

taking my seat in the chair, I was hoisted to the pulley. The line sagged badly, so that I was at a height of only about twenty feet. In a few minutes the breeze died out considerably, and I was lowered to the ground, where I waited for the wind to freshen.

After a short wait the wind rose to seventeen miles an hour, and when I was hoisted to the pulley there was not a great sag in the line. Grasping the halyard, I made it fast to the chair, and gave the signal to the men at the windlass. As the rope ran out the kites bore me up until I was as high as the neighboring houses, when I signaled to stop the windlass. A measurement of the trailing rope showed a height of forty-two feet from the ground to the chair. The sensation was not at all unpleasant—a gentle swaying and lifting not unlike the motion of a swing. I was tempted to go higher, for there would have been no difficulty; but I was not provided with a parachute, and I did not wish to run any unnecessary risk. After remaining aloft a short while and observing the action of the kites, I signaled to wind in, and when near the ground I was lowered by the pulley, with the satisfaction of knowing that this experiment at least had been a success, and that it was the first kite ascension in the United States.

In this ascent the lifting-area was:

	sq. ft.
C.....	22.6
F.....	40.0
B.....	90.0
E.....	160.0
Total.....	312.6

The weight lifted:

	lbs.
Four kites.....	59
Ropes.....	20
Chair and man.....	150
Total.....	229

The tension on the cord varied from 300 to 500 pounds. The angle from the windlass to the seat was 32° .

I am not altogether satisfied with the experiment, and I now see how many improvements may be made; but as a result of it I believe a kite can be built that will safely carry a man.

It is nonsense to suppose that the kite can ever replace the captive balloon, for in its very nature it is dependent upon the wind. On the other hand, a kite of the proper form, with a frame of steel tubes—for these offer great advantages of strength and lightness—and covered with strong cloth, can be safely used in a wind that would render an ascent by a captive balloon most hazardous, if not impossible. Such a kite can be made portable, its cost is relatively small, the expense of an ascent is nothing, and I think it highly probable that it might be a valuable accessory to the balloon service.

Again, there are instances where the balloon cannot be used on account of its size, such, for instance, as on a small war-ship. A tandem of ten folding cellular kites, each of about thirtysquare feet lifting-surface, could be stored in a small space, and could be sent up with a man, even in a calm, by the wind pressure due to the speed of the ship, affording the man an opportunity of observing everything within the range of a telescope.

To signaling with kites the same objection holds true—the wind is too uncertain to be relied upon. But occasions might arise when large flags or bright lights high in the air would prove valuable.

On the whole, the kite, though not a new invention, is new in its development. It has proved itself most efficient for some purposes, and doubtless the scientific study which it is now receiving will soon render this old toy an apparatus useful for many purposes of peace and of war.

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PHOTOGRAPHING FROM KITES.

INCLUDING ACCOUNTS OF THE FIRST PHOTOGRAPHING FROM KITES AND OF THE FIRST TELEPHONING AND TELEGRAPHING THROUGH A LINE HELD BY KITES.

ON May 30, 1895, at Bayonne, New Jersey, I obtained my first photograph by means of a camera suspended from a kite-line. This was undoubtedly the first aerial kite photograph of any kind taken in the Western Hemisphere. My instantaneous camera worked too

readily, however, making the first exposure too near the ground, although I sent the camera up several hundred feet, supposing the exposure had not been made. I first used a dropping lead weight with a fall of about six inches to operate the shutter, the detach-

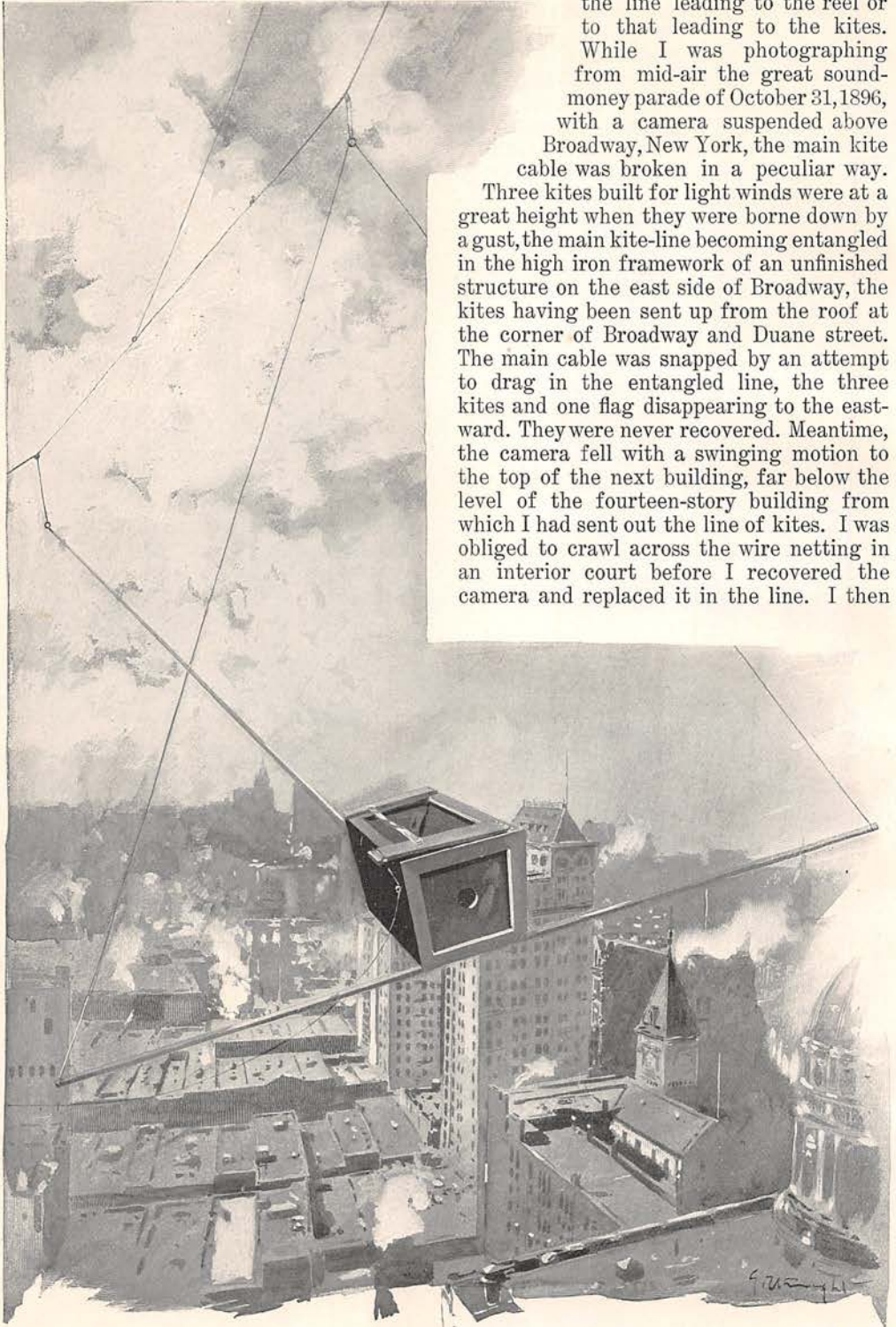
ment resulting when I pulled a special string running up from the earth; but I found that the fall of the weight detracted from the clearness of the picture by jarring the camera, and that the camera shutter would now and then be forced open, causing over-exposure and the destruction of the picture. I soon substituted an arrangement whereby the shutter could be snapped by means of a gradually increasing pull, which lessened the number of accidents and at the same time steadied the camera. My first bracing apparatus, or fastening to the upward-slanting kite-string, included a projecting spar which clearly indicated from below the direction in which the camera was pointing. I was forced to give this up, however, because the spar became unexpectedly part of the photograph. I finally used a triangular kite-stick frame guyed into my main kite-line in such a manner that a relatively horizontal view was taken. When the camera would rise no higher I would pull the special thread-like string leading up from the earth, snapping the shutter, and at the same time dropping a metal ball, which remained hanging by a



DRAWN BY G. WRIGHT.

TELEGRAPHING WITH THE AID OF KITES.

string six feet long. The gleam of the polished metal as the ball changed position, and its fall, could be seen at a great distance, although the signal-ball was only two inches in diameter. I have since discontinued this signal, as I found that the time was too valuable to waste in adjusting it, the dangers of a declining wind, of a break in the main line owing to a gust, of distortion of the bracing frame, with other perils, making it imperative that I should send up and draw in the camera as rapidly as possible. The chief danger in mid-air kite photography is that the strong pull of forty or fifty pounds used to lift the camera may break the line. This strain may be more than tripled any moment by a gust. In such an accident the camera does not fall directly, but swings downward with a pendulum-like motion, because it remains attached either to



DRAWN BY G. WRIGHT.

EDDY'S AËRIAL CAMERA.

the line leading to the reel or to that leading to the kites. While I was photographing from mid-air the great sound-money parade of October 31, 1896, with a camera suspended above Broadway, New York, the main kite cable was broken in a peculiar way.

Three kites built for light winds were at a great height when they were borne down by a gust, the main kite-line becoming entangled in the high iron framework of an unfinished structure on the east side of Broadway, the kites having been sent up from the roof at the corner of Broadway and Duane street. The main cable was snapped by an attempt to drag in the entangled line, the three kites and one flag disappearing to the eastward. They were never recovered. Meantime, the camera fell with a swinging motion to the top of the next building, far below the level of the fourteen-story building from which I had sent out the line of kites. I was obliged to crawl across the wire netting in an interior court before I recovered the camera and replaced it in the line. I then

continued my mid-air photographing until nearly 5 P. M.

The perils threatening a camera in mid-air are many, and increase rapidly with altitude. In August, 1896, a careless knot, tied by a well-meaning spectator when I was not looking, caused the descent of my camera into a tree-top on Boston Common. The camera and runaway kites were rescued with great difficulty, in the presence of a large crowd, in Beacon street. The films were not injured by the fall, and were afterward successfully developed. I think that glass plates would have been broken.

At Bayonne my camera has been lodged in telegraph wires, dragged through tree-tops, and bumped into the ground. The most usual accident is the chance catching of the shutter-string in weeds, prematurely springing the shutter.

The danger of falling from one's point of vantage is one to be borne in mind constantly by kite-fliers in cities. Of the six high buildings from which I have sent out my kites, all but two had parapets or walls protecting nearly all the edges of their roofs. Two of the buildings had low boundary walls, but were otherwise safe. The most dangerous roof I ever encountered was in Jersey City, where I flew kites in the darkness, and sent out colored clear-glass lanterns above the North River, during the great naval parade on the evening of October 24, 1896. This roof was not steep, but it had no protecting railing near its edge. Fortunately, the vague outlines of the chimneys gave me an indication of the outline of the roof. In two instances I have been obliged to run a protecting cable eight or ten feet within the roof boundary. While handling single kites in light winds I am often compelled to back toward the parapet while looking up at the kite to be sure that it still continues to rise. When removing the adjustable spools of cable from the reel I usually hold the kite strain of forty or fifty pounds temporarily by hand until another full spool is placed in the reel, which ordinarily I lash to a flag-pole or other projection. Should the line break, and this at times happens, I should be precipitated over the inside guard-line, and not over the edge of the roof. In case the kites are sent out before an inside guard-line is in position, I usually make fast to any railing, and then pay out around a flag-pole while facing the sheer descent to the street below. Then if there should be a break in the line I would fall toward the center of the roof, and not over a low parapet or cornice into mid-air.

From long practice at Bayonne, where the kites are sent out from vacant lots, and where I have had some severe falls over stones and other obstacles, I now keep up a double watch upon the declining kites and upon the nature of the ground over which I am backing, as well as upon the positions of telegraph wires, tree-tops, roofs, and chimneys. A stumble or fall when the kites are exerting a strain of fifty pounds, with the line cut to insert the camera, may cause the escape of the line and the recession of the kites to a great distance. Twice mine have escaped from Bergen Point and crossed the Kill van Kull diagonally to Staten Island, about two miles away.

When sending up my line on high buildings I have many reserve kites; and unless the camera also escapes, I let the runaway kites go, and send up a new set of about the same weight and adapted to the same wind-velocity. They are all tailless, and need that appendage only when they are badly made. Very light winds call for kites having thin paper and thin sticks, while powerful winds call for cloth and heavy bracing at the center of the kite. The fragile light-wind kites are constantly being destroyed by sudden increases of wind-velocity, while the strong-wind cloth kites usually last for years.

The rush of light into a camera high in the air is apt to cause over-exposure; and when a very high altitude is attained above a smoky city, the buildings photographed are not so clear as those taken when the camera is nearer the roofs. In some instances the foreground will be perfectly clear, while the distance seems to suffer from a slight waver of the camera. Sometimes the ground appears to be whirling, giving only fragmentary glimpses of objects, while in extreme cases there is nothing but a rotary streak. Occasional map-like vertical views are desirable, yet it is usually better to get a perspective horizontal view, which is more interesting. The mid-air camera, even with an ordinary lens, makes buildings and scenes look not so far away as they are. In a photograph taken with the camera above the City Hall, New York, the heights of Brooklyn look very near. The effect is like a mirage, a distant landscape, ordinarily invisible, seeming to rise into the sky. Some pictures have been taken diagonally, as if the square film were purposely held in a position resembling the shape of a diamond, while others appear to be tipped slightly, and some are perfectly square and regular, as if taken by hand from a tripod.

In winter the difficulty in handling heavy

strains is greatly increased. There is danger of slipping in the snow when the line is cut to insert the camera. The pull as the camera is about to start upward is always very strong, as we have seen; and should the person temporarily holding the line lose his footing, the whole line would escape. I have not yet sent out kites from a snow-covered roof in a great city, all my kite photographs in winter having been taken at Bayonne; but I believe that excellent and very novel photographs can be taken of the city's whitened roofs, with glimpses of snow-laden trees in the parks. In light winds, when the kites sink downward, much of the line would be on the roof and be damaged by melting snow, because moisture deteriorates the twine very fast. No appreciable damage will be caused if the temperature is below the freezing-point, because the snow will then be fairly dry. In open ground the line does not become seriously wet unless trodden into the snow during a thaw. While photographing with the camera sustained by kites on Christmas day, 1896, with deep snow on the ground, two or three kites were left on the surface of the snow during most of the day without damage. They were discarded as not having the right weight to fit the wind, which was deceptive in that it was strong aloft and light at the earth. I did not find this out until the topmost kite had risen to an altitude of about a thousand feet. At times when snow was falling I have had my kites in the air, but they were generally borne down by the accumulation of snow on their upper surfaces, which gathered faster than I could shake it off by vibrating the line. In time such snow usually wets the kite-cable. During my first experiment with a kite in the rain, I soon found that even a paper-muslin kite became very heavy from the soaking that it got, and that a wind of twenty miles an hour was hardly strong enough to sustain the kite, which attained a height of 568 feet, and remained in the air about two hours. The line became so heavy with rain that the kite would not rise very high. With a very strong wind and a powerful kite flown from wire, I believe that high altitudes can be maintained for hours in the rain. During a downpour in winter the reel can be easily pinned to the earth with iron pins, except toward spring, when much hammering is required to force the pins into the frozen ground.

A complete view of the horizon can be taken at one ascent by arranging eight or more cameras in mid-air, back to back, on a

circular platform, and snapping them simultaneously. I have completed designs for this apparatus, and I see no more difficulty in taking eight photographs than in taking one, if lighter-weight cameras of aluminium are used. That part of the horizon from which the sun shines would fog the film unless the cameras facing in the general direction of the sun were provided with colored shading-glasses to exclude excess of light. By such an octagon camera arrangement a man-of-war beyond the horizon, within a distance of twenty miles, could be found. In fact a group of cameras can be prevented from twisting, and a chart on the deck would give the number of the camera containing the negative of the distant man-of-war. At a height of nine hundred feet the horizon at sea is visible forty miles away. The hull of a vessel would be seen at a much greater distance than on land when photographed from aloft, because the dark landscape affords less contrast of light and shade, except in winter when snow covers the ground. Such a mid-air camera has some of the characteristics of the search-light, in that it discloses objects otherwise invisible.

Before the camera is sent into the air one should take into consideration the direction in which the kites are flying, the direction of the sun, the direction of the building or scene to be photographed, and the freedom from cloud shadows. The camera can be made to point anywhere. It is aimed at the object to be photographed before it is sent up, allowance being made for its probable position when in the air as related to the steepness and direction of the kite-line. It is often directed at right angles to the point toward which the kites are flying. In this way I am able to include a particular building in the view, with only a slight margin of uncertainty. The camera is often suspended behind the kite-line, and photographs it. It is difficult to place the camera above a street like Broadway, New York, because the distance to the camera cannot well be judged by the eye, and there is usually no time for measuring the cable paid out. The camera often points in such a way that I am included in the view while pulling the camera string. Street views from high buildings ought to be taken at noon, before the declining sun has cast the surface of the street into deep shadow. The camera in the air always looks farther away than it is; and in my anxious effort to get a view of the great sound-money parade in Broadway I overshot the mark several times.

The mid-air kite camera would be useful in time of war. The gas is forced out of a captive balloon in a high wind, taking away its ascending force at a time when a kite will do the work. Kites cost far less than balloons, and it is a fact that they can be flown during nearly every rainless day in the week, and even in the rain if the wind is strong. An enemy's encampment beyond high hills could readily be photographed and the negative developed in fifteen minutes. A print by electric light can be made in two hours, and by sunlight in less than five minutes, after the development of the negative.

In the autumn of 1895, in coöperation with Mr. J. Woodbridge Davis, I used my kites to float messenger buoys across the Kill van Kull. Mr. Davis's well-known live-saving kites, having been built for storm-winds of the open sea, were, as a rule, too heavy for coast use, and so he decided to use my tandem kite apparatus, because my kites, if rightly made, fly steadily in winds of from four to fifty miles an hour. The messenger buoys, both with and without keels, were towed by the kites rapidly to Staten Island, demonstrating the value of the Davis buoys for carrying messages ashore from ships. The keel-buoys floated at nearly right angles to the pull, thus maintaining the kites in the air even in light winds.

On the night of December 5, 1896, at Bayonne, probably the first kite telegraph and telephone messages were sent over a mid-air wire. Dr. William H. Mitchell, the electrician of the experiment, and Mr. Henry L. Allen were associated with me in accomplishing this difficult feat. The three kites, two seven feet and one six feet in length, were sent up at 4:30 P. M., held by a cord reel pinned to the ground with iron pins. The altitude attained was about one thousand feet. The kites were left in the air until 7 P. M., with the usual safety-lantern signal attached to the line, to notify me of the descent of any of the kites in the darkness. The thin electric wire, to the end of which a plummet lantern was fastened, was paid out through a pulley held high in the air by the kite-cable. The kites and wire were thus paid out and away until the plummet lantern carried down the wire beyond trees, telegraph wires, and houses, enabling us to attach telephones at each end of the wire. The voice of Dr. Mitchell came to me over the

wire, and was heard in the telephone with great clearness; and conversation was continued until nearly midnight, when the kites and wire were all drawn in. No battery was used in telephoning, the weak currents from the magnets in each telephone operating the line, with the probable assistance of earth and atmospheric currents, as shown by the clearness with which sounds and distant voices were heard. The apparatus could undoubtedly be used to drop a telephone wire over the heads of a besieging army in the darkness; but owing to differences in the direction of the wind, it would be necessary to communicate from the circumference of a circle. The changes of wind in a week would enable a party within a fort to drop a wire at a given point outside. Indeed, this could be done at once if the wind happened to be in the right direction. A white disk, which would be visible only to those looking for it as it approached the earth, could be sent aloft at night in place of the plummet lantern. The wire would drop its telephone to those expecting it in the besieged fortress.

In 1892 my first electric spark was drawn from a copper wire festooned to the kite-line and connected with a tinfoil-coated rectangular collector suspended aloft on the kite-cable. The power of the spark was greatly increased by means of a coil passed around soft iron. Archibald of England, who was the first to use steel wire for kite-line in 1884, complained of unpleasant shocks of electricity. During more than four years I have experimented almost incessantly with electricity drawn from kite-wires, and I find that the sparks cause an unpleasant sting. At Blue Hill Observatory, near Milton, Massachusetts, where I introduced my kites in 1894 with the courteous permission of Messrs. A. L. Rotch, H. H. Clayton, and S. P. Fergusson, owing to the dryness of the rock at the summit of the hill, the observers at times grounded the electricity by connecting their kite-wire with another running down the hill.

The impact of sparks from my kite-wire produces slight mechanical motion. This force, which interferes with those who use wires for kite-flying, will in time operate delicate appliances, enabling the mid-air photographer to change his films or glass plates and operate the shutter of his camera without hauling it down to the earth until the end of the experiment.

William A. Eddy.