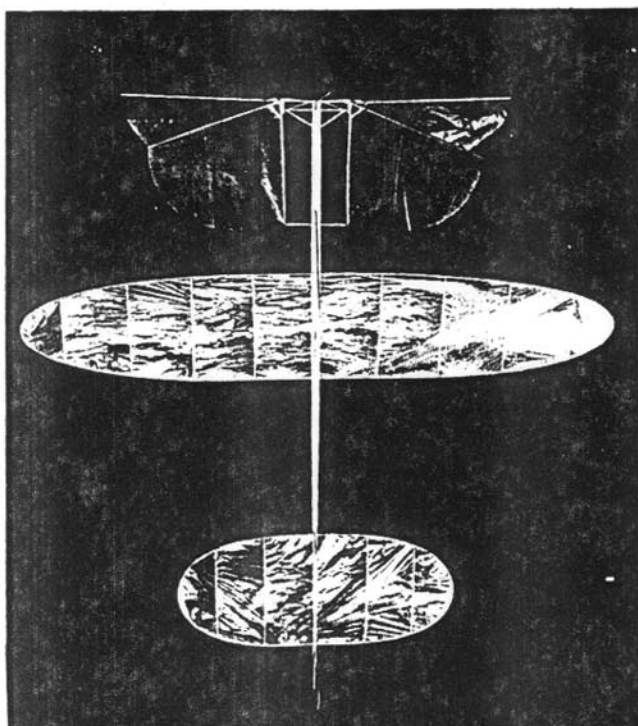


The photograph above shows the action of an ornithopter in motion. In picture below, rubber-driven crank that flaps the twin pair of flappers to make the whole thing go can be seen at the nose of the model on top. Normal flying speed is around three miles per hour! Unusual

Flip, Flop, the Ornithopter

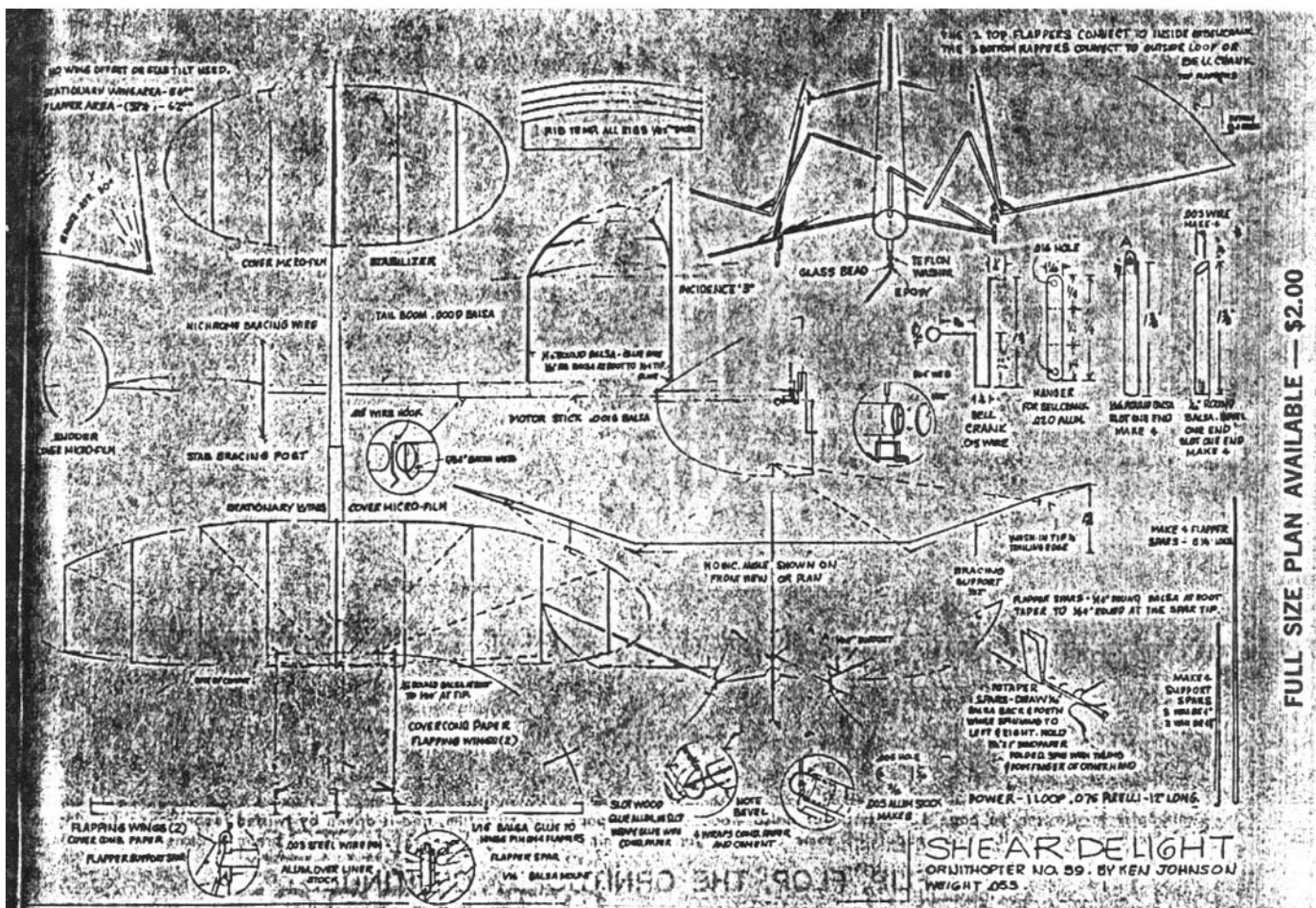
Finally, the ultimate in aeronautic technology: a model airplane that flies like a butterfly. Material for this article reprinted from April '71 Esquire magazine.

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● The shimmering object on the opposite page is not this year's idle trinket from Tiffany's, nor yet a glazed Amazonian butterfly from Brentano's. What it is, is an indoor flying model ornithopter from Reynoldsburg, Ohio, and a stablemate of the most successful indoor flying model ornithopter thus far produced in America. In the Spring of 1968, in a blimp hangar near Akron, a predecessor of this machine flew for five minutes, fifteen and two-tenths seconds, thereby acquiring for its maker, Kenneth B. Johnson of Reynoldsburg, the United States record for indoor model airplanes with flapping wings. Five minutes and a bit may not sound like much, but in fact it's a lot more than any full-sized, man-carrying wing flapper has ever done. As a rule, imitating the birds doesn't succeed very well for humans, chiefly because they can't imitate the birds closely enough. Mr. Johnson, who has been building ornithopters since 1964 and ought to know, explains: "An ornithopter cannot be like a bird. A bird has constantly variable incidence and camber in its wings, and it can open its feathers on the downstroke. The flapping wing of an ornithopter contributes very little lift to hold it up. Its principal function is as a means of propulsion to drive it forward, while the rest of the flying surfaces sustain it."

Nevertheless, almost anything will fly if it is made light enough. The most useful tool of the indoor-model builder



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DRAWINGS AND PIC ON FOLLOWING PAGE →

is a balance capable of weighing in thousandths of an ounce. On the ornithopter in photos, the fixed surfaces—wing and tail—are covered with microfilm, a substance invented by an M.I.T. student in the 1920's, made simply by pouring a liquid from a bottle on the surface of a tank of water and letting it set (the manufacturers of microfilm do not care to reveal exactly what is in the bottle), so that in effect you have a coat of clear lacquer on top of a pool of water. Though microfilm is perfectly transparent, interior refraction and reflection between its surfaces result in the transmission and reflection of incident light waves out-of-phase, so that gorgeous colors appear as shown here, much like an oil slick or a butterfly wing.

Getting the microfilm off the water and onto the airplane is much more difficult than putting it on the water in the first place. Also tricky is rolling hollow tubes from .016-inch sheet balsa to make the fuselage of the model. (The manufacturers of .016-inch sheet balsa aren't telling just how they cut it than thin, but claim that they can slice it down to .008-inch if desired.) The flapping surfaces at the nose of the model are of condenser paper, originally devised for insulation in small electronic parts, supported on tapered balsa spars which are connected to the rubber band by an .013-inch steel-wire crank. The entire machine, ready to go, weighs about forty thousandths of an ounce—that is to say, if you had twenty-five of them you would have an ounce of ornithopters—and is so delicate that it can only be flown indoors with the windows shut, preferably in a blimp hangar or other adequate space. (Last year's world indoor-model championships were held in a Romanian salt mine.) In fact, should the machine encounter the turbulent air caused by a man walking in front of it, it would probably be wrecked. "If you see one head-

ing for you," Mr. Johnson advises, "just stand still. It's so light that it won't be hurt by the collision, but if you try to get out of its way, it's likely to be torn up by the air currents."

If the reader happens to have an ornithopter that will fly longer than five minutes, fifteen and two-tenths seconds, and desires a little recognition, he may get in touch with the Academy of Model Aeronautics, which is a division of the National Aeronautic Association, which in turn is affiliated with the Fédération Aéronautique Internationale, and arrange a demonstration. Since, as Ken Johnson tells us, there are "maybe about ten guys flying indoor ornithopters today," your chances of reaching the top are much better than if you went in for drag racing or water skiing or any of the noisy, expensive mechanical sports. The A.M.A. also governs record claims for indoor helicopters, autogiros and numerous other classes of more orthodox propeller-type flying machines, most of which tend to be even lighter than ornithopters since they are not required to withstand the vibration of a pair of wings beating up and down. Competitive winning flight times for rubber-powered indoor models of the larger sorts run into forty minutes and upward, which, if you will think about it is a very long time for a rubber band to spend unwinding.

Readers who desire to try indoor ornithopting will not find the necessary materials at the local hardware shop, but they may be had from Micro-X Products at 5200 Pines Drive in Lorain, Ohio. Their catalog features such items as .008-inch balsa wood in eighteen-inch lengths at fifty cents a sheet (one sheet goes a long way) and .0005-inch Nichrome wire, used for bracing wings and so on,

(Continued on page 52)

Flip Flop, the Ornithop

(Continued from page 13)

which is impossible to feel with the fingertips and almost impossible to see with the naked eye, but nevertheless exists. Though your ordinary newsstand model-airplane magazines give occasional information about indoor flying, your real specialist's journal is *Indoor News and Views*, Box 545, Richardson, Texas.

What, you may well ask, is the place of ornithopters in man's endless quest for whatever it is he is after? We can only refer you for an answer to the movie *Brewster McCloud*, in which the eponymous hero, representing the Human Spirit and its Thirst for Freedom, flutters about the Astrodome in a man-powered ornithopter of his own making (actually the product of three months' labor by an art director, plus a few invisible wires). Alas, in the real world, ornithopter experimentation more or less subsided, except among the very persistent, with the Wright Brothers' demonstration that, as far as people were concerned, the air belongs to the propeller and not to the flapping wing. Before that, though, the nineteenth-century death rate for ornithopter builders ran around fifty percent. Three years ago you could have read in this very magazine about one John Seney, a qualified engineer from Delaware, who thought, back then, that man-powered ornithopter flight was just within his grasp. We haven't heard from Mr. Seney since, come to think of it.

In any case, yesterday's technology is always, or almost always, today's aesthetic—any machine that's old enough will

eventually, wind up in The Museum of Modern Art—and a beautiful translucent ornithopter ghosting through a blimp hangar at slower than the speed of a man walking is much prettier than an SST, adds nothing to the atmosphere, and can't be heard for more than a few feet. Leonardo da Vinci, as is well known, designed ornithopters in his spare time and persuaded a servant to try one out (Leonardo, a genius, wouldn't go up in the thing himself). That nexus persists, for Ken Johnson, by profession an advertising art director, once entered an ornithopter in a Pittsburgh art show, winning third place in Crafts and Sculpture, plus a cash prize of seven dollars and fifty cents. To be sure, the last Leonardo painting to change hands did so at a price somewhere above five million dollars, but Leonardo's ornithopter didn't work at all. ■