Changeling. An *Anopheles gambiae* larva carrying the GFP gene.

that could help edge that dream closer to reality. Some researchers hailed the new studies as milestones, but skeptics warned that the strategy may never work in practice.

Genetically engineering mosquitoes in any way—let alone making them resistant to infectious diseases—has been tricky. That changed a few years ago when researchers discovered a series of so-called transposons—short, movable stretches of DNA that can help insert new genes into a genome—that worked well in mosquitoes (*Science*, 20 October 2000, p. 440). Now, the field is making "massive strides forward," says molecular entomologist Paul Eggleston of Keele University in the United Kingdom. Last year, for instance, a team at the European Molecular Biology Laboratory in Heidelberg, Germany, reported that it had genetically modified *Anopheles stephensi*, a species that transmits malaria in India. In a proof of principle, the team inserted a gene that encodes green fluorescent protein (GFP) and demonstrated that the gene functioned in its new environment.

Now a team led by Marcelo Jacobs-Lorena of Case Western Reserve University in Cleveland, Ohio, has spliced into the same mosquito species a gene that confers resistance to *Plasmodium*, the parasite that causes malaria. The gene encodes a peptide, called SM1, that appears to block receptors in the mosquito's gut and salivary glands that *Plasmodium* needs to replicate inside the mosquito. In two experiments, mosquitoes carrying the gene lost their ability to infect mice with malaria; in a third study, they became much less effective vectors, Jacobs-Lorena reported.

Also at the meeting, Mark Benedict of the U.S. Centers for Disease Control and Prevention in Atlanta announced that his team has found a way to create transgenic *A. gambiae*, the most common malaria vector in Africa and a much bigger killer than *A. stephensi*. Again, the team slipped the GFP gene into *A. gambiae*. Jacobs-Lorena calls the work "a real landmark," because so many previous attempts to genetically alter *A. gambiae* had failed. Now, it's probably a matter of months before researchers produce a malaria-resistant version of *A. gambiae*, for instance by equipping it with SM1, says Eggleston.

But Harvard medical entomologist Andrew Spielman cautions that huge scientific and practical obstacles remain to be overcome before transgenic mosquitoes can be deployed in the field. These range from finding a way to ensure that they replace existing populations to dealing with ethical problems regarding the protection of inhabitants of a test site. Because of these hurdles, it's "extremely unlikely" that this line of research will ever make good on its promises, Spielman asserts. Eggleston concedes that the field faces many problems. But even if the altered mosquitoes are never released, he says, they will teach researchers a great deal about how malaria parasites interact with their host.

–MARTIN ENSERINK

PALEONTOLOGY

Unhatched Eggs Help Dinos Get a Head

Rugged as they look, fossilized dinosaur skulls are frustratingly hard to find. Exposure, scavengers, and flash floods ensured that few of the information-laden artifacts survived their day. Miraculously, though, the most delicate skulls of all—those of dinosaur embryos—sometimes come to light. In the past 13 years, paleontologists have identified embryonic remains of five kinds of dinosaurs, but only one, a duck-billed dinosaur, had an intact skull. Intact embryos of the long-necked, lumbering sauropods remained unknown—until now.

Heads up. The first complete skulls from embryonic sauropods were discovered in eggs from this site in Argentina.

On page 2444, three paleontologists describe the first articulated skulls—not much bigger than a postage stamp—of titanosaurs, a group of sauropods known only from incomplete skeletons and very few skulls. "This is a really exciting find," says Jeffrey Wilson of the University of Michigan's Museum of Paleontology in Ann Arbor. The embryos come from a site in Patagonia, called Auca Mahuevo, whose rocks are packed with thousands of dinosaur eggs between 71 million and 89 million years old. In 1998, Luis Chiappe of the Natural History Museum of Los Angeles County, Rodolfo Coria of the Carmen Funes Museum in Plaza Huincul, Argentina, and others described cantaloupe-sized eggs containing fragmentary bones—and the chisellike teeth of titanosaurs. Working with Leonardo Salgado of the Museum of Geology and Paleontology in Neuquen, Argentina, the team has now found six more embryos, some with intact skulls.

The 4-centimeter-long skulls may help show which skeletal features of titanosaurs developed in tandem and which are independent. That's important, because scientists determine evolutionary relationships by comparing such features, or characters, and spurious connections can lead them astray. The embryonic titanosaur skulls confirm earlier suspicions that two key sauropod traits—the orientation of the braincase and the position of the nostrils—are independent, Chiappe and his colleagues say. Further study could tease apart even more characters to help paleontologists sort out the sauropod family tree.

The embryos may also shed light on early sauropod evolution, about which relatively little is known. Although development doesn't necessarily replay evolutionary history, says paleontologist Eric Buffetaut of France's basic research agency CNRS, embryonic features may be reminiscent of more primitive sauropods. "If you can use embryos as proxy to reconstruct this early evolution, that's really original," he says. Buffetaut hopes the discovery of sauropod embryos will encourage other paleontologists to examine eggs in their collections.

–ERIK STOKSTAD

CLINICAL RESEARCH

India Acts on Flawed Cancer Drug Trials

THIRUVANANTHAPURAM, INDIA—Reacting to numerous regulatory violations in the testing of an anticancer drug, the Indian government has suspended all human trials for 6 months at the Regional Cancer Center (RCC) here in the southern state of Kerala. It has also closed a loophole allowing the unregulated importation of experimental drugs by requiring organizations to obtain approval before the testing or marketing of any drug.

CREDITS: (TOP TO BOTTOM) JOHN R. CLAYTON/CDC/APHL; AMERICAN MUSEUM OF NATURAL HISTORY

These steps by the Ministry of Health and Family Welfare in New Delhi follow a 300-page report submitted earlier this month by an independent panel investigating a trial that RCC ran in collaboration with Johns Hopkins University in Baltimore (*Science*, 10 August, p. 1024). The report, which remains confidential, concluded that there was no

Stoppage. India has suspended clinical trials at the RCC for 6 months.

"violation of human rights or use of any banned drug" but that not all of the required regulatory procedures were followed. In particular, it said that the RCC failed to obtain necessary approval from the Drug Controller General of India and clearance from the Health Ministry's Screening Committee for collaboration with a foreign agency in studying M4N, a methylated extract of the creosote bush being tested against oral cancers.

"The report highlights irregularities in the way research was being conducted at RCC," says Indian health minister C. P. Thakur. "We are now going to insist on a procurement of permission from the central government for all new drugs, whether for experiments or for their marketing." The RCC's director, Krishnan Nair, acknowledged in an interview with *Science* that the center had not fully followed regulatory procedures.

Along with the 6-month suspension, the ministry has ordered the institute to reconstitute its Institutional Ethical Committee along guidelines issued last fall by the Indian Council of Medical Research (ICMR) in New Delhi (*Science*, 3 November 2000, p. 919). In addition, it said that a representative of ICMR must sit in on discussions of proposed clinical drug trials.

The government has also decided that all medical research institutions must abide by those guidelines, which currently apply only to ICMR institutions. A second inquiry, by the Kerala branch of the Indian Medical Association, concluded earlier this month that although there was "no evidence of exploitation, ... it is doubtful whether all the [RCC] patients understood that they were participating in a human experiment." **–PALLAVA BAGLA**

CREDITS: (TOP TO BOTTOM) P. BAGLA; INSTITUTE FOR ANTHROPOLOGY, VIENNA

FORENSIC ANTHROPOLOGY

For Ice Man, the Band Plays On

BOLZANO, ITALY—Researchers threw a grand bash here last week to celebrate the 10th anniversary of the Tyrolean Ice Man's famous emergence from an Alpine glacier. But instead of giving Europe's oldest mummified human a cake with 5310 candles, they feted him with new insights into his origins as well as plans to compare his desiccated remains with those of South American mummies.

Ever since two hikers spotted his wizened head and shoulders sticking out of the ice on 19 September 1991, the Ice Man—nicknamed Ötzi by the Austrians because he was found in the Ötztaler Alps—has been the Copper Age's biggest celebrity. In the early 1990s, Austria and Italy waged a custody battle over the remains until precise measurements showed that the find was made on the Italian side of the border. That led to an amicable agreement that opened up scientific study. Perhaps the most sensational find came just a few weeks ago: Computed tomography scans revealed what appears to be an arrowhead lodged in the Ice Man's left shoulder, suggesting that he may have been a victim of foul play (*Science*, 3 August, p. 795).

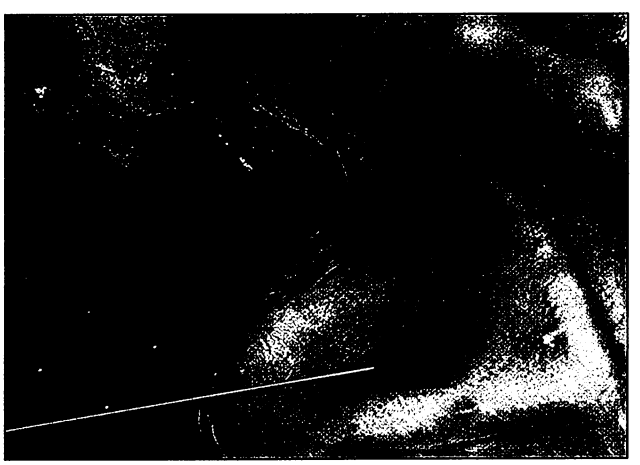
A decade of work has painted a clearer picture of the Ice Man's roots. For starters, scientists have used isotopic analyses to pinpoint his place of origin. The ratio of strontium-87 to strontium-86 in his tooth enamel indicates that he grew up eating plants grown on soils derived from gneiss and schist, the same kind of soil found in the South Tyrol region of Italy—and unlike Austria's limestone-based soils, says geochemist Wolfgang Müller of the Australian National University in Canberra. In addition, preliminary analyses of oxygen isotopes suggest that the Ice Man lived at a higher altitude as an adult, Müller says. This is consistent with the idea that the Ice Man came from Juval, a Copper Age site in South Tyrol.

Ongoing projects aim to use nondestructive techniques to examine the provenance and manufacturing methods of the Ice Man's copper ax; biopsy his prostate to learn about cancer in prehistory; and possibly try again to amplify his Y chromosomal DNA after one failed attempt. (This may contain clues to the spread of ancestral populations across Europe.) Some scientists also would like to dissect his shoulder to inspect the putative arrowhead—a decision that will be made after consideration in a future international forum, says Horst Seidler, scientific director of the Ice Man project.

Behind the headline-grabbing news, Ice Man researchers have forged new bonds with archaeologists who study Peruvian mummies. At the meeting, Seidler unveiled an agreement with the Leymebamba Museum in remote northcentral Peru. The museum, which got half of its initial funding from the Austrian government, opened in May 1998 to house about 220 16th century mummies from the Chachapoya tribe. Lessons gleaned from the Ice Man in how to preserve ancient tissue can be applied to these mummies, Seidler says, and can also boost investigations into the genetic and cultural heritage of modern Peruvians. Up to four of the mummies may be shipped to Bolzano in 2003 in hopes of revealing something about the Ice Man himself.

Seidler also announced a partnership with Chilean researchers working with the Prince of El Plomo. This Incan mummy was an 8-year-old child sacrificed near Santiago 400 years ago, then preserved in ice.

New findings can't come too quickly for Bolzano, where the Ice Man has lent his name or image to a phone card, a postage stamp, a gelato flavor, and a musical called *Frozen Fritz*, which premiered a week before the conference. Linking up with the South American researchers should help broaden the region's scientific strengths, says Seidler: "Bolzano should be much more than just a place where the Ice Man is displayed." But a decade on, Ice Man fever here is more passionate than ever—and unlikely to subside any time soon. "In 100 years," says archaeobotanist James Dickson of the University of Glasgow, "we may be arguing over what time he sat down to his last meal." **–BEN SHOUSE**



Cold warrior? A pathologist probes a wound near the putative arrowhead that may have killed the Ice Man.