PHOTOGRAPHY

Right Side Up

While "Stunting" For Its Makers, High Speed Camera Discovers Cat's Secret of Turning Over In Fall

By DR. FRANK THONE

"JUNIOR, *will* you stop tormenting that poor cat?"

A whole chapter of "Why Mothers Get Gray" might be written around the irrepressible drive of small boys to experiment with animals, especially with the family cat. Particularly did you delight in picking up poor Pussy by her four feet, holding her upside down, and letting go, to see how she always managed to land right side up. Whether you were impelled merely by a budding scientific curiosity, or had more utilitarian hopes of learning a trick that would be useful in unexpected falls out of trees or off woodshed roofs, that was the favorite experiment.

But you never learned the cat's secret. Pussy took her nine lives to her grave, and her nine-times-nine kittens and grand-kittens followed her in their time, without divulging that very useful trick of the feline trade. No matter how often you did it or how closely you watched, it was always all over in a split second. Pussy's performance, like that of the mystifying magician you gaped at on the stage, was too quick for the human eye to follow.

Seen by National Academy

No discredit to you or to any small boy for not finding out how the cat turns over. It required the resources of a great engineering laboratory and the cleverness of two ingenious and hard-working young scientists, to make the matter plain. But a short time ago a movie of a cat turning over in mid-air, of a couple of flies "taking off," of a canary launched into flight and a number of other too-quick-to-see movements done by living animals were shown before the meeting of the National Academy of Sciences at Cambridge, and the most learned men in America ceased for a while their discussion of cosmic rays, the expanding universe, and other things of like abstruseness to watch and applaud.

For they recognized that in the ultra-fast camera invented by Dr. Harold E. Edgerton and Kenneth Germeshausen, of the Massachusetts Institute of Technology, there is available to science not merely a fascinating toy for catching a cat doing a flip-flop but a scientific weapon of extraordinary power for use in solving all sorts of problems involving very rapid motion. Making motion pictures at the rate of hundreds, even thousands, of exposures a second instead of the conventional sixteen, this camera can "freeze" even a bullet in its flight, yielding a clear, sharp, un-fuzzed picture; and its slow-motion effects make those of the ordinary newsreel product seem to gallop by comparison. Every detail of the object in motion can be studied and scientifically analyzed.

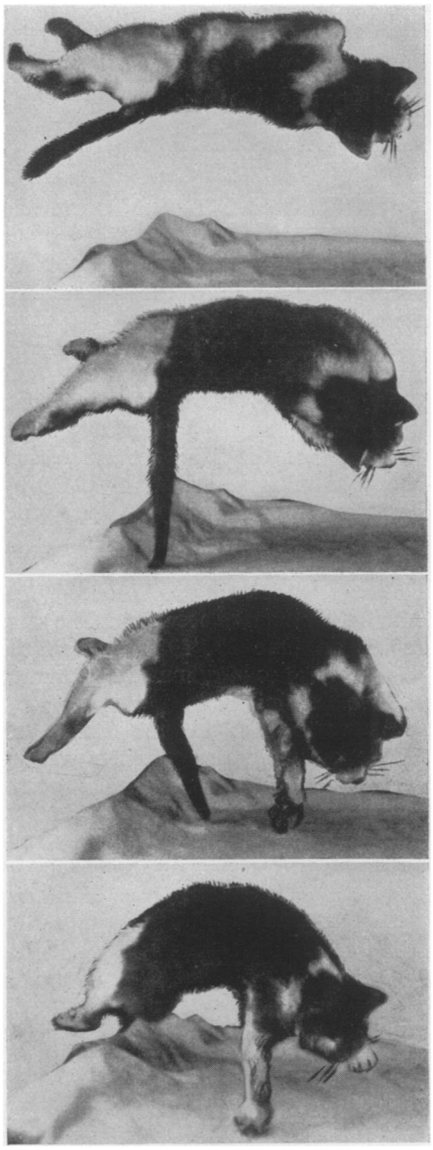
Flashlight Machine

The camera is actually a flashlight machine, taking whole strings of flashlights in a few seconds, instead of a single, much-fussed-over exposure. It has no shutter: the lens is open all the time, and the exposures are made either by electric sparks jumping a gap, or more usually by one or more specially constructed mercury vapor lamps so controlled by a vacuum-tube hookup that they flash and go out, flash and go out, any desired number of times a second, each time burning an image into the motion picture film as it races at high speed behind the ever-watching eye of the lens.

So when Dr. Edgerton reverted to his boyhood, and dropped an inverted kitten in front of the camera while his partner Mr. Germeshausen closed the switch, that pet of the laboratory at last betrayed every detail of Tabby's technique for turning over and landing on all fours. The drop was only a short one —less than two feet—but in that time the kitten made the turn. First her front feet came around, then her hind ones. Because of the shortness of the fall she barely had time to get those hind legs into position before she hit the table; a foot more of drop would have been to her better liking.

The pictures show the highly efficient mechanism a cat is, at this business of getting right side up while hanging onto nothing. She arches her inverted back, thus giving longer leverage for the the swiftly-working muscles. She even uses her tail as a balancing-pole, holding it rigid and swinging it in a direction opposite to that taken by her legs.

One detail of the cat's behavior in a natural fall the two experimenters did



KITTY'S FAMOUS FLIP

These four pictures show how a cat rights itself during a two-foot fall when dropped bottom side up.

Science Service, Inc. is collaborating with JSTOR to digitize, preserve, and extend access to *The Science News-Letter.* www.jstor.org

not have a chance to learn. Because they had to hold their kitten upside down for a moment before they let her drop, she had time to turn her head and study the place where she was to fall. It was noticed, however, that she turned her head in the same direction that she later turned her legs, so there was no lost action. Presumably all cats do this, swinging the whole body through a spiral, with the head leading off.

It may be a fundamental pattern in the behavior of all turning animals. You can see a fine example of it if you will watch a whirling dancer on the stage. The order is always the same: first head, then shoulders, then hips. It may be that the Edgerton-Germeshausen camera will some day become part of the equipment of schools of the ballet, to analyze the movements of the hopeful pupils and correct their faults.

Flies Face the Camera

However, for the present, the employment of the machine is less pretentious, being contented with the analysis of the movements of high-speed lower animals. One of the sections that most interested the members of the National Academy showed in silhouette the gyrations of two flies when they were launched unexpectedly into the air.

The flies were coaxed into position in front of the camera lens by a bit of jam on a piece of cardboard. They were permitted to get settled to their feast, and then the cardboard, attached by a string to the camera motor, was jerked quickly from under their feet when the machine was started.

Each time (for the fool flies came back to the jam time after time, as flies will) one of the insects was tossed into the air at a different angle—once or twice it was completely upside down. This enabled the scientists to see how a fly rights itself in the air. This is done by shortening the stroke of the "up-side" wing and strengthening the stroke of the "down-side" one, much as a rower in a boat corrects his direction by differing the pull on his two oars.

Once, when one of the flies was turned completely over, it flew the wrong way—downwards instead of up, until it touched the table, bounced over, and righted itself for a second launching, this time right side up.

Dr. Edgerton and Mr. Germeshausen got motion pictures of only two flies, for the film was made when autumn was fairly well along and there were few active flies left around the laboratory. But these two flies showed quite different modes of flight, though they were both of the same species. One of them struck down sharply and strongly with each beat of its wings, then brought the wings up more slowly, leading with the front edge, to begin another strong down-stroke. Most of the power was put into the downward beat.

The other fly got more of a "rowing" motion into its wing action. There was less lift in its strokes, but it gained ground on both forward and back swings of its wings. It will be interesting, when spring comes again and the two young scientists have more flies to work on, to learn whether these pestiferous but efficient insects know any other tricks of flight. Further studies on other insects, as well as on other flies, are scheduled.

A more agreeable flying subject was found in a pet canary. The little bird was held gently in the hand of one of the experimenters, while the other prepared and focussed the camera. Then the hand was opened, and the canary dropped into the air. The film shows wings swinging in a sort of figure-8 pattern as they gain a grip on the air and lift the bird out of its initial short drop. Interesting, too, is the action of the legs; as the canary drops into the air they go through alternate sweeping kicks, as though seeking a solid support that is no longer there. It has often been noticed that small birds fly with their feet well tucked up, but just how soon that happens the present film does not show, for the canary is still kicking as it flies out of the picture.

Snake's Tongue Pictured

Another quick-action film is that of the forked tongue of a snake, as it flickers in front of its scaly jaws. Snakes' tongues seem to move incredibly fast, to most of us; but the Edgerton-Germeshausen camera shatters that illusion. This is one of the slowest of the films, taken at a speed of only 250 exposures a second, yet it shows all details of structure and motion quite clearly.

This new tool of science was not originally designed for use in the solution of biological problems at all. Dr. Edgerton and Mr. Germeshausen wanted something that would "freeze" the motion of rapidly-turning electric generators and other machinery, and they worked it out with only its potential usefulness as an engineering research instrument in mind.

But once they had it fairly well developed, they could not resist trying a few stunts: bubbles bursting as bullets sped through them, golf balls wafted into the air under the impact of a driver, electric light globes flaking into fragments under a hammer, the slow splash of a dropped glass of milk or a cup of coffee, etc. Many of these earlier pictures have already become quite familiar to the public.

This article was edited from manuscript prepared by Science Service for use in illustrated newspaper magazines. Copyright, 1934, by EveryWeek Magazine and Science Service.

Science News Letter, February 10, 1934

ARCHAEOLOGY

Mound Builder Home Discovered in Louisiana

A LONG-STANDING mystery of prehistoric architecture in this country has been cleared up. The home of a Hopewell Mound Builder has been discovered, and science now knows what sort of houses were the "better homes" of the Midwest. James A. Ford, who is excavating at Marksville, Louisiana, under auspices of the Smithsonian Institution, has reported the discovery.

The post holes of the house are so clearly marked, Mr. Ford said, that the ground plan can be reconstructed. It appears to have been a one-room rectangular house about fifteen feet long and seven feet wide. It was partly underground, for a clearly marked pit was found in the center.

Archaeologists pronounce the house plan very similar to that of the Basket Maker Indians who lived in the Southwest in the centuries around the dawn of the Christian era. Homes roughly similar to this were rather widely diffused in the United States.

The Hopewell Mound Builders represented a high peak of cultural advancement in the prehistoric Midwest. Archaeologists first discovered them by exploring earthen mounds in Ohio, in which the dead were buried. These revealed that Hopewell Indians conducted trade over thousands of miles of wilderness, entirely on foot, in order to acquire copper, bears' teeth, volcanic glass, and other valued goods. The chieftains wore hammered copper breastplates and helmets and strings of river pearls and garments of woven cloth dyed in interesting patterns.

Recent discoveries in Louisiana have shown that a southern variation of the Hopewell culture existed contemporaneously with it and was closely allied.

Science News Letter, February 10, 1934