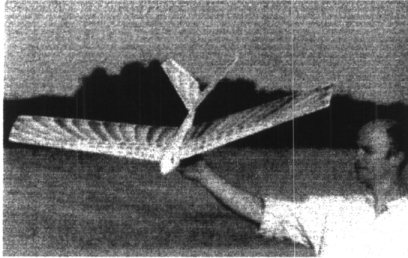


# Flapping Wings

THE ORNITHOPTER  
SOCIETY NEWSLETTER



## Piaf

by Albert Kempf

**F**lying the way birds do, by flapping wings, has been a dream for me for many, many years. After a lot of testing on small aircraft propelled by rubber bands, I finally ended up with an electric -powered bird-aircraft called "Truefly". Quickly, the Truefly showed an exceptional flight ability. So I started to analyze and quantify this new and extraordinary phenomenon.

I feel like it's the beginning of a great adventure with almost infinite prospects. The basis is built. Now we can imagine a lot of applications in the field of flapping flight. I would like to interest scale model manufacturers. Almost everything that flies has already been reduced to scale models, except birds and their very special way of flying. And what is fascinating is that the Truefly obtains performances that are the same as a propeller-driven aircraft. But the prejudices about the flapping flight are deeply anchored in the mind of the public and it is hard to make them change.

For the 1999 scale model meeting in Paris, I wanted to create another

version of the Truefly : an aircraft that would be easier to manufacture, handy, efficient and reliable. After many calculations, I optimized the results I had obtained with the Truefly. And the fruit of this new study is called "Piaf". It is a little bit smaller than the Truefly (wingspan drops from 1.6m to 1.2m) and much lighter (from 1.4 kg to 400g.) The basic principles are the same, but some of the mechanisms have been improved and the materials are different.

Even if I was very excited about this project and in spite of my will, the aircraft was unfortunately not ready for the 99 meeting. But there was another meeting which took place in Germany last summer, it is called Inter-Ex, and it gathers unconventional aircraft. There, I had three



magnificent flights. Everybody was enthusiastic. The Piaf won the prize of the Best Model in 2000.

A little bit later came the time of the next scale model meeting in Paris. For design reasons, I changed the material used for the fuselage : I used thermoformed plastic. The Piaf became a little heavier, so it was necessary to build new, larger wings to compensate the weight gain. Two days before the opening day of the



meeting, the brand new Piaf was ready to fly. I just got the time to test it in a field really quickly. I was not sure whether the bird was very well balanced. I was very anxious. But in fact, after a few flaps, the aircraft reached its flight speed, and rose up, and turned. It was magic. Enthusiasm, but also incomprehension could be read on the faces of the onlookers. How did it become possible ? How could this work so smooth and easily? About 15 flights have been made during the couple of weekends of the meeting., without any mechanical problems.

A lot of fascinated onlookers were surprised by the motor used. It is a "speed 280". Using a propeller, it would only carry 350 grams. But with flapping flight, this small motor was able to carry 500 grams with a responsive flight! Both the Piaf and the Truefly are piloted in with two axis (depth and direction). The flight is very stable and does not contain any particular difficulty. It just reacts the same way as a usual two-axis aircraft. Another peculiarity is that the center of thrust is located 40 or 50 % from the leading edge, even if I use an usual profile.

I have reached my first objective. Now flapping flight is a reality ! I have got many other projects. But of course, I need some support and collaboration. The realization of new projects from this basis would be a great and fascinating adventure. It would have very important repercussions in terms of notoriety and know-how.

Characteristics of the Piaf :

weight : 500g

wingspan : 123 cm

area : 23.2 dm<sup>2</sup>

motor : speed 280

Batteries : 8 cells of 350 mA

flight duration : more than 5 minutes

flap frequency : 2.8 flap/s

piloting : 2axis

## From the Editor

I would like to apologize for the extreme lateness of this newsletter. This is why I have combined the Spring and Summer issues into one 8-page double issue. I hope to have the Fall 2001 issue in your hands within weeks and then the Winter of 2002 to follow on time. Starting with the next issue, I will begin reprinting some of the more interesting articles from past years. Perhaps it will show us how far we have come in the near 20 years of publication of this newsletter. Recently I found a tantalizing bit of information. Apparently, Clement Ader tested a human powered ornithopter that could rise when tethered against a wind. Does anyone have more information about this craft?

## Q's and A's about the new possible type of aircraft.

**Author's foreword.** The subject - future Experimental Flapping Wing Aircraft (EFWA), the last possible type of aircraft, an addition to existing ones - airplanes and helicopters. I have chosen a bit unusual form - Q's and A's - because it allows to touch many aspects of the problem: everybody knows, that questions may be utmost different... So I ask questions, as it were from different persons, and answer them at once.

- **Question:** *What are you talking about? Aviation exists more than 100 years. Maybe some unknown fields left, but - "new possible TYPE of aircraft"! It is much more, real terra incognita and it is still unknown? whether it is possible in our advanced time?*

**Answer:** I have to say YES. Let us make a simplest classification of the types of aircraft. Any aircraft needs lift and propelling force at the same time to fly. If an aircraft uses wings to obtain lift force and airscrew or jet to obtain propelling one - what type is it? No doubt, it is an airplane. If the same airscrew is used to produce both lift and propelling forces - what is it? A helicopter. And if an aircraft uses the same wings to produce both lift and propelling forces like a bird - what is it? It is still unborn Flapping Wing Aircraft (FWA), the last member of the "classic" aircraft family, "little brother" of airplanes and helicopters. Manned motor FWA does not exist now and never flown, trust me or verify it yourself. So the whole class of aircraft is really absent now! Mankind has already visited the

Moon, but still cannot create an aircraft that flies like a usual bird, which you can see in your backyard. Such is an interesting paradox in our really advanced time.

- **Who are you?**

I am an engineer, live in Moscow, Russia, and my name Boris M. Doukarevitch. I designed a project of motor manned Experimental FWA, EFWA. Now I am looking for ways of embodiment.

- *Let birds flap with their wings if they want. We will fly by fixed-wing gliders, planes, as well as copters, and it is quite enough. We built these aircraft and our labors must not be in vain. Besides, there is much work to be done.*

Congratulations. Perhaps, you are content: you do just what you like to do and want nothing more. Continue and enjoy this happy life. I ought to notice only, that creation of the first-in-the-world EFWA - it is progress with use and with no negation of accumulated aviation experience. In the future will be no opposition and even competition between FWA and existing aircraft, because each member of this family of aircraft has its own destination, merits and demerits.

- *Hmmm.... I remember something. Web-winged, pterosaur like, awkward-looking experimental aircraft or scale models... Were all attempts of FWA creation unsuccessful? Why?*

Yes - all attempts to create manned motor FWA were unsuccessful (I do not speak about man-powered ones, which were, and are, absurd). Why? In general, it was too early. Progress moves from simple to complex, so the mankind learned first to create fixed-wing aircraft, planes, since they are simpler than future flapping-wing ones. However, nowadays planes (and especially gliders-

sailplanes, where you cannot rely upon life-giving power of motor) became utmost perfect. It is time to go further. Will mankind forever only watch the birds?

About scale models with flapping wings - yes, they are well-known and really can fly. It is possible to buy such a model as a toy for children. Unfortunately, these models fly by themselves, we still cannot control their flight (I mean - operation of flapping wings), so it is of no value.

- ***OK, maybe FWA will really appear in the future. What it will look like? Web-winged like a bat or feathered like a bird?***

Not at all. Is a modern glider web-winged or feathered? No. Like this, future EFWA will be very much similar (in motionless state) to a usual modern high-ratio glider, - see the figure below. Only an experienced eye can catch the differences: oversized "ailerons", visible joints between wings and centerplane which indicate possible mobility of wings. You can also see inlets for cooling air, which allow one to expect that there is a motor behind the pilot's cabin.

In state of motion: naturally, EFWA will flap its wings. Flapping frequency will be very low, in the range of 0 to ca. 1.5 Hz. All flight will be in silence, except of soft muffled exhaust of relatively low-powered motor. Not much more noise than that of VIP Mercedes.

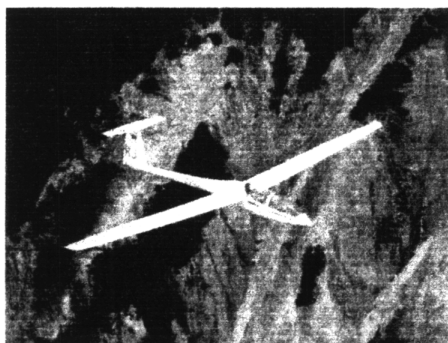
- ***Sounds good. However, I do not believe that such an evident, ordinary-looking vehicle - like a usual glider - was not invented and built before. What were the reasons? Can you explain in details?***

Yes, of course. I have learned of many FWA projects. There are two main faults.

Firstly - most of designers paid no attention whether their projects are perfect from the point of view of

usual, fixed-wing aerodynamics and experience. Moreover, the said designers did not strive to! It is mere ignorance: you cannot master algebra unless you know how to count. See, for example, American patent 3.498.574 of Mar. 3, 1970, author A. Ernst. The construction looks very obsolete: bad structure, bad aerodynamic forms, poor control of attitude and low gliding ratio...in the meantime, airplanes and gliders of the 1970's were already quite perfect.

Secondly, the next flaw is much more serious. It is enough to watch a flight of any great bird to notice how highly variable and extremely expedient wings movements are!



*Possible candidate for conversion*

And as far as I know, practically all FWA projects flapping wings are connected immediately with the motor via reduction gear. Some authors used rather complex paths of wing movements - like the figure "8" or other closed curve. The reason? "It is necessary to do so, according to my calculations". The result: an aircraft flaps with its wings with aggrivating monotony, like a windmill, and so is not able to takeoff and fly. Control over flapping wings must be not worse than that of live being - optimum, self-adjusting and complete.

I know only one patent of a motor FWA with relatively good control over flapping wings - it is the said American patent mentioned above! Unfortunately, there are other great flaws which depreciate all the pro-

jects...

I will not examine here other typical flaws of existing FWA projects, since these flaws are relatively not so serious. Unfortunately, even small missed flaw is able to kill the whole design.

- ***And how did you overcome these flaws in your project? What is your main idea?***

There are two main ideas.

Firstly. As you can see on the figure, the EFWA looks like an up-to-date glider: it has perfect aerodynamic forms. Moreover: it will be built on a base of a usual modern 2-seat motorless glider, e. g. German DG 505, Grob G-103 Twin Acro II, or similar one. Transformation from a glider into the EFWA comprises of rewiring, installation of new control system and a powerplant into the room of the second cabin instead of pilot's seat. It is very important to retain (at least, do not worsen too much) conventional properties, geometry and MTOW: the first EFWA must glide with fixed wings as well as the basic glider. It is the half of the future success and a guarantee of pilot's safety, in addition. Watch the flight of a sea-gull and you comprehend: easy and perfect flapping flight is possible only if perfect gliding already mastered.

Secondly. Control over flapping wing - it is the main, most important problem. So the main idea lies here. It is utmost simple; however, to make it comprehensible, I have to mention the experience of the Wright brothers.

During creation of the first-in-the-world airplane they had run against the analogous problem: how to control the flight? Nowadays all is clear for everybody, but a century ago two different approaches existed. The first one: plane must carry a pilot like train carries a passenger, i. e., with no interference of the latter, plane must fly by itself. The second: since it is impossible to create plane which is able to fly by itself, it is

necessary to assume a risk and to entrust a pilot with direct control, in spite of the fact that nobody could guarantee that a man is able to control over flight, since no man has flown before. (Except by balloons, but there is another approach.) Wright brothers did it: they rejected "control machines" and entrusted a pilot with direct by-hand control. It was very natural, bold and only right solution, though, maybe, forced and instinctive one.

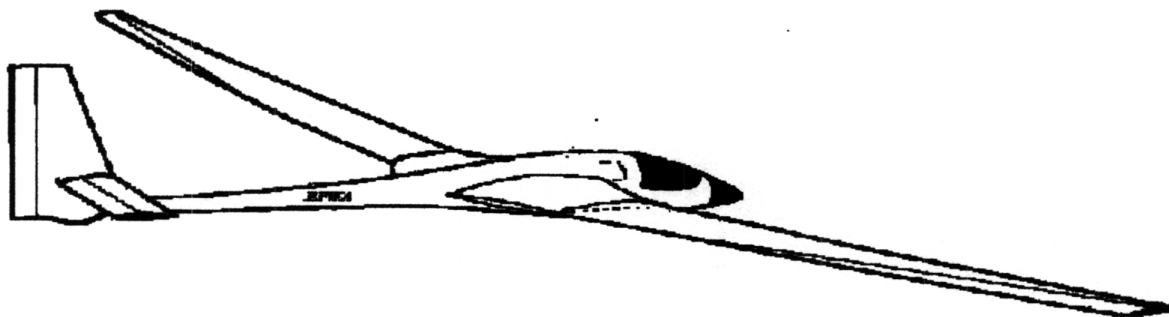
Now, 100 years after Wrights, the problem of control (in this case - over flapping wings) arose again. History repeats itself! Now it is impossible again to create a "wise" and perfect "flapping robot" due, at least, to absence of the trustworthy and

elevator of a light glider, and what about handling of long, heavy flapping wings? They transfer power which is necessary for flight, at least up to several HPs, which is certainly exceeds abilities of any man. The solution is evident - it is necessary to use hydraulic boosters which reduce efforts on the joysticks but retain feedback. A hydraulic pump driven with a motor supplies the energy for the said boosters (and therefore for wings and for flight as a whole), while the control depends exclusively on a pilot.

The similar way of control is used in the American patent mentioned above. It fits mainly for the first concept experimental aircraft, which is the subject now.

than mere assembly of standard ready-made parts: basic glider, suitable motor of any destination, ready-made hydraulic system parts from fighter or bomber etc. Wings and centerplane only are to be altered. About hydraulics - is it so awful while any usual car has it? The manufacturing will be many times cheaper than building from zero level, I daresay - will be very cheap, by aviation measures.

Please note also, that EFWA will be exclusively experimental, concept vehicle, belonging to no one of existing aircraft class! So it will be utmost "wild" machine, with no certifications, documentation, standard tests and so forth.



proven theory of flapping wing work. And again, as mentioned above, practically all FWA designers are still trying to create such a "flapping robot". But this way does not lead to success. That is why I see only one real and reliable way of solving the problem: to entrust a pilot with manual, direct, immediate control over flapping wings! (In fact, it is repetition of the Wright brothers' experience on a higher level.) Let him operate flapping wings as well as ailerons, rudder and elevator! A man is a very perfect creature and does not yield to any flying being; in process of safe training he will certainly find the way of flapping which gives maximum effect under the given conditions.

But! It is easy to operate rudder and

- ***The future FWA will be too complex and expensive.... Hydraulics, motor in the limited inner room of a usual glider.. Is this work feasible for homebuilders or small manufacturing company?***

Surely, future motor FWA will be more complex than its predecessor - motorless glider. This is an inevitable payment for freedom, the possibility of independent takeoff and active flight, as well as for establishing of the new class of aircraft. However, it is not so awful and expensive.

Let me remind once again that the very first EFWA will be created on a base of a usual glider; in fact, it will be a kind of glider conversion or remake. That is why creation will be approximately on 70% not more

All this greatly facilitates manufacturing and reduces the expenses too. It is necessary to make only one (1) flying sample, designed only for investigations and for limited number of simple demo flights with no overloads etc. - like the first plane of Wright brothers! So, though the manufacturing requires high technology, it can be fulfilled by a little company experienced in building of up-to-date motorgliders or even by qualified homebuilders. In fact, Wright Brothers were talented and bold homebuilders too! And it was quite enough.

- ***And what wonders will we see after the first takeoff of the EFWA?***

You will see only one real wonder: a great white "glider" suddenly started



to flap slowly with its wings and climb! By the way, I am not sure whether an independent takeoff will be provided from the very start. "Flyer" of the Wright Brothers had no independent takeoff either! Nevertheless, the devices for such a takeoff are known and can be included into the structure of the EFWA from the very beginning, if needed.

- ***What are the possibilities once this succeeds?***

Prospective is very great, though a bit vague now. No wonder, who dares to predict the future of an unborn child? However, I foresee the following:

- FWA will be first-in-the-world almost noiseless motor aircraft. The problem of excessive noise is very disturbing for aviation. This is the first chance to get rid of noise.
- FWA will be a useful and irreplaceable "test bench" for the practical investigation of flapping flight and of operation of flapping wings. It will give extremely valuable data which is impossible to obtain by any other way - neither by observations of flying things nor by scale or any other possible modeling. Using this data as a basis, scientists will be able to start creation of a new aerodynamic theory of flapping wings. Existing fixed-wing aerodynamics will enter into this new general theory as a simple particular case, for zero wing flapping frequency.
- according to theory of great Russian scientist N. E. Zhukovsky, FWA will be a very economical aircraft, since flapping wings throw off maximum mass of air at minimum velocity by comparison with a rotor or propeller.
- FWA will present great interest for leisure and sport. The first flying sample may cost big

money afterwards as a unique museum exhibit.) Perhaps, possession of flapping wings will greatly enhance maneuverability, as well as takeoff and landing parameters. Maybe, new kinds of air competitions will appear - for best beauty and perfection of flight, a kind of air slalom...

A bit later, some years after, when FWA will be more or less mastered, I foresee possibilities for:

- Automation and computerization of flapping wing control, which will liberate a pilot from routine monotonous work - a kind of flapping-flight autopilot.
- New methods of control, e. g. with use of biocurrents instead of joy-sticks.
- Creation of hybrid flying machines. Such an aircraft will have both propeller (for long-term even flight with fixed wings) and flapping wings for maneuvers, improvement of takeoff and landing, for noise reduction etc., with static or removed propeller.) This will be a wonderful universal light aircraft - a plane, glider and FWA at once!

However, it is the very beginning of the long way of the new aircraft type.

- ***OK, all this is very interesting, but what do you want? Since you are so clever, why do not you build your EFWA yourself? You disturb busy men instead - what for?***

A good question. Of course, any inventor ought to keep his mouth shut until he has showed the public something real, i. e. material. Unfortunately, I do bother busy men - why? Because the situation is changed in comparison with the Wright brothers times. They built

the first fixed-wing plane from zero and bothered nobody. However, creation of the first EFWA must start from level of a perfect glider, which is a product of advanced, high technology. A great volume of aviation experience accumulated here, obtained by hard labors. So, if you want to create the EFWA, you must "stand on shoulders of giants" (a phrase of Sir Isaac Newton), - i. e. men experienced in manufacturing of up-to-date high-ratio gliders-sailplanes, or to be such a giant indeed. I am sorry to confess that I am not such a giant. That is why I am looking for, figuratively speaking, "the second Wright Brother", a connoisseur of gliders. Otherwise the good idea may be lost, which is not good.

- ***This adventure seems too risky and unusual.***

It is a statement, not a question, but - a very sober thought. You know best about your own affairs! You are free person! Nobody in the world can make you - like as nobody made brothers Wright quit profitable and accustomed business (repair of bikes) and start creation of unbelievable, unseen before winged vehicle. First-in-the-world innovation - it is utmost special business; fortunately, extremely rare one. Since your innovation has no analogs and nobody knows about it, nobody wants it. No experienced experts exist, and nobody will advise, support and approve you. On the contrary, the whole world will oppose you! On the other side, the fame of discoverer is utmost valuable, should it is of interest for you... So think twice before you decide to start creation of the EFWA.

- ***What does your project look like? Is it more than a mere idea?***

Surely yes. However, there is the particularity.

As it was stated above many times, the first EFWA must be built on a

base of a usual glider. The model and structure of the glider can vary, - which one is available. That is why my project can be an exemplary one, "know how", if you will. Nevertheless, the project comprises all necessary information about the structure, testing, training of pilots, stages of implementation and so on. It enables to start creation immediately.

- ***Who can build the first EFWA - in cooperation with you?***

I guess, it may be a small aviation manufacturing company, experienced in building of modern (motor) gliders, or even a group of qualified homebuilders. The main, most important term - ambition, longing to be famous, to seize own position in aviation. Large, advanced, well-known companies as a rule are very conservative, awkward and supercilious, so I doubt that cooperation with them is possible.

- ***Is it of interest for a manufacturer to create your project?***

For manufacturer it will not be "someone else's" project, since this manufacturer will be considered as the author of the future patent, enjoying all rights. It is fair play, since a great amount of creative work is to be done. As to me, I do not intend to go aside; nevertheless, I surely will not be an only author.

- ***How can I get more info about the project? This project interests me.***

Contact me without hesitation.

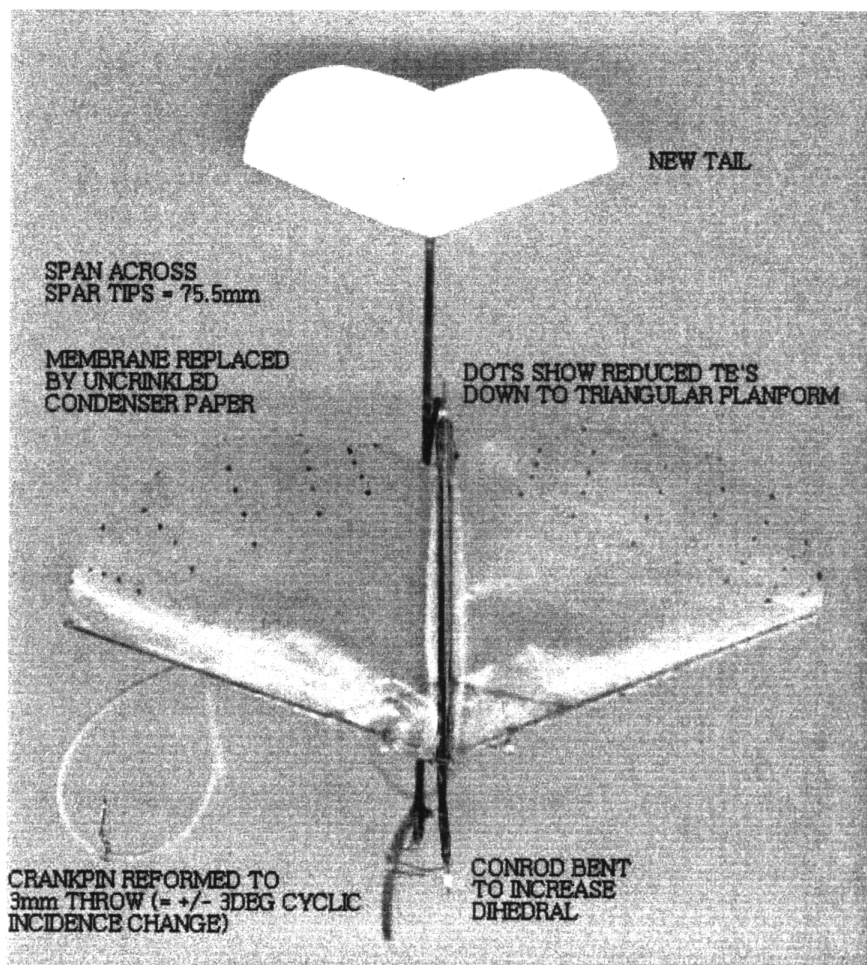
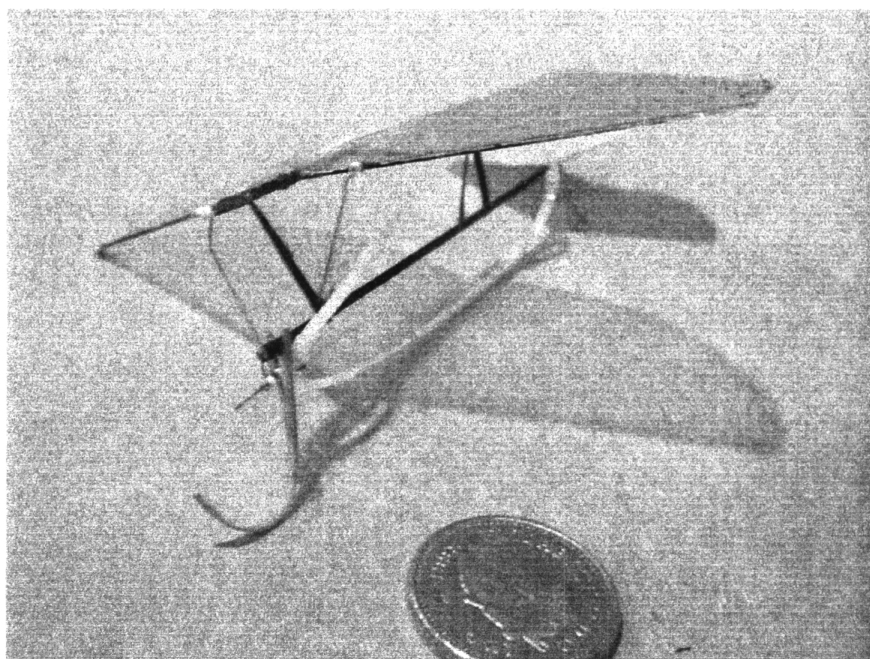
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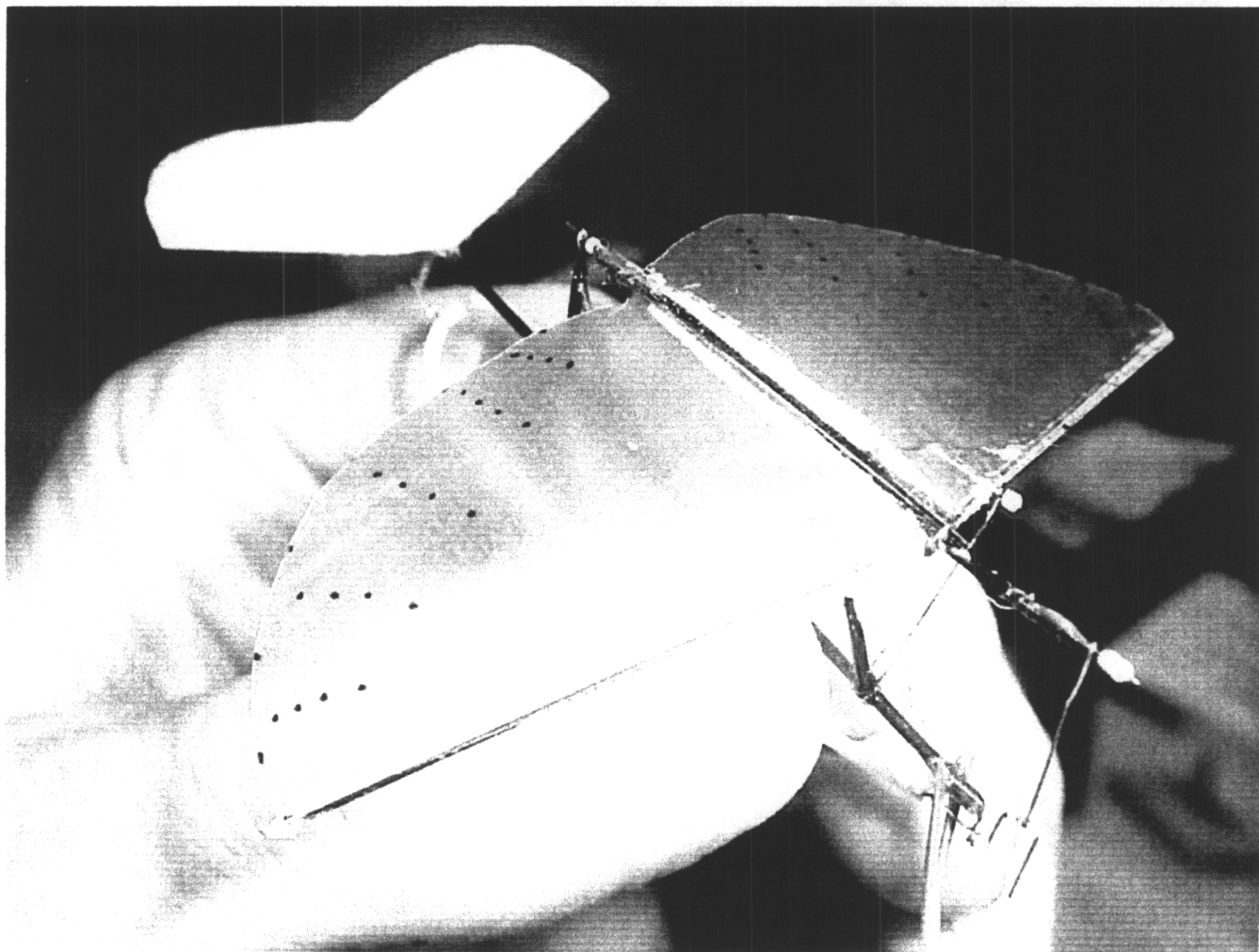
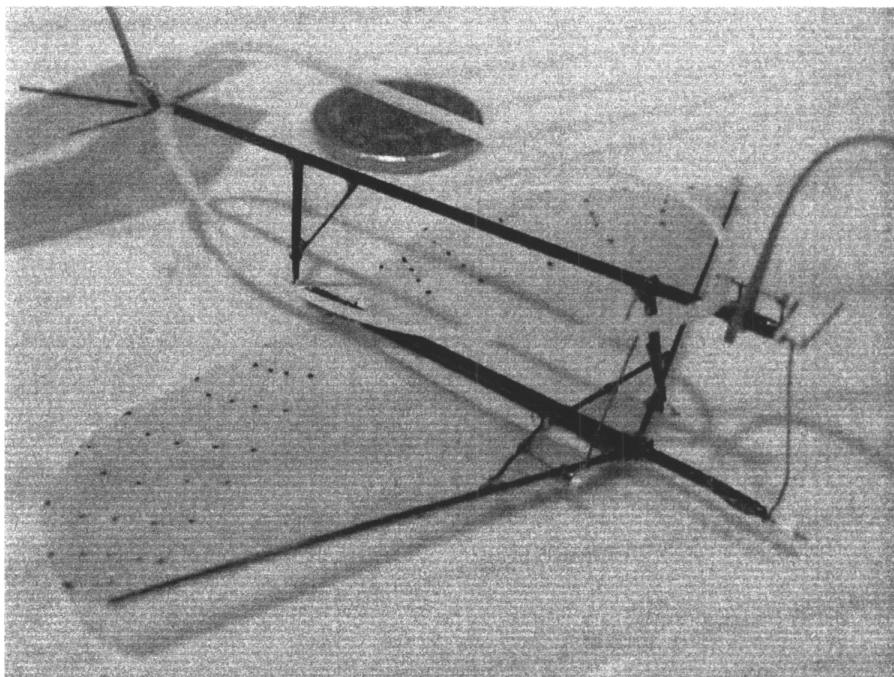
Email: bmdouk@chat.ru



## **“Snip”**

From OS member John Mack

An all-carbon rubber powered  
ornithopter. Notice the size and  
unusual flapping mechanism.  
Great Job John!



Sean Frawley  
32 Kenilworth Lane  
Warwick, NY 10990



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