BULLETINS

OF THE

Aerial Experiment Association

Bulletin No. XVI Issued MONDAY, OCT. 26, 1908

MR. McCURDY'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Alexander Graham Bell.....Editor.
Gardiner H. Bell.....Asst.Editor.
Charles R. Cox........Typewriter.
Mabel B. McCurdy....Stenographer.

Bulletins of the Aerial Experiment Association.

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Beinn Bhreagh, Near Baddeck, Nova Scotia.

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HYDROPLANES.

Beinn Bhreagh, Oct. 12, 1908:- We have all been disappointed with the action of Baldwin's hydroplanes and at the difficulty of knowing exactly what they do. At the speed of the Dhonnas Beag the hydroplanes have not given us very marked lifting effects. This, perhaps, is hardly to be wondered at when we consider that the load to be lifted is about 400 lbs. including boat and man and engine.

Why might it not be a good plan to tow the arrangement which would allow us to reduce the load to be lifted to a mere float sufficient to prevent the metallic hydroplanes from sinking. They would probably lift a light float without engine or man at a less speed than would be possible with a 400 lbs load; and it might be possible that the Gauldrie, "which goes about six miles an hour now", says Mr. Baldwin, might be able to tow it at a supporting speed. It certainly would be gratifying to see a boat, however light, lifted completely out of water by the hydroplanes. If we could only secure this result to begin with, we would probably be able to get a better idea of what the hydroplanes are doing and by variations in the arrangement grope our way empirically to an arrangement that would support a 400 lb. load.

We have in the Laboratory a number of old floats that would do for the purpose. I measured and weighed one of them the other day. It was 4 meters long and weighed 7 lbs. I also weighed some small floats that would do for outriggers.

The heaviest weighed 332 grams. Small silk floats would average less than one-half a pound. It would be necessary to provide a stiff frame to which to attach the hydroplanes and a cross bar or transversal truss to support the outrigger floats. But the weight need not exceed a few pounds.

Main float	7 lbs.
Two side floats	1 lb.
Frame for hydroplanes	10 lbs.
Cross bar	5 lbs.
For luck	2 lbs.
Total	25 lbs.

The hydroplanes would probably lift this load when towed by the Gauldrie, much better than they now lift their present 400 lb. load when propelled by an aerial propeller.

Mr. Baldwin found, by means of a spring-balance, that one set of these hydroplanes exerted a lift of about 75 lbs. Perhaps the three sets together may be able to lift a load of 25 lbs. completely out of water at the speed of the Gauldrie. The experiment is certainly worth making. A.G.B.

FRONT CONTROL.

Beinn Bhreagh, Oct. 13, 1908:- Should not the front control be at the rear instead of in front?

Imagine a long pole balanced on a horizontal axis at its middle, and carrying a horizontal surface at one end. Under the action of wind the surface will be carried to the rear like the vane of a weather-cock. If we hold the pole so that the surface is at the front end facing the wind the whole arrangement is in a state of unstable equilibrium requiring an effort to keep it in place. Is not this the case with the front control of an aerodrome, and would it not be better to use a horizontal tail at the rear?

The natural action of the wind of advance upon the front control is to upset the whole machine upwards or downwards so as to make a complete somersault and bring the front control to the rear as a tail. Whereas the natural action upon a horizontal tail at the rear is to keep the longitudinal axis of the machine parallel to the line of advance and prevent any deviation up or down excepting by the will of the operator. A.G.B.

DISCUSSIONS.

An important innovation on our practice was inaugurated October 14, 1908, by having a stenographer present during our discussion of the above note on "Front Control".

Miss Mabel B. McCurdy, having been appointed stenographer for the Association, was present October 14, and attempted to catch the points of the discussion for preservation. Her report, which was submitted to the speakers for correction, appears elsewhere in the present Bulletin.

It is believed that with Miss McCurdy's assistance we may be able to make such discussions a valuable feature of the Bulletins. A.G.B.

MOTORS.

Beinn Bhreagh, Oct. 16, 1908:- The Cygnet was just able to carry a man in the air and could not have carried a motor in addition. In designing aerodrome No.5, it was made large enough to carry a man, and an engine of the weight of a man, but the new motor now being completed in Hammondsport, Baldwin thinks, will weigh about 350 lbs with the various accessories required. That is, it will weigh more than two average men.

This leads me to suspect that we are not advancing in the right direction in the construction of our motors. Why this increased weight? Because we are trying water-cooling instead of air-cooling and water is 773 times as heavy as air.

But why do we try water-cooling? Because air-cooling has not succeeded so far in preventing our motors from becoming overheated in a very short time.

Overheating is undoubtedly a defect and we have to add on another instrumentality, air-cooling to remedy it. The employment of a cooling agent 773 times heavier than the former agent employed seems to me also to be a defect. We are correcting one defect by employing another.

Should our attention not be directed to the prevention of overheating rather than to its correction. If overheating is a necessary result of the type of engine we employ would it not be better to change the type?

This brings me to the consideration of the paper I read at the meeting of the Association in May 1908 (see Bulletin No.1, pp 27-29) concerning "Light Motors for Flying Machines", in which a new type of engine is suggested utilizing atmospheric pressure as its motive power. Of course we must use in our present experiments the motors we have with all their defects whatever they are, but this should not prevent us from considering the question of type, and from making experiments in a tentative way that would not interrupt the experiments already planned.

The paper referred to shows clearly, I think, that the materials composing the working parts of a motor can be made of thinner and lighter material where the operative power comes from without than when we use the expansive power of a compressed gas.

As the matter stands now in my mind there are three agencies needed in the atmospheric type of engine. (1) A means of rarifying air. (2) A means of storing it, and (3) the operative part of the engine. There can be no question that the operative part of the engine can be made lighter than if we used compression. It is also obvious that the reservoir for containing our store of rarified air can also be made lighter than a similar reservoir designed to stand the bursting pressure of a confined gas. The question then remains;can we employ light means for effecting rarifaction.

If we have to pump out air out of our reservoir by mechanical means we must employ a pump and an engine of some sort to work the pumping mechanism. This involves weight and must be put out of consideration.

We can effect the same end however, by the mere application of heat and heat has no weight. For example:- If we take a chamber of heated air at atmospheric pressure and then seal up the chamber and allow the air to cool, then upon cooling a partial vacuum will be found within the chamber and the rarified air can be used in the operation of the engine.

The question then resolves itself into the single point; can we heat the air in a chamber without employing heavy means. The following experiments made at Beinn Bhreagh Laboratory seem to indicate that we can.

A glass jar 12 inches in height and having a cross section of about 36 square inches was taken. A piece of paper was then lighted and thrown into the jar which was immediately turned upside down in a basin of water. The flame went out and the water rose so as to half fill the jar. This shows that the simple burning of a piece of paper expelled half the air within the jar so that upon cooling an unbalanced pressure was produced, equal to 1/2 an atmosphere which caused the water to rise in the jar. Suppose the intrusive water to be replaced by a piston moving in the jar as a cylinder we can calculate the pressure exerted upon the piston. A pressure of half an atmosphere is equivalent to 7 1/2 lbs upon every square inch of surface. The surface of the piston was equivalent to 36 sq. in so that the pressure exerted would have been 36 x 7 1/2 = 270 lbs.

Thus the simple burning of a piece of paper within the jar produced a pressure of 270 lbs.

In another experiment a little dish containing about a teaspoonful of gasoline was floated upon water. The jar was held mouth down over it for a moment so as to get warm and was then pushed down into the water leaving the burning gasoline floating inside the jar. The flame speedily went out and water rose within the jar until the jar was 6/10 full of water. The pressure that raised the water was equivalent to about six tenths of an atmosphere or in this case about 324 lbs.

These experiments are suggestive and indicate that very light means can be employed to produce the necessary rarefaction of air to work an atmospheric engine, and that it would pay to devote some attention to the matter. A.G.B.

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FLEXIBLE HYDROPLANES.

Beinn Bhreagh, Oct. 17, 1908:- This afternoon Baldwin succeeded in lifting the Dhonnas Beag completely out of the water on its hydroplanes, by reducing its weight by the omission of the engine and man and towing it, by the Skidoo. I believe this was done yesterday and this morning, but I did not myself witness these experiments. I saw the experiments this afternoon however, and they were certainly most striking. There was a clear space of about a foot between the bottom of the boat and the water. I need not describe the experiments here as field notes were taken by the Assistant Editor, Mr. Gardiner Bell and appear elsewhere in the Bulletin. The Skidoo makes a speed of between 7 and 8 miles an hour so it is evidently not necessary to employ high speeds to study the effects of hydroplanes. If very light floats were employed I have no doubt the hydroplanes would rise when towed by a row-boat! At all events we now have the certainty of being able to study the effects of hydroplanes at low speed and apply the results to heavy loads at high speeds. Try the hay-rake idea. Why not use the rubber floats we have for the support of hydroplanes. Tow them and study the effects of different arrangements of hydroplanes and the effects of loading. A simple arrangement would be a catamaran structure; a simple wooden frame for two of our rubber floats arranged catamaran fashion (see Fig. 1). The teeth of the hay-rake might be made flexible instead of rigid. Elasticity may be of advantage. Rigid hydroplanes perhaps not necessary. Flexible hydroplanes of the hay-rake pattern would also serve as elastic sledge-runners to glide over ice or land and springs to break the shock of a

FIG. I

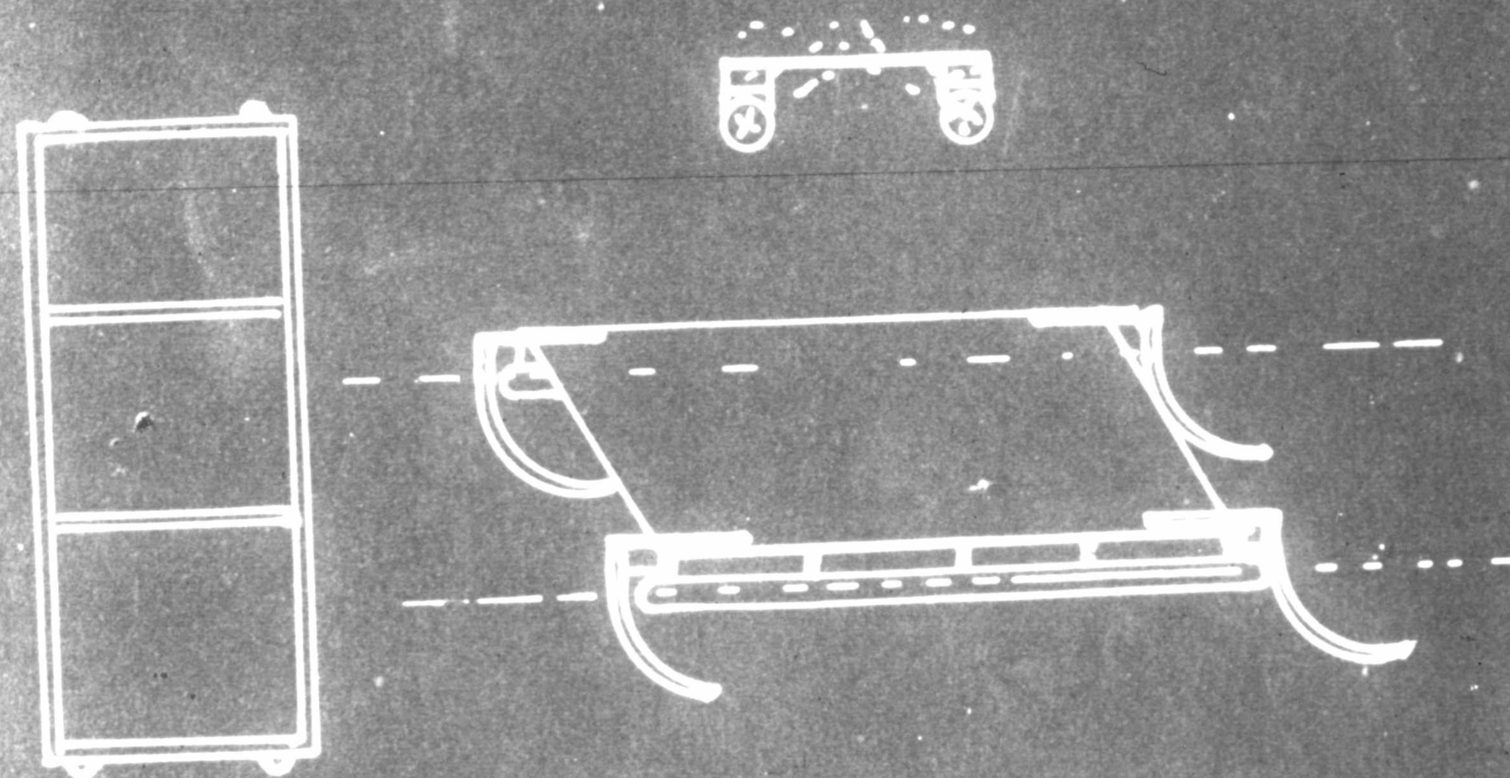
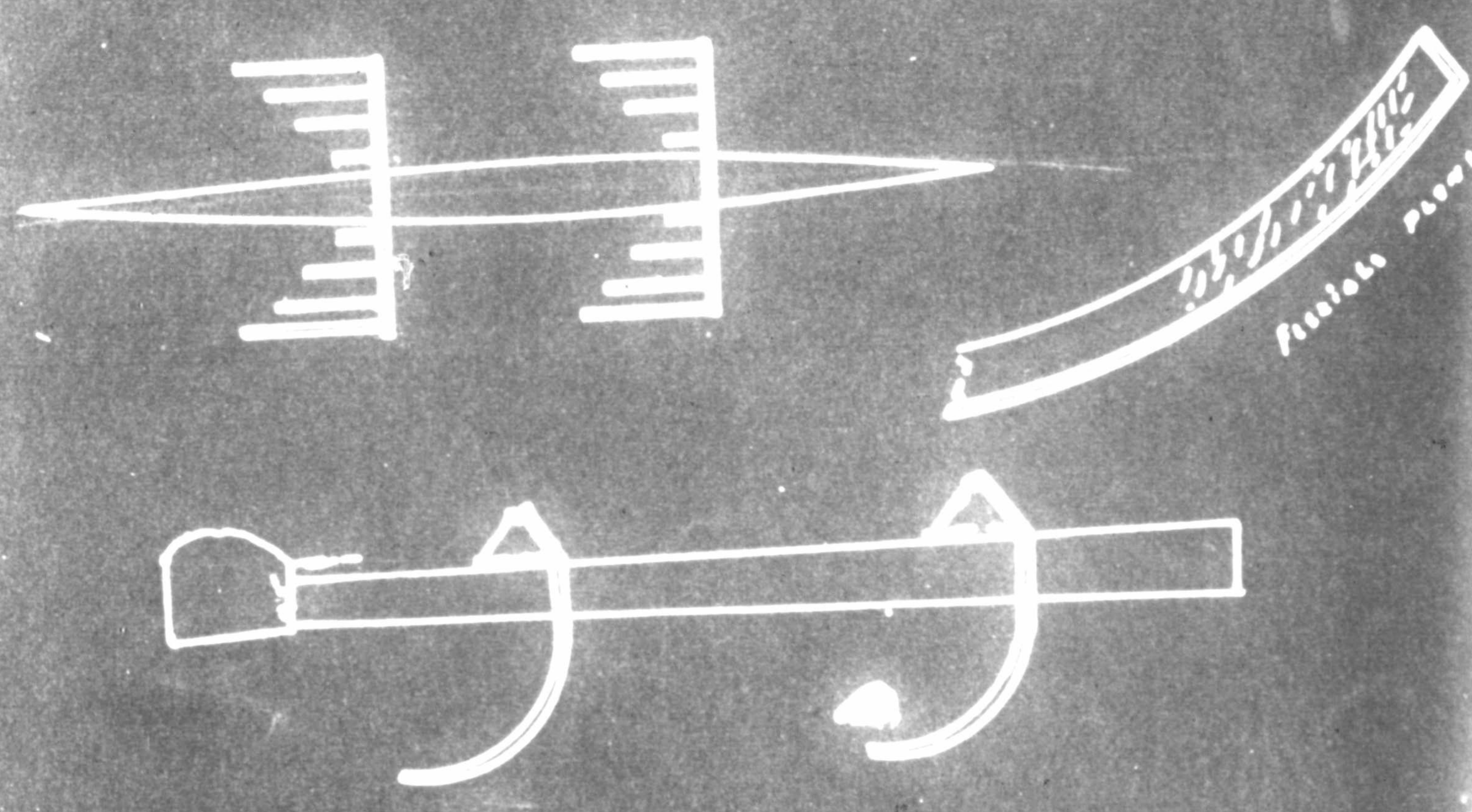


FIG. 2



bad landing anywhere. Flexible rods or flat ribbons increasing in length from the body outwards might be of advantage (see Fig. 2) as the hydroplane surfaces would diminish as the boat rises while the surfaces remaining in the water would be furthest removed from the body of the boat and thus increase its stability when elevated. As speed increases the angle of attack would become less on account of the flexibility of the rods or flat ribbons, which would be advantageous for speed At the same time, on account of the spring the angle of incidence would always be positive and could never become zero or minus. Use large surfaces to begin with and reduce afterwards. I think flexible hydroplanes are worth thinking about. If the springs are strong enough to support the boat on land they can never present a negative angle to the line of advance when in the water.

When a duck leaves the water do his legs trail behind him; and do his feet serve as hydroplanes to assist him in rising? A.G.B.

BALDWIN'S SUCCESS.

Beinn Bhreagh, Oct. 20, 1908:- At last after many discouraging experiences Mr. Baldwin's perseverance and pluck have met with their reward and on Oct. 20 his hydroplanes carried the Dhonnas Beag clear of the water with Mr. Baldwin on board (see photographs in this Bulletin). The boat did not rise under its own motive power or with the engine on board. It was towed by the motor beat Skidoo. The encouraging feature is that the speed required to cause the hydroplanes to manifest their lifting power was not high. The Skidoo makes on the average about 7.6 miles an hour and the hydroplanes lifted at a less velocity than this It is also encouraging to know that the thrust of the propeller to be used on the Dhonnas Beag is more than twice as great as the strain on the towing line during the experiments Oct. 20. The pull was 50 lbs. and the thrust of the propeller will undoubtedly exceed 100 lbs. There can now be no doubt that Mr. Baldwin will succeed in converting his hydrodrome into a hydro-aerodrome which will rise from the water into the air and become the pioneer forerunner of a new type of flying machine. A.G.B.

THE ARMY

Beinn Bhreagh, Oct. 22, 1908:-In response to my letter to the President of the United States (Bulletin XIII pp 32-33) I have received a communication from the Asst. Secretary of War to the effect that the War Department will detail an officer from the Signal Corps to be present in Hammondsport when the experiments with the new aerodrome are to be tried. I would suggest that both the June Bug and the Silver-Dart should be placed in condition for flight and that every information should be given to the officer who will succeed Lieut. Selfridge as the observer of our experiments in the interests of the United States Army. A.G.B.

AERODROME NO.5.

Beinn Bhreagh, Oct. 23, 1908:-The beading of the cellular part of aerodrome No. 5 has now been completed and the body section is being studied. A report upon the progress of No. 5 must be delayed on account of absence of room in this Bulletin. Mr. Baldwin's remarkable success with hydroplanes renders it advisable to make this a hydroplane number, and let other subjects take second place. I shall simply say, therefore, that a swinging seat has been placed within the body-study of aerodrome No. 5 (see Photograph appended) and that we are studying the question of the feasibility of working the front control by its means. A.G.B.

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TELEGRAMS FROM MEMBERS.

Aeronautical Society to Bell.

To A.G. Bell,
Baddeck, N.S.

New York, N.Y., Oct. 9, 1908:-Success of our exhibition November three depends upon your assistance. Can we rely on aeroplane. Please answer.

(Signed) Aeronautical Society.

Bell to Aeronautical Society.

To Aeronautical Society,
New York, N.Y.

Baddeck, N.S., Oct. 10, 1908:-Have no large kite. To assemble one impossible. June Bug in constant use. Regret inablity to help.

Graham Bell.

Curtiss to Bell.

To A.G. Bell,
Baddeck, N.S.

Hammondsport, N.Y., Oct. 20, 1908:- Dynamite charge effective. Results by mail. Manley wired as follows:- "If Committee announces contest for cup November three, will Association compete? He wants answer; advise us.

(Signed) G.H. Curtiss.

Bell to Curtiss.

Baddeck, N.S., Oct. 20, 1908:-Mr. Baldwin agrees with me that Association should not again try for the trophy until we have succeeded in flying the required distance in private, and we cannot interrupt our experiments to attempt this at the present time. Go ahead with the Silver-Dart and come down here as soon as possible. Hurrah for the dynamite.

(Signed) Graham Bell.

Bell to McCurdy.

Baddeck, N.S., Oct. 21, 1908:Notify Secretary of War when you are ready to try the Silver-Dart. Dept. will detail an officer to oberve the experiments. Yesterday Casey's hydroplane boat lifted more than a foot out of water with Casey on board but no engine. Towed seven miles an hour. Pull 50 lbs. Lift 300 lbs, and more. Success encouraging.

(Signed) Graham Bell.

EXTRACTS FROM LETTERS FROM MEMBERS.

Curtiss to Aerial Experiment Association.

Hammondsport, N.Y., Oct. 6, 1908:- Your message received. We are getting out sketch of the new 8 cylinder engine, together with description, as requested for the next Bulletin. We should be able to mail to-night.

Enclosed find a print of a group of famous aeronauts and motor-cyclists etc., and one of our testing frame for the double propellers. As you will notice these propellers are driven by "V" belts, both in the same direction. At the same engine speed these two propellers exerted a thrust of 50 pounds more than with the single propeller. The belts travelled nicely and caused no trouble.

In consideration however, of the danger of two propellers on separate axles, as brought home so forcibly recently, we have discontinued further experiments with this construction. G. H. Curtiss.

McCurdy to Bell.

Hammondsport, N.Y., Oct. 11, 1908:- I have just been reading over the Aeronautical Annual with special reference to Mr. Chanute's article and in the 1897 number opposite page 156 is a diagram of the left wing of an Albatross. As I looked at it the shape struck me as being about the same in plan as the Wright's propeller. It has that curious sawed-off cutting edge after all. Also as Casey pointed out the little gliders we used up in the kite house at Beinn Bhreagh seemed to glide better with the point to the front. Would we be infringing on the Wrights to try such a propeller.

J.A.D. McCurdy.

Curtiss to Aerial Experiment Association.

Hammondsport, N.Y., Oct. 14, 1908:- We enclose prints of the first two aeroplanes photographed together in America. The "June Bug" has been brought down and swung in the roof of the shed to make room for the "Silver-Dart" in the tent. We had some distinguished visitors yesterday, Mr. Schmidt of Washington, and a Mr. Saegmuller of the Bosch-Lomb Optical Co. of Rochester. Mr. Schmidt is one of the most wide-awake devotees to aviation we have met in a long time; he is also a good mathematician.

***The new engine is taking more time than we have ever required to build a new motor. As many men as can work are on it night and day. Everything is now here and it has commenced to assume form. Assembling will be finished this week.

G.H. Curtiss.

McCurdy to Baldwin.

Hammondsport, N.Y., Oct. 15, 1908:- Read with interest your article in the latest Bulletin (XIV) on Cutting Edges. It is a pretty thing, but I was thinking over the same subject and noticed that the Wright's propeller which has that peculiar cutting edge is shaped like and Albatross' wing in plan. Would it not be a good scheme to utilize this principle on your hydroplane boat and make the planes a little aft so presenting an angular cutting edge instead of a plane at right angles to the line of advance.

This might reduce the head resistance and not seriously affect the lift.

***The new engine will be ready to be assembled to-night and limbered up in the stand. It will then probably take a few days to refit the parts and re-assemble for tuning up. It certainly looks nice and if it developes the power we hope for, It will be a credit to the Curtiss Manufacturing Company, and Glenn can be proud of it.

***I received the promised articles from Mr. Chanute and am having a couple of copies made for our records as he wants me to return the original. I will forward you one to-night

J.A.D. McCurdy.

Curtiss to Bell.

Hammondsport, N.Y., Oct. 15, 1908:- The New York World recently printed an article headed "Air Travel" and credited it to me, or I might better say "charged" to me. I enclose copy of what I really said, but it was hashed over and added to suit the Editor. The dictation may be worth using in the Bulletin.

G.H. Curtiss.

(See article on "Future Air Travel" in this Bulletin).

Curtiss to Mrs. Bell.

Hammondsport, N.Y., Oct. 16, 1908:- Am sorry Mr. Bell could not have come to Hammondsport from Washington, and at least seen the "Dart". We did not think it advisable to attempt flights until the new engine was ready; it could have been tried out with the old "June Bug" engine, but as so much was expected and so many newspaper men and others would be on hand for trials, we thought it would be better to wait until we were sure of accomplishing more than had been done with the June Bug.

The moving pictures of the June Bug flights are here, and will be shown for the first time to-night. I wish you could be here to see them. Perhaps we can get copies from the films which can be shown as lantern slides. While this would not be as good as the real moving pictures, it would give a succession of views which would show the action of the machine in the air. I would like to know if you have a lantern at Beinn Bhreagh. I remember of hearing of pictures being shown there last year.

G.H. Curtiss.

Curtiss to Bell.

Hammondsport, N.Y., Oct. 17, 1908:-The enthusiasm for the flying machines in Hammondsport was greatly revived last evening by the exhibition of the moving pictures taken July 3-4 and 5. They were very good indeed, and I only wish there was some way we could send them to Beinn Bhreagh to be reproduced.

Two flights were shown, together with pictures of the machine taken out on the track, testing the engine etc. Unfortunately the Aerial Experiment Association was not mentioned nor was Hammondsport. One section, however, was described as showing the "Curtiss 40 H.P. motor", while Captain Baldwin and myself were announced to apear in another part.

A very touching incident was the life-like appearance of Tom and his dog Jack. Mr. Lyon of Rochester and Mr. Post are plainly seen, while Douglas in his knickerbockers is never out of focus. The boys who worked on the machine all appear true to life while the village urchins grinning faces show up in the fore-ground greatly to the delight of the audience.

The first announcement on the sheet was as follows:- "The great American Aeroplane, "June Bug" winning the American Trophy July 4, 1908. This announcement was printed around an outline drawing of an aeroplane in which the arched surfaces were most conspicuous.

I do not know if the pictures would be so interesting to a stanger who did not know the parties shown, although I hear that it has met with great success in New York.

I expect Monday to hear from the Aeronautical Society in reply to my letter of which I sent you copy yesterday. I will wire you what they say.

G.H. Curtiss.

RESUME OF THE AERIAL EXPERIMENT ASSOCIATION AT HAMMONDSPORT: Report by G. H. Curtiss, Director of Experiments.

Before the Association Headquarters were transferred to Hammondsport, word was received to build a glider, the object being to gain some experience before building a power-driven machine.

This glider was built of bamboo and sheeting, and practiced with at various times for the first 60 days, many successful glides being made, some by each of the members. In the meantime, the power-driven machine was started, it being the majority of opinion that greater progress could be made by going at once to the power-drive and practice on the ice. This proved true, although considerable knowledge was gained with the gliders, which were tried with many different forms of tail and control.

The first power machine was Selfridge's "Red Wing". In its first trial Mr. Baldwin made a flight of 320 feet. This was the first public flight of a heavier-than-air machine in America, and the longest first trial ever made by any heavier-than-air machine.

At the second trial of this machine, again ridden by Mr. Baldwin, the strong wind proved too much for the limited controlling surfaces, and the machine was wrecked. By this time the ice had gone, and a machine to run on wheels was built and called Baldwin's "White Wing". This was fitted with adjustable wing tips and several types of running gear were tried. Several successful short flights were made by members of the Association.

This machine was finally smashed, and a third one called Curtiss' "June Bug" was built to try for the Scientific American Trophy. This machine embodied features of the "Red Wing", and White Wing with improvements, and contained many original ideas, including bowed surfaces, adjustable wing tips and shoulder control, combination steering wheel and the three wheel running gear with auxiliary skids.

On July 4th the Scientific American Cup was won by Mr. Curtiss, covering a kilometer and as much more as the boundaries of the field would permit, something over a mile altogether.

The machine was then experimented with, and further improvements made and embodied in McCurdy's No.4, "Silver-Dart" which is completed and ready for the engine. The new type of engine is of great power and endurance and has been designed for this machine, which should be a "world beater".

This, together with the propeller experiments, and some kite flying in the early Spring, covers roughly, the work of Hammondsport. Besides what has been given the world, and recorded by the Association for future reference, the members have gained a knowledge of aeronautics which, if applied, should be of great benefit to the Art. G.H.C.

The attached letter from Mr. Dienstbach describes the A.E.A's aerodrome as seen by an outsider. G.H.C. (this appeared in Bulletin XIII pp 33-36).

THE NEW MOTOR:
By G. H. Curtiss.

Hammondsport, N.Y., Oct. 7, 1908:- The new eight cylinder 50 H.P. water-cooled motor being built for the A.E.A. differs from any motors previously built by this company in as much as it is water-cooled, and is of larger cylinder dimensions; the bore is 3 3/4" and the stroke 4".

The cylinders are placed in the form of a "V" four on a side as shown in the sketch, which also gives other dimensions.

This motor has mechanical intake valves and is built for durability and constant hard running. The engine alone will weigh about 175 pounds. G.H.C.

(A blue print of the motor is appended).

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Cylinder 50 H.P. Water-Cooled Engine for Silver Dart.

4 Inch Stroke 3[illegible] Inch Bore

FUTURE AIR TRAVEL:
By G. H. Curtiss.

The theory upon which many aviators are working is that the long narrow surfaces are most efficient, but with this form of surface the weight increases in greater proportion than the lifting power and the structure becomes weaker as its size is increased. It is this difficulty which is overcome by means of Dr. Bell's tetrahedral construction. This construction with its many small dihedral surfaces, also bids fair to solve the problem of stability.

The areoplane of the future may furl and reef its surfaces much the same as a ship's sails are adjusted to the conditions of the weather. Much higher speed will be made in the aerial flyers of the future than is now accomplished on land, because it will be necessary for these flying crafts to maintain a high speed in order to fight the wind. A light motor and a propeller of great efficiency will do much toward the practical development of the present aerodrome. This improvement of the surfaces is already being rapidly accomplished.

One of the diffeculties now experienced, and which was illustrated at Fort Meyer, is the loss of equilibrium. It is possible that the gyroscope will be brought into play to overcome this, but it is hardly probable that automatic equilibrium will ever be entirely attained.

Balloons and dirigibles have been of vast service in learning the peculiarities of the air, but within five years the heavier-than-air machine will have nearly replaced the lighter-than-air craft. The future aerial craft will be simply a development of what we know already. It is safe to say that there will be for several years great improvements in the motor balloon and the aeroplane, but there will be no combination of the two as has been predicted.

The airship which, within ten years, will carry men and freight from place to place, will be a natural evolution of the aerodromes of to-day and not the semi-accidental discovery of a genius. It will be the work of a man who is thoroughly familiar with the laws of fluid movement; with the effects of wind currents and the means of overcoming the numerous difficulties which are encountered in the air. It is in the practical application of the scientific knowledge at hand that the solution of the problems of aerial flight will be found. G.H.C.

BALDWIN'S EXPERIMENTS WITH HYDROPLANES OCT. 16, 1908: By Gardiner H. Bell.

Beinn Bhreagh, Oct. 16, 1908:- In the experiments made to-day the Dhonnas Beag was stripped of the engine and towed without a man on board by the motor boat "Skidoo, being steered from the Skidoo by chords attached to the extremities of the outriggers. Total weight about 100 lbs. The Skidoo made an average speed of 600 m in 174 sec, or 7.6 miles per hour.

Exp. 1 (Morning) She lifted practically clear out of the water running on her planes. Two sets of hydroplanes fore, and one aft. Pull 25 lbs.

Exp. 2 (Afternoon) The boat was tried with the same outfit as in the morning but an extra set of hydroplanes of only two blades was used aft. Result about the same as in Exp. 1. Pull 20 to 30 lbs.

Exp. 3 Boat was then taken out of the water and the new set of hydroplanes were attached. (Photograph not shown in this Bulletin). The boat with new hydroplanes weighed 140 lbs. In this experiment the efficiency of the new hydroplanes was shown by the boat lifting high out of the water in the rear. The new hydroplanes buckled on the port side.

Exp. 4. Boat was again hauled out of water and two fish-shaped struts were used one on each side of boat, to strengthen the hydroplanes. Also the rear hydroplanes of two blades was taken off. Again she lifted out of the water in the rear. She also had a decided lurch to starboard. Pull 50 lbs.

Exp. 5. Mr. Baldwin then got on board the Dhonnas Beag to try and steady her, making the total weight exceed 300 lbs. She did not lift from the water and the starboard strut pulled out and the port hydroplane again buckled notwithstanding the strength given by the extra strut.

A note by Mr. F. W. Baldwin dated Oct. 17, 1908, says:

> Yesterday (Friday Oct. 16) tried Dhonnas Beag towing her behind Skidoo. Three sets of hydroplanes first two forward and one aft; no engine and no man. The total weight was about 130 lbs. She lifted forward but stern dragged in the water so attached another set of hydroplanes well aft. This time boat lifted practically out of water; speed 100 meters 30 sec; pull 25 lbs. A slight pull on the line would lift boat clear out of water, so that you could see right under fore to aft.
>
> Then we put on new hydroplanes leaving on the other four. Weighed about 140 lbs with the hydroplanes. She lifted way up by the stern, port side of new hydroplane. Put a fish-shaped strap on each side to strengthen the hydroplanes and took off planes aft of the new ones to try and make boat balance. Boat still lifted by the stern. 100 meters in 30 sec; pull 50 lbs. Then I got on hydroplanes on the boat to try and trim her. 100 meters in 29 sec down. 100 meters in 30 sec up. Pull 70 lbs. Boat lifted, but not clear of the water. Starboard strap pulled out, and on taking boat out of water, found port side of planes buckled again.

I append these notes as they are important as coming from Mr. Baldwin himself.

G.H.B.

BALDWIN'S EXPERIMENTS WITH HYDROPLANES OCT. 17, 1908: By Gardiner H. Bell

Beinn Bhreagh, Oct. 17, 1908:- There is a noted difference in the experiments made yesterday and to-day from those of the past, in that the Dhonnas Beag was stripped of all her weight, engine and man, and was towed by the launch "Skidoo"; whereas heretofore she was driven by her own motive power and did not succeed in rising on her hydroplanes. The Skidoo made an average speed of 1000 meters in 307 seconds.

Exp. 1. Besides making the boat as light as possible the lifting surfaces of the forward hydroplanes were greatly increased by the use of a wooden hydroplane, about three inches wide inclined at an angle of 5°, which was lashed on below the two forward hydroplanes. (See photograph in this Bulletin). In the stern was a four-bladed hydroplane, and about three feet forward of this was another hydroplane of three blades.

Result: Boat lifted completely out of the water and ran along on her hydroplanes steadily, keeping the hull at least a foot clear of the water. She was inclined to be a bit heavy to starboard so a piece of lead was put on the port outriggers to counterbalance the effect. This had the desired effect. During the experiment the pull registered 50 lbs.

Exp. 2. As she was inclined to lift too high in the bow she was loaded down with 46 lbs. of lead well forward about three feet behind the forward planes.

Result: She took on a diving action, resembling that of a porpoise. Pull 50 lbs.

Exp. 3. The lead was shifted at lower end of course about three feet farther forward, bringing it immediately above forward plane. With this balance she plunged more severely than before.

Exp. 4. Lead shifted away aft, with the result that the boat lifted away out in the bow.

Exp. 5. Again the weight was shifted forward about a foot and a half bringing it nearly amidship.

Result:- She dove up and down with above adjustment.

Exp. 6. The weight was then removed and Mr. Baldwin got aboard the Dhonnas Beag. With his weight the boat did not lift out of the water. Pull registered 85 lbs.

Exp. 7. Mr. Baldwin then got off and the 46 lbs weight was placed as far forward as possible. With this adjustment she jumped up and down, the whole boat keeping parallel with the water.

Exp. 8. Again weight was shifted back about a foot. She still continued to dive badly.

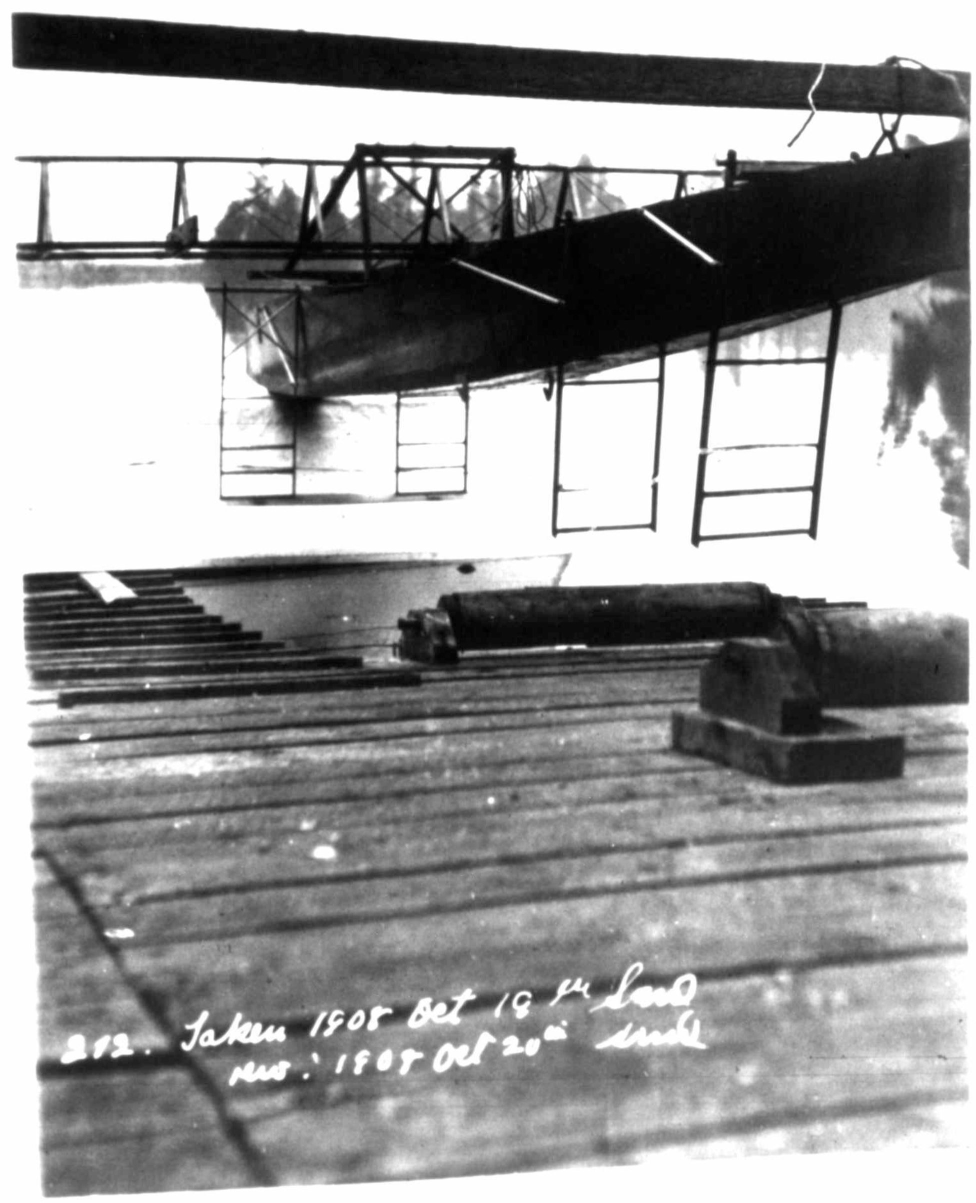
Exp. 9. Shifted weight three feet forward of center of gravity. Jumping action parallel with water.

Exp. 10. Shifted weight three feet back of center of gravity. Held her nose steadily high out of water. Pull 70 lbs.

Exp. 11. Shifted weight to center of gravity. Plunged up and down in the bow. Pull varying from 40 to 60 lbs.

Exp. 12. Weight was then taken off. She rose out of the water a foot fore and aft and stayed there.

G.H.B.


212. Taken 1908 Oct 19th
1908 Oct 20th


209. Taken 1905 Oct

BALDWIN'S EXPERIMENTS WITH HYDROPLANES, OCT. 20, 1908: By Gardiner H. Bell.

Beinn Bhreagh, Oct. 20, 1908:- In experiments to-day two wooden hydroplanes were used, instead of one as in the last experiments reported, one fore and one aft. Each plane was lashed on to the bottom of two sets of the regular iron hydroplanes.

Exp. 1. The Dhonnas Beag immediately upon gaining headway, went up on her hydroplanes and stayed there as long as headway was maintained. Some difficulty was found in keeping her one an even keel and she drifted badly from side to side.

Exp. 2. Two strips of wood, one on either end of the outriggers were tried as a means of steadying her. (See photograph). 46 lbs of lead was put amidship. She lifted high out of the water, but it was very hard to steady her in this position.

Exp. 3. Mr. Baldwin then got on board the Dhonnas Beag. As soon as sufficient headway had been gained by the launch the Dhonnas Beag came out of the water on her hydroplanes holding the boat a foot clear of the water until speed was slackened.

In above experiment:-

Pull 52 lbs. Speed 100 m in 35 sec down
Pull 42-50 lbs. Speed 100 m in 32 sec up.

200 m in 67 sec.

This was a red-letter day at Beinn Bhreagh. Present as witnesses:- Mrs. A.G. Bell, Miss Mabel B. McCurdy, Dr. A. G. Bell, Mr. F. W. Baldwin, Mr. Gardiner H. Bell, Mr. Bedwin and members of the Laboratory Staff including Messrs. Malcolm MacFarlane, John MacLean, Wilson Rudderham, and William MacDonald. G.H.B.

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A STEP IN ADVANCE: By F.W. Baldwin.

Tuesday Oct. 20, 1908, marked a new phase in our hydroplane experiments. Previous to this our hydroplanes have not yielded results definite enough to make deductions from, or reliable enough to base calculations upon.

The retarding effect of the hydroplanes upon the boat was the only action we were perfectly sure of. The lift being a very uncertain ~~quality~~ quantity while any part of the hull remained in the water.

On Tuesday Oct. 20, however, we succeeded for the first time in lifting the hull and a man well out of the water, so that at last we have a pure hydroplane action, and a means of measuring accurately all the factors involved.

With the planes set at 5° (Angle of incidence) and an average pull of 50 lbs. the lift was 300 lbs. This result while in no way remarkable is nevertheless promising. Taking the $\frac{\text{lift}}{\text{drift}}$ as the measure of efficiency we get $\frac{300}{50} = 6$, which means that even with the crude planes employed in this experiment, we can lift a boat clear of the water with a propeller thrust equal to 1/6 of her displacement. Once a hydroplane boat under her own power can lift clear of the water i.e. (substitute the vertical pressure of the planes for displacement) we have every reason to expect, both from theory and practice, that the high speed we have been looking for is obtainable.

Of course a great many improvements over the planes used at once suggest themselves. For example:- The cutting edges of these were at right angles to the line of advance;

their head resistance unnecessarily large, and their curvature too flat for efficiency. In all these particulars we expect our new metal planes to be an improvement. They present only slanting cutting edges, and are much finer in section.

However, this may be, we have now something satisfactory to work from, and it is encouraging to note that even with our present inefficient planes, we have at our command the necessary propeller thrust to lift the Dhonnas Beag out of the water, and convert her from a boat to a hydrodrome.

It might be well for us to now give some thought to the stability of such a machine. The boat, at present of course is very unstable when the hull is well above the water. While it travels smoothly when balanced it has no automatic stability and it requires a lot of attention on the part of the operator to keep her on an even keel. Probably a dihedral angle on some of the planes might be used to remedy this defect, or Dr. Bell's suggestion of using planes on the hay-rake principle. In any case lack of stability with the hydrodrome is not attended by the same danger or difficulty as with the aerodrome. Let us get out of the water first, and seek stability afterwards.

F.W.B.

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DISCUSSION CONCERNING FRONT AND REAR CONTROLS OCT. 14, 1908: Report by Mabel B. McCurdy, Stenographer of the Association.

(Report of the Stenographer revised for this Bulletin).

Beinn Bhreagh, Oct. 14, 1908:- Dr. Bell read to Mr. F.W. Baldwin and Mr. Gardiner H. Bell his note upon "Front Control" given elsewhere in this Bulletin; whereupon the following discussion took place:-

Mr. Baldwin:- In the first place I think the aerodrome with its front control is not comparable to a pole with one surface on it. There are two surfaces on the pole that would represent the machine. The main surface is behind the center of gravity, or whatever point you want to take as a pivot.

I think one of the greatest things about a bow control is that you can see what you are doing, that makes up for a great many deficiencies, having the whole control in full view and seeing exactly what it is doing. In fact, I think, all steering or working parts should, if possible, be in full view. If your bow control breaks, why you would know where you are! When the Red Wing tail broke I did not know it had broken at all. You want to get your moveable parts in front where you can see them. You can make your truss strong, you can make your rigid parts strong; the things that go wrong are your working parts. Now the Red Wing certainly broke her tail on one side. Everybody excepting myself knew it, but I didn't until I came down on the ice. Now I should have seen it had it been in the bow. It is perfectly possible for a tail to break and operator not to know enough to shut off when to shut off might save his life. An accident to the stern might cause you to lose control of the whole machine and you might not know what was wrong.

The dangerous thing is loss of headway. In all our machines that is the only thing we have to fear very much. As long as you have good steerage way you won't have a very bad fall. If you lose headway, I think a bow control is a safer proposition than a tail because your center of pressure, when in flight at small angles, is well forward. Your weight has to go forward when you speed up. You must either have your center of gravity well forward of the center of surface or else shift the controlling planes to meet it. You could have your center of gravity somewhere near the center of surface of the machine and control the travel of the center of pressure by using your front control at a negative angle and then if you lose all headway your machine is nicely balanced for a slow glide, the center of gravity being very little in advance of the center of surface. I think the safest possible proposition would be a good big bow control on a good long arm and travel with it at a slightly negative angle.

Dr. Bell:- Then I understand that you admit the main proposition, about the pole with a horizontal surface at one end to be correct, but think that the main surface of the aerodrome being back of the center of gravity, renders the two cases not comparable, that in fact in the aerodrome case, you have two surfaces, one in front and the other behind the axis of turning, and the one behind very much larger than the one in front. But in this case the main surface which is supposedly back of the axis of rotation is inclined with its rear edge downwards. In other words it is tilted up in front. Thus so far as its action as a rudder is concerned it would tend to make the machine dive-----------------

Mr. Baldwin:- No, no it balances all right. They are not tending to thus turn the machine over. If the center of gravity is right under the center of pressure there is no turning tendency.

Dr. Bell:- Yes, but if the surfaces are back of the center of gravity why is there not a turning tendency, why don't they act like a rudder steering the bow down under headway.

Mr. Baldwin:- Because the part behind is not as effective.

Dr. Bell:- Well, anyway now you admit the main proposition, but don't think that the two cases are quite comparable, that there is not a single surface away out in front. As I gather your idea, the front control would be, you think, a more efficient safeguard in case of loss of headway than a rear tail.

Mr. Baldwin:- Yes.

Dr. Bell:- Now let us look at that. We lose headway and under these circumstances neither a front control nor a rear tail will operate to direct a machine.

Mr. Baldwin:- I don't think that is quite correct.

Dr. Bell:- No rudder will work without headway. Now we lose headway and the machine begins to drop under the action of gravity. Then we have "downway", not "headway", and in the interests of safety is it not advisable that the machine should turn head down rather than tail down? Now the effect of a single surface away out in front would, under the influence of downway tend to send the head up, and lead to a stern fall. Whereas the influence of a rear tail would be to elevate the stern and lead to a dive with subsequent recovery of headway when the machine would be again under control. I speak here of the tendencies of the front or rear controls. You introduce a new element and place the center of gravity in front of the center of surface so that, under the influence of gravity alone, the machine will dive when headway is lost, and then claim that the front control is safer because its tendency to turn the head up, when dropping, neutralizes to a certain extent the tendency of gravity to turn the head down. Whereas the influence of the rear rudder tends to make the dive greater. So that your proposition is that the front control, combined with an advance in the center of gravity, is safer than a rear control, combined with an advance in the center of gravity.

Mr. Baldwin:- That is it in a nutshell. They are equally safe if you have a long enough distance to drop; but if you have only got a short distance it is much better to have a machine with which you could regain steerage way more quickly. Now I think you can regain steerage way more quickly and without such a steep dive, when you have a bow control and preferably carry it at a slight negative angle. In all our machines the center of gravity must be well forward of the center of surface of the machine.

Dr. Bell:- Why?

Mr. Baldwin:- Well, because as a machine travels at an increasing speed and a less angle of incidence, the center of pressure does move forward, we know that. Take any of our machines and balance them up, put your center of gravity underneath the center of surface of the machine. Now propel that at any small angle of incidence, and it won't balance. The bow goes up. With the surfaces we have used the center of pressure moves forward almost to the front edge of the machine. About 8 inches back was a fairly good balance for the center of gravity. Now the planes are 6 feet deep so that we know that the center of gravity must be well forward on the machine to balance it when in motion. Now when the machine hasn't any headway with that balance, if you suspend the machine, and let it suddenly drop it will take a very bad dive, and then recover headway. Just like the little gliders it would go along and dive, then go along and dive again etc. etc. Now you can have the center of gravity further back in the machine if you have a front control at a negative angle.

Suppose you have a tail and lose headway. Then under the influence of downway the action of the tail turns the stern up increasing the tendency to dive.

Mr. Gardiner Bell:- That tail isn't going to make your action any worse, on account of pressure on the upper surface of the tail resisting turning action.

Mr. Baldwin:- You don't get pressure on the upper surface until you have headway, and you don't get headway until you have downway.

Now let that machine drop, it will tend to dive more speedily with this tail on. With a bow control it tends to check the dive.

Dr. Bell:- You think the pressure is on the under surface of the tail, Gardiner Bell thinks it is on the upper surface.

Gardiner Bell:- You take both cases, one machine with a tail, and the other without; you can turn the machine without the tail quicker than the one with the tail. The resisting pressure will be on the upper surface of the tail the moment the machine turns, that is if the tail is fixed or stationary.

Mr. Baldwin:- According to Dr. Bell's proposition the thing with a tail let free to fall will tend to do the weather vane act and drop with its head vertically downwards.

Dr. Bell:- I think we are all agreed upon the point that the principal danger to the aviator is in loss of headway. Now in all machines so far made the center of gravity is in front of the center of surface so that when we lose headway the machine dives and the front control by its resistance tends to check that dive. It is equally obvious that if the center of gravity was behind the center of surface then the rear tail would check the stern dive which would result? But the question comes in my mind why do we have to have that center of gravity in front of the center of surface, why would it not be safer, without headway, to have it directly under the center of surface. Suppose the reason to be, and I think it is right, that when headway is gained the center of pressure moves forward and we have to have the center of gravity under the center of pressure in order to balance. Then the faster the machine moves and the slighter the angle of the main planes with the line of advance the more the center of pressure moves forwards, which would mean that the center of gravity also has to move forward to balance the machine.

Now are we not going on the wrong principle altogether to balance an instability that results from a change in the center of pressure, by making a change in the center of gravity I think the Wright Brothers introduced an enormous improvement over the acrobatic method of Lilienthal when they proposed to counterbalance such changes by the action of moveable surfaces Why would it not be better in this case also to have the center of gravity under the center of surface, the safest position without headway, and counterbalance the effect of the movement of the center of pressure by means of moveable surfaces.

We have hitherto been considering the front control versus the tail. Why not have both together? They can co-operate with one another in steering under headway and would not both be safer than either alone in coming down without headway?

Mr. Baldwin:- I think that is all right. That is exactly what I mean by carrying the bow control at a negative angle to leave your center of gravity somewhere near the center of surface, although in advance of it so that if you do lose headway you are in a better position to control the dive.

Dr. Bell:-There is a great deal in Gardiner Bell's idea. Under a vertical drop the pressure of the air acting on the under surface of the tail would of course tend to push the tail up. But the actual effect depends very largely upon where the center of gravity is. If the center of gravity is directly under the center of surface of the main planes the tail would undoubtedly act in that way. But if the center of gravity is in advance of the center of surface of the main planes then the resistance of the air on the upper surface of the tail would lessen that tendency to turn, and so would the resistance on the lower surfaces of the front control, and both of them together, resist the turning tendency resulting from the eccentric position of the center of gravity. The axis of rotation in this case being the center of surface, or center of resistance.

Mr. Gardiner Bell: Why not use your tail for a sustaining surface as well as a tail? The front control evidently is a good thing because it does things quickly; but why not limit the bow control by using a rear tail and then too you can put your center of gravity away back. Then you have your front control, and your rear tail helps to sustain as well as keep your equilibrium. There is a certain amount of sustaining surface in the tail because you move your center of gravity further back, and also, I think, the only place you can have your control is in front, but the tail limits the front control so it is not such a dangerous thing in the hands of the operator.

Mr. Baldwin:-Mighty good thing to check you up just the same. It gives you the ability to recover quickly.

Mr. Gardiner Bell: And it really does not matter how far back you put your tail does it?

Mr. Baldwin: You bet your life it does! Anything behind the propellers is a bad proposition. There is a draft of air from the propellers upon any rear surfaces, and if they are inclined so as to be supporting surfaces, then when your propellers stop the change in the balance of the machine might be very great.

Mr. Gardiner Bell:- In that case it would be a good scheme to put your rear tail further back.

Mr. Baldwin: There is a drag to the tail though.

Dr. Bell:- This is shown in the Hammondsport experiments. The speed of the June Bug was greatly increased by the omission of the tail. There is one consideration you can get great longitudinal extension by using both the front control and the rear tail, and at the same time get quick action by using them simultaneously.

Mr. Gardiner Bell: Mr. Baldwin's idea of having the front control at a negative angle so as to intensify the safety seems to me to be wrong in principle.

Dr. Bell:- Why?

Mr. Gardiner Bell: Because there is nothing that brings about resistance so much as that.

Dr. Bell:- That is, introduces an artificial resistance to advance.

Mr. Gardiner Bell: That is what I mean.

M.B. McC.

THE STABILIZING EFFECT OF THE STATIONARY TAIL:
By Gardiner H. Bell.

Beinn Bhreagh, Oct. 14, 1908:- One of the great problems seems to be, where to put the horizontal control, or controls, and whether or not to use a tail.

Undoubtedly the front control is the most effective, and for this reason, if not handled properly is the most dangerous. It can cause a fore-downward plunge quicker than anything. But it can also check a plunge more effectively than a rear control. The action of the front control, however, is limited by the position and area of the tail, supposing there is one.

For example a horizontal tail ten feet in the rear of the machine will have a more stabilizing effect than a tail five feet in the rear; the cause for this is leverage. Hence the power of a front control will be less in the first case than in the second.

In case I then, the fore and aft stability will be increased and the power of the front control will be diminished. It is obvious that with a stationary tail the horizontal control must be in front. You don't want to increase your sustaining area from fore to aft, but you do want to increase your stability. Hence why is not a stationary horizontal tail, say fifteen feet in the rear a good thing? G.H.B.

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LOEB TO BELL.

White House, Washington, D.C., Oct. 8, 1908:- Your letter of the 5th instant has been received and by direction of the President has been called to the attention of the Secretary of War.

Wm. Loeb, Jr.,
Sec. to the President.

(See Bulletin XIII pp.32-33 for letter to President Roosevelt).

ASSISTANT SECRETARY OF WAR TO BELL.

War Dept., Washington, D.C., Oct. 17, 1908:- I have the honor to acknowledge the receipt, by reference from the White House, of your letter addressed to the President under date of 5th instant, regarding work of the Aerial Experiment Association, and to express appreciation of your courteous offer in placing the technical information of this Association at the disposal of the War Department.

The different types of aerodromes which the Association has available have been noted, and an officer will be detailed from the U.S. Signal Corps to witness special flights of aerodromes at Hammondsport, N.Y., in accordance with your suggestion, upon being informed of the dates upon which such flights are to take place.

The death of the young officer referred to by you is deplored by all.

Robert Shaw Oliver,
Assistant Secretary of War.

THE PHILLIPS FLYING MACHINE.

(See Aeronautical Journal July, 1908).

It is interesting to note the experiments of an English inventor, who has, for some years been working on a machine of an entirely different type from those which are now claiming our attention.

Experiments were first made with a model in 1893 by Mr. Phillips. The sustaining surfaces consisted of a series of planes assembled in such a way as to resemble venetian blinds. There are over fifty of these slats, each 22 feet long and 1 1/2 inches wide. They were slightly concave and tilted at about two degrees with the horizontal.

In general dimensions the machine was 25 feet long, breadth, 22 feet, and 11 feet high. The total weight, including load was 420 lbs.

The machine was mounted on three wheels, the single wheel leading. The propeller which was 6 feet in diameter had an eight foot pitch and developed a thrust of about 75 lbs. the motor power used was steam, the engine developing about 8 H.P., and weighing 200 lbs. Coal was used for fuel; the machine was started on a circular track about four feet wide.

It was governed by a wire running from the machine to the center of the circular track. During one trial the machine supported itself in the air for about 2000 feet flying about four feet above the track.

Mr. Phillips was so encouraged by these experiments that in 1907 he constructed a much larger model.

In this machine the principle involved is the same but instead of having only one set of sustaining surfaces, arranged like venetian blinds, there are four of these sets on frames arranged one behind the other. The total weight of the machine is 500 lbs. The motor develops about 20 H.P. The propeller used is seven feet diameter. G.H.B.

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THE KIMBALL HELICOPTER.

(See Aeronautics for Sept).

Above the Chassis, which consists of three wheels, a light framework, and a four cylinder 50 H.P. water-cooled engine is a system of propellers in a very light framework, inclined at an angle of about 20 degrees with the horizontal. There are twenty of these propellers, each propeller having four blades. Their diameter is four feet and their pitch is very low. They are to be run at 1000 revolutions per minute. G.H.B.

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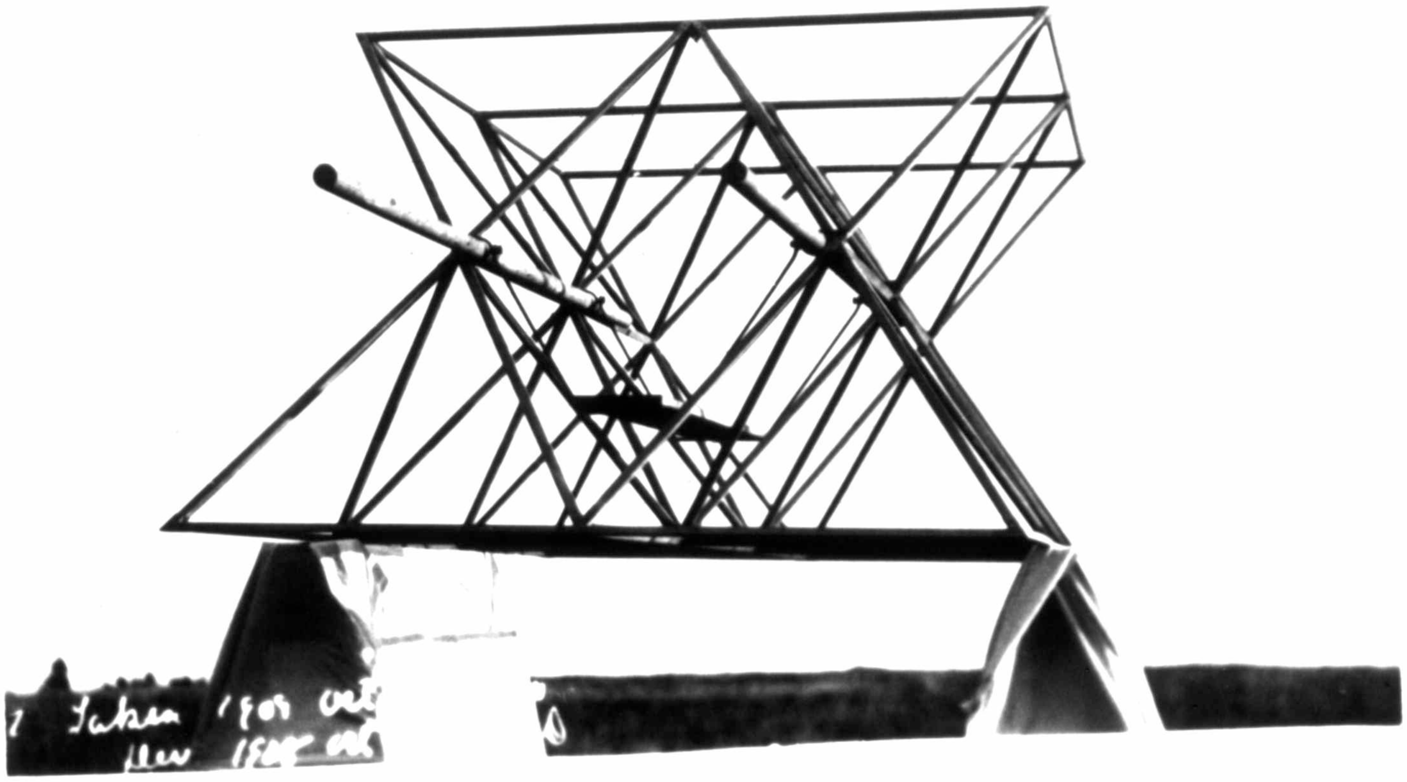
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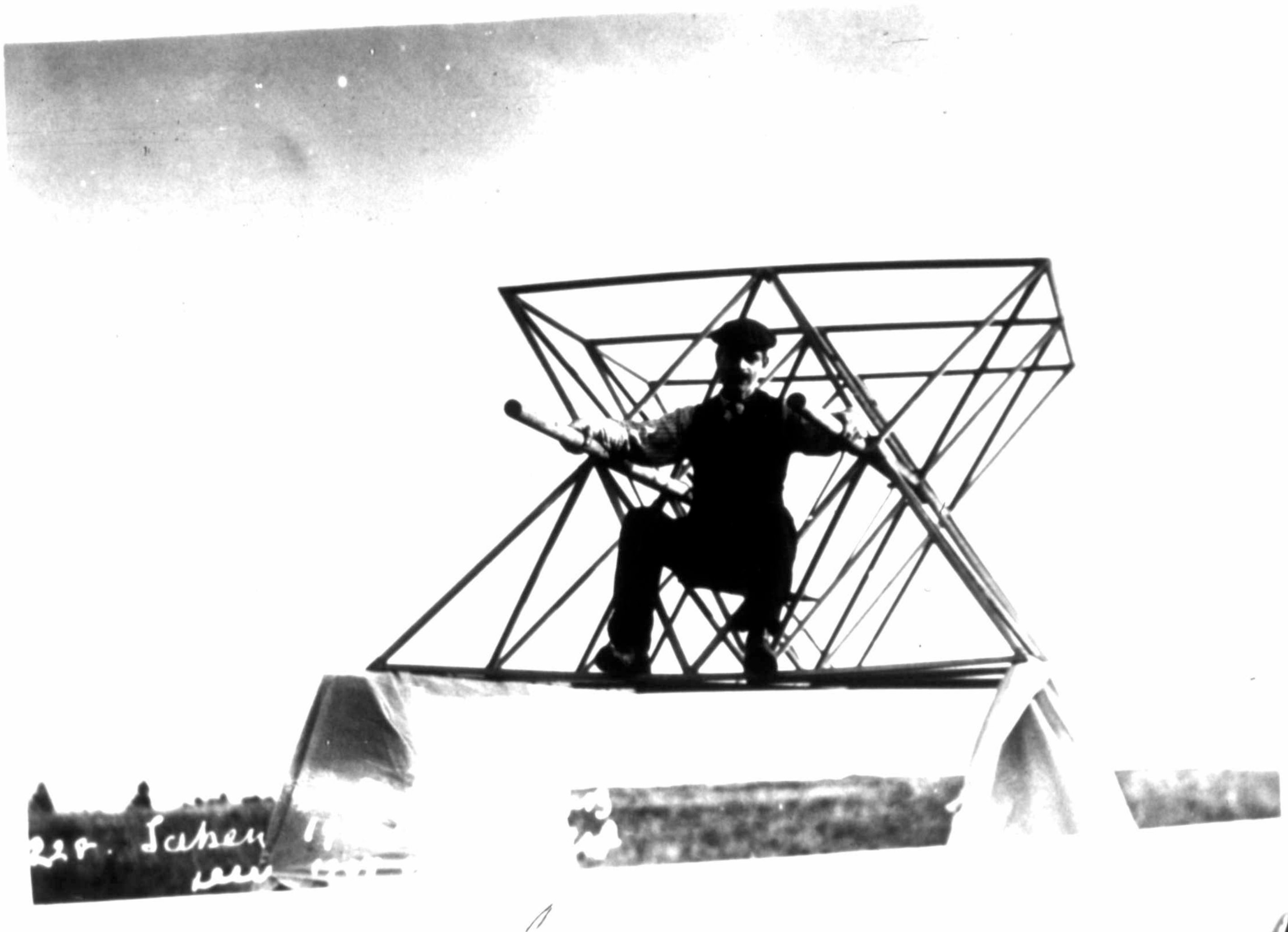
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