EPIDEMIOLOGY

The sky is no limit

The advantage of an increasingly interconnected physical world has generated a dangerous by-product: the threat of major pandemics such as HIV-AIDS, SARS, or more recently the threat of pandemic influenza. In an attempt to forecast with accuracy the spread and worldwide impact of epidemics, an international team of researchers from CNRS, CEA, the University Paris-Sud and Indiana University (US), has studied the role played by air travel in this process.[1]

For the first time, scientists were able to access the International Air Transport Association database: This includes information from the largest 3100 airports in the world, 265 airlines (including number of passengers on each flight) and their flight connections (99% of all international air traffic). By matching this information with disease patterns from cities and census information from 220 countries, they were able to achieve significant predictions.

The research team, led by Alessandro Vespignani, CNRS researcher and professor of informatics at the University of Indiana, used a stochastic model (a statistical process in time involving random variables) to obtain evolving maps of contamination levels or to monitor the disease evolution.

Researchers took into account two factors with opposing effects on predictability. On the one hand, a large airport has many connecting flights, which reduces predictability (any passenger can travel to one of 200 possible destinations). "On the other hand, we were able to identify which routes were the most widely used, a factor that increases predictability," states Alain Barrat, co-author of the study and researcher at the Theoretical Physics laboratory of Orsay.[2] Therefore routes through which an epidemic spreads can be identified, and the accuracy of those predictions can be quantified.

This study is extremely useful since it gives government and health agencies a reliable reading of how a global epidemic spreads. "Inclusion of additional data, such as hygienic conditions in various countries or seasonal travel forecasts can make these predictions even more accurate," concludes Barrat.

Saman Musacchio

1. V. Colizza et al., "The role of the airline transportation network in the prediction and predictability of global epidemics," *PNAS*. 103 (7): 2015-20. 2006.
2. Laboratoire de Physique Théorique d'Orsay (CNRS / Université Paris-XI joint lab).

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MARINE ECOLOGY

Bloom or Bust? Diatoms Decide

Diatoms are photosynthetic plankton (microscopic algae) ubiquitous in oceans and freshwater systems. They are a major source of nutrients for marine organisms as well as a major producer of oxygen. They have been dubbed the "lungs of the ocean," producing about 20 % of the oxygen we breathe–as much as all the rainforests combined. Their ornately-patterned silica cell walls are a source of inspiration for nanotechnologists, who dream of replicating similar structures for the semi-conductor industry. But despite their beauty, usefulness, and environmental importance, their basic biology is still poorly understood.

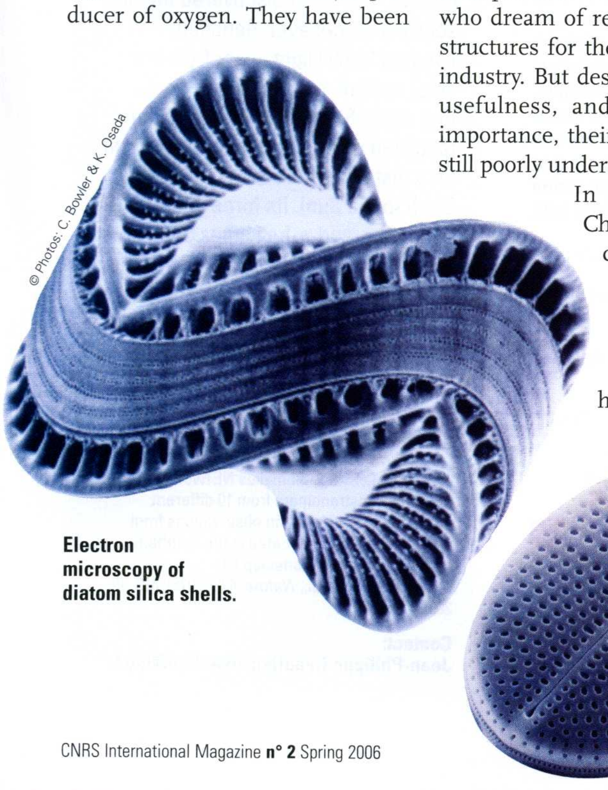
In a recent paper,[1] Chris Bowler and his colleagues from the Paris-based Diatom Morphogenesis Laboratory,[2] show how diatoms may communicate with each other via aldehyde compounds released by wounded cells.

Diatoms undergo seasonal population explosions, known as phytoplankton blooms. These blooms attract billions of predators, from which diatoms protect themselves by releasing aldehyde compounds. However, these chemicals not only compromise the hatching success of grazers, they also kill the diatoms themselves. Interestingly, diatoms have a sophisticated calcium and nitric oxide-based surveillance system for monitoring environmental stresses that can detect the release of aldehydes by its wounded neighbours. Bowler and his colleagues show that the response to aldehyde is dose-dependent–high doses of aldehyde trigger cell death, which may lead to the termination of a bloom. However, low doses induce resistance to the compound's toxic effect. Diatoms thus adapt cell fate by actively monitoring their environment. Bowler's work suggests that they communicate among themselves and sometimes commit mass suicide.

Bowler is keen to explore other aspects of diatom communication. For example, diatom afficionados have long known that the organisms have sex. However, exactly how they do it and how they find each other in the water is still unknown. Perhaps diatoms are doing a lot more communicating than we think.

Min Alverson

1. Vardi A et al., "A stress surveillance system based on calcium and nitric oxide in marine diatoms." *PLoS Biol.* 4 (3): e60. 2006.
2. Laboratoire Signalisation et morphogenèse des diatomées (CNRS / Ecole Normale Supérieure joint lab).



Electron microscopy of diatom silica shells.

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