

Fireflies in lockstep - synchronous flashing of fireflies

Carl Zimmer

Most fireflies flash at random, each to its own drummer. In Tennessee there are fireflies that do it differently: they synchronize.

THE FIREFLIES THAT will emerge this June around the United States will generally flash in a random-looking fashion, each one sending its own signal--except for the ones that live in the clearing next to the Faust family cabin in the Great Smoky Mountains of Tennessee. Those fireflies will send out five to eight flashes in unison, stop for a quarter of a minute, and then do it again. Occasionally they will flash in waves that ripple down the hillside like waterfalls of light. On June evenings the Faustus of Knoxville used to sit on the porch of their summer cabin, watching the hypnotic display of natural synchrony as they waited for darkness to fall. It was a decades-old family ritual.

The Faustus have recently given up their cabin, but this year their fireflies will have scientific company: Jonathan Copeland, an ethologist from Georgia Southern University. Researchers like Copeland have also watched synchronous fireflies for decades--but only in Southeast Asia, along the banks of tidal rivers, where whole trees blink on and off for hours every night of the insects' breeding season. Since the experts had almost never seen persistent synchronous flashing elsewhere, they had come to believe that there must be something special about Southeast Asia. Then, in 1991 Lynn Faust, a 37-year-old housewife, read a magazine article about the Asian fireflies. She wrote a letter to the editor, who forwarded it to Copeland, who didn't take it too seriously: he had received tips like that before.

Last June, though, Copeland decided to make the trek from Statesboro, Georgia, to the Faust cabin, to check out Faust's claim. "I had come there alone," he recalls, "and I didn't quite know where the cabin was, nor did the rangers. Finally I found the cabin and just sat down next to my car. It got to be dusk, and nothing happened. Some fireflies came out but they weren't doing that much, and I thought, 'Good grief, I've come 200 miles for this?' I waited a bit longer, daydreaming, and then looked through the woods. All of a sudden through the trees I could see a group of fireflies going flash-flash-flash-flash, and then they'd stop for a few seconds, and then flash-flash-flash-flash. I thought, 'Oh my God, it is there.'"

The human eye, though, sometimes perceives synchrony when it isn't really there. So Copeland recorded the fireflies with video cameras and light meters. He's still analyzing all the data he collected that night and during the rest of the fireflies' three-week mating season. But the instruments have already confirmed one thing: the fireflies at the Faust cabin were flashing within three-hundredths of a second of one another. Thanks to Lynn Faust, Copeland is onto the first consistently synchronized fireflies ever seen in this hemisphere.

Now he's hoping to figure out exactly how and why they do it. Fireflies, it's generally thought, achieve synchrony in much the same way that a crowd of people clap in unison at a baseball game. If you begin to clap by yourself, you pick a tempo of your own, but as you hear others clapping you adjust the interval of your claps so that your next one will be closer to theirs. A synchronous firefly likewise flashes rhythmically if it is alone. The rhythm, researchers believe, is simply the involuntary product of a circuit of neurons. If you flash a light a few times in the insect's eye, however--thereby deluding it into thinking it has a neighbor--the firefly changes its flash interval to bring itself into step with the light.

But the Great Smoky fireflies--they belong to a common species called *Photinus carolinus*--behave in a more complicated way than many of the Asian ones. Not only do they flash together, but they stop flashing together as well, and then start again. Two different neural circuits may be at work, says Copeland. One fixes the intervals between the flashes in each five-flash burst. The fireflies appear unable to change this circuit: once they start flashing, they do so automatically. But the circuit that controls the interval of darkness between the bursts, Copeland has found, seems to change when the firefly is exposed to a different pattern of light. Presumably that's how the insect keeps time with the rest of the group.

Why it should want to keep time is a more puzzling question. As in Asia, in Tennessee it is the male fireflies that flash in unison. A male firefly of any species flashes in order to attract the attention of females; if a female likes his signal, she flashes back, and they begin a conversation of light that can ultimately lead to mating. Given this ritual, there doesn't seem to be much point to flashing in unison: How can you expect to be noticed when you look like all the other male fireflies around you?

There must be some advantage to going with the crowd that outweighs the anonymity. Copeland speculates that synchronized flashing may help a male *P. carolinus* get to first base with a female. There are several species of firefly in the Great Smokies, he says, each with its own flash pattern, and a female *P. carolinus* might find it difficult to recognize an individual male of her species among a field of strangers. By flashing in synchrony, the males create a brighter light that has a better chance of getting the female's attention. Then when she responds, they can stop cooperating and start looking out for their individual genetic interests, racing to get to her first.

Copeland is less sure that the beautiful wave flashing has a real function; he thinks it may just be something the Great Smoky fireflies do when they happen to be too crowded together. In such close quarters they might respond only to the bright flashes of their immediate neighbors instead of keeping time with the whole swarm. That's the principle behind the baseball stadium wave: while you listen to the whole crowd in order to clap in unison, you only react to neighboring fans to help make a wave.

All these ideas will need to be tested this June and in many Junes to come. Copeland suspects that *Photinus carolinus* will turn out to flash in synchrony in other places besides the Great Smokies. But the population next to the Faust cabin already offers an unprecedented opportunity to finally get to the bottom of this

strange phenomenon--if only because it's so accessible to the labs of Copeland and other firefly researchers. "We can do experiments to find out what's going on," says Copeland. "That's something that no one's been able to do with Southeast Asian fireflies."

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