BULLETINS

OF THE

Aerial Experiment Association

Bulletin No. I Issued Monday, July 13, 1908

MR. McCURDY'S COPY.

BEINN BHREAGH, NEAR BADDECK, NOVA SCOTIA

Bulletins of the Aerial Experiment Association.

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BULLETIN No. I ISSUED MONDAY, JULY 13, 1908.

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Beinn Bhreagh, Near Baddeck, Nova Scotia.

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WORK OF THE AERIAL EXPERIMENT ASSOCIATION.

As recorded in telegrams sent by members of the A.E.A.

To Charles T. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 17, 1908, 5 P.M.---The Aerial Experiment Association, which has its winter headquarters at Hammondsport, N.Y., is an association of experimenters who are working conjointly to promote the progress of aviation in America.

At present there are five members: Alexander Graham Bell, F. W. Baldwin, J.A.D. McCurdy, Glen H. Curtiss and Thomas Selfridge. Their object is the construction of a practical aerodrome, or flying-machine, driven through the air by its own motive power, and carrying a man.

In pursuance of this aim, the Association has already built two aerodromes.

No. 1. Selfridge's "Red Wing", upon plans approved by Lieut. Selfridge, and

No. 2. Baldwin's "White Wing", upon plans approved by Mr. F. W. Baldwin.

The tetrahedral aerodrome of Dr. A. Graham Bell will probably be No. 3, and then will follow Nos. 4 and 5, the aerodromes of Mr. Curtiss and Mr. McCurdy. It is expected that all these aerodromes will be built within the present year.

The two aerodromes that have already been completed have been wrongfully ascribed in the public press to Dr. Bell the Chairman of the Association. His aerodrome has not yet been completed, and work will not be resumed upon it until June, when the headquarters of the Association will be removed to Baddeck, Nova Scotia, where Dr. Bell has his summer home.

The work on Dr. Bell's machine progressed last year at Baddeck to the point of constructing a large tetrahedral kite known as the "Cygnet", which, on December 6th, 1907, successfully carried Lieut. Selfridge up into the air to a height of 168 feet over the waters of the Bras D'or Lake. At the conclusion of this experiment the "Cygnet" landed very gently upon the surface of the water, and floated there, quite uninjured by its experience in the air. It was subsequently wrecked by being towed at full speed through rough water by a powerful steam-boat. By that time the season had so far advanced in Baddeck that further experiments with Dr. Bell's structures had to be postponed until the opening of navigation in the present year.

In June the Baddeck experiments will be resumed by the Association, by the construction of another tetrahedral structure upon the general model of the "Cygnet", and the attempt will then be made to convert the kite into an aerodrome by providing it with motive power.

The first aerodrome actually completed by the Association was Selfridge's "Red Wing". This aerodrome made a successful flight of 319 feet over the ice on Lake Keuka, near Hammondsport, N.Y., on March 12th, 1908, in the presence of many witnesses. This experiment was somewhat remarkable, as being the first successful public flight of a flying-machine in America, the earlier flights of the Wright Brothers at Dayton, Ohio, having been made in secret. The machine had been provided with sledge-runners, and glided over the ice for about 100 to 150 feet before it rose into the air. It then flew very steadily at a general elevation of from 10 to 20 feet above the surface of the ice, carrying Mr. F. W. Baldwin as aviator.

The newspapers very generally reported the aviator as Capt. Baldwin, the balloonist, but this is a different man. Mr. F. W. Baldwin is a young engineer, a graduate of Toronto University, and a grandson of the celebrated Robert Baldwin, one of the founders of the Dominion of Canada, and premier of Upper Canada before the Confederation. Mr. F. W. Baldwin is the same engineer who designed and constructed the tetrahedral tower of steel which stands on Dr. Bell's estate near Baddeck, Nova Scotia; and the new aerodrome now awaiting trial at Hammondsport has been designed by him.

Aerodrome No. 1, Selfridge's "Red Wing", came to an untimely end on March 17th, 1908, by an accident which completely demolished the machine, although fortunately the aviator and the engine escaped uninjured. The Association then immediately began the construction of aerodrome No. 2, Baldwin's "White Wing".

Both aerodromes have been constructed in the aerodrome shed of Mr. Glen H. Curtiss of Hammondsport, who acts as Director of experiments for the Aerial Experiment Association. The actual work of construction has been under the charge of Mr. William F. Bedwin, Superintendent of Dr. Bell's Baddeck Laboratory. The engine employed was specially designed for the Association by Mr. Glen H. Curtiss, and was manufactured by the Curtiss Manufacturing Company of Hammondsport.

On May 13th, 1908, an attempt was made to fly the new aerodrome, No. 2, Baldwin's "White Wing", at the race track near Hammondsport. The aerodrome had been provided with light wheels, like bicycle wheels, to enable it to run over the ground until sufficient headway had been gained to enable it to rise into the air. The race track, however, proved to be too narrow to enable it to be used for this purpose, as the ends of the wing-piece were not raised sufficiently from the ground to escape contact with the raised sides of the track. The attempt was therefore made to start the machine from the grass plot contained within the oval race track, but the attachment of the wheels proved to be too weak to stand the strain of running over rough ground, and broke before much headway had been gained. The damage was repaired next day. The machine has been placed at a higher elevation above the wheels, so that it is hoped that the next experiment may start from the race track itself, instead of from the grass lawn, as the smoother surface of the track will give a better chance for getting up the necessary initial speed.

(Signed) Graham Bell.

To Charles F. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 17th, 1908, 8 P.M.---- A preliminary trial was made this evening of the aerodrome "White Wing", designed by F. W. Baldwin, and constructed by the Aerial Experiment Association of which Dr. A. Graham Bell is Chairman. The aviator's seat was occupied by Lieut. Thomas Selfridge, U.S.A. The people of Hammondsport turned out in large numbers to witness the experiment. No attempt was made to rise into the air.

The machine had been provided with wheels, but steering gear was not attached to them, as it was thought that the aerial rudder would control the motion of the machine while on the ground. This proved insufficient for the purpose, however, for the machine could not be kept from running off the track to one side or the other. It was therefore decided to make a slight change in the attachment of the front wheel, and provide it with steering gear, so as to enable the operator to steer the machine on the race track for a distance long enough to gain sufficient speed to get into the air. No attempt will be made to fly until the operators are satisfied that they have the machine under full control on the ground.

(Signed) Graham Bell.

To Charles F. Thompson,

Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 18th, 1908, 5 P.M.----The aerodrome "White Wing" made a short flight here to-day, carrying its designer, F. W. Baldwin, to a height of about 10 feet. The pressure of the air on the elastic rear edge of the lower aero-plane caused it to foul the propeller, and the aerodrome was therefore brought down to the ground, after having traversed a distance of 93 yards. The damage will be easily repaired.

The new steering gear, attached to the front wheel, worked satisfactorily, so that there is now no difficulty in keeping the machine on the race track while running on the ground. The race track has been widened by ploughing up a portion of the adjoining field and smoothing it with a roller.

(Signed) Graham Bell.

To Charles F. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 19th, 1908, 6 P.M.---Lieut. Selfridge made two flights this afternoon in Baldwin's aerodrome, "White Wing". In first experiment machine ran 210 feet in six and a half seconds, on race track, before leaving the ground, and made a flight of 100 feet in two seconds, at elevation of three feet, and ran 201 feet on rough ground after landing, without injury to running gear. The flight was impeded by loose guy wires catching in propeller, but no damage resulted. In second experiment the machine made a beautiful and steady flight of 240 feet, at an elevation of at least 20 feet in the air, but landed badly in a newly ploughed field. The aerodrome is uninjured, but the truck carrying the front wheel ploughed into the ground, and injured front wheel. The damage can be easily repaired. The members of the Aerial Experiment

Association are encouraged to believe that the engine has abundant power, and that the machine is under good control in the air, so that skill alone on the part of the aviator is all that is needed to accomplish much longer flights.

(Signed) Graham Bell.

To Charles T. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 21, 1908---G. H. Curtiss of the Curtiss Manufacturing Company made a flight of 339 yards (1017 feet) in two jumps in Baldwin's "White Wing" this afternoon at 6.47 P.M.

In the first jump he covered 205 yards then touched, rose immediately and flew 134 yards further when the flight ended on the edge of a ploughed field. The machine was in perfect control at all times, and was steered first to the right, and then to the left before landing. The 339 yards was covered in 19 seconds, or 37 miles per hour. A previous trial was made earlier in the day but resulted in no flight.

The motor is a duplicate of the one used by Curtiss when he made his record of a mile in 26 2/5 seconds, 136.4 miles per hour. This is the world's record for a first attempt.

(Signed) Selfridge.

To Charles T. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., May 23, 1908---J.A.D. McCurdy handled Baldwin's "White Wing" in her fifth flight to-day. 183 yards was covered in 10 3/5 seconds at 35 miles an hour. The maximum height was about 20 feet.

Quite a strong quartering wind was blowing which McCurdy did not correct for by his lateral controls, this being his first trial, which caused the machine to careen and strike her right wing first. She then turned turtle pivoting on the nose and finally rested on her top plane with engine and wheels in air. The center panel was so strongly built, however, that it remained intact, the engine staying fast in its bed. Neither operator nor engine were in the least injured. The machine itself was, however, quite badly damaged, and it will take a couple of weeks to complete repairs.

This flight was the fifth made by the "White Wing" which has now traveled a total of 674 yards in the air.

Baldwin	40	yards
Selfridge	112	"
Curtiss	339	"
McCurdy	183	"

Selfridge's "Red Wing" traveled with Baldwin a total of 147 yards which makes a grand total of 821 yards covered by the Aerial Experiment Association in seven flights since March 11, 1908, with absolutely no damage resulting to either operator, or the engine which was the same in both machines.

(Signed) Selfridge.

To Charles T. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 19th, 1908---Preliminary tests of running gear and surfaces were made to-day with aerodrome No. 3, Curtiss's "June Bug", which extended so late into the evening that there was no time left to make a flight.

(Signed) Graham Bell.

To Charles F. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 20, 1908---An unsuccessful attempt was made this evening to raise the aerodrome "June Bug" into the air.

(Signed) Graham Bell.

To Charles F. Thompson,
Supt. Associated Press, N.Y.

Hammondsport, N.Y., June 21, 1908---The Aerial Experiment Association aerodrome No. 3, Curtiss's "June Bug", made three successful flights here this afternoon with Mr. G. H. Curtiss as aviator. The first flight was 456 feet at the rate of 28.1 miles per hour; the second was 417 feet at the rate of 31 and one half miles per hour; the third was 1266 feet at the rate of 34 and one half miles per hour. This last flight is the longest yet made in public in America, and is only Mr. Curtiss's fourth attempt.

(Signed) Graham Bell.

(Note:- Copies of Associated Press Dispatches written by Lieut. T. Selfridge after June 21, 1908 have not been received in time for this Bulletin. A.G.B).

To Mr. A. Graham Bell,
King Edward Hotel, Toronto.

Hammondsport, N.Y., June 25, 1908---"June Bug" made record flight early this morning, 725 yards at an elevation of forty feet. Time 41 seconds. Wind 8 to 10 miles an hour blowing with machine. Tips worked beautifully and machine under perfect lateral control; front rudder inefficient, hence descent.

Surfaces have been revarnished and colored yellow stretching them tight and absolutely air proof. Nothing materially injured. Will try again this evening.

(Signed) J.A.D. McCurdy.

To Alexander Graham Bell,
Prescott, Ont., or Kingston, care of
steam-boat Toronto of R.O. Steam-boat
Line, which left Toronto to-day at two P.M.
for Montreal, and if too late to catch boat
repeat to Windsor Hotel, Montreal, Que.

Hammondsport, N.Y., June 25, 1908---Curtiss flew eleven hundred and forty yards, three thousand four hundred and twenty feet in sixty seconds this evening about 7.30. We have telegraphed and telephoned Secretary Aero Club of America that we are now ready to try for the Scientific American Cup. Hurrah!

(Signed) Selfridge.

To Dr. A.G. Bell,
Victoria Hotel, Charlottetown, P.E.I.

Hammondsport, N.Y., July 2, 1908---All arrangements made with Aero Club for trophy trials on July fourth at Hammondsport.

(Signed) J.A.D. McCurdy.

To Dr. A. G. Bell,
Victoria Hotel, Charlottetown, P.E.I.

Hammondsport, N.Y., July 3, 1908.---Flew three quarters of mile to-night. Everything O.K. for July fourth.

(Signed) J.A.D. McCurdy.

To Dr. A. Graham Bell,
Victoria Hotel, Charlottetown, P.E.I.

Hammondsport, N.Y., July 4, 1908---Captured trophy to-day by flying distance of one mile in one minute and forty-two seconds. Flew full distance of valley. Came down on account of trees making beautiful landing. Machine under perfect control and everybody happy.

(Signed) J.A.D. McCurdy.

To Mauro, Cameron & Lewis,
Solicitors of Patents,
Washington, D.C.

Charlottetown, P.E.I., July 5, 1908---Please send some one to Hammondsport, N.Y. at once at my expense to examine the aerodrome of the Aerial Experiment Association which has just won the Scientific American Trophy for heavier-than-air machines. We want to know what patentable features there may be about the machine. See Mr. Curtiss and report by mail to me at Baddeck, Nova Scotia. Take Lackawana or Erie train to Bath; local from there to Hammondsport.

(Signed) Graham Bell.

To G. H. Curtiss,
Hammondsport, N.Y.

Charlottetown, P.E.I. July 5, 1908---I have telegraphed Mauro, Cameron and Lewis of Washington to send patent expert to Hammondsport to examine "June Bug" and report to me what patentable features there may be about machine. Ask members of Association to give him every assistance. Accept our heartiest congratulations upon your magnificent success.

(Signed) Graham Bell.

To J.A.D. McCurdy,
Hammondsport, N.Y.

Charlottetown, P.E.I., July 5, 1908---Thanks for telegrams. I recommend postponing further experiments until machine has been examined by patent expert. Important to keep machine uninjured until then. Just off for Baddeck.

(Signed Graham Bell.

To Aerial Experiment Association,
Hammondsport, N.Y.

Pictou, N.S., July 6, 1908---If McCurdy wishes to follow on line of "June Bug", I recommend that McCurdy's machine be now built at Hammondsport and headquarters be retained there for the present. In meantime don't run any risk of injuring "June Bug" until an application for a patent has been prepared. Would like Baldwin to help me in Baddeck soon as possible, and when we are ready for motor would like all to come to Baddeck. If these plans are acceptable would simply let it be known that at my request further trials of "June Bug" will be postponed until another aerodrome has been completed so that in case of accident to one machine another will be available for experiments. Would say nothing about patents outside as this would only stir up other inventors to forestall us in the patent office. Telegraph reply to Baddeck.

(Signed) Graham Bell.

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

Hammondsport, N.Y., July 7, 1908---Meeting held on receipt of telegram. Decided to follow your suggestion, which was in accordance with McCurdy's decision. Casey and wife start North in a day or so.

(Signed) T. Selfridge.

To Aerial Experiment Association,
Hammondsport, N.Y.

Baddeck, N.S., July 7, 1908.---Thanks for telegram. Please write and telegraph Mauro, Cameron and Lewis, Washington, D.C. to send representative to Hammondsport if he has not yet appeared, and request representative to prepare an application for a patent at my expense. I will confirm matter by letter from here. Baldwin should not leave Hammondsport until he has given the patent expert what information he may desire concerning machines made in Hammondsport. First Bulletin of Association will be issued from here, Monday July 13, giving you full information as to what we are doing here. Please ask each member to write to me full account of what he is doing in Hammondsport, the information to be incorporated in succeeding Bulletins to be issued every week. In this way we can keep in touch with one another and incidentally secure written records of thoughts, ideas, and work done. Trouble will be saved here by sending six copies of any drawings or photographs illustrating letters.

(Signed) Graham Bell.

LIST OF PAPERS PRESENTED MAY 17, 1908.

The following papers were read at a meeting of the Aerial Experiment Association held at the headquarters in Hammondsport, N.Y., May 17, 1908:-

Papers 1,2, and 4 will appear in subsequent Bulletins.

Nos. 3,5,6, and 7 appear in the present issue. A.G.B.

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PLANS FOR AN IMPROVED MOTOR FOR FLYING MACHINES: by G.H. Curtiss.

(Read May 17, 1908).

While extremely light motors may not be absolutely necessary in order to make a successful heavier-than-air machine, it stands to reason that a light motor of equal strength and reliability would be of great advantage. Other parts of the flying machine could be made heavier or could carry more load in the shape of freight or fuel.

The motors made by the Curtiss Company up to date have been the outgrowth of the cycle motor, and while they give as great power per pound weight as any motors which are now built for the trade, a much lighter motor of equal power can be built.

In designing such a new motor, we may consider first the system of cooling the cylinders. For aeronautical purposes, it is evident that the air cooled engine has many advantages. The weight of the water and radiators alone is objectionable, then there is danger of leakage where light construction is used. It would be impracticable to carry a large supply of water where if air could be utilized, a supply is always at hand. I am satisfied that cylinders up to 3 5/8 inches in diameter can be satisfactorily cooled with air. the power of the engine is therefore limited only to the number of cylinders.

The type of multi-cylinder generally adopted is that of our eight cylinder engine which consists of two sets of four cylinders on the sane case at an angle of 90 degrees.

This construction gives perfect balance and good results generally. There is only one form in which anywhere near as many cylinders can be assembled with as little crank-case and shaft weight, and that is placing the cylinders in the form of a star with all the connecting rods attached to a single crank. With this construction, both the crank-shaft and crank-pin can be run upon roller bearings which will add about ten per cent to the power of the engine, and do away with three-fourths of the crank-case and crank-shaft weight found in the eight cylinder "V" type.

The two disadvantages of this type of engine are the difficulty of operating valves and lubricating the cylinders and bearings. The latter may be managed by forcing the oil through the shaft and connecting rods and feeding direct to each cylinder. Naturally the cylinder, or cylinders pointing down would get too much oil. While there is practically no way of preventing this, the trouble of fouling the plugs may be prevented by placing them in the sides of the cylinder and the exhaust valve in the end. The surplus oil which goes in these cylinders would then be blown out with the exhaust. The placing of the valves in the head would also help out greatly in the cooling of the cylinders, and a blast of air blown crosswise would keep them sufficiently cool to allow its being run continually. The overheating of the exhaust valve can be prevented by using the same valve on the intake stroke, the in-rushing gas keeping it cool.

I believe that we can build a 35 horse-power engine of seven cylinders 3 1/2 x 4 placed at equal distances apart around a crank, each cylinder fitted with a single valve in the head; the gasoline being fed mechanically to each cylinder, at a weight of approximately 75 pounds, and would stand up and give full power for ten hours running.

The following sketch shows the general design of such a motor. The explosions take place in rotation as follows:- 1-3-5-7-2-4-6, making perfect balance and constant torque.

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A QUERY CONCERNING THE NATURE OF THE TORQUE PRODUCED BY TWIN PROPELLERS ROTATING IN THE SAME DIRECTION: by J.A.D. McCurdy.

(Read May 17, 1908).

Through the agency of the "Proceedings of the A.E.A." I would like to present a few thoughts concerning the torque produced in an aeroplane by the action of its propeller, or propellers and to enquire if there is perhaps a corellation between the action of double propellers rotating in the same direction, and the action produced in a kite composed of tetrahedral cells when struck diagonally by a gust of wind.

It is quite evident that a single propeller driven direct produces a torque and tends to revolve the machine in the opposite direction to which the propeller turns.

This torque may or may not affect the steadiness of the machine while in flight, but it is certain that if the torque were zero one of the elements which tend to tip the machine laterally would be eliminated.

Now let us consider the action of two propellers rotating in oposite directions but in the same plane. By analysing the forces produced by the torque of these propellers and by taking moments of these four forces about the axis of the machine, we find that the resultant is zero, hence no resultant torque is produced in the aeroplane.

Now let us consider the third case of the two propellers rotating in the same plane, but in the same direction. If there were no resultant torque produced in this case, we can readily see the advantage of using this combination for trasmition would be reduced to a minimum. By assuming a few arbitrary figures and applying them to a graphical diagram we can perhaps see the reasoning more clearly.

Let us choose 8 ft. propellers centered 10 ft. apart. Suppose for simplicity that the torque produced by each propeller is 240 foot pounds. That we could represent by 30 lbs., acting at the circumference of the blades. This gives us two sets of forces which we can combine into two separate couples.

The magnitude of one couple would be 30 x 18 = 540 ft. lbs., acting negatively. The magnitude of the other couple would be 30 x 2 = 60 ft. lbs., acting positively. By taking the difference of these two couples, we obtain a resultant of 540-60 = 480 ft. lbs., acting negatively, or in the direction opposite to the motion of the hands of a watch. This means that a resultant torque is produced in the aeroplane having a magnitude of 480 ft. lbs., acting positively.

Now is the reasoning employed here applicable to the condition existing in a tetrahedral kite when struck by a diagonal gust of wind, supposing the cells to be miniature propellers rotating in the same direction? If so would there not be a tendency to upset?

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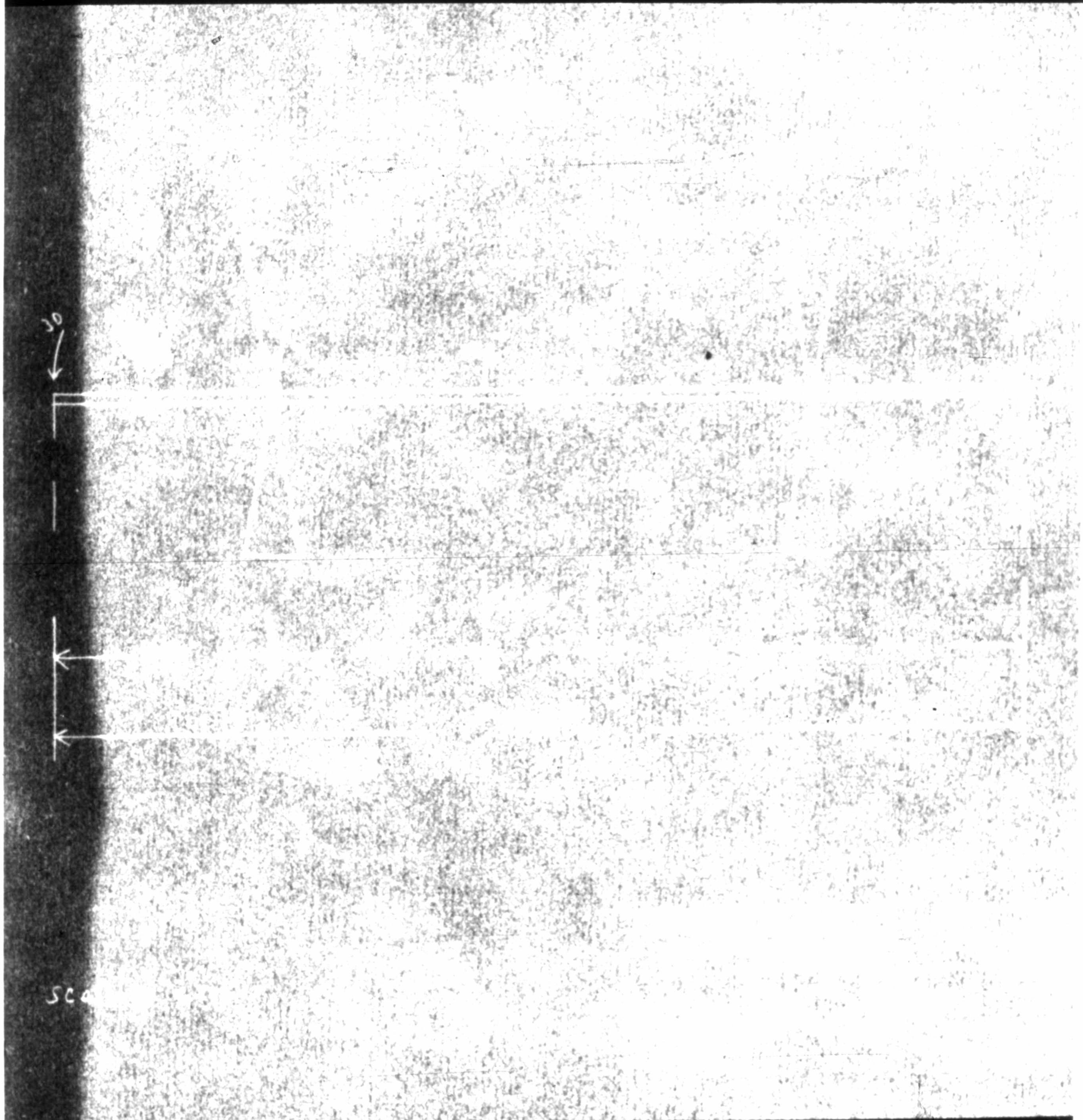
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SOME THOUGHTS CONCERNING THE EFFECTS OF ATMOSPHERIC PRESSURE UPON AEROPLANES: by Alexander Graham Bell.

(Read May 17, 1908)

In considering the action of moving air upon the surfaces of inclined aeroplanes, we should not lose sight of the fact that air exerts a statical pressure, due to the weight of the atmosphere as well as a dynamical pressure due to its own motion.

Calculation shows that a very slight diminuition of atmospheric pressure on the upper surface of an aeroplane, or a very slight increase of static pressure on the under surface, would cause a lifting force to be exerted on the aeroplane equalling, if not exceeding the lift produced by a violent wind. This fact has so important a bearing on the theory of the aeroplane that it may be well to elaborate the point.

The weight of the atmosphere exerts a pressure of about fifteen pounds upon every square inch of surface; or, in other words, atmospheric pressure exerts, upon an aeroplane a pressure of about 2160 pounds per square foot of surface.

We are apt to ignore this pressure, enormous as it is, because when an aeroplane is at rest, atmospheric pressure on the upper surface is balanced by an equal pressure from below.

The case, however, is materially different when the aeroplane moves forward or when the wind blows upon the under sura surface of an inclined aeroplane, for the air is then condensed below and rarefied above, so that the equilibrium of statical pressure is disturbed.

I shall not attempt to discuss the extent to which the equilibrium is disturbed, or whether the effect extends over the whole of both surfaces of the aeroplane, or only over parts of them. I shall simply show that a very slight disturbance in the equilibrium of statical pressure will materially affect the lift.

The atmosphere presses downwards upon the aeroplane with a force of 2160 pounds upon every square foot of surface. It also presses upwards with an equal force. If then, the atmospheric pressure acting upon the upper surface should be reduced by only 1/2160th part, the pressure on the under surface remaining unchanged, a lift would be produced equivalent to one pound per square foot of surface.

How slight a change of atmospheric pressure this means will be appreciated when we try to measure it by the movement of a mercury column. At normal pressure, the mercury stands at a height of about 30 inches. The rarefaction then required to produce a lift of one pound per square foot, would cause the mercury to fall 1/2160th of 30 inches, or 1/72 of an inch, an amount too small to be readily perceived: But if we assume that the statical pressure is increased below the aeroplane as well as diminished above, and to an equal extent, the movement of the mercury column would only be one half of the above amount. That is:- In order to produce a lift of one pound per square foot, the rarefaction above the aeroplane would be represented by a fall in the height of the mercury column of 1/144th of an inch, and the condensation below, by a rise of equal amount.

Thus, a difference of atmospheric pressure on the two sides of an aeroplane of so slight an amount as to be practically imperceptible when measured by a mercury column would result in an unbalanced statical pressure upon the aeroplane of the same order of magnitude as the dynamical pressures with which we are accustomed to deal. From this I draw the conclusion that all theories of aeroplane action that ignore the effects of atmospheric pressure must be grossly in error.

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SUGGESTIONS REGARDING THE CONSTRUCTION OF LIGHT MOTORS FOR USE IN FLYING MACHINES; by Alexander Graham Bell.

(Read May 17, 1908)

An arch of bricks quite strong enough to carry a railroad train, if turned upside down and supported by its two extremities would probably break in pieces from its own weight, for, under such circumstances its resisting power would depend upon the cohesive strength of the mortar employed, and not upon the strength of the bricks. In its normal position the character of the cementing material is of comparatively slight importance and the bricks might even hold together without any mortar at all.

In a similar manner a hollow cylinder of any material is better adapted to withstand a pressure from without than from within on account of its circular or arched cross-section. A compressional force applied from without tends to push the parts of the cylinder more firmly together; whereas a bursting pressure from within tends to separate the parts from one another and they are only kept in place by the force of cohesion which cements them together. External pressure thus tends to bring into play the full resisting strength of the material of the cylinder, the strength of the elemental "bricks", so to speak, of which it is composed whereas internal pressures are only resisted by the "mortar".

A cylinder composed of material just strong enough and no more, to resist the crushing effect of the atmosphere when all the air is removed from within, would evidently burst under an internal pressure of one atmosphere. In order to resist such a strain from within it would be necessary to strengthen the walls of the retaining chambers by using thicker and therefore heavier material.

Now lightness of construction is a great desideratum in a motor intedned for use in a flying machine; and the above consideration suggests the thought that a motor utilizing atmospheric pressure as a motive power could be constructed of thinner and lighter material than would be possible in the case of a motor employing the expansive power of a confined gas. So far as power is concerned it matters not whetehr the operative pressure comes from without or within, for in both cases the operative power depends simply upon the difference between the external and internal pressures. So far as weight is concerned, however, it makes all the difference in the world.

Some objections of course immediately obtrude themselves, but I do not think they are insuperable by any means: In utilising atmospheric pressure as a motive power we are limited to a single atmosphereof pressure, whereas we may have two or more atmospheres of pressure within our cylinder if we make it strong enough to resist the strain. Through the expansive power of a confined gas we can certainly obtain greater intensity of action than would be possible where atmospheric pressure is employed.

Perhaps, however, two cylinders each operating under a single atmosphere of pressure may be able to do the work of one cylinder at two atmospheres, and quantity may be made the equivalent of intensity.

Here the question arises: Can the two weaker cylinders be made to weigh less than the single, stronger cylinder required to stand the greater strain? I think there can be no doubt about it.

A cylinder, to resist a bursting pressure of one atmosphere, must evidently be made of heavier material than one calculated to resist the same strain from without; and its strength, and therefore weight, must probably be doubled to enable it to resist a two-fold strain. If this is so the thicker and stronger cyli der will weigh more than both of the weaker cylinders combined.

Where we reduce the weight of an engine to the minimum consistent with the proper exhibition of power accidents are always liable to arise, because we approach the limit of strength of the material employed. Excessive internal pressure may cause the cylinder to explode, but excessive atmospheric pressure would only crush it in without any risk of injury to the aviator.

I commend this whole subject to the serious attention of Mr. G. H. Curtiss, as opening up a promising line of enquiry that may lead to the discovery of a lighter and sfaer motor than has hitherto been produced for use in flying machines.

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WORK OF BEINN BHREAGH LABORATORY.

Report by Wm. F. Bedwin, Supt.

Laboratory opened May 25, 1908. First work started was to repair the old empty Frost-King kite, and also repair the Ring-Kite made last year. A photograph of the latter is shown on p. 33.

The stock for racing hulls for the new catamaran structure arrived on June 6, and on June 8 we laid the first keel. The two hulls are now nearly ready to be connected together with deck for support of the launching device. Both hulls are now in the condition of the one shown in the photograph on p. 32.

We have finished assembling a bank of 1992 winged cells ready for incorporation into the new tetrahedral aerodrome Size 60 cells on top, 8 cells high, and 8 cells deep. the upper photograph on p. 33 shows this bank of cells upside down on the floor of the aerdrome shed in the position in which it was put together.

We have made three kites of tetrahedral construction which are now completed and ready to fly. Two are duplicates of kites used in Hammondsport; and the third is of similar sh shape and size, but made in three sections so as to have a hollow interior. Photographs of these kites, A,B,C, rae shown on pp 34, 35, 36.

Kite A p. 34, of full tetrahedral construction, contains 408 winged cells.

Weight 9036 gms.
Surface 22 sq. m (Oblique)
Ratio 411 gms. per sq. m (Oblique).

Kite B p. 35, of skeleton construction, contains 253 winged cells, and 155 empty cells.

Weight 8576 gms.
Surface 13.7 sq. m (oblique).
Ratio 626 gms. per sq. m (oblique).

Kite C, p. 36, of sectional construction contains 340 winged cells.

Weight 8766 gms.
Surface 18.4 sq. m (oblique).
Ratio 476 gms. per sq. m (oblique).

We have under construction and about three-fourths completed, 100 triangles, each having a side of 50 cm., to be assembled in pairs to make 50 cm. cells. These are covered with nainsook stretched tightly and cemented to frames with gutta-percha tissue. The frames are similar to those used in the triangular gliding models employed in the kite house last year.

Stock on hand: We have laid in a good stock of Cygnet beading; also of aluminum in the form of tubing, sheets, bars, and wires. We have now on hand 12300 empty tetrahedral cells and 2200 winged cells made here during the past winter, besides 5000 winged cells left over from last year.

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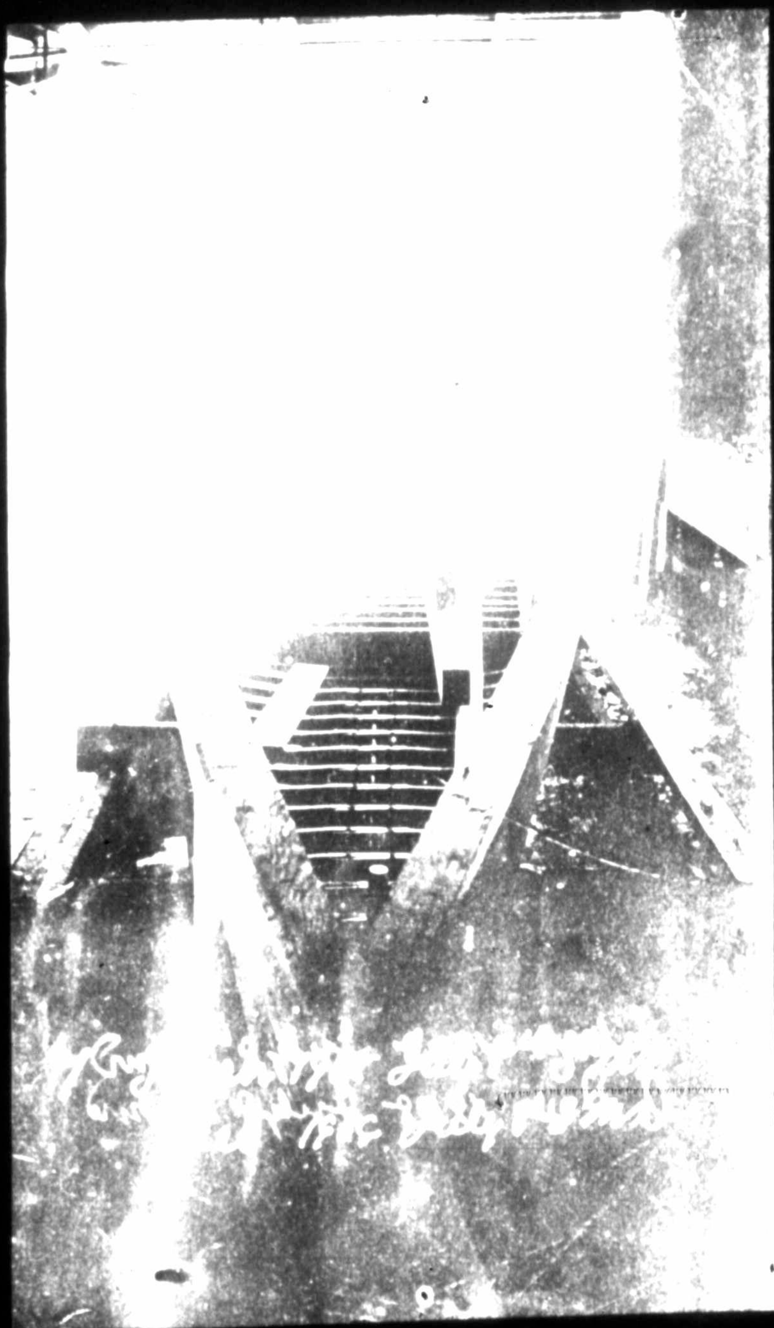
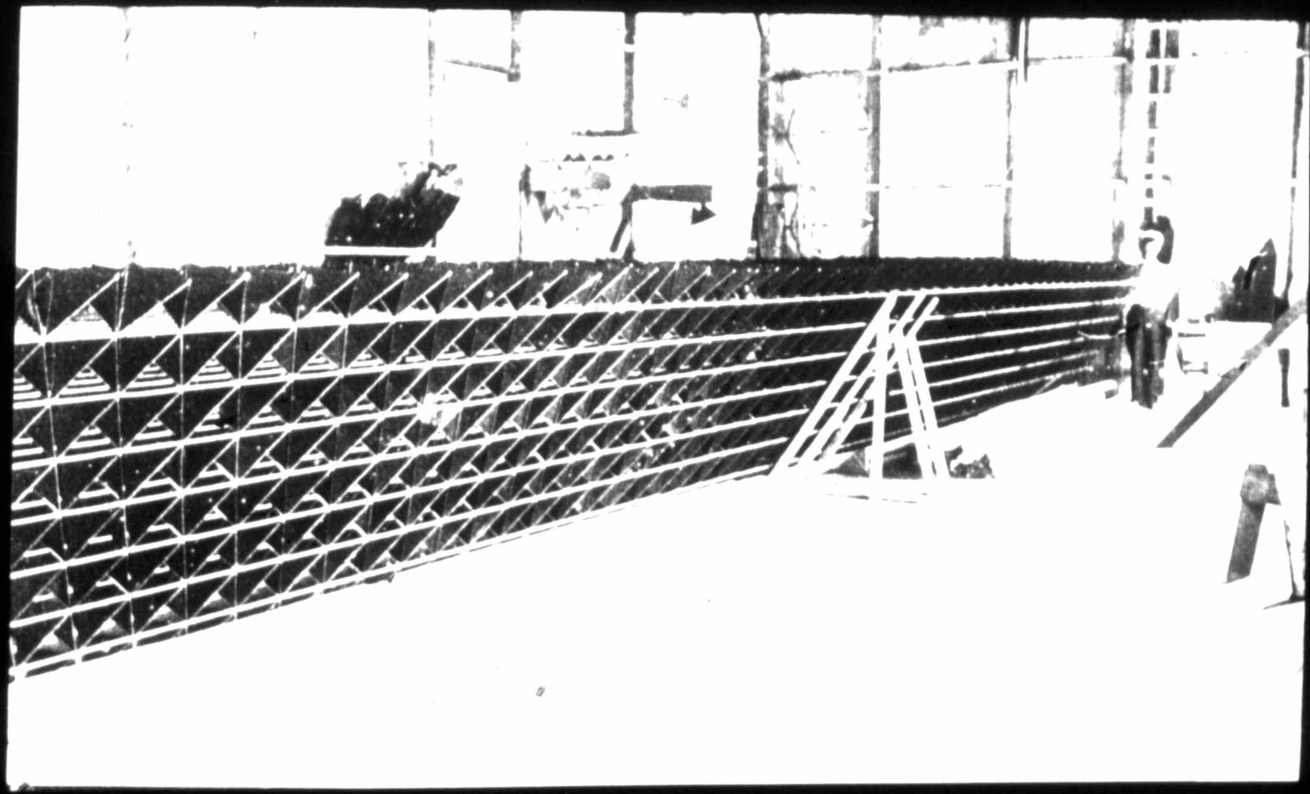
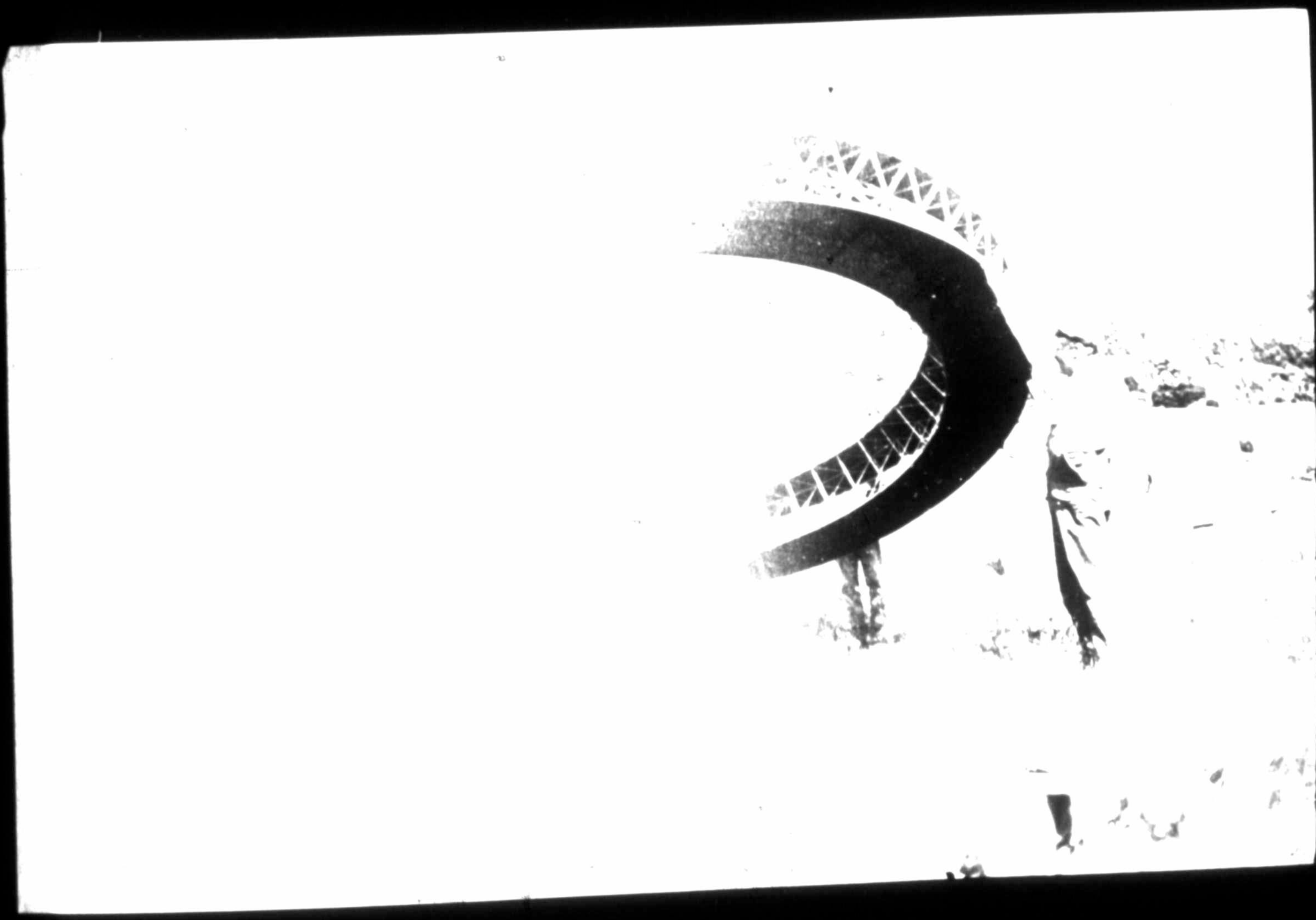
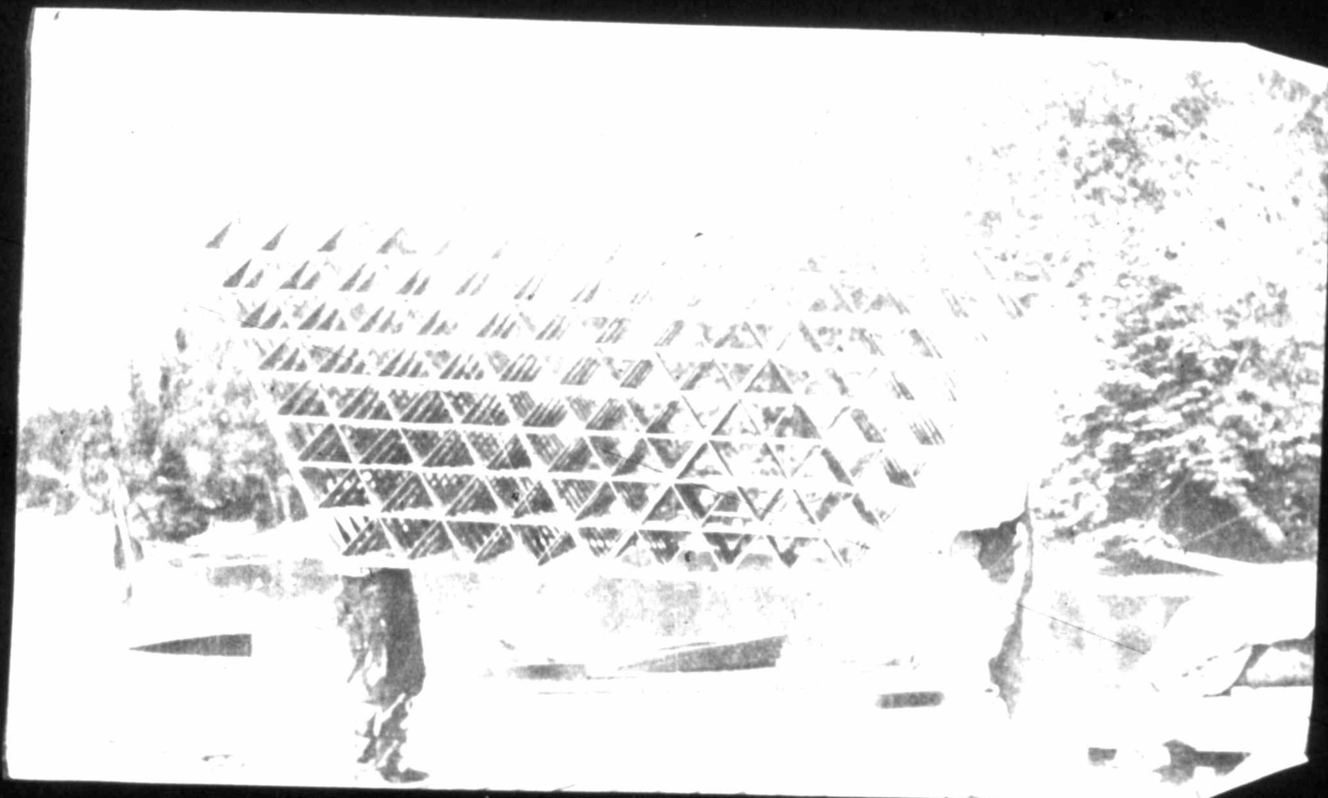
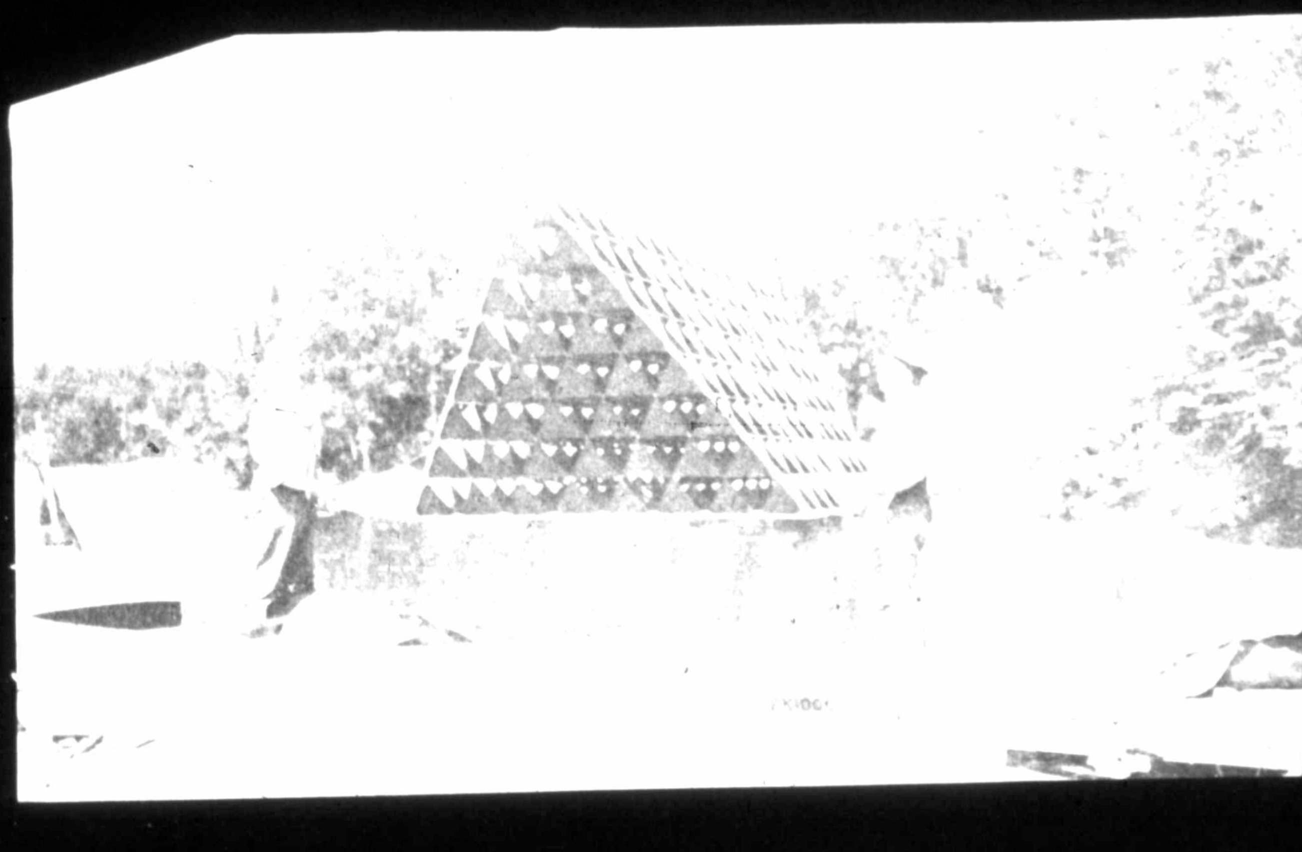




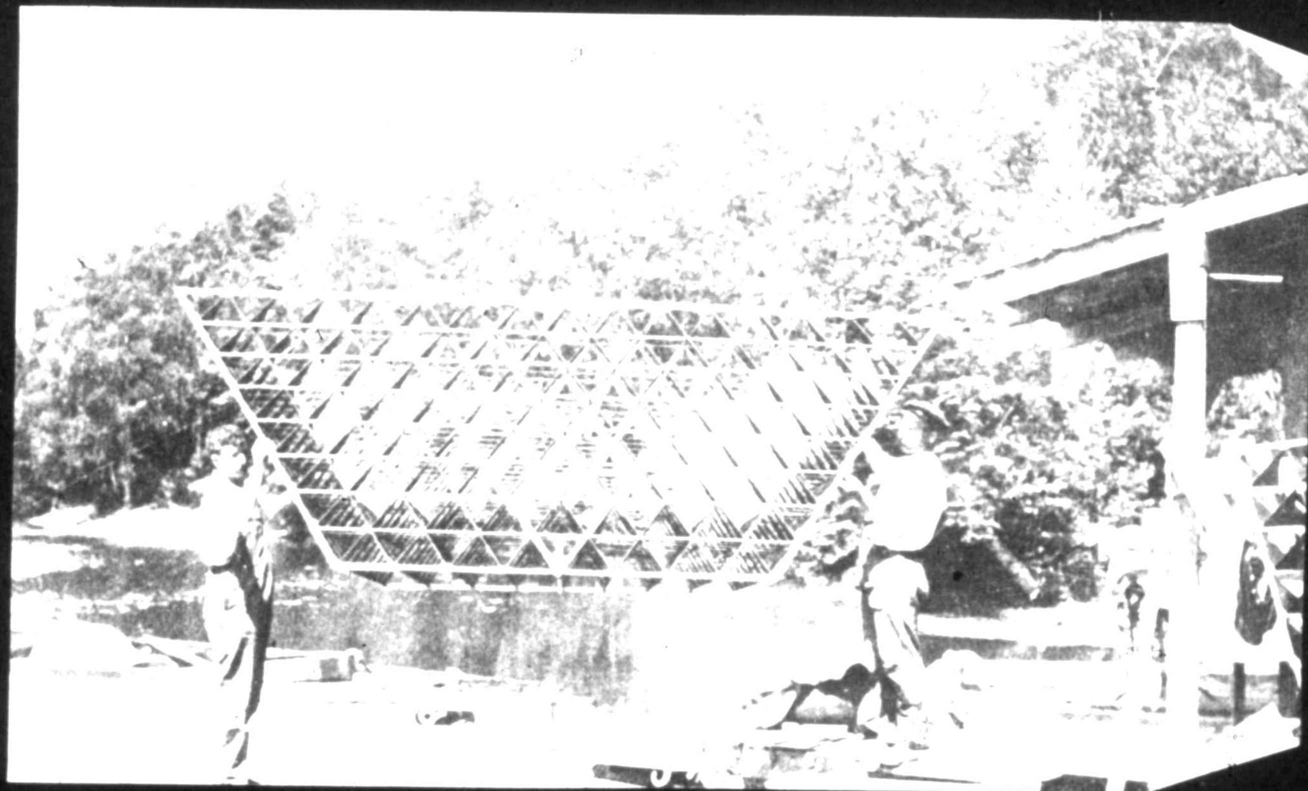


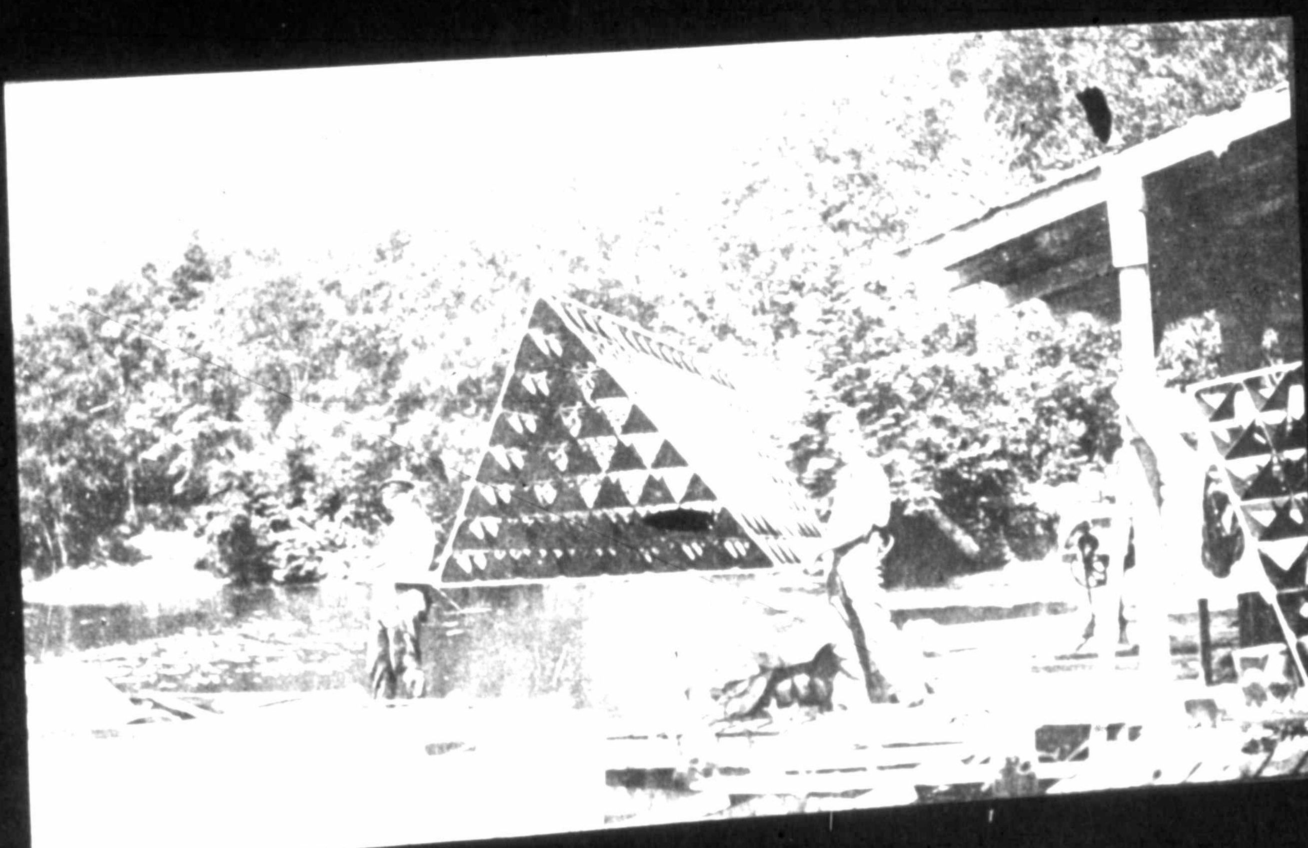
KIEE A.

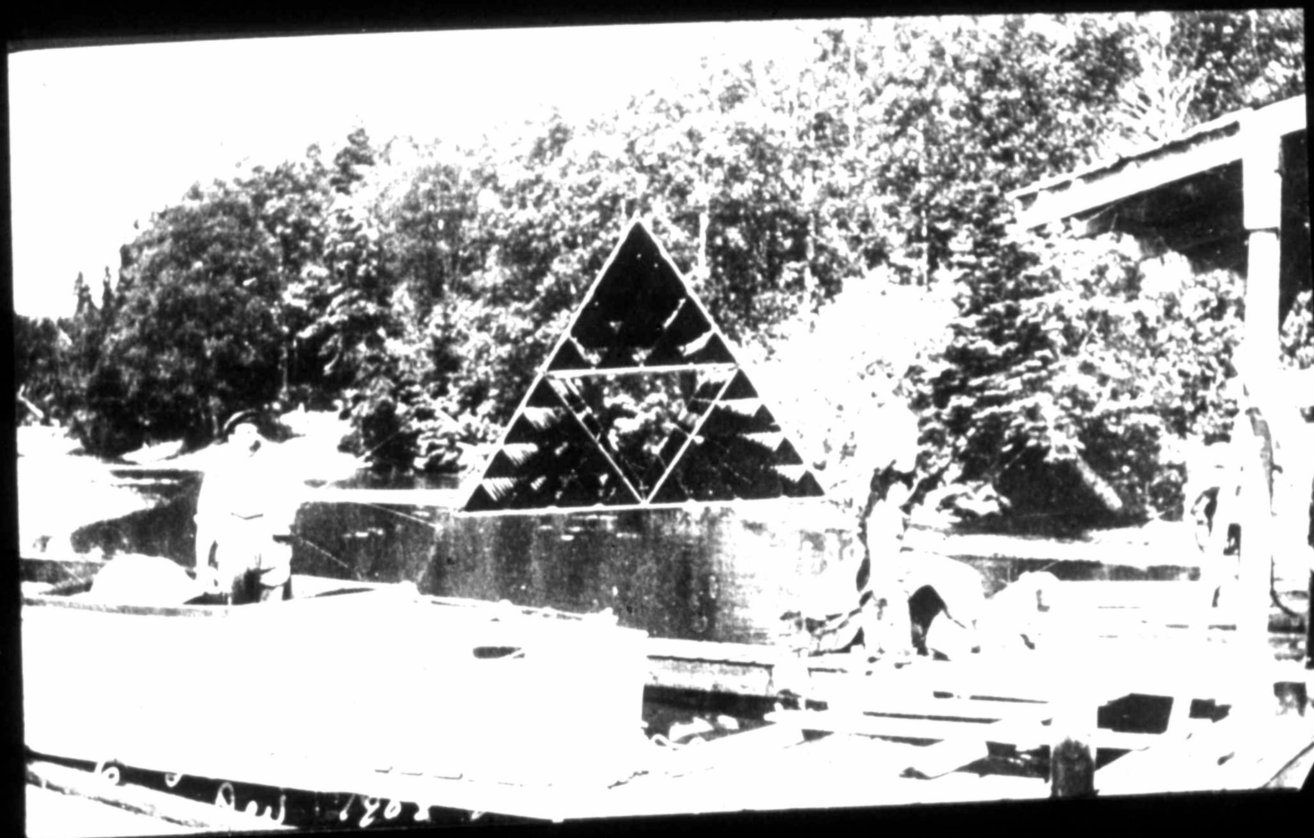


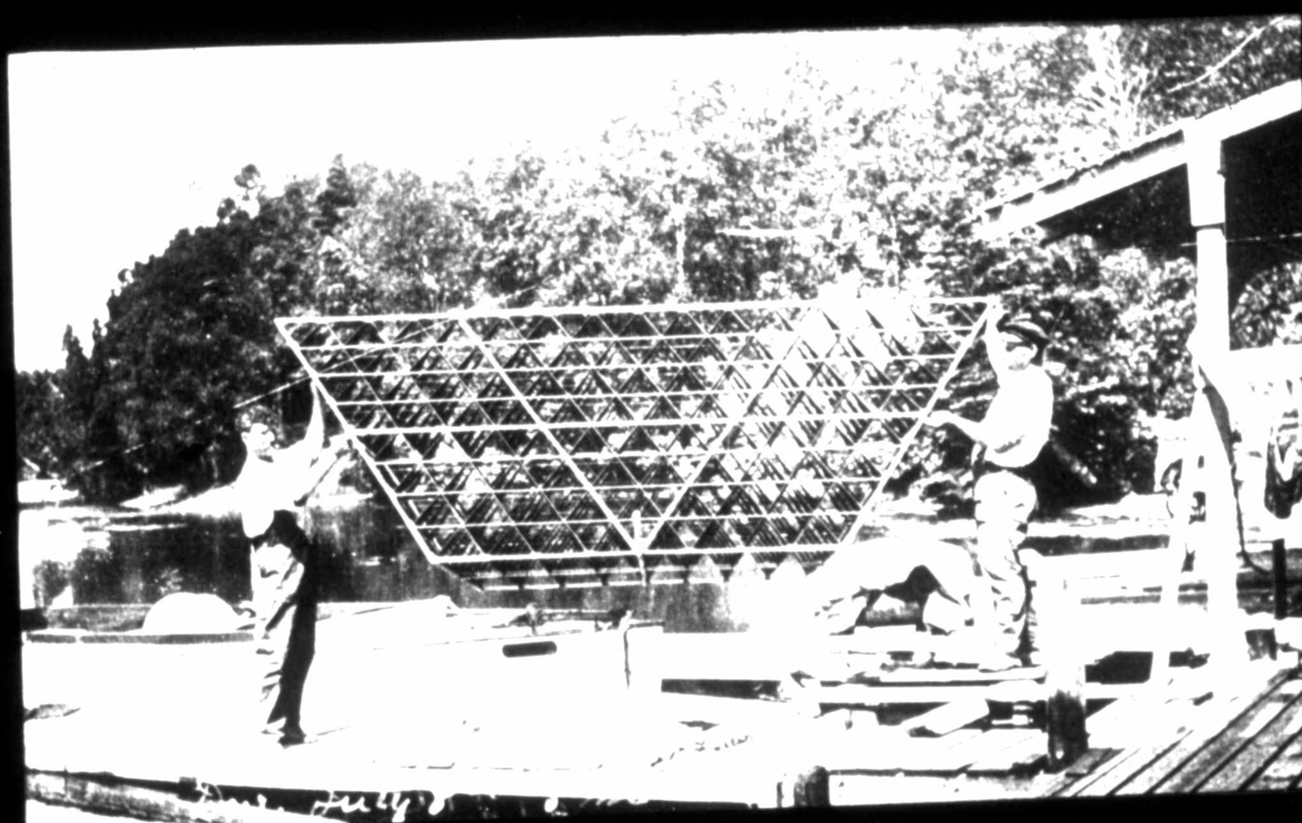


KITE B.









TRIAL OF THE RING-KITE.

July 7, 1908.

The Ring-Kite shown in photograph on p. 33 was tried on Tuesday July 7, flown by line attached to the front edge of the lower aeroplane. What little wind there was came from about N.E., blowing down the mountain towards the Bay, maximum velocity estimated at about 5 miles an hour. This wind was sufficient to support the kite in the air although the p point of attachment of the flying-line was as far forward as possible; and the kite seemed to fly very steadily.

The point of attachment was then shifted successively further back towards the rear edge of the front aeroplane. The kite then flew at a greater elevation, but developed a tendency to slide to one side off the wind. Whether this was due to the fact that horizontal surfaces were alone employed, or to a slight distortion of the kite produced by the breaking of a few cell-sticks is not yet certainly known.

The upper and lower aeroplane rings had been rather heavily beaded on their outer and inner edges, but no beading had been provided extending from the lower to the upper aeroplane, so that breaking strains upon landing were resisted only by the light cell-sticks.

In order to enable the above experiment to be made a few stout sticks were fastened in front where the flying-line was attached connecting the lower and upper surfaces, and a short keel stick was added, so that the kite was somewhat head-heavy.

Upon landing after the first experiment a few cell-sticks were broken on one side where the superposed aeroplanes were not connected by beading. The subsequent trials were made without repairing this damage, although there was a visible distortion of the kite.

RING-KITE.

Weight 8626 gms.
Surface 11 sq. m (horizontal).
Ratio 784 gms. per sq. m (horizontal).

The photograph on p. 39, made by Mr. Grosvenor shows the Ring-Kite in the air. A.G.B.

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