Scorecard

Rating last year's Areas to Watch

The Large Hadron Collider

This year, the world's largest atom smasher had its first real chance to reveal new particles and new phenomena. We predicted that the first big results would arrive not from the LHC's two biggest particle detectors, ATLAS and CMS, but from the smaller LHCb detector—which was expected to test previously seen hints of new physics in the behavior of particles called B_s mesons. Alas, it hasn't yet. And neither LHCb nor the other three LHC detectors have seen incontrovertible proof of new physics—a fact that makes some scientists nervous.

Adaptation genes

In 2011, many ecologists and evolutionary biologists started using faster, cheaper sequencing technologies to search for genes and gene activity patterns that help organisms thrive in nature. Researchers discovered genes that underlie mimicry in butterflies, and several papers revealed how the plant *Arabidopsis* is adapting to climate change. But most of these efforts have not yielded the promised gene finds—yet.

Laser fusion

Some things are hard to rush, and getting a self-sustaining fusion burn at the National Ignition Facility is turning out to be one of them. Researchers at Lawrence Livermore National Laboratory in California are still working to get the world's highest energy laser pulse to squeeze deuterium and tritium until their nuclei fuse. Some researchers fear it may never work, but Livermore's finest are working through the problems one at a time and remain confident of success.

Hammering viruses

More and better immune-system generalists—so-called broadly neutralizing antibodies—came to light in 2011. These antibodies disable a wide range of flu and HIV variants instead of targeting just a specific one, providing hope for broad-ranging vaccines. After defining the structure of one such antibody that targets HIV, one group improved on its potency, a first step toward clinical value. Others have determined what these antibodies bind to on the virus. But no one has figured out which viral proteins or sugars prompt the formation of these antibodies in the body. That's what's needed for a vaccine.

Electric vehicles

Change can be a tough sell. A year ago we suggested that sales of new mass-market plug-in electric vehicles could be sluggish due to concerns about the vehicles' limited range. And so they were. Nissan sold more than 20,000 copies of its new Leaf, while Mitsubishi, Chevy, and Tesla combined for about another 25,000. Not a bad start, but it's still paltry beside the roughly 17 million vehicles sold in just the United States every year. And the feds' new inquiry into the safety of the Chevy Volt's lithium-ion batteries won't help.

Malaria shots

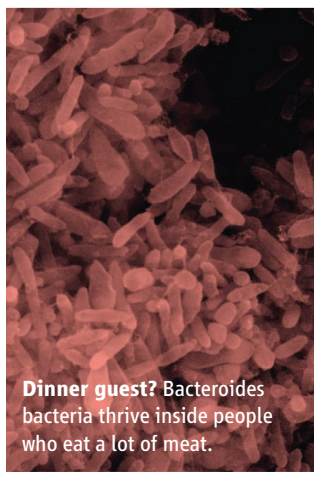
The results of the first phase III trial of a malaria vaccine came out in October. They met the modest expectations raised by phase II studies and were hailed as a milestone for this notoriously difficult research field, despite the vaccine's shortcomings (see p. 1633).

Microbes R Us

OVER THE PAST SEVERAL YEARS, STUDIES HAVE REVEALED AN astonishing diversity in our so-called microbiome. Portfolios of resident microorganisms vary from individual to individual—even twin to twin—and from body part to body part. Researchers were left scratching their heads over whether they would ever make sense of the composition of these communities or show how they affect human health.

In 2011, researchers discerned a pattern amid the complexity. A European consortium evaluated the gut microbial makeup of 22 Europeans using differences in a bacterial gene to distinguish the species within and between individuals. They compared these microbiomes with about a dozen previously characterized in Japan and the United States.

Far from being random, our internal microbial communities fell roughly into three enterotypes, which the researchers dubbed *Bacteroides*, *Prevotella*, and *Ruminococcus* after the dominant microbe in each. The gut microbiomes from larger samples of 154 Americans and 85 Danes also fit well into three groups, indicating that there are a limited number of well-balanced communities in the human gut. The classifications weren't correlated with people's age, weight, sex, or nationality. Each enterotype differed in how it processed energy and in which vitamins it produced, factors that could influence the health of the human host.



Dinner guest? Bacteroides bacteria thrive inside people who eat a lot of meat.

More work is needed to confirm that enterotypes are real. Meanwhile, another team found that types seem to correlate with diet. For example, *Bacteroides* thrived on high-meat diets; *Prevotella* did well with vegetarian fare. Neither enterotype was affected by 10 days of dietary restrictions, suggesting that they are more influenced by long-term eating trends.

This year, researchers also made other strides in understanding how diet affects the microbiome. They introduced 10 human gut bacteria into germ-free mice and monitored the composition of the bacterial community as the mice consumed different proportions of protein, fat, starch, and sugar. The results suggested rules for predicting how a change in food will alter the abundance of each species. The approach will help clarify the interplay between diet and microbes in nutrition and disease.

Several other studies provided more clues about the microbiome's role in disease, development, and immune function. Going even smaller, researchers continued to characterize the virome: all the viruses of the body. Far from being alien invaders, our microbes are integral to who and what we are.

Published by AAAS