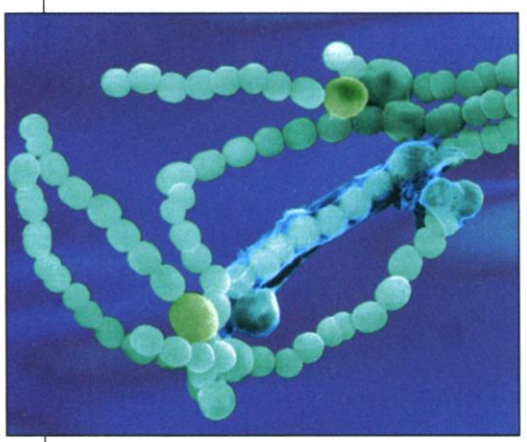
Earth, Air, Fire, and Water

It has taken us a long time to recognize the significance of the ubiquity of the microscopic life revealed by Robert Hooke through his compound microscope. This is despite our reliance on microorganisms for our daily bread, cheese, and beer, and our vulnerability to the predations of less benign types. Now we are coming to recognize that for billions of years, virtually everything in the physical environments of Earth has been transformed to some degree by the activities of simple living organisms.

In this issue, we aim to give an idea of the scale of the activity of microorganisms, and the extent to which the rest of life on Earth relies on them. The ubiquity of microorganisms raises particular questions about speciation and counterintuitive discoveries about the biodiversity of small widespread organisms (Finlay, p. 1061), an understanding that is radically different depending on the type of environment under observation (Torsvik *et al.*, p. 1064). Microorganisms concentrate at interfaces, where nutrients and energy tend to fluctuate. And at the interfaces between the lithosphere, hydrosphere, and atmosphere, we see in action Hooke's observation that life can be turned to stone with the recycling of biological matter into physical matter (Newman and Banfield, p. 1071). The huge biomasses of microorganisms that grow at these interfaces can have a major impact on regional geochemistry; for example, in mineral and hydrocarbon deposition, and the nutrition and waste of plankton blooms. Indeed, planktonic organisms are thought to have had a fundamental influence on the evolution of Earth's atmosphere (Kasting and Siefert, p. 1066).



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Along with the modern realization that microbial life is ubiquitous have come glimpses into the unexpected metabolisms of organisms that live in extreme physicochemical conditions (Reysenbach and Shock, p. 1077). New discoveries are making scientists rethink conventional understanding of life's capabilities and how metabolisms have evolved (see News, pp. 1056 and 1058). Despite these insights into the scale of microbial influences on wider environments, before extrapolation or prediction, we still have to work out how to translate genome and molecular studies into an ecological context relevant to single microorganisms (Fenchel, p. 1068). The techniques still have to be developed even to culture a representative selection of the microorganisms we know are out there (Kaeberlein *et al.*, p. 1127), and the tools have to be built to integrate the amassing genomic data with geographical information before we can exploit these discoveries in a meaningful way.

In 1665, Hooke's illustrated volume *Micrographia* was a bestseller, and it looks like the extraordinary story of microbial ubiquity will run and run. Maybe we will discover some new vital forces; certainly the new breed of interdisciplinary geobiologists will supply us with volumes of enthralling and challenging discoveries.

–CAROLINE ASH, BROOKS HANSON, COLIN NORMAN

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***See also* Science's *STKE* on p. 975, *Report* on p. 1127, and *News of the Week* story.**

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