On Waterproofing Concrete.

On account of the number of inquiries received from correspondents as to methods of waterproofing cement blocks or monolithic concrete, the SCIENTIFIC AMERICAN has been investigating what is being done in the way of improvement of existing methods.

The Concrete Association of America has conducted a valuable series of experiments and distributes its findings free of charge in a public-spirited manner, but the results obtained are largely negative.

Some preparations are found to be effective under certain conditions, but none hitherto has been found to be equally reliable with all mixtures and under all circumstances.

The need and requirements of external paint for concrete, if only to counteract the variable porosity which cannot be avoided unless the personal equation in concrete mixing is eliminated, is so well put in a paper read before the recent convention of the American Society for Testing Materials, by Mr. G. D. White, that we quote a part of it by permission.

"Unless extreme care is exercised in the preparation, mixing, and workmanship of concrete for solid or reinforced work, which is not always commercially possible, the resultant concrete is not impermeable, or at least not uniformly impermeable to water or moisture. Where perfect materials have been used with perfect workmanship, we have another difficulty, another problem to solve. Concrete is a non-conductor of heat. It is, naturally, a cold-blooded animal. The difference in temperature between the concrete wall and the atmosphere (the warmer the day the greater the difference in temperature) causes a condensation of moisture on the surface. This is annoying, and a detriment to health in living and office rooms; a loss of room or loss by damage in storerooms and warehouses; an objection in any building, no matter what its nature or purpose.

"Hollow concrete blocks, tiles, brick, etc., have various defects. They are not only porous but capillary positive, and thus absorb moisture from 5 to 40 per cent of their own weight. Due to rain and snow, walls built of these materials become water-soaked, and remain soaked for varying lengths of time. During certain seasons of the year, and especially in some sections of our country, they remain soaked for months.

"The fact that dry walls are essential to health and comfort is generally known, and so well appreciated that the question of dampness has been a restraining agent to a much larger and more extensive use of concrete by the building trades of this and other countries.

"The tendency to stain, the frequence of efflorescence, and difference in color due to difference in materials and to intermissions in concrete, are defects of a less serious nature.

"A drawback that includes concrete in all forms is the uninviting, unattractive color. Replace our buildings of marble, of terra cotta, of granite, of wood handsomely decorated, with buildings of concrete, and note the contrast. The dirty gray of ordinary cement or concrete becomes monotonous to the observer even where there is but a sprinkling of concrete among buildings of more pleasing construction.

"If to the strength, cheapness, durability, and fire-resisting properties of concrete can be added impermeability to moisture and decoration, we will have a building material as nearly perfect as the world has ever seen, and this within the means of every builder.

"In recognition of this fact, various concerns and individuals have placed on the market and recommend as a solution to the problem, various treatments and coatings.

"For the sake of convenience, I will divide these into four classes. In my investigation of the various treatments and materials included in these classes, I have endeavored to be unprejudiced, and to give to each its true worth and full value.

"I. WATERPROOFING COMPOUNDS IN LIQUID OR POWDERED FORM, MIXED WITH THE CONCRETE IN ITS PREPARATION.

"This is a help in that it lessens and retards, in a measure, the moisture-absorbing tendency of concrete. It fails in the desired attainment for the following reasons:

"Improper distribution, which is difficult of regulation.

"When properly distributed, it does not render concrete entirely impervious to moisture.

"It has a tendency to weaken the tensile strength of concrete.

"It does not decorate.

"The increase in value is not proportionate with the increase in cost.

"It deteriorates with age, that is, a concrete block containing the waterproofing compound, on the first application of water will absorb certain varying quantities. On subsequent applications, allowing the block to dry in each instance, larger quantities are absorbed.

"II. TREATMENTS PREPARATORY TO THE USE OF LINSEED-OIL PAINTS.

"Treatments in various forms have been advanced and recommended by some of our leading master painters, and indorsed by most able research chemists. For the sake of brevity, I have included in my paper but three of these treatments:

"(a) Hydrochloric or muriatic-acid wash.

"(b) A wash consisting of a solution of zinc sulphate and water.

"(c) A wash consisting of ammonium carbonate and water.

"From a chemical standpoint, muriatic acid, no matter in what strength, nor what the character of the concrete, is not only useless as a remedy, but detrimental in its action. Master painters who have endeavored to put it in practice have discovered to their sorrow a confirmation or a demonstration of the chemical theory.

"Theory favors and practical tests confirm as the best adapted to the purpose, the former of the two latter methods."

The author proceeds to give the chemical reactions of these various washes with the concrete ingredients, and shows in a convincing manner the reasons why they fail in their desired object. He adds:

"The treatment with zinc sulphate or ammonium carbonate, even though successful, does not offer a solution to the problem, because a linseed-oil paint is unsuited for either exterior or interior painting of concrete. The gloss robs the surface of the appearance of stone or masonry. Linseed oil has water-absorbing and lacks water-resisting properties. It cannot be applied over a damp or wet surface, which means that following a rainstorm or rainy season, a painter must wait weeks and perhaps months before he can commence work on or complete a contract already begun.

"III. COLORLESS LIQUID COATINGS.

"Certain of these may be of some value or service in retarding moisture absorption and efflorescence, but they are all alike found lacking in the following respects:

"They serve to emphasize any defects in, or difference in color of, concrete construction.

"They impart to concrete a soggy, water-soaked appearance.

"They do not render impermeable to moisture for any length of time.

"They do not decorate."

Under his fourth heading Mr. White summarizes paints for concrete, with the practical conclusion that there are none which fulfill all the requirements of a severe list which he gives. The principal of these are that it must be applicable to a wet surface and at the same time waterproof when set: it must be applicable to the concrete without previous treatment of the latter, durable, economical, and pleasing to the eye, must act as a bond between concrete and a plaster coat, and remain hard in the presence of water, in addition to possessing all the qualifications of ordinary paint such as working well under the brush, filling voids and leveling up irregularities of surface.

Although Mr. White did not say in his paper that he knew of any satisfactory paint, we have reason to believe that he has been instrumental in the production of one, or at least that it has been developed with a special view to fulfilling the requirements outlined in his paper.

We have recently seen tests, and the results of long-continued tests, of a paint called Cementhide, which seems to fulfill all the exacting conditions above referred to.

At a cement-block factory in Newark, N. J., a part of the process consists of the curing of the newly-made blocks by subjecting them to steam for thirty-six hours, accelerating their setting and providing a much more constant and uniform supply of moisture to the cement than can be obtained by spraying.

For this purpose two curing rooms are used, each of which is opened to be emptied and refilled on alternate days, the steam being turned off in the morning and on again at night. The steam is therefore continuously applied to the interior of the walls for 36 hours out of every 48. The rooms themselves are built of concrete blocks, and were formerly constantly saturated with moisture. It was evident from the outside which room was filled with steam from a thin film of moisture trickling down the exterior of the walls, which had to be drained away. Six months ago the interior was painted with two coats of Cementhide, and now there is no evidence of moisture on the outside of the walls, while the interior has a smooth, hard surface differing little from that of well-finished cement except in its pleasant color.

Blocks made as identically as possible from one batch of concrete have been tested under varying conditions, one plain and the other painted. The unpainted block was found to vary in weight with the water, absorbing it according to the amount present in the atmosphere or from the ground, while the weight of the painted block varied not at all. Blocks painted in a variety of pleasing colors have been left exposed to sun, rain, and wind for months without being apparently affected. Concrete painted with this material takes a plaster coat better than natural concrete, both concrete and plaster adhering to the paint more firmly than they do to each other. It has even been shown that the rise of moisture by capillarity in monolithic concrete set in moist ground is stopped by a coat of Cementhide between the top of the underground concrete and the masonry or other concrete continuation upward of the wall. The paint has a dull finish not unlike the concrete itself, but smoother and of any color desired, and appears to remain hard and to preserve the surface of the concrete indefinitely. One cannot imagine a more severe test in any ordinary building than that imposed at the block factory above mentioned, and it would seem that this paint should have widespread possibilities when it is sufficiently introduced on the market.

THE MODERN ICARUS.

BY JOHN ELFRETH WATKINS.

Tradition asserts that the first to sacrifice himself to the problem of flying was Wang Tu, a Chinese mandarin of about 2,000 years B. C. who, having had constructed a pair of large, parallel and horizontal kites, seated himself in a chair fixed between them while forty-seven attendants each with a candle ignited forty-seven rockets placed beneath the apparatus. But the rocket under the chair exploded, burnt the mandarin and so angered the Emperor that he ordered a severe paddling for Wang.

Then there is left in stone a partial account of experiments by Man-U, an Assyrian priest who attempted to fly from the temple of Baal. The next victims of aviation whom we find are certain criminals whose arms and legs the ancient Leucadians annually fitted with wings of various design and who were then hurled from the "Rock of Sappho's Leap," a boat awaiting them in the sea below to give them liberty should they succeed in solving the problem.

The first fatality of the kind in our era seems to have been a Roman who during the reign of Nero attempted to fly high in the air over the Eternal City. During the Dark Ages one Dante while trying to fly with a pair of wings, at Perouse, fell upon the top of St. Mary's Church and broke his leg. The Prior of Tongland in 1510, before the Court of Stirling donned feathered wings and, leaping from a tower of the castle, fell into the "mydding" (dunghill). Allard, a tight-rope performer, was crippled by a fall while trying to fly before Louis the Grand, at Paris, about 1660.

Thus far all such accidents were results of attempted aviation, for the balloon was not invented until 1783, when this new vehicle of the air met with an accident in Philadelphia during some experiments by Rittenhouse and Hopkins who, after sending up dogs and cats in a cage carried by a captive bunch of 47 hydrogen balloons, persuaded James Wilcox, a carpenter, to trust himself in the cage. After floating over the city he found himself drifting toward the Schuylkill River and, becoming terrified lest he should descend into it, punctured some of the balloons. Coming to earth with a thump he broke his wrist.

The next victims, Pilatre de Rozier and M. Romain, set out from Boulogne in 1785 in a car supported by a fire balloon underneath a hydrogen balloon with which compound arrangement they expected to cross the English Channel. In a quarter hour, when at a height of 3,000 feet, the apparatus took fire and the scattered fragments were found upon the seashore along with the awfully mangled bodies of the aeronauts. Next Olivari, ascending from Orleans, in November, 1802, also met death by his balloon catching fire.

In April, 1808, M. Mosment ascended at Lisle waving a flag decorated with the imperial eagle of France and the assembled spectators shouted with delight. He dropped an animal attached to a parachute and it came safely to the ground. Later a murmur of horror rolled over the crowd which learned that in one of the ditches outside the city M. Mosment had been found, lifeless and covered with blood. The same day the balloon came down seventy miles away.

In July, four years later, the corpse of Bittorff, after his balloon had caught fire, was found stiff and cold upon the roof of a house outside Mannheim. Shortly afterward Count François Zambeccari tried, like Rozier and Romain, to combine the fire and gas balloon but after adding flame to powder he crashed down from the heavens, his body, charred and mutilated, being picked up near Boulogne.

Mme. Sophie Blanchard, widow of a French aeronaut, made an ascent July, 1819, in the presence of a vast crowd, from the Tivoli Garden, Paris, setting off fireworks as she rose. Suddenly a great flash was seen above her basket and the crowd, thinking this to be a part of the display, shouted: "Bravo!" But the flames were seen to spread and the balloon to come down. Her basket caught against the projection of a roof and spilled her out upon the pavement, where she was picked up dead.

The first military martyr was Lieut. Harris, of the British navy, who, in May, 1824, while studying the strategic value of balloons attached to warships, was dashed to earth and killed by the breaking of a valve in his balloon. And in September of the same year, Windham Sadler, going up from Blackburn, England, was dropped to his death near Bolton, his balloon having collided with a chimney.

When John Wise, greatest of all American balloonists, abandoned his muslin balloon, in 1836, for the "Meteor," wrought of silk, he went up in it from Lancaster, Pa., on a showery day in May. He sailed to the southward and was soon lost in a big black cloud. That night he descended near Port Deposit, Md., and, mooring his balloon near a farmhouse, aroused the family. It was drizzling and he was discharging the gas from the upper valve when someone brought a light, exploding the gas in the heavy atmosphere. Wise was thrown back ten feet, severely scorched, and some of those gathered round were badly burned. Wise was taken to Philadelphia, where he recovered.

In July, 1837, an immense crowd gathered in Vauxhall Gardens, London, to see an aged savant, Robert Cocking, test his new parachute. It was of Irish linen, had a circumference of 107 feet and was fastened below the basket of a balloon, wherein two aeronauts were stationed. Mr. Cocking got into the smaller basket of the parachute and the big balloon, after taking him slowly up, drifted gracefully away. But a rider following on horseback, arrived at a field near Lee, in Kent, just in time to find the dead body of Cocking, who had fallen through the air a mile in the collapsed parachute.

Another victim of the parachute was Leturr, killed in 1854 while attempting a descent, and soon afterward Arban, of France, while rising in a balloon from Barcelona was blown into the Mediterranean and lost. Then in 1850 Gale made a fatal flight, while in 1863 Chambers was suffocated by balloon gas, in England.

In 1873 at Ionia, Mich., the populace cheered as the brave aeronaut, Mountain, rose from their midst in his big balloon. He floated gaily aloft at first but suddenly the fastenings of his basket gave way and he fell from such a height that his body penetrated the earth for some distance.

And next came the first recorded fatality from winged flight since the Dark Ages. Vincent de Groof, renowned as the "flying man," while giving an exhibition at London, in July, 1874, fell suddenly to earth where his corpse was picked up with the stilled wings attached.

In 1875 J. Croce-Spinelli and Spivel, two French savants, while attempting to break the record for altitude in their balloon "Zenith" rose so high above France that the intense cold deprived them of power to descend. When the "Zenith" came down they were found frozen to death in the basket. During the siege of Paris two balloons with escaping passengers drifted off to sea never to be heard of, and in 1888 the corpse of Simmons, who had ascended from Olympia, came to earth near Malden.

Hiram Maxim, a few years later, spent $100,000 on two immense heavier-than-air flying machines, the last —which weighed 8,000 pounds—making a false start, in July, 1894, when the machine ran off the guard rails. Maxim gave up in disgust and turned to other problems.

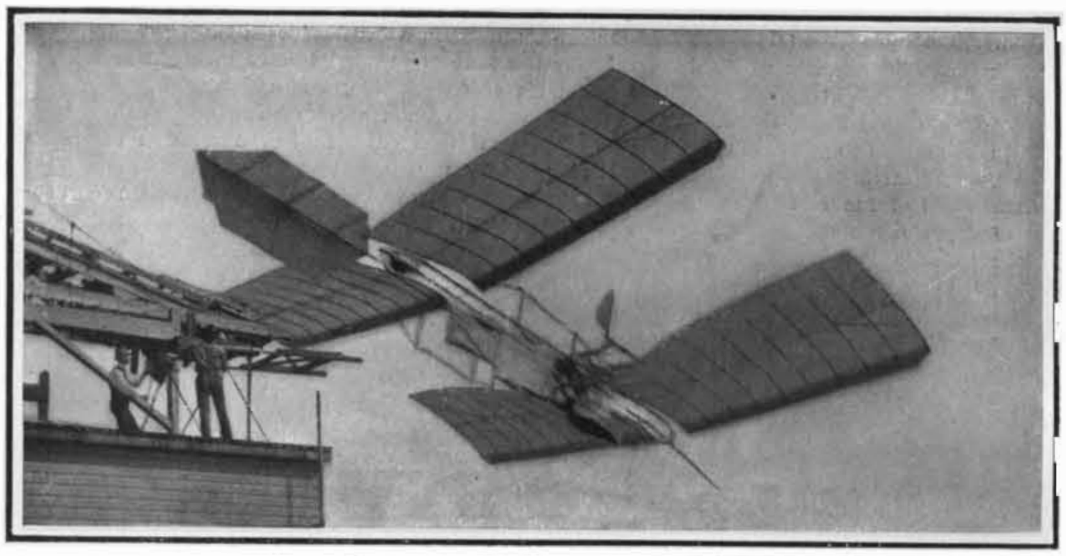
Then, in 1896, Otto Lilienthal, of Berlin, after a quarter century of tedious experimenting, brought forth a double-decked aeroplane in which he soared through the air at race-horse speed, sixty or seventy feet above ground. Prof. Robert W. Wood, of Johns Hopkins University, went over to Berlin to test the apparatus and made the snapshot used herewith. A few days after this picture was taken Lilienthal fell from the same apparatus, in the same spot, and was picked up dead. Shortly afterward the experimenter Pilcher, who had been continuing Lilienthal's methods in England, met death in much the same way.

The same year S. A. Andree of Sweden, accompanied by Nils Strindberg and Dr. Eckholm, two other adventurous Swedes, started in his balloon from Spitzbergen in search of the North Pole, and no trace of them has since been found.

In 1896 the hope of science was renewed by Langley, our great astronomer and physicist, who after a decade of the most careful experimentation, flew a steam aerodrome three quarters of a mile over the Potomac. This not being large enough to carry its engineer the army allowed the inventor $50,000 with which to perfect a man-carrying machine. The quarter-size model of the latter also steamed successfully over the Potomac in the face of the wind; but when the full-size aerodrome was about to leave the launching track a defective part of the launching apparatus caught it and precipitated it—engineer and all—into the water. Although the big aerodrome never had a chance to try its wings, the press so ridiculed the enterprise that appropriation for repair was refused and Langley, despite his other great contributions to science, died a disappointed man.

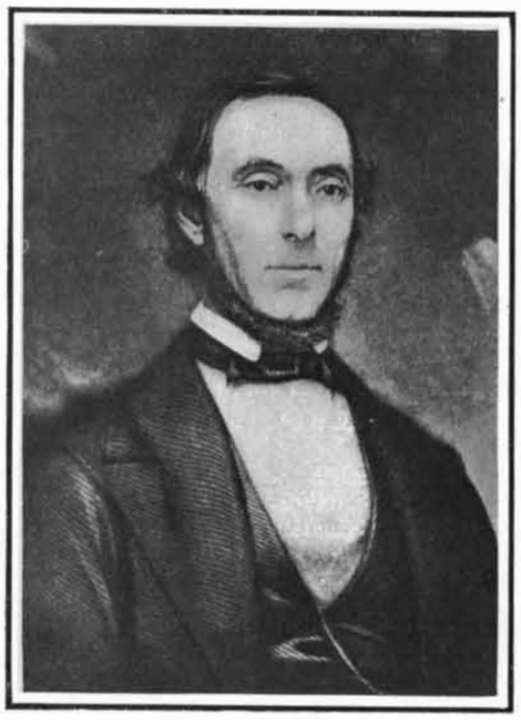
Count Zeppelin's new craft, 443 feet long, was making a long official test splendidly in August, 1908, when the balloon caught fire.

And finally comes Orville Wright, riding to victory in his heavier-than-air machine, which is scarcely inside the goal when it dumps him out with a broken thigh and several fractured ribs; and with him spills



False start of Langley "aerodrome," 1903.

Otto Lilienthal

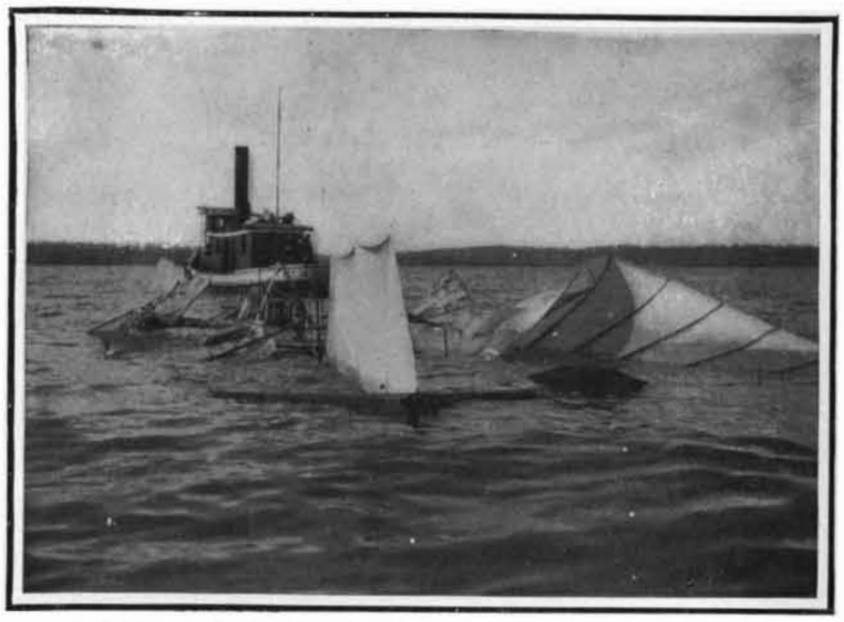


John Wise.

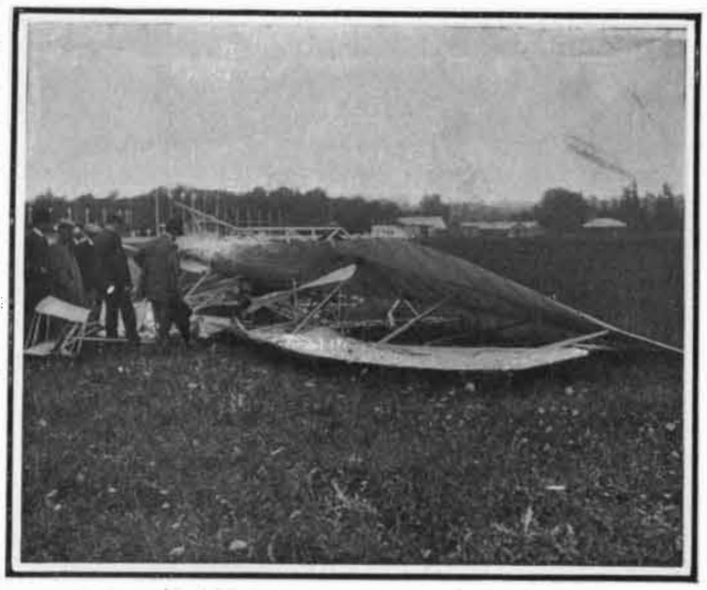
Otto Lilienthal.

S. A.

Lieut Thomas E. Selfridge.

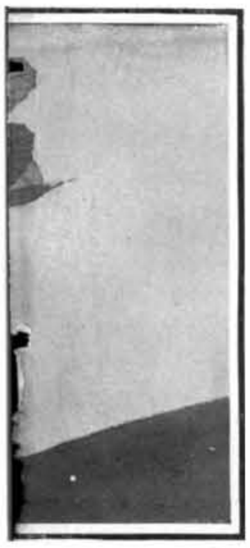


Towing wreck of Langley "aerodrome" back to houseboat, 1903.

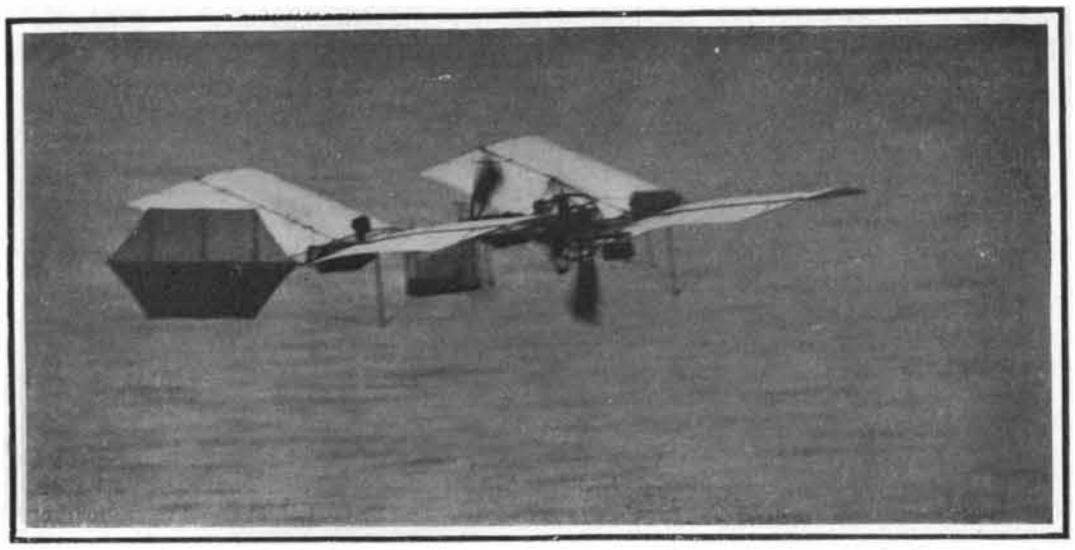


Lefebvre's machine after the accident.

Lefebvre, who was killed in France.



s fatal flight.



Langley's last model. Telephoto snapshot of it in flight

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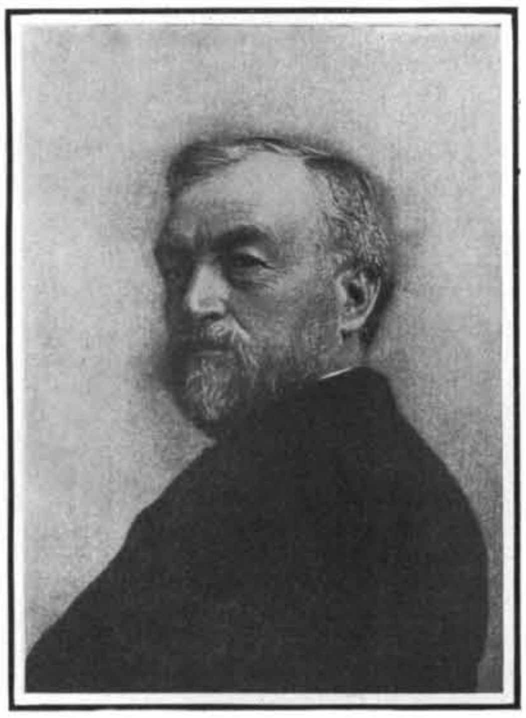
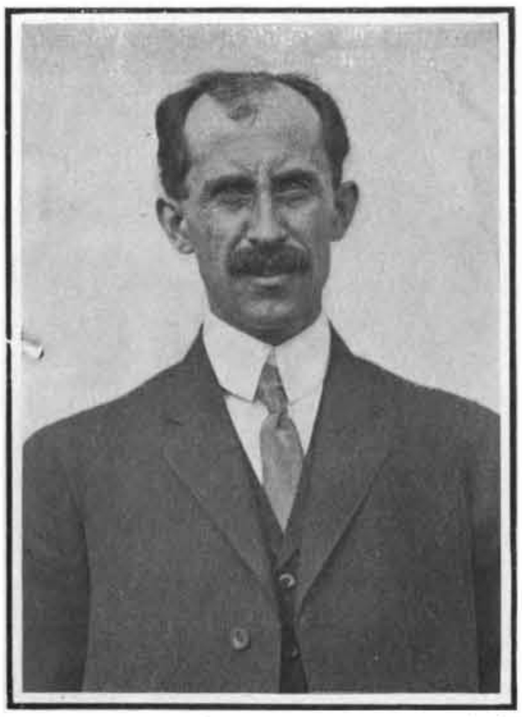


Samuel Pierpont Langley.



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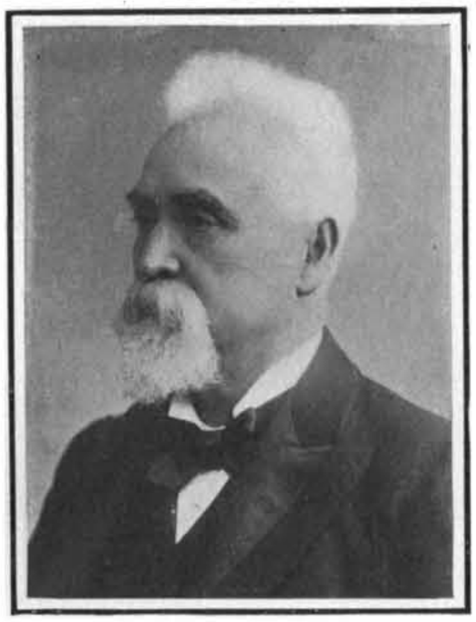
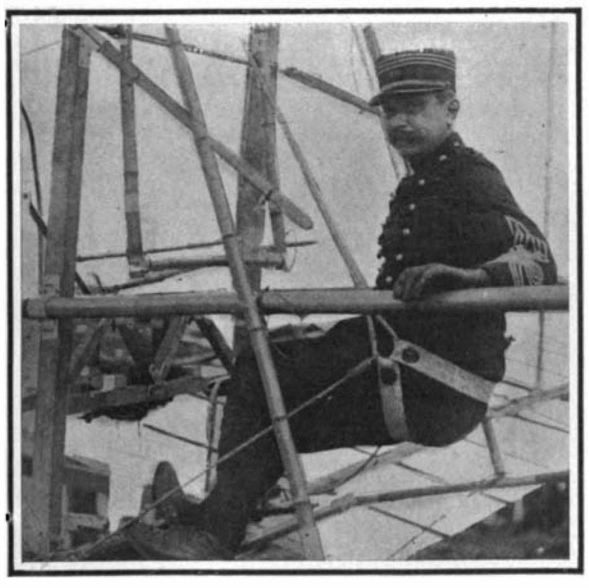
Orville Wright.

Langley aeroplane in the Potomac River.



Sir Hiram Maxim.



Captain Ferber.

Ferber's aeroplane No. IX.

to earth young Lieut. Selfridge, whom soldiers solemnly bear on a litter to the military hospital where occurs, three hours later, one of the more recent of the many fatalities of our chronicle of tragedy.

The two fatal accidents which have occurred in France with the motor-driven aeroplane within the last few weeks, have further dampened the enthusiasm of many would-be aviators. The first of these, which happened on September 7th, resulted in the death almost instantly of Lefebvre, who was one of the newest and probably the most daring of all the French aviators. The second one, which occurred only last week (September 22nd), snuffed out the life of Capt. Ferber, who was probably the best-known theorist and practician in the art of aviation in France. Both of these accidents occurred while the men were trying out new machines. In the case of Lefebvre, he was making his first flight with a new Wright biplane. The machine rose in the air without difficulty, and flew for some distance in a straight line. Lefebvre made an excellent turn, and was flying back again in a straight line when suddenly the machine dived to the ground, striking its head on with terrific force. The motor fell upon the aviator, who was crushed and had his skull fractured.

Capt. Ferber, on the other hand, was experimenting with a new Voisin aeroplane. He had flown half a mile at a height of about 25 feet and was making a turn when the machine tipped a great deal, and also dropped on the turn, so that the end of the lower plane struck the ground. The machine reared on its nose, and Ferber was thrown to the ground, the motor falling upon him. He managed to extricate himself, and was able to walk to the grandstand with the aid of some spectators. He said that he had flown too low, and that he had been bothered by the wind in making the turn. He was not seriously injured to all appearances, but in a few minutes a hemorrhage set in, and he died before a doctor arrived. The machine was badly damaged, and it was a wonder that the aviator was not instantly killed. Capt. Ferber probably did more than any other man to bring the art of aviation to its present advanced point. He was much of a theorist, and only lately he published an article in which he deplored the weight of the present-day machines, and gave it as his opinion that no progress had been made in perfecting these during the past six months. The fatal accident, which occurred at Boulogne, was preceded by another bad smash less than a week before. In this instance the machine broke a rudder and one of the planes.

Rate of Helium Production.

In a recent issue of Nature Mr. R. J. Strutt contributes a communication on "Rate of Helium Production from the Complete Series of Uranium Products."

A knowledge of this constant is essential to the estimation of the ages of minerals from their helium content. In a paper published in Proc. Roy. Soc., July 28th, 1908, Mr. Strutt gives the ages of some minerals provisionally on the assumption that the rate was 9.13×10^{-8} cubic centimeters per gramme U_3O_8 per annum. This rate was calculated from Rutherford's indirect data. It has received much support from Sir J. Dewar's determination of the rate of production by radium with its immediate products. Mr. Strutt is now in a position to confirm it further by an experiment on the rate of growth of helium in a solution of pitchblende. He speaks of *a* solution, but it has been found impracticable to take up all the constituents by one solvent. Two solutions were necessary.

The pitchblende solutions contained 115 grammes of U_3O_8, and yielded in sixty-one days a quantity of helium, which was measured as 2×10^{-6} cubic centimeters in the capillary of a McLeod gage. This gives the rate as 10.4×10^{-8} cubic centimeters per gramme U_3O_8 per annum. No stress can be laid on the close agreement with Rutherford's estimate in view of the very small gas volume measured. The experiment proves, however, that that estimate is of the right order of magnitude. Larger scale experiments are in progress, and these, in conjunction with similar experiments on thorianite, will, it is hoped, enable data on the quantity of helium in minerals to be translated into estimates of time with full confidence.

Railway Tree Planting.

The Pennsylvania Railway is planning to set out more than 1,000,000 trees. This will make a total of 3,430,000 trees planted in the last three years to provide for some of the company's future requirements in timber and sleepers. This constitutes the largest forestry plan yet undertaken by any private corporation. Heretofore the company's forestry operations have been confined to a limited area between Philadelphia and Altoona. This year, however, 65,000 trees are being set out on tracts of land near Metuchen and New Brunswick, N. J. In addition there are to be planted within the next month 207,000 trees near Conewago, Pa., 136,000 in the vicinity of Van Dyke, 334,000 at Lewistown Junction, 7,000 at Pomeroy, and 205,000 at Denholm.