acts as master switch. MacAyeal notes that the Laurentide ice sheet served as a huge insulating blanket for the underlying bedrock, trapping the heat that flows up from Earth's interior. Eventually, the bottom layer of ice would have melted, he proposes. With the meltwater as a lubricant, the ice sheet would lose its footing and collapse to half its 2-kilometer height by unleashing icebergs. Then the ice sheet, having lost its pent-up heat, would begin to grow again.

That cycle of ice growth and collapse, MacAyeal thinks, might account for the repetitive temperature shifts seen in the Greenland ice record. Before collapse, cold winds would whip around the massive ice sheet in eastern Canada, keeping the region cold. But after the ice sheet collapsed and the cold winds abated, the ocean would warm gradually. The resulting evaporation, according to MacAyeal's scheme, would increase salinity and turn on deep-water formation and its attendant flow of heat from the south. Thus each ice sheet collapse would trip the ocean switch, unleashing a major pulse of warming. Between collapses, says MacAyeal, the ocean switch would make smaller oscillations of its own, driving the smaller intervening climate shifts.

If it takes ice sheets to flip the conveyor belt, that same climate switch should be pretty stable in today's post-ice-age world, say researchers. "My views have changed in the last year," says paleoceanographer Scott Lehman of the Woods Hole Oceanographic Institution. He had been quoted as saying that recent findings of abrupt climate change late in the ice age suggested that "the present climate is very delicately poised." Now Lehman says, "It seems that the conveyor may be a little more robust...than some scenarios had it."

But if the climate system has one switch, it may have others. Today's climate seems to have its own tremors, as researchers studying a link between changes in the Pacific and a decade of wild and woolly weather over North America have learned (*Science*, 20 March 1992, p. 1508). By studying the unruly climate of the last ice age, researchers are hoping they can find any other switches and put them out of bounds before humanity in its ignorance fiddles with them.

–Richard A. Kerr

Additional Reading

R. B. Alley *et al.*, "Abrupt Increase in Greenland Snow Accumulation at the End of the Younger Dryas Event," *Nature* **362,** 527 (1993).

G. Bond *et al.*, "Evidence for Massive Discharges of Icebergs Into the North Atlantic Ocean During the Last Glacial Period," *Nature* **360**, 245 (1992).

S. J. Johnsen *et al.*, "Irregular Glacial InterStadials Recorded in a New Greenland Ice Core," *Nature* **359**, 311 (1992).

MEETING BRIEFS

Old Feuds, New Finds Mark Anthropologists' Meeting

At the annual meeting of the American Association of Physical Anthropologists (AAPA), held in Toronto from 14 to 17 April, there were few dazzling fossils or fresh theories to steal the show. So researchers concentrated on the field's long-standing controversies. *Science* offers a sampler of some of the more spirited debates.

Seesawing on Syphilis

Ever since a syphilis-like disease ravaged Europe in the early 1500s, scientists and historians have been searching for the cause of the dreaded epidemics. One theory in particular has had a roller-coaster history, being favored in the early 1900s, rejected in the 1960s, and resurrected in the past few years. That's the idea that Columbus and his crew brought the scourge back from the New World. But new data presented at the Toronto meeting support the idea that the *Treponema* bacteria, which cause syphilis and related diseases, was present in the Old World long before Columbus set sail. The European picture is changing "very rapidly," says Donald Ortner of the Smithsonian's National Museum of Natural History.

Syphilitic sign. Crater-like scar suggests syphilis-causing bacteria were in Europe before 1492.

The notion that Columbus brought syphilis to Europe was made plausible by the paucity of evidence for the disease there before 1492. In contrast, *Treponema* left clear tracks in pre-Columbian America, where many skeletons show classic signs of treponemal infection: lesions and thickening of the bones, and, occasionally, a distinctive crater-like scar with radiating lines in the skull. At AAPA, three independent teams brought forward similar cases from Europe. Both Ortner and Ann Stirland, an independent anthropological consultant in Towcester, England, reported signs of treponemal disease in skeletons from English burial grounds; historical records suggest the bodies were buried before 1492. Stirland recovered three such skeletons from the church cemetery of St. Margaret In Combusto, in Norwich. Most convincingly, on the skull of one middle-aged male, she found the pattern of pits and star-shaped lines that is a definitive sign of treponemal infection. Ortner and his English colleagues reported on a young woman buried in Black Friar's Cemetery, Gloucester, whose skull also exhibits the stellate lesions, and whose limb bones have the characteristic scarring.

And *Treponema* may have plagued Europeans long before the Renaissance if Maciej Henneberg and his wife Renata Henneberg of the University of the Witwatersrand in Johannesburg, South Africa, are right. They found signs of treponemal disease, including thickened skulls and shin bones, in 47 of 272 skeletons found at Metaponto, a rural Greek colony in what is now southern Italy. Grave goods buried with the skeletons suggest dates of 600 B.C. to 250 B.C.

But these finds haven't convinced everyone. While the Metaponto skeletons are undeniably ancient, the bony pathologies they display could have been caused by other diseases, such as anemia, insists George Armelagos of Emory University in Atlanta. And the English skulls haven't been precisely dated yet. Armelagos believes the evidence for the Columbian introduction theory is "overwhelming —thousands of individuals from Florida to Ohio," while the European evidence is equivocal, relying on a handful of skeletons. He and Ortner agree, however, that more data—and better dates—from European graveyards may resolve the issue.

Gorilla Genetics

Some of the most interesting science happens through serendipity, and anthropology is no exception. For example, Maryellen Ruvolo of Harvard University was seeking to shore up her case for close kinship between humans and chimps, when she turned up some unexpected results about another great ape, the gorilla. Her new data, and unpublished

work from other labs, suggest that the endangered gorilla, considered a single species, is surprisingly diverse genetically. That could have important conservation implications, because it suggests that two or even all three of the gorilla "subspecies" may be distinct species that should be conserved separately.

Such conclusions are a long way from Ruvolo's original research. She was exploring the relationship among chimps, gorillas, and humans by sequencing a mitochondrial gene that codes for an enzyme called cytochrome oxidase subunit II or *COII*. Her results on that contentious issue—she found that chimps and humans are closely related—sparked much debate and raised questions about potential problems in her methods (*Science*, 19 October 1990, p. 376).

One particular methodological issue led Ruvolo to gorillas. Even within one species, mitochondrial genes can be extremely variable, as Donald Melnick of Columbia University recently found in macaques. If this were true of other species, then using a single individual to represent an entire species—as Ruvolo and most other molecular systematists had been doing—could lead to serious errors. So Ruvolo sampled additional individuals, both human and from each species of great ape: common chimp, pygmy chimp, gorilla, and orangutan.

Humans and chimpanzees showed relatively little individual variation in their *COII* sequences—1/2% for humans and pygmy chimps, and 1% for the common chimp. The two species of chimp differed by about 3%. But the gorilla subspecies presented "a big surprise," exhibiting as much diversity as the chimp species. Western lowland gorillas (*Gorilla gorilla gorilla*) exhibited a 3% sequence difference from eastern gorillas, which include the eastern lowland gorilla (*G. g. graueri*) and the mountain gorilla (*G. g. beringei*).

Ruvolo's data match perfectly the picture sketched by genes from another part of the mitochondrial genome, a rapidly evolving area called the control region. Karen Garner, formerly of the San Diego Zoo and now of the U.S. Department of Agriculture Forest Service research lab in Delaware, Ohio, sequenced this region in about 60 gorillas. Like Ruvolo, she found that eastern and western gorillas were as different from each other as the two chimp species.

All this genetic data fits well with behavioral evidence now emerging from long-term studies of wild gorillas in West Africa, says Diane Doran of Duke University, one of the few gorilla-watchers at the meeting. Those studies suggest that eastern and western gorillas eat different foods—western lowland gorillas like fruit, for example, while mountain gorillas in the east prefer nettles and thistles.

These findings suggest that conservationists ought to be even more cautious about preserving the gorilla, says Oliver Ryder, geneticist at the San Diego Zoo, who, with Garner, gave Ruvolo the gorilla samples. If western lowland gorillas—the kind mostly found in zoos today—are genetically distinct from both mountain and eastern lowland gorillas, then it's important to conserve each subspecies separately and avoid interbreeding, both in the wild and in zoos. The same caution would also apply to the two orangutan subspecies Ruvolo studied, which she found were even more genetically diverse, showing 5% differences in their *COII* gene sequences.

And what of Ruvolo's original question about the evolutionary relations among humans and our ape cousins? After her AAPA presentation, her opponents were still dissatisfied with the evidence, believing that gorillas and humans are closely related—or at least that the three-way split is too close to call. But Ruvolo says her new data still support close ties between humans and chimps, and that gorillas—all three kinds—are more distant cousins to both.

Hyoid hubbub. Can you tell the difference between modern human *(top)*, Neanderthal *(middle)*, and pig *(bottom)* hyoids?

At Each Others' Throats

For more than a century, paleoanthropologists have been trading barbed remarks over whether Neanderthals could talk. Today the issue is more important than ever, because it touches on another current debate: whether the stout-bodied, heavy-browed Neanderthals were part of the ancestral line of modern humans in Europe or whether they were an evolutionary dead end, swept aside by anatomically modern humans from Africa.

Toronto was the site of the latest oral arguments, with the fracas centering on the only known Neanderthal throat bone, found in Kebara cave, near Mt. Carmel in Israel. Described in 1989 by Baruch Arensburg of Tel Aviv University and colleagues, the bone has been noisily disputed ever since. Argument has focused on two issues: the dimensions of the 60,000-year-old bone, and what it reveals about Neanderthal speech. Surprisingly, in Toronto the rival camps were in partial agreement on both issues, but their conclusions seem to leave questions of Neanderthal speech and lineage as vexing as ever.

First, researchers tackled the size and shape of the small, U-shaped bone, called the hyoid. Arensburg and colleagues originally took six measurements of the Kebara hyoid, and found it similar to that of modern humans. But Jeffrey Laitman and Joy Reidenberg of the Mt. Sinai School of Medicine dispute their method (*Science*, 3 April 1992, p. 33). This year, Reidenberg presented their data on more than 100 pig hyoids, and found that the pig and Kebara hyoids are similar on two of Arensburg's original six measures.

Immediately after Reidenberg sat down, David Frayer of the University of Kansas got up to challenge her results. He called the pig comparison "misleading" because human and pig hyoids are so different. Arensburg's six dimensions are useful in comparing the similarly shaped modern human and Kebara 2 hyoids, says Frayer, but the measurements do not capture the obvious shape differences between the Kebara and pig hyoids. He pointed out that any two objects can be made to seem alike—if compared by inappropriate measures. "It's time to recognize the Kebara 2 hyoid for what it is: anatomically indistinguishable from modern humans," he said. On this point, meeting attendees concurred, with opinions running strongly pro-human and anti-pig.

In fact, even Reidenberg agrees that Kebara 2 looks "pretty human." She insists that her main point is that the measurements used to call the hyoid "human" aren't relevant to Neanderthals' ability to make sounds. On this issue, the position of the hyoid in the throat is crucial. The hyoid lies just above the larynx, or voice box, and just below the pharynx. If the bone were positioned too high, the pharynx would be too small to make all the complex sounds of human speech.

Reidenberg and Laitman measured hyoids from more than 30 mammalian genera, and concluded that the size and shape of a hyoid bone and its position in the throat are not correlated. Says Laitman: "These metrics seem to be absolutely meaningless as far as the upper respiratory tract is concerned." This time, Frayer gave the grudging agreement. "The hyoid by itself probably doesn't tell us anything about laryngeal position," he said.

Thus, after the war of words was over, the opposing sides seemed to agree on two key issues: The Kebara hyoid does indeed look quite "human"—and that fact by itself doesn't prove Neanderthals could talk. And that leaves room for more vocal debate about the role of Neanderthals in human evolution.

–Elizabeth Culotta