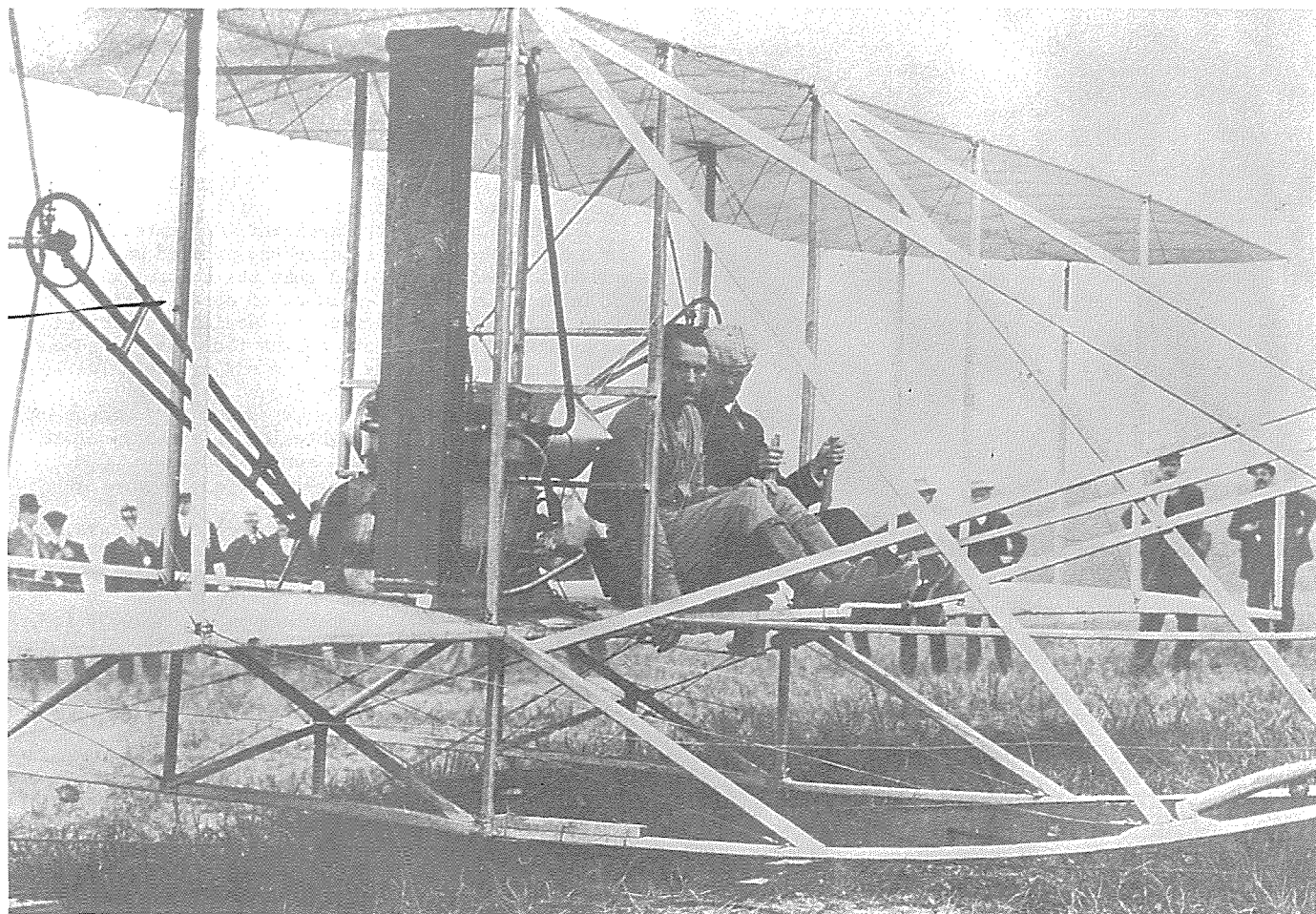




Lt. T. F. Selfridge (l.) and Orville Wright just before flight that resulted in first Army aviation fatality.

Mortality in Army Aviation

A document of considerable historic interest was prepared on 28 February 1914 by the Office of the Chief Signal Officer, War Department, Washington, D. C. and has been made available to the JOURNAL through the efforts of Member, Robert F. Brooks. Prepared as a Memorandum for the Chief of Staff, its subject is Mortality in Army Aviation, and the document traces in detail the 11 fatal aviation accidents which had occurred since the initiation of Army aviation in 1908. Excluding a brief introduction, the full report is presented herewith.

BRIEF DESCRIPTION OF ACCIDENTS AND PROBABLE CAUSES

Accident No. 1:

Mr. Orville Wright was flying the original Wright type of machine for acceptance test at Fort Myer, Va., with Lieut. T. F. Selfridge as passenger, on September 17, 1908, when one of the propellers broke, the machine being at that time about 75 feet from the ground. The machine side-slipped and nose-dived, striking the ground with such force as to fatally injure Lieut. Selfridge and break Mr. Wright's leg.

Cause of Accident: Breaking of propeller and consequent loss of lift in the machine. Lieut. Selfridge's

death can in no way be connected with any question of type of machine or skill of pilot.

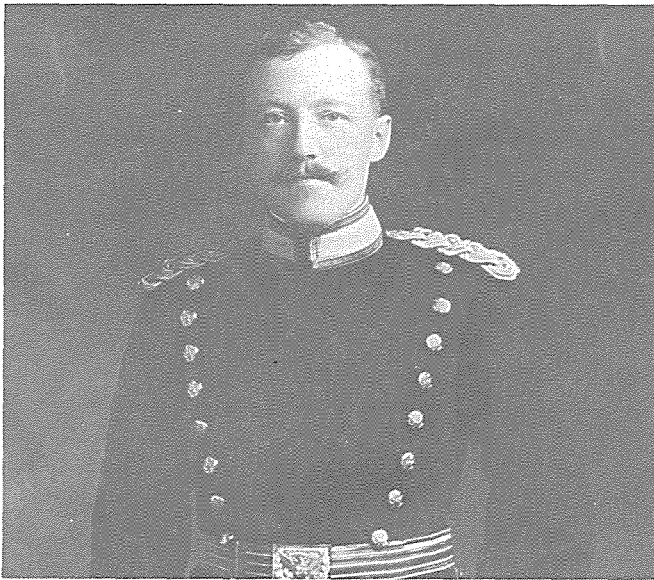
Accident No. 2:

Extract from Proceedings of Board of Officers held at San Antonio, Texas, May 10, 1911:

From the evidence given the Board finds that Lieut. George E. M. Kelly (for whom Kelly AFB is named) had made a flight of approximately five minutes duration, in a Curtiss bi-plane, at about 7 A.M., May 10, 1911, under good atmospheric conditions. As a result of this flight he met his death.

He had made a not abnormally hard landing. Upon landing at least one and possibly both sides of seat fork were broken at a point between pilot seat and foot seat. At the same time it appears that one diagonal bamboo brace from front wheel to front elevator was broken, and its mate was bent.

After striking the ground the first time, the machine bounded to a height approximating 10 feet, and gradually rising to about 30 feet until, within about 75 yards of the camp of the Eleventh Infantry, it made a sharp turn to the left, banked up the turning wing, and made an abrupt dive to the ground. Lieut. Kelly was thrown clear of the machine to a distance of about 20 feet.



Lt. George E. M. Kelly. (Photo - Nat'l Arch. 18-P-121)

As a result of the first impact with the earth it is apparent that the pilot lost control of the front elevator and therefore had only partial control of the machine.

It is the unanimous opinion of the Board that the front wheel must have struck an abrupt depression in the ground or some obstacle causing the strain which resulted in the break.

From all of the preceding facts the Board is of the unanimous opinion that the accident was due to the efforts of Lieut. Kelly to avoid endangering the occupants of the Eleventh Infantry camp in which endeavor it became necessary for him to make a sharp left turn, which, in the crippled condition of the machine, put more strain on the controls than would have been required in a straight away landing. Such straight away landing was impracticable owing to the proximity of the tents.

Probable Cause of Accident: Error in judgment on part of pilot in selecting an unsuitable landing place.

Accident No. 3:

Extract from Proceedings of Board of Officers held at College Park, Md., June 12, 1912 (Pilot, Mr. A. L. Welch; Passenger, Lt. Layten Hazelhurst):

That the machine arose from the ground, made a circle of the field, and then flew south a distance of nearly 1/2 mile, made a turn over towards the trees and flew north at a height of about 150 feet. The machine was then pointed down at an angle of about 45 degrees, with the power on, and glided down in this position to a height of about 30 or 35 feet from the ground. Mr. Welch was then seen to work at his levers and the machine came up to the horizontal position when it seemed to quiver, and the wings appeared as if they were raised up, the ends being from two to three feet higher than the center section. It seemed to pause for a moment and then dove headfirst into the ground. The engine was heard to run until the machine struck; then it was enveloped in a cloud of dust. This accident occurred about 6:13 P.M. (June 11th).

From all testimony of eye-witnesses and a careful examination of the machine, the Board is of the opinion that the accident was due to the fact that the operator endeavored to bring the machine upward too suddenly, thus throwing a greater strain upon the front spars than they were able to withstand. The spars broke and the wings collapsed, bending outward and backward. The machine being relieved of the support of these outer

planes, was precipitated to the ground.

Probable Cause of Accident: Error in judgment on part of pilot in gliding with power on and pulling machine up too suddenly. (Both men killed.)

Accident No. 4:

Extract from Proceedings of Board of Officers at College Park, Md., October 2, 1912 (Pilot, Lt. Lewis C. Rockwell; Passenger, Corporal Scott):

Immediately after the accident (September 28, 1912), the board proceeded to examine the wrecked machine and upon this examination found that the control wires were all intact. From the testimony of eye-witnesses, the board is of the opinion that the accident was caused by the aviator misjudging his height from the ground and his failure to bring the machine out of the glide in sufficient time to clear the ground.

Probable Cause of Accident: Error in judgment on part of pilot in not straightening up machine before striking the ground. (Both men killed.)

Accident No. 5:

Extract from Proceedings of Board of Officers, San Diego, California, April 22, 1913:

From these affidavits and statements of eye-witnesses, the following decision was reached:

Lieut. Brereton left the hangars about 10:30 A.M. April 8, 1913, piloting the flying boat, No. 15, with Lieut. Rex Chandler as passenger who accompanied him for the purpose of learning the controls of this machine.

At time of departure, the wind was blowing fairly strongly and somewhat unsteadily, and so-called "puffs" were particularly bad in the vicinity of Point Loma. The bay near the place of the accident is subject at times to treacherous gusts from the ravines on Point Loma which apparently converge there, making even sailing, as well as flying, difficult in that particular part.

Flying into the wind, Lieut. Brereton attempted a right turn to start returning. When the turn was partially completed, a sudden gust of wind struck the machine, augmenting the amount of its bank to such a degree that despite every effort on part of the pilot to regain control, that it slid inward and downward falling about 100 feet into 30 feet of water. Apparently the nose and right wing struck simultaneously. The forward portion of the boat was splintered and separated from the rear but the planes held up the wreckage. Lieut. Brereton was thrown out and escaped with little injury, but Lieut. Chandler, sitting on the right, was pinned beneath the wreckage and drowned before help arrived. Each man wore helmet and "non-sinkable" coats, and Lieut. Brereton probably owes his escape from serious injury, in part at least, to his helmet, as both received serious blows on the head.

The machine was almost completely wrecked. The engine was not damaged to any extent, and other saved parts were: one aileron, the stabilizer, and the rear section of the boat.

The board is of the opinion that the accident was due to bad atmospheric conditions, aggravated by the natural sluggishness of the flying boat in answering its controls. It considers no person responsible for the accident.

The two senior members of the board are of the opinion that had the accident occurred to a standard hydro-aeroplane, both pilot and passenger might have been thrown clear of the wreckage and escaped serious injury.

Probable Cause of Accident: Bad atmospheric conditions.

Accident No. 6:

Extract from Proceedings of Board of Officers held at San Diego, Calif., May 10, 1913:

No person actually witnessed the accident. From the testimony and evidence obtainable the board reached the following decision:



Three photos showing the wreckage of the Wright B, aircraft number 4, in which Lt. Lewis C. Rockwell and Corporal Scott lost their lives. The accident occurred at College Park, Maryland on September 28, 1912. (Photos Newscone, taken by MacCortee)

Lieut. Joseph D. Park left the aviation field on North Island approximately 5:20 o'clock A.M., May 9, 1913 with the intention of flying to Ascot Park near Los Angeles.

His object in an early start was to avoid strong winds which might rise later in the day.

At 8:30 in the morning, a telephone message was received stating that Lieut. Park had been killed at Olive, California.

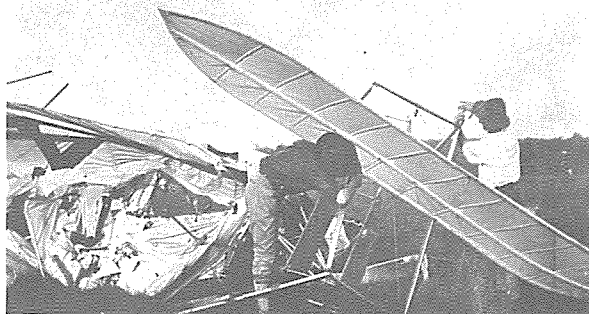
The members of the board and the medical officer, Captain M. A. Reasoner at once proceeded to the scene of the accident in an automobile, arriving there about 1:00 P.M.

The wreck of the machine and the remains of Lieut. Park had been removed to Santa Ana, Calif., by direction of the County Coroner, the wreckage being taken to the National Guard Armory, and the body to the undertakers. The wrecked machine was examined by the board and the body identified by the President of the board before proceeding to an examination of the scene of the accident.

Lieut. Park had landed on a small knoll, the area of the top of which was such that it gave him about a run of 300 feet before he came to the slope which was about 20 degrees. At the bottom of the slope was a ridge or embankment. Beyond the ridge was a small valley or ravine, which was covered with trees. On the opposite side was another equally steep slope to the top of another small hill, beyond which was a flat open valley of about four or five square miles in area. The high barley so retarded the speed of the machine that it did not rise before reaching the descending slope.

It ran down this slope until it reached the ridge and, striking this, undoubtedly bounded into the air. About 50 feet beyond the ridge was a tree or sapling. The machine struck the tree about five feet from the ground at the left end of the engine section. The force of the blow tore away the entire left side of the machine.

It swung around to the right of the tree, landed at a distance of about 100 feet on the right rear wheel. This broke the right panels and caused the machine to turn completely over to the left, as the entire left side of the machine was gone. From the position of the radiator, it had evidently fallen on Lieut. Park's head and due to the weight of the engine behind, had crushed it into the ground. The machine had apparently never left the ground until it reached the small ridge above



mentioned and then only for a distance of about 50 feet.

Nothing but a perfect landing in the small difficult area could have avoided an accident in alighting.

The board is of the opinion that the accident was due entirely to the poor judgment of Lieut. Park in attempting to rise from such a place.

The knoll was of such a small area and surrounded by such obstacles that it would have been impossible for any machine to have arisen from it. The accident was in no way due to the fault of the machine which was in perfect running condition.

The following features connected with the accident remain inexplicable to the board:

1. Why Lieut. Park did not choose any of the large flat fields in the vicinity in which to land.
2. Why, after landing, he attempted to leave in the direction he did, when a glance around him would have shown him its very apparent danger.
3. Why he disregarded instructions received prior to his start to communicate personally with the Commanding Officer in case he landed before reaching his destination.

Probable Cause of Accident: Poor judgment of pilot.

Accident No. 7:

Extract from Proceedings of Board of Officers held at Texas City, Texas, July 8, 1913:

That Lieut. Loren H. Call left the aviation field at 6:21 A.M., July 8, 1913, in aeroplane No. 11, a type C machine, made by the Wright Company of Dayton, Ohio, for the purpose of practicing accurate landing without power. This landing is one of the tests for qualification as military aviator and Lieut. Call left the field with the understanding that Lieut. R. C. Kirtland and the crew of the machine would follow him to the smooth ground north of the camp of the Fourth Field Artillery, where he would make the test with Lieut. Kirtland as official observer. The air conditions were quite good at the time he left the field, although there was a slight puffy wind blowing from the north, the anemometer record showing that at 6:45 A.M., the wind had a strength of six miles per hour. While flying at an elevation variously estimated at from 600 to 1200 feet (Lieut. Call's barograph was broken, the record sheet showing that the needle failed to register at any time during the flight), the plane fell resulting in the instant death of Lieut. Call and the complete destruction of the aeroplane, at 6:45 A.M. July 8, 1913.



Lt. Loren H. Call. (Photo - Nat'l Archives 111-RB-5790)

From the testimony it appears that the aeroplane assumed a very dangerous angle, with the left wing at least 45 degrees lower than the right; that Lieut. Call evidently attempted to straighten out the machine by turning to the left and pointing the nose down; that the machine then took a very steep angle downward which gradually became a perpendicular drop, and that between 200 and 300 feet from the ground the plane began to turn upside down, at which time the wings collapsed, the plane then falling straight to the ground striking upside down.

There was nothing found to indicate any engine trouble in the air.

Probable Cause of Accident: Stalling and subsequent incorrect use of rudder by pilot. The collapse of the wings is a common result in accidents of this sort and does not necessarily indicate any structural weakness in the machine, but a great increase in pressure due to velocity of fall.

Accident No. 8:

Extract from Proceedings of Board of Officers held at San Diego, California, September 5, 1913:

All witnesses agree to the following facts:

Lieut. Ross L. Love left the field at 7:23 A.M., September 4, in Wright machine No. 18. He climbed to approximately 2,000 feet and flew at that altitude until 8:01 A.M. when he started a volplane. After completing a right turn at an altitude of approximately 1,000 feet, he continued on a straight-away glide, very little, if any steeper than the normal gliding angle of this machine. At an altitude of about 300 feet he was observed to put on power. He continued gliding at approximately the same angle as before for quite a perceptible interval of time. Then the angle of glide gradually became steeper and steeper, the machine becoming vertical.

There is a difference of opinion as to whether the machine went beyond the vertical or not, but the majority of witnesses are of the opinion that it did, striking the ground on the top plane first. The position of the machine seemed to bear this out. Witnesses are uncertain as to whether power was kept on until he struck the ground. The machine was a total wreck, but an examination showed all wires intact. Up to the time of the final dive, Lieut. Love seemed to be flying well, with the machine under thorough control, and as far as anyone could tell, there was no collapse of any part of the machine in the air. The machine was thoroughly examined before Lieut. Love went up and had already been flown several times that morning.

The board is therefore of the opinion that the accident was due in no way to any defect in the aeroplane itself. The air at the time was slightly puffy, but not dangerously so. The machine at all times up to the final dive seemed to be under thorough control, therefore, the only reasons that can be given for the accident are either that Lieut. Love became unconscious in the air, or that the dive was caused by bad air. Immediately after the accident full details were telegraphed to Mr. Orville Wright, who telegraphed in reply that he was convinced the accident "was due to slight gust when descending at too great speed and too small an angle of incidence."

Probable Cause of Accident: Stalling.

Accident No. 9:

Extract from report of department signal officer, Philippine Department, dated Manila, P.I., November 15, 1913:

The death of 2nd Lt. C. Perry Rich, P.S., who was detailed as student officer to the Signal Corps Aviation School in March, 1913, occurred yesterday, November 14th at about 12:19 P.M., about two miles off the beach at Pasay while in the performance of his duty of flying in hydroaeroplane No. 12. The machine was flying at an altitude of approximately 500 feet and through some unaccountable reason, Lieut. Rich fell from, or was thrown out of the hydroaeroplane to the waters of Manila Bay. Instant death resulted, as when the relief party arrived on the scene it was found that he had breathed his last. The cause of the fall will probably never be definitely known, as it seems that he got a good start and was progressing nicely at that altitude - when suddenly the machine was seen to wobble and tilt forward and Lieut. Rich was seen to fall clear of the machine - striking the water with terrific velocity, and the machine fell directly, or as near as could be determined, upon him. Some native fishermen, who were near, held up the body until the torpedo boat Decatur, which was anchored in Manila Bay, arrived on the scene a few minutes after the accident. Everything possible was done to resuscitate Lieut. Rich but all efforts were unsuccessful, and his body was brought to the Army and Navy Club, thence by ambulance to the Army Morgue, this city, where it will be held until the sailing of the December 15th transport, when the body will probably be returned to the United States.

Probable Cause of Accident: Stalling; impossible to determine whether caused by failure of motor or pilot.

Accident No. 10:

Extract from Proceedings of Board of Officers held at San Diego, California, November 25, 1913:

About 7:00 A.M. on this morning of November 24, 1913, Lieut. Eric L. Ellington, Chief Instructor, made a short flight in aeroplane No. 14, returning safely to the hangars after perfectly normal flight of some five minutes duration. No trouble had developed either with the engine or machine, except that the engine was heard to miss once or twice while in the air.

Lieut. H. M. Kelly then made a careful examination of all parts of the machine, at the conclusion of which both he and Lieut. Ellington got into the machine for a



Lt. Eric L. Ellington. (Photo - Nat'l Arch. 18-P-59)

flight. At this time Lieut. Ellington was heard to give Lieut. Kelly some final explanations as to the correct use of the double throttle, both foot and hand, with which the machine was equipped. After a short flight around the southern part of the island, the machine was noticed apparently returning to Wright Field with the engine missing badly. While still about one mile from the Wright hangars, the machine was brought into a normal gliding angle and the engine apparently throttled down, tho' still missing. It was the opinion of witnesses at this time that it was the intention of the pilot to make a landing and not attempt to make Wright Field with the missing engine. At the beginning of this glide the machine was probably 200 feet from the ground. The glide continued normal until about 75 feet from the ground when the angle of glide suddenly steepened into a headlong plunge into the ground. At the moment of striking the ground the machine was about vertical.

In the opinion of the board, the accident was caused by an inherent tendency in this type of machine to plunge downward upon any sudden accession of power during a glide.

The board further believes that such an accession of power took place at the movement of the plunge, or rather just before it. A puff of smoke was observed from the engine by one witness at this instant, giving the appearance of full power having been suddenly turned on, probably accidentally.

All controls of the wrecked machine were intact.

Probable Cause of Accident: Stalling due to remaining too long in air with missing engine and starting glide.

*

*

*

Accident No. 11:

Extract from Proceedings of Board of Officers held at San Diego, California, February 10, 1914:

Statement of 1st Lieut. V. E. Clark, C.A.C.:

Q. Please state to the board all that you know of the accident to Wright hydroaeroplane No. 10, yesterday, which resulted in the death of Lt. Henry B. Post.

A. I was standing near the eastern end of the main hangar watching Post come down. I had watched him from an elevation of probably 2,000 feet, all the way. After he got down below a thousand feet I remember thinking he was pointing down very steeply. From a thousand feet down to the time the machine collapsed, he was spiraling widely and with very little bank. I believe that his gliding angle increased gradually from 1,000 feet down to what I judge to be between 500 and 600 feet, when the machine appeared to me to round over and point practically vertical. At the same time - that is, as the machine rounded over to the vertical, I saw Post, or a black body which I took to be Post, thrown well forward and out of the machine. Immediately the machine collapsed. I am not sure that Post was thrown clear before the collapse, but I believe this to be the case. Post's body reached the water while the collapsed machine was still 75 or 100 feet in the air, and his body struck the water at a point which I estimated to be 300 or 400 feet away from the machine, and in the same direction from the machine as the direction of movement of the machine at the time of its dive.

The fact that Lieut. Post had descended from an altitude of approximately 12,000 feet to an altitude of 1,000 feet without difficulty, and in a normal manner, as far as can be determined from the evidence submitted herewith, leads the board to the opinion that the responsibility for the accident, resulting in the death of Lieut. Post was not due to any known fault or action on the part of Lieut. Post. That although the machine descended from approximately 1,000 feet to approximately 600 feet, at an increasingly steeper angle, ultimately assuming at the latter altitude a vertical head-down position, the board cannot believe that this was caused through any fault of the operator, Lieut. Post.

The board is therefore unable to determine the cause or fix the responsibility for the accident to Wright hydroaeroplane No. 10, which resulted in the death of Lieut. Post.

The board is finally of the opinion that the cause of the accident to the Wright hydroaeroplane No. 10, was due to the machine going into a vertical, head-down position, causing excessive pressure on the planes which resulted in the collapse of some part or parts of the machine.

Probable Cause of Accident: Difficult to determine from the testimony: may have been due to pointing the machine down too steeply when Lieut. Post fell forward from the machine. Immediately afterwards the machine collapsed, probably due to excessive air pressure caused by great velocity of fall.

GENERAL DISCUSSION

From the above extracts it can be inferred that of the eleven accidents occurring, one was caused by the breaking of a propeller (accident #1), one by land-on unsuitable ground (accident #2), one by adverse weather conditions (accident #5), three through bad judgment used by pilots (accidents Nos. 3, 4 and 6), three by stalling (accidents Nos. 7, 8 and 10) and two, cause undetermined, probably stalling. In none of the above accidents is there any record of the controls having failed. In accident #10, the motor is reported to have been missing; in #9, the motor may have given trouble. In accidents Nos. 3, 7 and 11, collapse of the wings was noted; in the two latter cases collapse was due to excessive air pressure caused by too rapid a descent; in #3, to an unnecessarily great strain on the wings in pulling up the heavily loaded machine too abruptly.

Since 1911 a record of flights has been kept. This record gives the name of the pilot and passenger, the type of machine, the time in air and the elevation reached during the flight. All these records have been carefully compiled with a view of ascertaining whether or not any clue to the causes of the accidents could be determined therefrom.

The annual mortality rate is evidently not a proper measure of the extra hazard due to flying, as the rate depends solely on the ratio of the number exposed to risk while flying to the number of casualties during the year, and bears no relation to the duration of the hazard. When a relatively small number of persons are engaged in flying, one casualty more or less, makes a great variation in the annual rate. It is evident that the true measure of the risk is the number of hours in air per casualty per year, as the longer one remains in the air, the greater the probability of occurrence of an accident. If the hours in air per casualty increase from time to time, the actual risk is diminished in the inverse ratio, Table A. The number of flights per casualty per year serves as a basis for arriving at the relative frequency of the casualties. Such increase in the number of flights per casualty shows a decrease in their relative frequency, Table B.

There are three ways of computing the annual mortality rate, depending upon the viewpoint; first, by the ratio of the total number exposed to risk, both pilots and passengers, to total casualties, Table C; second, the ratio of the total number exposed to risk, pilots only, to the casualties among the pilots, Table D; third, the ratio of the total number exposed to risk, pilots and those passengers who were killed, to total casualties, Table E.

Table A

Year	Hours in air per casualty
1911	64.83
1912	74.98
1913	105.56
1914*	125.41

Table B

Year	No. Flights per casualty
1911	372
1912	477
1913	479
1914*	515

Table C

Mortality rate; number exposed to risk includes pilots and passengers.

Year	No. Exposed to Risk	Casualties	Mortality Rate
1911	42	1	2.38
1912	105	4	3.80
1913	145	7	4.80
1914*	57	1	1.75

Table D

Number exposed to risk, includes pilots alone; casualties includes pilots alone.

Year	No. Exposed to Risk	Casualties	Mortality Rate
1911	9	1	11.11
1912	21	2	9.52
1913	39	5	12.82
1914*	21	1	4.76

Table E

Number exposed to risk includes pilots and passengers who were killed.

Year	No. Exposed to Risk	Casualties	Mortality Rate
1911	9	1	11.11

1912	22	4	18.18
1913	39	7	17.94
1914*	21	1	4.76

(*To February 9th inclusive)

It is evident from Table A that the extra hazard due to flying has been greatly reduced in the U. S. Army. In fact, at present, it is twice as safe to fly as it was in 1911; Table B indicates that accidents are at present much less frequent, in fact, as seven is to ten. Table C indicates the true measure of the annual mortality rate, while Tables D and E show the fallacy of basing the annual mortality rate on partial and incomplete data.

The following table gives the hours in air and number of flights of the various types of machines used by the Signal Corps from the beginning of 1911 to February 9, 1914.

Machine	Hours In Air	% Freq. of Use	No. of Flights	% Freq. of Use
Burgess	276.46	22.68	1528	25.05
Curtiss	515.35	42.28	2337	38.32
Wright	427.11	35.04	2234	36.63

The ten accidents since the beginning of 1911 have occurred in the following types of machines: Burgess 1; Curtiss, type D, 2; Curtiss Flying Boat, 1; Wright, type B, 1 and Wright, type C, 5; the relative percentage of frequency being Burgess, 10; Curtiss, 30; Wright, type B, 10; and Wright, type C, 50.

From the above it would appear, not only from the standpoint of hours in air, but also from the number of flights and frequency of occurrence that there has been a greater tendency to accident in the Wright type C machine, than in the others. For this reason, the commanding officer, Signal Corps Aviation School, San Diego, California, was instructed by wire on February 16, 1914, to suspend flying in the Wright machines pending an investigation of this subject by a board of expert aviators which was convened at San Diego for that purpose.

The following table gives the data as to the amount of use to which the machines were put previous to the time of the accidents:

Acc. No.	Type of Machine	Hrs. in Air	No. Flights
1	Original Wright, #1	---	---
2	Curtiss D, #2	Record Incomplete	
3	Wright C	During acceptance tests	
4	Wright B, #4	26.03	149
5	Curtiss FB, #15	21.60	59
6	Curtiss D, #2	Record Incomplete	
7	Wright C, #11	23.68	132
8	Burgess, #18	31.40	178
9	Wright C, #12	8.10	68
10	Wright C, #14	00.21	2
11	Wright C, #10	10.40	49

The following indicated the experience of the pilots who were killed:

Name	Hours in Air	Total No. Flights	Certs.
Lt G.E.M. Kelly	No Record	No Record	
Lt Rockwell	15.40	100	P.
Lt Park	36.98	175	P. MA
Lt Call	16.98	53	
Lt Love	12.25	52	P.
Lt Rich	21.58	60	P.
Lt Ellington	86.85	469	P. MA
Lt Post	59.83	245	P. MA
P. -- F.A.I. Pilot		MA -- Military Aviator	

After having been detailed to aviation duty the pilot is sent to the Signal Corps Aviation School, where he receives theoretical and practical instruction in the art of flying. In my opinion, nearly every one of the above accidents was due to the pilots, not the machines.