A Compass in a Plant: Algal Magnetism

Like a tiny compass needle, a type of green alga has been found to respond to magnetic fields. The recent discovery of algae that swim along magnetic field lines could provide a link between magnetotactic bacteria, found in the 1970s, and a magnetic sense in higher organisms, such as bees, pigeons, tuna and others, which are thought to be sensitive to the earth's magnetic field.

The magnetotactic algae were discovered by three Brazilian physicists — Henrique Lins de Barros, Darci Motta Esquivel and Jacques Danon of the Centro Brasileiro de Pesquisas Fisicas in Rio de Janeiro — while they were observing bacteria under an optical microscope equipped with magnetic coils. They noticed that microorganisms ten times the size of the bacteria were also executing sharp U turns when the magnetic field was reversed.

L. P. H. de Oliveira, an expert on algae at the Instituto Oswaldo Cruz in Rio de Janeiro, identified the algae as belonging to the genus *Chlamydomonas*. These algae were found in sediments from Lagoa Rodrigo de Freitas, a polluted coastal lagoon near Ipanema Beach in Rio de Janeiro.

De Barros announced the finding at the annual meeting of the American Association for the Advancement of Science in Washington, D.C. The Brazilian scientists had been working with Richard B. Frankel of the Francis Bitter National Magnet Laboratory at the Massachusetts Institute of Technology on studies of magnetotactic bacteria.

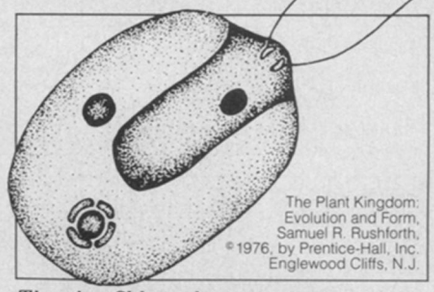
In contrast to bacteria, which are among the simplest living creatures, algal cells are labeled eukaryotes because they contain a cell nucleus and other internal structures typical of higher organisms. Frankel says this is the first unequivocal observation of magnetotaxis in a eukaryotic organism.

The algae, propelled by a pair of flagella, migrate southward along the earth's magnetic field lines. Because of the inclination of the earth's field at Rio de Janeiro, the algae move away from the surface toward the sediments. Frankel says the magnetic response mechanism of the algae appears to be similar to that in magnetotactic bacteria (SN: 5/26/80, p. 267).

The bacteria synthesize particles of magnetite (Fe_3O_4), which give the cells a magnetic dipole moment. Bacteria from Northern Hemisphere sediments swim north along magnetic field lines; bacteria from Southern Hemisphere sediments swim south. Because the earth's magnetic field is inclined at an angle that increases with latitude, the bacteria are directed downward and kept in the sediments, away from the water surface.

The next step, say the researchers, is to determine whether the algae also contain magnetite particles and to determine if the response varies with the location on the earth's surface, as it does for bacteria. The researchers would also like to find out whether other types of algae show similar behavior. More than a dozen distinct types of bacteria behave in this way, including spherical, rod-shaped and helical bacteria, and species found in both freshwater and marine sediments. Frankel says the discovery is just the beginning of a new field of study, and a whole range of questions are awaiting answers.

One question is why algae would seek the darkness of sediments. Each *Chlamydomonas* cell contains a single cup-shaped chloroplast and can use light to produce starch by photosynthesis. However, this type of alga is known to move away from light that is too intense. Frankel speculates that the alga can also live off other organic matter and does not necessarily have to produce its own food by photosynthesis. Frankel also wonders whether there is an ecological relationship between the magnetotactic bacteria and the algae.



The alga Chlamydomonas *uses its two flagella to propel itself. Researchers have observed that the motion of one species of* Chlamydomonas *is also affected by magnetic fields and think it may contain a string of magnetite particles.*

Over the years, researchers have found magnetite in many organisms besides bacteria. The list includes chitons (a class of marine mollusc), honeybees, butterflies, homing pigeons and dolphins. The first plant may soon be added to the list, and the old notion of animal magnetism may need to be enlarged. —*I. Peterson*

'Creation-science' law is struck down

Advocates of "creation science" were dealt a stunning blow this past Tuesday when U. S. District Judge William Overton ruled unconstitutional Arkansas' Act 590. Overton based his decision on the headline-grabbing testimony presented during a two-week trial in Little Rock, Ark., last month (SN: 1/2/82, p. 12).

Had the law, which was to have gone into effect next fall, not been struck down, Arkansas public schools would have been compelled to "give balanced treatment" to the teaching of what the State termed "creation science" any time the theory of evolution was taught. But in his 40-page decision, Judge Overton declared that Act 590 "was simply and purely an effort to introduce the Biblical version of creation into the public school curricula." For this reason, Overton said, the act violates the separation of church and state guaranteed under the First Amendment to the Constitution.

The ruling cheered board members of the American Association for the Advancement of Science, who were convening in Washington at their annual meeting. Only the evening before, they had adopted a resolution that called legislation requiring the teaching of creation science in public schools "a real and present threat to the integrity of education and the teaching of science." The board charged that, "Whereas the Association respects the right of people to hold diverse beliefs about creation that do not come within the definitions of science," creationist groups are actually imposing their beliefs — "disguised as science ... to the detriment and distortion of public education in the United States."

In its defense of the law, the State's attorneys elicited testimony from more than a dozen witnesses who claimed creation science could be taught without reference to religion. The law in fact requires that teaching of creation science "be limited to scientific evidences ... and must not include any religious instruction or references to religious writings."

Yet a basic tenet of creation science, as defined in Act 590, is that the universe, energy and life were created suddenly, and "from nothing." So this "argument that creation from nothing does not involve a supernatural deity has no evidentiary or rational support," Overton wrote in his decision. "Indeed, creation of the world 'out of nothing' is the ultimate religious statement because God is the only actor."

But the case is not closed. Arkansas' Attorney General has indicated that the State intends to appeal. And in Louisiana, the only other state where legislation similar to Act 590 has passed, a constitutional test of its law by the American Civil Liberties Union is slated to begin soon.

—*J. Raloff*