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A/S
WISE

FLYING IN THE BEGINNING

By HUGH D. WISE
Colonel, Retired, United States Army

Colonel (then Lieutenant) Hugh D. Wise in 1896 at the time of the experiments described in this article

Foreword

By GENERAL WILLIAM MITCHELL
Former Assistant Chief of the Army Air Corps

THE Wise family of Virginia has from the beginning of our history been pioneers and originators in our civic, economic, and military development. Colonel Hugh D. Wise was outstanding in his conception of the application of aerial devices. He always had in the back of his head the idea that if a person could go over the hostile army and reach a vital point through the air, victory would be assured. In furtherance of this he began experimenting with kites in 1896. He developed these at first so they would lift a wire over the rivers bordering New York City. Over this wire a telephone could be operated. Next he lifted cameras so they could take photographs from on high of a position presumably occupied by an enemy, which would give decisive information to our own forces. Next, he developed man-lifting kites and actually went up himself, a pioneering accomplishment. Then he found that when the cord to the ground was no longer operating, he could glide against the wind from a higher to a lower place. This was the beginning of flight in our country as we know it today. All he needed was a motor to carry him on. Later, Professor Langley and the Wrights developed their motor-driven aircraft, which really were motor-driven gliders.

Hugh Wise has been so modest that the people of America little know what he did to develop the most decisive influence in present day military and economic development—the heavier-than-air flying machine, which we know as the airplane. Had Hugh Wise not been called to the Spanish War and the Philippine Insurrection from his experiments and diligent work to develop aerial locomotion, he might have gone down in history as the developer of the flying machine.

I have known Hugh Wise for many years. When I first saw him in the Philippines, he was the aide-de-camp of General Joseph Wheeler, one of the greatest cavalry commanders that the world has ever seen. Most of our expeditions into the Philippines were started at night. The dogs of the villagers, by barking, always gave the alarm. If we fired rifles at them to kill them, this only accentuated the trouble. But Hugh Wise had developed a corps of bow and arrow men who were so expert that they would hit the dogs at practically every shot. They made no noise, the dogs stopped their barking, and the expedition moved on.

When confronted with the problem of lifting antennae for radio high in the air during the beginning of our radio art in 1903, I used Hugh Wise's kites to lift my receiving apparatus miles above the earth and took messages from the longest distances that had then been received. This result was not due to us, but to Wise.

Hugh Wise has always been modest and conservative about what he has said concerning his accomplishments, but no one has done more to advance the art and science of aerial navigation than he has. The narrative which follows tells only a part, and a very small part, of what he has done. All of us who have followed in his footsteps appreciate not only the deep thought he put into his work but the initiative and the will-to-do, which entailed the exposure to danger of his own personal being, and the ability to rise above criticism and carping that is always present when an entirely new experiment is tried.

All of us "old-timers" take our hats off to Hugh D. Wise for his pioneering experiments that not only showed us the way to the development of flying but indicated to us how original thought could be applied to the development of the greatest military power the world has ever seen—military aeronautics.

WHAT little I may have contributed to the development of flying machines came from no initial attempt in that direction but as a result of efforts to utilize the kite as a means of support for signal apparatus. The idea of using the kite in our army, for that purpose, though usually accredited to me, was, in fact, not mine. Unquestionably it had its inception with Captain James Allen, Chief Signal Officer at Governors Island in 1896 and, later, Chief Signal Officer of the Army.

One day Captain Allen showed me in an engineering magazine an article by Lawrence Hargrave, an engineer of New South Wales, in which article Hargrave described a kite he had developed and with which he was experimenting. "It seems to me," said Captain Allen, "that we might use this kite in our Signal Corps," and he urged me to take up the subject. Though not in the Signal Corps, I was interested in the novelty of this investigation which promised amusement and excitement.

In those days, money was not easy to get from the government, especially for what might appear to conservatives as a "wild-cat" notion, but Captain Allen was able to get hold of a small sum with which to help me, so I started.

THERE was little information to be had about kites because, until then, they were regarded simply as playthings. The Chinese had developed them farthest but not along scientific lines; the legends of Icarus and Darius Green were not helpful; no accurate data were available as to the experiments of Leonardo da Vinci who seems to have tackled the problem in his usual scientific way.

At the time, Lilienthal, in Berlin, was experimenting with gliders but he was still at the very beginning and Langley had then had no success. Therefore, beyond this kite of Hargrave's, we had nothing with which to commence, and so it became our starting point.

The Hargrave kite is, I believe, the father of the modern cellular kite as also it was the first step toward the development of the glider and the airplane. It may therefore be deserving of some brief description.

Roughly, it consists of two rectangular parallelopipeds connected by a trussed central spine. There are four surfaces upon which the pressure of the wind acts as a lifting force and there are four others, vertical to these, along which the flow of the wind tends to hold the kite headed into it and, at the same time, keeps the kite on an even keel.

The point of attachment of the flying-cord, on the central spine, close to the forward cell, becomes the pivotal point for motions of the kite. The greater effect of gravity being aft of this point,

the rear cell is pulled down lower than the forward cell, thus presenting the lifting surfaces to the wind. The proper angle at which the kite stands is regulated by the placing of the flying-knot, and the balance so obtained between gravity and wind pressure will then be automatically maintained.

If for any reason one side of the kite receives more pressure than the other side, it will be forced back but then the vertical, or side, surfaces are rotated about the central spine into position more normal to the wind, thus increasing the pressure upon them and so equalizing pressure on the sides of the kite.

IT is to be observed that the useful component of the force which manifests itself by pull on the cord is the vertical "lift." Hence it is the experimenter's purpose to adjust the angle of incidence to the wind and the balance of the kite so as to obtain maximum lift with steadiness of flight.

I omit here, as I shall throughout this article, discussion of many forces, such as wind-friction, which, though of great importance for the experimenter to understand, are probably not essential in this story.

Having obtained two excellent soldier assistants, one a rigger and the other a carpenter, our work began with the construction of a small Hargrave kite, about five feet of beam with about 35 square feet of lifting surface. Then, to the entertainment of the children of the post and the amusement of officers and soldiers, we daily flew kites on the parade ground. At this time, I think I was generally regarded as a candidate for the Army Insane Asylum and, certainly, had I been playing marbles in the street with my assistants we should have received no more pitying glances from passers-by.

Our first kite was followed by others, modified in proportions and structure as we progressed in the understanding of their action.

In the beginning I realized that our experiments were not a simple case of "cut and try" and that the action of a kite was in fact a determinable problem which could be accurately calculated mathematically. The data for the study of wind pressure on an inclined and moving surface were, however, at that time, exceedingly scarce, though Smeaton's "Tables of Wind Pressure," Duchemin's studies of the same subject, and Langley's "Aerodynamics" served as a basis for my own experiments and kept me busy while my assistants produced apparatus and kites.

Meantime, thorough tests of materials were made and from these we learned that no other material was so suitable for frames as was straight-grained spruce; that for tension members piano-wire was best; and that the covering could be nainsook, muslin, or heavy unbleached cotton, according to size of kite, closeness of weave being unimportant.

The flying-cord was a difficult as well as an important problem. Even the best of cotton cord, because of stretching and consequent weakening, was unsatisfactory, and the same fault was found with most other cords. We finally settled upon a hard-laid and sized blocking cord which is used by hatters. This could be had in weights suitable for kites of sizes from small to very large. It is not only the strength and weight of the cord that must be considered but also its diameter, for upon that depends the surface presented to the wind, the pressure of which on the long catenary of the line is a far greater handicap to the kites than is the weight.

We had learned that the ideal cord for flights to great altitude, as well as for withstanding heavy strain, was steel piano-wire. Later, we used this when we were sending aloft the meteorograph to great heights but the difficulty of handling wire and the necessity of a complicated reel rendered it impracticable for Signal Corps use in the field and that was the purpose of our investigations. We therefore stuck to cord and to our comparatively simple wooden drum reel.

Having settled upon a type of kite, our modification of the Hargrave, we built a number of them of from four to six feet beam, from 20 to 50 square feet of lifting surface, and began sending aloft on them various kinds of signal apparatus such as flags, semaphores, lanterns, and flares which, operated from the ground by cords, enabled us to send messages. We next suspended electric bulbs from the kites and with these we could flash the dots and dashes of telegraph codes or, by using different colors, could use the Navy Ardoise system.

We had soon learned, however, that because of the swinging, darting and diving of a single kite, suspension from it of signal apparatus was quite unsatisfactory, so we had come to using the "tandem" in which two or more kites carried the load

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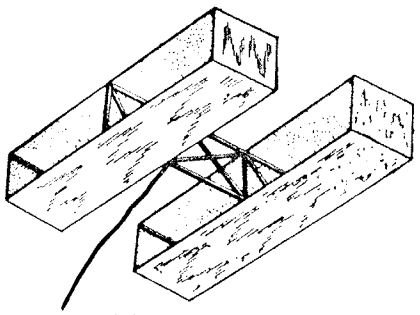
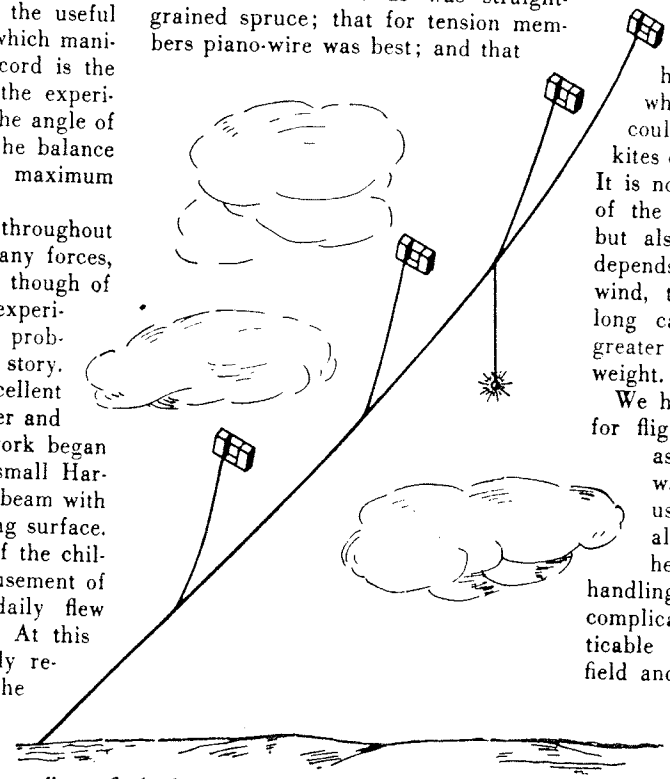
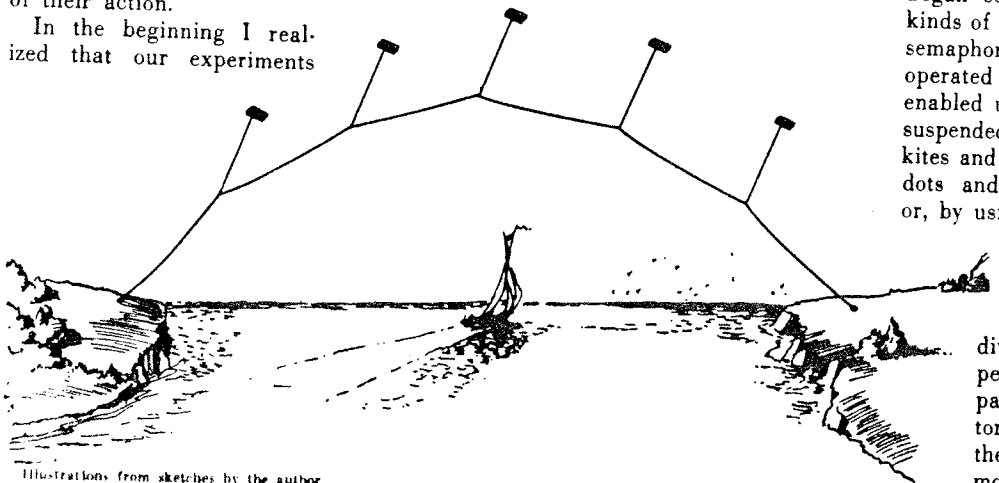


The Hargrave kite



". . . flash the dots and dashes of telegraph codes . . ."



Illustrations from sketches by the author

". . . communication was opened while ships passed beneath the cable . . ."

it binds the harsher coating ingredients in a soft, pliable coating and greatly increases the folding strength.

The use of the new ingredient has passed the experimental stage, several of the large paper manufacturers having been engaged in making and marketing the paper for nearly a year to test its qualities and acceptability among printers.

A Permanent Synthetic Blackboard

A GLASS blackboard combining the virtues of slate with original and exclusive properties of its own has recently been developed by the New York Silicate Book Slate Company, New York City. The board, known as Seloc antiseptic glass blackboard, is a deep black and will not fade or become glazed. It has a velvety surface, free from imperfections. The board is patented and consists of black plate glass with a suspended abrasive uniformly dispersed throughout the glass while molten. Experimental tests equivalent to 100 years' wear have left the sample in as good condition as when new. The thickness and weight of the board are the same as with natural slate, and the cost is but slightly higher.—*A. E. B.*

Thunder Does Not Sour Milk

CONTRARY to popular belief, thunder does not have anything to do with the souring of milk, says the United States Department of Agriculture. Just before a thunderstorm the atmosphere is unusually warm or even uncomfortably hot. This warm condition is ideal for bacteria to work, and the sour milk is a result. The heat and bacteria do the trick, not the thunder. More attention to cooling the milk is suggested to prevent souring at these times.

New Anesthetic Deadens Pain for Longer Period

A NEW anesthetic, which continues to kill pain after an operation but has no habit-forming power, was reported at a recent meeting of the American Chemical Society in a paper by Dr. T. H. Rider and E. W. Scott of the William S. Merrell Company of Cincinnati. The new anesthetic, called diothane, is local and is said to outdo both cocaine and novocaine. The drug is closely related to a number of similar organic anesthetics which are not particularly effective. A few slight changes in positions of atoms account for its potency.

"This compound," said Dr. Rider, "is the only one at present available which is not only stronger than either cocaine or novocaine but can be used satisfactorily in any surgical operation that can be done under local anesthetic. At the same time it is not habit-forming and is less toxic than either cocaine or novocaine.

"Clinical studies have been made with diothane which have shown that its use in actual practice leads to more favorable results than the use of previously known anesthetics.

"Among the outstanding effects is the slowness with which the anesthesia disappears. Because of this the patient is more comfortable after operation than is usually the case."—*A. E. B.*

FLYING IN THE BEGINNING

(Continued from page 141)

while others, below, supported and steadied the cord and kept up its sag.

With tandems of kites supporting the wire at intervals we were able to send field telegraph lines out for long distances and across ground assumed to be swept by hostile fire.

Not the least interesting of this class of test was the sending of a small cable to Brooklyn. The end, secured to a float, when received there was attached to a telephone by which communication was opened while ships passed beneath the cable held arched over Buttermilk Channel.

This stunt attracted much publicity and a civil engineer in Mexico, having read of it in the papers, wrote to me that he was confronted with the problem of putting a cable across a wide, deep cañon in the bottom of which there was a raging torrent. He wanted to know whether kites might not be used to carry across a rope by which the cable might be hauled over. He sent me a map and sketches of the place and I replied, sending him directions for the building and operation of kites he would need. A month or so later, an enthusiastic letter from him told of the complete success of the undertaking.

BY this time my mail was full of kite correspondence. Many of the letters were from serious scientific men, including Baden-Powell, in England; Lilienthal, in Germany; Hargrave, in New South Wales; Langley and others in our country. Many were from cranks with all sorts of fool ideas and suggestions. Numerous express parcels came too, frequently "express charges collect," with models which were usually absurd, and often the senders requested the return of these after trial.

Also I was now coming into rather unpleasant notoriety with people who regarded my kite experiments as utter nonsense and I regret to say that some of these were officers of the Army who regarded my work as a reflection upon official intelligence. My comrades at the post understood the purpose of my experiments but, nevertheless, they could not resist the temptation to twit me about my "flying-machines" and they took to calling me "Darius." I resented this because they knew as well as I that I was at that time considering no flying-machine.

We next branched off into attempts to gain high altitudes and, though it was of no particular military importance, we were sending aloft a box which contained thermometer, barometer, psychrometer, anemometer, and other meteorological instruments for readings in the upper air.

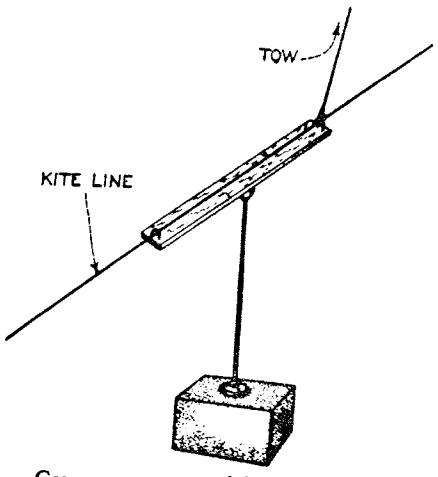
When the Weather Bureau recognized the value of this phase of kite work, it took it up and, under the direction of Professor Marvin, it accomplished surprising results at the Blue Hills Observatory and other stations. Meantime, Professor Alexander Graham Bell had become interested and he had developed a new type of cellular kite for high altitude flights. I therefore began to feel that if I was sent to the lunatic asylum I should at least be in good company.

ne use of kites came some years after this when radio was in its infancy. Captain William Mitchell, of the United States Signal Corps, in 1904, using a tandem of modified Hargrave kites, raised the antenna of a radio two miles in the air and received a message from the S.S. *Navarisk*, 1900 miles away, the distance record at that time.

By the winter of 1896 we were having considerable success with aerial photography and were trying to perfect an apparatus by which a hostile position might be photographed from behind our lines.

At first, the camera was carried on a light platform suspended from the kite-cord and adjusted for pointing by means of the suspension cords. The shutter was operated by mechanism from an alarm-clock which sat beside the camera.

With this crude device some really remarkable results were obtained, fully justifying further experimenting. The final development was a specially constructed camera box equipped with long-focus lens



Camera set-up used by the author for aerial photography with kites

and holder for plates or film roll. The box contained a clock-work shutter mechanism which could be set to operate at a given time.

Attached to the top of the camera-box by a ball and socket joint was a slender rod which hung from a light wooden "rider" on the kite-cord. This rod attached to the rider by means of a disk-and-pintle so it could swing in a vertical plane but could not twist horizontally. A guy back to the rider prevented the rod from swinging forward past vertical with the wind (not shown in the drawing above).

The kite-cord passed through eyes at each end of the rider so it could slide along the line, and to the forward end of the rider was attached the cord of a towing kite to take it up.

The place on the kite-line to which the camera was to go having been decided upon, calculations were made of the angles for pointing to the object to be photographed, the camera was pointed and sent up. At the fixed time the shutter mechanism operated.

We succeeded in getting excellent photographs of lower New York while the operators were safely concealed behind the fort on Governors Island, more than a mile away. The kites and apparatus were, of course, in view but they offered a relatively small [illegible] and were much less

[illegible] balloons which, until then, had to be relied upon for such work.

There remained the serious disadvantage, however, that the Hargrave type kites we were using did offer a target and also they were bulky and hard to pack. We therefore commenced experimenting for a less conspicuous and a more portable kind. This we finally developed from a kite invented by Mr. Eddy of Bayonne, New Jersey.

The frame consisted of a central vertical backbone and a cross-piece perpendicular to it. The cross-piece, about 12 percent longer than the upright, crossed it at about 18 percent of its length from the top and the cross-piece was bent back into a shallow bow. The cover, somewhat wider than the length of the cross-piece, was gathered in a wedge-shaped pleat along the backbone which thus became a central keel on both sides of which the cover, bellying back, formed stabilizing pockets. The edges of the cover were hemmed around steel piano-wire so that there could be no stretching and the corners were fitted with small rings which engaged in snap-hooks on the ends of the sticks. The piano-wire bow-string was also quickly detachable; less than a minute was required to assemble or to dismantle the kite. When dismounted the sticks were rolled up in the cover and the kite was ready for shipping.

This kite lacked the power of the cellular kite but it flew at a very steep angle and proved to be excellent for our purpose.

Four six-foot kites of the Eddy type served to carry the camera to any desired height and, when rolled, could be comfortably carried on the shoulder. The reel-box, with rope handles, was fitted to take the camera and the developing paraphernalia, so the entire equipment was easily carried by two men.

IN the spring of 1898, soon after our entry into the Spanish War, it was necessary for us to know the whereabouts of Cervera's fleet which might be a menace to transports going to Cuba. It had been lost track of but was supposed to have gone into the harbor of Santiago de Cuba.

In the mobilization camp at Tampa I had my aerial photographic equipment, the Regimental Commander having directed me to take it with us. General Shafter sent for me and asked whether the harbor of Santiago could be photographed over the hills at its entrance.

As a test, he then sent me out on a ship to try to photograph the harbor of Tampa from outside. This was satisfactorily done and I delivered him photographs showing the details beyond obstructions.

He then ordered me to be prepared to go to Santiago to do the same thing. Naturally, I was enthused and was confident of being able to settle the question as to whether or not Cervera was there but before I was started Cervera's presence was discovered. General Shafter then ordered me to take the apparatus on the expedition to Cuba but the campaign there never necessitated its use.

(To be concluded)

In the concluding part of this article, Colonel Wise tells of his progress from the kites described above to man-carrying kites and then to his first successful glider which was launched on a hill-side from a bicycle.—**The Editor.**

FLYING IN THE BEGINNING

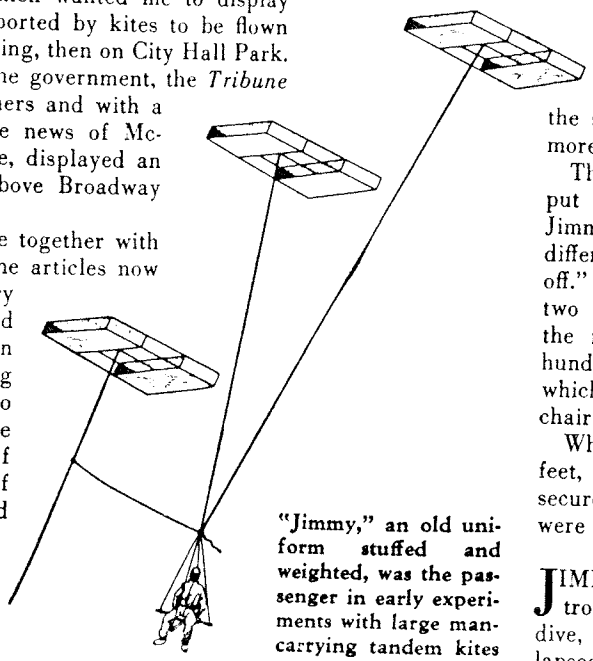
By HUGH D. WISE
Colonel, Retired, United States Army

The author

(*Concluded from September*)

IN the first part of this article, I got somewhat ahead of my story. In the autumn of 1896, while we were still working at Governors Island and when funds were at a very low ebb, I having spent all the money Captain Allen could get for the experiments, I received a flattering offer from the New York *Tribune* which wanted me to display election returns on banners supported by kites to be flown from the top of the Tribune Building, then on City Hall Park. My kites being the property of the government, the *Tribune* paid the cost of constructing others and with a tandem of these we sent up the news of McKinley's election and, at its close, displayed an immense flag a thousand feet above Broadway —a novel spectacle at that time.

The profits from this enterprise together with some money received for magazine articles now made it possible to build some very large kites for man-lifting. I had long wanted to do this but, even then, I had no intention of doing more than lifting an observer to heights from which he could see over intervening obstructions. If that could be done by means of kites, so much less expensive and so much easier to transport than balloons, it would be of great military value. Langley was then at work on his flying-machine and I was in correspondence with him but I was not working in that field.

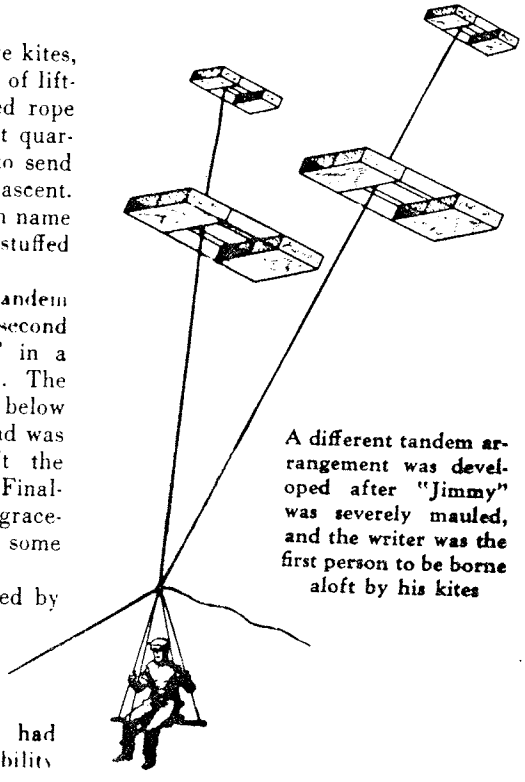


"Jimmy," an old uniform stuffed and weighted, was the passenger in early experiments with large man-carrying tandem kites

HAVING built some very large kites, with nearly 200 square feet of lifting surface and having obtained rope and a large winch from the post quartermaster, we were soon ready to send aloft a man for the first kite ascent. This man was "Jimmy," by which name we designated an old uniform stuffed and weighted to 150 pounds.

Three kites were sent up in tandem and, where the cord of the second joined the main line, "Jimmy," in a boatswain's chair, was tied on. The third kite was attached a little below that point. A blustery veering wind was blowing, so before Jimmy left the ground he took a severe mauling. Finally, however, he rose and floated gracefully out above New York Harbor some 200 feet above the water.

Ferry boats were nearly capsized by Jimmy's admirers who crowded their rails and whistles shrieked hurrah to his unhearing ears. When he was hauled in he did not know as we knew, that he had demonstrated not only the possibility but also the practicability of sending an observer aloft on kites. He had not gone very high but all that was needed to send him higher was the support of the rope below him by more kites.



A different tandem arrangement was developed after "Jimmy" was severely mauled, and the writer was the first person to be borne aloft by his kites

The next day the same tandem was put up but, profiting by the mauling Jimmy had received on his first trip, a different method was used for the "take-off." At the junction of the cords of the two upper kites a pulley was rove to the main line and over it passed a hundred-foot halyard to one end of which was fastened the boatswain's chair.

When the pulley had risen about 50 feet, Jimmy was hoisted, the halyard secured to the main line and the kites were run out.

JIMMY, however, was due for more trouble. The second kite, taking a dive, fouled the main line and collapsed. The jerk on the upper kite tore out its center rib and Jimmy, followed by the one remaining kite, plunged to the ground where, unlike Humpty Dumpty, his pieces were gathered together again.

Profiting by this accident, we arranged the tandem differently. The center ribs of two kites were bound together. Two tandems, each of two kites, were made. The upper or smaller kite of each of these was attached to the back of the lower which it thus steadied. Where the two tandem cords were brought together the pulley was rove in and the single cord from that point was supported where necessary by other kites.

A day or so after we had made this new arrangement, and when there was a brisk breeze blowing, I took my seat in the boatswain's chair and was hoisted to the pulley where I secured the halyard. I then signaled to have the kites run out and had the thrill of feeling myself borne smoothly and steadily upward, vis-à-vis Miss Liberty who, across the harbor, seemed to wave her torch to me in a friendly way.

Ferry boat passengers were apparently as interested in me as they had been

in Jimmy and the whistles gave me the same vociferous greeting. It would be an interesting question of law as to how much the responsibility might have been mine had one of those ferry boats capsized but it is certain that no damages could have been collected because all of my assets had gone to the construction of the apparatus.

The daily papers had quite fully exploited these recent experiments so my mail was more than ever full of letters with just the necessary suggestions and advice. One man even sent me a parachute for, having read of my "miraculous escape," supposing it was I who fell when Jimmy got his tumble, he thought I should guard against such accidents.

THIS parachute, conical in shape, was constructed of heavy canvas and iron rings. It was about the size of a large barrel and, perhaps, somewhat lighter. The ingenious idea of its inventor was that in the first rapid descent, air would be compressed in the top of the cone so that there would be more air to sustain it. Naturally, I was not prompt in using this device and, later, when the inventor wrote asking me to report on it, I told him so. In his irate reply he said that I was a coward and that I was afraid to trust myself to the parachute. While I would hate to admit the first of these charges, I fear that I must plead guilty to the second.

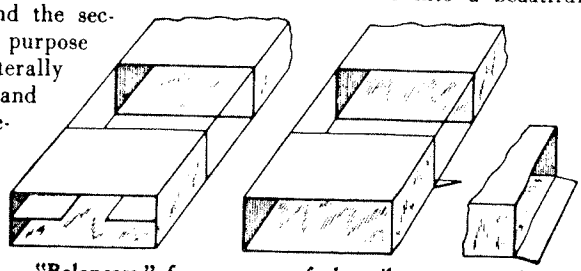
Repeated experiments and numerous ascents resulted in much improvement in our apparatus and in methods of harnessing the tandem but, among other troubles which were accentuated with the heavily loaded kites, was the difficulty of making them fly on an even keel and at desired angles so the different tandems would not interfere with one another.

We therefore introduced, between the lifting surfaces of the forward cells, auxiliary planes or panels which could be adjusted to desired angles to equalize pressure on the two sides of the kite or to make it fly at a desired angle. Later, we placed these panels along the back edge of the lower forward lifting surface. We called these auxiliary planes "balancers" but, as a matter of fact, they were what afterward came to be known as "ailerons," the first similar to the Curtiss and the second to the Farman. Their purpose was to balance the kite laterally or to send it up or down and that is exactly what ailerons are for in the modern airplane with which we were then unconcerned.

Heretofore, Jimmy's ascents, as well as those of my assistants and myself, had been made suspended from the main kite-line but now we began experimenting to the end that a man might ride in the kite, between the forward lifting surfaces or in the chair close up to the kite. For this we used a very large kite and Jimmy, somewhat reduced in weight, was the aeronaut. Poor old Jimmy! He could be repaired, so he always had to try things first. He went aloft repeatedly in different positions but never so satisfactorily as by our earlier methods. The introduction of weight into the kite upset the balance and Jimmy was, of course, not competent to adjust the ailerons while in flight.

We had now satisfactorily established the fact that kites could be advantageously used for carrying aloft signal apparatus, photographic apparatus, meteorological instruments and even a man; that they could be used for running out telegraph wires and cables or even for suspending them and we might have been content simply to improve upon this progress but for an accident.

One day, while handling a large kite of the Eddy type in a high wind, I was lifted five or six feet clear of the ground. To avoid being thrown backward on the kite and smashing it, I reached up and seized the cover at the cross-sticks. This depressed the top of the kite and it went into a beautiful glide forward, landing me gently some yards from where I had stood.



"Balancers," forerunners of the aileron, were developed by the author to afford control of the kites

We at once took the kite to the top of a nearby parapet, some ten feet high, where, facing the wind while my assistants held the kite horizontally over me, I grasped the cord at the intersection of the sticks in one hand and the cord to the lower point of the kite with the other. Then I jumped forward and glided to a gentle landing 50 feet away.

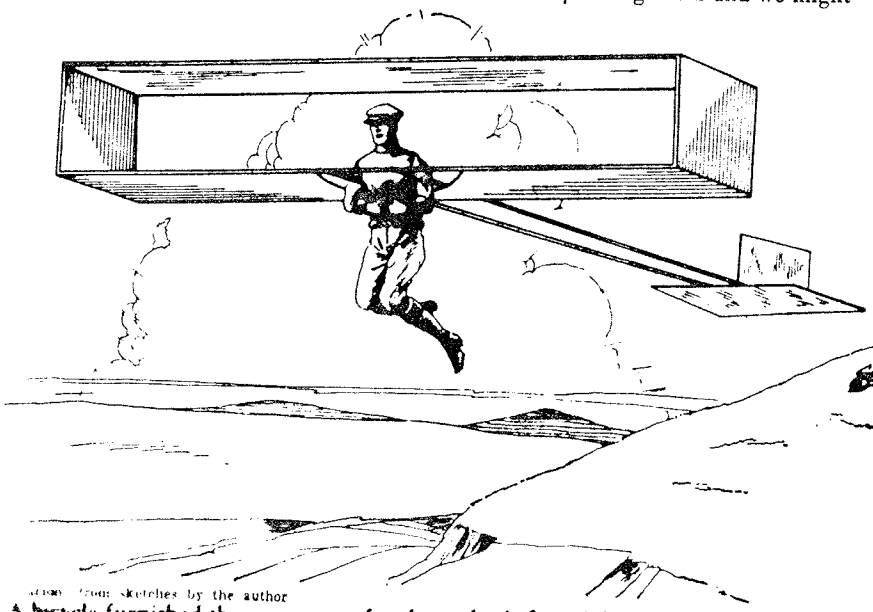
FASCINATED with the sensation of actual flight and realizing that the length of the glide could be increased by rapid motion forward at the take-off, I took my bicycle to the top of the ramp of the old fort. There I mounted, my assistants holding the kite while I took the cords as before. At my signal they let go and I pedaled down the steep incline. Near the bottom, I depressed the tail of the kite, drew up my legs and let go the bicycle and I felt myself lifted and gliding forward.

This glide, however, did not end in a gentle landing but with a bump which wrecked the kite and well nigh sent me to the hospital; but I had glided, or flown if you will, by purely mechanical means.

My interest being thoroughly aroused, I now found myself looking upon my kite experiments as merely directing toward this more interesting phase. When a kite flew without a cord, it was a glider. If a glider could make its own supporting wind, it would be a flying-machine. Why not?

We went to work in the shop producing many small models which were first flown as kites and then tested as gliders by running them down an inclined wooden runway. Finally, the most satisfactory of these was reproduced in size sufficient to support the weight of a man.

(*Please turn to page* 251)



From sketches by the author

A bicycle furnished the momentum for the author's first glider flight. ". . . . I [illegible] lifted . . . and carried 20 feet up, while I still went forward . . . ."

Sil-Fos melts readily at 1300 degrees Fahrenheit. This is even lower than the melting point of silver solders containing 50 percent silver, which require from 1400 degrees to 1600 degrees Fahrenheit.

Sil-Fos is free flowing, penetrates quickly and alloys with adjacent metal, making a strong, sound bond. When used with borax flux, which requires a heat of about 1400 degrees momentarily, Sil-Fos becomes even more fluid. At this higher temperature its free-flowing, penetrating qualities are enhanced.

These qualities also lead to economy, since only a small quantity of this new brazing alloy is required. In fact, only a film is needed when joints are tight fitting. Laboratory tests on copper-to-copper lap joints made without using flux have shown an average tensile strength of 33,000 pounds per square inch, with an elongation of 17.2 percent in two inches.—*A. E. B.*

FLYING IN THE BEGINNING

(*Continued from page* 213)

This device had a front cell like the front cell of our kites but it was completely framed to give it rigidity. In place of the rear cell there was a pair of intersecting planes, perpendicular to each other; one was vertical, for holding the head of the glider to its course; the other was horizontal, for regulating the angle of incidence. The central spine consisted of two stout strips which rested upon the frame of the lower lifting surface, about two feet apart in front and coming together at the rear, and it was trussed with piano-wire.

An opening in the cover of the lower surface permitted the bicycle rider to put his head and shoulders up between the two spine-sticks upon which he could rest on his arm-pits while his arms extended down to enable him to grasp the bicycle handles. His head and upper body were therefore within the forward cell while his legs projected below.

When he left the bicycle or, rather, when it left him, he could by shifts forward or backward, by bends, squirms and acrobatic contortion regulate, to some extent, the angle of flight and the balance of the glider.

In the light of subsequent advances, this was a crude contrivance but we seem to have been "getting warm" in our search and a glance at the sketch will show that the machine was strikingly similar to those which, later, were to fly.

Trials soon emphasized a difficulty which we had, of course, anticipated. A kite or a glider must be sustained by air pressure on its lifting surfaces. With a kite this is accomplished by holding these surfaces against the wind by a string. For a glider to rise it must have an air-speed forward to replace the cord pull and we had no means of getting this speed except by the bicycle whose ground speed, especially when retarded by the glider it carried, was not in itself sufficient. We could add to the air-speed by running down the ramp of old Fort Columbus against a wind but calculation showed

Occasions when a gale like this was blowing in exactly the right direction were not frequent but we practiced to be ready and lost no opportunity when it did come.

Pedaling down the steep incline against even a moderate wind I could feel the glider tug and lift and had learned much of my lesson before the necessary wind came. When, one day, we had the longed-for gale, to my delight I felt myself lifted from my saddle and carried 20 feet up while I still went forward with the momentum. Sliding, twisting, and squirming on the arm-rests, I managed to keep the contraption right-side-up and we went into a glide for a little way until it turned over and landed me with a bump on a smashed machine.

Days were spent on repairs and changes until another favorable gale gave us another chance. In this we had more success but the test ended as before with a bruised experimenter and a broken glider.

Time after time this was repeated and never did my housekeeper need kindling wood nor cleaning-cloths but the gliders were steadily improving and I was becoming more skilful in their handling. Finally, one day in the spring, a test, the last one we made that year, resulted in a sustained flight of 200 yards with a rise of about 40 feet—very little when compared with the recent sustained glide of twenty-one hours by Lieutenant Cocke but enough, at that time, to give us great elation and high hopes.

EARLY in the summer of 1897, my detail at Governors Island ended and I returned to my regiment at Madison Barracks, New York. I took with me the paraphernalia for continuing my experiments but my duties gave no opportunity to use them until winter. Winter on the Canadian border is no time for such work out of doors but I spent much time in my shop preparing for spring. Much of my work was, of course, with models, some of which were tested in a crude wind-tunnel through which the air current from extemporized electric fans was blown.

One model I equipped with a motor consisting of twisted rubber bands which drove a little two-blade propeller. This little machine could rise and scud along for a considerable distance and, though now comparable only to common toys, it was then a scientific curiosity. At least it proved to my satisfaction that all that was needed for the construction of a practical flying machine was exactly what we did not then have—a motor light enough and strong enough to do the work for which we were then depending upon the wind.

My spring experiments never took place for, in April, my regiment went to Florida for mobilization with the Cuban Expedition. Possibly I owe my life to this because fighting Spaniards may have been safer than experimenting with gliders.

Four years later, when I returned from the Philippines, Chanute had made a successful glider. Wright had improved upon it and was harnessing it to the recently perfected gasoline engine. The kite had dropped its cord and become the glider. The glider was manufacturing its own wind to be an airplane. Today, the autogiro is attacking the problem of rising and land-