At peace with itself, an ant triumphs

Argentine ants are marching relentlessly around the globe in part because they have given up scrapping among themselves, suggest California researchers.

These ants, *Linepithema humile,* reap big benefits from a let's-just-get-along style, say David A. Holway and his colleagues at the University of California, San Diego. In the Oct. 30 SCIENCE, they report that peaceful laboratory colonies of Argentine ants spent at least twice as much time foraging and produced almost three times as many offspring as warlike colonies.

That peace dividend by itself may not entirely explain why the species has burst out of South America during the past century and spread as far as Australia. However, "it's a contributing factor," argues Holway.

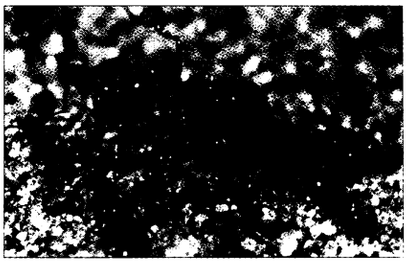
At first glance, Argentine ants seem unlikely world conquerers. "They're 2 millimeters long, they're brownish, and they're not very exciting-looking for an ant," Holway admits. Yet in many countries, they crowd out native ants and disrupt the lives of other creatures (SN: 8/23/97, p. 116).

In studying the Argentines' success, Holway and his colleagues tested aggression between colonies. When the researchers paired individuals from different colonies, ants collected in their original South American range often fought. "They lunge at each other; they form a ball, and in a few minutes, they're both dead," Holway explains. However, most Argentine ants collected in California remained peaceable when confronting a stranger from a distant nest.

The researchers then used California ants to create 22 pairs of colonies of identical size. Most colony pairs came from nests that tolerate each other, but some came from the rare nests known to fight each other. After 70 days, ants without same-species aggression had bigger colonies. The researchers believe that those superior numbers are the key to the ants' expansion, Holway says.

He's not the first to note the ants' neighborly manners. For an article on altruism, TRENDS IN ECOLOGY AND EVOLUTION ran a cover in March 1997 showing a French Argentine ant queen posing amicably beside a Swiss one, with their nation's flags painted on their bodies.

Behavioral ecologist Deborah M. Gordon at Stanford University says the beneficial effect of low aggression is "an idea that should be pursued, but there are other ideas that should be pursued, too." For example, in California, whichever ants find food usually keep it, and latecomers just back away. "Generally, the Argentine ants tend to get there first," she says.



Marc S. Dantzker/UCSD

Small, dark Argentine ants gang up on a native Californian harvester ant.

Phil Ward, an ant biologist at the University of California, Davis, finds decreased aggression a plausible factor in takeover success. Once they have high numbers, Argentine ants can "both find food well and defend it well," he says. Also, the United States offers the ants freedom from Argentine parasitic flies.

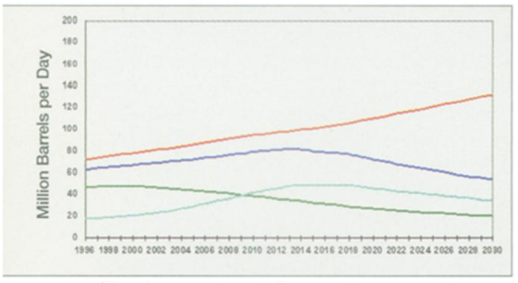
Being neighborly is hardly the only path to world domination, Walter R. Tschinkel of Florida State University in Tallahassee points out. Many fire ant colonies rip apart strangers within minutes, he says, yet their spread through the southern United States isn't going badly at all. —*S. Milius*

Geologists anticipate an oil crisis soon

Cheap oil has helped fuel the economic boom of the 1990s. But petroleum prices will jump drastically in the near future, as the world starts to feel the pinch of tightening hydrocarbon supplies, according to several forecasts.

Some see the shock coming in only a few years, while others put it off for more than 2 decades. Nonetheless, these pessimistic predictions agree that oil production will soon peak and then start sliding downward, even as demand for oil continues to climb.

"For over 150 years, mankind has been used to an ever-growing supply of cheap and abundant energy," says Colin J. Campbell, a former exploration geologist now doing studies for Petroconsultants in Geneva. His analysis calls for production to peak in less than a decade. "The implications of this on industry, world politics, and economics seems to me to be enormous," he said this week at the annual meeting of the Geological Society of America in Toronto.



The International Energy Agency projects a declining world conventional crude oil production (dark blue) after 2015. Graph also shows the global demand for oil (red), the oil production of Middle Eastern OPEC countries (light blue), and that of other countries (green).

Campbell and his colleague at Petroconsultants Jean H. Laherrère reached their conclusion by estimating the remaining underground reserves of so-called conventional petroleum—oil that is relatively easy to extract. Such oil accounts for 95 percent of the 800 billion barrels of oil that the world has burned thus far, says Campbell.

Going country by country, Campbell and Laherrère started with published tallies of oil deposits and made adjustments in cases where industry data indicates that nations had inflated their figures. Extrapolating from these numbers and past oil-discovery rates, they estimate that roughly 1 trillion barrels of oil remain in known and undiscovered fields.

Production will peak, they hypothesize, when the quantity of oil already burned equals the amount yet to be extracted. They expect that point to come within a decade but project oil prices to jump even sooner. The economic impact will occur when nations in the Organization of Petroleum Exporting Countries gain control of the market after production begins to drop outside the Middle East.

When worldwide production starts falling, nations could tap into nonconventional sources of oil, such as heavy oil, tar, and hydrocarbons locked in shales. But these will cost more to extract and process, say the researchers.

Numbers only slightly more optimistic appeared in a March report by the International Energy Agency in Paris, which estimates there are 1.5 trillion barrels of conventional oil in reserves. The agency predicted that production would peak before 2015, so by 2020, demand will exceed supply by 17 million barrels a day.

At this week's meeting, John D. Edwards of the University of Colorado at Boulder estimated that 2 trillion barrels of oil exist in known and undiscovered fields. Though he pushes the production peak back to 2020, his result "should urge us now to consider replacement energies."

Some energy analysts, however, dispute such worrisome forecasts. Thomas S. Ahlbrandt of the U.S. Geological Survey in Denver, who leads an ongoing federal effort to estimate global reserves, finds hope in new technologies that allow companies to pursue oil in the deep sea and other areas previously unexamined. "Since 1990, the area available for exploration has doubled in the world."

Advances are also helping companies after they locate oil. Three-dimensional seismic imaging has improved the mapping of fields, and whereas engineers once bored only vertically through Earth's crust, they now can steer their drilling, even horizontally.

In its 1998 International Energy Outlook, the U.S. Energy Information Administration concluded that "technologies continue to evolve that significantly enhance both exploration and production capabilities." It does not forecast production to peak during the time frame of its analysis, which runs to 2020.

Economist Morris Adelman of the Massachusetts Institute of Technology challenges the practice of estimating oil reserves. "Nobody knows how much hydrocarbon exists or what percentage of that will be recoverable," he says.

Judging from the histories of other geologic commodities, Adelman sees reasons to expect an increasing petroleum supply. "The tendency to deplete [a resource] is counteracted by increases in knowledge," he says. —*R. Monastersky*

Big shocks push volcanoes over the edge

Earthquakes and volcanoes are alike in at least one way: They cluster along the margins where tectonic plates grate against each other as they move across the planet. Yet scientists have had little evidence that one earth-shaking event can trigger the other. Now, Alan T. Linde and I. Selwyn Sacks of the Carnegie Institution of Washington (D.C.) say that some of the world's most powerful quakes seem to set off volcanic eruptions.

A handful of researchers previously have tried to link individual shocks and eruptions, but "you could never be sure they weren't just coincidences," Linde says. There is one link between a quake and a volcano that everyone agrees was no coincidence, and it caught Linde's eye.

In 1992, a magnitude 7.5 earthquake near Landers, Calif., triggered knots of activity far away. It set off rumbling under Long Valley, a collapsed volcano 400 kilometers to the north. The valley shuddered hundreds of times a day. What's more, sensitive instruments detected swelling of the pool of magma stewing below the surface.

Long Valley did not erupt, but a question burned in Linde's mind. "Suppose the Long Valley system had been poised, just ready to go," he says. "Could this type of thing be the trigger that tips it over the edge?"

To see whether past earthquakes had ever pushed volcanoes over the brink, Linde and Sacks scoured global records dating back as far as the 1500s. They chose earthquakes greater than magnitude 7.0 and volcanoes for which the eruption start date was known.

The geophysicists reported in the Oct. 29 NATURE that 8 of the study's 204 earthquakes of magnitude 8.0 or greater seemed to trigger same-day eruptions within 750 km. Altogether, 11 volcanoes blew their tops on the same day as these big quakes, but only 5 or fewer erupted on any of the 1,000 days before or after.

"If that's not just a fluke, it means earthquakes can cause things to happen at a distance where the shaking can't even be felt," says David D. Jackson of the University of California, Los Angeles.

To test the strength of the finding, Linde and Sacks randomly selected dates before or after each of the earthquakes and then recorded the number of eruptions on these dates. In 100,000 trials, only once did even eight eruptions cluster on one of the random dates. The chance of coincidentally having 11 eruptions, as in the historical data, is "terribly, terribly teeny," Linde says.

Jackson points out that the study's parameters limited the possible outcomes. If they had chosen a hypothesis that included different magnitude cutoffs or different time intervals, he says, the results might have been different.

Even Linde says that scientists won't be using earthquakes to predict eruptions any time soon. "You need a coincidence of physics," Linde says. "[The volcano] must be sitting and waiting to erupt for the earthquake to trigger anything."

Although a triggering effect is rare, "this is another tool for looking into how volcanoes prepare for eruption," Linde says. "The more you know about the physics of the volcanic system, the better you can tell what's going on."

Eruptions aren't the whole story, he adds. "There are probably a lot more like the Long Valley case, where the earthquake goes off and there's no eruption, but there is some flurry of activity at the volcano."

Few volcanoes, however, are monitored well enough to detect the kind of small changes seen in Long Valley's magma chamber. Such monitoring is bound to catch on, Linde says. "Just a couple of weeks ago, we put our first strainmeter on the slopes of Vesuvius, and we're hoping to get them on Etna and Mauna Loa as well." —*S. Simpson*

Blood, semen harbor distinct HIV mutations

Research on AIDS has hinted that HIV can evolve along distinct lines in an infected man's blood and semen. Studies also have shown that the virus mutates in ways that make it resistant to some drugs. U.S. and Swiss researchers now report findings that combine these concepts: Genetic mutations sometimes lead to different patterns of drug resistance in a man's blood and semen.

The scientists find, for example, that viral mutations providing resistance to anti-HIV drugs emerge in the blood but not the semen of some men, that the opposite also occurs, and that sometimes two distinct mutations bestowing resistance against the same drug arise in the different locations in the same man. They report this compartmentalization of HIV mutations in the Oct. 22 journal AIDS.

The drug-resistant HIV probably derives from a mutated virus that survived the drugs that killed off the main viral population, says Ann A. Kiessling, a virologist at Harvard Medical School and Beth Israel Deaconess Medical Center in Boston. In a study released last year, Kiessling and her colleagues analyzed semen and blood from an HIV-positive man who had taken antiviral drugs for several years and a protease inhibitor for 4 months. The man's blood revealed HIV resistance to protease inhibitors, but his semen didn't.

In the new, larger study led by researchers at the University of North Carolina (UNC) at Chapel Hill, HIV showed mutations associated with resistance to medication in 8 of 11 HIV-positive men whose blood and semen were tested periodically for up to 58 weeks. As in Kiessling's study, not all of the mutations arose on parallel tracks in blood and semen.

Of the eight men who developed resistance to anti-HIV drugs, seven had viral substrains in their semen that were different from those in their blood. For example, one patient developed viral mutations indicating resistance to the drug AZT in his blood but not in his semen. Three other men developed AZT-resistance mutations in both semen and blood, but the timing varied. Surprisingly, one showed resistance in his semen earlier than in his blood.

Resistance to protease inhibitors, drugs that dramatically slow replication of virus-infected cells, varied as well. In two patients, mutations subverting these drugs appeared only in the blood. "This suggests the possibility that the protease inhibitors were not getting into the semen [in these men]," says study coauthor Myron S. Cohen, an infectious disease specialist at UNC.

The compartmentalization indicates that blood tests for HIV may not reveal a drug-resistant virus in semen. "If men are sexually active and pass it on, the next person will have that much more difficulty benefiting from the drugs," Cohen says.

"This underscores [the point] that just because you're on antiviral therapy, it doesn't mean you don't have to practice safe sex," says Anthony S. Fauci, director of the National Institute of Allergy and Infectious Diseases in Bethesda, Md. —*N. Seppa*