Ornithopter Modeler Society Newsletter

SUMMER 1985

flapper facts

Volume II Number III J.Patrick Deshaye, Ed.

WHERE'S THE PLANS?

Anyone acquainted with the Facts is going to wonder why the newsletter is so late, so long on words and so short on plans. Well, it's growing pains, I guess... We have our charter, you've paid your membership dues, you expect results-- then you don't send me any plans or articles! We must rid ourselves of this mentality that makes us sit back and expect something from everyone else once we've paid or money. The only way to fill up this newsletter with exciting stuf is by contributing plans and articles to it; diverse and controversial stuf especially... Typewritten, 8 1/2x11 inches, single-spaced, one or two pages. Now, I know I may have scared some of you away with my strict enforcement of the submissions format, but when we end up with a newsletter like this one where the bulk of the submissions come from the club officers who are already up to their ears in... Well, you get the picture. Please remember that the submissions format allows everyone a voice in the club newsletter, okay?

Now, why so late? Because the President (Frank) and the Editor (me) have been working bleary-eyed on the OMS Ornithopter Design Manual, fully illustrated, which will be sent to members free. It will be the first of its kind, easy to revise and probably be immensely useful to people who are just starting out and haven't got a clue. It could really build up the club kitty if we sell it to non-members at about three bucks a throw. All illustrations are completed and the text is now in dot-matrix printout form.

This newsletter is excessively wordy because tons of negotiating and paper-shuffling had to go through to get where we are. Some exposure to this will let you know that the club leadership has been working in yourbest interest.

True, Pat

IN THIS ISSUE:

The Ornithopter Postal Contest is definitely on. Read more about Paul (though he is no longer on our list, we apparently are still on his) MacCready's efforts. Read about how little flapper modeling has changed in over 100 years. For something really weird, we have our President's canard bipe plans, which are worth six minutes. Not bad for something so... so... weird. Also included is the third in a series of mysterious Japanese plans submitted by W. Williams: a flapper-propulsion device which porpoise-tails its way through the air...

PHOTO FOR THOUGHT

That's new member Robert Knutson holding an engine-powered ornithopter, perhaps forty years ago. He has told the Whites that, while it "didn't fly worth a darn," it was still a lot of fun. Look upon this as an invitation, Mr. Knutson, to submit an article on how you got those wings to flap.

REPORT OF THE SECRETARY TO ALL OTHER OFFICERS OF THE OMS

First, I must apologize to each and every one of you that this report is so long in coming, and I hope each of you will understand and sympathize that with the advent of warm weather, who really wants to stay inside and type letters. I do that all day and the outdoors beckons when the weather is as beautiful as it has been in Catawissa. Sorry guys, will try to do better for the next report, as long as it isn't due until we have about ten inches of snow on the ground.

First order of business: The Club Charter has been received from the AMA and will be forwarded to President Frank Kieser, along with a copy of this letter and the membership list. Each of you will also receive your Club chevron for the office you hold. Our members now number 30 and thanks to Bob Meuser,with his plug in Model Aviation, we got a couple who hadn't been on the list before. Quite a few on the original list did not respond, and should have by now, and I don't know the reason. Cost sure can't be the factor, $7.00 doesn't seem all that high. Maybe the interest just wasn't there to begin with.

The finances of the club are not in too bad a shape considering we only have 30 members. Total intake for membership was $226.00, of course, a few contributed more than the $7.00 required for membership to get the ball rolling, and we really appreciate the extra income. Thank you. Expenses were for postage and printing for our newsletter and the fee to the AMA for the Charter. We have a balance of approximately $182.00.

Roy has talked to Frank about the postal contest and at that this point, I really don't know where it stands. We really should get one rolling, but the problem being, what prizes are to be awarded. The Treasury of the Club really couldn't stand any big prizes at this point. ANY SUGGESTIONS WILL BE WELCOME AND HEARTILY RECEIVED!!!!! AND APPRECIATED.

Also, as to the postal contest, how about some thoughts on the categories, such as , Do we have different ceiling categories, bi-plane, cunard and single wing? Come on guys, lets have some correspondence along these lines and let us know what you're thinking out there. It's your club and lets have some conversation, even if it be by mail.

As you can tell from the membership list, we cover just about every section of the U.S., with members also in Canada and England. We may have more members coming with the possible publication of an article in Flying Models by Larry Kruse. Roy and I met Larry in Oklahoma City this past March at a contest sponsored by Bill Baker's club. Larry is sharing honors with Dave Lindstrum in the indoor column and wants to do an article on ornithopters. I'm sure Larry will give the club a boost in the column.

Dated, May 10, 1985.

Shirley A. White
Secretary, OMS
Rt. 1 - Box 241
Catawissa, MO 63015

AeroVironment Inc.

NEWSLETTER NUMBER 3

QUETZALCOATLUS NORTHROPI REPLICA

May 1985

The attached paper, "The QN™REPLICA -- THE TIME TRAVELER" is a preliminary version of an article prepared for this year's National Air and Space Museum research report document. The paper gives a review of the background, development activity and plans of the Quetzalcoatlus northropi project, and so serves as the main part of this newsletter.

Newsletter #1, June 1984, announced the project; Newsletter #2, July 1984, summarized results of the workshop at CalTech July 1985; a press release and a technical report accompanied the press conference given December 5, 1984, at the National Air and Space Museum; and a press release went out April 1985 from NASM announcing that Johnson Wax (S.C. Johnson & Son, Inc., Racine, Wisconsin) had agreed to provide the major funding support.

There have been many articles about the project in newspapers and magazines. There has also been wide coverage by radio and TV. A ten minute "Videolog" segment has been shown a number of times by Channel 28, the PBS station in Los Angeles. This segment treated the project background and model testing with an appropriate amount of perspective and humor. Project information can be obtained most readily from Rita Cipalla, Office of Public Affairs, Smithsonian Institution's National Air and Space Museum, Washington, D.C. 20560, (202) 357-1552. Here at AeroVironment we refer inquiries to the Smithsonian so that at this stage we can concentrate on the technical aspects of the work.

The project is in the middle of an intensive developmental stage wherein results are hard to convey. The most important work is developing technologies in three areas: 1) the structure, especially the wings, neck, and head, 2) the mechanisms for wing flapping and control, and 3) the aerodynamics and autopilot details for providing stability and control. In each area the work combines considerable theory with actual constructions and tests. The constructions focus primarily on solving critical problems, and so do not look like pterodactyls except that an 18' span version is nearing flight status. This 18' model has the appropriate shape and, while being only half the size of Quetzalcoatlus northropi, is representative of the smaller related Quezalcoaltus sp. (we call it QS). The initial goal of QS is to work out problems in yaw control (via head turning, manipulations of the fingers out on the wings to cause drag, and wing twist) and launch (via an electric winch pulling up a stabilized carrier on which QN rests). Once satisfactory stability and control are achieved during glide, the final wings with flapping and full articulation will be added.

The signal for yaw control is derived from a combination of yaw angle (for the present monitored by an angle-sensing vane) and yaw rate (from a rate-of-turn sensing gyro). The yaw control obtainable from head and hand movements has been found adequate during tests of QS mounted on a vertical-axis swivel mounted on a van and driven at air speeds up to 50 mph, and further testing may show the hand movements to be unnecessary. The signal for pitch control is derived from similar angle and rate sensors operating about the pitch axis. Pitch control is then to be achieved by wing sweep, as already demonstrated on some smaller models, although on initial flights QS will glide with a fixed wing having flaps and ailerons.

(over)

825 Myrtle Avenue
Monrovia, California 91016-3424
818/357-9983

The wing structure uses carbon fiber and foam, with latex covering. The developmental test panels have exhibited excellent strength and flexibility, are becoming easier and easier to build, and, when painted, are turning out to look very "biological."

For landing, QS glides (gently) down to land on a skid on its stomach. The head is tilted upward just before touchdown so if QS pitches forward upon contacting the ground the rounded and ruggedized front of the neck coasts along the ground, protecting the vulnerable head and its actuating mechanism.

As for the wing articulation, the spar exits the body through a universal joint, like an oar. The end inside the body is spring-balanced against gravity load and manipulated by servos to provide up and down and fore and aft motion. Another servo rotates a tube which twists the outer portion of the wing. The relative motion of the various servos will be controlled by an onboard computer responding to onboard sensors and radio commands from the ground.

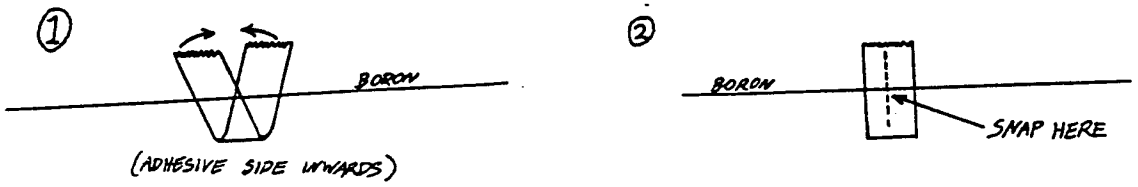
The project is supporting Dr. Wann Langston to examine the structures of his Quetzalcoatlus fossils, including making casts of joints, to provide more insight about shapes and articulations. He and Dr. Kevin Padian are interacting with a project artist/biologist Gregory Paul to provide the best possible sketches of the appearance of the creature.

Paul B. MacCready
Program Director
President, AeroVironment Inc.

BORON HAZARDS

Like many other Indoor modellers, I have recently been using boron fibres in models, and have noticed a safety problem. With diverse cutting methods tried (shearing, scoring, snapping), tiny shards of boron are invariably produced. Some of these fragments are barely visible, yet are potentially hazardous. Boron is highly toxic, despite being fairly inert, and such fragments can painlessly pass into the skin. Should they pass into the bloodstream they could end up lodging in vital organs, with results that are better imagined than described.

I have devised a method of cutting boron that should be safe, and have presented it here for discussion and possible adoption. Better suggestions are most welcome! At the point where I wish to cut the boron it is enclosed in a small piece of clear tape, like this:



The boron is then snapped inside the tape (sketch 2), and the ends withdrawn. One small fragment of boron will then be found trapped inside the tape; dispose of carefully. Don't squeeze the ends of the tape together too hard, or you will have trouble removing the ends of the boron.

Philip Watson
March 5, 1985

Ornithopter Model Society

1985-1986 Postal Contest Regulations

1) **Event definition**: An ornithopter is a freely flying model aircraft which derives its lift and propulsion primarily from flapping its wings.
   - Flights must be made indoors and launched within two meters of the floor.
   - The total supporting surface must not exceed 1500 square centimeters. The supporting surface includes all surfaces used to obtain lift of pitch control. Areas are measured by traces around surfaces. The sum of the areas of any fixed supporting surfaces must not exceed one-half the area of the flapping surfaces.
   - The model must be powered by strands of extensible rubber only. There is no restriction on the weight of the model, or on the weight of the rubber which is used.

2) The contest will be judged on the maximum duration of a single flight. To compensate for the handicap of ceilings between 20 and 100 feet, flights durations in those ceilings will be multiplied by a factor $k = \sqrt{(100 / c)}$. Above 100 feet there is no correction. There is no limit on the number of flights which may be attempted. Flights are to be recorded to the nearest second, disregarding any fraction.

3) Flights may, at the discretion of a local Contest Director, be made at any contest or record trial sanctioned by the AMA or other national organization, or organized by any local club.

4) In the event of any doubtful situation, the judgement of the Contest Director will be applied. Ultimate authority rests with the Event Director.

5) Entries: There is no entry fee for members of the OMS. Entry for non-members is $5, except that the fee is waived for entrants not resident in North America. A complete entry consists of:
   i. The entrant's name and address, the date and place of the flight, and indication of the ceiling height under which the flight was made.
   ii. A scale three-view plan of the model, including pertinent dimensions of the model and motor.
   iii. A photograph of the model, in black-and-white or color.

6) Flights may be made any time between June 1, 1985 and July 31, 1986. Notification of flights must reach the Event Director by August 15, 1986.

7) Reports of flights or requests for additional information should be directed to the OMS Event Director: David Erbach, 71 Brixford Crescent, Winnipeg, Manitoba R2N 1E1, Canada. Telephone (204) 256-2537.

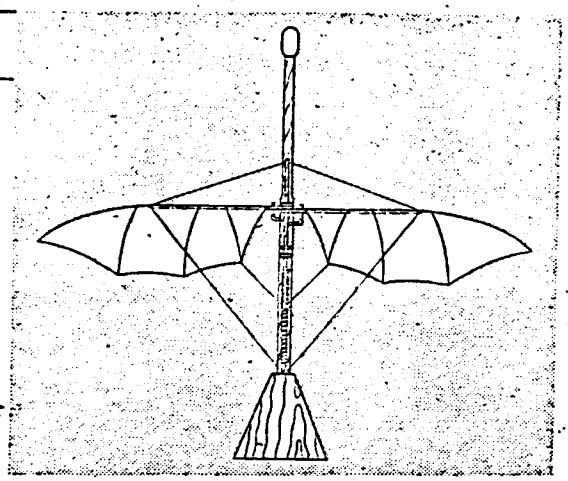


Fig. 3. Plan view of Mr. Tatin's ornithopter the "Bird".

This decision to use "long, narrow wings," that is, wings of high aspect ratio, was a real advance in aeronautical design. The results of such early pioneer experiments are reflected in the fine models of to-day, and on efficient wings of aeroplanes such as the "Liberator" and the "Super-Fortress."

"By means of these long, narrow wings Mr. Tatin has reduced the time during which the wing reaches a suitable position for acting on the air when it first descends.

"Granted the fact, so long established, that a bird flies more easily if it rests its wing against a great volume of air, it will be understood that the maximum speed of movement will also be the most advantageous as regards the reduction of expended force. The inventor, finding that he could not prevent his mechanical birds from losing force in proportion as they attained considerable speed, remedied this defect by *placing the centre of gravity in front.* In consequence of this, the bird in full flight preserves the same equilibrium as the real bird hovering in the air, and its speed is, to a certain extent, passive, the mass of air pressing of its own accord against the wings, all expenditure of force therefore being utilised for suspension. Thus has Mr. Tatin been enabled to increase the weight of his appliances, without increasing the motive power, and yet obtains double the course."

This part is not over clear, but it is interesting to note the word "appliance" used instead of "model," and at the end the word "course" for "duration."

The description of the "Bird" is most interesting: "The apparatus, looked at sideways or from behind, is composed of a light wooden frame, on which are two small supports crossed by an Axletree so as to form two cranks. This axle receives a circular movement from an india rubber spring. The crank on the foremost plane causes the rising and falling of the wings, which move around (pivot about) a common axis, and pass the dead points as the cranks of a locomotive do—so the action is maintained."

The ingenious wing flapping mechanism is shown in Fig. 2. As the cranks revolved, the wings were not only given their oscillating movement, but the angle of incidence changed throughout the cycle, and was at its maximum as the wings approached their highest position on the up stroke.

The ratio of incidence to "angle of flap" was governed by the relative angle of the two cranks. This appears to be about 135 degrees and must have played a great part in the success of the mechanism.

The description of the mechanism continues: "But the wing does not only move as a whole; every part of it, particularly as it rises, shows a tendency to inclination, which is most marked towards the extremity; the part the the body alone preserves an invariable obliquity."

Little mention is made of the construction of either model, but the wings were evidently silk covered, as is mentioned in the next extract. The first paragraph of this is rather mystifying, and the "screw" mentioned must refer to the propeller.

"Tatin was of the opinion that it is with the screw it is necessary to direct the twisting movement; and to obtain it with all its transitions, he has substituted for silk wings, which fold up, some wings composed entirely of strong feathers, arranged in such a manner that they slipped one over the other when in motion. The arrangement was perfect, but still not suitable for adaptation to the large bird. The inventor therefore returned again to the use of silk wings which he appears to have definitely adopted. By means of certain modifications which he has certainly introduced in his large apparatus —viz., a change in the shape of the wings, variation of the amplitude of flapping, etc., M. Tatin has been enabled to make great progress. The bird, acting by means of compressed air, at first could only raise three-quarters of its own weight, but finally lifted itself entirely. And we must take into consideration that the apparatus has to struggle against the weight of the steering apparatus, which nullifying the vertical and horizontal reactions of the bird during flight, constantly fulfils the office of regulator."

No indication is given of the size of the models, apart from the fact they were launched by hand, which is rather a pity. Both of them appeared to fly, and one of them, probably the "Aerophane," covered 210 feet. The "Bird" is said to "continue flying for several seconds when it is set in motion." That it should fly at all is a remarkable achievement for those early days. I know, for I have built a similar bird myself which was most unsuccessful. When launched, the wings of this maze of struts and cranks had a strong inclination to remain still, while the fuselage jerked up and down so violently that after a very short while the whole thing was shaken to pieces.

Looking through the current issue of the AEROMODELLER it is evident that the design of models has improved in comparison with the striking advance of design apparent in the real aircraft of to-day.

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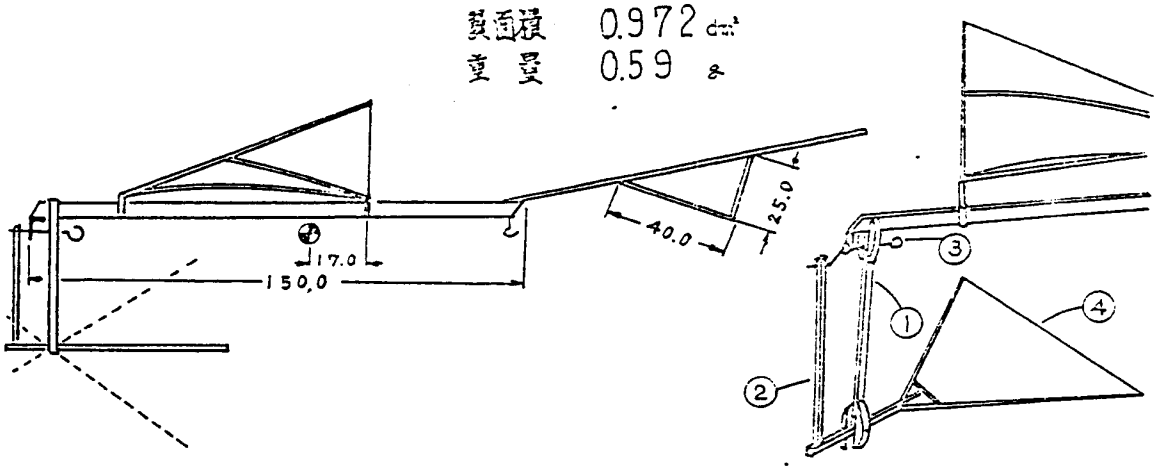
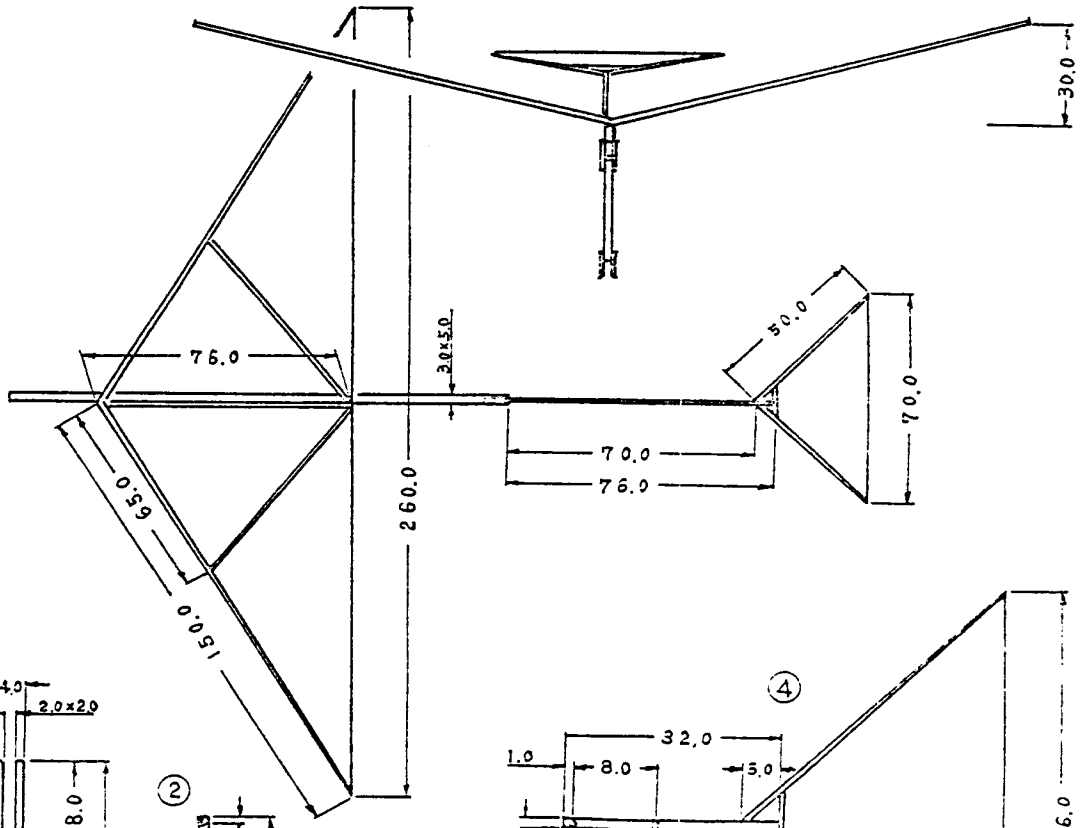
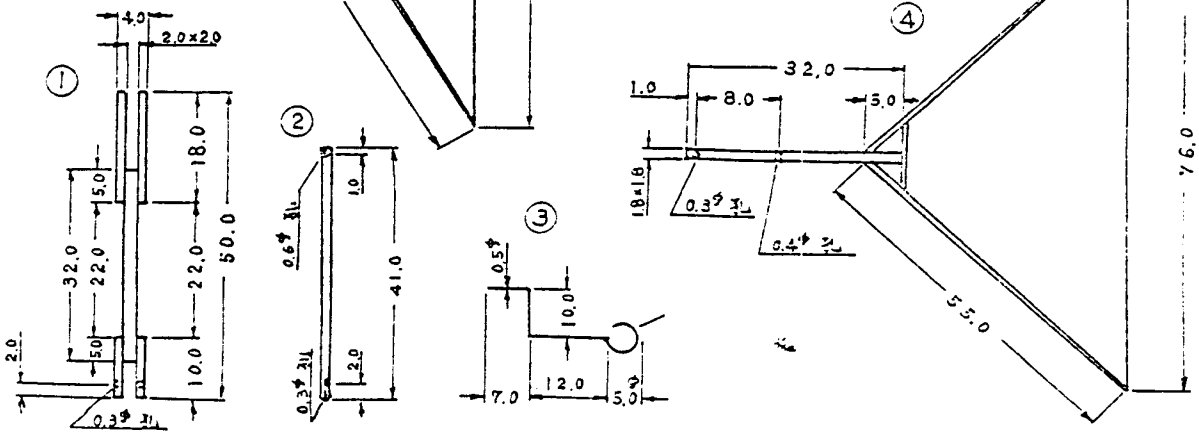
ムナビレ・ヒコーキ　MU-3

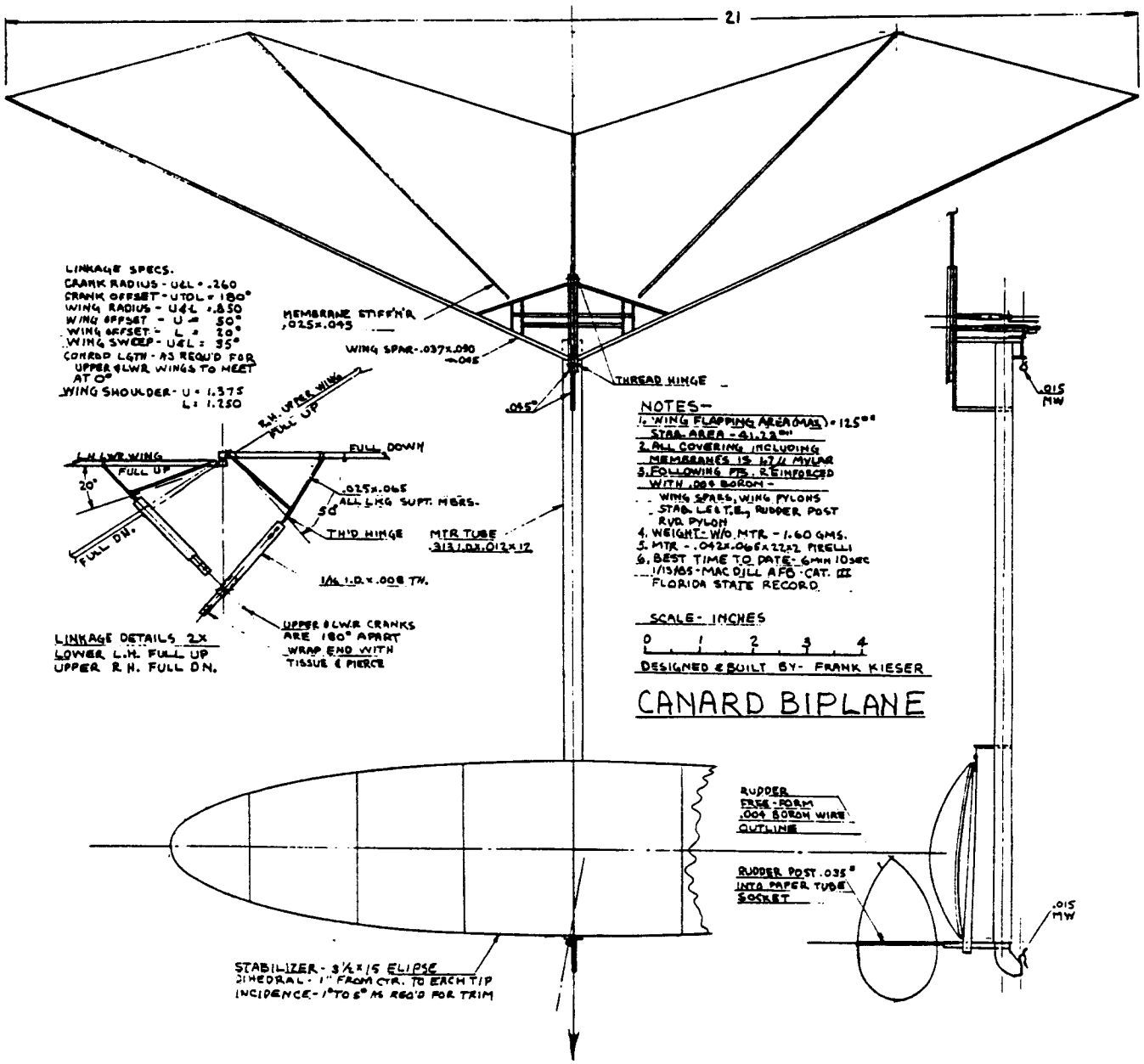
全　長	270.0	mm
全　巾	256.0	〃
翼面積	0.972	dm²
重　量	0.59	g







OMS FLAPPERPET #7



BIPLANE CONFIGURATIONS

Frank Kieser

Probably the most popular biplane configuration in terms of relative wing motion is the one originated by White in which the motion of the two upper wings is almost in phase while the lower wings are in the order of 90 to 120 degrees out of phase with their respective upper wings. This configuration has subsequently been used by Destaye and Ronrbaugh with outstanding results. A fundamentally different configuration is one developed by Watson and also used successfully in the 1983 International Postal Contest. Watson placed the upper and lower wings on either side exactly 180 degrees out of phase with each other and then displaced the right hand set approximately 90 degrees out of phase with the left hand set. Both these configurations can be found in previous issues of Flapper Facts and are discussed in my article, Linkage Design.

What are the relative merits of these two configurations? The linkage required to produce these motions is of the same relative complexity and weight, both requiring a double throw crank. The smoothness of the drive, that is the uniformity of the torque throughout the crank revolution is relatively the same. It is probably more a function of the specific dimensional parameters than of the configuration. The White configuration allows for a fixed wing between the flapping sections while with the Watson configuration this is not convenient if the linkage is kept simple. I am sure that many consider this an advantage of the White design.

The other significant difference as I see it is that in the Watson design, the upper and lower wings on both sides are exactly 180 degrees out of phase. This means that as the wings flap, the vertical components of the air flow from the upper and lower wings are directly opposed and the resulting forces cancel out. As the wings come together there is maximum relative velocity between the two wings which should result in maximum propulsive efficiency. With the White design, there are periods in the cycle when the upper and lower wings are moving in the same direction thus this maximum efficiency is not achieved. The body motions produce by the forces of flapping are basically a vertical motion for the White configuration and a horizontal motion for the Watson configuration. The net result is, does the greater propulsive efficiacy outweigh the greater fixed wing area? I suggest that more of the experts try the Watson configuration to resolve the question.

That's member Hewitt Phillips holding his latest, a White-type phased biplane.