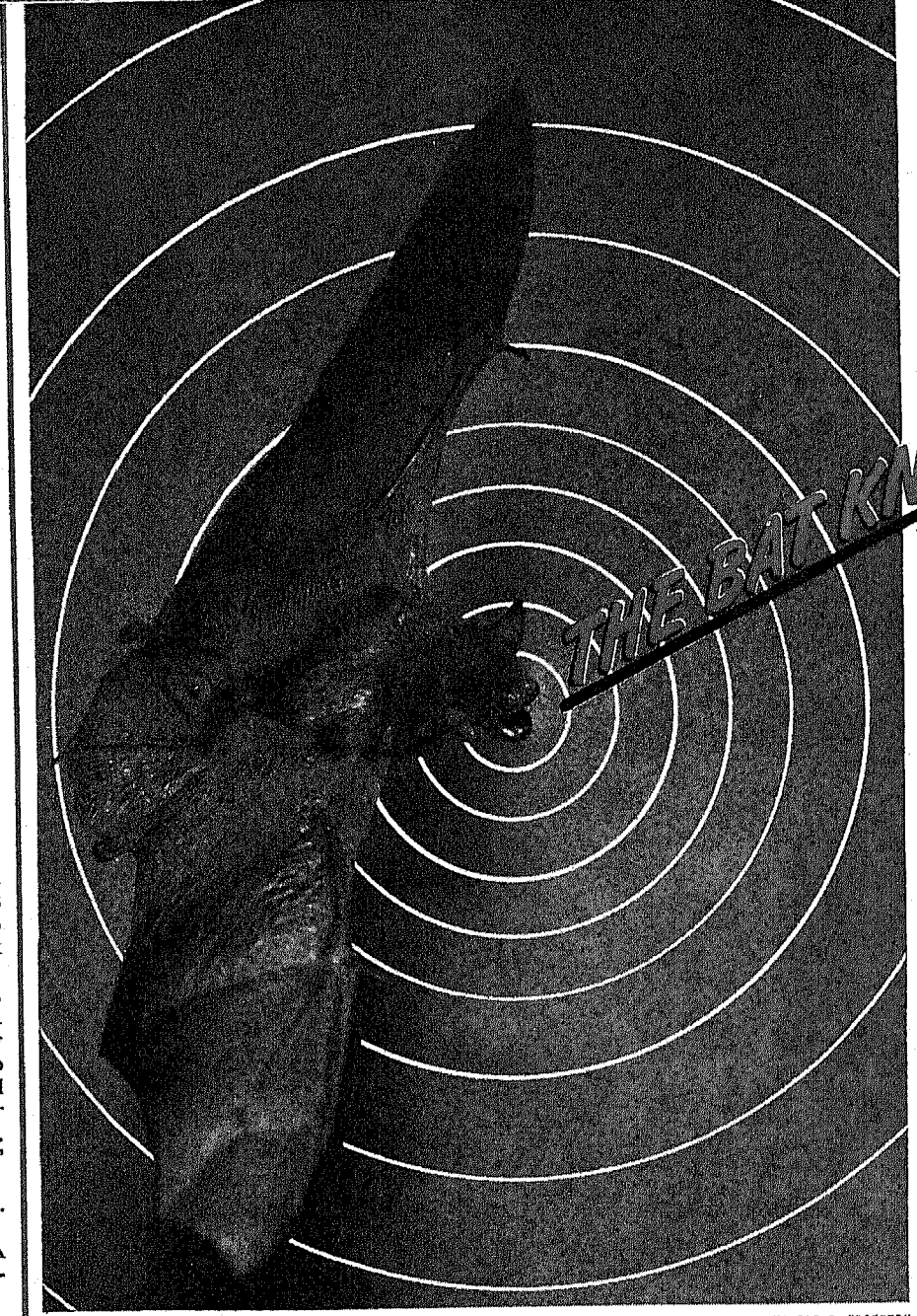
THE BAT KNEW IT FIRST

For some 60,000,000 years a little winged mammal has used one of man's most recent discoveries, radar, to find his way in the dark



PHOTOGRAPH FROM PROFESSOR HAROLD E. EDGERTON

RADAR, with its power to safeguard night-flying planes against crashes into mountainsides or collisions with other aircraft, is an old story in the world of nature. Its advantages were discovered by that odd creature, the bat, at least sixty million years ago. Ever since the day when a small, mouselike animal spread leathery wings and became the first mammal—and to date, the only one—to acquire the power of flight, the bat has been flying about the dark places of the earth and doing remarkably well about avoiding the trees, cliffs and buildings in his path. He escapes mishap by using a system that bears an uncanny resemblance to radar.

As everyone knows, radar detects approaching planes or other objects in the sky by filling the air with a series of high-frequency radio waves, then receiving the echo that bounces back from anything in the path of the signals. The bat's method is very similar. Instead of radio waves, he sends out a staccato series of high-pitched cries.

These are not the squeaks you hear as he flies overhead on a summer evening; the bat's radar signals are pitched too high for human ears to hear—too high, perhaps, for the ears of any creature except himself. These supersonic cries fill the space into which he is flying. They strike some object in his path.

After proving that bats do not depend on sight to dodge obstacles—blindfolded bats flew just as well as those that could see—Galambos and Griffin made an important discovery: The bats blundered about helplessly if their ears were plugged or if their mouths were taped shut. To detect objects in their path, apparently they had to hear something. But what? Since they also required freedom to open their mouths, evidently they heard sounds they uttered themselves.

To discover whether the bats might be producing sound inaudible to human ears, Galambos and Griffin borrowed elaborate sound-detection apparatus from Harvard's Professor G. W. Pierce, a specialist in supersonics. When the instrument, capable of translating supersonic sound waves into audible sound, was set up in the laboratory, the bats were again released. Instantly the apparatus gave out a tremendous, chattering clamor. The din continued as long as there was a bat in the air, ceased as soon as the last bat had tired of fluttering about the room.

When their tests were finished, the Harvard scientists had a complete picture of the bat's method of blind flying. This is what happens: When a bat is about to take off—from his perch on the wall of a cave, in a hollow tree, or on the inside of your window

to the cruising level of thirty per second. Why don't we hear the clamor of the bat's incessant cries as he flits about overhead? It's a matter of the frequency of the sound wave. The bat's signaling voice lies in the wave band of about 50,000 cycles or vibrations per second. Human ears detect sound anywhere in the band from 20 to 20,000 cycles. The limit of hearing for dogs and cats is about 35,000 cycles, and for rats about 40,000. These figures are higher than those for any other mammals tested, except bats, which appear to hear sounds up to at least 98,000 cycles, perhaps higher.

Not only are they equipped to hear their own signals; bats have extraordinarily well-developed vocal apparatus for uttering these high-frequency sounds. For years, anatomists have marveled at the great development of the bat larynx. In one species, the African hammerheaded bat, this organ is so enormous that it is one third as large as the entire body cavity. In all bats, the vocal cords are short and tough. Large muscles are attached to the voice box in such a way as to put great tension on the cords.

How bats developed their sonic detection apparatus is not known, but of all animals they are most in need of some such device. Practically all bats are night feeders and most live on insects which they capture on the wing, dodging, twisting and turning in intricate aerial maneuvers. Some live in dense forests, where they hunt among the trees. Others use deep limestone caverns as sleeping quarters. Entering and leaving the caverns, the bats must fly long distances through the pitch-black corridors.

Mother Bat Knows Best

The bat's radar system sometimes means more than individual safety. Mother bats carry their newborn young with them during the first days of life. The youngster clings to its mother's fur with claws and teeth, and rides with her far into the night skies as she searches for food. After a few days, however—perhaps when the young bat becomes too heavy to maintain his perilous hold—Mother leaves him at home, hanging him up in good bat fashion by his hind claws on the wall of their cave while she goes a-hunting.

Fossil records, which often tell much about the beginnings of animals, are incomplete in the case of the bat. The earliest known fossil is quite a good replica of present-day models and helps not at all in revealing what the first bats were like or who were their ancestors. This first known bat lived in Eocene days, that curious period some sixty million years ago when tropical plants grew in Alaska.

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This amazing system, antedating modern electronics by millions of years, has been revealed by two scientists working in the laboratories of Harvard University, Doctors Robert Galambos, now of the University of Rochester Medical School, and Donald Griffin. Ever since 1794, when Spallanzani performed the first experiments on the flight of bats, researchers have been trying to explain the bat's ability to fly in complete darkness without accident.

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When their tests were finished, the Harvard scientists had a complete picture of the bat's method of blind flying. This is what happens: When a bat is about to take off—from his perch on the wall of a cave, in a hollow tree, or on the inside of your window shutters—he begins to send out his signals, a series of supersonic cries. At first, the cries are uttered at a comparatively slow rate, less than ten per second. Then, as the bat launches out into the air, they come faster, at a steady rate of thirty per second.

Now something happens. The bat hears a faint echo of his cries coming back to him—trouble ahead! Instantly he speeds up his cries, uttering up to fifty a second. The increased burst of sound apparently gives a stronger echo, telling his alert brain just where the obstacle is. He changes his course until the echo becomes fainter, dies away. Then, as he speeds safely past the tree or post or church steeple, his cries drop back to the cruising level of thirty per second.

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But long before the first fossil record, the ancestor of the bat, scientists believe, was a shrewlike creature, tree-climbing, flightless. When these forerunners of bats were learning, first to leap from tree to tree, then to make long glides from the treetops to the ground, and finally to launch out into aerial space, they must have developed, along with leathery wings, the special faculties that probe the darkness and make night flying safe. There must have been failures and fatal crashes in those early trials. We know only that those pioneering bats finally succeeded, that they perfected and used the counterpart of radar millions of years before man laboriously developed it. . . .

Rachel L. Carson