HUMAN EVOLUTION

# Max Planck's Meeting of The Anthropological Minds

**Four years since it began, a novel German experiment in tackling anthropology's thorniest problems is beginning to bear fruit**

**LEIPZIG, GERMANY**—On a summer day in 1997, four near-strangers climbed high into the German Alps to mull over an offer that promised to transform their lives. The Max Planck Society had just asked the researchers—primatologist Christophe Boesch, linguist Bernard Comrie, geneticist Svante Pääbo, and psychologist Michael Tomasello—to create an institute on human and primate origins, evolution, and culture. Max Planck was tempting them with scientific liberation: generous funding that would enable them to assemble a world-class team and free them from grant-writing for the rest of their careers. But the prospect was a gamble. Did they really want to relocate to the former East Germany, where the Max Planck insisted that the new institute be located? Also preying on their minds was a huge wildcard in any attempt to form a cohesive team: How would the four acquaintances get along?

By the time they came down from the mountains, the answer was clear. "The chemistry between us really worked," says Pääbo. And when they visited Leipzig after their alpine encounter, they found that this historic university town 180 kilometers southwest of Berlin was cultured and livable, not a drab Soviet holdover. "I thought, 'I can recruit people, I can sell this place,' " says Tomasello.

That's just what Tomasello and his colleagues have done. Dozens of scientists from all over the world have flocked here since the Max Planck Institute for Evolutionary Anthropology opened in early 1998. (Now renting space in a former printing company, the institute plans to move into a new $30 million facility by 2002.) Part of the allure, says Max Planck president Hubert Markl, is that the institute helps fill an important gap. "Modern evolutionary biology was not very well represented in Germany," he says. The institute also fits with the Max Planck's goal of strengthening science in the former East Germany (*Science*, 22 December 2000, p. 2244).

Since coming to Leipzig, the four scientific directors of the new institute have continued much of the research that made their names: Pääbo's work with ancient DNA, Boesch's studies of wild chimpanzees, Tomasello's research into human and ape cognitive abilities, and Comrie's study of language diversity. But Leipzig's generous funding has also enabled them to strike out on new paths, as well as sow the first seeds of interdisciplinarity. While Pääbo's group has begun exploring genetic differences between humans and apes, Boesch has created a genetics lab to probe family relationships among chimps. And as Tomasello shifts into new studies of language acquisition, Comrie has teamed up with Pääbo's group to examine the relation between languages and the genetics of the people who speak them.

Although a handful of interdisciplinary anthropology programs exist elsewhere, they are "not as coordinated and focused" as the Leipzig center, says University of Pittsburgh paleoanthropologist Jeffrey Schwartz. As Alan Cooper, director of the Henry Wellcome Ancient Biomolecules Center in Oxford, U.K., puts it, the institute "promises to synergize" research areas that often have little to do with each other. But some researchers say it is too early to tell how much synergy may develop. "It's still very new," says cognitive neuroscientist Marc Hauser of Harvard University. So far, he says, "the impact is more from the individual players."

### DNA detective work

The idea for the experimental venture gestated for several years. In 1993, a Max Planck representative first ran the concept past Pääbo, a Swedish researcher at the University of Munich with a formidable reputation in ancient DNA research. A couple of years later, an outside committee chaired by geneticist Walter Bodmer of Oxford University endorsed the project and recommended hiring Pääbo to get the ball rolling. "The thought was that [Pääbo] would be the leader who would bring in the others," Bodmer says.

Pääbo has used his share of the Leipzig largesse—the institute has a $7.8 million budget spread across four departments—to build a state-of-the-art ancient DNA lab. Teasing DNA from millennia-old specimens is challenging, requiring painstaking use of the polymerase chain reaction (PCR)—which amplifies tiny amounts of DNA so it can be sequenced—in a lab shielded from modern DNA. Pääbo has campaigned hard for rigorous techniques to avoid the contamination that has sent many lofty claims crashing to earth. "In a field plagued with poor operating practices," says Cooper,

**Ancient DNA wizard.** The Max Planck hired geneticist Svante Pääbo to get the ball rolling at its new Leipzig institute, designed to probe human and primate origins and culture.

CREDIT: MPG—EVA

Pääbo's lab "is one of the few with an unquestioned reputation."

Pääbo also maintains a long-standing interest in human origins. In a paper in *Nature* last December, his group, working with Ulf Gyllensten's team at the University of Uppsala in Sweden, reported the sequencing of the entire mitochondrial DNA (mtDNA) sequence from several dozen people around the world. Since the late 1980s, a number of researchers—including Mark Stoneking, an mtDNA pioneer now in Leipzig—showed that human evolutionary trees could be created by measuring the variation in mtDNA sequences among living humans. The new mtDNA data, Pääbo and Gyllensten claim, provide some of the strongest evidence yet that all modern humans are the descendants of ancestors who lived in Africa nearly 200,000 years ago.

And the team has moved full tilt into one of the hottest areas in molecular anthropology: deciphering the genetic differences among humans, chimps, and other apes. This may provide clues to how and why the human and ape lineages diverged—as well as which genes might be implicated in the cognitive talents that distinguish humans from other species. Although human and chimp DNA differs by less than 2%, little is known about the few genes that appear to make all the difference. This year Pääbo's group described key differences among humans, chimps, and monkeys in how homologous genes are expressed and regulated, especially in the brain (*Science*, 6 April, p. 44).

As one institute researcher says, half-jokingly, "the Max Planck thinks that Svante is going to win the Nobel Prize, and the rest of us are here to be his playmates." The truth, insists Pääbo, is that he and his group are thriving in the interdisciplinary environment.

One such collaboration is using linguistics to reconstruct hidden strands of human prehistory, such as early migration patterns. Researchers in Pääbo's department, especially Stoneking, have teamed up with Comrie's linguists to probe how closely languages and genetic profiles are correlated among the peoples of the Caucasus Mountains. Geneticist Luigi Luca Cavalli-Sforza, now at Stanford University, pioneered similar methods, albeit with less sophisticated techniques, in the 1970s. The new work, claims Comrie, suggests that "the correlations between linguistic patterns and population genetics are not as close as Cavalli-Sforza thought they would be."

**Blood brothers?** Despite speaking different languages, Armenians *(above)* and Azerbaijanis *(left)* are closer genetically than previously thought, new Leipzig findings suggest.

Armenians, for example, are closer genetically to Azerbaijanis—their nearest neighbors, whose language has little in common with Armenian—than to other Armenian-speaking populations living farther away. This finding suggests that in the Caucasus, at least, replacement of one language by another—either Armenian by Azerbaijani or the other way around—has played a greater role in current linguistic patterns than has population migration. This and other studies under way in Leipzig are "already making major contributions," says linguist Peter Cole of the University of Delaware, Newark.

Comrie, who still tackles purely linguistic issues such as language diversity, says he could never have found enough funding for these more classical studies if he hadn't come to Leipzig. For someone with a humanities background, he says, "if you get an outside grant, it's usually a small amount for a small project."

### Family ties

Molecular approaches, as a complement to meticulous fieldwork, are also big in Boesch's primatology department. Since 1979, he and his colleagues have been studying wild chimps at Taï National Park in the Côte d'Ivoire, using observation techniques that minimize contact with the animals and thus reduce the degree of human influence on their behavior. Such studies have shown that chimps in different parts of Africa have different "cultures," including variations in tool use, grooming practices, and courtship behaviors (*Science*, 25 June 1999, p. 2070).

Boesch, who worked at the University of Basel in Switzerland until coming to Leipzig in 1998, says the move has given him "a marvelous opportunity" to create a new primatological research group and assemble his own team of crackerjack geneticists rather than relying on outside scientists. This has enabled his group to help resolve controversies around chimp behavior that have dogged the field.

Boesch is at the center of one of these controversies. In 1997, for instance, he co-authored a study published in *Nature* that concluded from a genetic analysis of infant Taï chimps that females were surreptitiously mating with males outside their community. Half the Taï offspring, they found, were not related to their supposed fathers. Primatologist Jane Goodall and others challenged this finding in last May's issue of *Molecular Ecology*, arguing that they saw no evidence for such "extra-group paternity" in chimps in Tanzania's Gombe National Park. Goodall's group came to a similar conclusion after reanalyzing the Taï data as well, suggesting diplomatically that further genetic studies could help resolve the discrepancy.

At Leipzig, with the genetic tools needed to conduct a more sophisticated analysis of the Taï data, Boesch has taken up the gauntlet. New work, led by geneticist Linda Vigilant in Boesch's lab, analyzed DNA from hair and feces left by Taï chimps. Although such collection techniques are not new, Vigilant and her co-workers employed strict checks—such as ensuring that samples have enough DNA for analysis and repeating each PCR run many times—that enabled them to distinguish reliable DNA samples from those likely to give spurious results. After analyzing a larger subset of the Taï community, they concluded that extragroup paternity was, in fact, minimal, as Goodall had suggested.

CREDITS: (LEFT TO RIGHT) AP PHOTO/SERGEI GRITS; AP PHOTO/OLEG NIKISHIN

Whereas Boesch must travel to Africa to observe chimps, a new $14 million primate facility at the Leipzig Zoo serves Tomasello's purposes just fine. He and his coworker, psychologist Josep Call, are conducting numerous experiments at the facility to determine how human contact affects chimp behavior (see sidebar, p. 1247). Tomasello is also undertaking an intense study of human language acquisition. He's devoting a substantial chunk of his Leipzig funds to recording several hours of conversation each week between several mothers and their children. "We pay the mom to be a research assistant, and she turns on the tape recorder," he says. The recordings, which begin at about age 2 when children start speaking more than one word at a time, require as much as 20 hours of transcription per hour of tape to ensure their accuracy. Aided by an army of transcribers, Tomasello's group has recorded two children for a full year. "We want to trace the language back all the way, where did it come from. If you go back day by day, it's like an archaeological record."

Although the Max Planck has brought together some of the brightest lights in their fields, observers say it is too early to judge whether the Leipzig recipe will succeed in spawning a new era of interdisciplinary work in anthropology. The institute plans to create two more departments—one in biological anthropology and one in social or cultural anthropology—and recruit topflight scientists in the coming months. These will be critical partners in the interdisciplinary marriage and position the institute to move beyond the compartmentalization that many researchers believe is slowing down the field. "The real question," says Harvard's Hauser, is whether uniting these disparate fields will "actually influence how they do their work and think about [research] problems."

–MICHAEL BALTER

SCIENCE AND COMMERCE

# Chemists for Hire: Have Flask, Will Travel

**A new breed of entrepreneurs—synthetic chemists—are selling their skills to drug companies through contract shops**

Two decades into the molecular biology revolution—which was supposed to herald the end of the age of chemistry—organic chemists are suddenly in hot demand. Potential drug targets are piling up faster than companies can adequately test them, for lack of those skilled in the art of organic synthesis. That leaves firms such as Bristol-Myers Squibb and Eli Lilly scrambling to add hundreds of chemists to their research staffs—and offering them $80,000 a head, signing bonuses of up to $40,000, and moving expenses. Even with those perks, however, there doesn't seem to be enough chemists to go around.

Enter the chemist-entrepreneurs. A growing group of skilled synthetic chemists is seizing the opportunity to build chemistry-for-hire companies that custom-synthesize organic molecules. It's a strategy that many in the pharmaceutical and biotech industry admit is often cheaper and faster than doing it themselves. "There's been an explosive growth in companies set up to do contract synthesis at scales ranging from the milligram to the kilogram," says Gifford Marzoni, a chemistry agent at Davos Chemical Corp. in Englewood Cliffs, New Jersey. Davos is a virtual synthesis shop that booked $100 million in revenues last year, up 10-fold over the past 5 years, by matching companies that need molecules with those that can make them.

Evolutionary Chemistry, a biotech start-up in Boulder, Colorado, turned to Davos recently when it needed some modified nucleotides for one of its drug-discovery efforts. Marzoni, in turn, is putting together a deal between Evolutionary Chemistry and a small company that can handle the assignment. "We couldn't afford to hire the chemists that we need, let alone find them, so we have to go outside the company to keep our projects going at full speed," says Ted Tarasow, Evolutionary Chemistry's director of chemistry.

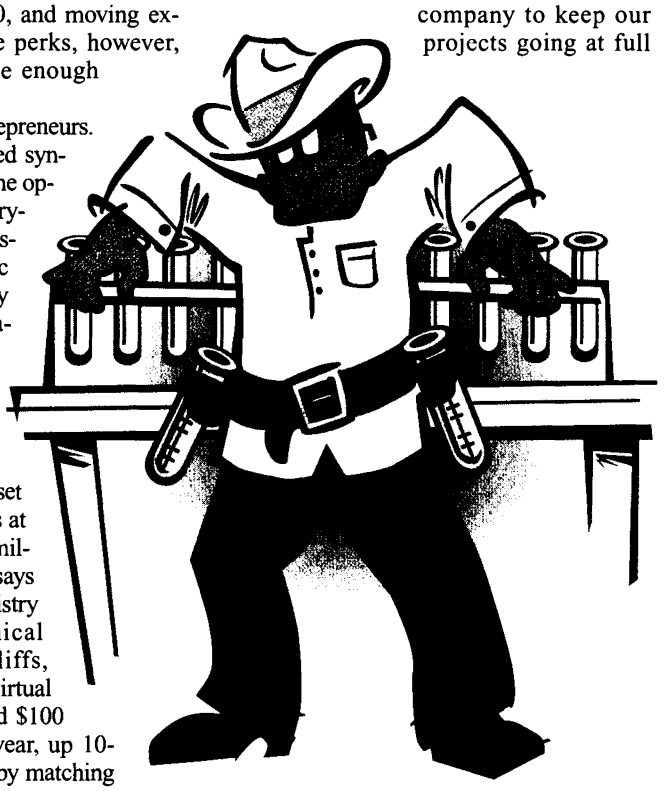

ILLUSTRATION: TIM SMITH

The dearth of skilled organic chemists goes back at least a generation. In the late 1970s, say longtime academic chemists such as Robert Coates of the University of Illinois, Urbana-Champaign, the best and the brightest students went into molecular biology, not stodgy old chemistry. Indeed, with characteristic hubris, some molecular biologists claimed that biotechnology was going to relegate synthetic chemistry to the back bench of drug development efforts. "Protein therapeutics were the story of the day, then," recalls Bruce Diel, a synthetic chemist and founder of ChemFinet, an online marketplace for synthetic chemists based in Overland Park, Kansas. "Synthetic chemistry was passé."

Around the same time, the negative publicity surrounding environmental disasters such as Love Canal further depleted the talent pool. "The only time chemistry made the news was when something negative happened, and that drove away many good students," says Thomas D'Ambra, who 10 years ago founded Albany Molecular Research, the grandfather of the chemist-for-hire industry, headquartered in Albany, New York. By the early 1990s, molecular biologists were generating a torrent of drug targets—and both pharmaceutical and biotech companies were realizing that protein-based drugs, with their large molecules, were not going to replace small organic molecules as drugs.

Today, with the completion of the human genome project, drug companies big and small concede that they shouldn't have built up their molecular biology capabilities at the expense of their chemistry groups. Bristol-Myers Squibb, for one, has stated that it intends to hire enough chemists over the next few years to shift the biologist-to-chemist ratio in its drug-discovery labs from 3:1 to 1:1. And many biotech companies admit in private that their drug development efforts are hamstrung by the inability of in-house chemists—if they even have any—to