kicked the can down the road to the next manuscript.”

“The experiments were eminently worth doing,” says virologist Peter Doherty of the University of Melbourne in Australia, who spoke at the Royal Society symposium, referring to both H5N1 reports. “Having this information is useful,” he notes, suggesting that it is also worth knowing whether mammalian-transmissible H5N1 flu strains can also change from being “mild,” as these appear to be when one ferret infects another, to become more virulent in this mammalian host. NSABB serves an “important function,” he adds, by convening “experienced scientists” to evaluate the research while situating itself between the “scientific community” and “the security and political communities.”

“The Black Queen here refers to the Queen of Spades, which players in the game of Hearts try to avoid because it’s so costly,” Lenski says. This card-game metaphor helps one to visualize how reductive evolution can make microbes with streamlined genomes among the most successful on Earth.

The lost Prochlorococcus gene that these researchers study is katG, which protects some but not other species in the Synechococcus-Prochlorococcus clade from hydrogen peroxide, a by-product of photooxidation. Even sterile filtered sea water exposed to sunlight in the laboratory accumulates enough hydrogen peroxide in a few hours to kill cultured axenic katG-deficient Prochlorococcus strains. Although exposure to hydrogen peroxide in the wild should be similarly costly, it is not, according to these researchers. Neighboring organisms protect Prochlorococcus, which carries “less genetic baggage,” reducing its requirements for energy or nutrients, “which are in short supply in the open ocean,” Morris says.

“Genomic streamlining requires that the lost genes are dispensable for the organism in its natural environment,” Zinser says. “That turns out to be true for Prochlorococcus because other bacteria in the community protect their own interiors with katG-encoded catalase-peroxidase—a primary defense against hydrogen peroxide—and enough peroxidase activity leaks out to protect all the cells in their immediate vicinity. In this way, some marine microbes act as unintentional ‘helpers,’ protecting the vulnerable majority—the ‘beneficiaries’—as a side effect of helping themselves.”

“Leakiness” is a pivotal feature of the BQH, but it is also necessary that the “public goods” produced are energetically or nutritionally vital to nearby cells as well as to the producers. “Any function that is both leaky and costly to perform is a potential target for gene loss,” Lenski says. Inorganic nutrient acquisition, nitrogen fixation, and biofilm matrix deposition meet these criteria, and are currently being investigated within the BQH framework.

The phenomenon of cells protecting neighbor cells is neither altruistic nor self-enriching, according to the BQH. Nonetheless, both producer and recipient sometimes benefit from the association. “For example, the heterotrophic helpers probably depend on Prochlorococcus for carbon, so if genome reduction enables their beneficiary to increase its rate of organic carbon production, then the helper community also benefits greatly from the relationship,” Morris says. “Thus, the relationship between Prochlorococcus and its helpers is . . . mutualistic.”

“This elegant hypothesis touches on the well-known ecological concepts of commensalism, mutualism, or parasitism, and provides a framework to test some underlying assumptions about their evolution in microbial communities,” says Anton Post at the Marine Biological Laboratory (MBL) in Woods Hole, Mass.

Marcia Stone is a science writer based in New York City.

MINITOPIC
Single Assay Poised To Detect Pathogens along with Drug Resistances

A single RNA-based assay identifies both infectious organisms and the antibiotics to which they are resistant or susceptible, according to Deborah T. Hung of Massachusetts General Hospital in Boston and her collaborators. After identifying specific pathogens on the basis of their RNA “signatures,” cells in clinical materials are subjected to a brief “antibiotic pulse,” which gives rise to changes in behavior of a “small set of bacterial transcripts” that is used to differentiate drug-susceptible from resistant organisms. “When used to analyze clinical urine specimens, the assay identified pathogens and determined their antibiotic sensitivities without the need to amplify nucleic acids or isolate organisms,” the investigators note. Details appear in the April 2, 2012 Proceedings of the National Academy of Sciences (doi: 10.1073/pnas.1119540109).