these weights are suspended at equal distance from the centre, so as not to disturb the equilibrium of the ship when they are loaded or unloaded.

When the ship rises the screw propellers are able to find undisturbed columns of air against which a pressure can be exerted. The weights are then taken aboard the ship, which is now "heavier than the air." It is now a huge kite sustained in the air on the same principle of the kite, i. e., the relative velocity between the aeroplane and the air, and the pressure of the wind against the aeroplanes is used to sustain the dead weight of the airship.

Argument Against the Balloon

My argument against the balloon in its present state is that it presents an immense surface to the wind and is easily swerved from its course unless the current of air is dead ahead.

The aeroplane constructed on the lines of the wings of a bird offers little resistance from any direction, and enables the aeronaut to navigate the air more or less in the manner of a sailing vessel.

My airship combines the virtues of the aeroplane and the balloon. Why, you ask? The wings of my machine are filled with gas. The body is hollow, a cigar shaped structure with cells for the gas, which would not be noticed when the big machine is sailing through the air. But it is a help in sustaining the weighty vessel.

As far as I have studied there has always been some difficulty in arranging for the return of the aeroplane to terra firma. How can danger be avoided? When an airship settles to the earth it must be done gradually. My aeroplane is so constructed that with the folding of the wings the big ship will settle prettily and with hardly a jar. The aeroplanes, you must know, fold compactly and at the direction of the man who controls the machine. I claim many new features for my ship. Here are some of them:—

The aeroplane being heavier than the air, and without having large surfaces exposed to the action of the wind, it will escape the buffeting accorded a balloon in the wind.

Its stability is the best, as the centre of gravity is as low down as possible.

The action of the wind upon the aeroplanes is similar to the effect suffered by a bird in its flight—i. e., the aeronaut can direct my machine against the strongest wind and by means of the deflection of the aeroplanes can descend and ascend according to will.

Direct ascension is possible, no previous running of the flying machine being necessary.

There is no danger of accident in case of a break in the machinery of the motor or in case of a puncture or leak in the gas holding cells, as the dimensions of the aeroplanes are sufficiently great to counteract the gravity of the dead weight and to allow the airship to descend quietly to the ground.

No castout filling and refilling of the gas cells is necessary. Safety valves are provided to prevent the bursting of the cells.

The folding of the aeroplane enables the aeronaut to descend as rapidly as he desires and with safety.

The complete collapse of the aeroplanes reduces the space occupied by the machine when it is ease.

Here are the dimensions of my areoplane:—

Length, 50 feet; width, 40 feet; depth, 5 feet.

Body or ship—Length, 28 feet; diameter, 7 feet.

Screw propellers, 6 feet; pitch, 11 feet.

Net area of each propeller, 27 square feet.

Revolutions per minute, 1,000.

Supporting surface of both aeroplanes, 3,264 feet.

Engine, thirty horse power.

Kite Foretells Success of Air Ship.

WILBUR R. KIMBLE.

FROM a laboratory point of view the problem of aerial locomotion is solved. The most convenient forms of aeroplane are the various types of tailless kites brought to a high state of perfection in the last few years. The commendable work of the Weather Bureau in 1896 marked an epoch in the development of the kite and gave a strong impetus to scientific research in this direction.

The statement by Professor Bell to the effect that a successful airship will behave as a kite when anchored to the earth and conversely and that an efficient kite will serve as a model for an airship bids fair to be realized. The thinkers devoted to this subject have practically come to the conclusion that the commercially successful airship will have no gas bag, and that it will, in fact, be heavier than the weight of air displaced. They recognize in the improved tailless kite an airship pure and simple that only awaits the attachment of a suitable motor. The various successful devices for soaring or sailing are in reality a reproduction of a portion of a kite surface.

It will be observed that ordinary kites develop notable features. First, the centre of gravity rises from some point in the string to a point somewhere within the space circumscribed by the outlines of the kite's framework, whether single plane or multi-cellular. The apparatus will then be more sensitive than before, but when balanced its swaying and diving proclivities for the most part disappear.

Making use of the parallelogram of forces of mechanics and applying it to the distribution of pressure about the surface of a kite furnish a simple and accurate method of studying kite phenomena (Fig. 2). Allowing the two adjacent sides of the parallelogram to stand for the horizontal pull and the vertical lift, it will be found that the line of motion will be along the diagonal in direct line with the kite string.

Dropping into the technique of the subject, the horizontal pull, or thrust, in the case of an airship, we will call the "drift," and the vertical lifting force the "lift." The ratio of the two to each other will express the true efficiency of the apparatus at a constant speed.

Diagonal of the Joint Forces

As the diagonal of the joint forces always meets the kite surface at right angles to the surface at that point, the parallelogram may be drawn at any time by letting fall a perpendicular from the junction of the diagonal and the kite surface and extending a horizontal from the same point at right angles to the perpendicular. Right lines from this horizontal and perpendicular to a second point lower down on the diagonal will complete the figure (Fig. 3). The horizontal line will mark the angle of incidence of the air current with the kite surface, and the smaller the angle of incidence the greater the lift in proportion to the drift and the higher the efficiency of the machine.

It is obvious from the foregoing that the string will take up a position representing the diagonal of the parallelogram of forces, the horizontal component of which stands for the pressure of the air current and the vertical for the relative weight of the kite and its load. The nearer an absolutely vertical position is reached and maintained by the kite line the greater the difference between the lift and the drift and the higher the efficiency of the kite running free.

While an increasing load lowers the efficiency of the lift, it may be restored by a comparatively small increase in speed. Increased speed within wide limits increases the leverage efficiency, and also increases the ratio of "lift" to "drift," and lessens the necessary area of sustaining surface as the square root of the velocity in feet per minute. The power required to drive the apparatus increases as the cube of the speed, and hence for high speeds the weight of the motor in pounds per horse power per second becomes the most important factor.

It is here shown that as the speed decreases the weight of the motor may be increased till the ordinary commercial types of gasolene or steam motors, weighing twenty to fifty pounds per horse power, become available. As the "drift" and the "lift" correspond to the sine and cosine of an arc, it follows that for an angle of fourteen degrees from the vertical the ratio of the "drift" to the "lift" would be roughly 24 to 97, or one to four, and a leverage efficiency of seventy-five per cent. In other words, were the kite line to be divided into two strands and one carried forward to a horizontal position, a pull of one pound on this line would support the kite and added load sufficient to make up four pounds dropped vertically from the other half of the divided kite line.

When the kite line is released to a distance of forty feet or more it begins to assume the form of a catenary under the influence of the force of gravity and the pressure of the air currents. The curve deepens with increasing length of line till the angle of the line no longer bears much relation to the efficiency of the kite itself.

Principle of Leverage.

Deductions from these data are of considerable importance because they demonstrate that a pressure or a pull of one pound properly applied will hold six pounds or more in the air. The principle involved is analogous to that in a lever of the second class. When weights are added and the kite is made to do work phenomena appear somewhat different from those when it flies free, mainly because of the formation of a new centre of gravity at an increased distance from the centre of pressure, which greatly increases the stability of the apparatus.

For developing the greatest lifting power in the kite the load should be arranged at a point directly in line with the flying string. Apparently the most stable point in conjunction with high efficiency is where the kite string is fastened to the hanger. Supposing the hanger to be properly arranged and adjusted, the movement of the load toward the rear tends to lower that end and throw the forward end upward, thus increasing the area of the sustaining surface exposed to the action of the air, resulting, however, in a loss of lifting efficiency, unless the wind speed is increased to restore the original angle of incidence.

With a lessening of the speed of the current the body of the kite drops backward, as shown in figure 7, until sufficient cross section of the wind stream is covered to re-establish equilibrium. This kite is therefore automatic in a large degree. The pressure against the kite surface varies directly with the area of the cross section of the stream of air deflected and with the square of the velocity of the wind or speed of the kite through the air. It is evident that if the kite is advancing through the air its speed should be added to the wind speed, and deducted if losing ground.

When the load is carried forward of the centre of air pressure the lift tilts the kite forward, spilling some of the wind, and with the lessened support the apparatus, properly balanced, will start off down an inclined plane of air on a journey back to earth and against the wind.

This manoeuvre may be repeated at will by a simple rigging, which consists of a pulley attached to the hanger at the point where the string is usually fastened, and then running the kite string from the forward tip of the kite down through the pulley to the operator.

The weight, of about twenty ounces for a six foot kite, varying somewhat with the strength of the wind, should be fastened to the new or second hanger a distance of six or eight inches from the pulley and sufficiently far from the kite tip to leave a little slack when the weight is drawn up to the pulley. It will be readily understood that as long as the tension necessary to hold the kite in the air is maintained on the kite string the weight will be held closely to the pulley, as in figure 7, when, all the forces being in equilibrium, the apparatus seeks and holds a position at the greatest altitude permissible by the length of line and the general efficiency.

Like an Airship.

With the kite well up in the air (Fig. 8) a quick release of the tension on the line lets the weight fall forward and away from the pulley by force of gravity a distanse gauged by a knot in the string. The shifting of the load thus forward turns the kite into an airship, sailing forward with the flying line slack and under its own steam, the kinetic energy stored when the kite and weight were raised aloft (Fig. 9). In this instance the weight of the kite was seventeen ounces and the load was of iron and lead weighing nineteen ounces, or a total of two and a quarter pounds.

If, now, a third hanger is fastened to one tip at the side of the kite (Fig. 9) the other end of the string tied to the weight in such a manner as to divide the load when the tension is released on the main line, the weight will swing to the side, as well as forward (Fig. 11), and the kite will circle to the right or left, according to the position of the weight, making many turns in its spiral path before reaching the earth.

When balanced in the air by a strong breeze and the angle of incidence reduced till the flying line assumed a horizontal position, thus measuring the "drift," the pull on the string dropped upon one occasion as low as six ounces (Fig. 12), with a total weight of thirty-six ounces. The ratio of "lift" to "drift" in this instance was six to one.

The latest data on this subject refer to the little Santos-Dumont No. 9, recently completed and successfully operated in Paris. The most interesting point for the purposes of the present discussion is that an air thrust of about sixty-five pounds was obtained with a three horse power motor, which, with only a ratio of "lift" to "drift" of five to one in a properly constructed aerodrome, would support 325 pounds, or a weight greater than the Santos-Dumont No. 9 and its operator combined. A reference to the curve in Fig. 4 shows that still better results may be expected at the slow speed of about sixteen feet per second, at which the Santos-Dumont No. 9 was designed to be operated.

Sixteen feet per second is but little more than ten miles per hour. More powerful machines, including the Spencer machine, of London, have accomplished not more than two or three times this speed. A speed of twenty miles per hour is undoubtedly within the scope of the present commercial gasolene and other vapor motors by means of aeorplanes, and with improvement in the motor the "heavier than air" machines therefore commence about where balloons left off.

Langley's Great Speed.

The first machine to fly—Professor Langley's—made a speed of about thirty miles per hour for the short time it was in the air. When it is realized that twelve men are necessary to develop one horse power by turning cranks the failure of man to propel himself through the air by means of his own power is understood. The extraordinary development of light and efficient gas and steam motors for automobiles in the last few years puts a new face on the problem of aerial locomotion.

A twenty foot specimen of the Eddy type has a superficial area of about two hundred square feet and at a speed of twenty miles per hour should have a "lift" of something over four hundred pounds. With a ratio of but four to one "lift" to "drift" the engine and propeller of the Santos-Dumont No. 9 could thus be depended upon to pull two hundred and sixty pounds through the air at a speed of from twelve to twenty miles per hour.

As a fact, however, the twenty foot kite is impracticable, because, as discussed by Professor Newcomb and others, doubling the size of a satisfactory small model cubes the weight, while the sustaining surface increases only as the square of the increase in dimensions. Multiples of a small model are, however, an entirely different proposition, as they may be combined in such a manner as to apparently evade this mathematical law.

Five nine foot kites, yoked as in Figs. 14 and 15, furnish a practicable and efficient sustaining surface equivalent to the twenty foot kite referred to above, and thus the cellular kite, whether made up of multiples of the rectangular frame box kite, the Bell tetrahedral frame or the Eddy single plane in lattice frame, solves the problem of large aeroplanes, the weight of which increases practically as the sustaining surface.

Any of the forms of kites here shown may be fitted with the rigging in Figs. 7, 9 and 10. A four cell Bell tetrahedral kite is thus equipped (Fig. 16). Fig. No. 17 is a snapshot of a flight made with a leaden weight attached at the forward end and which under these conditions seems to fly equally well with the Eddy model, although with less lift per square foot of surface.

Running a second flying line from the extreme forward tip of the kite down to the operator (Fig. 18) affords a means of perfectly regulating the height of flight, a slight pull on the second line causing the kite to sink toward the earth, while a release of this pressure permits it to again mount upward.

The new high speed steam turbines now successfully competing with low speed reciprocating engines for all classes of work offer untold possibilities in this connection. There is an enormous field for the aerodrome in the transportation of mail and express matter alone. A machine of sufficient capacity to carry one man at a speed of fifteen to twenty miles per hour will probably be made at a cost of something under five hundred dollars.

The possibilities of the subject are too great for general appreciation. A traffic line with no maintenance of way expenses is certainly ideal and must prove profitable.

Queries of Many Kinds Answered Briefly by the Oracle.

In order of precedence in England, which comes first, the sovereign's brothers or his grandsons? BRIT.

The grandsons.

When in travel and at hotels is it obligatory to give a tip to servants, and if so, how much? IGNORANT.

It is only obligatory so far as custom makes it so. Without it the patron cannot get what he pays for and is subjected to annoying importuning and insult. The amount depends on the willingness of the victim to pay.

Why is the "greenroom" of theatres so called? STAGE.

Not on account of its occupants, but on account of the verdant tint in which it has been the rule to furnish and finish it, so as to relieve the eyes after the glare of the footlights.

What is the origin of the name of the preserves called "bar le duc?" READER.

It is called after a town of that name in France.

Which comes first, thunder or lightning? ABE H.

Lightning comes first, and the thunder follows it immediately; but as light travels so much faster than sound, if we are at a distance from where the phenomena occur there is a very perceptible time between the flash and the sound.

Is the expression "I mean to see justice done" perfectly proper, and is it proper in speaking of a house to say, "It stood on the road between" two certain cities? E. H. W. E.

Both are proper, though some persons prefer to say "in the road."

Is a Roman Catholic layman eligible to the office of Pope, or must the candidate be a cardinal? JOHN.

Several persons have asked this question. A layman is eligible.

Which has the most intelligence, the horse, dog or elephant, and which is the most intelligent of animals? REED.

The chimpanzee is the most intelligent. The elephant, dog and horse stand in the order here given.

Will you please advise me whether pink paper stands for that state of affection ordinarily designated as love or if it is blue paper, and is there any special color of paper signifying friendship? COUNTRY.

Pink, which is suggestive of the color of the blood that the palpitating heart pumps, must be accepted as the emblem of love, while blue typifies the feeling that follows being jilted and that sometimes comes with disappointment after marriage. Friendship knows no color.

Where did the term "codfish aristocracy" originate, and to whom was it applied? B. E. S.

In Massachusetts, where it was applied to families that had grown wealthy out of the cod fisheries.

When was the "benefit of clergy" abolished in England? K. R. S.

In 1827, during the reign of George IV.

To settle a controversy, please tell us how many stars there are in the constellation of the Little Bear. K. AND G.

Twenty-four, seven of which form the little dipper.

When and by whom was the custom of ringing the Angelus bell instituted? HENRY.

In 1316, by Pope John XXII.

Will the New York underground railway be ready for traffic this year? N. H. G.

The contractors who are building it say that it will.

Will you please tell me the difference between Deism and Theism? K. J. E.

They both signify a belief in the existence of God. The first is applied in a bad sense to one who hesitates to accept the theory of a divine revelation, and the second is applied in a good sense.

Was there ever such a town as Ono? QUEER.

Yes. It was a town of Benjamin. Consult your Bible, I. Chronicles, viii., 12.

Can you properly call it a calm when you can feel the wind blowing? F. Y. R.

Certainly. It is a calm when the wind is not more than three miles an hour.

Can you tell me the meaning of "pont-y-glyn"? ED.

It is Welsh, and means the bridge of the glen. They had no word for bridge, and during the Roman occupation took their word pont from pontis, which means a bridge.

Was there ever a Pope Peter except the first Peter? CONSTANT.

There was not.

Has the number of hairs in a man's head ever been counted? J. W. K.

Yes, they have been numbered. There is a wide range in individuals, from next to none up to 150,000. The average lies between that number and 129,000.