Haxby reported that he could predict from the pattern of activity which category of object a person was looking at. Furthermore, if he excluded the voxels corresponding to the face area, he could still use the activation in the rest of the ventral temporal cortex to predict whether someone was looking at a face, suggesting that the entire area participates in face recognition. And if he excluded all voxels except those in the face area, he could use the face area's activation to predict whether someone was looking at a shoe or a cat, say.

Analyzing fMRI data in these new ways demonstrates that the brain can maintain "unique representations of an essentially unlimited variety of faces and other objects," Haxby says. He suggests that the ventral temporal cortex may be organized according to yet-unknown features, just as other parts of the visual system are tuned to edges or orientations or colors.

"This is an important set of findings," says MIT's Kanwisher. "People have been making lots of loose talk [that representations of objects can be distributed widely in the brain], but this is the first serious demonstration I've seen that the information is present in many areas of the ventral pathway."

What sorts of features might the ventral temporal cortex be tuned to? Rafi Malach of the Weizmann Institute of Science in Rehovot, Israel, presented some of the first clues. Face and place areas aren't in the exact same spots in everyone's brains, but the face area is almost always slightly lateral to the place area. Malach suspected that this might have something to do with the fact that people usually see faces in the center of their visual fields, but when they look at a landscape, they scan a much larger area. He presented people with the same pictures either in the center of their visual field or at the edges. Central images activated parts of the ventral temporal cortex close to the face area, while images at the edge of the visual field activated place areas.

Haxby suggests that the ventral temporal cortex isn't organized as a patchwork of specialized face, place, and shoe areas, but as a distributed map of different features, such as where something usually falls in the visual field, as Malach's work suggests. In this way, this part of the brain could represent a panoply of objects and categories according to how much they activate different feature-sensitive spots.

With studies such as Haxby's and Malach's, "people are moving to a framework level" of understanding object representation, says Cornell's McCandliss. But it will be some time before they know for sure how the brain tells a warbler from a greeble.

–LAURA HELMUTH

PALEONTOLOGY

Paleontological Rift in the Rift Valley

A bitter dispute over rights to hunt for fossils in the Tugen Hills indicates that the old way of regulating paleontology in Kenya is in flux

TUGEN HILLS AND NAIROBI, KENYA—Martin Pickford stands in the middle of a long, dry gully lined with tamarind and acacia trees. A light breeze ushers a handful of cottony clouds across the blue African sky toward Lake Baringo, some 20 kilometers to the east. Pickford points with a sunburned arm to a spot on the gully's bank. "That is where we found the humerus," he says proudly. "And just over here, one of the femurs and an upper canine tooth, and further down there, parts of the mandible and the molars." Last October, a team led by Pickford, a geologist at the Collège de France in Paris, and Brigitte Senut, a paleontologist at France's National Museum of Natural History, found 13 fossil fragments of what they believe is the earliest known ancestor of modern humans. Although scientists are still debating whether the fossils belong to the human family (*Science*, 23 February, p. 1460), their undisputed age of about 6 million years—roughly the time when genetic evidence suggests that the human line split from that of the chimpanzees—means that these remains could help researchers untangle the increasingly twisted roots of the human evolutionary tree. And just last month, during a 2-week season here at the foot of Kenya's rugged Tugen Hills, Pickford and Senut found several more fossils—including the middle portion of a lower jaw—that they believe also belong to this claimed early hominid, which they have named *Orrorin tugenensis*.

Such a dramatic find would normally be cause for rejoicing among human origins researchers. Instead, *Orrorin*'s discovery has set off a bitter internecine battle. Pickford and Senut's very right to excavate here has been challenged by some other scientists, most notably anthropologist Andrew Hill of Yale University, who claims that the pair is encroaching on turf his team has been studying since the 1980s. Hill and other researchers argue that Pickford and Senut have flouted long-established rules governing paleontology research in Kenya. Pickford and Senut deny these charges, countering that they have acted legally and followed all required procedures. They maintain that a campaign against them has been orchestrated primarily by paleontologist Richard Leakey, a claim Leakey vehemently denies.

Disputed territory. Possible early hominid fossils found in the Tugen Hills have focused attention on a dispute over excavation rights.

Turf battles among paleoanthropologists are nothing new. For decades, scientists working up and down the great Rift Valley of Africa and Asia—where many of the world's most important hominid fossils have been found—have fought over the right to unearth these precious keys to humanity's evolutionary past. The fossil wars have left wounds that have taken years to heal (*Science*, 14 January 1983, p. 147; 11 December 1987, p. 1502; and 14 April 1995, p. 196). But the fight over the Tugen Hills seems to run deeper than most of these other disputes, and it has implications for the way paleontology will be managed and conducted in a country that holds vital importance for the field.

Pickford and Senut see the battle as a struggle over the power of the National Museums of Kenya (NMK) and the Leakey family, which pioneered paleontology in Kenya and has long dominated the NMK. The NMK has traditionally held virtual veto power over permit applications, and it is the official repository for fossils unearthed in the country. Pickford and Senut's work is being supported by a rival museum system—called the Community Muse-

ums of Kenya (CMK)—established in the late 1990s with the help of native Kenyans who argue that their heritage has been monopolized for too many years by too few researchers. They are getting important support from government officials, apparently including Kenyan President Daniel arap Moi, a member of the Tugen tribe who is originally from the Baringo area.

Although most researchers agree that wider access to fossil sites is a desirable aim, many observers are fearful that the rivalry between the two museums could ultimately create chaos by leading to overlapping permits and competing claims and, perhaps, limit access to the fossils themselves.

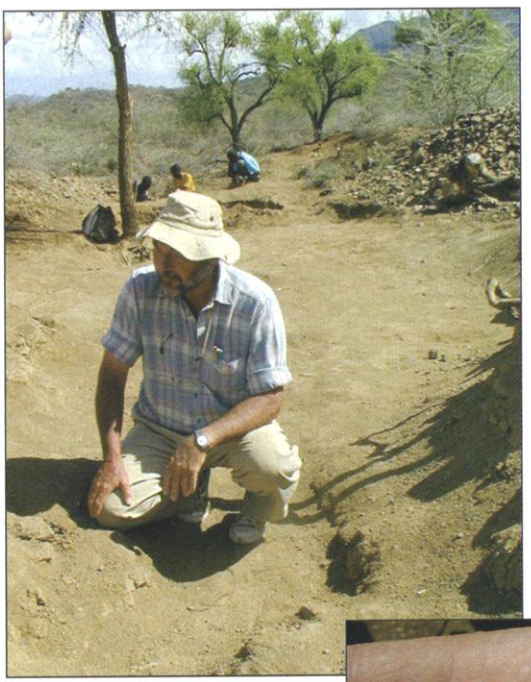
Deep roots

There are four principal actors in the drama now being played out in Kenya: Martin Pickford, 57, who was born in the United Kingdom but moved to Kenya when he was 3 years old; Richard Leakey, 56, born in Kenya to the famous fossil-hunting pair, Louis and Mary Leakey; Hill, 54, a British subject now living in the United States; and Eustace Gitonga, 50, a Kenyan who once headed the NMK's exhibits department and who is now director of the CMK.

The paths of some of the players first crossed many years ago. Pickford and Leakey, for example, attended high school together in Nairobi, and Pickford says the two were "great buddies" during those days, visiting each other's homes and spending weekends and holidays together. Leakey agrees that he and Pickford were once good friends. Pickford and Hill were anything but buddies. The two were graduate students together during the 1970s at the University of London under the legendary geologist William Bishop, who died in 1977. "Andrew [Hill] despised Martin [Pickford], and vice versa," says a colleague who knows them both well. "He [Pickford] wasn't the sort of person I wanted to be chummy with," Hill says.

Although they disliked each other, Hill and Pickford followed similar trajectories. Both took an interest in the Baringo area: In 1970, Hill and other colleagues found some australopithecine remains near the lake, and in 1974 Pickford discovered a molar in 6-million-year-old sediments that he now believes may belong to *Orrorin*. And after they received their doctorates in 1975, both ended up working at the NMK, Hill as a research fellow and later administrator with an institute linked to the museum, and Pickford as head of the museum's antiquities and monuments department. By that time, Leakey had become director of the NMK, a post he held from 1968 to 1989.

Both Hill and Pickford left Nairobi by the early 1980s. But they coincidentally encountered each other at the museum again on 2 July 1985. Pickford was passing through Nairobi, together with Senut, on his way to a research site in Uganda, and Hill was doing research of his own in the museum. What happened on that day is a matter of intense dispute, but it set the stage for the subsequent turf wars.



Fertile ground. Martin Pickford in a dry gully where 6-million-year-old fossils, including an incisor found last month (*right*), were unearthed.

On 3 July, Leakey wrote to Pickford charging him with attempting to steal documents from the museum's archives and banning him from the NMK's research facilities. The documents in question were some of Bishop's notebooks, which his widow had donated to the museum archives.

Pickford insists he was only borrowing the notebooks to photocopy them and had signed them out in the archives' logbook—a version of events that is supported by Senut. He is convinced that Hill had something to do with the accusation against him, because, he says, Hill was keeping an eye on him while he searched through the archives. Leakey says Pickford's borrowing of the notebooks was "exceedingly irregular" and that there was "circumstantial evidence" that he intended to steal them.

Over the next 9 years, Pickford wrote repeatedly to Leakey, the museum's board of directors, and finally the government ministry in charge of the museum, protesting his innocence and trying to clear his name. But he remained banned from the museum. Because the NMK's endorsement of a scientist's application to the government for a research permit was traditionally required to do paleontology work in Kenya, his banishment from the museum amounted to a blanket ban on doing research in the country.

Declaration of war

In 1995, Pickford teamed up with Gitonga to declare public war on Leakey. Gitonga, an artist who constructed many of the museum's exhibits, had his own beef with the NMK's former director. He says Leakey forced him to leave the NMK in 1987 after accusations—which Gitonga denies—that he had mishandled funds allotted to erect a large sculpture of a dinosaur in front of the museum. Pickford and Gitonga launched a broadside against their common enemy in the form of a book entitled *Richard E. Leakey: Master of Deceit*. It recounts not only their own battles with Leakey but also those of other researchers, both Kenyans and foreigners, whose correspondence with Leakey they had managed to acquire. The book paints a highly unflattering portrait of Leakey, accusing him of various schemes and manipulations designed to increase his power and personal wealth at the expense of the museum and other scientists.

To many researchers, as Pickford himself puts it, the book was evidence "that I had finally gone off my rocker." Pickford adds that he is "not proud" of the book but insists that he had "no alternative" but to publicly attack Leakey. "For 10 years I had tried to get my scientific rights reinstated, but all my efforts [had] failed," he says.

Pickford and Gitonga's public attack on Leakey was just the first step in their campaign to end what they saw as the NMK's monopoly on paleontology research in Kenya. Since 1983, when Kenya's current antiquities laws were passed, NMK officials have interpreted these laws to mean that the museum had to approve all paleontology research permits before they could be issued by a government ministry and that any fossils discovered were the property of the government. "These fossils are very rare," says the NMK's current director, archaeologist George Abungu. "There must be a govern-

CREDITS: FUTOSHI MORI

The Case of the 'Forged' Letter

NAIROBI—On 17 March 2000, geologist Martin Pickford of the Collège de France in Paris was arrested near Kenya's Lake Turkana on a charge of fossil hunting without a permit. According to Pickford, the arresting officer, from the Criminal Investigation Division (CID)—the nation's FBI—presented him with a letter, dated 2 November 1998, stating that his research permit had been revoked. This letter is at the center of a bitter dispute over excavation rights in the Tugen Hills, where Pickford and his co-workers are accused of encroaching on a site long under study by a rival research team (see main text).

Pickford has long maintained that the letter is a forgery. His opponents, however, have cited it as proof that his recent work in Kenya is illegal. "If the letter is a forgery, Pickford's permit is valid," says George Abungu, director of the National Museums of Kenya (NMK). "If the letter is real, his permit is not valid." Ultimately, the Kenyan courts may have to decide which it is.

Three key documents in this tangled saga all bear the signature of Josephat Ekirapa, then head of the government department that issues research permits, which at that time was housed in the Office of the President: A letter, dated 30 October 1998, notifying Pickford his permit application had been approved; the 2 November letter revoking the permit; and the permit itself, a blue card with Pickford's photo on it, issued 28 days later, on 30 November. Pickford claims he did not receive the revocation notice until more than a year later, when it was handed to him in the NMK parking lot by a researcher now studying in the United States.

That researcher was Stephen Gitau, now an anthropology graduate student at Southern Illinois University in Carbondale. Gitau, who was doing research at the NMK at the time, says he launched his own investigation into rumors that Pickford was encroaching on the sites of other scientists. His motivation, he says, was his concern for Kenya's "national heritage" and the possibility that "laws were being broken." He says he went to see Ekirapa twice, first to check on the validity of Pickford's permit, then to get a copy of the letter revoking the permit.

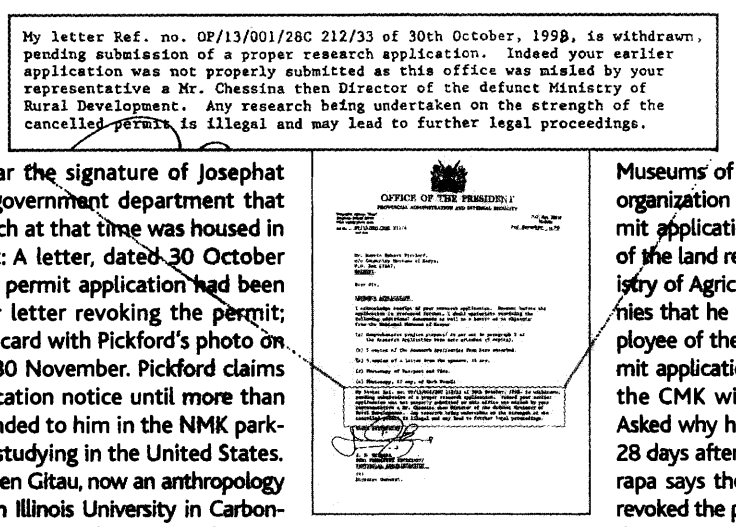
Gitau says Ekirapa had his secretary type up a duplicate copy of the letter, and he claims that Ekirapa added some additional lines to it, providing more detailed reasons why the original permit had been revoked. In late November 1999, Gitau handed the letter to Pickford, who was passing through Nairobi.

Pickford says he took one look at the letter and was convinced it was a forgery. In his diary that evening, he noted such irregularities as the letter's date—almost a month before Ekirapa signed his permit—and the fact that it was not typed on government stationery, but rather on a photocopy of old government stationery containing a typographical error.

Gitau insists that the letter is genuine and was given to him by Ekirapa personally. Ekirapa also insists that the letter is genuine and that he signed it. But he says he does not remember Gitau or Gitau's visit to his office, and he denies adding extra lines to the letter. The file on Pickford's application, now housed in the Ministry of Education, Science, and Technology, contains a carbon copy of the 2 November letter that does not contain the lines at issue.

Ekirapa says he revoked Pickford's permit because an official in the Ministry of Rural Development had misrepresented Pickford as an employee of the ministry in urging Ekirapa to grant him a permit. The official—whose name was misspelled in the letter Gitau gave Pickford—is Elisha Chesiyna, chair of the board of the Community Museums of Kenya (CMK), a nongovernmental organization that had sponsored Pickford's permit application. Chesiyna, who is now director of the land reclamation department in the Ministry of Agriculture and Rural Development, denies that he misrepresented Pickford as an employee of the ministry; a copy of Pickford's permit application states Pickford's affiliation with the CMK without referring to the ministry. Asked why he signed Pickford's research permit 28 days after he had supposedly revoked it, Ekirapa says the "most likely" scenario is that he revoked the permit after signing it and predated the revocation notice.

Ekirapa insists that Pickford has "no excuses" for continuing to do research in Kenya after he received the letter. "If he thought the letter was a forgery, he should have come to see me about it," he says. Pickford says that when he received the letter, he was about to leave Nairobi and turned it over to CMK director Eustace Gitonga for further action. Kenya's public prosecutor has declined to pursue a case against Pickford. Gitonga says the letter will be used as evidence in a lawsuit Pickford and the CMK have filed for false arrest. **–M.B.**


My letter Ref. no. OP/13/001/28C 212/33 of 30th October, 1998, is withdrawn, pending submission of a proper research application. Indeed your earlier application was not properly submitted as this office was misled by your representative a Mr. Chessina then Director of the defunct Ministry of Rural Development. Any research being undertaken on the strength of the cancelled permit is illegal and may lead to further legal proceedings.

OFFICE OF THE PRESIDENT

Contested letter. Pickford claims this letter, apparently revoking his permit, is a forgery.

ment institution responsible for them."

But Pickford and Gitonga reject this interpretation. Gitonga, who is well connected in Kenyan politics, began quietly working with a group of anti-Leakey politicians and government officials to establish the CMK as a rival institution. "The primary issue was recapturing the national heritage of Kenya, which had been exploited in a lopsided manner by a small group of people," Gitonga says.

The CMK, whose headquarters occupy a suite of offices in downtown Nairobi, was established in 1997. According to Gitonga, its annual operating budget is about $65,000, raised primarily from its own board of directors as well as other private donors. Its eight-member board of directors includes Gitonga, Senut, and Collège de France prehistorian Yves Coppens, as well as a ranking official in the Ministry of Agriculture and Rural Development and a local representative from the Baringo area.

Gitonga and other CMK board members say that they have received considerable support from President Moi. The organization has also found an important ally in Andrew Kiptoon, a former research minister and the current parliamentary deputy from the Baringo North district, which includes the site where *Orrorin* was discovered. Kiptoon's district also covers the town of Kipsaramon, where in 1993 Hill and his co-workers found the remains of a 15-million-year-old fossil ape called *Equatorius* (*Science*, 27 August 1999, pp. 1335 and 1382) and where the CMK is building a regional museum—the first of 23 such museums it is planning to construct. In June 1998, Kiptoon invited Pickford to begin working again in the Baringo area. Shortly afterward, the CMK began applying for research permits for Pickford and his co-workers—and that is when the battle began in earnest.

The turf war erupts

On 30 October 1998, the head of the department responsible for issuing research

permits, which at that time was housed in the Office of the President, approved Pickford's application to conduct paleontology research in three Kenyan provinces, including the Baringo area. And on 30 November, the same official signed the permit itself, a blue card with Pickford's photo attached. But when NMK officials, including Abungu, heard about the permit, they challenged its legality and demanded that it be rescinded.

Pickford's file at the research department—the department has since been transferred to the Ministry of Education, Science, and Technology—includes a carbon copy of a letter dated 2 November 1998 revoking the permit, pending approval by the NMK. Pickford has long contended that this letter is a forgery, citing among other things the fact that it is dated 28 days before the permit was issued and that he did not receive a copy until a year later (see sidebar). This letter has been at the center of allegations by Abungu, Hill, Leakey, and others that Pickford's activities in Kenya have been illegal.

Events came to a head just over a year ago. On 17 March 2000, Pickford was arrested by an officer of the Criminal Investigation Division (CID)—Kenya's FBI—while collecting fossils in the Lake Turkana area, where the Leakey family has discovered numerous hominid remains over the past decades (*Science*, 23 March, p. 2289). The arrest came 3 days after Leakey, who was then head of the Kenya civil service, wrote to Abungu alerting him that Pickford was at Turkana and urging him to contact CID to "intercept" him. Abungu says he complied with this request, including sending NMK personnel to help the CID officer find Pickford. But Kenya's public prosecutor declined to pursue the case, and Pickford and the CMK are now suing Leakey and the NMK for damages.

The current head of the research permit department, Addy Kaaria, insists that Pickford's permit is not valid because it has been revoked. Kaaria is supported in this assertion by the education ministry's permanent secretary, Japhet Kiptoon (brother of Andrew), who told *Science* that Kaaria "knows the files" and that his word on who does and does not have a permit is "official." But Kaaria also says that Senut—along with two other scientists who work with the team, from Japan and Spain—does have a valid permit to conduct research in the Baringo area. But so, too, does Hill.

Pickford and Senut have repeatedly claimed that Hill has not worked in the area since the 1993 discovery of *Equatorius*, and Andrew Kiptoon told *Science* that before inviting the pair to work in Baringo he checked with local people who also said Hill had not been around for years. But Hill's field notebooks and the testimony of other members of his team—as well as researchers who have visited the team in the field—indicate that he has conducted lengthy field studies in the vicinity during most of the past 8 years.

In February 1999, Leakey sent a fax to Collège de France's Coppens, who sponsors Pickford and Senut's work in Kenya, asking him to "use [his] influence" to stop Pickford from "moving onto another colleague's site." But Coppens told *Science* that although he "regrets" the conflict between the two teams, he has "full confidence" that Pickford and Senut are conducting their research in an "honest manner."

Yet the presence of two teams working in the same area is alarming to many researchers. "It is bad for the science," comments John Yellen, the U.S. National Science Foundation's archaeology program director. "The fossils lose an enormous amount of their value unless put in the proper stratigraphic and chronological context." Yellen adds that this context can be obscured if "one group screws up what the other group is doing." Richard Potts, director of the human origins program at the Smithsonian Institution in Washington, D.C., agrees. He argues that modern paleontological methods—which attempt to place fossil finds "into large-scale time and space relationships," including analysis of ancient environments and climates—"require access to large expanses of terrain without conflicting or competing activities by different research groups."

Potts, who has worked in Kenya for many years himself, adds that the ultimate solution may be for the NMK and CMK to work out "a well-coordinated strategy" to pursue common research goals. Indeed, some researchers believe that the CMK is here to stay, as either a rival or a partner to the NMK's traditional authority over paleontological research. "The bottom line is that we have to go along with what the Kenyan government says, whether we like it or not," says Yellen.

Even Abungu agrees that the NMK's monopoly should be ended. "Pickford and Gitonga may be going about this the wrong way, but what they are saying is right," he says. Indeed, Abungu told *Science*, he is now working on a proposed revision of Kenyan law that would allow universities, as well as nongovernmental organizations like the CMK, to sponsor scientists for research permits—a right the CMK insists it already has. But the proposed law would still require fossils to be housed in the NMK's collections, a provision Gitonga and other CMK officials say they will fight. (The remains of *Orrorin* are currently kept in a bank vault in Nairobi, although CMK leaders say they plan to build a museum in the city that would include a safe storage area for fossils.)

CMK's challenge to the NMK also challenges the Leakey family's influence over paleontology in Kenya. The Leakeys have always been powerful forces in the NMK. (Although Richard is no longer in charge, his wife, Meave, is now head of the museum's paleontology division.) "Perhaps it is a historical accident, but control of the museum has long been in the hands of a family dynasty," Abungu acknowledges. "We have to open up the playing field."

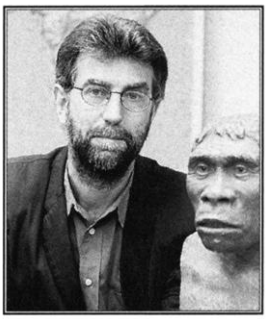
But in Hill's view, something very different is at stake in his dispute with Pickford, Senut, and the CMK: "They are not undermining a Leakey hegemony; they are undermining really good Kenyan laws on antiquities and monuments."

—MICHAEL BALTER

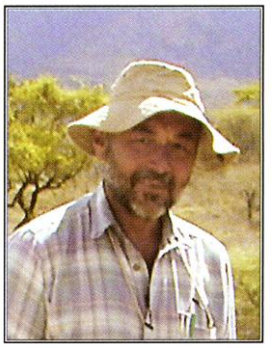
With reporting by Carl Zimmer.

Dramatis Personae

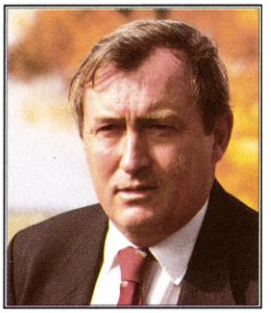
Eustace Gitonga. Challenger to Kenya's paleontological power structure.



Andrew Hill. Holds a permit to excavate in region where Pickford is working.



Martin Pickford. His group also holds permits to work in the disputed area.



Richard Leakey. His family has long been influential in Kenyan paleontology.

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