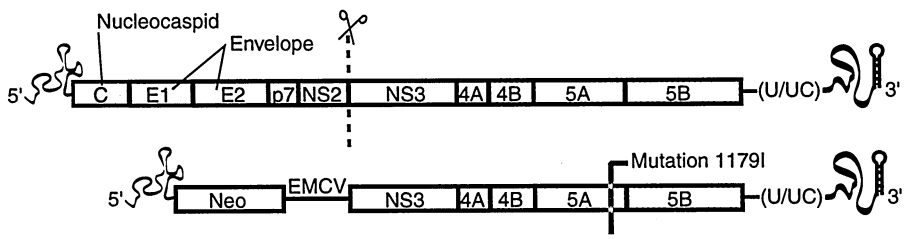
companies are battling for priority. Already, Chiron Corp. of Emeryville, California, has filed a string of lawsuits to protect its patents on HCV (*Science*, 2 July 1999, p. 28). Rice has begun making his replicon system available through a small company he founded, Apath LLC of St. Louis. Other groups are said to be developing similar replicons, and these, too, could become available. Apath is offering nonexclusive licenses to use its so-called "Blazing Blight 7" technology. The name refers to the system's blazing efficiency in producing HCV proteins and to the co-inventor at Washington University, Keril Blight.



Cut and paste. From the hepatitis C genome (top), researchers cut genes for structural proteins and added others to make a replicon (bottom). A productive mutation (S1179I) appeared in region 5A.

Rice, now at Rockefeller University in New York City, says his replicon builds on earlier work by Ralf Bartenschlager and colleagues at the Institute for Virology at Johanes-Gutenberg University in Mainz, Germany. In work reported last year (*Science*, 2 July 1999, p. 110), Bartenschlager's team took the HCV genome apart and reassembled it into a replicon, editing out parts and adding new pieces, including an antibiotic resistance gene that can be used to select the cell clones that produce the viral proteins.

Replicons have drawbacks, however. Although they include genes that regulate some host-pathogen interactions, they do not include key genes that enable the virus to infect human cells and replicate normally (see diagram). And according to Rice, Bartenschlager's initial system is inefficient, producing HCV proteins in only about one in a million host cells.

To improve the efficiency, Rice and Blight rebuilt the system using Bartenschlager's data from GenBank, looking for genetic mutations that might enable the replicon to be more productive. They found 10 interesting mutations, one of which, called S1179I, was outstanding. Replicons with this mutation produced abundant viral proteins in one out of 10 host cells. "That really makes a big difference," Rice says. "It means you can do experiments over a long term" without having to rely on cumbersome cell selection techniques, and "it is going to allow us to do genetic studies on a much shorter time scale."

Chisari says that the Rice team's work provides "a major improvement in the efficiency of the replicon system that Bartenschlager developed." He and Stanley Lemon, dean of medicine at the University of Texas Medical Branch at Galveston, note, however, that it will be important to develop a system that can produce all the important HCV proteins. Both Bartenschlager and Rice are working on such projects.

Academic researchers also hope that the Apath replicon will be easy to obtain. Until now "it's been hard to get a system that was widely enough available so that people could play with it," Lemon says. It will be great news, he continues, if this innovation means that the technology will now be widely available. Bartenschlager could not be reached for comment.

Asked whether Apath would seek restrictions on academics' use of the new technology, Rice said he does not want to do anything that would "impede academic research." Apath may ask for a 30-day prepublication review of scientific papers written by those who use the technology. And it may request that such investigators who produce patentable discoveries negotiate first with Apath on the intellectual property rights. But aside from that, Rice says, "I think that sharing material for academic research should be done with as few strings as possible."

–ELIOT MARSHALL

CREDITS: (LEFT TO RIGHT) RICE *ET AL.*; NIH

PALEONTOLOGY

Tiny, Feathered Dino Is Most Birdlike Yet

Last November, in what was to prove an embarrassing blunder, *National Geographic* magazine trumpeted the discovery of a "missing link" between birds and dinosaurs. *Archaeoraptor* turned out to be a primitive bird with a dinosaurian tail glued on (*Science*, 14 April, p. 238). Even so, many paleontologists saw a silver lining in the debacle: The chimera consisted of two partial specimens interesting in their own right. Now Chinese paleontologists describe the dinosaurian half, and they say it reinforces the same message as the falsified *Archaeoraptor* did: Birds evolved from dinosaurs.

The new fossil, dubbed *Microraptor*, is by far the smallest adult dinosaur yet discovered—about the size of a crow. Like some

ScienceScope

Looking for Alternatives British scientists should beef up their research on alternative medicine, according to a report issued last week by the House of Lords' Science and Technology Committee. Noting a dearth of high-quality research in alternative medicine, the committee urged the National Health Service and the Medical Research Council to develop a few "centres of excellence," following the path taken by the U.S. government's National Center for Complementary and Alternative Medicine. The report added that the work should ultimately be guided by a clearinghouse that is partly funded by the government.

In a separate report, the Foundation for Integrated Medicine, an advocacy group headed by Prince Charles, offered to fill that role. It outlined a 5-year, $7 million plan to jump-start new research, support existing studies at medical schools, and fund 5-year fellowships to train medical students in research methods for alternative medicine. Right now, the field is "not particularly respectable as a research career," notes the foundation's Tricia Darnell. Increasing funding would make it "more mainstream," she says.

The foundation hopes for backing from the U.K. Department of Health but admits the agency has been "lukewarm" to the idea. Meanwhile, the foundation welcomes feedback (www.fimed.org) and is waiting for a government response to the House of Lords' report.

Apple II Last January, some observers dubbed neuroscientist Gerald Fischbach "director-to-be" of the National Institutes of Health (NIH), after Harold Varmus quit the post for a prestigious job in New York City. But by spring, the White House had decided that election-year politics would sink the planned promotion of Fischbach, who had run the National Institute of Neurological Disorders and Stroke for 2 years.

Now, Fischbach is also headed to the Big Apple. Columbia University last week appointed him to its top medical post. As vice president for health and medical sciences, he will command an $815 million budget and be dean of the faculties of health and medicine. His wife, Ruth Fischbach, is leaving a biomedical ethics position at NIH to become a professor of bioethics in psychiatry at nearby Columbia-Presbyterian Medical Center.

Contributors: Richard Stone, David Malakoff, Erik Stokstad, Eliot Marshall

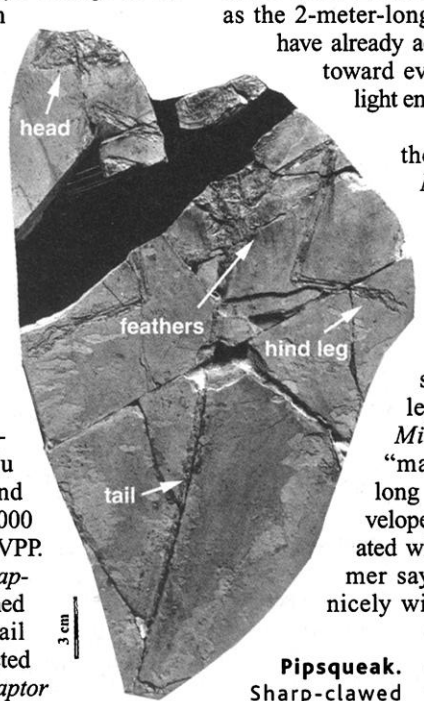
other dinosaurs from the fossil beds of northeastern China's Liaoning Province, the creature sported feathers on its body. It also has skeletal features that tighten the link between dinosaurs and birds, including clawed feet that may have been adapted for perching on branches. Such a lightweight creature was almost certainly a nimble climber, says Larry Witmer of Ohio University's College of Osteopathic Medicine in Athens. "I can't see how you could keep this thing out of trees."

Microraptor came to light when Xu Xing, a paleontologist at the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) in Beijing, heard about a dinosaur that Liaoning farmers had unearthed months before in the same fossil beds where *Archaeoraptor* had been found. Xu bought the specimen and some others for about $5000 and took them back to IVPP. He had studied *Archaeoraptor*, and when he examined the new dinosaur, the tail looked familiar. "I suspected that [the tail of *Archaeoraptor* and *Microraptor*] might be the same thing," Xu says, "but I could not believe things like this would happen." Xu contacted *National Geographic*, which published a retraction. Meanwhile, Xu and his IVPP colleagues Zhonghe Zhou and Xiaolin Wang continued to study *Microraptor*.

Xu, Zhou, and Wang report in this week's issue of *Nature* that the creature belongs to the dromaeosaurs, dinosaurs that many paleontologists consider the closest dinosaurian relatives of birds. (Other paleontologists suspect that *Microraptor* may belong within another group of birdlike dinosaurs, the troodontids.) Like *Sinornithosaurus*, another dromaeosaur from Liaoning, *Microraptor* is surrounded by carbonized impressions that resemble the contour feathers covering the bodies of modern birds. But *Microraptor* does *Sinornithosaurus* one better: Close to its thigh, the impressions appear to stick out from a central shaft, called a rachis, which is a defining feature of true feathers. "These structures look exactly like feathers preserved on the bodies of birds in the same rock," says feather expert Rick Prum of the University of Kansas, Lawrence. Bird-dino skeptic Larry Martin, also of the University of Kansas, says he sees only "broad filaments of something."

But *Microraptor* has other features that ally it with birds. For one, it is the first known adult dinosaur smaller than *Archaeopteryx*. (Fusion of certain bones indicates that the specimen was more or less full grown.) Its 47-millimeter-long trunk would fit in the palm of your hand. A dinosaur that small—unlike other known birdlike dinosaurs, such as the 2-meter-long *Velociraptor*—would have already accomplished a key step toward evolving into a creature light enough to take wing.

The feet, too, resemble those of *Archaeopteryx*. *Microraptor*'s claws are highly curved, and the first digit is positioned farther down the foot than in other dromaeosaurs. Tom Holtz of the University of Maryland, College Park, suggests that *Microraptor*'s ancestors "may have been in trees long enough that it had developed specific traits associated with that life habit." Witmer says that adaptation fits nicely with the idea that flight evolved not on the ground but in tree-dwelling animals—a minority view that he shares with Zhou and a few others.



Pipsqueak. Sharp-clawed *Microraptor* was light enough to climb trees.

No one is sure about *Microraptor*'s climbing habits. "Just because you have a curved claw doesn't mean you have to be up a tree," says Jim Clark of George Washington University in Washington, D.C. "We don't know enough about what these animals were doing, and we certainly don't know enough to test ideas about whether the ancestors of birds were arboreal or cursorial." With the controversy of *Archaeoraptor* just behind them, paleontologists may take a while to decide whether to place *Microraptor* out on a limb.

–ERIK STOKSTAD

JAPAN

Human Cloning Ban Allows Some Research

TOKYO—Japanese legislators last week approved a ban on human cloning that leaves room for the use of certain techniques in basic research. The action comes at the same time officials in two other countries—China and France—aired similar proposals that would prohibit so-called reproductive cloning while recognizing the possible importance of the technology in combating disease and improving human health.

The Japanese law, passed by the Diet on 30 November, bars the implantation into a human or animal womb of any embryos produced by transferring a human cell into an enucleated egg. It also proscribes implanting hybrid embryos, produced by matching a human cell with an animal egg or vice versa, and chimera embryos, in which early human and animal embryonic cells would be fused. Violators would face penalties of up to 10 years in prison or a fine of up to $90,000.

At the same time, the Japanese law does not forbid creating such embryos. "I think it is a very reasonable bill, in that it will allow basic research to continue," says Takashi Yokota, a researcher at the University of Tokyo's Institute of Medical Science, who is planning to use human stem cells to study basic stem-cell mechanisms.

An official of the Science and Technology Agency says the bill was deliberately worded to allow in vitro research using cloning techniques and human cells. "There is a possibility of this technology having important medical research applications," he notes. However, any such research will require the approval and oversight of a national review board. A government advisory panel is expected to work out details within the next year.

On 2 December, a panel of scientists advising China's human genome project held an open discussion of issues relating to genetic research, during which several panelists expressed concerns about the dangers of cloning. In 1997 China's health minister announced that the government was opposed to human cloning and that scientists and doctors were not allowed to participate in any research toward that goal, although social scientist Qiu Renzong, chair of the genome project's ethics committee, noted that research on technology to generate human organs for use in medical treatment is not prohibited. The government is also drafting a law that would regulate genetic research in plants, animals, and humans. The proposal is expected to be presented next year to the State Council, says Wang Hanpo of the Ministry of Science and Technology.

In France, Prime Minister Lionel Jospin announced on 28 November that the government was preparing bioethics legislation that would modify a 1994 law prohibiting all research on human embryos. The changes would preclude reproductive cloning but allow research on embryonic cells under strict conditions, including a requirement that the cells come from "spare" embryos from fertility clinics that would otherwise be destroyed and that the parents give full consent. The bill is expected to be introduced in the spring.

–DENNIS NORMILE

With reporting by Ding Yimin in Beijing and Michael Balter in Paris.

CREDIT: XU ET AL., *NATURE* 408 (6813), 705 (2000)