BULLETINS

OF THE

Aerial Experiment Association

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MR. Mc CURDY'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

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Bulletins of the Aerial Experiment Association.

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Baird Branch, Near Baddeck, Nova Scotia.

12 10 H.

FROM

HAESELER PHOTOGRAPHIC STUDIOS
1518 WALNUT STREET,
PHILADELPHIA, U. S. A.

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ILLUSTRATIONS.

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EDITORIAL NOTES AND COMMENTS.

This Bulletin is devoted specially to thoughts suggested by the disaster in which our Secretary Lieut. Selfridge met his death.

For the fine photograph of Lieut. Selfridge which forms the frontispiece of this number we are indebted to Mr. Conrad Frederic Haeseler, a former pupil of the Pennsylvania Institution for the Deaf at Mt. Airy, Philadelphia. Mr. Haeseler was born deaf and educated exclusively by the oral method having entered school on the first day that the oral class was begun. He was the first pupil to graduate, under the oral instruction, from that Institution, and the only one of the original class that finished the entire course of instruction. He was the first pupil, sent to a hearing school from the Mt. Airy Institution, having been placed in the school of industrial art in Philadelphia where he earned three scholarships in three successive years. This with two additional years at the Pennsylvania Academy of Fine Arts, gave him fully six years of active art study. At the end of that time he became interested in photography, in which his father (Albert S. Haeseler) encouraged him, as being a more practical occupation for a deaf man. This has resulted in the establishment of a large photographic Studio, and a reputation enjoyed by no other Philadelphia photographer. Mr. Haeseler has certainly succeeded in producing the finest and most natural photograph of Lieut. Selfridge I have seen.

Mr. Winfield Scott Cline, Photographer of the Department of Agriculture, is spending his vacation at Beinn Bhreagh and giving us the benefit of his expert services in photo-

graphing apparatus here. Mr. Cline was present at the disaster to Orville Wright's machine when Lieut. Selfridge lost his life and took the last photograph of the machine in the air. He had just finished the exposure and was changing his plate holder when the accident occurred. He was the first person, with the exception of two mounted soldiers, to reach the scene of the disaster and go to the aid of the injured men. When the propeller broke he was standing quite close to the aerodrome shed and had thus an exceptional opportunity of observing what happened. The account which he has been kind enough to write for us contains some new points not hitherto touched upon I think by other observers. He is decidedly of the opinion that the machine, instead of diving head down as others have led us to believe, began with a stern dive with the front control up in the air. After falling about half the distance to the ground moving backwards a short distance it resumed its horizontal position for a moment and then dived head downwards on a reversed path. He thinks that Mr. Wright was regaining control of the machine when it struck the ground and that if the accident had occurred at a considerably greater elevation in the air, He would have succeeded in averting the catastrophe.

This is an entirely different account from any other I have seen and is not corroborated by any published evidence so far as I know. Former accounts have been written by witnesses who were at a great distance away. Mr. Cline was near at hand and had a side view of the apparatus. His observations therefore are more likely to be correct than those

of distant observers. An examination of the plan surfaces of the Wright aerodrome led me to think that the center of gravity was not further forward than the center of surface and may even have been a little behind it, in which case we might expect a stern dive to begin with followed by an oscillation bringing about a front dive just as Mr. Cline describes it. His observations are certainly entitled to careful consideration. A.G.B.

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THOUGHTS SUGGESTED BY ORVILLE WRIGHT'S DISASTER OCT. 25, 1908: by Alexander Graham Bell

In the case of the accident to Orville Wright's flying machine, we have reason to believe that a propeller blade caught in one of the rudder wires; and that the propeller and the wire both broke, leaving the machine with a single propeller in operation and with its steering gear out of order.

Now Orville Wright's two propellers were placed one on either side of the longitudinal axis of the machine. Thus it happened that when the right propeller broke, the left propeller continued pushing, not in the central line of the machine, but on the left side of it; and the machine at once turned sharply to the right.

It is obvious that such a turning action, if not quickly neutralized by steering to the left, would cause the machine to move in a circle of small diameter, or even to spin round like a top, a condition not favorable to support in the air, if indeed not absolutely fatal to it.

The only thing possible for Mr. Wright to do under the circumstances was to shut off power and attempt to glide to the ground. This he did with disastrous results to himself and his passenger.

The fatal result to our friend and associate, Lieut. Selfridge, brings home to us, as nothing else could do, the advisability of studying closely all the causes that could lead to such a catastrophe, so as to avoid them in our future experiments.

The accident shows us how careful we should be to see that our propellers have plenty of room; and that there

should be nothing near them that could possibly catch, or that could possibly be drawn within reach of a rotating propeller by the powerful suction exerted by one face. The breaking of a propeller in the air may evidently become a serious matter, and we would do well therefore to make absolutely sure that our propellers are constructed of such strong and sound material that they could not possibly break under the centrifugal force generated by their rapid rotation; and that the blades are so stiff that they could not break by bending under the pressure of the air driven from them. In Laboratory experiments we have had propellers smash from all these causes, and we cannot be too careful in our inspection of propellers to be used in actual flight.

We may learn also from Orville Wright's experience that double propellers, rotating in opposite directions, although exceedingly desirable because they eliminate the disturbing effects of torque and gyroscopic action, introduce an element of danger when arranged as in the Wright machine.

It might perhaps be safer to use concentric propellers both pushing (or pulling) in the central line of the machine. Then if one is put out of commission, the other will continue pushing in the central line and not to one side of it. Some disturbance of equilibrium might still result from unbalanced torque, or gyroscopic action, but the danger would not be so great as when combined with an ex-centric push.

With concentric propellers two engines, one for each propeller, might be of advantage; for should one of the engines break down in the air both propellers would not stop.

One of them would still continue in action pushing in the central line. It is hardly likely that both engines, or both propellers, would give way at the same time; and, in case of accident to one, the aviator would not be obliged to come down at once without being able to choose his place of descent.

When the accident at Fort Meyer occurred, Mr. Wright did not know exactly what had happened, for the rudder and propellers were behind him, and therefore out of his sight. He did not dare to look round very much, for the operation of his controlling levers demanded all of his attention at the time.

This emphasizes the importance of the suggestion made by Mr. F. W. Baldwin that the moveable parts of an aerodrome should be placed in front of the aviator as much as possible, so that he may keep them under constant observation (see discussion concerning front and rear controls, Bulletin XVI, pp.36-44). If anything went wrong he would then see at a glance what had happened, and would be in a better position to meet the emergency.

Mr. Baldwin suggests that the vertical rudder should be placed in front of the machine instead of at the rear like the horizontal rudder known as the "front control". In both cases the natural and proper position would seem to be at the rear; but no inherent reason exists why the vertical rudder should not be able to operate in front, at least as well as the front control.

Where it is impracticable to put moveable parts in front, it might be worth while considering whether a fixed

mirror in front might not be of advantage into which the aviator could look and see the moving parts behind him, or on either side, without the necessity of turning his head.

The Wright machine, after the accident, was found with its head pointing in a very different direction from that in which it was going when the propeller broke, suggesting the idea that it had spun around at least 90° before it reached the ground, and had thus lost its notion of translation through the air. Whether or not this was the immediate cause of the disaster to the Wright machine, it is safe to say, that under present conditions of aerodrome construction, loss of headway is the greatest danger the aviator has to fear. This, I think, will be admitted by all.

But why should loss of headway be accompanied by danger? This is of the greatest consequence for us to determine for a machine may lose headway at any moment from causes that are quite beyond our control. An engine may break down, a propeller may go, even an unexpected gust of wind may stop our machine for a moment, and at once danger results. What usually happens under such circumstances? The machine turns head down and dives. What does this indicate? That the machine is not properly balanced when headway is lost. The turning down of the head shows that the center of gravity is too far forward for a good balance when headway is lost. The advanced position of the center of gravity is then the cause of the danger.

Now it is somewhat disconcerting to find that the tendency of progress in the Hammondsport experiments has been to advance the position of the center of gravity in our mach-

ines. This has been done by bringing the place of the aviator further forward in the machine than before, by omitting the tail, by using a heavier front control, and by putting the front control at a greater distance from the main supporting aeroplanes. We should give grave consideration to the question whether these changes have, or have not, increased the danger to the aviator in the event of loss of headway.

But why should there have been this tendency of progress in our experiments to bring forward the center of gravity. I think it results from the fact that we naturally desire that our machine should be properly balanced when in rapid flight. The June Bug, in its early days used to climb under the full power of the motor. Instead of remedying this defect by the use of a larger front control we advanced the place of the man, thus violating the important principle that changes of equilibrium should be balanced by the action of moveable surfaces, rather than by changes in the position of the center of gravity.

The center of pressure of course is further forward when a machine is in motion, than when it is stationary in the air; and, in order to be properly balanced, the center of gravity should come under the center of pressure.

The following propositions are important and interesting and should be fully discussed:-

1. If the machine is properly balanced when it has no headway, it will become unbalanced when headway is gained. The head then turns up, with a tendency to continue the turning movement until the head points vertically upwards towards the sky.

2.If an aerodrome is properly balanced while it has headway, it will become unbalanced when headway is lost. The head then turns down, with a tendency to continue the turning movement until the head points vertically downwards towards the ground.

Both are dangerous conditions, but there is a noteworthy difference between them:-

3. We can correct the climbing tendency by steering down with the front control, because there is headway; but we cannot correct the diving tendency by steering up, because there is no headway.

You cannot steer a boat without headway far less a flying machine. The first condition is far safer than the second.

When there is no headway the front control can no longer exercise its function as a horizontal rudder. When turned up at a positive angle to the horison it is no longer pushed up by the pressure of the wind of advance. For the same reason there is no air pressure against it to push it down when turned at a negative angle. It is merely passive in its action and resists the very upward and downward turning movements it would cause in its active condition.

Where the machine is head-heavy when headway is lost, as in the second case noted above, the machine tends to turn downwards at the head, and the surface of the front control resists this turning tendency.

At first sight it would appear that by increasing the surface of the front control we could prevent a dive, but consideration will show that this is not so.

When headway is lost, the presence of a front control will not prevent the tendency of a head-heavy machine to turn head downwards, however large its surface may be, or however

far out it may be placed in front of the main supporting aeroplanes. The most it can do is to retard the turning movement. It cannot prevent it. The machine retains a tendency to turn completely over until the head points vertically downwards towards the ground.

This is a dangerous tendency not fully realised by us, I think, and the cause not clearly understood by all. Let me try to explain the point.

In a stationary machine if the center of gravity is too far forward for correct balance the machine turns over in front and dives. If it is too far back it turns over backwards and dives stern down; and the safe position for the center of gravity lies somewhere between. Is not this point the geometrical center of surface of the whole machine - the geometrical center of all the surfaces concerned including the front control?

When the machine falls without any motion of translation in the horizontal direction it acquires "downway", not "headway"; and the geometrical center of surface becomes the center of pressure or resistance.

Now as the machine falls the extended surfaces resist the motion, being pushed upwards as it were by the air pressure below. If therefore the center of pressure and the center of gravity are not in the same vertical line, a turning couple is produced which tends to turn the machine around an axis between the centers of pressure and gravity: Or rather in this case, the center of pressure is itself the axis of rotation, for though the air pushes upwards against the surfaces,

it does not succeed in pushing them up, they are falling all the time. It only succeeds in retarding their drop, so that they fall more slowly than the center of gravity and thus produce the turning effect.

Now when there is no headway it appears that the center of pressure is in the geometrical center of surface. If this is so it follows, that if the center of gravity is displaced from that position, either forward or backward, or to either side, the machine tends to turn over on the heavy side until the center of gravity comes vertically under the center of pressure. With a head-heavy machine the tendency would be to turn completely over forwards until the head points towards the ground, and no front control could prevent it if the machine has no headway. Here lies the danger. It is obvious that we must study the cause of this tendency and combat it if possible. Perhaps a <u>simile</u> may make my position more plain.

Substitute for the center of gravity, the bob of a pendulum; and, for the center of pressure, the axis which supports it.

Now hold the pendulum out horizontally from its point of support and allow it to drop. The pendulum will then turn upon its axis until the bob comes vertically beneath the point of support. No resting place is found until that position is reached.

Now can we prevent this action by giving the pendulum a front control? Prolong the rod of the pendulum as far as

you like beyond the bob, and attach to its extreme end a resisting surface which may be as large as you choose. Now hold the pendulum out horizontally as before with the resisting surface also horizontal and let go. The pendulum will swing more slowly than before on account of the resistance of the front control; but the point I would enforce is this, that the resisting surface however large and however far removed from the axis of rotation, will not prevent the turning movement from continuing steadily to the very end, when the center of gravity comes directly beneath the center of support.

The same is true of an aerodrome which is head-heavy in the slightest degree. The front control will not prevent it from turning completely over, head down, if it has no headway: Only headway can save it.

Now it is noteworthy that an aerodrome with its center of gravity at the center of surface does not have this tendency <u>to continue turning over</u>, even though it should be tipped one way or the other.

Suppose it should be tipped slightly down in front. It would begin to slide down an inclined plane; but gravity has no tendency to make the dive become steeper, as would be the case were it head-heavy, stern-heavy, or side-heavy. On the contrary, from the very first gravity exerts a corrective influence. As the center of gravity tends to assume the lowest possible positionits action is to lower the elevated side of the aerodrome, instead of depressing the lower side still more thus causing the surfaces of the aerodrome to return to the horizontal position.

This central position of the center of gravity, while it places the aerodrome in the safest condition if it has no headway, has its disadvantages. The surfaces will not remain horizontal for any great length of time, but, under the action of the varying conditions met with in the air, will tip slightly one way or the other.

For example:- Let the surface tip down a little in front, and the machine glides down forwards in stable support so long as its headway is inconsiderable. As more headway is gained the center of pressure moves forward while the center of gravity remains behind at the center of surface. Thus as the machine glides downwards on its inclined path the center of gravity, being behind the center of pressure loads the machine down behind the axis of rotation, so that gravity over-balances the machine backwards performing the function of a rudder to steer the machine up to the horizontal position again. But during this process the machine has gained headway so that the turning movement would go a little further than the horizontal position, and the machine would begin to climb with its surfaces tilted up in front until its headway was exhausted and it came to a stop. The surfaces then being inclined downwards at the rear, the machine would begin to slide backwards down an inclined plane, but gravity would not act to increase the inclination. With the re-appearance of headway, which in this case would be stern-way, the center of gravity would be in front of the center of pressure and thus again act as a corrective influence to bring the machine up to the horizontal and beyond.

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Suppose that the original inclination should take the form of a tip to one side, then after gliding down hill a little way on that side, the machine would move up until its side-way was exhausted, and then commence a reverse glide down on the other side.

Thus, however the surfaces should happen to tip in the first instance, the machine would fall with an oscillating motion, first moving one way, and then reversing its path.

The inclination that could be most easily controlled by the aviator is the downward tip in front, so that the machine should gain headway rather than stern-way or side-way. This can be secured by having the center of gravity a little in front of the center of surface, only just sufficiently so to prevent the possibility of a stern tip. When the machine then begins to glide down hill in front, the headway gained will enable the aviator to use his front control as a rudder. The further movement of his machine would then be within his own control.

We are here of course dealing with a machine that has lost its motive power, so that the propelling power is gravity alone. The aviator, having secured control must preserve his headway at all hazards, or he will lose his steering power. He should be careful to keep his machine on the down-grade. Should he steer the machine on a horizontal path, or upon an up-grade, the resistance of the air would soon check his advance and he would be helpless until the machine should make another dive.

The important lesson to be learned is that the center of gravity, although it should be in front of the center of surface to secure a front dive when headway is lost, should be as little removed from that point as possible. The further forward the center of gravity is placed, the quicker will be the turning action produced by gravity and the steeper the dive that is necessary to restore headway.

Those conditions then are important which reduce the rapidity of the turning movement, so that there may be time to gain steering headway before the head has tipped down to a dangerous extent. The conditions that reduce the rate of turning are:-

1. The center of gravity as near the center of surface as possible, so that gravity may not have much leverage to help the turning movement.

2. The front control very far removed from the main supporting aeroplanes, so as to secure the advantage of leverage in resisting the turning movement.

3. Large surfaces upon the front control to increase its resisting action.

4. A horizontal tail very far removed from the main suporting aeroplanes, to retard the turning movement by the pressure of air upon its upper surface.

5. A large surface for the tail to increase its resisting action.

All these conditions tend to reduce the velocity of the turning movement, and therefore facilitate the acquisition of steering headway before the downward tip has become too steep for safety.

The conditions that increase the velocity of the turning movement, and hence increase the danger to the aviator when headway is lost are the reverse of these viz:-

1. The center of gravity far in front of the center of surface.
2. The front control near the main planes.
3. Small surfaces upon the front control.
4. The tail near the supporting aeroplanes.
5. The tail surface small, or omitted altogether.

A large front control well removed from the main aeroplanes, and a large horizontal tail equally far removed behind would give great longitudinal stability to the apparatus; and by this we mean in reality that the vertical turning movements would be slow.

It is desirable however, that when in motion we should be able to steer up or down quickly if we so desire; and by making the front control and the tail both moveable, we secure the very desirable combination of quick steering when in motion by moving both controls simultaneously so as to co-operate with one another, and slow turning when headway is lost by holding both fixed.

There is still another point about the front control. The location of the axis upon which it turns is important. We are accustomed to place the axis nearer the frontedge than the rear, so as to secure the point that when the machine is in rapid motion the center of pressure of the front control shall fall upon the axis. This of course reduces the power

necessary to turn it because the air pressures are nearly balanced on either side of the axis.

But how about the operation of the front control when the machine has lost headway? In such a case the main surface of the front control being behind the axis of rotation and the center of pressure being also behind the axis in that case, an unbalanced pressure would exist upon the under surface of the front control when the machine begins to turn down in front for a dive, which tends to lift the rear of the front control, and cause the front control to be inclined downwards in front, thus assisting the dive instead of resisting it. Thus at the most critical time, when headway is lost, it would take more power to move the front control, than under ordinary circumstances when the machine is in motion.

Who knows but what this action may have contributed to the Wright disaster! With surfaces large enough to be difficult of manipulation under the ordinary conditions of rapid flight it may well be possible that the aviator may not have sufficient strength to resist the turning tendency of the front control at a critical moment of time when it is important that the surfaces should offer their maximum resistance to descent Why would it not be safer to place the axis of rotation in the middle of the front control, so as to make it as easy as possible for the aviator to handle it when headway is lost.

If I am right in my various lines of reasoning, it is extremely important that the center of surface of the whole machine, when the front control is held parallel to the main aeroplane surfaces, should not fall behind the center of gravity .

I do not think it did so in the case of the Wright machine. I made a rough estimate of the area of the front control, of the area of the main surfaces, and of their distance apart, and came to the conclusion hat the center of surface, under the conditions specified above, came very near the front edge of the main aeroplanes. The center of gravity appeared to be at about the same point, or a little further back, so that if the surfaces of the front control had been held rigidly in their position of maximum resistance I do not see how a disastrous dive could have resulted. The evidence however seems to point to the conclusion that the apparatus really did make a dive head first.

I can only understand this, upon the supposition that the front control was inclined at the time of the fall, either by the action of the aviator, or by the unbalanced pressure of the air below it when headway was lost.

It is obvious that if the surfaces were very much inclined the aparatus might perhaps have become head-heavy; and this head-heaviness would have been increased by the fact that the machine carried two men instead of one both seated at the front part of the lower aeroplane.

Suppose for example that in such a machine the surfaces of the front control should be turned into the vertical position instead of the horizontal, so as to be placed edgeways to gravity, then the whole support of the machine would have been thrown upon the main aeroplanes. The center of gravity would then be in front of the center of surface of the main aeroplanes, and the machine would become head-heavy.

Of course it was impossible for the front control of the Wright machine to assume this vertical position on account of limitations to its motion. But if the surfaces were much inclined head-heaviness might perhaps have been produced though in a lesser degree.

Of course it is impossible to say exactly what happened in the case of the Wright machine; but I would urge upon the Hammondsport members to calculate and make sure that the center of surface of the Silver-Dart is not behind the center of gravity when the front control is placed in its most resistant position. I would also have then consider the advisability of placing the axis of rotation in the middle of the front control rather than further forward.

There is one other point and I have done. In an aerodrome without headway a stable condition results when the center of gravity is in the same vertical line with the center of surface.

1. If the center of gravity be vertically above the center of surface, then, though the machine is balanced, it is in a state of unstable equilibrium, like a walking-cane standing upright upon its end.

2. If the center of gravity be below the center of surface, we have a stable condition with a liability to swing, like an oscillating pendulum hung from its support.

3. If the center of gravity and the center of surface are absolutely co-incident, a stable condition results which the action of gravity cannot disturb. This point is well worthy of consideration.

In conclusion it seems to me desirable that the center of gravity should be a little in front, and a little below the center of surface; but that the displacement from this safe

position should be as slight as possible, and only sufficient on the one hand to prevent the possibility of a stern dive, and on the other to be certain that the machine will tend to keep right side up.

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SYNOPSIS OF PRECEDING PAPER.

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A NEW THOUGHTS CONCERNING WRIGHT DISASTER:
By G.H. Curtiss.

Hammondsport, Oct. 30, 1908:- I have been reading with great interest your paper on the cause of the Orville Wright disaster. Your deductions are confirmed by our experience with the "June Bug".

When the aviator sat close to the main surfaces, good landings were invariably effected, the rear wheels usually striking first. As we moved the aviator forward, the machine showed a tendency to pitch down and strike on the front wheel first when the power was shut off. I would suggest the following method of overcoming this difficulty.

Balance the aerodrome so that it will glide at a low speed of 12 or 15 miles an hour. Place the propeller well above the center of resistance so that as the speed increases, and the center of pressure travels forward, the tendency to lift in front will be overcome by the push of the propeller and the machine should fly at, say, 40 miles an hour with the front control in a neutral position. Should the engine stop, the tendency to pitch down forward is neutralized by the absence of the thrust in the upper part of the aerodrome.

While the push of the propeller will not exactly balance at all speeds the change in the center of pressure, the difference can be taken care of by the front control.

G.H.C.

A NEW THOUGHTS CONCERNING WRIGHT DISASTER:
By F.W. Baldwin.

Beinn Bhreagh, Nov. 11, 1908:- My candid opinion is that we will never know exactly what did happen to Mr. Wright, nor learn any useful lesson from such meagre and conflicting accounts as we have of the disaster.

Unless Mr. Wright himself should see fit to enlighten us there is very little to base our deductions upon. The indirect cause of the loss of control we know was due to the turning action produced by the eccentric thrust of the unbroken propeller. The lesson from this is clear and convincing but further than this it seems dangerous to speculate as to the immediate cause of the subsequent dive which really wrecked the machine. Our knowledge of the facts is very limited indeed.

Without the least disparagment to Mr. Cline who was one of the many first to arrive at the scene of the disaster, or to the version of it, which he was good enough to give us the benefit of, it is only right to note that such was their excitement that eye witnesses could not agree even as to which propeller broke. Now if we are to arrive at any useful conclusions it seems to me that we must confine ourselves to the facts and reason only from that which we know to be true. There are so many plausible explanations that when we consider the extreme likelihood of a combination of any number of these a diagnosis of cause and effect is almost certain to be astray.

If a critical study of the Wright's machine should disclose any defect it would of course be decidedly helpful, but for my own part I can find nothing faulty either in

principle or design. While I attach no importance to my own views upon the subject, in the hope of illustrating the complexity of the problem, I will suggest two other factors which may have contributed to the accident.

First. Was Mr. Wright's aerodrome well balanced in a vertical sense? That is, was the line of the propeller thrust at or near the center of resistance, or was it above this point?

Second. Was not the center of gravity too low giving a pendulum action tending to increase the amplitude of any swinging motion. Both of these features, if true, would be accentuated by the additional weight and head resistance of a passenger in a two man flight as Mr. Wright had it arranged.

All that we really know of the actions of the machine could be most reasonably explained by the thrust being above the center of resistance, and the center of gravity being below the center of resistance. I do not for a minute claim that this was the cause of the accident, nor would I like to infer it, but from looking over photographs of Mr. Wright's machine, it seems at least as reasonable as that it was head-heavy as suggested by Mr. Boll.

The uneasy pitching and scending observed previously when Mr. Wright flew in a gusty breese may have been caused by the propeller thrust being above the center of resistance and the center of gravity acting as a pendulum.

On the other hand this tendency may have been due to the rotary motion of the wind, so that when as simple an action as this is open to argument, it seems hopeless and unscientific to make deductions from such flimsy premises as we

have.

Mr. Bell's simile of a pendulum does not seem to me to be very well chosen in as much as the axis about which an aerodrome tends to turn is not fixed.

Mr. Bell says:-

> "When headway is lost, the presence of a front control will not prevent the tendency of a head-heavy machine to turn head downwards, however large its surface may be, or however far out it may be placed in front of the main supporting aeroplanes. The most it can do is to retard the turning movement. It cannot prevent it. The machine retains a tendency to turn completely over until the head points vertically downwards towards the ground".

This would undoubtedly be true were the center of surface (or whatever point the machine tended to turn about as an axis fixed in the air) but is this the case. Let the machine lose headway and fall in this way. If it be only slightly head-heavy the turning action will then be slow. It will quickly acquire headway due to the horizontally resolved component of pressure being a propelling force. The machine, axis and all will then move forward, the center of pressure regain its position vertically above the center of gravity and balance be restored without the machine showing a continued tendency to turn completely over until the head points vertically downwards towards the ground.

Mr. Bell's general conclusions are of course correct and should guide us in not producing a badly balanced machine. I do not quite agree with what he says about the axis for a front control. To pivot it at the center of surface would give us a still more dangerous arrangement. The center of pressure would be in front of the axis at high speeds, a posit-

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ion of unstable equilibrium which would make control difficult and loss of control much more dangerous than as we have it at present.

I think we will learn more from a careful study of the Wright's machine than by guessing as to what happened to it in the air. F.W.B.

THE WRIGHT ACCIDENT BY AN EYE WITNESS.

By W.S. Clime.

As had been my daily custom since Mr. Wright's arrival at Fort Meyer, Sept. 17 found me at the Fort again to witness another of his spectacular flights. The missing of a car made my arrival at the Fort somewhat later than usual that evening, and upon reaching the south end of the field, the motor was already humming out its warning note that the flight was about to begin. Deciding to remain where I was and desirous of securing a photograph of the machine before it acquired the normal flying height, I awaited its coming, and exposed a plate as it swept by with the grace and ease of a soaring bird. For several complete circuits of the field the flight was uneventful. The novelty having worn off to such an extent that one no longer kept his eyes glued to the machine, but only gave a glance upward when it went directly overhead. It was at such a time that Wright could be seen, hands on levers looking straight ahead, and Lieut. Selfridge to his right, arms folded as cool as the daring aviator beside him.

While walking over to the aerodrome shed and in front of it, after having made an exposure on the machine directly overhead, there was a crack like a pistol shot coming from above. Looking quickly up I saw a piece of a propeller blade twirling off to the southward. Realizing instinctively that something terrible was about to happen, I stood riveted to the spot for a moment with my eyes on the machine. For a brief period it kept on its course, then swerved to the left and with a swoop backwards, but in an almost perpendicular

manner it fell for half the distance to the ground. Then suddenly righting itself regained for an instant its normal position only to pitch forward and strike on the parallel planes in front for altering the elevation, raising an immense cloud of dust that momentarily hid it from view. The terrific impact instantly reduced the structure into an inconceivable mass of wreckage, and it was apparent that the machine was partially inverted, the skids being on the top, and the machine lying in a position at right angles to its course when the accident occurred. At topmost speed I ran over to where the machine lay and found that two mounted soldiers had preceded me by a few seconds. Throwing my camera to the ground with sufficient force, as I discovered later, to knock all of my plates out of the holders, and break half of them, I caught hold of one of the curved surfaces and with all my strength pushed it up and broke it. Mr. Wright was under it and a few feet from me apparently in great pain and moaning. He had fallen across a wire stay and one of the struts of the machine, and was suspended by his chest and stomach. His feet were barely touching the ground, and his hands were hanging limp; blood was streaming down his face and trickling in a tiny stream from his chin, but he was conscious and feebly said, "help me".

Lieut. Selfridge was lying on his back almost directly beneath Wright, but to Mr. Wright's right. One of the enlisted men reaching over caught Mr. Wright around the body and lifted him clear of the wreckage. It was then that he exclaimed "Be careful of my leg". It is exceedingly difficult

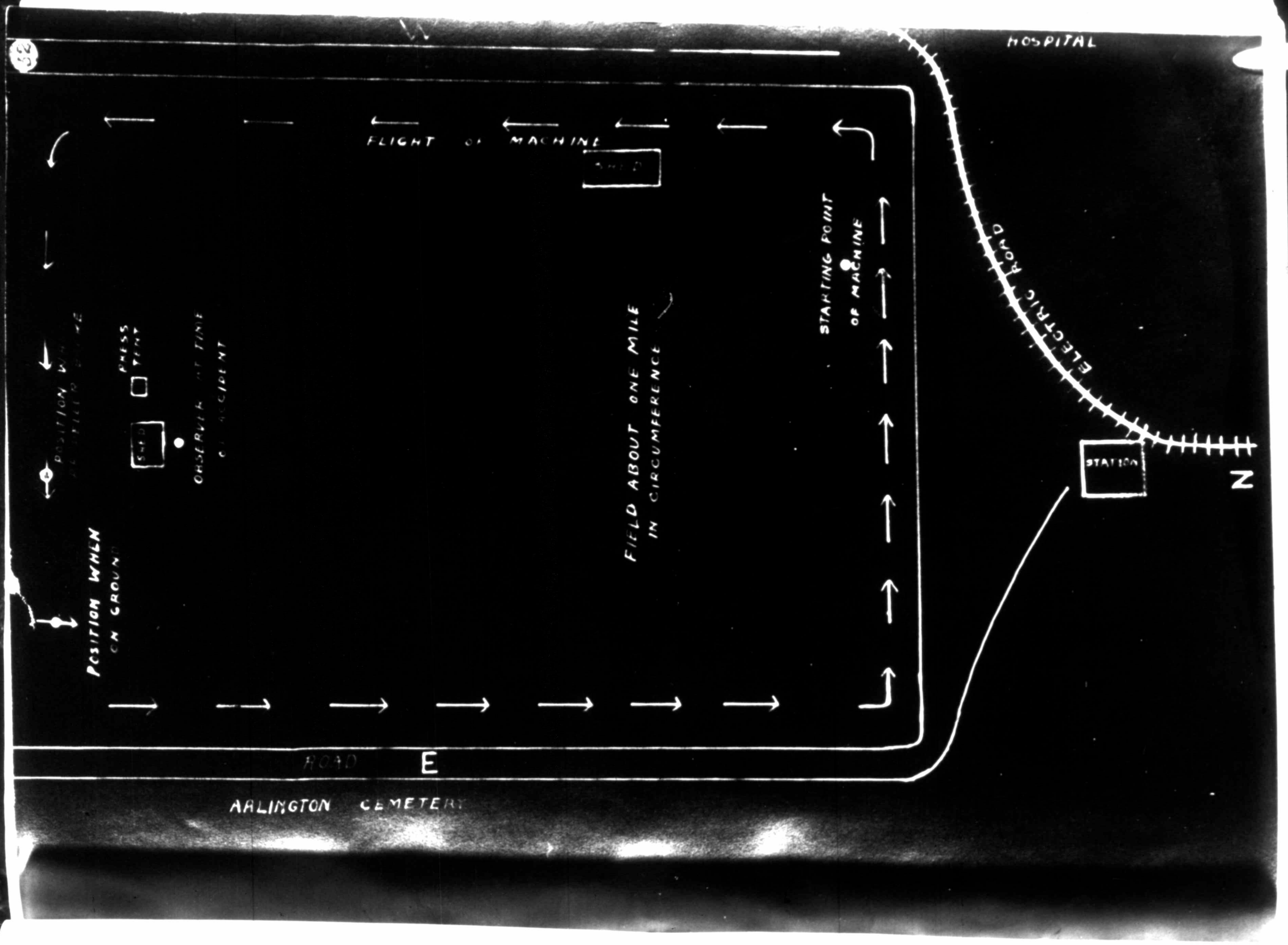
to describe with exactness just what ones movements were during the intense excitement of the moment. I have a hazy recollection of the two enlisted men and myself lifting up and carrying Mr. Wright clear of the debris, and laying him on the grass. Turning back to the machine we tried our utmost to reach Lieut. Selfridge, who was lying on his back and had apparently struck the ground with the back of his head and base of the spine. His knees were slightly drawn up due perhaps to the wreckage beneath him. Wire stays, pieces of canvas and broken struts were piled in confusion about him, and it was impossible for the few at hand to do more than feebly attempt to reach him. His face and clothing were covered with blood. He was unconscious and if he spoke at all I did not hear him.

The last rays of the setting sun were gone, the dampness of night was in the air, and a slight fog was already enveloping the distance. The silence was unbroken save for the low moaning of Wright, and as I looked about me in a helpless sort of way a wierd spectacle presented itself; horsemen were galloping madly across the broken field in our direction. A picture of my idea of a cavalry charge in actual battle, and in their rear a mass of humanity blended together by the twilight into a low black line, and approaching with ever increasing rapidity. It took but a few minutes for the horsemen to travel the third of a mile to the wreck and on their arrival pandemonium broke loose. Orders for the ambulance, shouts to prevent smoking and striking of matches, the odor of gasoline from the broken tank being strong in the air, the

pushing back of the ever increasing crowd by the soldiers and the rushing here and there of newspaper correspondents and photographers. A striking contrast to the former period of deathly stillness, but a relief to ones overwrought nerves. Willing hands soon extricated Lieut. Selfridge from the wreckage and physicians at hand administered as best they could to the two injured men. After what seemed an interminable length of time two stretchers were brought to the scene, and the unfortunates placed upon them and carried across the long field to the hospital.

The diversity of opinion as to which propeller was broken, was probably due to the peculiar position in which the machine lay. In some manner too quick for me to perceive, the machine turned at right angles to its path of flight and was headed to the northward when it struck the ground. The wreck was so complete that it was difficult to make out its original construction, but that it was the right propeller I am convinced, as I distinctly remember noting that the propeller toward the east had both its blades broken off completely, while the one toward the west was unbroken. This would have made it the starboard propeller that was broken. Photographic evidence has since corroborated this fact.

I agree with Mr. Wright that if the propeller had broken at a greater distance from the ground, the accident would not have occurred, the machine was regaining its equilibrium when it struck. The accompanying diagram will explain the position of the machine, and my own at the time of the accident. W.S. Clime.


HOSPITAL
ELECTRIC ROAD
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N
FLIGHT OF MACHINE
STARTING POINT OF MACHINE
FIELD ABOUT ONE MILE IN CIRCUMFERENCE
PRESS TENT
OBSERVER AT TIME OF ACCIDENT
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ARLINGTON CEMETERY

THE LESSONS TO BE LEARNED FROM THE WRIGHT DISASTER? By Gardiner H. Bell.

We are very greatful to Mr. Clime for the article he has written concerning the Wright disaster at Fort Meyer. Mr. Clime had undoubtedly a position of great advantage from which to view the accident, and he had the good fortune of being the first civilian on the field.

It has been suggested that if we knew just what took place after the breaking of the propeller while the machine was in the air, many valuable lessons might be learned from the accident. Undoubtedly we should gain much if we could know the actions of the machine when the propeller broke; but is this not impossible?

It is very difficult to follow the manoeuvres of a body in mid-air: It may be because the eye has no definite background by which to gauge the direction of a moving object, but however this may be the fact is important and only goes to show the helplessness of deducting practical knowledge from such a case as this.

We are told that there was a report like that of a pistol; the machine lurched forward a few times and came to earth. Following this the utmost confusion reigned. The crowd one and all rushed madly to the scene of the disaster. Somebody called for an ambulance.

It was interesting to know the different views on the subject of what happened, but technically they can be of no importance.

We are asking a man to describe accurately what happened in the space of a few seconds. We are not taking into

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consideration the intense excitement immediately following which alone is enough to block from the mind of the calmest the most commonplace circumstances. We are asking a man to describe accurately the manoeuvres of a machine driven through space, performed with out warning in the twinkling of an eye. We are not taking into consideration the tremendous rapidity with which the machine performed those curious manoeuvres in mid-air. We are asking him to put down in black and white that which he actually saw, yea, that which actually happened, so that the world may know - and benefit by the knowledge.

No two stories are the same. The view of the local press agent is of little importance. He was there. He saw it. Therefore it was his duty as a press agent to relate exactly what happened in detail. He did not realize, or it was not his business to realize, that there was every reason why he should not know what happened; and if he goes on telling the same story to a new victim each time, with a few variations, he will very likely, in time, believe it himself. G.H.H.

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