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Life from Scratch

Geneticists have determined the minimum number of genes for life. Writing in the December 10, 1999, Science, the researchers looked at the two smallest bacteria known (called mycoplasma), which have about 500 genes, and found that at least 265 to 350 are necessary. The study provides clues to the nature of life and may pave the way for simple life-forms to be custom-made in the lab, although that step, requiring lipids, sugars and other cellular components, is still a ways off. An accompanying article by bioethicists finds no moral quandaries now but observes that questions will continually arise as technology improves.

—P.Y.

Minty Insecticide

Move over, citronella: scientists led by Padma Vesudevan of the Indian Institute of Technology in New Delhi have determined that peppermint oil can also repel mosquitoes and kill the larvae. They floated films of the oil, extracted from the peppermint plant Mentha piperita, on top of larvae-filled water; a day later nearly all the larvae were killed. The protection rate, based on the experience of volunteers who spent several nights outside, averaged 85 percent. The oil was especially effective against Anopheles culicifacies, the principal carrier of malaria in India. The work is to appear in an upcoming issue of Bioresource Technology.

—D.M.

Speed Demons

Your 56K modem is toast in the future: on the next-generation Internet, researchers transmitted standard Internet protocol data 40,000 times faster, at 2.4 gigabits per second. The record feat, done last November by a consortium that includes the University of Washington and Microsoft, transmitted the equivalent of 150 cable television channels. Researchers at Lucent Technologies’s Bell Labs also announced data transmission records, but through optical fibers. They crammed 1,022 wavelengths of light into a single fiber (commercial systems carry about 100, and each wavelength is a channel); system capacity was 37 gigabits per second. With a single wavelength, they transmitted at 160 gigabits per second.

—P.Y.

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CLIMATE

METHANE FEVER

An undersea methane explosion may have driven the most rapid warming episode of the past 90 million years

Not often does a past geologic event exemplify what the actions of humanity may inflict on the world. Most global changes, such as the waxing and waning of ice ages, take so long that they are indiscernible in human lifetimes. But 55 million years ago a series of methane gas blasts may have choked the atmosphere with greenhouse gases at a pace similar to that at which the burning of fossil fuels pumps them into the air today.

Back then, at the end of an epoch of time known as the Paleocene, temperatures in the deep ocean soared by about six degrees Celsius. This worldwide heat wave killed off a plethora of microscopic deep-sea creatures and produced a bizarre spike in the record of carbon isotopes. Five years ago paleoceanographer Gerald (“Jerry”) Dickens of James Cook University in Australia proposed that a belch of seafloor methane— a greenhouse gas with almost 30 times the heat-trapping ability of carbon dioxide— caused the shock. But no one had actually seen evidence of where this catastrophe might have happened— until now.

Dickens, working with Miriam E. Katz of Rutgers University and two other researchers, recently discovered evidence of the exact sequence of predicted methane warming events buried under half a kilometer of sediment off Florida’s northeastern coast. “It’s the first really tangible evidence of methane release from that time,” says marine geologist Timothy J. Bralower of the University of North Carolina at Chapel Hill. “It’s almost too good to be true.”

Katz, who helped to retrieve the prized seafloor sediment in 1997, was searching initially for the extinction. Some bottom-dwelling creatures called foraminifera, or forams, suffocated in the warmer water because it contains less oxygen than does cold water. Their hard shells were eventually buried in the seafloor muck.

Staring through a microscope for hours at time, Katz painstakingly separated thousands of salt-grain-size forams from their muddy mass grave using a tiny paintbrush. Her search revealed that 55 percent of the species of deep-sea forams had disappeared from the fossil record in a blink of an eye in geologic time— less than 10,000 years within the late Paleocene climate fever. Katz’s colleague Dorothy K. Pak of the University of California at Santa Barbara found that the shells of the surviving forams clearly recorded the carbon isotope spike.

Within the foram deathbeds, Katz was startled to notice a 25-centimeter-thick layer of jumbled chunks of mud.
triggered a seafloor landslide, and the jumbled mud layer looked like the smoking gun of just such an event. That’s when Katz called Dickens into the project. He based his original methane escape scenario on the fact that methane hydrate deposits, which today contain something like 15 trillion tons of gas, are the only place where organic methane exists in abundances that could alter the isotopic signature of the foram shells. When Dickens and Katz searched for the landslide source, they found chaotic sediment layers just downhill from a buried coral reef—an ideal place for gas bubbles to have gathered before freezing into icy hydrates. Still, not everything is solved. Richard D. Norris of the Woods Hole Oceanographic Institution notes that an abrupt change in deep-ocean currents, rather

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**BY THE NUMBERS**

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**The U.S. Trade Deficit**

As an indicator, the trade deficit is most peculiar, for it is both a sign of prosperity and a portent of decline. For the past 25 years the deficit rose when times were good and fell during recessions. Exports provide jobs for almost 12 million Americans at above-average wages, while imports contribute to low inflation by offering a variety of goods at modest prices.

But the huge trade deficit, at a record-breaking quarter of $1 trillion in 1999, poses the threat of a large and sudden devaluation of the U.S. dollar if foreign holders become pessimistic about the American economy. That could result in higher prices for imported goods, leading to domestic inflation and, subsequently, to higher interest rates and a slowing of the economy’s growth rate.

A major cause of the current high deficit is the disparity between the economy of the U.S., which is growing rapidly, and those of most other countries, which are not. The consequence has been a slackening of demand in these countries for U.S. goods. Another important reason is overspending by U.S. consumers. Today’s level of consumer debt, in the opinion of many economists, is particularly worrisome, for it could induce widespread bankruptcy when the economy slows, as it inevitably must. A leading student of the deficit, Catherine L. Mann of the Washington, D.C.–based Institute for International Economics, estimates that the current imbalance can be sustained for two to three years—enough time, perhaps, to put in place measures that would reduce the likelihood of a sudden devaluation. Such measures might include reducing trade obstacles further, training workers better and encouraging consumers to save.

The tremendous expansion of American foreign trade after World War II was facilitated by the General Agreement on Tariffs and Trade (GATT), which dates to 1947, and by the World Trade Organization (WTO), established in 1995. They gave the international trading system a measure of stability and predictability, thus encouraging trade worldwide, which in real terms has gone up more than 10-fold since 1960. The extraordinary increase in American trade beginning in the late 1960s and early 1970s was, according to Mann, the result of several factors, such as the cumulative effect of the reduction in trade barriers, the demand for foreign imports as incomes rose, the more open international financial environment and the internationalization of the production process through foreign investment. The growth of the deficit during the 1980s occurred when the U.S. came out of the 1981–82 global recession faster than other industrial countries did.

Among the goals that the U.S. hopes to achieve in future WTO negotiations are an extension of the moratorium on Internet taxes, the elimination of foreign agricultural subsidies and the strengthening of intellectual-property rights. But these aims may be more difficult to realize now because of demands from the newly resurgent U.S. labor movement. The unions believe, with some justification, that globalization of markets gives employers too much power, because they can threaten to move operations to a low-wage country. The labor movement, together with allies among environmentalists and human-rights activists, demonstrated its strength by persuading the U.S. House of Representatives to reject in 1998 reauthorization of “fast track” authority. (Fast track expedites trade negotiations by compelling Congress to vote on trade agreements without attaching amendments.)

This new coalition wants countries that export to the U.S. to ban child labor and guarantee the right to unionize. It wants protection against WTO actions that infringe on U.S. environmental laws and more transparency in the operation of WTO decision-making panels, which work behind closed doors. Many WTO members, particularly developing countries, vehemently object to including labor and environmental regulation under the WTO umbrella, believing it to be a maneuver by the U.S. to discriminate against their exports. Despite the acrimonious collapse of the Seattle WTO talks this past December, negotiations are likely to resume, for virtually every country has a vital stake in promoting the continued growth of world trade.

—Rodger Doyle (rdoyle2@aol.com)
than exploding hydrates, could explain
the landslide. And what caused the
methane to come out in the first place is
not clear. One possible trigger is the
five-million-year warming trend that
led up to the end of the Paleocene and
had already poised the planet for dra-
matic change. When the bottom waters
reached a critical temperature, the frag-
ile hydrates may have decomposed in a
sudden blast.

Even so, Katz says, it would have
taken a series of such blasts to generate
the nearly one trillion tons of gas that
Dickens calculated would have been
necessary to account for the isotope
spike. But besides melting, hydrates
have another, shorter way of going
from the seafloor to the sky. On a re-
search cruise off the coast of Oregon
last summer, Erwin Suess of the Re-
search Center for Marine Geosciences
in Kiel, Germany, and his colleagues
saw refrigerator-size chunks of buoyant
methane hydrate that had made a kilo-
meter-long trip from the seafloor to the
ocean surface before disintegrating.

A final question burns in Dickens’s
mind: “Once we get all of that carbon
into the system, how do we get it out?”
Understanding the consequences of the
late Paleocene warming is crucial for
the earth’s current inhabitants. Even if
we stopped driving our cars and burn-
ing coal in power plants today, Dickens
says, the carbon dioxide that is already
there would still have an impact down
the line.

—Sarah Simpson

In Brief, continued from page 24
More Than a Wobble
Astronomers generally infer the pres-
ence of extrasolar planets from the wob-
bling motion of their stars. Now they
have witnessed a distant planet passing
in front of its star (in this case, HD 209458,
150 light-years away). Using the planet’s
shadow, researchers measured the planet’s
size and deduced that it has two thirds the mass
of Jupiter and a 60 per-
cent larger radius. The
results appeared in the
January 20 Astrophys-
ical Journal Letters.

On the heels of this discovery, a British team
reports in the December 16, 1999, Nature
of having detected reflected starlight
from a planet orbiting star Tau Boötes, 50
light-years away. After filtering the plan-
et’s light from the star’s, scientists estima-
ed the planet to have eight times the
mass and to be nearly twice the size of
Jupiter and concluded that it is bluish-
green in color. Eventually both methods
will be used to determine the composi-
tion of distant planets and possibly to re-
veal those suitable for life.

—D.M.