Can humans sense earth's magnetic field?

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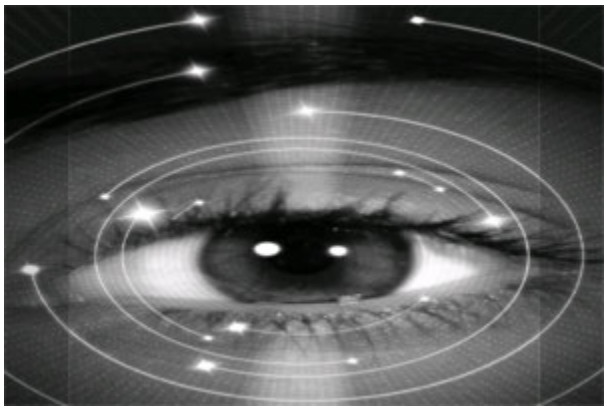

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A researcher studying how monarch butterflies navigate has picked up a strong hint that people may be able to sense the earth's magnetic field and use it for orienting themselves.

Many animals rely on the magnetic field for navigation, and researchers have often wondered if people, too, might be able to detect the field; that might explain how Polynesian navigators can make 3,000-mile journeys under starless skies. But after years of inconclusive experiments, interest in people's possible magnetic sense has waned.

That may change after an experiment being reported on June 21 by Steven M. Reppert, a neurobiologist at the University of Massachusetts Medical School, and his colleagues Lauren E. Foley and Robert J. Gegear. They have been studying cryptochromes, light-sensitive proteins that help regulate the daily rhythm of the body's cells, and how they help set the sun compass by which monarchs navigate.

But the butterflies can navigate even when the sun is obscured, so they must have a backup system. Since physical chemists had speculated the cryptochromes might be sensitive to magnetism, Dr Reppert wondered if the monarch butterfly was using its cryptochromes to sense the earth's magnetic field. He first studied the laboratory fruit fly, whose genes are much easier to manipulate and showed three years ago that the fly could detect magnetic fields but only when its cryptochrome gene was in good working order.

He then showed that the monarch butterfly's two cryptochrome genes could each substitute for the fly's gene in letting it sense magnetic fields, indicating that the butterfly uses the proteins for the same purpose.

One of the monarch's two cryptochrome genes is similar in its DNA sequence to the human cryptochrome gene. That prompted the idea of seeing whether the human gene, too, could restore magnetic sensing to fruit flies whose own gene had been knocked out. In the journal Nature Communications, Reppert reports that this

is indeed the case. “A reassessment of human magnetosensitivity may be in order,” he and his colleagues write.

The human cryptochrome gene is highly active in the eye, raising the possibility that the magnetic field might in some sense be seen, if the cryptochromes interact with the retina.

Reppert said the focus on human use of the magnetic field for navigation might be misplaced. Following an idea proposed last year by John B. Phillips of Virginia Tech, he said the primary use of magnetic sensing might be for spatial orientation.

“It could be providing a spherical coordinate system that the animal could use for spatial positioning,” he said.

Dr Phillips said that Reppert’s work was of interest but that he had been surprised by an experiment in which Reppert disrupted the part of the cryptochrome thought to interact with the magnetic field, yet the flies had still detected the magnetism. “It’s 50-50 whether he’s really studying what he thinks he is,” Phillips said.

Reppert replied that he had already ruled out the alternative explanation suggested by Phillips.

But both scientists agreed on the possibilities opened up by the cryptochrome system. Depending on how the proteins are aligned in the eye, insects may perceive objects as being lighter or darker as they orient themselves in relation to the magnetic field, Phillips said.

In fact, the cryptochrome system might supply a grid imposed on all the landmarks in a visual scene, helping a squirrel find a buried acorn, or a fox integrate its visual scene with what it hears. “This is the fun stage where we are not constrained by many facts,” Phillips said.

If butterflies, birds and foxes possess such a wonderful system, why would it ever have died out in the human lineage? “It may be that our electromagnetic world is interfering with our ability to do this kind of stuff,” Phillips said.

As for Reppert, he is now planning his next step, that of understanding how the cryptochrome proteins sense the magnetic field and how they convey that information to the fruit fly’s and monarch’s brain.

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