FALL '92

OMS flapper facts

Flapper Facts is now back in print! I am Nathan Chronister, and I will be serving as editor at the request of Roy White. Quarterly publication of the newsletter will resume starting with this issue.

Flapper Facts provides a unique and much-needed opportunity for swapping of information on ornithopters. Although meets and personal correspondence may put you in touch with other ornithopterists, only this newsletter will allow you to share detailed information with over 120 others from around the world. Without this newsletter, you could miss out on the latest indoor O-modeling ideas, or you might not learn about upcoming developments which will bring radio-controlled ornithopters within reach of the average hobbyist. Because model magazines and manufacturers provide little or no material specific to ornithopters, *Flapper Facts* is the only way to stay informed.

Flapper Facts relies on reader input to maximize these benefits. Due to the small readership it is especially important for you to send in your ideas. If you have any news, suggestions, ornithopter plans, or views you'd like to share, please send them to me at the return address on the back of this issue.

This new issue has been paid for by remaining OMS funds, but we are just about out. Please send $5 (or, for overseas members, $7 US funds) made payable to Nathan Chronister. This should cover costs for the next eight issues.

On the last page please find a survey, to be returned with your payment, which will let me know what you are interested in reading about in future issues of Flapper Facts. Newsletter content will also be determined by what you send in, of course. I apologize for the lack of construction features in this issue. There will be more in the future.

Welcome back to OMS. I hope you find this issue of *Flapper Facts* to be both informative and enjoyable.

Nathan

Product Review:
Tim Bird is built to last.

Ornithopters have often been described as fragile, inconsistant machines requiring great skill and patience. The Tim Bird, however, is anything but. Made and pre-assembled by Guy de Ruymbeke in Paris, the Bird uses strong, flexible nylon in the mechanism and spars, with steel wing levers, mylar wings, and a very thin plastic fuselage that bends but doesn't break. The flight is brief, but the Tim Bird is rugged enough to be flown over and over.

Flying the Tim Bird: Nothing could be simpler. A rachetting winding crank is built in to the tail. All it takes is 60 turns. When you are ready, a lever beneath the flapping mechanism frees the crankshaft, and the wings begin their noisy flapping.

The tail must be adjusted in its handy ball-and-socket joint to make the Bird fly as straight as possible; like all airplanes, it tends to loose altitude in a tight turn. Flights of 100 meters are possible (on a windy day).

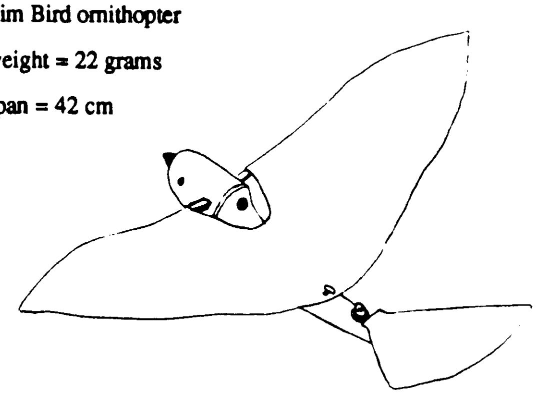
Tim Bird has been marketed as a toy, but it is very useful to the experienced ornithopterist. It makes a great introduction to ornithopters for anyone who is interested in getting started in the hobby, but also it's durability and snap-together design make it a valuable tool for the experimenter. You can take out the wings in 3 seconds, for example, and replace them with some of your own. You can try new ideas without building a whole new ornithopter.

You can find Tim Bird in toy stores, science stores, museum gift-shops, and in a variety of mail-order catalogs for about $8. Many of these also sell the Timmy Bird, a smaller counterpart of the original also available in the form of a bat, and a special Tim Bird told apart by the crest on its head which automatically locks its wings at the end of the flight,

Tim Bird ornithopter

weight = 22 grams

span = 42 cm



becoming a glider. The latter is more difficult to find. The original Tim Bird has been around since 1969. Ⓞ

Experiments:
Tim Bird reveals secrets of ornithopter design.

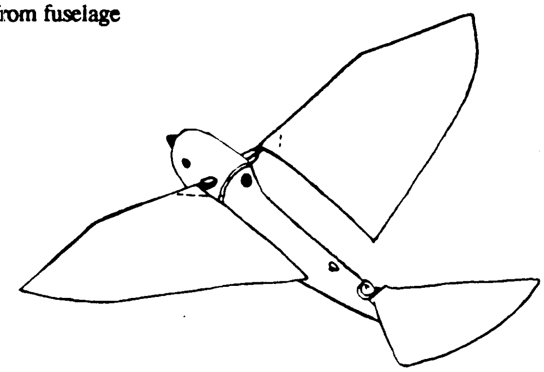
The Tim Bird's snap-together construction allows it to be easily modified without interfering with the flapping mechanism. This allows testing of a large number of wing designs without having to build a single flapping mechanism.

To study the effects of wing area and aspect ratio on performance, I made new wings with bamboo spars and glued on shims to hold them firmly into the wing sockets. I flew the model repeatedly with various wing sizes, demonstrating some O-modeling concepts everyone should know. Large wings cause the motor to unwind more slowly, increasing time aloft. But since power=energy/time, the power output of the motor actually decreases. If the wings are too big, the model will descend. Tim Bird's optimum wing size is slightly larger than that of its original wings.

Long, narrow wings allow rapid unwinding, resulting in a high flight speed, but if the wing is too narrow it won't have enough lift. Also, the inertia of the spar will waste a lot of the energy.

Other wing designs I have tested include one in which the wing membrane was separated from the fuselage. This was very successful. Another used the variable-incidence rigid panel concept and flew well enough to warrant further experiments some time in the future.

Tim Bird with wings separated from fuselage



Power required for flight can also be determined using the Tim Bird. Someone with a reliable indoor model should repeat my experiment to see how power requirements vary between the two model types. The more people do this, the more we'll learn!

To keep this interesting I will not go into the details here, but I will provide a copy to anyone who sends an SASE and wants to give it a try. Just to summarize, the power is calculated as follows:

1. To find the power for level flight, I first observed the number of turns of rubber, **n**, at which level flight is just achieved. This is tricky.

2. The energy per turn of rubber is determined by setting up the motor on a test-bench with a propeller attached, wound n times. Multiply the force exerted at the tip of the propeller (measured with a scale) by its radius times 2π.

3. The time required for the nth turn of rubber to unwind is estimated as follows: Measure the time required for n+5 turns to unwind, and subtract from this the time for n-5 turns. Divide by 10 to get the average time per turn between turn #n+5 and turn #n-5. This approximates the time required for turn #n to unwind. (Time the model in flight rather than in your hand because the airflow over the wings increases the unwinding rate by up to 30%. Repeat several times and take the average.)

4. Divide the energy per turn by the time per turn to get the power output.

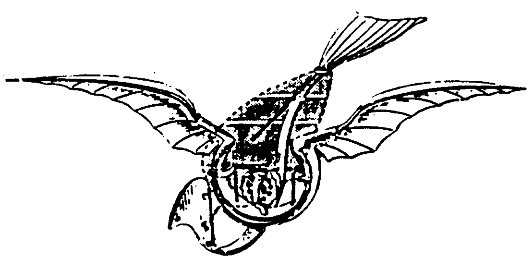
Using this procedure I estimated the level-flight power output of the Tim Bird to be 0.4 watts. Since the Bird has a mass of .022 kg, the specific output is 18 watts per kg. Using a computer program (From *Bird Flight Performance*, by C.J. Pennycuick) which estimates the power requirements of birds in level flight, I found that the Tim Bird uses about twice as much power as a real bird of equal weight, if that bird has the same wing size as the Tim Bird. A more realistic feathered friend would have a much higher wing-loading than Tim Bird, and use about the same amount of power.

These results are tentative because error in the experiment is very high. However, more work on the subject is sure to provide more solid conclusions. The ability to estimate ornithopter power requirements will be especially important in the development of electric ornithopters, but certainly has applications in rubber power as well. I encourage you to do some work of your own so that we can compare results and perhaps develop some more accurate techniques. -Nathan Chronister ©

History part 1:
Before the Wrights

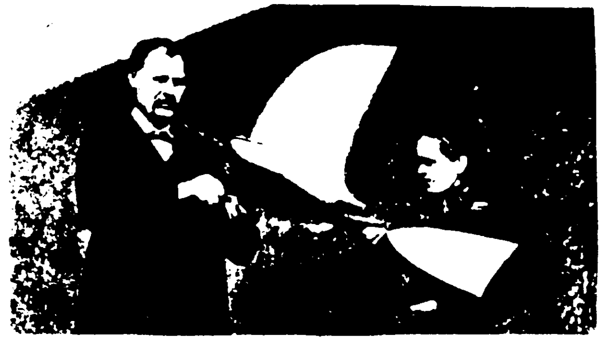
The early period of ornithopter experimentation preceeding the 1903 success of the Wright Flier was interesting, because during this time many people still believed that ornithopters would be the first successful powered aircraft. It is also interesting because it marks the development of rubber-powered ornithopters very similar to those of today. This article will describe some of the early successful models, but to narrow the scope of the article, the vast number of failed attempts will not be discussed.

Although historical information on ornithopters is extremely sparse, there are flights on record from as early as 1870, when Gustav Trouvé flew a model for over 60 meters using a series of exploding cartridges for power. These were fired into a Bourdon tube which drove the downstroke of the wings.



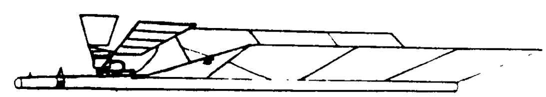
Trouvé, 1870

The first rubber-powered ornithopters soon followed. By 1872, Jobert and Hureau de Villeneuve had flown the first of these, soon to be followed by other inventors. (rubber-powered airplanes had been flown by Pénaud in 1871.) By 1879, Pichancourt was already selling the "oiseau mécanique" in Paris, almost a hundred years before the Tim Bird hatched. Otherwise similar to today's monoplane ornithopters, some of Pichancourt's were impressively large, spanning roughly 4 feet and being fairly heavy.



M. et Mme. Pichancourt, 1879

Lawrence Hargrave, around 1890, built models powered by compressed air. Some were flapper-propelled, while others were true ornithopters. One of his models weighed about 2 kg and had a wing area of 2.8 square meters; it flew 104.6 meters. He went on to build a steam-powered ornithopter later that decade.



Hargrave, 1891

The early pioneers had a different vision than today's omtihopter modelers. They were working towards the man-carrying ornithopter, so their designs grew steadily in size and power. After the airplane became successful, interest in the ornithopter remained strong, and as technology improved, a number of internal-combustion powered models were successfully flown, as were some man-carrying gliders with wings that flapped as an assist. These will be covered in the next issue.

Bibliography:

Carnahan, Walter H. "Flapping Wing Aircraft" *Sport Aviation*, August 1976.

Johnston, S. Paul. *Horizons Unlimited.*

News:
Dan Garfinkel's gas ornithopter

Last month I received a letter from Dan, who is currently working on his second gas-powered ornithopter. He writes:

"My first one (pictured in *Flapper Facts*) was deliberately built overweight, as a test stand.

The operation of the wings was good & I learned lots. My next one will fly!!! ...

I'm planning a 48 to 50 inch wingspan with an .049 for power, design very similar to my old one, but much lighter."

If all goes well, we may be able to see Dan's creation in flight at the '93 Nats in Lubbock, TX. You can read more about Dan's first model in the summer 1990 issue of *Flapper Facts*, which includes a photo and some construction details. Both are biplanes, a configuration well suited to such low wing loadings.

Gas-powered success misrepresented in nat'l magazines

gas-powered ornithopters are uncommon and difficult to build, but examples have flown successfully as long ago as the 1930s. Despite this fact, engineers Jeremy Harris James DeLaurier claim to have set, in Sept. 1991, a world record for the "world's first successful engine-driven aircraft with flapping wings" (*Discover*, April '92). This mistake on their part reflects the public ignorance about ornithopters: the widely held belief that they are only found on black-and-white newsreels and were the product of mad scientists. It is this ignorance which allowed the two men to greatly over-rate the significance of their work for personal gains. Very few people could see the falsehood of their claims.

In a *Science & Technology Week* (Aug/Sept 1989) article, they claim that "toy" ornithopters, unlike theirs, cannot produce lift with which to glide. They don't seem to realize that model ornithopters **do** glide if a wing-locking device is provided. There is no qualitative aerodynamic difference between the two.

The ornithopter has a span of 5 feet, weighs 6.5 pounds, and uses a 1 hp model airplane engine. The engine acts through belts and pulleys to raise and lower the center section straight up and down. The wings are attached to the center section in the usual way, but are also attached, outboard of the main hinge, to the fuselage via struts. As the center section is raised, these struts pull the rest of the wing down. The resulting wing motion is like that of any other ornithopter except that the center section moves up and down. A unique and advantageous feature of the wings is that they are thick rather than membranous, but still twist with the airflow like membranous wings. Unlike the wings of most birds, they do not partially fold on the upstroke.

Survey! Your input will help make this a better newsletter. Age ____

1. What types of ornithopter are you most interested in?
2. What types of models do you build, other than ornithopters?
3. What are your main sources of information on ornithopters?
4. On the back, please tell us about any interesting ornithopter projects you've been working on.