EYE IN THE SKY

by

J. R. QUICK

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Un roman de Rétif de la Bretonne.

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"EYE in the SKY"

INTRODUCTION

From the dawn of history, man has striven to release himself from the shackles that made him an Earth-bound creature.....In Greek mythology, we read of that cunning architecht and sculptor, Daedalus, who fashioned two pairs of wings from feathers and wax, so that he and his son, Icarus, could escape to Sicily from their imprisonment on the island of Crete. They flew away with the wings fashioned to their shoulders, but Icarus, according to the myth, fell into the sea when the sun melted the wax on his wings (Figure 1).

Retif de la Bretonne, in his work on the subject[1], provides a picture of a flying man, with very artistically designed wings, fitting exactly to the shoulders, and carrying a basket of provisions suspended from his waist (Figure 2).

History also discloses that, as soon as man could get a "bird's eye view" from whatever height he had access to, he climbed and used his eyes .....First, he took advantage of high hills, mountain tops and towers..... and, later on, balloons, birds, kites, rockets and airplanes.

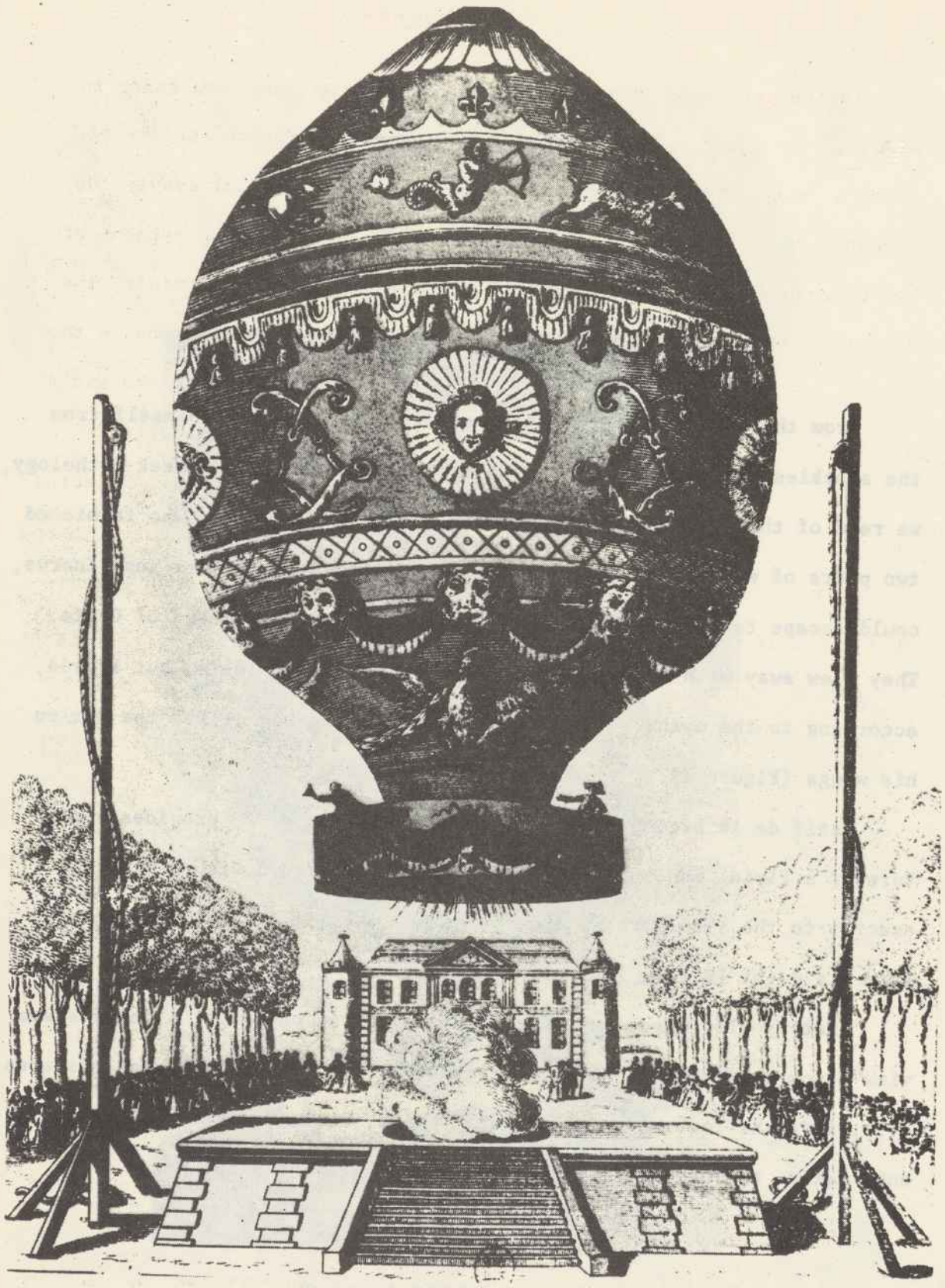


FIGURE 3 A Montgolfier (Hot Air Balloon)

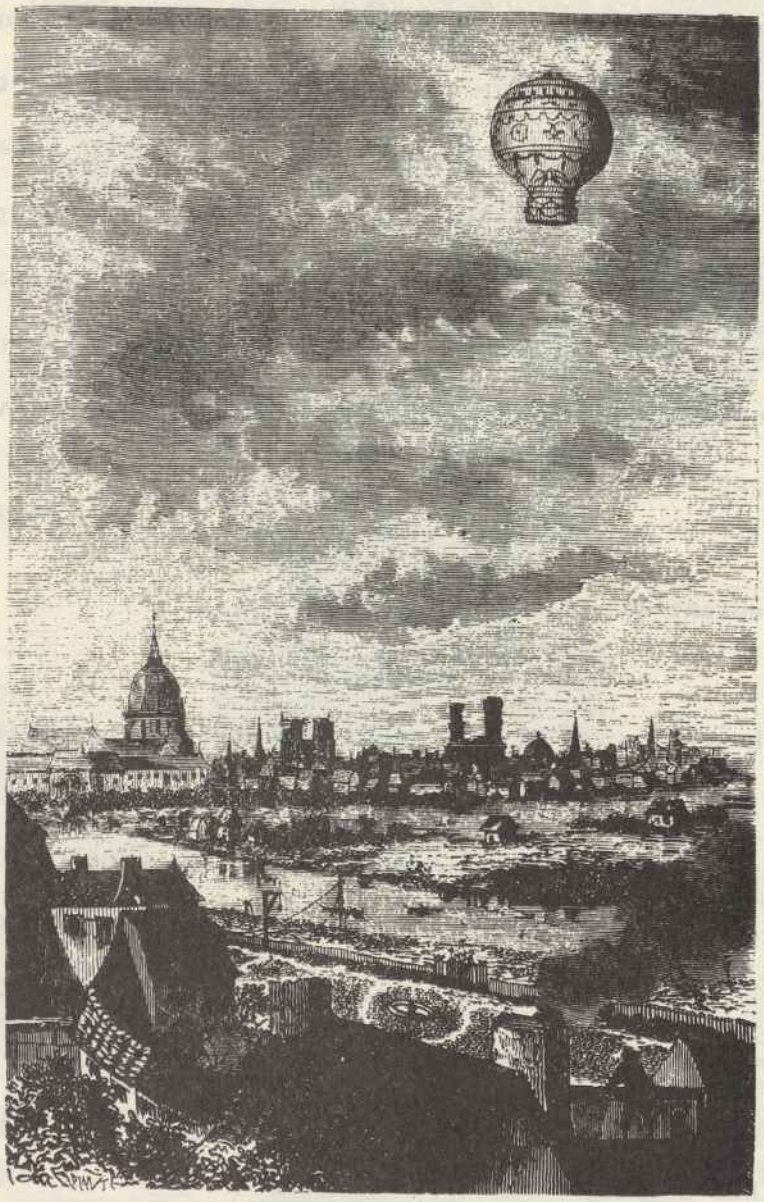
EARLY BALLOONING

In the year 1783, Benjamin Franklin, the American Ambassador to France, was chosen to serve on a committee of the French Academy of Science that had been appointed to witness a most unusual event. On November 21 of that year, the committee was present in the gardens of the Chateau de la Muette, near Paris, to see the first aeronauts, the Marquis d' Arlandes and Pilatre de Rosier, take their positions in the gallery of a Montgolfier, or hot air balloon (Figure 3). In the early afternoon, the ropes were cast off and their huge balloon rose and sailed majestically over the roofs of Paris (Figure 4). Thirty minutes later, having accomplished the first manned aerial reconnaissance voyage in history, the voyagers returned safely to the ground.[2] When asked what possible useful application could be found for such activities, Mr. Franklin is reported to have replied,

"C'est l'enfant qui vient de naitre?"[3]

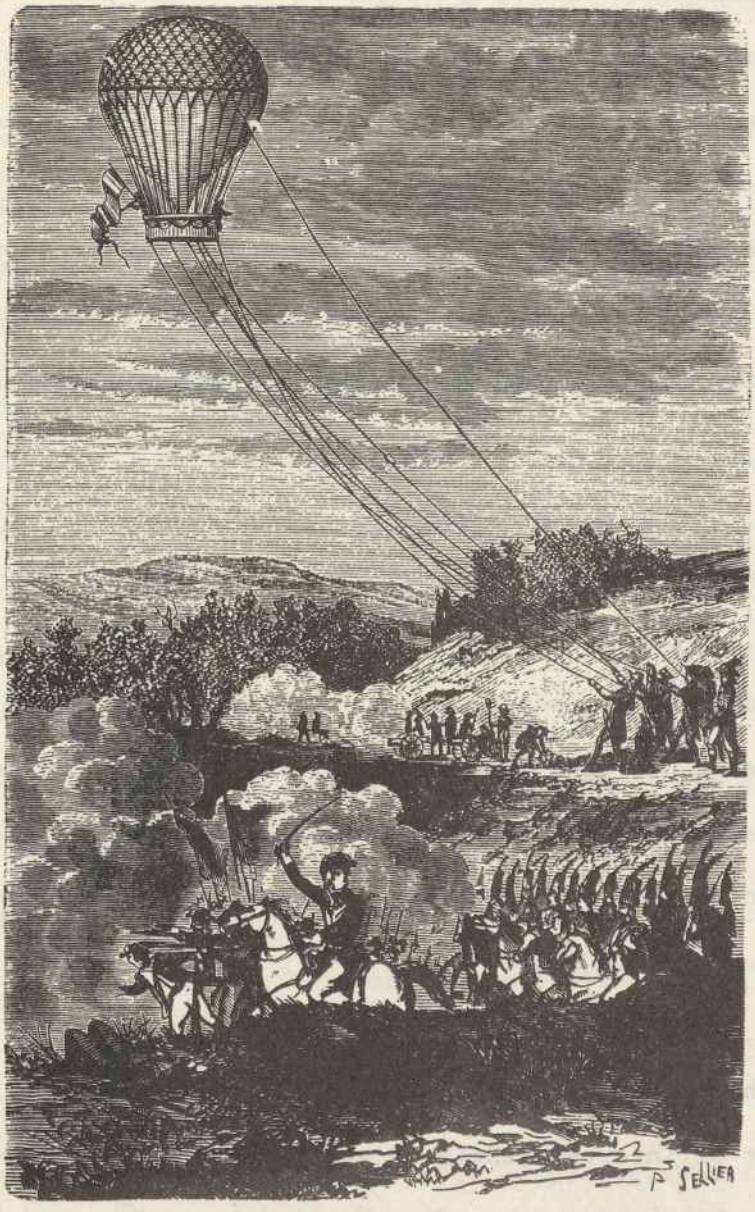
The French were quick to seize upon the military potential of aerial transport, and, at the battle of Fleurus in 1794, they were the first to use the balloon for military reconnaissance.[4] Capt. Coutelle, a young French physicist of great talent, rendered memorable service during the battle. Using a captive balloon, he took up his aerial post of observation and transmitted instructions to the men below by means of colored flags (Figure 5). Napoleon Bonaparte later established a balloon corps to serve with his armies.

The first successful manned balloon flight in American was made on January 9, 1793, by Jean Pierre Blanchard, a pioneering French balloonist



Passage du ballon du marquis d'Arlandes au-dessus de Paris
21 novembre 1783).

FIGURE 4 Ballooning over the Rooftops of Paris



Ballon qui servit aux observations militaires pendant la bataille de Fleurus.

FIGURE 5 Balloon in Use at the Battle of Fleurus

who had already figured in some of the earliest achievements to be entered in the chronicles of air travel[5] .....The site was near Independence Hall, Philadelphia--then temporary capitol of the United States. A large crowd assembled for the occasion, including President George Washington, then in the closing months of his first term as Chief Executive. It was Blanchard's 45th ascent to the skies, although his first to be made away from Europe. He had thought himself accustomed to the crowds of people attracted to his take-offs back home, but he was astonished by the sight of the multitudes he beheld as the balloon gained altitude.

> "What a sight", he is reported to have said. "How delicious for me to enjoy it!"[6]

Thus did the balloon become a favorite device for both Europeans and Americans, who soon were vying with each other to find new ways to make each ascent more daring and more entertaining for crowds at country fairs and other public gatherings. It got so bad that Scientific American reported in 1849:

> "To the shrewd man of science, balloons have ceased to be a matter of interest; their object of late has been more to amuse the crowd and benefit the adventurer."[7]

BALLOON PHOTOGRAPHY

The first known photographs were introduced in 1839 by Daguerre. Soon after that date, the science of photogrammetry was developed, although it was not known by that name. The very first reference to the application of photography in making topographic maps was about 1840, when Dominique Francois Jean Arago, the French geodesist, referred to the Daguerretype process of Daguerre and Niepce before members of the Chamber of Deputies in Paris, and advocated the use of photography by topographers.[8]

In 1849, Col. Aime Laussedat, an officer in the French Corps of Engineers, embarked upon a determined effort to prove that photography could be used to advantage in the preparation of topographic maps. His exhaustive researches and experiments, carried on over a long period of years, have caused some modern writers to refer to him as the "Father of Photogrammetry".

In 1858, he experimented with a glass plate camera in the air, first supported by a string of kites, and later by a captive balloon. In 1859, he constructed a surveying camera with known data, and plotted certain parts of Paris by a method called "Metrophotogrammetric", which, to a certain extent, could be compared to the intersection on the plane table. His attempts at aerial photography had to be abandoned in 1860, because of the difficulty in taking a sufficient number of photographs from one air station to cover all the area that the outlook commanded. Laussedat's ideas for compiling topographic maps from photographs were at first held in ridicule by most of his contemporaries. He continued with his work, however, and finally succeeded in developing a mathematical analysis for

converting overlapping perspective views into orthophotographic projections on any plane.[9]

In 1898, Laussedat published a book in which he described his research on methods and instruments for the compilation of topographic maps.[10]

Gaspard-Felix Tournachon (called Nadar) began his career as a French caricaturist and journalist; in 1853, he opened a photographic studio in Paris that was to become one of the popular gathering places of the city. Nadar had a fine regard for showmanship, as well as his reputation. It is not unusual, therefore, that he took up the fashionable sport of ballooning.[11] With the help of the brothers Godard (soon to be France's most prominent balloonists) he became a skilled aeronaut himself. Inevitably, it occurred to Nadar that he was the first photographer-aeronaut; in 1856, therefore, he filed a patent on the idea of photographing from a balloon.

His resolve, which was to "get photographic views of the earth at a certain height in the air", was accomplished despite the jeers of scoffers. Collodion plates were his biggest difficulty. They had to be coated fresh just before exposure, then be shielded from hydrogen gas which leaked downward from the balloon, causing unwanted chemical reactions. The problem was overcome by constructing, in the airship's basket, a darkroom of orange cloth reinforced by a black lining. Late one afternoon during the summer of 1858, after many repeated failures, Nadar ascended once more above Paris. The light proved unsuitable, and he had drifted out to the country. So, coming down near Le Petit Bicêtre,

he "parked" his balloon under guard overnight. Next morning, still undaunted, he went up again, and, at 80 meters, made an exposure, the first recorded successful attempt at aerial photography.[12]

"They drew me down," Nadar related. "I leaped out and rushed to the inn, where, all excited, I developed my plate."

Triumphant, Nadar emerged to show the results. Indisputably, though faintly, the negative showed the hamlet's three houses, a farm yard, the inn, even roof tiles, a gendarme, and a cart whose driver, in surprise, had drawn up right in front of his balloon.

"I was right," he concluded. "Aerial photography is possible."

Immediate capitalization on this success, was, however, hindered by Nadar's need for daily bread.

"When I was in the air," he explained, "my photographic business suffered."

Confident that he could map all of France in a few months, he tried to sell the French government on the idea of a gigantic land survey, which he planned to make with his camera and balloon, "Le Geant". To his dismay, he found that his proposal met with more laughter and ridicule than acceptance (Figure 6).

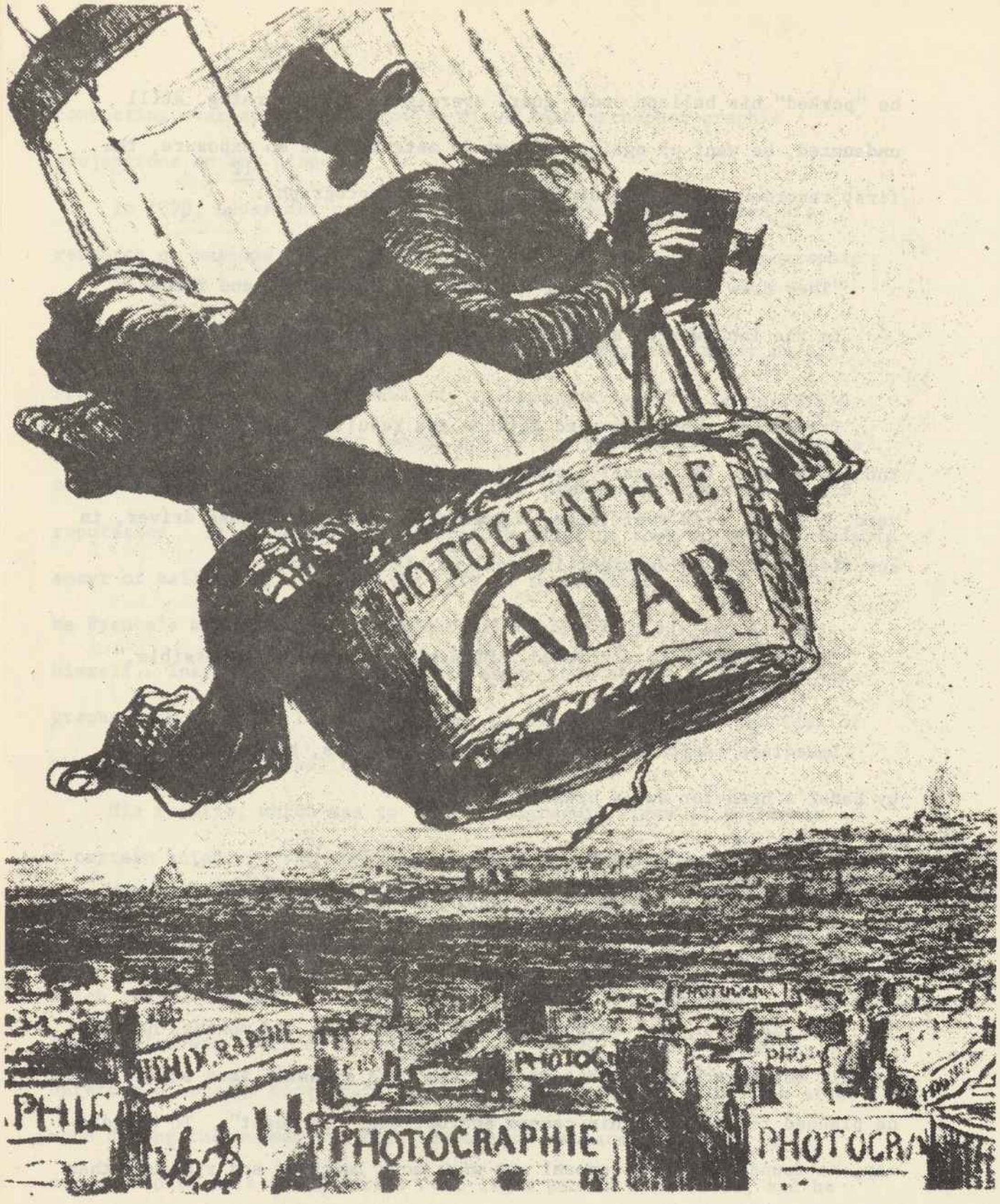


FIGURE 6 Nadar raising photography to the height of the art.

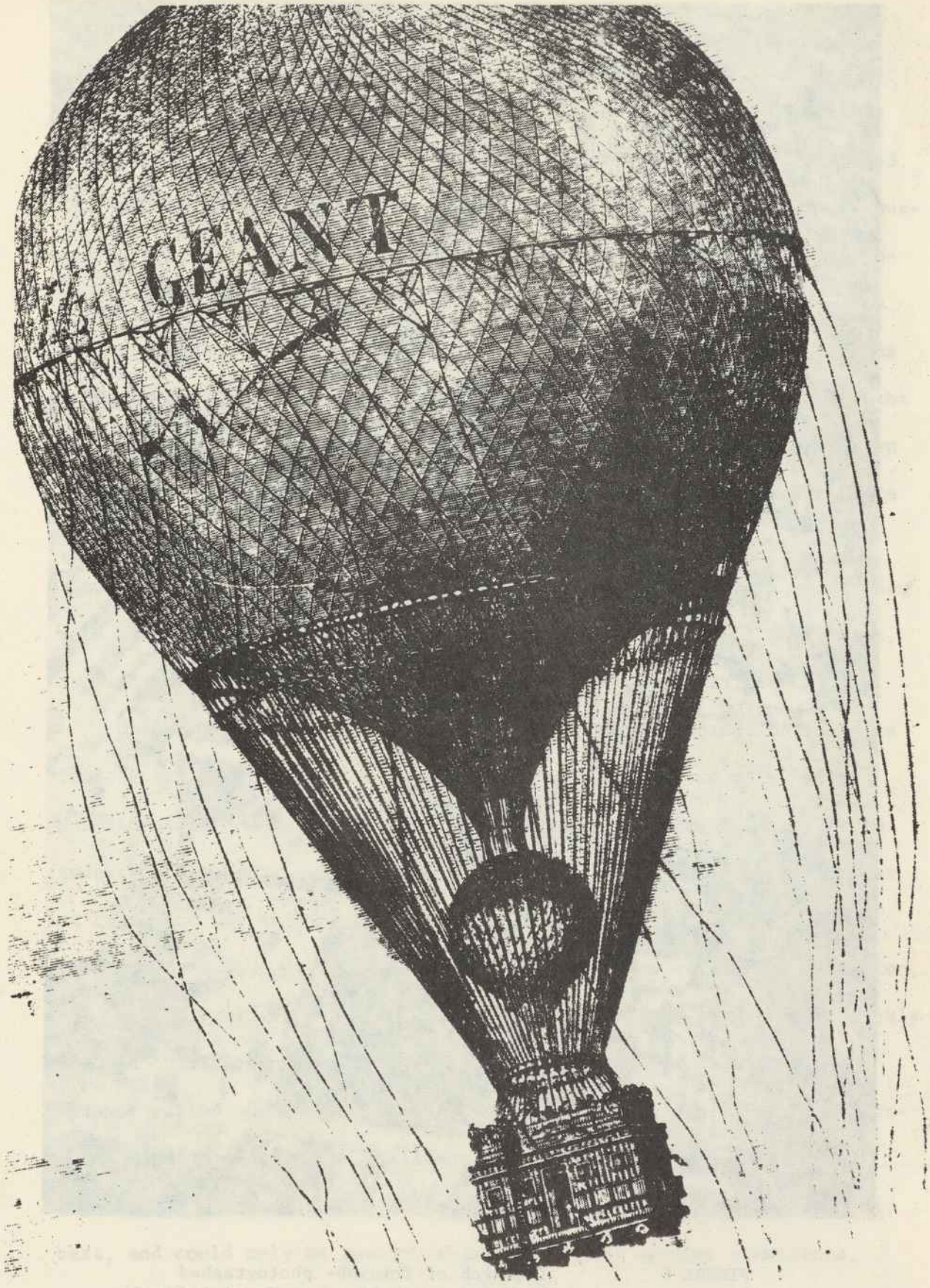


FIGURE 7 Nadar's balloon "Le Geant"

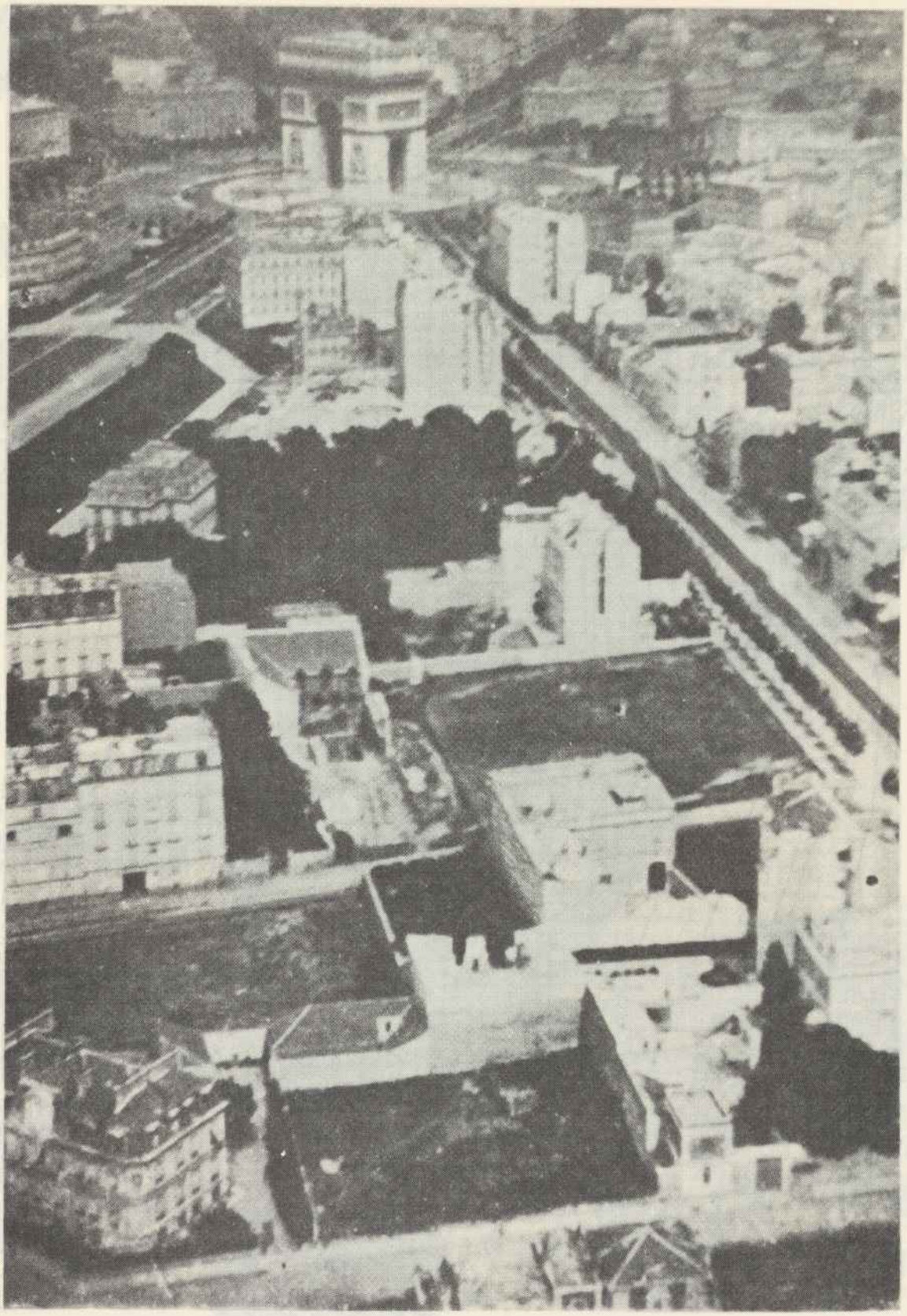


FIGURE 8 The Arch of Triumph- photographed by Nadar, probably from Henri Gifford's captive balloon in the Hippodrome.

Le Geant - "The Ill-fated Monster", "An Absurd Scheme" (as referred to by the Paris Press) was built for Nadar by Eugene Godard in 1863. Its balloon contained over 200,000 cu. ft. of gas, beneath which was suspended a monstrous, 2-storied basket capable of carrying twelve passengers (Figure 7). Its first ascent--over Paris on 4 October 1863--soon landed near Meaux after a routine flight. The second flight, two weeks later, ended disastrously in one of the most publicized accidents of the century. Mistaking a cloud bank for the sea, the pilot brought it down in a high wind near Hanover, after a 400-mile journey. The unfortunate passengers were dragged along with the gondola, as it crashed through the countryside, demolishing everything in its path. Bruises among them were many and painful, but, miraculously, none were fatal. The public, as might be suspected, soon became tired of such business....[13]

Undaunted, Nadar made many aerial photographic expeditions, and in 1868, succeeded in viewing Paris as few Parisians had seen it before. Unfortunately, he was unable to attain sufficiently regular results to undertake his "pet project"--the land survey. The photographic process at that time was not yet equal to the task of aerial photography. A balloon, even when moored at the end of a line, was constantly in motion, so that the photographer was forced to open and close his shutter quickly between oscillations of the basket. Slow collodion emulsions just weren't suited for such conditions. Although Nadar proved that a photograph could be made from a balloon, with pictures such as the one he took of the Arch of Triumph (Figure 8), it was a random proposition at best, and could only be accomplished under ideal weather conditions.

When, in 1863, the American Journal of Photography reviewed Nadar's work, it optimistically observed:

> "As the rotary and onward movements of the balloon cannot be stopped, to get rid of the objectionable defect, the camera apparatus must be made to open and close not only with the utmost rapidity, but also without vibration, sudden jerk, or shake. The plates, in short, cannot be exposed too rapidly, too shortly, nor too quietly. These are points the mechanicians will soon overcome, and hundreds of adventurous photographers will soon, no doubt, follow their active pioneer, and bring down scenes innumerable from cloudland."

Interest in balloon reconnaissance was not confined to France. America's honor roll of balloon photographers is topped by J. W. Black of Boston (probably the original "Boston Blackie"). On October 13, 1860, Black, accompanied by the noted Providence, Rhode Island, aerialist, Prof. Sam King, who served as navigator, ascended to 1,200 feet in the "Queen of the Air", and successfully photographed parts of the city of Boston on wet collodian plates.[14]

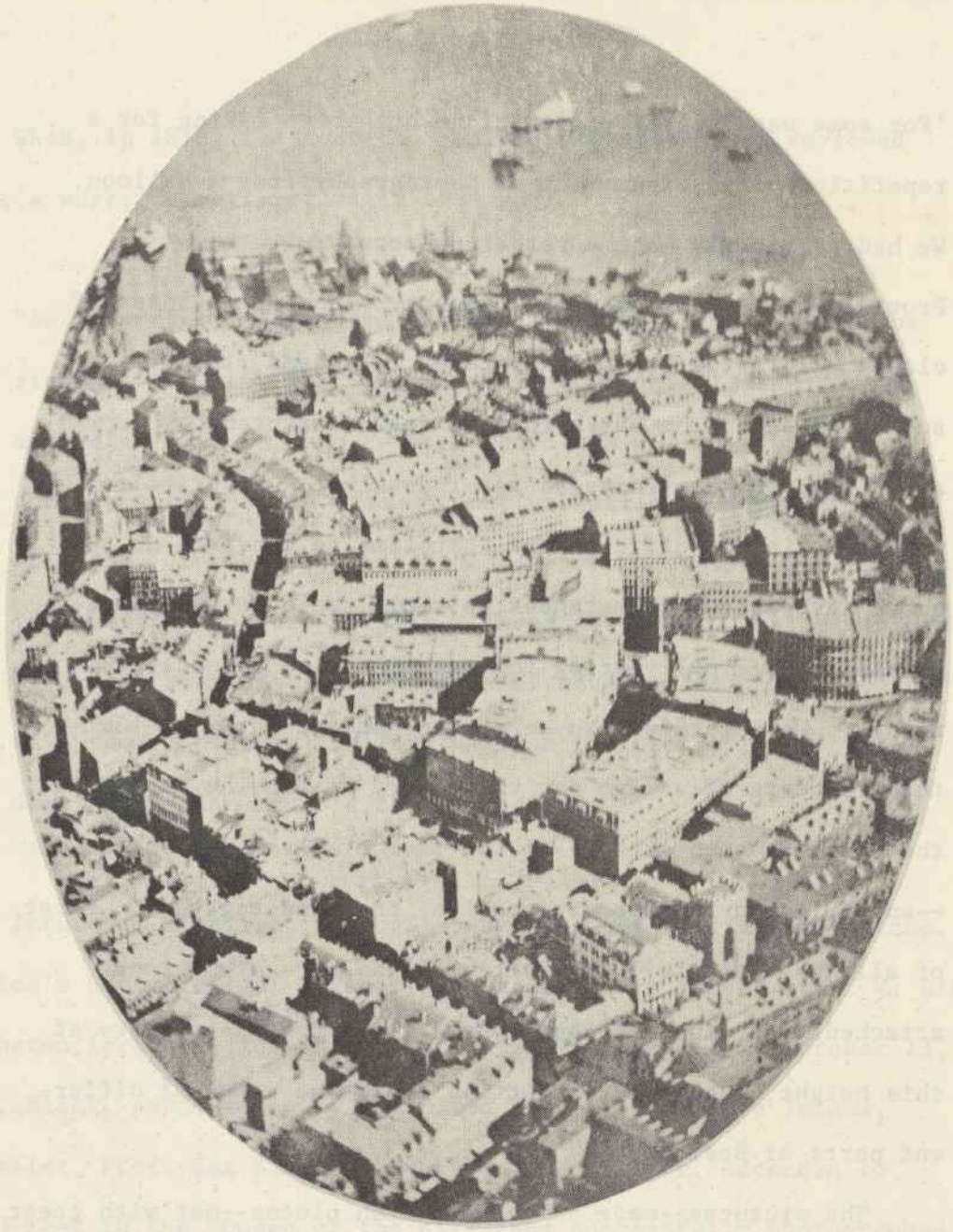
King's own account, which appeared in the Boston Herald on 16 October 1860, was quoted under the banner headline:

> "The Late Balloon-Photo Experiment: Mr. King of well known firm of King & Allen aeronauts, furnished this account:

" 'For some weeks past, preparations have been making for a repetition of an experiment of photography from a balloon. We had previously made a rather unsuccessful attempt at Providence, in consequence of the sky becoming overcast of clouds before the balloon was ready to ascend, throwing such a shade on the earth that to take instantaneous impressions with any distinctness was impossible. Nevertheless, we accomplished sufficient at that time to convince us that under favorable circumstances we could overcome all difficulties, and finally bring the experiment to a successful result. We determined to persevere, and on Saturday last--the prospects of a fine day being very flattering--Mr. Black, the eminent photo artist--of the firm of Black and Batchelder --and I, as on the former occasion, ascended together. First of all, we arose to 1,200 feet by means of a stout rope attached to a windlass, and, while remaining staitionary at this height, succeeded in getting some fine views of different parts of Boston..'..."

The pictures--made on wet colodian plates--met with great acclaim. One of these remarkable photographs, which shows the business district and the masts of square-rigged ships (Figure 9) was immortalized by Oliver Wendell Holmes, who described it with the phrase:

"Boston--as seen by the eagle and the wild goose."



BALLOON VIEW OF BOSTON.

George O. Carpenter
from Knight Allen

FIGURE 9 Boston - "as seen by the eagle and the wild goose".

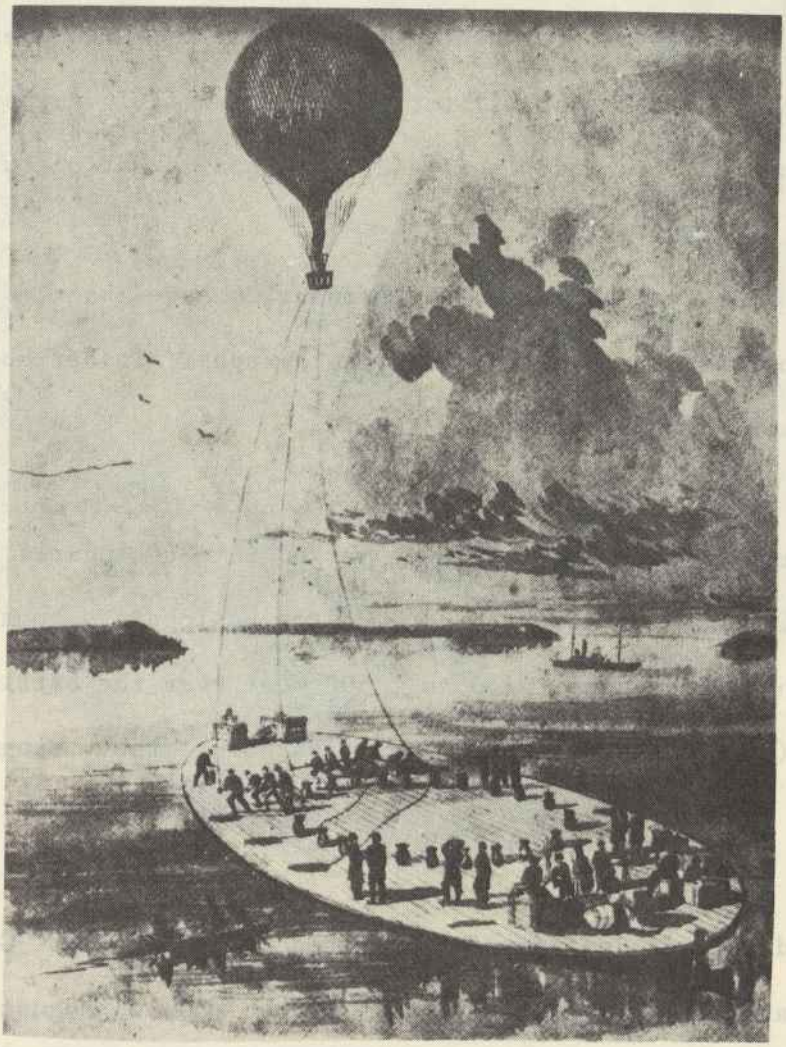
Later in the year, Black had the honor of presenting a set of his balloon photographs to the American Photographic Society. Less than a year later, members of this group were advocating military balloon photography.

Directly after the outbreak of the Civil War, in April, 1861, Thaddeus S. C. Lowe went to Washington to offer the Government his services in using balloons for military observations. In August, 1861, Lowe moved his balloon into the field and began operations with the Army of the Potomac[15] (Figure 10).

Some works[16] on the history of aeronautics have asserted that Lowe's balloon corps did make aerial photographs. In her book, Air Spy, Constance Babbington Smith states that:

> "Two prints were made, and each marked into 64 squares. General McClellen had one, and the two balloonists took the other one and ascended to 1,500 feet over the battlefield (Figure 11). From this vantage point, they telegraphed to the General the exact movements of enemy troops."[17]

The Old Records Section of the United States Adjutant General's Office contains the original "eyeball" sketch made on August 10, 1861, by the aeronaut, La Montain. A copy of his handwritten notes to Maj. General Butler appears with the sketch (Figure 12).....A reproduction of this letter is shown on page 23.



BALLOON-BOAT *G. W. Parke Custis*, WITH BALLOON *Washington*
IN ASCENSION NEAR BUDD'S FERRY, MARYLAND

Lowe Collection, U. S. National Museum, No. 30913-A

FIGURE 10

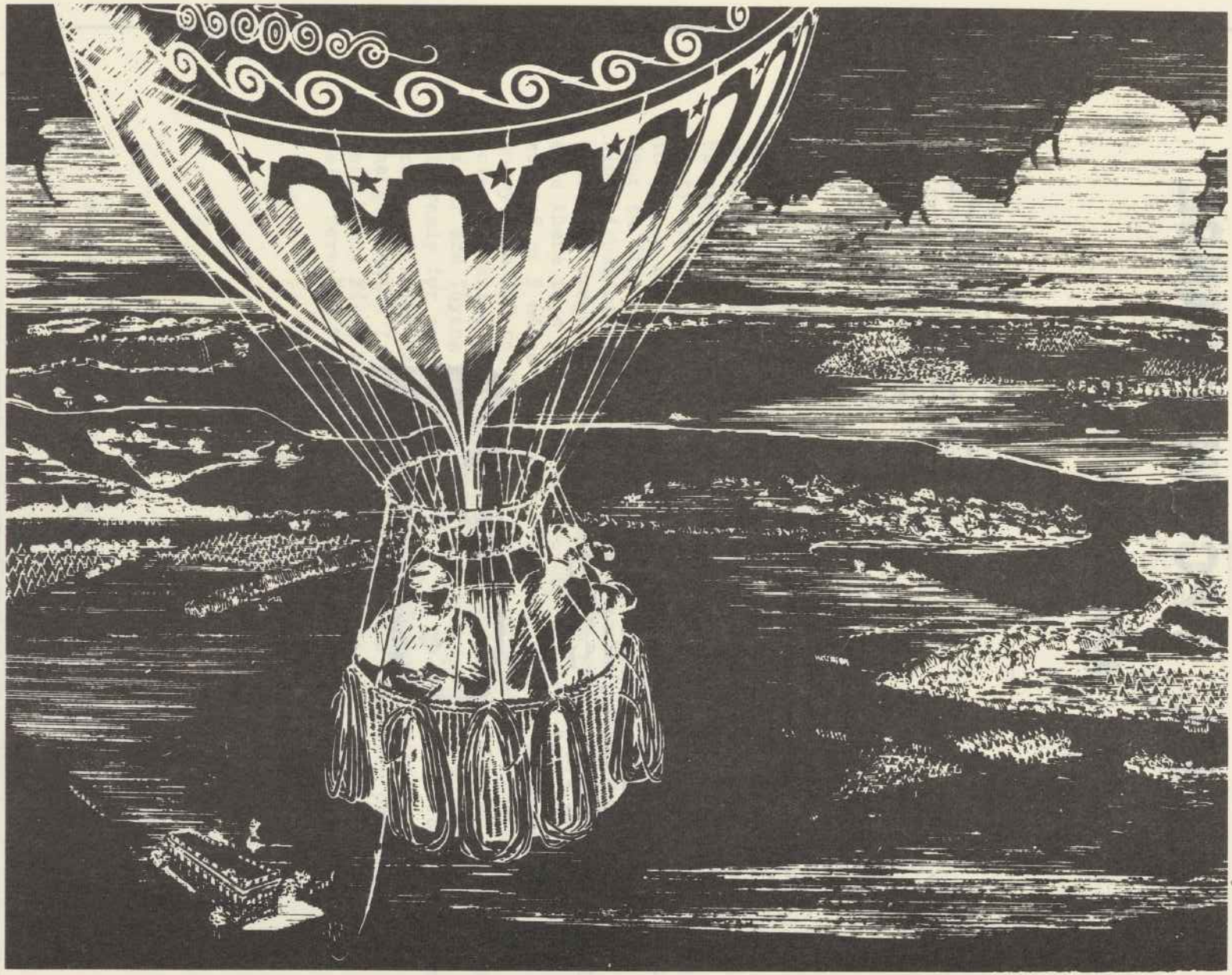
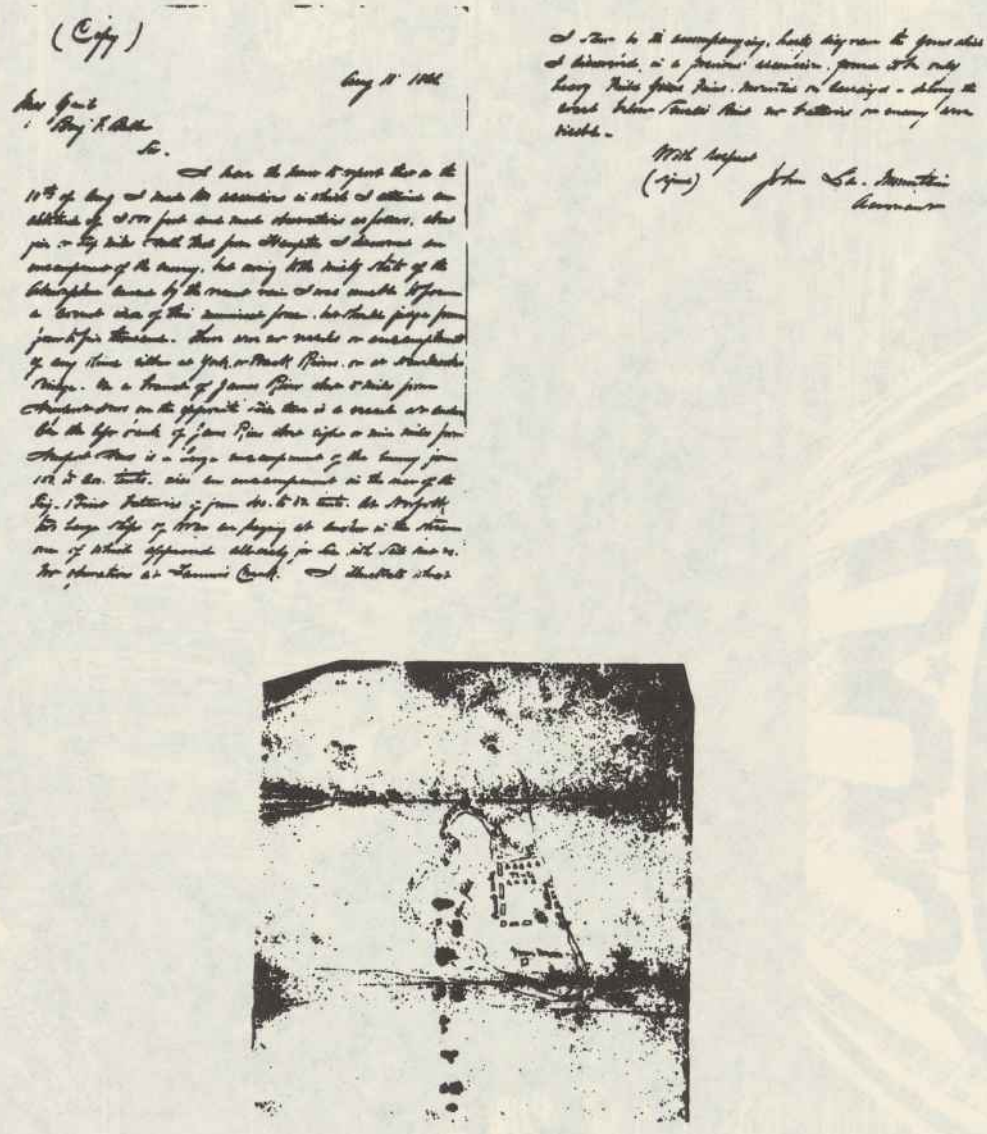


FIGURE 11 Balloon in use as aerial observation post during the American Civil War.

AERIAL RECONNAISSANCE

AUGUST 10TH 1861



Aerial reconnaissance was first used by the United States Army in 1861. The above is a reproduction of one of the earliest aerial reconnaissance reports. The original is in the Old Records Section of the A.G.O.

1050 A.S.

FIGURE 12 La Montain's aerial reconnaissance report.

C O P Y

10 Aug 1861

Maj Genl Benj F Butler

Sir:

I have the honor to report that on the 10th of August I made 2 ascensions in which I attained an altitude of 2500 feet and made observations as follows: About 5 or 6 miles north west from Hampton I discerned an encampment of the enemy, but owing to the misty state of the atmosphere caused by the recent rain I was unable to form a correct idea of this _____ force, but should judge from four to five thousand. There were no _____ or encampments of any kind either at York or Back River or at New Market Bridge. On a branch of James River about 5 miles from Newport News on the opposite side there is a vessel at anchor. On the left bank of James River about 8 or 9 miles from Newport News is a large encampment of the enemy from 150 to 200 tents, also an encampment in the rear of Big Point batteries of from 40 to 50 tents. At Norfolk two large ships of war are laying at anchor in the stream, one of which appeared all ready for sea with sails _____ to. No operations at Farmers Creek. I illustrate what I saw by the accompanying hasty diagram. The guns which I discovered in a previous ascension proved to be only heavy Field Pieces, Mortars or carriages - along the coast below Servells Point no batteries or enemy were visible.

With respect,

John LaMontain
Aeronaut

In what must be considered an exhaustive study of T.S.C. Lowe and the balloon corps, F. Stansbury Haydon disputes the claim that aerial photographs were taken by Lowe, and backs up his statements with rather conclusive evidence against this claim:

"There is no available evidence, either in Lowe's papers, in the voluminous archives of the War Department, or in the papers of McClellen, Macomb or Warren, (officers of the Union Army under whom Lowe served), to show that Lowe ever carried on the proposed experiments, or took photographs from his balloons during the war. In November, 1862, he stated in a letter to Maj. General John G. Parke, Burnside's chief of staff, that he had with him a set of powerful magnifying lenses with which a photograph three-inches square can be magnified to the size of 20-feet square. But the letter does not mention any photographic operations, nor did Lowe, in enumerating the auxiliary equipment in his train, include mention of any cameras, or similar apparatus. It is only reasonable to assume that, had such service been performed, some mention of it would have appeared in this letter, or in Lowe's long and detailed report of the corps' operations submitted to Secretary Edwin M. Stanton in 1863.....Still more conclusive evidence lies in the fact that no aerial photographs have ever been found in the War Department Archives, or in the Archives of the Signal Corps. To assume that formerly existing prints of this kind have all been

lost is not reasonable, since a number of maps made from the air have survived. It is most unlikely, had aerial photography been practiced, that every print would have disappeared from the files."[18]

In 1871, a long-needed breakthrough in sensitized emulsions came about when the cumbersome wet plate method was replaced by the gelatin dry plate. One of the first to adopt this great improvement was the English inventor, Walter B. Woodbury, who, in 1877, patented a camera which, by utilizing dry plates, became an almost automatic system of balloon photography[19] (Figure 13).

Woodbury did away with both the aeronaut and basket, and proposed that only the camera itself should ascend with the balloon. Attached to the camera and balloon was a long cable, within which were woven three wires for conducting an electric current. The operator was stationed on the ground to manage both camera and balloon. By sending a charge of current through the wires, he could simultaneously actuate the shutter, make an instantaneous exposure, and revolve a cube within the camera to bring a fresh plate surface in position for the next exposure. This system of aerial photography was intended by Woodbury for military use, as it would be easier to use in the field, requiring a much smaller balloon than one that was manned, and would not place an aeronaut under shellfire.

On June 8, 1879, a Parisian, M. Triboulet, with camera pivoted on the basket's edge to make vertical shots possible, exposed his plates from a free balloon at 500 meters (Figure 14). A sudden rainstorm

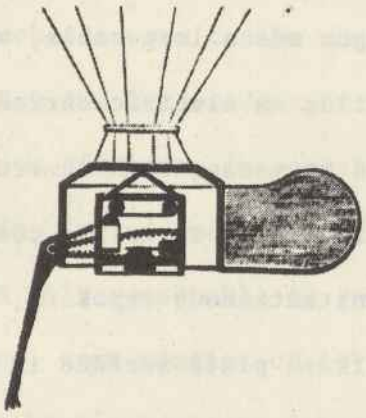
A.D. 1877. **No. 1647.**

WOODBURY, Walter Bentley.

"BALLOON PHOTOGRAPHY."

A PHOTOGRAPHIC camera is suspended to a balloon, which is held captive by a rope containing three insulated wires.

A tail is provided to keep the balloon in its proper position.



A current passing up by the first wire causes a clockwork apparatus, attached to the camera, to actuate rolls holding the sensitive film in such a manner as to bring a fresh portion of the film behind the lens after an exposure has been made.

A current through the second wire actuates the shutter, and the third wire acts as the return in both instances.

FIGURE 13 Woodbury's automatic system for balloon photography.

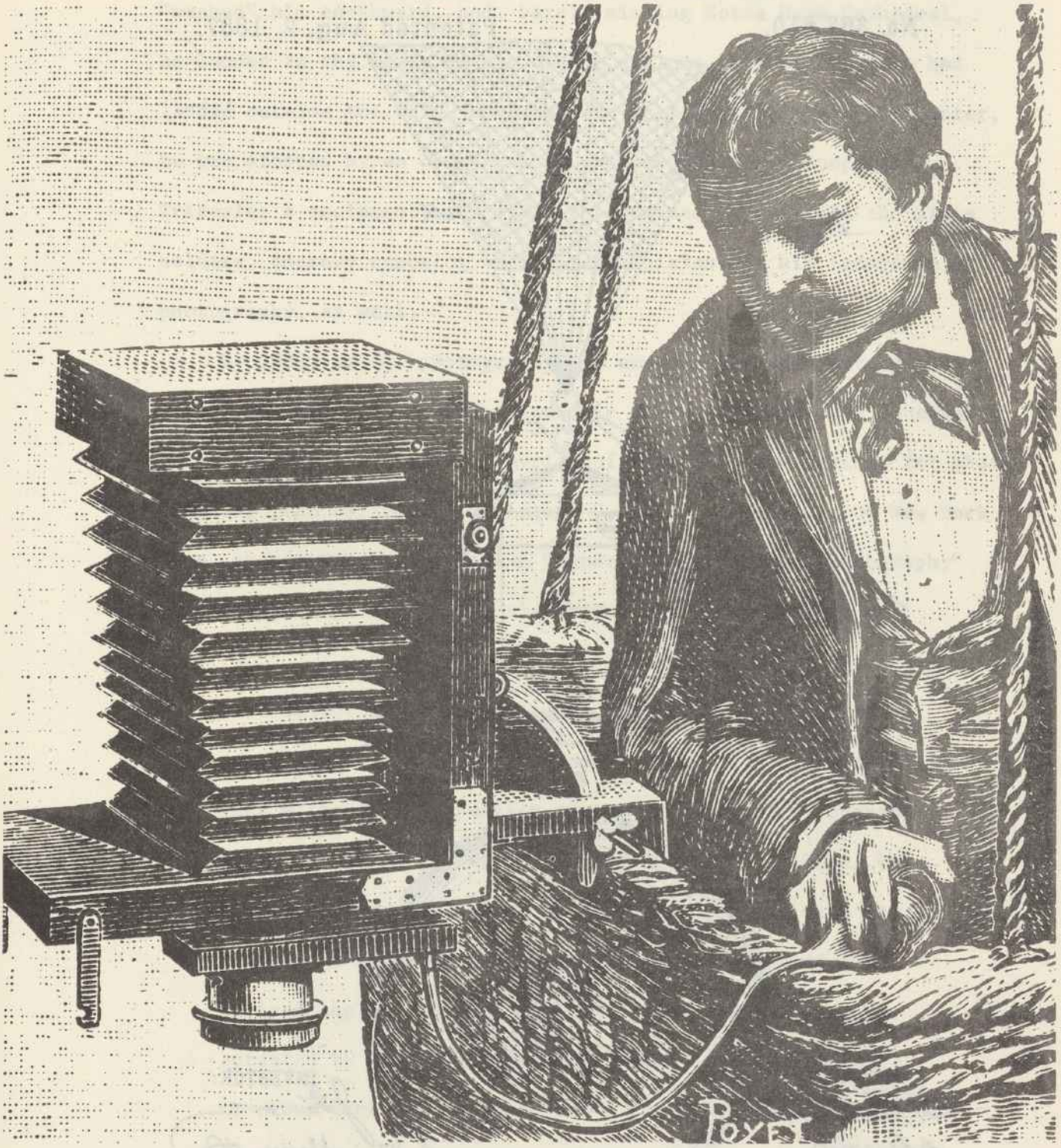


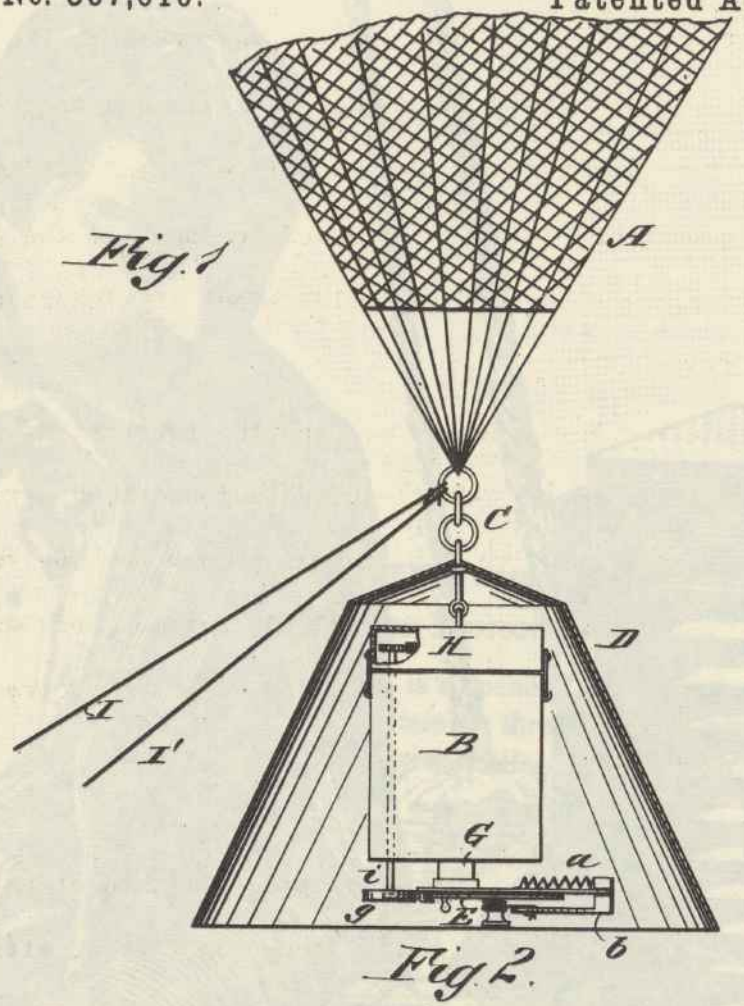
FIGURE 14 Triboulet uses a camera pivoted on the basket's edge for vertical photography

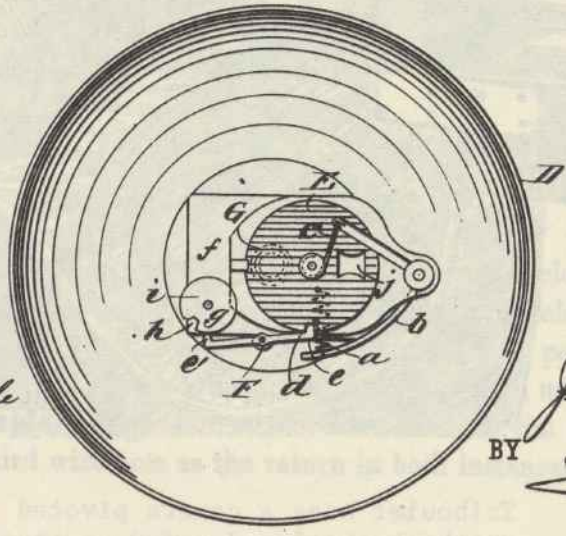
(No Model.)

J. FAIRMAN

APPARATUS FOR AERIAL PHOTOGRAPHY.

No. 367,610. Patented Aug. 2, 1887.





WITNESSES:
F. M. Ardle
C. Sedgwick

INVENTOR:
J. Fairman
BY Munn & Co
ATTORNEYS.

FIGURE 15 Fairman's apparatus for aerial photography.

"washed" him earthward, and, barely missing Notre Dame Cathedral, he landed in the Seine River, whence sailors rescued him. He had landed outside the city, however, and when he attempted to re-enter, he was stopped by an over-zealous customs officer. Inspecting Triboulet's equipment, the officer proceeded to open all the plate holders, thereby exposing not only the plates but his ignorance of photography, as well.

By 1880, aerial photography had aroused the interest of many inventors, and writers for scientific journals found much material for their stories among the myriad of ingenious new devices for photographing from balloons. On August 2, 1887, J. Fairman, of New York City, obtained a patent for an "Apparatus for Aerial Photography" (Figure 15). In his patent claim, Mr. Fairman states:

> "The object of my invention is to provide a method of an apparatus for taking photographic views from a great altitude without the necessity of the presence of an operator. In carrying out my invention, I attach to a balloon, kite or suitable projectile, a photographic camera, with its lens and tube pointing vertically downward, or at any desired angle, and I provide the camera with a shutter actuated by a spring and controlled by clock-movements or other time arrangement, and I inclose the whole in an inverted funnel to insure steadiness during ascent."

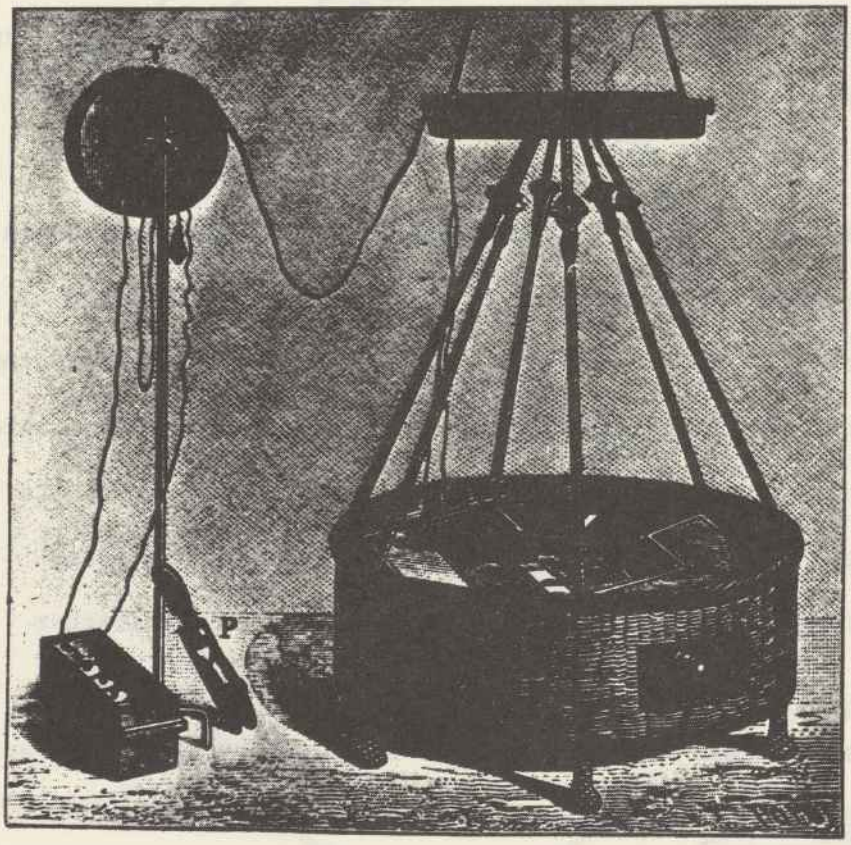


FIGURE 16 **The aerial panoramic camera invented by the Frenchman Triboulet.**

To some enterprising pioneers, the balloon afforded an unexcelled position for making panoramic photographs. Among others who designed and built their own aerial panoramic cameras was our unfortunate friend Triboulet, who, in 1890, combined ideas and built an automatic panoramic camera to be carried skyward by a captive balloon (Figure 16).

Following Prof. King's Boston experience with J. W. Black, more than a score of air-minded photographers used his many balloons in unsuccessful efforts to get aerial photographs. It was 30 years later, in 1890, that the reason for so many failures was determined. Studying results of these early American experiments, W. N. Jennings, a philadelphia photographer, concluded:

> "When the light of the sky floods the landscape, the quickest shutter speed is far too slow for a wide open lens and instantaneous plate."

Jennings, accordingly, stopped down his lens, used a slower emulsion and a yellow color screen. In July, 1893, with King as his navigator, Jennings obtained some truly remarkable views of Philadelphia and its environs.[20] His double-coated, orthochromatic plates were small, but even when enlarged to 24 x 36 inches, the prints, as Jennings pointed out, had all the qualities of a rich steel engraving without a fuzzy line (Figure 17).

The same year that Jennings was experimenting over Philadelphia, Mr. C. B. Adams, of Augusta, Georgia, obtained a patent on a "Method

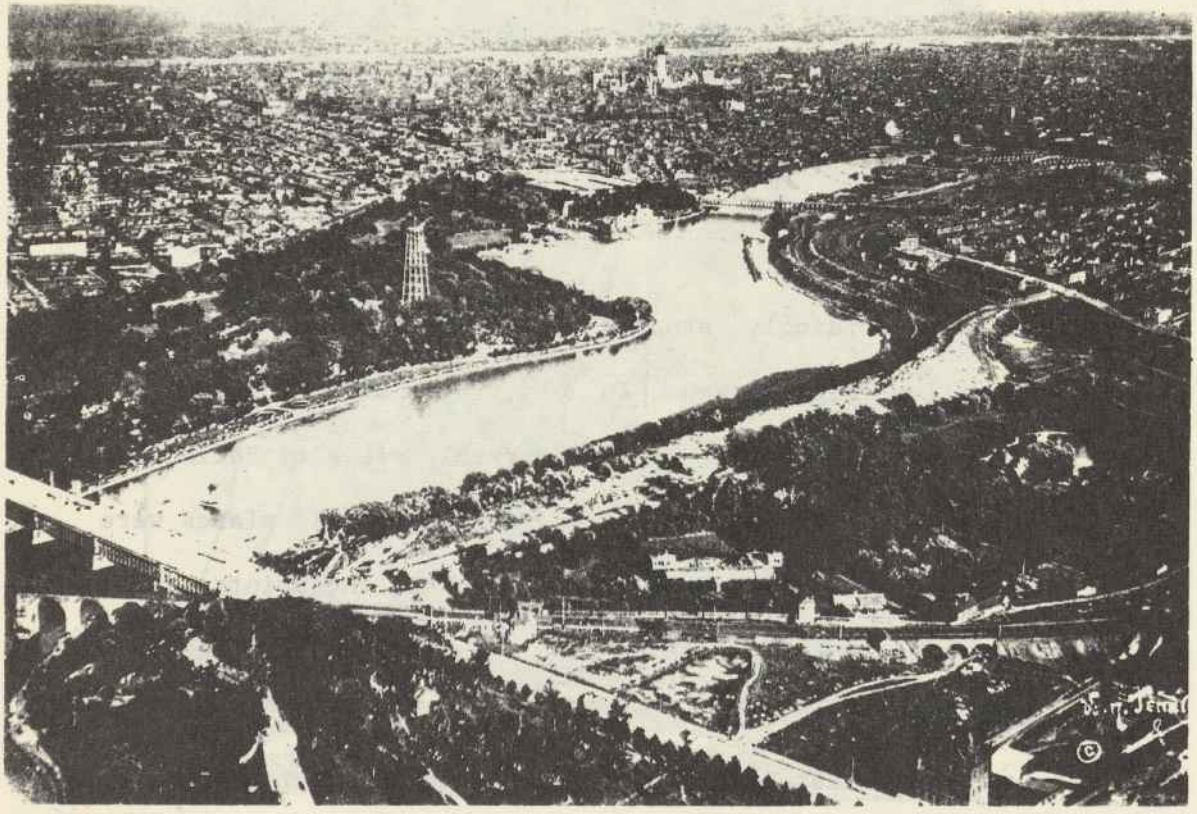


FIGURE 17 Jenning's balloon-view of Philadelphia - July 4, 1893

(No Model.) 2 Sheets—Sheet 1.

C. B. ADAMS.

METHOD OF PHOTOGRAMMETRY.

No. 510,758. Patented Dec. 12, 1893.

FIG. 1.

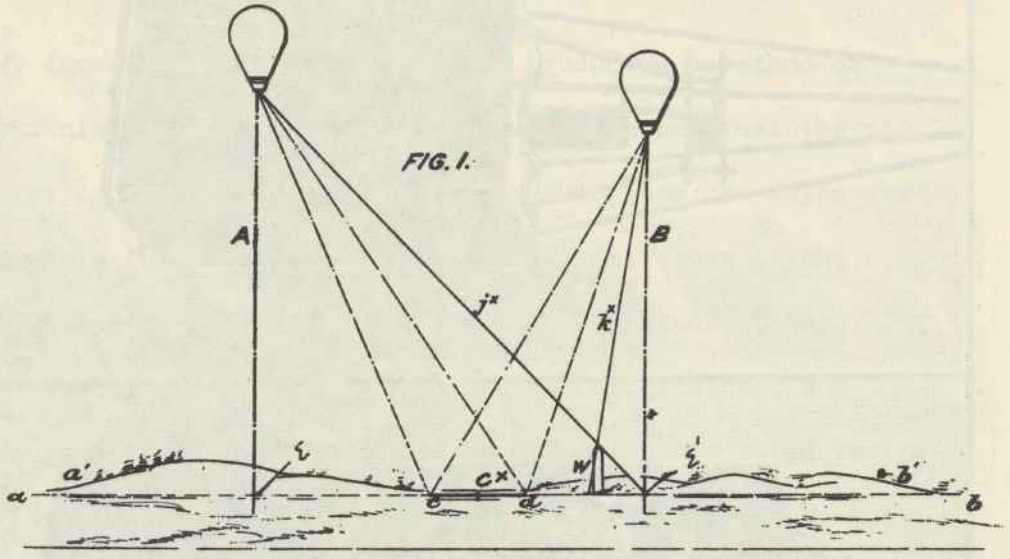


FIG. 2.

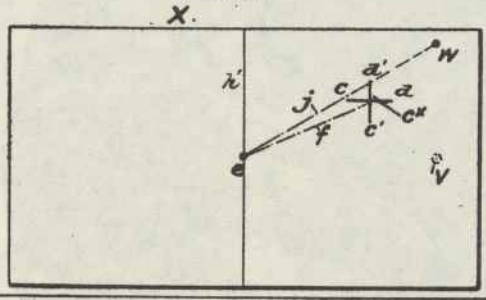
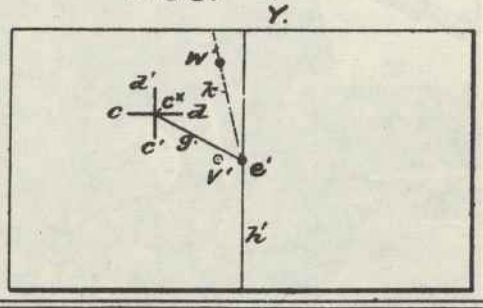
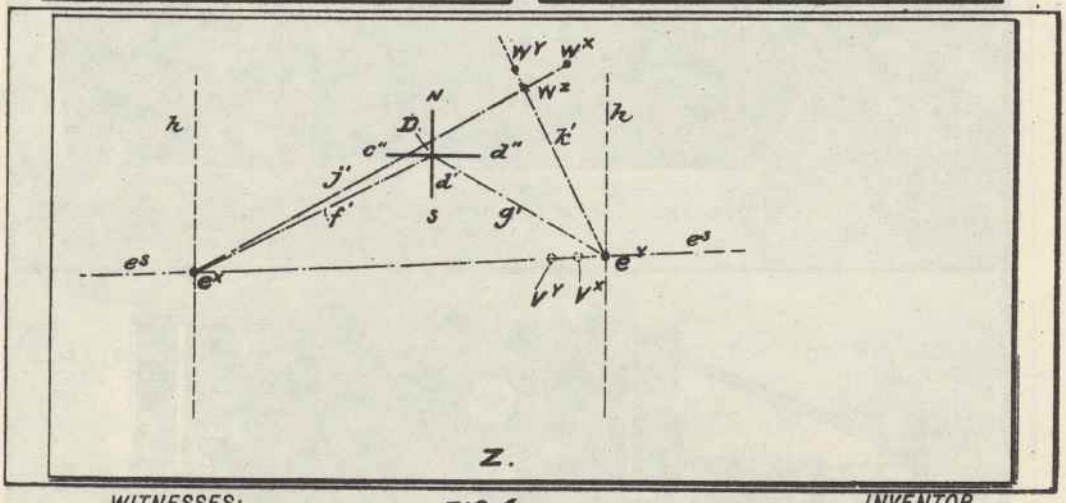


FIG. 3.





WITNESSES:

Fred G. Dieterich

W. D. Bloudel.

FIG. 4.

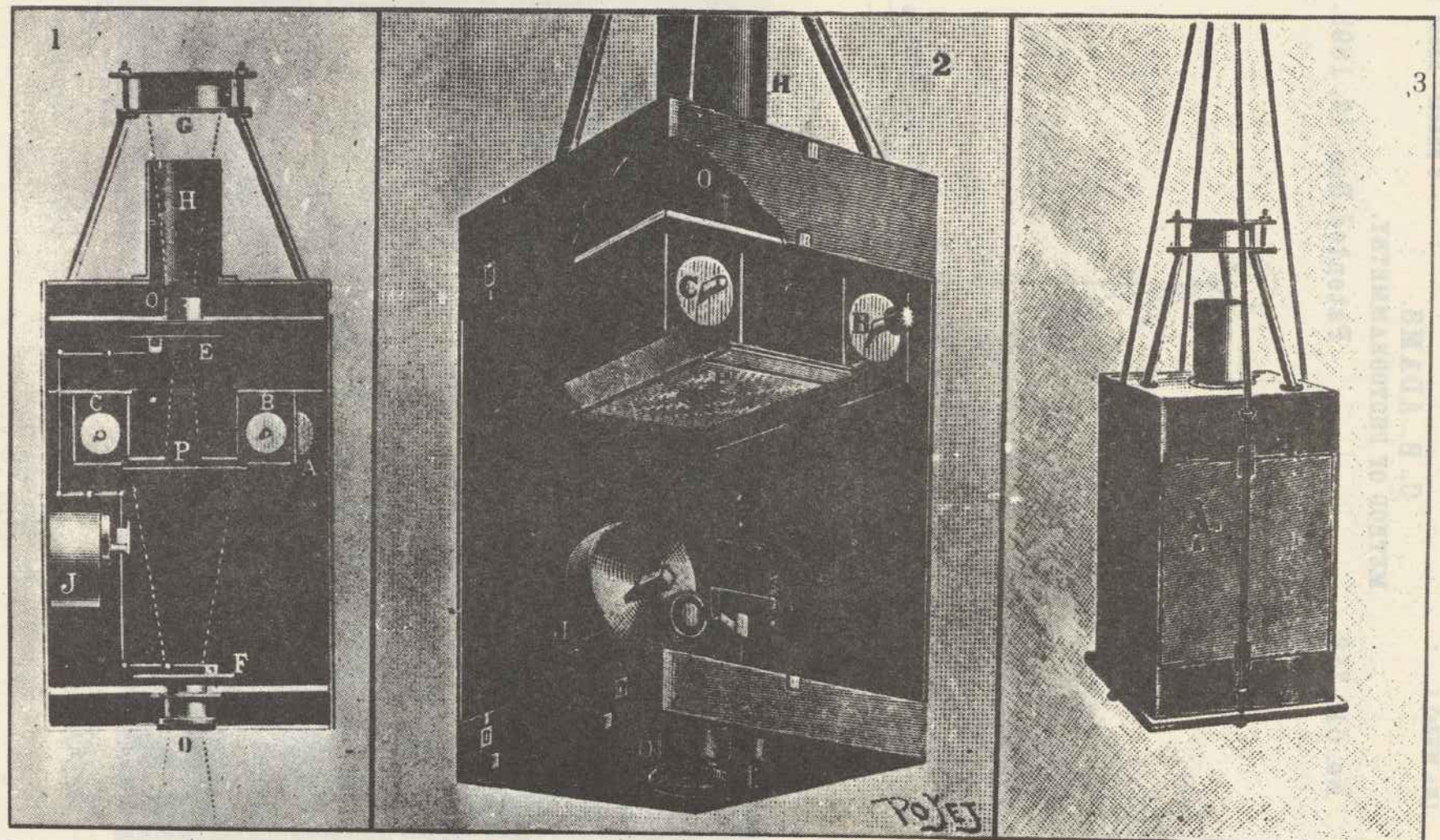
INVENTOR

Cornele B. Adams

BY Munn & Co

ATTORNEYS.

FIGURE 18 Adams' method of photogrammetry.



Cailetet's aerial camera for automatically registering heights reached by balloons.

FIGURE 19

of Photogrammetry" (Figure 18). He declared:

> "My invention has for its object, producing a method of obtaining aerial photographs in such a manner that the pictures can be converted into topographic maps, to delineate not only the horizontal positions and distances of the objects correctly, but from which the altitude of the objects can be quickly and accurately ascertained, and such results obtained without the aid of other field instruments. My invention has also for its object, producing a method in which the results stated can be obtained in a simple manner with absolute accuracy."

A Frenchman, L. Cailetet, using the newly developed roll film, devised a camera for use with unmanned balloons which would automatically record the height reached by the balloon.[21] His device (Figure 19) superimposed the image of an aneroid barometer on the film as each exposure was made. Describing his invention for the readers of La Nature, Cailetet remarked:

> "This apparatus was submitted to experiment for the first time on October 21, 1897, in an ascension organized by the Commission d' Aerostation Francoise, for the purpose of testing various automatic apparatus designed for the exploration of the upper atmosphere."[22]

Balloon photography, after struggling half a century, had at last "arrived", but only a brief time remained for its advocates to enjoy their triumphs.....

KITE PHOTOGRAPHY

The use of kites for obtaining aerial photographs developed as an outgrowth of the adoption of kites to meteorological investigations. In England, E. D. Archibald, a meteorologist, is given credit for making the first successful photographs from kites about 1882.[23] Meanwhile, across the Channel in France, A. Batut, of Paris, began experiments in kite photography in 1886. Batut later recorded his achievements in a textbook published in Paris in 1890.[24]

Archibald's system embodied use of several kites, attached tandem-style to each other, with the camera suspended below the furthermost kite on the line. Batut used only one lozenge-shaped kite, to whose backbone the camera was attached by a triangular support. To release the shutter he provided a "slow match", or fuse, which was lit before the kite was raised, and which eventually ignited a thread controlling the shutter. Simultaneously, also, release of a piece of paper indicated to the operator that the exposure was completed. To determine the altitude at which the picture was taken, Batut's equipment included an aneroid barometer with a self-registering photographic apparatus. As the camera's shutter closed, the movement opened a tiny aperture, through which the rays of the slow match printed on a strip of photographic paper the shadows of two needles, from which the altitude could

be figured. Both Batut and Archibald made "map views", with the lens pointed straight downward. At Rheims in 1890, another photographer, Wenz, made the first horizontal perspective view from kites, although, as the record states, "the slant was very great."[25]

In the U. S., another meteorologist, William A. Eddy of Bayonne, New Jersey, on May 30, 1895, made what he claimed was the first photograph from a kite ever taken in the western hemisphere. Eddy used a "Bullet" camera with a 3½" x 3½" film, and employed a timed slow match to release a weight attached to the shutter. The camera was enclosed in a box attached to a revolving table, and its rear could be raised or lowered in a slot by a set screw, so that the lens could be directed at any slant to any desired compass point. Finding that the dropping weight caused a blurred picture, he added a light cord on which a steady pull could be exerted from the ground to steady the camera at the time of exposure. He also used a light wooden T-frame attached to the kite line and the camera to prevent side swing in more than one direction. With 6 to 9 kites on his line, Eddy obtained pictures at heights up to 1,000 feet and claimed that it might be possible to raise the camera to 16,000 feet.

For best results, however, he recommended an altitude of not more than 500 feet, with a camera making pictures under 4 inches in size. Larger pictures, he argued, would require heavier cameras and involve danger of breaking the kite line. With his kites, he stated, he made as many as 32 aerial pictures in a day, and occasionally made simultaneous snapshots with three cameras working together on his line. During the Spanish-American War, his system was sent to Puerto Rico

by General Greely, where it proved to be a valuable auxiliary to balloon photography.[26]

Another kite photographer was Lt. Hugh Wise - Madison Barracks, New York, who, in 1895, constructed the device shown in Figure 20. If the kite did not have enough lift to get the camera off the ground, the kite would be raised to the desired height, and the camera sent upward on the kite line like a sailboat.

The outstanding American exponent of kite photography was George R. Lawrence of Chicago, whose achievements brought him world-wide attention. In 1902, Lawrence developed a kite system using as many as 17 kites, which lifted his cameras up to 2,000 feet. Pictures from two to eight feet long were made by his seven different aerial cameras, which weighed from 400 to 1,000 pounds. He employed this outfit in aerial surveying work in the western states and on an African exploration expedition. One of the most famous panoramic views--that of San Francisco after the fire--was taken by Lawrence from a complex arrangement of kites.[27]

In July, 1903, some prophetic statements appeared in Photo Miniature magazine, in an article entitled, "Aerial Flights - In Fact & Fancy":

> "The time has come to talk about aerial photography. Many things are in the air.....It is not wholly improbable that, ere many years have passed, the airship excursion will be at least as popular as the automobile tour of today, or that the schoolboy of tomorrow will study topography at first hand,

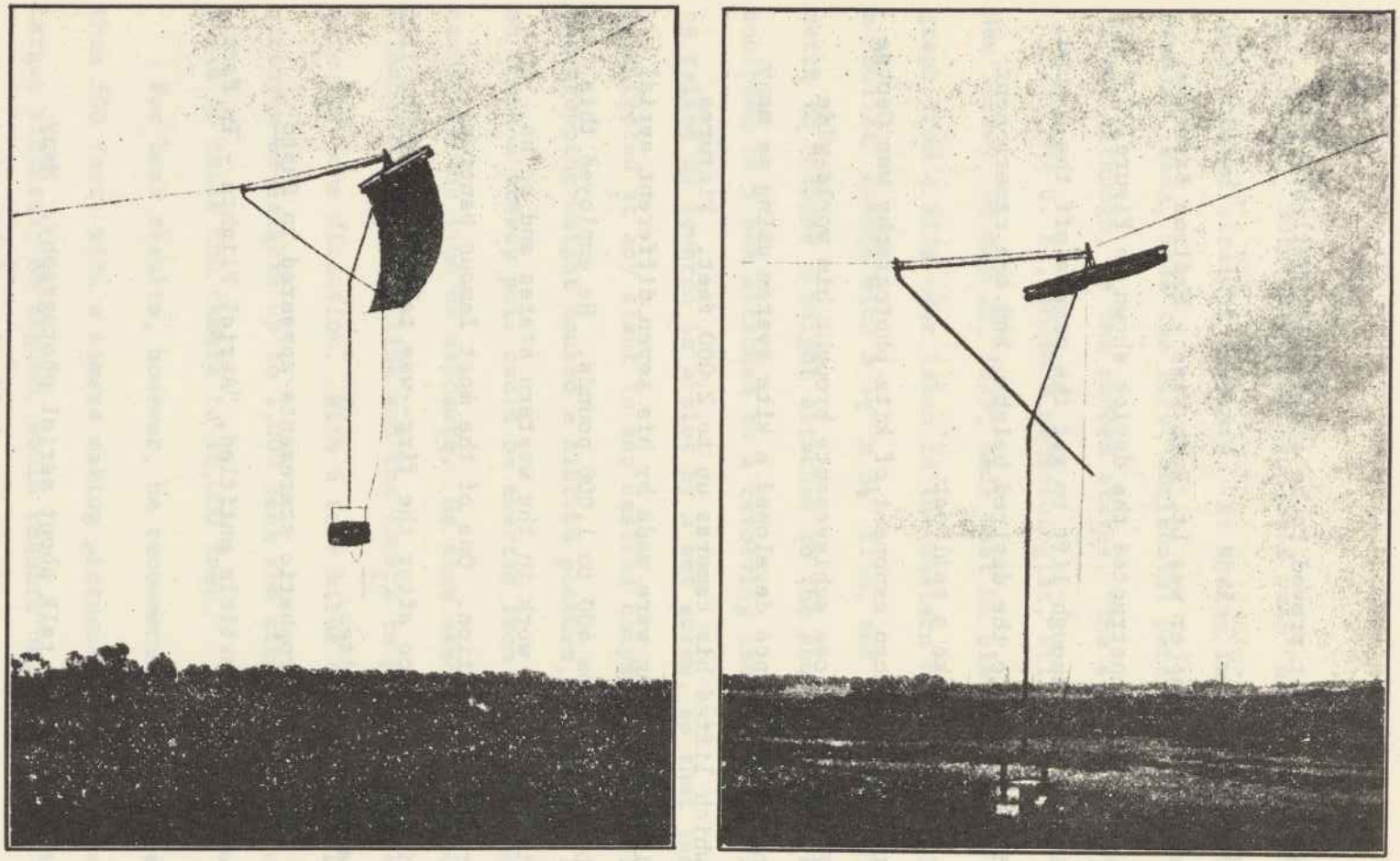


FIGURE 20 Kite photography - 1895

from the actual fact, instead of the schoolroom map.....Photography must not fall behind its opportunities. The telephotographic lens has solved the ancient problem concerning Mahomet and the mountain.....

"But this is set down as an aerial flight in more than one sense of the phrase. The sober facts are sufficiently inspiring. At the St. Louis Exposition, the airship will take its place with the turbine and trolley car as a practical factor among modern methods of transportation. Along the Potomac, Langley is busy with his gigantic airplanes, undismayed by failure, and confident tomorrow will uncover the long-sought secret of mechanical flight.....The conquest of the air is well begun, and photography should play its part in advance....."[28]

ROCKET PHOTOGRAPHY

Rocket reconnaissance, contrary to popular belief, is not new. On July 25, 1891, a patent was granted to Mr. Edmund Edwards for Mr. Ludwig Rahrmann, Germany, for a "New or Improved Apparatus for Obtaining Bird's Eye Photographic Views" (Figure 21). The patent description reads:

"The present invention is applicable more especially to military operations by taking photographic bird's-eye views of fortifications or other positions occupied by an enemy from a distant

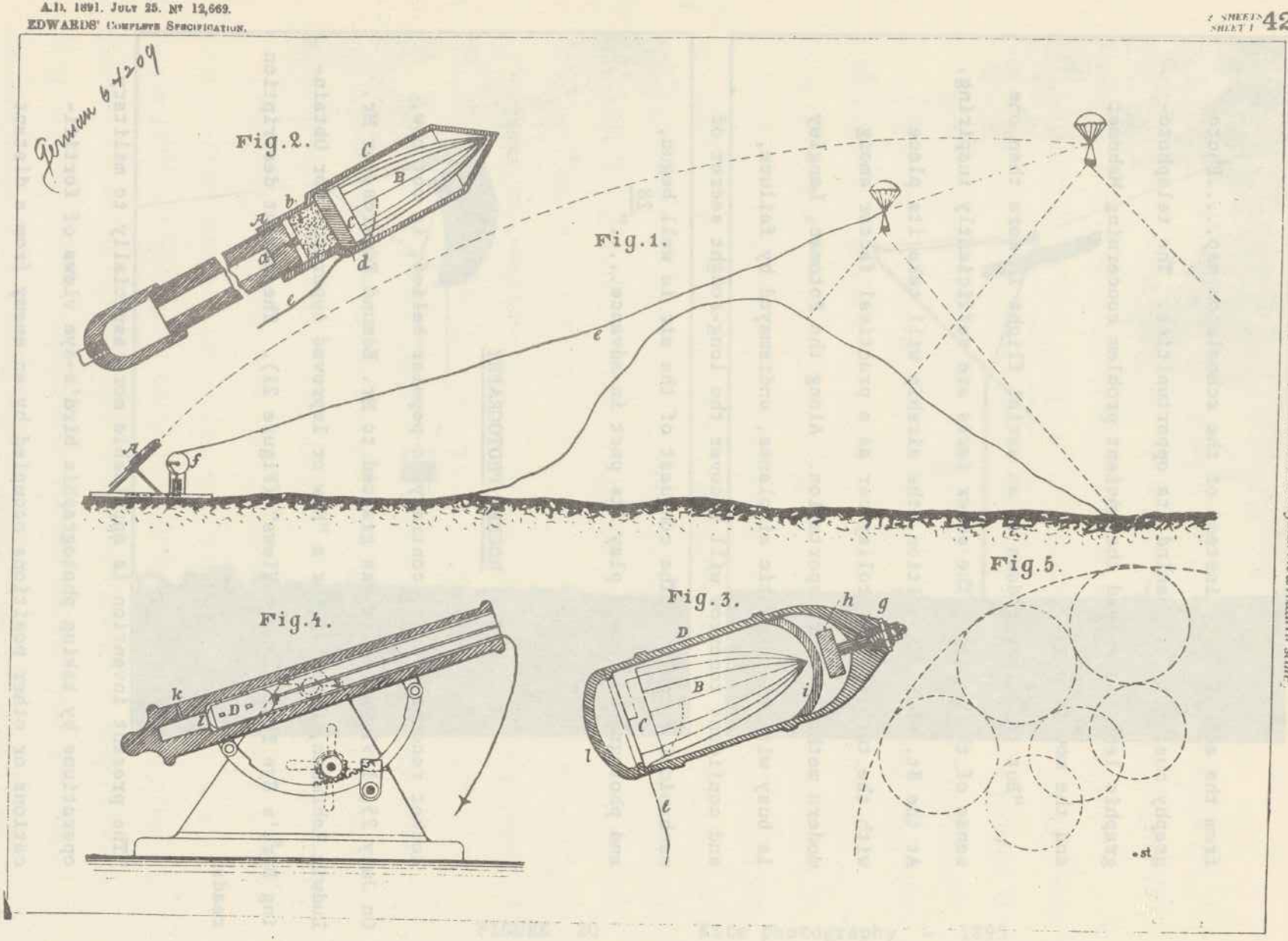


FIGURE 21 Ludwig Rahrmann's apparatus for "bird's-eye photographic views" - 1891

position where they are not visible. The projectile is fired high in the air in the direction of the object to be photographed, a charge of explosive being then ignited and the parachute apparatus being thereby set free from the projectile. The parachute then opens automatically, falling by itself, the photographic apparatus hanging perpendicularly below it, and by a suitable arrangement taking one or more instantaneous photographs of the positions on the earth below, the parachute being then brought back to the point from which it was projected by a line, one end of which is attached to it, the other being retained at the starting point."

Mr. Rahrmann suggests that his invention will work both with ordinary guns or with rockets.

Sixteen years later, on August 13, 1907, another ingenious German, Alfred Maul, obtained a patent for a:

"Device for Maintaining an instrument in the position in which it has been adjusted, and is particularly appreciable to apparatus which, for the purpose of obtaining photographs of surrounding country, is projected into the air. The device consists of a vertical flywheel connected with the instrument and mounted so as to turn on two horizontal axes located at right angles to each other. After the instrument has been adjusted, the flywheel is caused to rotate at a very high speed, and since it is suspended

No. 863,035. PATENTED AUG. 13, 1907.

A. MAUL.

DEVICE FOR MAINTAINING INSTRUMENTS IN ADJUSTED POSITIONS.

APPLICATION FILED MAY 17, 1906.

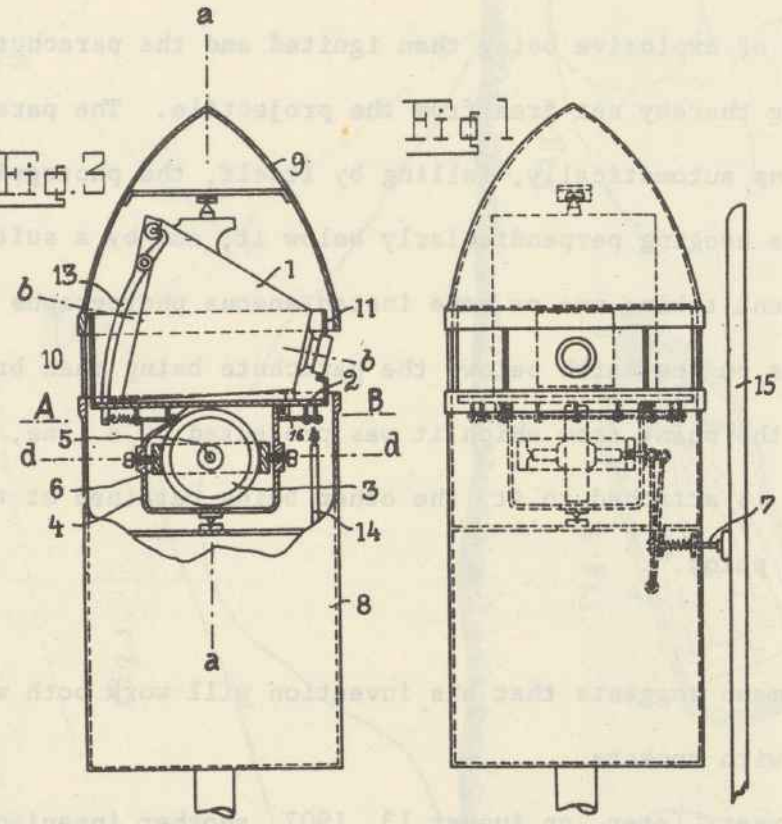


Fig. 3

Fig. 1

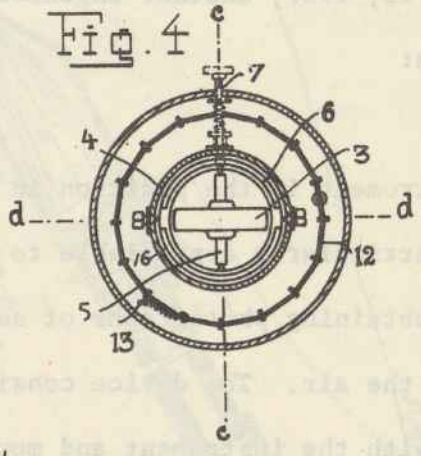


Fig. 4

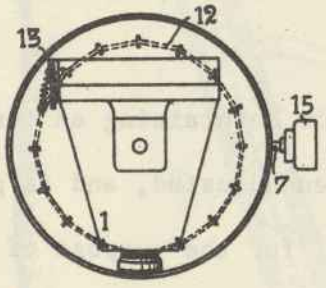


Fig. 2

Witnesses:—
Chauncey H. Schiering
Paul Arres

Inventor:—
Alfred Maul
by Paul A. Schiering
his attorney

FIGURE 22 Alfred Maul's gyro-stabilized camera for rocket reconnaissance - 1907

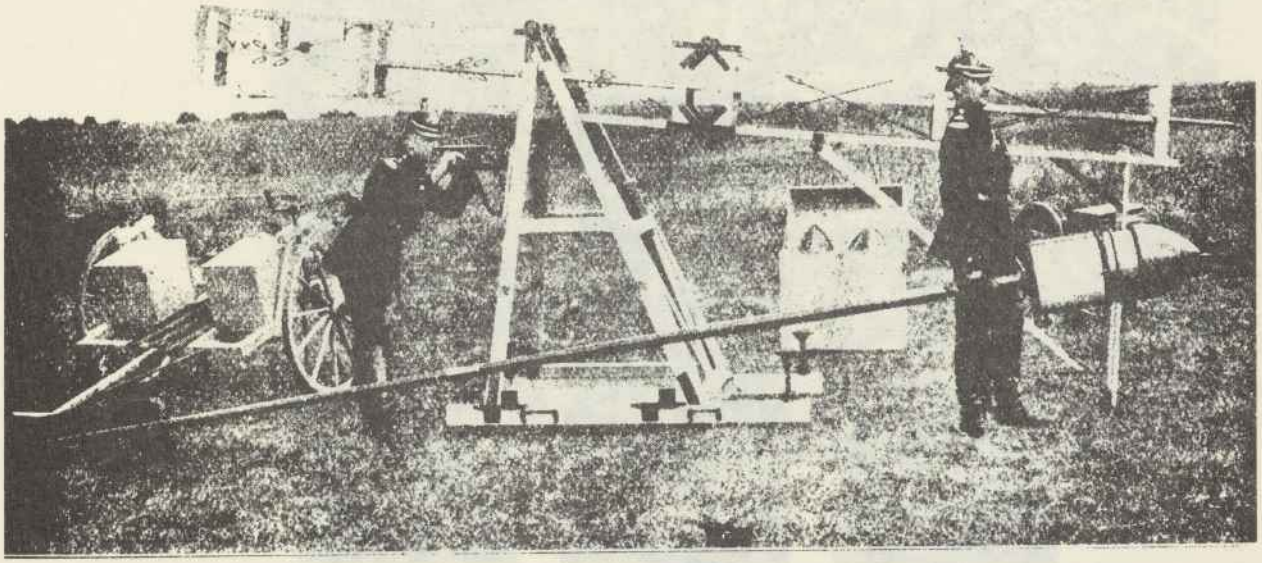


Abb. 6. Mauls photographischer Raketenapparat; im Vordergrund die 6 m lange Rakete, in deren Haube die Kamera sitzt, dahinter die zur Einstellung der Bildrichtung und zum Abfeuern der Rakete dienende Lafette, links davon der zur Beförderung dienende Handwagen, rechts ein Kasten mit Ersatzraketen.

FIGURE 23

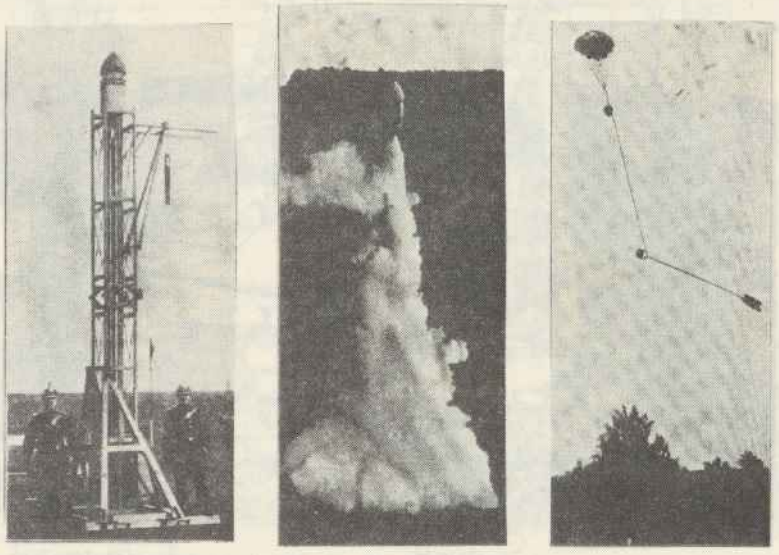


FIGURE 24

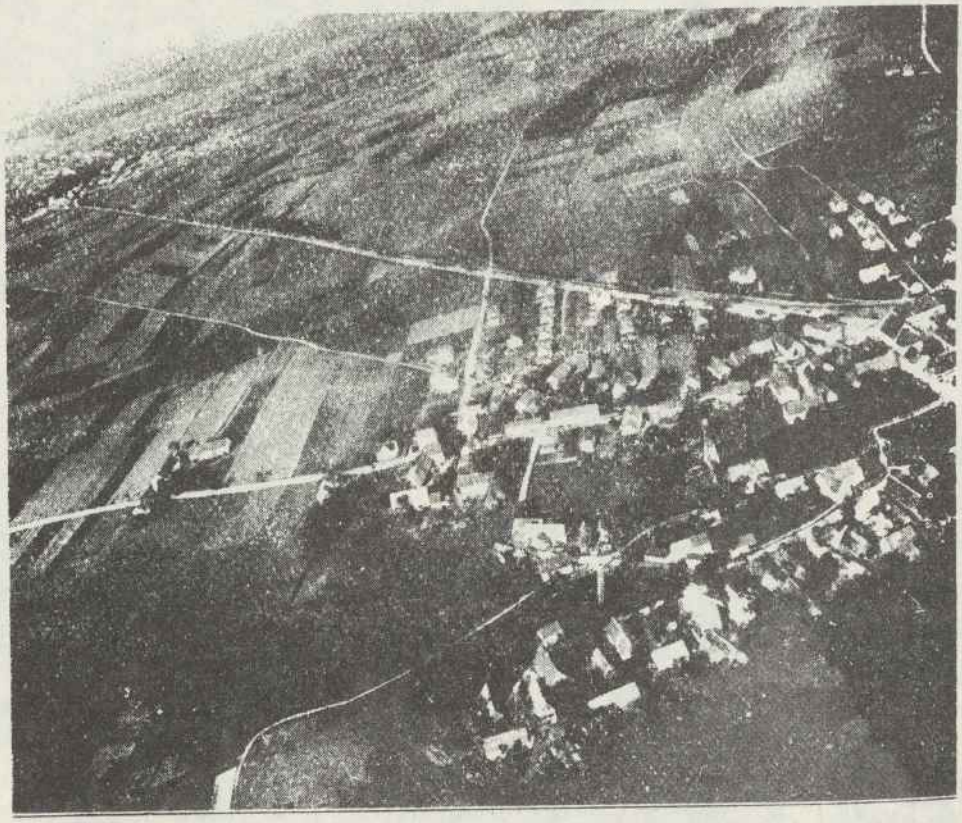


Abb. 10. Lausnitz in Sachsen, mit dem Raketenapparat aus 600 m Höhe aufgenommen.

FIGURE 25

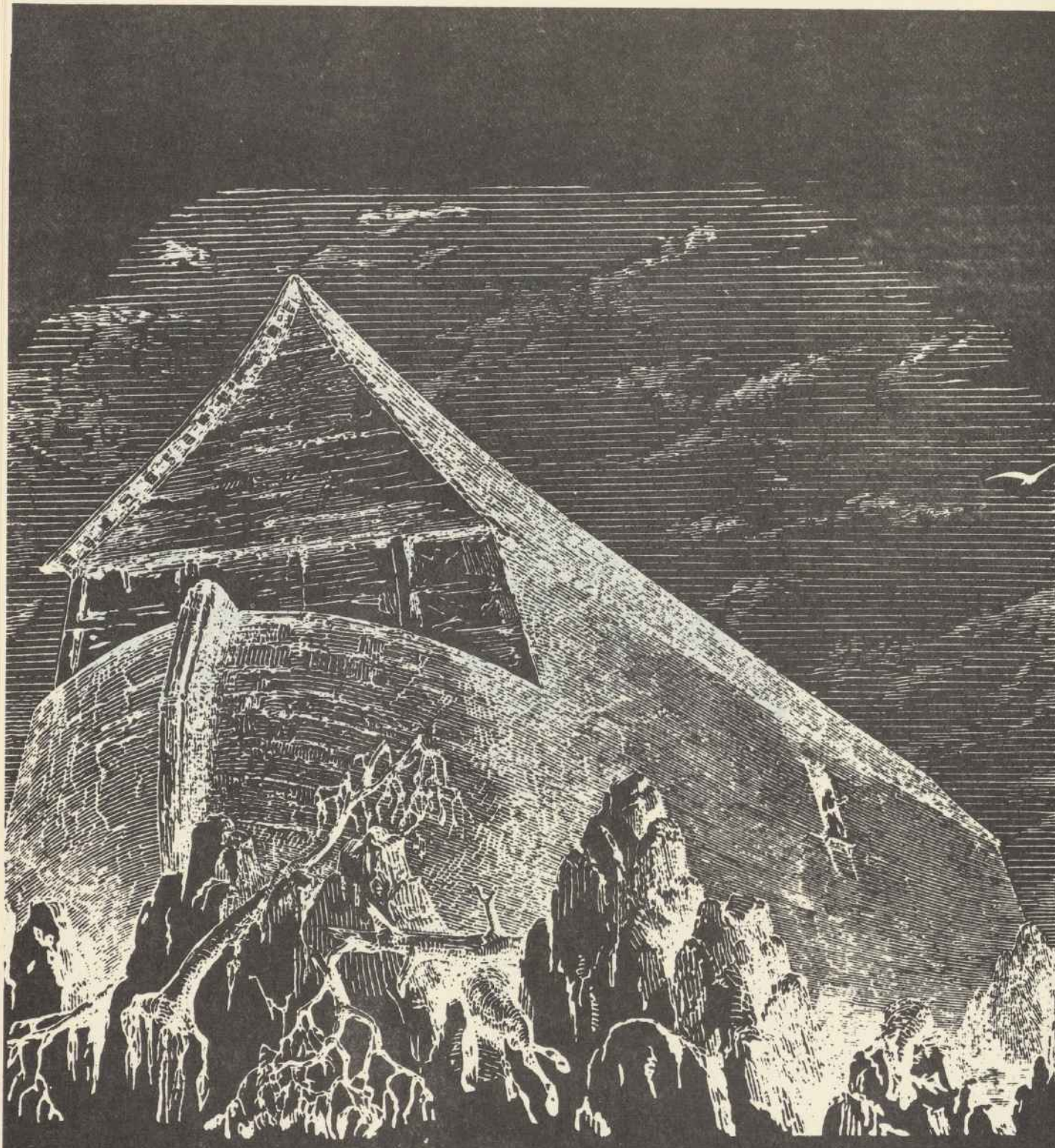


FIGURE 26 Noah's Ark

by means of a universal joint, the instrument will be prevented from revolving on its vertical axis" (Figure 22).

What Maul was describing was none other than a camera with a stabilizing gyroscope--the granddaddy of the gyro-stabilized torquer mount used extensively today for aerial photographic equipment.

In putting his idea into practice, Maul started with a small camera, about the size of a Rolliflex, and by 1912, he had worked up to a 90-pound system including an 8 x 10 view camera and gyro, which he succeeded in boosting to what was then the phenominal height of 2,600 feet[29, 30, 31] (Figures 23, 24 25).

PHOTOGRAPHY: FOR THE BIRDS

The first man to recognize the value of a "bird's eye in the sky" was the alert, intelligent pilot of a unique cargo ship.....his name was Noah, and his ship was the Ark (Figure 26):

> "And he stayed yet another seven days; and again he sent forth the dove out of the ark and the dove came in to him in the evening; and, lo, in her mouth was an olive leaf plucked off (Figure 27): so Noah knew that the waters were abated from off the earth."[32]

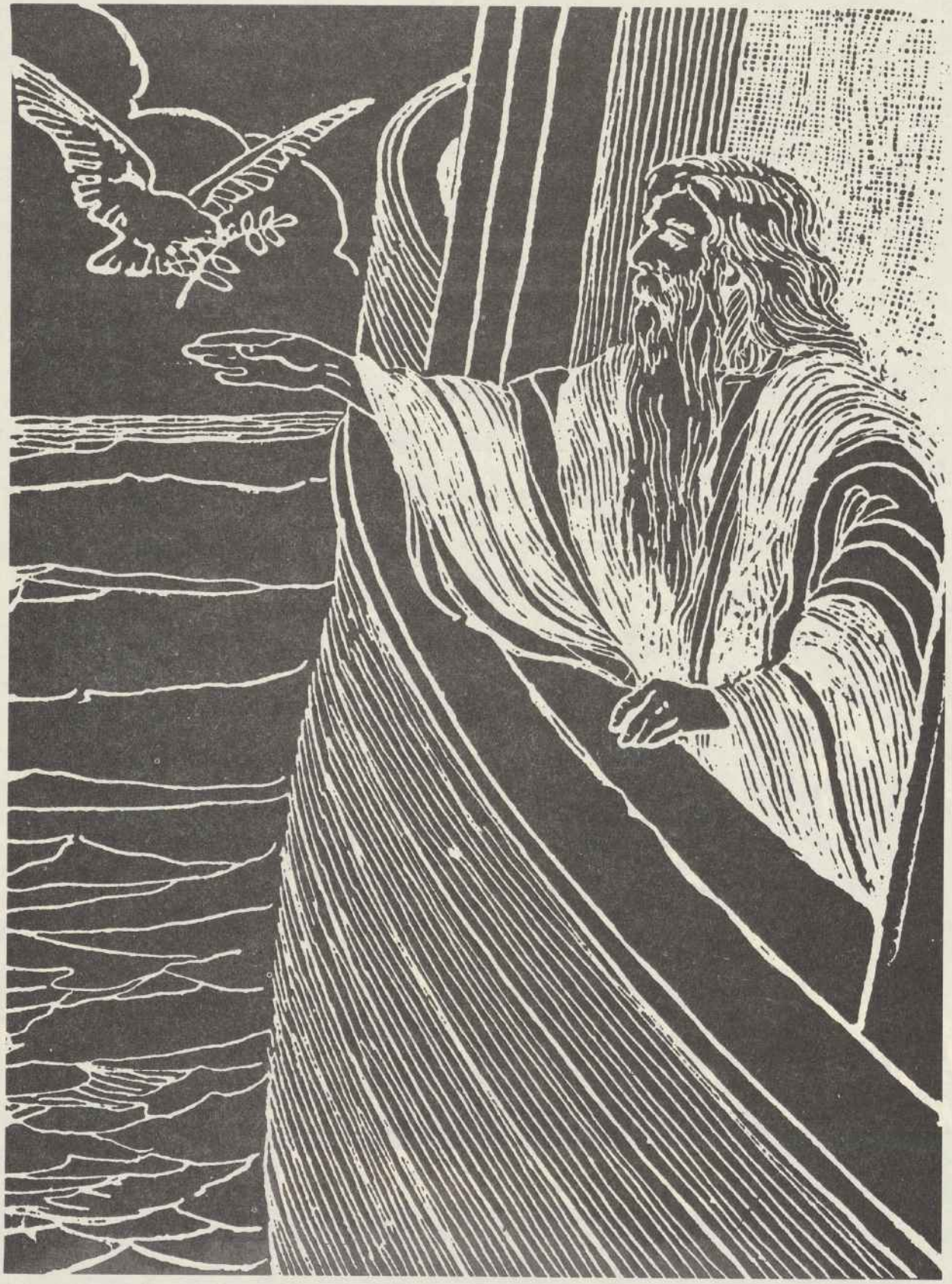


FIGURE 27 ".....and lo, in her mouth was an olive leaf plucked off....."

C. H. Gibbs Smith, a Companion, Royal Aeronautical Society, in his book on the subject of ballooning and aerial voyages[33], tells about the French photographic scientist, Rene Dagron, who, during the escape from Paris in 1870, used 57 pigeons to carry 100,000 microfilm messages into Paris, which was then under seige.

Robert S. Quackenbush, Jr., former president of the American Society of Photogrammetry, in his recent article in the Manual of Photo-Interpretation, mentions one Julius Neubronner, who, in 1909, published a pamphlet describing carrier pigeon aerial photography. Neubronner's camera permitted 35 automatic exposures, each 6 x 9 cm. In commenting upon his ideas, he is said to have remarked:

> "Just at the moment when men transform themselves into birds, the birds become photographers!"[34]

AIRPLANE PHOTOGRAPHY

Almost sixty-one years ago, on the windswept dunes of Kittyhawk, North Carolina, aviation history was made by two bicycle mechanics from Dayton, Ohio. On December 17, 1903, Wilbur and Orville Wright achieved powered flight with a heavier-than-air flying machine, thereby releasing man from his shackles as an earth-bound creature, and thrusting him into the air and space ages which followed.....Five years later, almost to the day, the use of the airplane for aerial reconnaissance was already being forecast in scientific circles. One author went so far as to predict that:

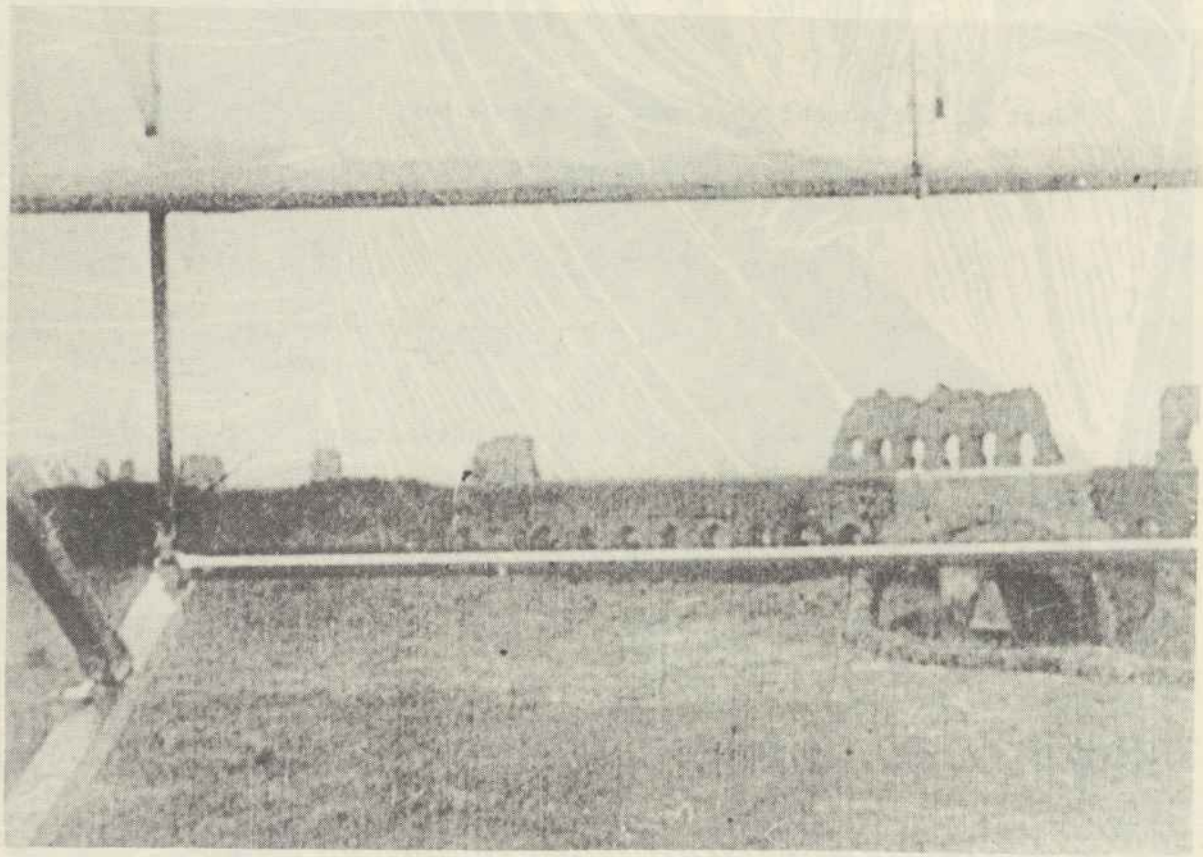


FIGURE 28 The first aerial motion picture - Centocelle, Italy, April, 1909

"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. It would be entirely possible for Wilbur Wright to take an officer up with him, rise to a height of 1,000 to 1,500 feet, sweep over 25 to 30 miles of an enemy's terrain and secure a thoroughly accurate sketch of the lay of the land....."[35]

Whether or not Wilbur read and was prompted by this account is anybody's guess. In any event, history records[36, 37] that in April, 1909, at the town of Centocelle (near Rome, Italy), he made 42 flights, 23 of which were for training purposes, on which Italian Naval Officers took part. On one of these flights, a "bioscope" motion picture man, whose name is unrecorded, accompanied Wright and took the first aerial motion pictures on record[38] (Figure 28).

One of the earliest pioneers in airplane photography was Beckwith Havens. Four years ago, I was browsing through the January, 1958, issue of American Airman magazine, and came across a picture of Mr. Havens, seated in a single seater Curtiss pusher airplane. The date was 1911. The object which attracted my attention, however, was the camera that had been installed beneath the wing. Curious as to details, I wrote to Mr. Havens, asking him for pictures of the airplane, plus any aerial pictures that he might have obtained. Within a week, Mr. Havens answered my letter, and inclosed the photographs I had requested. The airplane,

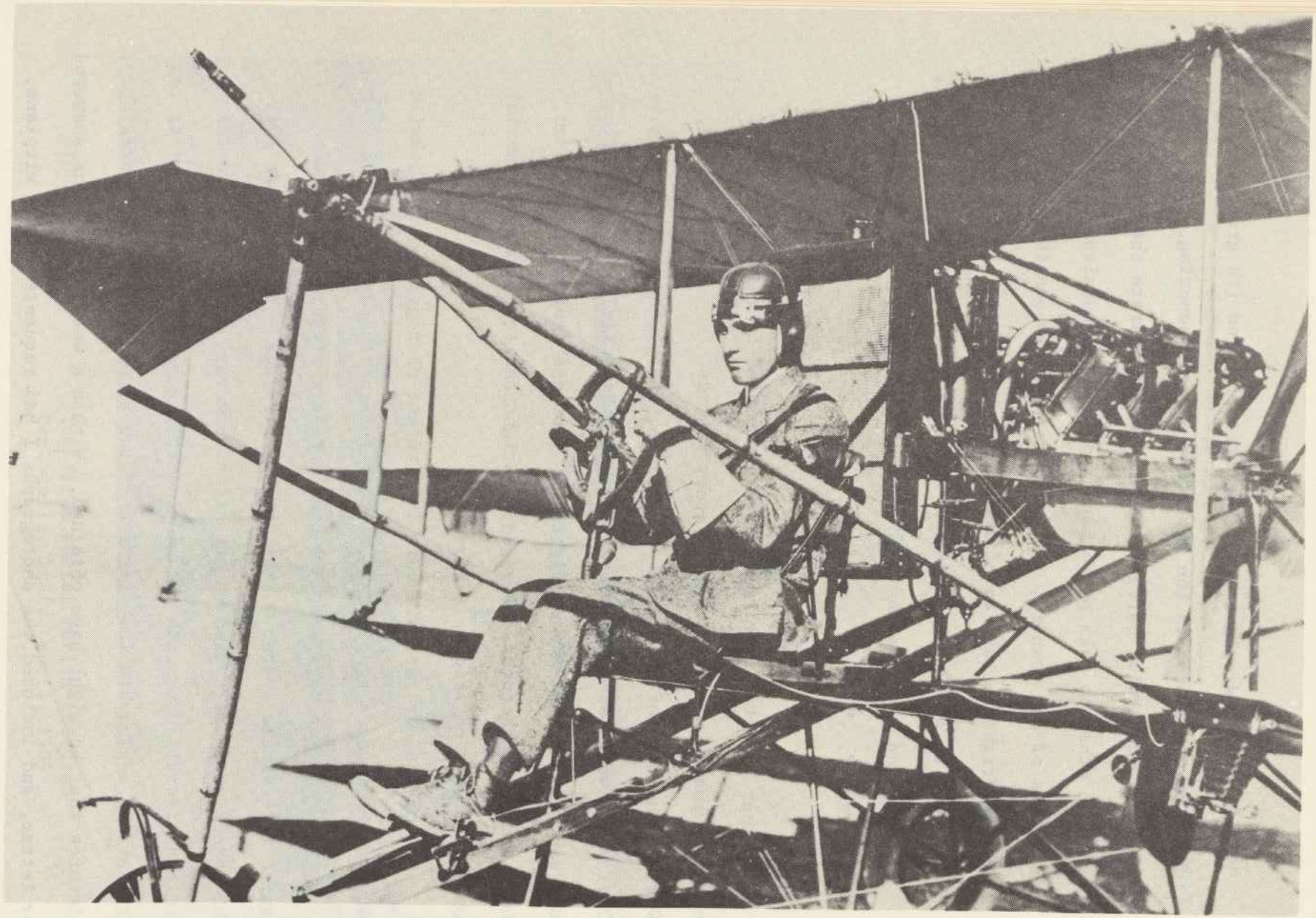


FIGURE 29 Beckwith Havens and his photo-reconnaissance aircraft - 1911

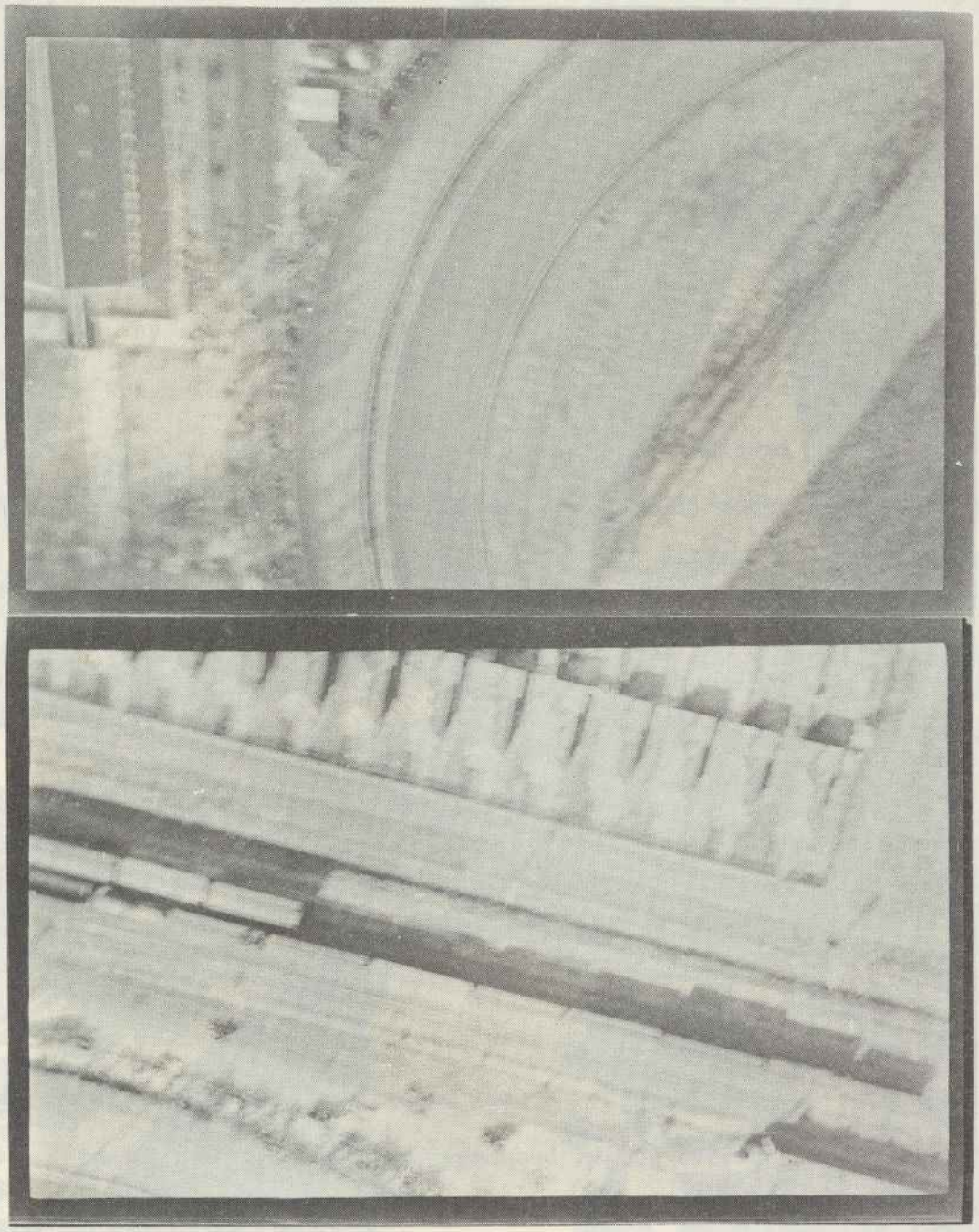


FIGURE 30 The first "still" photography from an aircraft.....Dallas State Fair, 1911

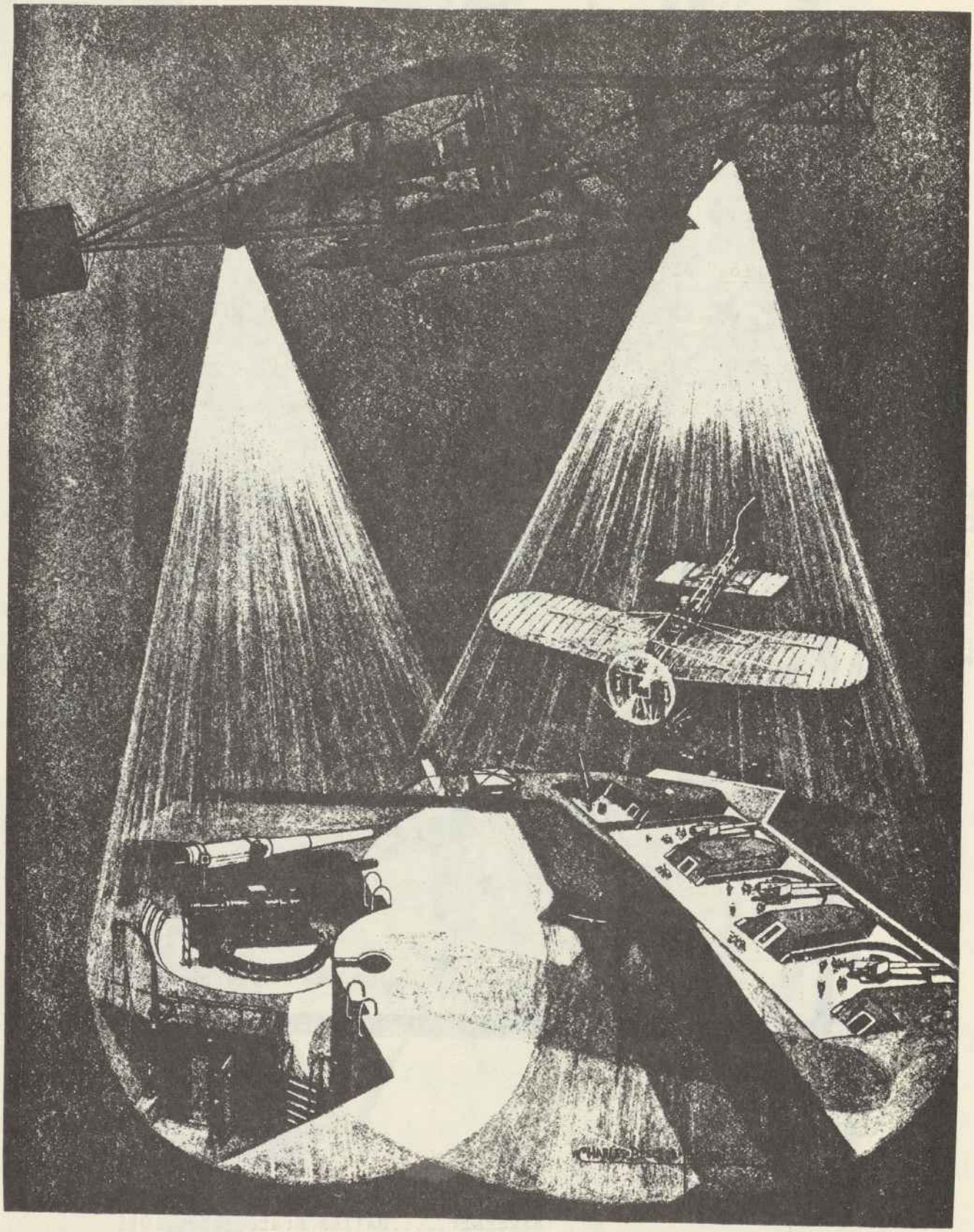


FIGURE 31 Photographic scouting at night.

showing pilot, camera and "controls", is shown in Figure 29. Two of the aerial photographs he obtained are shown in Figure 30. A copy of Mr. Haven's letter is shown on page 58. According to Fred S. Tobey, these photographs were the first ever taken from an airplane[39]. To the best of my knowledge, they are the first "still" pictures; the first "motion" pictures were made two years earlier, as previously indicated, by the Italian photographer who flew with Wilbur Wright.

The Wright brothers' success with aerial motion picture photography by day, soon led to the prediction of similar techniques by night. In 1911, for example, an artist's drawing (Figure 31) appeared in Scientific American, accompanied by the following statements:

> "Night photography would be even better, for then the aeroplane could steal over fortifications and flash its light upon them for a few brief moments while pictures were taken. The height of the machine above the target, and hence, the scale of the pictures might be determined by means of two searchlights placed at opposite ends of the machine and mounted in such a way that their beams would intersect always at a fixed distance below the aeroplane. The height would then be shown by the size of the intensely illuminated spot produced by the overlapping portions of the beams of light."[40]

Any account of photography from airplanes would be neither accurate nor complete without mention of the man who made his entrance upon the

BECKWITH HAVENS
519 EAST 86TH STREET
NEW YORK 28, N. Y.

Sept.19th.1960

Dear Mr.Quick;

Sorry this is not the size picture you requested but hope it will do.

I was doing a weeks exhibition flying at the Texas State Fair,Dallas in 1911.A newspaper reprter covering the show carried a camera and we talked of the possibility of taking pictures from the plane,a single seater,all Curtiss built in those days.As you see we attached the camera to the wing,and the bulb to the control wheel and I enclose four samples of the result,pictures of the fair grounds,and printed in the paper each day.

In an article in Squire magazine some time ago,on aerial photography,these were given credit with being the first photographs taken from a airplane.

Sincerely

Beckwith Havens

scene in 1919, and who was to dominate the field that was nearest and dearest to his heart.....The most important factors which the aerial photographer must combat to secure good photographs are distance, speed, and lack of adequate illumination..... and it is in these three broad problem areas that General George W. Goddard made his greatest and most lasting contributions. As Amron Katz appropriately states:

> ".....Trying to plot George Goddard in a coordinate system requires more dimensions than are commonly available. I could talk for hours just about Goddard as a personality and a character, but more hours would be required to tell about him as a military man, as a laboratory chief, as a goad, a tormentor, a photographer, and a developer--not only of film and ideas and equipment, but of people.....
>
> ".....Goddard raised a whole generation of people who had the ennobling experience and opportunity of ranging across all aspects of aerial photography from focusing the cameras, testing them in the laboratory, installing them, flying them, processing the pictures, analyzing the pictures, making scientific tests, going overseas, visiting the consumer, etc., etc..... As a result, many of us had truly marvelous experiences..... (although) at the time we didn't think these experiences we were having were very marvelous or ennobling. It turns out in retrospect that Goddard was right and we were wrong....."[41]

FIGURE 32 Lt. George W. Goddard

Thus did Goddard become the common denominator who linked inseparably all of us who have had the vision to realize (and the gratitude to admit) that those experiences were ennobling and marvelous.....

A search of records covering the early stages of aerial night photography convinced me that relatively little developmental activity took place before May, 1919. This date marks the sudden awakening of Night Photography from its state of dormancy, for it coincides with the entrance upon the scene of a young Army Air Service flying officer who was blessed not only with a strong will and a burning ambition, but who combined a vivid imagination with uncanny foresight. From the time of his appointment as Officer-in-Charge of all photographic research and development in the Engineering Division at McCook Field in Dayton, Ohio, George Goddard changed the shapes and guided the destinies of many research and development tasks, but none with greater influence or impact than that of Aerial Night Photography. Haunted by the thought than an enemy could, and probably would, move under cover of darkness, and recognizing the intelligence advantage were such moves to be photographed, he concieved the idea of creating an artificial "sun". Thus was the photoflash bomb "born" in the mind of its creator - Lt. George W. Goddard (Figure 32). For the next three decades, many other interesting characters shared with Goddard the development of his new-fangled device. More often than not, they found themselves cast in starring roles in a never-ending series of dramas ranging from near-tragedy to light comedy....

One such account conerns a night mission during the early 1940's .....Goddard was in the air dropping flash bombs. Several of his engineers, including Gail Borden and Amron Katz, were watching proceedings

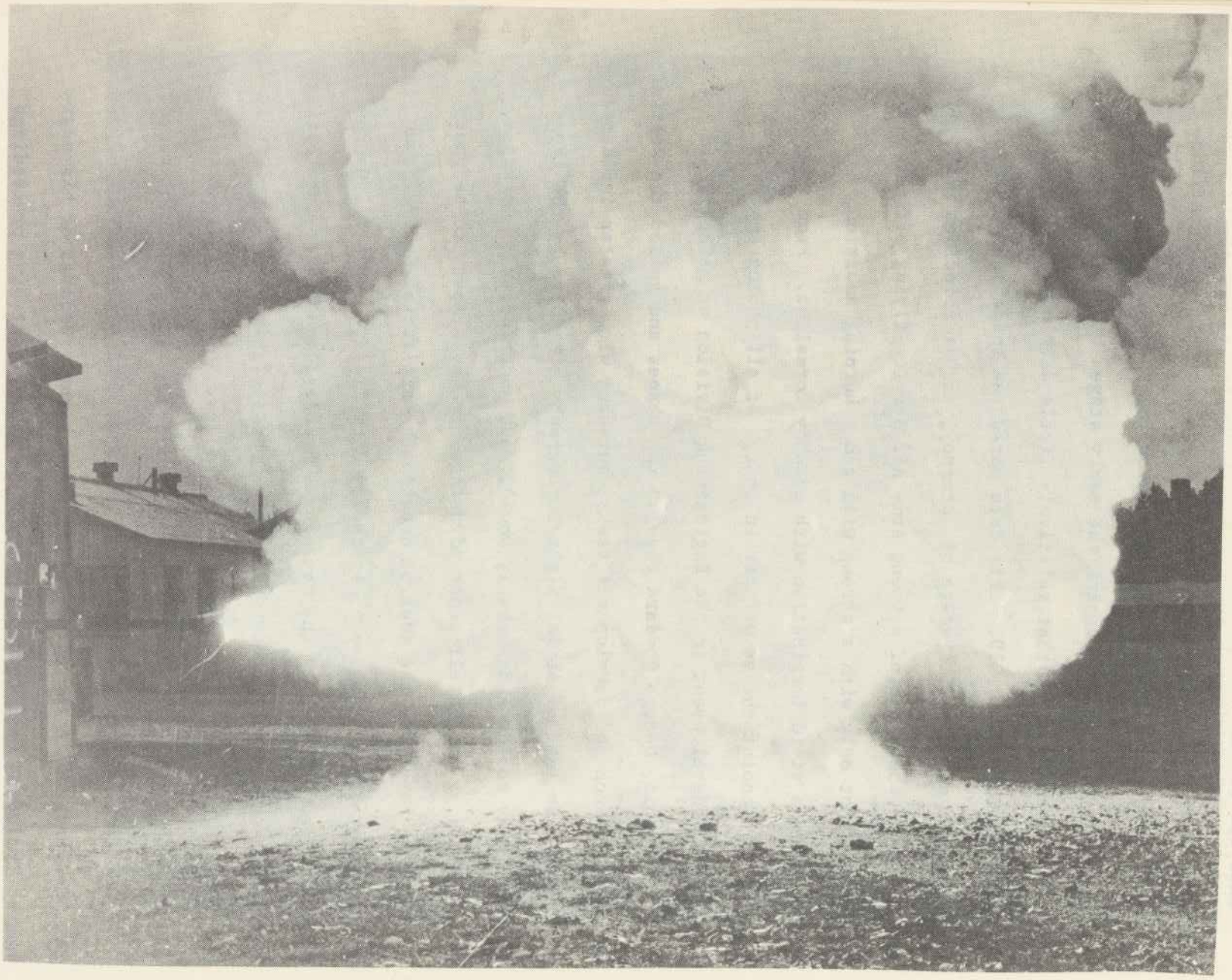


FIGURE 33 Hell Roarer resembles Lucifer's fiery furnace.

from the ground, when a violent electrical storm suddenly came up. Following a jagged, brilliant flash of lightning, there came a loud clap of thunder.....Borden turned to Katz and remarked:

"Well, that's either God or Goddard!"

The most (cursory) inspection of primitive religions shows that worship of the sun and of fire was universal. The truth is curiously illustrated by the fact that even our word "Devil" literally means the "Shining One"[42] .....The Bible, too, is replete with incidents based on the vast importance of fire as symbol and agent - whether divine or demonaic, whether the white glory of Heaven or the crimson flares of Hell[43] .....

In keeping with Marvin Dana's historic comments on the subject, the most spectacular of George Goddard's pyrotechnic progeny was part devil, part demon, and all fire....It was the "Hell Roarer" - so named by Dr. Richard G. Clarke, Director of Air Force research on ordnance at Wesleyan University (ORDWES), Windsor Locks, Connecticut....Clarke, wincing at the white-hot flame and loud whooshing noises belching forth from his latest experiment for General Goddard, probably fancied he had opened the door into Lucifer's Fiery Furnace (Figure 33).

The origin of the idea was the Engineering Studies Unit in Goddard's Photographic Laboratory at Wright Field. Sharing in the conception of this diabolical device were two "partners in crime" --

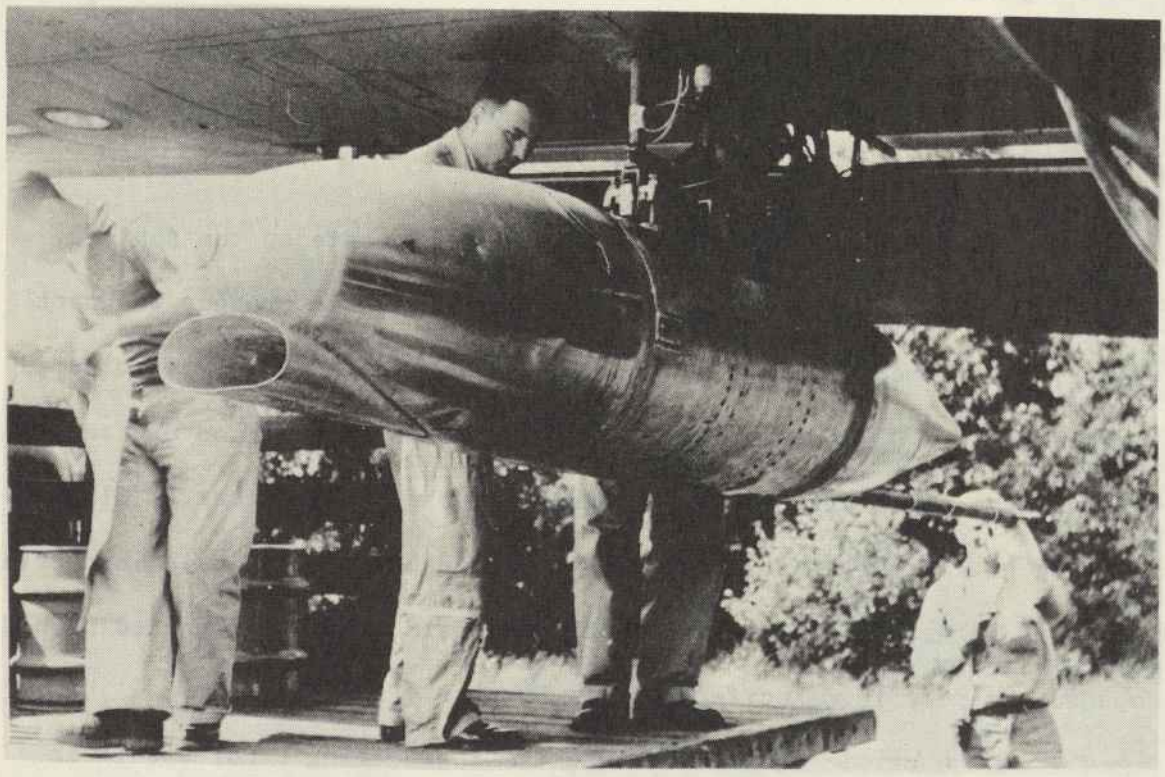


FIGURE 34 Prototype magnesium burner is readied for maiden flight.

Lt. Col. Albert L. Wallace, Jr., and Major Oscar G. Johnson. Basically, their scheme was to ignite and burn finely powdered magnesium dust in the tail pipe of a reconnaissance jet aircraft, and then to record - either by "eyeball" or camera - the objects on the ground thus illuminated..... Successful bench tests by ORDWES engineers of a scale model jet engine convinced Goddard that he was ready to build a full size unit. His already fertile imagination thus newly stimulated, Goddard pressed the "ON" button in his Wright Field laboratory, turning it into a veritable washing machine, which began to churn and pulse with his own patented brand of tumbling action. Nary an engineer, draftsman, electrician, plumber, machinist or welder escaped his determined efforts to exploit his newest idea - the airborne "open hearth". Unlike some inventions, the "Hell Roarer" was not created as the result of leisurely, untrammeled reflections on the part of some inspired genius.....The simple fact is that it was whacked together in nothing flat under the constant surveillance of Goddard himself, who, by the way, could make it hotter for you than any "Hell Roarer" ever invented.

Thus was the first flyable model fabricated. Included among its features was a screw mechanism for feeding the powder from its storage hopper into a funneled tail pipe. Two king-size electrodes, energized by a spark coil, were mounted in the exhaust funnel to ignite the powder as it was forced through the tail pipe (during flight) by ram air supplied by a nose intake scoop. The entire assembly was housed in a standard 165 gallon fuel tank, adapted for external pylon suspension beneath the wing of an RB-26 night reconnaissance aircraft (Figure 34).

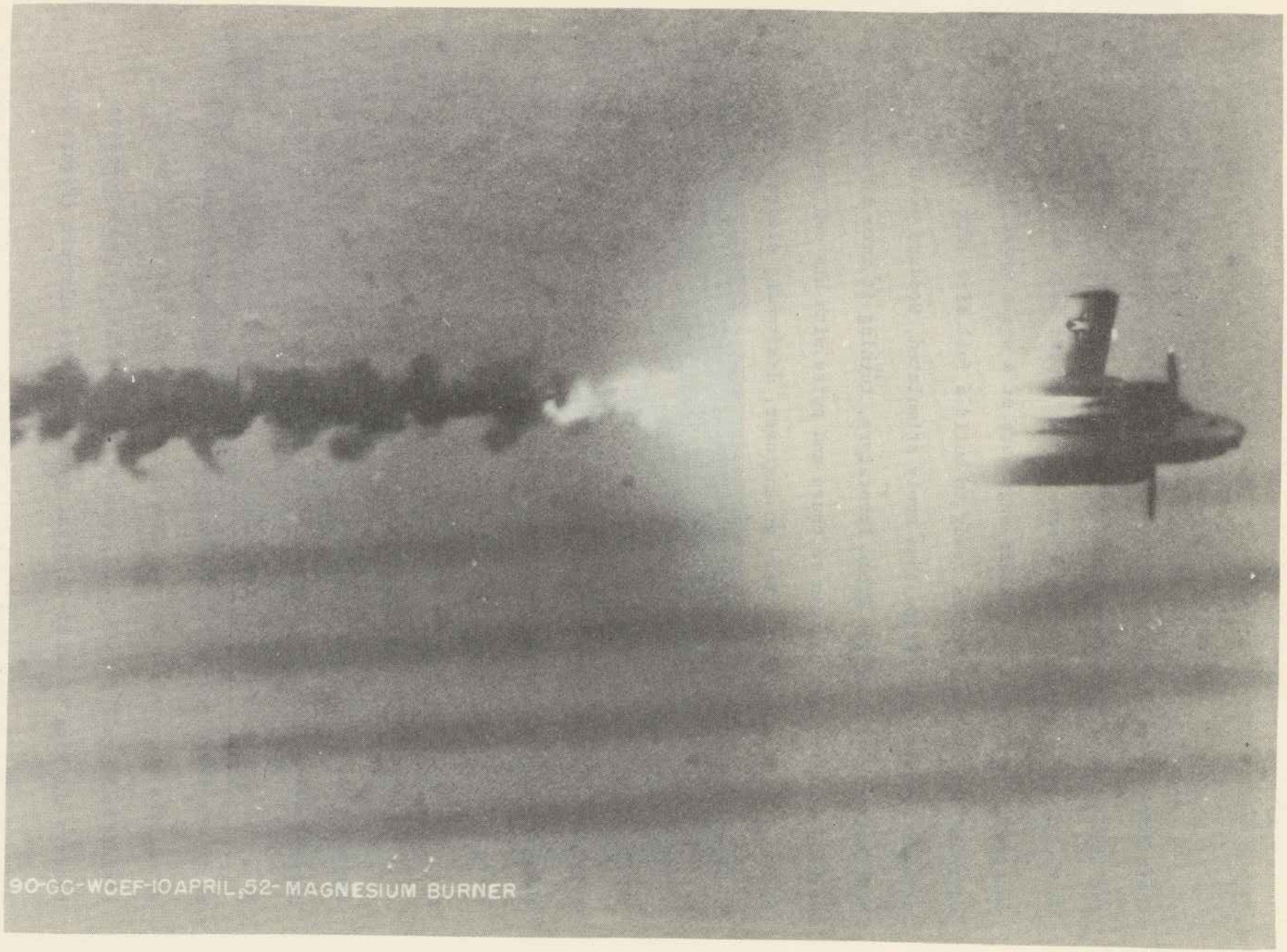


FIGURE 35 Not Haley's Comet....George Goddard's INFERNAL combustion engine

The magnesium burner proved to be of limited value as a practical reconnaissance tool. There were some (the author included) who were convinced the thing wasn't worth the powder to blow it to the place from which it derived its name.....From a public relations standpoint, however, the "Hell Roarer" was sensational. It made a jim dandy torch for political rallies, United Fund Drives, 4th of July celebrations, reorganizations, etc.....

So some dark night, if you see a strange light in the sky, and wonder whether it might be Haley's Comet, perish the thought.....it's probably George Goddard's Infernal Combustion Engine[44].....(Figure 35).

So much for the historical (and perhaps somewhat hysterical) past .....Lest we feel inclined to consider it too lightly, however, in our rush to meet the challenges of the present, and the unknowns of the future, let us remember that we are not the first to face unknowns.... .....

When, on August 3, 1492, Christopher Columbus sailed from Palos, Spain, he thought he was going to India. He was mistaken, but what he did discover--that which he had not forseen at all--proved to be of far greater significance.....Indeed, we are led to agree with Berthold Laufer, that:

"It is not the gray, cold naked objective truth that counts in the history of mankind, and will advance the cause of civilization, but it is the flight of human imagination, the impulse and visions of a genius--very often his errors and miscalculations--which have stimulated inventions and progress."[45]

J. Robert Quick

J. ROBERT QUICK
JULY 1964

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