METHANOGENS IMPLICATED IN MASS EXTINCTION 250 MILLION YEARS AGO

Barry E. DiGregorio

Methane-producing *Methanosarcina acetivorans* microorganisms, which are found in oil wells, deep-sea hydrothermal vents, and oxygen-depleted sediments, are now implicated as being responsible for the cataclysmic Permian–Triassic (PT) extinction that occurred about 250 million years ago, according to Daniel H. Rothman at the Massachusetts Institute of Technology in Cambridge, Mass., and his collaborators. Details appeared 29 April 2014 in *Proceedings of the National Academy of Sciences* (doi:10.1073/pnas.1402074111).

“The isotopic composition of carbon deposited around the time of the extinction shows that the end-Permian event is unequivocally accompanied by changes in the carbon cycle,” Rothman says. “That led us to seek the cause of those changes. We focused on the dynamical behavior of the isotopic changes. This allowed us to conclude that there was an exponential, or possibly super-exponential, burst of carbon added to the oceans and atmosphere.”

Geologists and other scientists long speculated that a surge in volcanic activity could account for the PT extinctions. However, isotopic changes during that period are not consistent with volcanic activity accounting for such a burst, according to Rothman and his collaborators, who reasoned that microbial communities are capable of exponential, or faster, growth. “Having made that realization, we then investigated the genomic record of microbial evolution,” he says. Their first efforts were to determine more precisely when *Methanosarcina*, with its efficient metabolic pathway for producing methane from carbon monoxide, likely emerged.

Rothman’s team used a combination of carbon isotopic analysis, phylogenetics, nickel analyses, and mathematical arguments to arrive at their conclusion. Each exhibited their own technical difficulties. “In many respects the hardest part of this work is the linkage of the disparate parts into a coherent hypothesis that not only makes sense mech-
World Health Organization (WHO) officials recently issued several reports with warnings on worldwide antibiotic resistance, a resurgence of polio, and a major outbreak of Ebola virus in West Africa:

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- In May, WHO warned that the recent spread of polio “constitutes an ‘extraordinary event’ and a public health risk . . . for which a coordinated international response is essential.” The “over-riding priority . . . must be to interrupt wild poliovirus transmission . . . as rapidly as possible through . . . supplementary immunization campaigns with oral poliovirus vaccine, surveillance for poliovirus, and routine immunization.”
- Through early June in West Africa, Guinea reported 351 cases of Ebola, including 226 deaths, while Liberia reported 11 deaths among 12 suspected cases of Ebola, and Sierra Leone reported 89 cases and 7 deaths, according to WHO officials. Meanwhile, this outbreak appears to be attributable to a new Ebola virus variant, according to Delphine Pannetier of INSERM and Sylvain Baize of Institut Pasteur in Lyon, France, and their collaborators. Details appeared 16 April 2014 in the New England Journal of Medicine (doi.org/10.1056/NEJM-Moa1404505).

MINITOPIC
WHO Documents Antibiotic Resistance, Polio, Ebola Outbreaks

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During the 65th World Health Assembly (WHA) in May, WHO officials released a strategy for disease prevention and control in the next decade, which is centered on strengthening the public health system. The strategy is designed to improve the preparedness and response capacities at the primary, intermediate, and national level. . . .

An investigation that linked the sharp rise in antibiotic resistance to a surge in availability of nickel, a mineral that has given rise to a bloom of the bacteria Methanosarcina, is one of the examples of the kind of thorough and nuanced research that can help inform the current global conversation about the world’s health and its future. . . .

The ideas presented in the Rothman paper are not unreasonable, but I think it is fanciful to think that microbes ‘caused’ the PT extinction,” says David Bond from the University of Hull in the United Kingdom. “Maybe they played a part in the predicted volcanism-climate-change-anoxia-extinction scenario, but we are still a long way from understanding the actual causes of this event.” He also says that the new hypothesis provides a “highly plausible mechanism for generating observed carbon isotopic shifts.”

Barry E. DiGregorio is a freelance writer in Middleport, N.Y.

PUBLIC HEALTH
Rules from 2005 Ease Matters for Officials Coping with Outbreaks

Jeffrey L. Fox

With their 10th anniversary looming, the International Health Regulations (IHR) of 2005 are gathering plenty of praise these days—a rarity for rules affecting practically every country on the planet. Thus, despite difficulties in implementing these rules and applying common standards to disparate countries, IHR 2005 is “widely accepted” among the nearly 200 countries that signed the document, according to Keiji Fukuda of the World Health Organization (WHO), which is charged with implementing the rules. He spoke during a two-day workshop, “Emerging Viral Diseases—the One Health Connection,” convened by the Institute of Medicine (IOM) Forum on Microbial Threats and held in Washington, D.C., last March.

The IHR rules, which are meant “to prevent, protect against, control, and provide a public health response to the international spread of disease in ways that are commensurate with and restricted to public health risks, and which avoid unnecessary interference with international traffic and trade,” require countries to “report certain disease outbreaks and public health events to WHO.” The rules also require countries to “strengthen core surveillance and response capacities at the primary, intermediate, and national level. . . .”

The H1N1 influenza pandemic, whose initial outbreaks occurred early in 2009 first in Mexico and then in California, provided the first test of IHR 2005 and led to its first formal review the following year, according to IOM President Harvey Fineberg. He was one of 24 experts from as many countries who served on a World Health Assembly (WHAS) committee to conduct that review. One “special challenge” for the committee was to hold its meetings open to the public, heading off criticisms that “WHO was being secretive,” he says.

The WHA committee came to several key conclusions about IHR 2005, according to Fineberg. First, the new rules “helped the world be better prepared” to cope with emerging diseases, even though many countries still fall short in terms of their core capacities for dealing with such emergencies, he says. Another issue is that, although IHR 2005 rules are binding, enforcement measures are lacking and, instead, depend on what can be negotiated with or cajoled from each country.