ENTOMOLOGY

Sight is Wealth Even to Humblest

The Insect Views His World Through Myriad Lenses, Yet May Perceive Much the Same Forms as Does Man

By DR. FRANK THONE

See Front Cover

MAN, by self-appointment Monarch of the World, strides in ponderous majesty across the meadows, crashes through the undergrowth in the woods. Quite alone, he tells himself, looking about with self-satisfied, unobservant eyes.

Quite alone? Not by any manner of means. Every step of the way is cleared by scores or hundreds of little creatures, which do not dare to challenge his overpowering bulk, but which are as quick to see him as he is slow to notice them. Their eyes may not be as good as his, but they use them to better purpose.

As indeed they must. Down in the fierce and merciless little world among the weeds and grasses there are no agreed-on codes of fair competition. The only ethic is still that of the jungles kill and be killed, eat and be eaten—intensified rather than ameliorated by being focussed into such small parcels of hungry and anxious life. Every sense and faculty must be incessantly ready for service in fight or flight; even momentary inattention is a crime which automatically invokes its own death-penalty.

Now, of all the messengers sent by the outer world to a living creature's sense organs, light is the swiftest and most direct. Scent depends on the wind, and the wind is always half a traitor, for it leaves everything to leeward, or "downwind" quite in the dark so far as warning odor is concerned. The same treasonable wind, though it cannot quite extinguish warning sounds, can and does distort them and give them false direction; for sounds travel in air and may thus be bent by the wind that moves the air.

Seeing is Believing

But light plays no such tricks: what can be seen is much more reliable "news" to the brain, whether reasoning or merely automatically reacting, than what is heard or smelt or felt. So when you come trampling into their ken, the insects and spiders and other creeping things receive, through their multiplex eyes, unmistakable warning to "scram!" For the moment of your crushing coming, at least, the jungle distinctions between predator and prey are wiped out in a common seeking for safety; there is a leveling truce of terror among the Very Small in the presence of the Very Big. The motion to adjourn is carried by a tremendous majority of Eyes.

On scrabbling feet, on leaping legs, on whirling wings they go—all except those well camouflaged in leaf-green or stick-brown, or too dull of sight or wit even to run for their lives. Those that see best leave earliest, and are likeliest to go farthest; for the best eyes go with the best wings.

After you have passed, of course, the normalcy of hungry hunt and fear-driven flight settles over the deceptively peaceful-appearing meadow or brushland again, until another major apparition of doom (perhaps only a cow, this time) comes crashing along.

What is the Mechanism

How are these little citizens of our familiar countryside jungles equipped to spy us from a safe distance—the few feet or even the few inches that enable them to seek safety before a crushing foot descends, or a clumsy giant motion knocks them into a possibly wing-crumpling fall? What are these multiplex eyes like? Do they resemble our own? If not, are they superior or not so good?

The answer is a paradox. The eyes of insects and their relatives are basically like our own, but in almost every particular they are different.

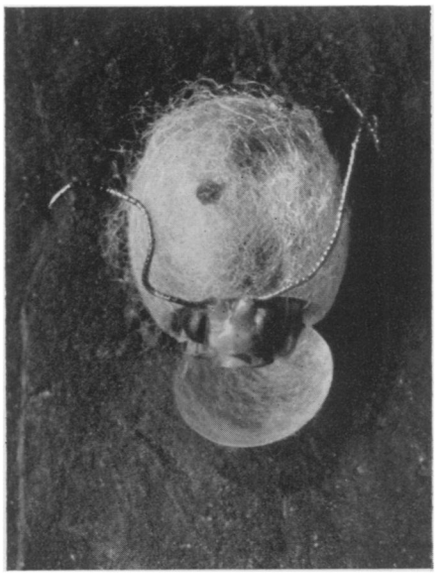
The human eye has a small opening, the pupil, through which the light passes. Its size is variable, controlled by the bordering iris. The light is focussed by a remarkably flexible, adaptable lens, and the image it forms falls on a network of light-sensitive nerve ending cells, the retina, as a single picture for transmission to the brain.

The insect eye is built as unlike that as can possibly be imagined and still be an eye. Instead of being a single, unitary structure, it is made up of a large number of distinct sections, or "facets." In effect, each facet is a slender wedge or inverted steeple-like pyramid, squeezed together on all sides by its crowding companion facets. An orange sliced crosswise gives a rough notion of the cross-section of an insect's eye; the fruit of the Osage orange, formerly much used for hedges, affords an even better model.

Cannot be Focussed

Each of these facets is topped by a rounded, lens-like horny front. It does serve after the manner of a lens, but it cannot be focussed as the lens in your own eye can, so that it presumably does not form so sharp an image on the bottom of its narrow little cone. But the very narrowness of the cone limits to some extent the imperfection of the image, and also helps (along with all its neighbor cones) to give a very acute perception of movement in what the insect eye chances to be loking at.

At the bottom, or narrow end, of this lens-topped cone are just a few light-sensitive nerve-endings, or "retinal elements." The picture formed by an insect's eye, then, is a patchwork or mosaic, with the image repeated over



"WITH ROUND EYES OF WONDER"
When a young insect comes into the world, as this golden-eyed lace-winged fly is doing, the first things that emerge are its information-getters—its many-faceted eyes and sensitive, exploratory antennae.

and over a thousand or ten thousand times, depending on the number of facets in the compound eye. Scientists are of the opinion, however, that by the time this compound picture has been transmitted to the insect's brain it has somehow been blended into one—just how, it is not certain.

Eyes Nearly Cover the Head

Such, then, is the eye that is turned on your approaching bulk, multiplied myriad-fold by the numbers of small lives that hasten to get out of your way. Perhaps the most magnificently developed insect eyes in the world belong to the dragon-flies: they cover almost all of the creature's head, and enable it to see not only approaching possible enemies, but also to detect, pursue and capture unerringly on the wing the mosquitoes and other small insects that are its food. At the other end of the scale are the small, poorly developed, dull-seeing eyes of earth-dwelling beetles and other primitive insects; some of them, indeed, being quite without eyes, useless in the perpetual dark of their chosen dwelling-places.

In addition to these remarkably developed compound eyes, insects have smaller, simple eyes on top of their heads. These little eyes, or "ocelli," are of supplemental use.

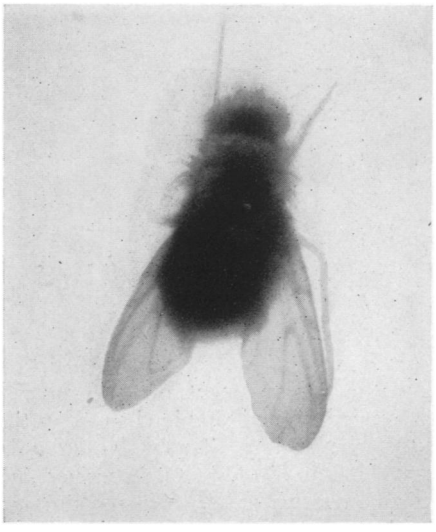
Compound eyes are distributed throughout the great animal group that includes not only insects but spiders, scorpions, lobsters and crabs. Spiders have no less than eight eyes apiece, distributed variously on their fearsome "faces."

Like a Camera

The eye of a mammal is an optical instrument resembling in its plan a photographic camera, the lens being analogous to the camera lens. It is double-convex and focuses the images of the objects upon the sensitive back wall inside the eye, just as the camera lens focuses the images upon the sensitive plate within it.

A consideration of these facts suggested to Prof. Walter E. Flowers of Spokane, Wash., the possibility of removing the crystalline lens from the eye of a recently killed animal, mounting it carefully and using it to make photographs. After a number of rather difficult experiments he made some unusually interesting photographs.

The photograph of an ordinary house-fly, which was made by the crystalline lens taken from the eye of an ox, is shown on this page. The natural lens was simply mounted in the camera in the place of the ordinary camera lens.



A FLY AS SEEN BY AN OX

This experiment was extremely difficult on account of the softness and delicacy of natural lenses. They had to be handled with camel's hair brushes and only a small percentage of those so mounted could be uninjured and capable of producing a perfect photograph. In these experiments Prof. Flowers found a few lenses imperfect because of the growth of cataracts, which made portions of the lenses opaque.

The perfect crystalline lens is a very beautiful object, being entirely colorless and transparent. It refracts light very strongly and is capable of producing exceedingly perfect images upon the photographic plate. As it magnifies considerably, it can be used for a class of work which is intermediate between ordinary photography and that of microscopic photography.

Prof. Flowers believes that further experiments with crystalline lenses from different eyes may more fully demonstrate their usefulness and lead to important practical results, especially if a method of fixation for hardening these lenses could be found which would allow them to retain the exquisite beauty of form and transparency they have in the eye of the living animal.

Into the small space of a water beetle's eye are crowded about 20,000 facets, perfectly hexagonal in shape, each one a perfect lens capable of producing images of an object. If a portion of the cornea is removed and spread flat on a glass slide, it is possible to make a multiple image photograph by the combined use of the microscope and camera. When this photograph is taken, the images are entirely too small to be seen except through a microscope.

The mosaic photograph of George Washington on the cover of this week's SCIENCE NEWS LETTER was made in this way by Prof. Flowers. Exceedingly careful adjustments, delicate lighting and exact focusing were necessary. A special developer was required for the plate and utmost care was needed in its manipulation to bring out details.

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ASTRONOMY

First "Gold From Sky" Found in Meteorite

SCIENCE'S first recorded discovery of gold that has fallen from the sky to the earth was reported by Dean Gillespie of Denver, to the American Association for the Advancement of Science.

A stony meteorite found near Melrose, New Mexico, was analyzed by H. G. Hawley of the Nininger Meteorite Laboratory in Denver. Minute amounts of gold were detected. Just to be sure, this unusual result was checked by an American Smelting and Refining Company assay.

There will, however, be no gold rush to the shooting stars, because the quantities of gold are entirely impracticable for commercial recovery.

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