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MIGRATION RATE OF MUD BACTERIA AS A
FUNCTION OF MAGNETIC FIELD STRENGTH

by

Barbara D. Teague, Michael Gilson
and Ad. J. Kalmijn

November 1980

TECHNICAL REPORT

*Prepared for the Office of Naval Research
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Woods Hole, Massachusetts 02543

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Migration rate of mud bacteria as a function of magnetic field strength. BARBARA D. TEAGUE, MICHAEL GILSON, AND AD. J. KALMIJN.

Certain marine and freshwater mud bacteria are endowed with a permanent magnetic dipole moment. This moment is attributed to an endogenous chain of tightly coupled, single-domain magnetite crystals. When separated from the mud, these magnetic bacteria swim north, following the earth's magnetic field lines. As at Woods Hole, Massachusetts, the field lines are steeply vertically inclined, the bacteria rapidly return to the bottom substrate where they seem to thrive best. To quantify this migration, we measure the time to traverse the distance between two lines, 1 mm apart, as a function of the ambient magnetic field strength. Using dark-field illumination, we observe single organisms as they migrate in a low-oxygen hemocytometer chamber. We control the ambient magnetic field by regulating the current through a Helmholtz-coil system. At high magnetic field strengths, the bacteria follow a virtually straight path, swimming at rates around 150 $\mu\text{m}/\text{sec}$. At lower field strengths, they take a more random path which reduces their migration rate. Although they swerve moderately at the earth's magnetic field strength (0.5 gauss), the bacteria still achieve about 80% of their maximum migration rate observed at higher-gauss fields. This suggests that the bacterial dipole moments are well adapted to orientation in the earth's magnetic field. Since the strength of their magnet determines the degree to which the organisms overcome random motion, we can estimate the magnitude of their dipole moment.

This research is conducted under the auspices of the Office of Naval Research, as part of Kalmijn's WHOI-MBL project N00014-79-C-0071 NR 083-004, in collaboration with Drs. R. P. Blakemore and R. B. Frankel.

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