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AIR-SHIPS AND FLYING-MACHINES.

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On my journey from France to America, on board the "Deutschland," I occupied my leisure in reading the interesting book by Mr. H. G. Wells entitled "When the Sleeper Awakes: a Story of the Years to Come," and in putting on paper some reflections suggested by the two chapters which principally claimed my attention: "While the Aëroplanes were Coming" and "The Coming of the Aëroplanes."

That which always strikes me in books of this sort is the effort of imagination put forth by the authors in discerning in the distant future things which to-day lie under the very eyes of men more practical or less near-sighted, who know how to look at the things which are close to them.

Mr. H. G. Wells speaks of aërial navigation as men talked of automobile locomotion about ten years ago, believing that they predicted the future without suspecting that they spoke of the present. They were far from thinking that, at the end of the nineteenth century, carriages propelled by petroleum, by steam, by electricity, comfortable and rapid, would be speeding over all the roads of the world.

Apropos of "horseless carriages," as automobiles were at first called, being defined by their negative qualities, people said: "Our nephews will perhaps see them, but not we." The reality has transcended the dream, and the practical automobile has come before the nephews have had time to fill their uncles' places.

Again I am astonished to see that, in the field of aëronautics, the ideas of dreamers, as opposed to those of scientific men, turn exclusively to what they call aëroplanes—that is to say, toward flying-machines, which as yet exist only in the future, and which raise themselves, or to speak more accurately, will raise themselves, without the assistance of any gas lighter than air. They do not perceive that from now on, the air-ship furnishes a solution of the problem of aërial navigation, and realizes without difficulty the first condition of every system of aërial motion—which is to float in the air, carrying with it its aëronaut; although flying-machines without a balloon have been, until now, only toys, not capable of carrying a man or even of supporting their own weight in the air more than a few minutes.

Certainly the time will come when, thanks to the development of light motors, man will be able to travel like the birds, borne without gas by vast aëroplanes. But the best means of arriving at this result is by the construction of many air-ships and by frequent tests, made not under cover but in the open air.

People err in continually opposing, as they do without reflection, "aërostation," whose principle requires a combination of materials which is lighter than the air displaced by it, to "aviation," which involves a combination heavier than the air.

As a matter of fact in the air-ship—such, for instance, as my "No. 6"—both principles are employed. The balloon, in the form of a spindle, measuring thirty-three metres in length and six metres in diameter in the middle, is heavier than the air, since it does not rise of itself when the propeller is stopped. My air-ship is nothing else than a sort of tubular aëroplane, into whose construction enters hydrogen gas under pressure, which keeps tense its vast surface, with the least possible weight of materials. I use hydrogen as a constituent part of the tubular aëroplane to insure the rigidity of its fabric, in place of a solid frame-work which would not produce for the moment the same effect without the greatest difficulty. For the same reason, for certain pieces of mechanism which do not demand the re-

sistant qualities of steel, I use aluminum, which, next to hydrogen, is the lightest substance known to industry: for the same reason, also, with the constant aim of diminishing the weight of the mechanism, I have adopted, as an essential part of the armored frame-work which supports the car and the aëronaut, a combination of pieces of pine-wood bound together by metallic threads so fine that they weigh almost nothing. So I was able to construct, in tubular form, the only aëroplane which has ever succeeded in raising itself and its aëronaut while remaining heavier than the air, about twenty kilogrammes being supported by the dynamic action of the propeller.

Nature sets us the example of this economy of weight in making hollow the quills of the feathers of birds, which must be at once light and solid—in making even their bones hollow, substituting air for the marrow of the bones of terrestrial animals.

If I were content to affirm the necessity of an apparatus heavier than the air, without at the same time insisting upon replacing by hydrogen, by aluminum and by threads of steel the heavy materials hitherto employed in the construction of flying-machines, I could have produced in a thousand different ways an aëroplane heavier than the air—so heavy that, like so many others, I should have remained on the ground, instead of flying around the lightning-rod of the Eiffel Tower.

Persuaded that the principle of aërostation and that of aviation do not in the least degree exclude each other, I have sought to unite them in the same mechanism, and, so doing, I think I have reconciled the two opposing schools of thought, which have struggled on paper, with no benefit to science, for the last hundred years. During four years of uninterrupted work, I have forced myself to solve practically the two fundamental problems, the equilibrium and the direction of balloons, deriving the ascensional force at the same time from the static action of the hydrogen and from the dynamic action of the screw.

With this end in view, I ballast my machine sufficiently to make it heavier by some pounds than the weight of the volume of air which it displaces. It cannot raise itself by the unaided effort of the hydrogen. From the propeller I demand the complement of necessary force. That is so real a factor, that, when I stop the motion of the propeller, the air-ship descends gently toward the earth by its own weight.

This is the method by which I regulate, at my pleasure, the ascension and the equilibrium of the mechanism. At the bow of the air-ship is attached a guide-rope, weighing a hundred pounds and sixty yards in length. Under these conditions, the contents are distributed from one end to the other of the air-ship, so that the axis of the frame-work, which is also that of the screw, may be perceptibly parallel to the horizon.

Near the middle of the guide-rope, is attached to it the end of a small cord which is under the control of the aëronaut, and thus permits him to bring the weight of the guide-rope, more or less, toward the centre of gravity of the mechanism.

At the moment of departure, I pull upon the cord; the guide-rope is thus brought toward the centre, and the bow of the air-ship, relieved of a part of its weight, rises at the same time that the stern lowers itself; for the entire mechanism is rigid owing to the pressure of the hydrogen.

The screw then acts at the extremity of an axis inclined obliquely to the horizon. Its action is diverse. It not only propels the air-ship, but causes it to mount, following the inclined plane which contains its axis in space. To arrest the upward motion and to adjust the air-ship to the altitude which I desire to maintain, I direct its axis toward the horizontal plane by allowing the guide-rope to return, more or less, toward the bow. If I desire to descend, all that is necessary is to let the guide-rope return to its normal position, that which it held before the start. Besides, I have, in the frame-work, bags of ballast, which I can move by means of small cords, for the purpose of lowering the bow of the air-ship and descending more quickly.

In a word, I can move myself in a vertical direction, without getting rid of the ballast and without loss of hydrogen, by simply varying the inclination of my tubular aëroplane of hydrogen under pressure.

My air-ship differs, then, essentially from the ordinary balloon, which mounts or descends only by losing either ballast or gas—that is to say, by the rapid exhaustion of its means of aërial existence.

The air-ship which I have invented has certainly more resemblance to an aëroplane, properly so called, than to a balloon. I hope to make the resemblance closer still, and even to arrive at a complete identification of the air-ship and the flying-machine,

by supplying the future numbers of the series of my air-ships with inclined planes, whose surface, added to that of the envelope of the balloon, will act in union with it, under the propulsive action of the screw, in supporting the weight of the mechanism.

I am beginning even now to perfect my "No. 6," adding to it, for the experiments which I expect to make in London in June, inclined planes which, placed toward the bow of the air-ship, will have the effect not only of lifting the ship but of correcting its pitching motion.

If, as I hope, I obtain good results, the speed will be perceptibly greater than that which I realized between Saint-Cloud and the Eiffel Tower.

Beginning with this year, I shall attempt to apply in the air the principles of aviation properly so called, by subjecting my air-ships to a continual evolution.

In the same proportion that I increase the extent of the inclined planes symmetrically disposed at the right and left, I shall reduce the surface of the envelope of varnished silk, and, consequently, the volume of hydrogen relatively to the power of the motor.

Thus I expect gradually to diminish the rôle of the hydrogen, making secondary its importance which is now primary, and even completely doing away with the use of this gas.

The air-ship will then have become an aëroplane in the absolute sense of the word, and I hope that some day we shall see it such. That day is undoubtedly not far distant, but the flying-machine will be achieved only by the way of evolution, by making the air-ship pass through a series of transformations analogous to the metamorphoses by which the chrysalis becomes the winged butterfly.

My air-ship, which raises itself by pushing back the air, has already done better than the chrysalis, whose elongated form it resembles. It may be that very soon nothing will prevent it from freeing itself completely from its cocoon of silk lined with hydrogen, and from being wholly comparable to a butterfly.

The air-ship, then, as it exists to-day, and the aëroplane absolutely without gas, to which we shall come, will form the two extremes of a series of aërial machines between which the aëronaut will have his choice, following his taste or consulting the at-

mospheric conditions or the length of the course, in selecting the machine, more or less sustained by hydrogen or by the propeller, whichever best responds to his wishes.

For myself, ardently devoted as I am to the captivating study of aviation, I am persuaded that the air-ship, thanks to the hydrogen, will always have an advantage over the aëroplane in being able to carry a great quantity of combustible material for long journeys, a number of travellers, and a considerable weight of merchandise—an advantage which will give it a practical utility unquestionably superior in commerce or in war. On the other hand, the flying-machine will without doubt attain, for short distances, an incomparable speed, the advantages of which will be in certain cases very appreciable—for instance, in crossing a strait like the Strait of Dover, in the journeys of the wealthy, or in the transmission of despatches at a high rate.

But when I think that an air-ship of the length of the Transatlantic steamer "Deutschland," constructed with the proportions of my "No. 6," would transport a thousand voyagers of my own weight, with a sufficiently powerful motor and the necessary amount of petroleum, from New York to Havre in two days, I cannot help finding the dirigible balloon more interesting than the aëroplane from the economic point of view, which is the dominant one in the world of to-day.

This is not the conception of a romancer. It is an affirmation which I can easily make good by figures; and, what is better, it will, I am firmly convinced, within a few years have become an accomplished fact.

Evidently this condition will not make itself, but it will be achieved because there is no conquest to which the entire human race aspires more ardently than to the empire of the air.

To attain this end, a series of tests in the open air will be necessary—tests not contemplated by inventors who, in their distaste for action, confine themselves to sketching vaguely upon paper projects impossible of realization.

Aërial progression will be achieved not in the mysterious recesses of the laboratory, but in the air itself. As the child learns to walk only by trying to walk, so man will learn to fly only by effectually practising flying.

The problem of aërial locomotion, contrary to the tradition which has so long retarded its solution, has no secrets. It de-

mands only work in full light, in the open air, much perseverance and a little audacity—the audacity of which the swallow sets us an example when it tries its unaccustomed wings for the first time beyond its nest.

One is often astonished that the evolution of the air-ship should have required so many years, when other inventions have been perfected so rapidly. How should the air-ship make progress when in a half-century aëronauts have done nothing to aid it?

The balloon—at first a simple bag of inflated paper over a fire of straw,—created by the genius of Montgolfier, transformed into a silken sphere inflated with hydrogen, metamorphosed into an air-ship by the genius of Henry Gifford, who in 1852 gave the first demonstration of the great problem, having the sublime daring to carry a steam engine in his car—demands now for its final evolution the application of the naphtha motor, which already gives us a single horse power under a weight of six pounds.

When modern industry places at our disposal the treasure of energy stored up in petroleum (10,000 calories transformable into force in one kilogramme of this precious fluid), I ask myself what do the "aviators," torpid with passive waiting for a light motor, demand? And what are the aëronauts doing, spending twenty years in the application to aëronautics of the electric motor, which it is impossible to conceive of as applied to aërial navigation, since, with its generator (battery or accumulator), it is the heaviest of known motors.

More than all I am astonished that empirics, always mired in the ruts of routine, insist obstinately on controlling the spheric balloon only by emptying their sacks of ballast, since it is a buoy as refractory to direction as to equilibrium, over which for more than half a century generations of amateurs and professionals have lost their time.

I think that in the last four years I have demonstrated amply that a petroleum motor does not necessarily set fire to the hydrogen of an air-ship. That is, indeed, among the possibilities; balloons can burn in the air as well as ships in the water. But I maintain that one can, without taking leave of one's senses, raise a balloon with petroleum.

Why in this case not attempt this very simple matter of making a screw revolve in the air by the same motive power which

succeeds so admirably with automobiles, and controlling a rudder analogous to that of a ship?

I wish that in the past I might have seen many builders of air-ships take part in aërial contests. Progress is only achieved at this price: it should be the work of all.

To my knowledge, there are in existence a dozen petroleum balloons, completed months ago, some of them belonging to millionaires, to whom the expense of aërial experiments would be a trifle. I have done all that I could to induce them to compete in the *Grand Prix de Paris;* for nothing is more annoying to me than to be alone in the air during a competition. I hope to have an opportunity of meeting them at the competitions at London or St. Louis and elsewhere. For it is probable that the multiplication of contests will attract a number of competitors, and it is for this reason that I beg for the organization of aërial contests in America, as well as in Europe.

Nothing is easier than to take part in the next experiments; for, in the present conditions of aëronautic industry, scarcely a month's time is needed for the construction of an air-ship. For my own part, at the beginning of this month of May I have in process of construction three new air-ships which will be finished before the first of June. These will be "No. 8," "No. 9," and "No. 10" of the series. In their general construction they resemble "No. 6," which won the *Grand Prix de Paris* in 1901, which made five voyages in the Mediterranean in January and February, 1902, and which I shall ride again at London in June. But they differ from it in their dimensions, in the perfecting of details, which I wish to study in succession.

I am doing this for the sake of example; and if, contrary to my hope, I do not encounter those who wish to compete with me, on either side of the Atlantic, there is left to me, at least, the resource of exhibiting my air-ships in the leading cities of the world, with the object of popularizing, by every means in my power, the idea of aërial navigation.

The essential thing is to create a universal movement in favor of aëronautics.

Until lately, I have thought that to attain this end it was enough to ascend into the air myself, and to multiply my experiments, at the risk of my life. But now I see that this is not enough, and that, before the aërial idea becomes practical, it

will be necessary to popularize it by means of the pen. For this reason I am writing this first article.

For a long time, I have been solicited to express my opinions on the state of the aëronautic question, and until now I have refused, thinking that action was more serviceable than writing. But some recent interviews have shown me that there is much prejudice to be destroyed and much scepticism to combat, the existence of which concerns the future of aërial navigation and its practical utility, which is denied by some men who have never mounted the car of a spherical balloon, and who, in consequence, are no more competent for the discussion of the question than I should be for the interpretation of Babylonian hieroglyphics.

I believe it to be the duty of those who have made a study of aëronautics to destroy the errors implanted in the minds of the public by those who are ignorant of the first word of this branch of science. It is for this reason, I repeat, that I have decided to publish this first article.

And if a single article is not enough, I shall write a series of as many articles as the balloons I construct or the ascensions I make, for I perceive in closing this one that it is shorter and more convenient to pen a system of aërial navigation on paper than to set it in motion and make it perform its functions.

And, if it is impossible to set forth the vast and multiple problems of aëronautics within the narrow limits of magazine articles, I am resolved to publish in different languages the voluminous manuscript in which, for four years, I have summed up, for my own instruction, in the form of a treatise, the scientific principles and the historic facts of aërial navigation, from the more remote times until the present day.

This book will be, I hope, a revelation to readers so often deceived by authors who are ignorant of even the elements of the aërial question. In it I shall explain why and how I became an aëronaut, and I shall not be content till every person is an aëronaut, either in air-ships or in aëroplanes, but in the open air and not "*en chambre.*"

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