University of Arizona identified 13.5-million-year-old fossilized fish jaws from what is now Colombia's Magdalena River basin as belonging to a living species: the giant herbivorous fish *Colossoma macroponum*, now found only in the Orinoco and Amazon rivers. Lundberg suggested that the fish once roamed all three rivers, but that about 10 million or 11 million years ago, the rising northeastern Andes cut off the Magdalena from the other two rivers and caused local extinction of *Colossoma* and other species in the Magdalena basin.

In the 1980s, *Colossoma* was thought to be an anomaly, and there was little data to support the impact of the rising Andes on the fish's biogeography. In the past few years, however, *Colossoma* has acquired company, as all sorts of species have turned out to be relatively ancient. Lundberg has found fossil teeth of flesh-eating piranhas just like those that patrol the Amazon and Orinoco today; he's also uncovered skulls of large, still-extant catfishes from the lowland rivers east of the Andes. All these fossils date back to about 13.5 million years ago—long before any glacially induced climate changes.

At the meeting, ornithologist Shannon Hackett of the Field Museum showed that some Andean birds, too, are of great antiquity. She and colleagues presented evidence gathered both from traditional fossil studies and from molecular analyses of genetic divergence in avian DNA and proteins. The studies measure how long ago a bird species diverged from other species on the avian family tree, using fixed dates from the study of a few bird fossils, such as those of geese and quail. Researchers then take the genetic distance between living representatives of the ancestral species and divide by their times of emergence to estimate an average rate of avian speciation. Hackett then extrapolated backward to estimate when Andean taxa such as tanagers, antbirds, and brushfinches emerged. She found that these and other modern Andean birds have lineages dating back 4 million to 10 million years—an order of magnitude older than previous estimates. "A lot of divergence predates 10,000 years and, perhaps, the Pleistocene itself," she says.

UNIV. OF ARIZONA

Fresh catch? Fossil Andean fish, 13.5 million years old, are related to this modern catfish.

Some systematists have questioned Hackett's technique, however, because it assumes a constant rate of divergence. But Hackett defends it in this instance because "it is not used for precise calibrations, but only for gross estimates." She is confident that these studies document that lineages of these birds are older than previously thought. And she adds that many South American birds don't migrate, which reduces gene flow and the potential for differentiation of bird populations, thus helping to explain the low speciation rate.

John Flynn of the Field Museum says that for him it was "a surprise but not a shock" to learn that many South American lineages are much older than previously believed. After all, the prevailing view that South American faunas are evolutionary youngsters was largely supported by extrapolating data and models from North America, a sometimes dangerous practice. And as more ancient lineages come to light, Flynn and other researches expect that these understudied fauna in a remote region of the Earth may have still other surprises to offer.

–Anne Simon Moffat

AIDS

SIV Data Raise Concern on Oral-Sex Risk

"Safe sex" was once the battle cry of everyone from health care workers to hotline operators who give out information about AIDS. But that phrase has gradually been replaced by one that is subtly different: "safer sex." The subtext to this change is that risks associated with sex can be reduced, but they cannot be completely eliminated. Condoms can break. Trusted longtime partners can have surreptitious affairs. And as researchers learn more about how transmission occurs, once seemingly "safe" practices can get bumped a few rungs up the risk ladder. Now, the results of a monkey study, reported in this issue on page 1486, may lead to a reexamination of the risk of HIV infection from a practice that has seemed relatively safe: oral sex.

The new study, headed by oncologist Ruth Ruprecht of the Dana-Farber Cancer Institute in Boston, assesses the risk of nontraumatic oral exposure to SIV, the simian AIDS virus. Ruprecht's team at Dana-Farber, in collaboration with a group at the Tulane Regional Primate Research Center, found that when they gently placed various concentrations of SIV on the backs of the tongues of seven monkeys, six of them became infected. Even more surprising: The minimum dose needed to infect monkeys with this strain of SIV was 6000 times lower than the minimum dose needed to infect them via the rectum. "It's a very engaging paper," says Kenneth Mayer, a clinical epidemiologist at the Brown University AIDS Program. "The data have to be taken seriously, although they certainly don't square with the [human] epidemiology to date."

Ruprecht stresses that her data indicate that the amount of SIV needed to infect a monkey via oral exposure is still relatively high—roughly 800 times what it takes to become infected by an intravenous (iv) injection of the virus. And, as the paper underscores, it is highly unlikely that anyone could become infected by HIV from casual contact, such as kissing or sharing a fork. Her take-home message: "Given enough inoculum, the oral route can lead to infection."

DANA-FARBER

Surprising data. Ruth Ruprecht found monkeys are easily infected by oral exposure.

As Ruprecht and her co-authors point out, there is scant published evidence that HIV is transmitted between humans via oral sex. Although the scientific literature is sprinkled with a few cases of men becoming infected by men through oral sex, assessing the risk has been all but impossible. "Oral exposure is so ubiquitous in the course of anal sex that you can't disentangle them," says Mayer. Epidemiologist Ann Duerr of the Centers for Disease Control and Prevention (CDC) says it has been equally difficult to assess the risk of women transmitting the virus to other women through oral sex. "There's very, very little data that this is a way women get infected," says Duerr. "All I can say is CDC has tried to look at this through its surveillance data, and we don't pick it up."

Ruprecht and her colleagues didn't set out to assess the potential risks of oral sex, however. Instead, they were interested in tracking the transmission of HIV from infected mothers to their newborns. They were focusing on the possibility that newborns swallow HIV during the birthing process, a supposition supported by the finding that blood in the gastric aspirate of newborns strongly predicts whether they will test positive for the virus. They also knew that babies had very low levels of gastric acid. This led them to test whether using drugs to lower gastric acid levels in adult monkeys would make the animals more susceptible to oral doses of SIV. The drug had no effect.

That wasn't the only hypothesis that didn't hold up. After finding that their initial thesis was wrong, the researchers decided to compare oral transmission to other routes, expecting to find it easier to infect monkeys both rectally and intravenously. Although iv injections easily infected 13 of 18 monkeys using relatively dilute doses of SIV, higher doses of virus given rectally only infected two out of eight animals. "I find it very, very surprising," says Duerr.

Duerr and others voice some caveats about the study, however. They point out that the monkeys were exposed to cell-free SIV, while human oral exposure would be more likely to occur through infected cells, which may make it harder to establish an infection in the recipient. There is also evidence that human saliva can render HIV less infectious. And the rectal tests may provide no indication of the relative risks of oral versus anal intercourse, because anal intercourse causes microlesions that can make it easier for the virus to get into the bloodstream.

Christopher Miller, a primate researcher at the University of California, Davis, isn't surprised by the data, however. He and his co-workers have a paper in press that also shows that monkeys can routinely be infected by oral exposure to SIV. Miller suggests that the high rates of oral infection may be because adult, captive primates often have gingivitis in the junction between the teeth and the gums, setting up a route of infection similar to the lesions caused by anal intercourse. Ruprecht counters that the animals her group used were young and had no obvious gingivitis. She suggests that the mechanism of transmission might be through the tonsils, which make a good home for HIV-1, as Ralph Steinman and Melissa Pope at Rockefeller University in New York, working with Sarah Frankel and colleagues at the Armed Forces Institute of Pathology in Washington, D.C., recently reported in *Science* (5 April, p. 115).

Brown's Mayer says he expects the new monkey data will be a hot topic at the international AIDS conference in Vancouver next month. "I think it's going to lead to a lot of discussion, and I hope it makes people take pause," says Mayer. "Right now, there's a certain amount of complacency because of the epidemiology." Duerr notes that CDC recommendations already call for using a condom during mouth-to-penis contact.

Ruprecht is quick to acknowledge that the data in her paper raise more questions than answers. But at the very least they are a further reminder that, until the precise mechanisms of HIV transmission are known, it is safer to refer to "safer" sex.

–Jon Cohen

HEART DISEASE

Chlamydia Linked to Atherosclerosis

For decades, an odd group of bacteria called *Chlamydia* has given microbiologists a series of surprises. These pathogens, once known chiefly for causing illness in parrots, were originally thought to be viruses because they can only grow inside animal cells. Then *Chlamydia* turned out to be behind several sexually transmitted diseases. And in the 1980s, microbiologists recognized that an unusual pear-shaped form was a new species, *C. pneumoniae*, which accounts for about 10% of pneumonia cases—and probably infects most people at one time or another.

Now the *Chlamydia* story is taking an even more startling turn. A small but growing stack of papers links *C. pneumoniae* with atherosclerosis, the clogging and hardening of the arteries that lead to half the deaths in the United States. The latest look at this association, reported in the June issue of the *Journal of the American College of Cardiology*, turned up a surprisingly high incidence of *Chlamydia* in the arteries of patients with atherosclerosis, but found little sign of the pathogen in arteries damaged after heart transplants. The results are spurring additional research on the crucial—and difficult—question of whether the link is causal or merely coincidental.

E. HAMMOND

Heart attackers. *Chlamydia* antibodies glow in diseased artery.

A link between a pathogen and atherosclerosis is "a fascinating idea," says University of Wisconsin cholesterol researcher Alan Attie. But researchers are cautious, because infection theories have come and gone in the past. "I don't think anybody is convinced that [the link] is causal," says University of Chicago pathologist Robert Wissler, "but [the] evidence makes you want to study the whole thing further."

Chlamydia was first connected to atherosclerosis during a screening for infectious agents in heart patients in Finland, reported in 1988 by Pekka Saikku of the University of Helsinki. Epidemiologist J. Thomas Grayston at the University of Washington and colleagues followed up, expecting to disprove the link. "I thought it was unlikely," says Grayston, a respiratory pathogen expert who first identified *C. pneumoniae* as a new species.

Instead, Grayston and others found that heart patients with atherosclerosis generally had high levels of antibodies to *C. pneumoniae* in their blood as compared with controls. The organism itself could be detected in an average of 50% to 60% of diseased coronary arteries. In a paper in the 15 December issue of the journal *Circulation*, Grayston's group extended the findings to carotid arteries as well.

Many of these studies lacked controls, in part because they are hard to find: Atherosclerosis is present at some level in most adults. But in the most recent report, Utah cardiologist Joseph B. Muhlestein and colleagues compared tissue from patients treated for atherosclerosis at LDS Hospital in Salt Lake City with control tissue from people who died of other causes. They tested fresh artery tissue from 90 patients with a *Chlamydia*-specific antibody and found a positive result in 79%—"a very high incidence," says the group's pathologist, Elizabeth H. Hammond. "We were shocked." Of the 24 control specimens, only one, or 4%, showed any sign of the antibody. Additional, unpublished control samples also show no evidence of *Chlamydia*, adds Hammond.

Even though the number of controls is small, the result is important, says Grayston, because the contrast between the two groups is so clear-cut. What's more, the Utah team's controls included 12 samples from people who had undergone heart transplants. The absence of *Chlamydia* in this tissue is especially significant, the Utah researchers say, for these arteries are damaged, but not by atherosclerosis. Thus their results may imply that *Chlamydia* is linked to atherosclerosis itself, not simply to damaged arteries.

Both the Utah and Washington groups are now running studies in animal models of atherosclerosis to investigate how *Chlamydia* travels from the respiratory system to the arteries, and what it might do once it gets there. The ultimate goal is to learn whether the presence of the bacterium is a coincidence or a cause of the fat and cell buildup in arteries. Because atherosclerosis is considered to be a response by the blood vessel to some sort of injury, says Attie, it is plausible that bacterial infection could contribute to the injury, along with such established factors as high cholesterol.

Still, wary physicians note that atherosclerosis has been associated with infections ranging from periodontal disease to herpes, but there's still no conclusive proof that an infectious agent plays the primary causal role in most cases of heart disease. And all sorts of innocent organisms can flock to the scene once a tissue is damaged. "Passengers occur in diseased tissues over and over again," says Wissler.

Yet he and other researchers are mindful of one striking infection theory that didn't go away: Peptic ulcers, long blamed on too much stomach acid, are in most cases the result of infection by the bacterium *Helicobacter pylori*. Whether *C. pneumoniae* will follow in *H. pylori*'s tracks remains to be seen, but Grayston, for one, wouldn't be surprised. "They've always been a fascinating group of bugs," he says.

–Christine Mlot

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