RANDOM SAMPLES

edited by CONSTANCE HOLDEN

GPS Helps to Plot Cambodia's Killing Fields

An international team of researchers is using the latest satellite and communications technology to map what one calls the "epidemiology of genocide" in Cambodia during the 1970s. What's emerging is proof of a highly organized industry of slaughter.

ADAM MARCUS

Land of corpses. Grave site near Phnom Penh.

Using Global Positioning Satellites (GPS), investigators with the Cambodian Genocide Project, led by East Asia historian Ben Kiernan of Yale University, have been taking detailed fixes on the "killing fields" created by dictator Pol Pot. Between 1975 and 1979, the Khmer Rouge murdered 1 million to 2 million Cambodians who were seen as threats to "Democratic Kampuchea" and buried them in more than 20,000 mass graves around the country.

The Cambodian government surveyed the killing fields in the early 1980s, but the new effort is far more exhaustive, says Yale political scientist Craig Etcheson, who runs the project's Phnom Penh office. The graves overlap closely with roads and rivers, says Etcheson, so that it's clear they were used for mass transport of bodies. The surveys are revealing the extent to which the killings were "centrally controlled," he says. "And that ability to rule from a position of central authority is something that has never before been seen in Cambodian history."

So far, some 8100 gravesites have been mapped. By overlaying these with political and geographic maps, researchers are gaining an unusual multidimensional portrait of mass murder. Engineer Chris Rizos of the University of New South Wales in Sydney, Australia, who is helping with the investigation, says it's an "excellent example" of applying GPS not for military or economic gain but "as a means of documenting and trying to understand a black period in history."

Information from the project, initially funded by $0.5 million from the U.S. State Department and supplemented by $250,000 from the Henry Luce Foundation, will be put on the Internet next month, accessible via http://www.yale.edu/cgp.

Einstein: A Step Ahead of Himself

Science historians have discovered that Albert Einstein predicted gravitational lensing, an astronomical phenomenon that is used in calculating the rate of expansion of the universe, nearly a quarter century before he bothered to describe it in print. The discovery "throws another beam of light on Einstein's Mozart-like creative flow of ideas," says Harvard physicist Gerald Holton.

Gravitational lensing, in which light from a distant object is bent by the gravity of intervening bodies, was not observed by astronomers until 1979. In 1936, Einstein published a note in *Science* predicting the effect. Now, it seems, he had it figured out in 1912, several years before he completed the general theory of relativity.

In a paper on page 184, Jürgen Renn of the Max Planck Institute in Berlin and colleagues cite proof in the form of notes and equations Einstein jotted down during a 1912 visit in Berlin. University of Maryland historian of science Stephen Brush says Einstein could have arrived at his deductions using existing theories. On the other hand, "does this mean that by 1912 he already had the same fundamental physics that comes out of the 1916 theory?"

Einstein himself thought the lens theory "of little value" and submitted the 1936 note only at the prodding of a friend.

Super Silk

Spider webs have been touted as having the strength of steel. But the thread spun by the deadly black widow may even be strong enough to stop a bullet.

Scientists have been intrigued by the round webs of orb spiders because the draglines that serve as the spokes offer a model for new superstrong synthetic fibers. But biologist Anne Moore of Scripps College in Claremont, California, has found that cobwebs—tangled clumps of silk—contain even tougher stuff.

Moore cut pieces of scaffold silk from five black widows' webs and measured the force needed to break them. She found two kinds of scaffolding silk: One can be stretched by 25% before breaking and is twice as strong as an orb spider's dragline. The other is less elastic but stronger, making it about as durable as Kevlar, a synthetic fiber used in bulletproof vests, Moore reported at the annual meeting of the Society for Integrative and Comparative Biology in Albuquerque, New Mexico, last month. Says spider-silk researcher John Gosline of the University of British Columbia in Vancouver: The strength and stretchability of the black widow's product is "astounding."

Fish Sex: All in the Head?

Machismo in both man and beast is usually attributed to the sex steroids, particularly testosterone, manufactured in the gonads.

But there's an exception: the Caribbean bluehead wrasse, *Thalassoma bifasciatum*, a coral-reef fish distinguished by the ability of females to change into males when males are lacking. John Godwin, a behavioral endocrinologist at North Carolina State University, and his colleagues suggest that the fish's masculinity is decided by its brain—specifically, a hormone called arginine vasotocin (AVT)—and not the gonads.

Wrasse males come in two types: the aggressive blue-headed "supermale," a frequent spawner, and the timid but longer lived yellow male. When a supermale leaves a spawning site he has been protecting, some females and yellow males attempt to take on the job within minutes. Both change colors temporarily, and soon one takes the place of the missing supermale.

Z. LESZCZYNSKI/ANIMALS ANIMALS

Supermale. He's replaceable.

The speed of the transformation made Godwin suspect brain chemicals were at work. Sure enough, the changes occurred even in fish whose gonads had been removed, according to a report in the 22 December 1996 *Proceedings of the Royal Society*.

The researchers targeted AVT, a hormone associated with sexual behavior, by measuring its messenger RNA in the brain. Normally, females produce little AVT, but as they turn into supermales their output goes up fourfold, even outstripping dominant males, the researchers report.

Endocrinologist David Norris of the University of Colorado, Boulder, warns that it's still possible that AVT levels are rising in response to stress. Nonetheless, he says it looks as though AVT "is an instrumental part of this sex change."