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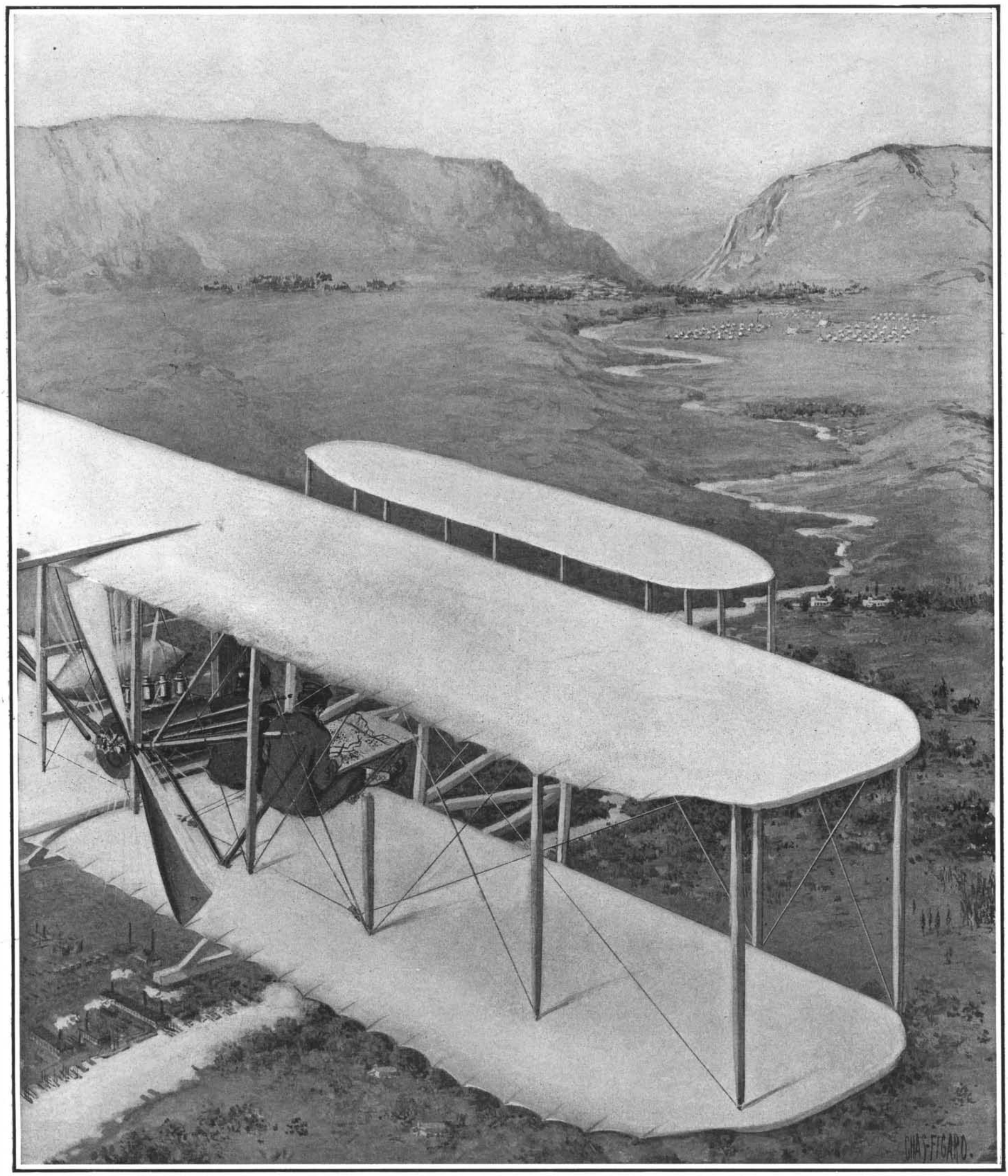

The aeroplane will find its principal field of usefulness as a scout. At an elevation of from 1,500 to 2,000 feet, it will be possible to make an accurate map of the country occupied by the enemy, and note the strength and disposition of his forces.

THE AEROPLANE MILITARY SCOUT.—[See page 450.]

THE AEROPLANE MILITARY SCOUT.

The astonishing advances which have been made during the past year in the development of the aeroplane and the dirigible balloon, have encouraged our War Department to ask Congress for an appropriation of $500,000, for the purpose of building dirigibles and aeroplanes and carrying on the general work of military aeronautics. We consider that the Department is fully justified in requesting this appropriation. The work done by the Wright brothers, both in this country and in France, to say nothing of the successful flights accomplished by Farman, Bleriot, and Delagrange, and the sensational journey by the monster dirigible of Count Zeppelin, is a fact of profound significance. These flights prove that the problem of mechanical flight is passing, if it has not already passed, out of the domain of theory and academics into that of the practical and useful. At the present writing it cannot be disputed that as compared with the dirigible the aeroplane holds the first place in popular, if it does not in official favor. The flight by Wilbur Wright of over an hour, the straightaway journey of Farman across country for seventeen miles, and the round-trip flight of Bleriot of eighteen miles across country, are feats which exceed the most optimistic expectations of the early months of the present year. Wright, with a 25-horse-power engine, has shown that he can maintain a speed of 35 miles an hour, and Farman and Bleriot, in their cross-country flights, averaged about 50 miles an hour.

It may as well be recognized at once that the aeroplane can never be seriously considered as a means of transportation on any extended scale. The present indications are that a single machine can never hope to carry more than two or three passengers. For the carriage of heavy freight it is altogether out of the question; although it is possible that it may have a field of usefulness in the post office and express service, for the transmission of important mail and light packages with the least possible delay.

Undoubtedly the greatest field of usefulness of the aeroplane will be in military operations; although even in this field its work will be of a limited character. Its small carrying capacity will prevent its being used on any extensive scale for the carrying and dropping of high explosives. The amount of explosive which it could take up would be so insignificant as to have no particular value for this purpose. The attack on fortifications, arsenals, dockyards, fortified camps, and cities by landing within them high-explosive shells, can only have any decisive effect upon the outcome of a war, if the high explosives can be thrown in enormous quantities. The dropping of a few isolated shells could work only a limited amount of damage, and unless they could be accurately aimed, they would represent so much time and money thrown away. Experience in bombardments has proved this fact conclusively. It was only after the capture of 203-Meter Hill outside Port Arthur, when the fire of the guns could be accurately directed, that the heavy mortar batteries were able to do any very effective work. Now to aim the one or two high-explosive shells which an aeroplane could carry so that they would unerringly hit some particular point below, would be a practical impossibility, for reasons which it is not necessary here to enter into.

The military aeroplane of the future will find its greatest field of usefulness in the important work of scouting. The military scout will carry two men; one to operate the machine, and the other to take photographs and make reconnaissance sketches of the country. The striking picture shown on the front page of this issue, is no mere dream of the enthusiast. It would be entirely possible for Wilbur Wright to take up with him an officer, rise to a height of 1,000 or 1,500 feet, sweep over 25 or 30 miles of an enemy's country, and secure a thoroughly accurate sketch of the lay of the land, the disposition and strength of the enemy, the various roads by which he might attack or be attacked, and all the other information which it would be the duty of the reconnoitering officer to secure. Because of the height at which the aeroplane would travel, and the uncertainty as to its speed and direction of flight, it would be an extremely difficult object to hit; and it would be possible for several shells of the small caliber which would be used in an attack to pass through the canvas of the aeroplane without impairing its stability.

Restoring Burnt Carbon-Steel Machine Tools.—When lathe or planer tools of carbon-steel have been overheated or burnt by being heated up to a temperature of say 2,100 deg. F., near the melting point, they may be restored, according to Mr. George T. Coles, in a recent article in the American Machinist, by reheating to 1,100 deg. F., or a very dark red, and then quenching in boiled linseed oil. This treatment is very simple and inexpensive, with no nostrums or chemicals to be used, and may be the means of saving a good tool, so that it can be used with satisfactory results.

The Vacuum Airship.

BY G. J. DERR.

Count Zeppelin's successful flights have proved that the rigid system of dirigible construction is the correct one, but the accident which terminated his flight of last summer illustrates the danger of using hydrogen and other inflammable gases. Although men willingly risk their lives for great objects, and although we have so mastered steam and electricity that we are no longer afraid of steam boilers, high voltage dynamos and transformers, it is nevertheless desirable to reduce the elements of danger to a minimum.

It is said that explosions by lightning will henceforth be prevented by the employment of earth connections, wire netting and other protective devices, but everybody who is familiar with the vagaries of inflammable gases knows how easily explosive mixtures with air are produced by slight defects in the gas bag and how often explosions are brought about by various causes. For example, sparks may be produced by impact, some metals spontaneously become very hot in explosive gaseous mixtures, particularly if the metals have been previously heated by the sun's rays, etc. Wireless telegraphy is another possible source of danger.

There are other objections to the use of hydrogen. It is still a comparatively costly gas and it cannot be obtained everywhere in large quantities. At present it is produced chiefly by electrolysis, as a by-product of the electrolytic manufacture of chlorine and alkalies. The cost of compression, containers and transportation, however, makes the gas, when delivered, very expensive, and the cost is still greater if the hydrogen is generated on the spot expressly for the purpose of filling the balloon. Although methods of producing hydrogen directly from water and coal, without electrolysis, are being developed, and although we are told that Zeppelin's balloon sheds and landing stations will soon be equipped with hydrogen generators, presumably electrolytic, the danger and inconvenience attending the employment of hydrogen will still remain.

In view of these facts the writer desires to call attention to a possible method of dispensing with hydrogen. The valuable property of hydrogen is its lightness. Now, a balloon filled with air may be made even lighter than the same balloon filled with hydrogen at atmospheric pressure if the air is sufficiently rarefied. Francisco Lana called attention to this principle, in connection with aeronautics, in 1670, but at that time it was impossible to construct a vacuum balloon light enough to rise in the air and yet strong enough to withstand the crushing pressure of the external atmosphere. Now, however, when we have at our disposal so light and strong a metal as aluminium, and perhaps other equally suitable materials, the vacuum airship seems at least worthy of discussion.

Retaining, approximately, the dimensions of Zeppelin's airship, suppose that 10 hollow globes of aluminium, each 20 meters (65.6 feet) in diameter and with walls 1 millimeter (1/25 inch) thick, are joined in a straight line, forming a vessel 200 meters (656 feet) long. The lifting power of the 10 globes, when completely evacuated, will be about 16 tons. Aluminium walls only one millimeter thick would be far too weak to resist, unaided, the external atmospheric pressure of about 15 pounds per square inch, the force of the wind, and the weight of the suspended parts, but half of the buoyancy, or eight tons, may be used to compensate the weight of an internal skeleton. Motors capable of furnishing 400 horse-power would weigh about 2 tons, leaving about 6 tons for the car, propellers and other mechanism, crew, supplies, etc. If the globes were evacuated only to a residual pressure of 53 millimeters (2.1 inches), in which condition they would have the same weight and buoyancy as if they were filled with hydrogen at ordinary atmospheric pressure, their aggregate lifting power would be about 13 tons, and they would not require so much stiffening, so that more than 3 tons would still be left for the car, passengers, etc. Besides, it may be possible to make both the skeleton and the shell of substances lighter than aluminium, such as paraffined wood and India rubber strengthened by imbedded wires. Air pumps that produce a partial vacuum as low as 53 millimeters are already in practical commercial use, and it should not be difficult to construct pumps of great capacity and rapid action, by which the balloons could be exhausted to the required degree very speedily.

Every balloon station would be provided with great pumps of this character, but the vacuum airship would possess a peculiar advantage in carrying with it a portable air pump by which the necessary degree of exhaustion could be maintained or restored in the event of leakage or slight accidents. In a hydrogen airship, on the contrary, losses of gas cannot be supplied during the flight, but can only be compensated by throwing out ballast carried for that purpose.

The vacuum airship could also be made to sink and rise by admitting and extracting air, and could be steered in a vertical plane by operating on the air chambers individually. Its flight would not be stopped by lack of gas and, on reaching its station, it would be quickly restored to its original efficiency.

Several problems must be solved before the vacuum airship, here suggested as a possibility, can become a reality. It is for the mechanical engineer to decide whether or not a sufficiently light and strong vacuum airship, stationary air pumps of the necessary capacity and rapidity of operation, and perhaps also portable air pumps of the required lightness and efficiency can be constructed with the materials now known to technical science.—Illustrirte Aeronautische Mitteilungen.

To Detect and Estimate Boric, Salicylic, and Benzoic Acids in Foodstuffs.

Boric Acid.—The substance, mixed with lime or magnesia, is incinerated, and the ashes are leached with warm water containing a little hydrochloric acid. A measured portion of the solution is neutralized until it fails to bleach phenol phthalein and, after the addition of a measured quantity of a 10 per cent solution of mannite, is titrated with an alcoholic solution of soda.

Salicylic Acid.—The best method is Freyer's, in which the salicylic acid is converted, by excess of bromine, into tribromophenyl bromide, which is estimated iodometrically.

Benzoic Acid.—The benzoic acid is extracted by means of a volatile solvent, a few drops of ammonia are added and the mixture is evaporated until nothing is left but an aqueous solution of ammonium benzoate. The addition of a dilute solution of lead acetate precipitates lead benzoate, which is washed, dried, and weighed.

The Supposed Inheritance of Acquired Characters.

Dr. Francis Darwin, in his presidential address before the British Association, spoke as follows:

"Fischer showed that when chrysalids of *Arctia caja* are subject to a low temperature a certain number of them produce dark-colored insects; and further that these moths mated together yield dark-colored offspring. This has been held to prove somatic inheritance, but Weismann points out that it is explicable by the low temperature having an identical effect on the color-determinants existing in the wing-rudiments of the pupa, and on the same determinants occurring in the germ-cells."

T. D. A. Cockerell suggests in Nature that still another explanation is possible to cover at least some such cases. In discussing various types of latency, Dr. Shull (American Naturalist, July) has recently defined as "latency due to fluctuation" those cases (of which many are known) in which the special characters of a race do not appear except under suitable conditions. Following this idea, it is possible to think of the dark *Arctia caja* appearing after exposure to cold as representing a variation which possessed an inherent tendency to darkness not exhibited under more ordinary conditions. Indeed, this must have been the case, since only "a certain number" were affected. Given such a variation, it is not unreasonable to suppose that when examples were mated together the tendency would be so emphasized as to appear under normal temperatures, thus producing an apparent case of the inheritance of acquired characters.

The Current Supplement.

The current SUPPLEMENT, No. 1720, opens with an illustrated article on the steamship "George Washington," which is the latest type of passenger and freight-carrying vessel, embodying as it does every innovation known to the shipbuilding industry. Mr. James Denny writes on marine engineering, past, present, and future. Sidney H. Hollands contributes an article on "A New Departure in Aerial Propellers." W. W. Massie has prepared a diagram on electric wave lengths, whereby he eliminates the necessity of repeated calculations. The question whether explosion gas turbines or combustion gas turbines offer the greater practical possibilities is discussed. A. T. Cameron contributes an article on the number of radio-active elements and their properties. The Concrete Pier at Santa Monica, Cal., is described and illustrated. This is the first reinforced concrete pier to be built in the West, and probably the second in the world. Dr. Armand Billard shows the effect of agitated or moving water on animals. Prof. Meltzer's consideration of an animal as an engineering structure is concluded.

To Frost Window Panes.—The following process can be used for lights of glass already set in the sash. Dissolve 1 part of wax in 10 parts of oil of turpentine and add 1 part each of varnish and siccative. With this mixture the panes are coated on the outside, and before drying, dabbed with a pad of cotton wadding. If desired, small quantities of Paris blue, madder lake, etc., may be mixed with the wax solution.