A book charging anthropologists with mistreating Yanomamo Indians and conducting flawed research has reopened old wounds in the community. It has prompted a fierce firefight, but so far little public soul-searching

Anthropological Warfare

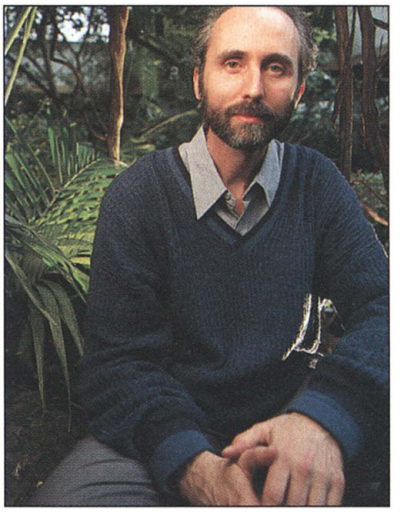
In one of the most remarkable gatherings in the annals of anthropology, almost 1000 researchers, students, and journalists jammed into a hotel meeting room on 17 November for a raucous symposium. The subject: *Darkness in El Dorado: How Scientists and Journalists Devastated the Amazon* (W. W. Norton), a just-released book by journalist Patrick Tierney. Well before publication, *Darkness*—a detailed, 400-page indictment of the treatment by anthropologists and the media of the Yanomamo Indians in South America—had become "an enormous problem for the entire discipline," according to Amazonia specialist Thomas P. Myers of the University of Nebraska, Lincoln. Surprisingly, the symposium, held at the annual meeting of the American Anthropological Association (AAA), included no researchers who specialize in the Yanomamo. AAA representatives, asked about the lack, succinctly explained the problem: The rift within the discipline had grown so bitter that no neutral Yanomamo experts could be found.

Combatants. Journalist and author Patrick Tierney (*right*) and his chief target, ethnographer Napoleon Chagnon with Yanomamo villagers.

The Yanomamo are a group of 27,000 Native Americans who occupy a Texas-sized chunk of forest around the Orinoco River at the border of Brazil and Venezuela. (They are also known as Yanomami, Yanoama, and Yanomamö—different terms come from different dialects.) Living in 300 scattered, ring-shaped village compounds in the forest, the Yanomamo are among the least westernized peoples on Earth. They have exerted a continuing fascination on anthropologists; more than three dozen have worked with them.

By far the most well known is Napoleon A. Chagnon, a professor emeritus at the University of California, Santa Barbara (UCSB). Chagnon began his fieldwork in 1964 and quickly became celebrated for his first book, published in 1968, *Yanomamö: The Fierce People*—"the greatest ethnography ever done," according to anthropologist Mark Flinn of the University of Missouri, Columbia. Until the 1970s, Chagnon worked with James V. Neel, a prominent geneticist at the University of Michigan, Ann Arbor, and documentary filmmaker Timothy Asch, who eventually made 39 films with him. Both collaborations ended fractiously, in part because Chagnon thought that he was not receiving proper credit. (Asch died in 1994; Neel, early last year.)

The three men are at the center of *Darkness in El Dorado*. Many of Tierney's criticisms of them have long been voiced within anthropology itself, for Yanomamo ethnography has been a focus of intellectual and political strife for 25 years. In addition, Chagnon's work has featured prominently in the sociobiology wars, the high-voltage debate over the extent to which human behavior is genetically determined. But Tierney's book, says Kenneth Good, a Yanomamo specialist at New Jersey City University in Jersey City, "brings in so much new material that even those of us who have been on the scene are amazed. ... A lot of anthropologists are running scared, and I believe there will be international legal repercussions." Indeed, on 21 December Venezuela created a blue-ribbon commission to investigate Tierney's allegations.



Although *Darkness* faults researchers and institutions from the Atomic Energy Commission to *National Geographic*, it focuses on three main areas:

- A 1968 measles epidemic that killed "hundreds, perhaps thousands" of Yanomamo; the book contends that Neel's group, which included Chagnon and Asch, may have exacerbated or unintentionally even caused this epidemic; Tierney also accuses the researchers of conducting unethical genetics studies.
- Chagnon's characterization of the Yanomamo as "fierce" and violent, and his later claim that Yanomamo who have killed have greater reproductive success; Tierney argues that both are wrong and have led to abuse of the group.
- The disturbance of the Yanomamo economy by anthropologists, whose massive provision of goods to villagers, in Tierney's account, has upended traditional political balances, debased wealth-seeking villagers, and even led to murderous conflict.

Tierney has received support from many Yanomamo experts and some other anthropologists, including Marshal Sahlins of the University of Chicago, who wrote in a *Washington Post* review that *Darkness* is "a revealing book, with a cautionary message that extends well beyond the field of anthropology."

But Chagnon sharply disagrees. "Almost every damn sentence in the book is false," he said in an interview with *Science*. "There's absolutely nothing in the book about me, for instance, that's accurate or that isn't distorted in a way that makes normal behavior look foolish."

"I can't imagine more serious charges," says Kim Hill of the University of New Mexico, Albuquerque, who strongly disputes most of them. "But they all point to a

CONTINUED ON PAGE 419

CREDITS: (LEFT TO RIGHT) ANTONIO MARI; NICK CARDILLICCHIO

CONTINUED FROM PAGE 416

serious problem: Anthropology has a huge lack of policy about interacting with uncontacted peoples." He adds: "If this book focused attention on the enormous suffering, now and in the future, of native peoples [in South America], I could almost forgive Tierney his massive mistakes."

A case of measles

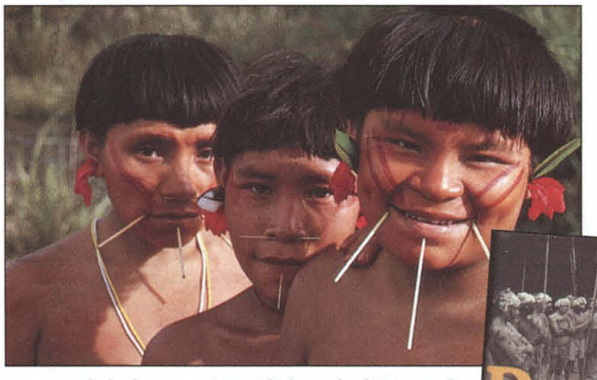
Tierney's most explosive charge is that Neel and his colleagues used a risky measles vaccine, with disastrous results, to inoculate Yanomamo they were studying in an ethically problematic genetic survey.

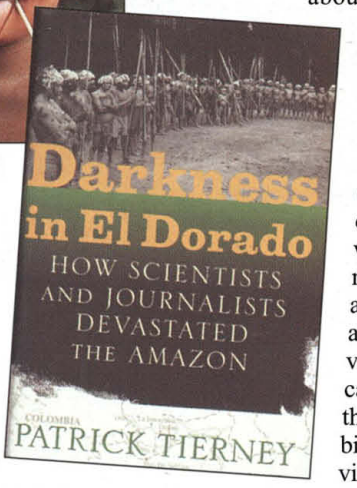
The U.S. Atomic Energy Commission funded Neel's genetic studies, which began in Japan after World War II. One of the goals was to establish background levels of spontaneous mutation in the Yanomamo, whom Neel believed to be exposed to fewer environmental mutagens than were people in industrialized societies. From the mid-1960s to the 1970s, Chagnon functioned as a kind of house ethnographer for the study.

During the Michigan team's first visits to the Yanomamo in 1966 and 1967, "they drew titers [standard test volumes of blood] for measles," says Neel's son, physician James V. Neel Jr. "They found the Amerindians had virtually no exposure to measles." In eight of 10 tested villages, the Yanomamo had almost no measles antibodies at all. "My father realized that if in fact wild measles ever got into that population, they were at very high risk of catastrophic consequences," says his son. "The death rate in a virgin [unexposed] population is 20% to 30%."

When Neel, Chagnon, Asch, and three other members of the Michigan team arrived in Yanomamo territory on 22 January 1968 to draw more blood for their genetic studies, they came equipped with 1000 doses of Edmonston B measles vaccine, which Neel had obtained gratis from Lederle and Parke-Davis, according to his papers. By that time, however, Edmonston B was being replaced in Western nations by the newer Schwarz vaccine, which had many fewer side effects. Tierney therefore criticizes Neel's choice of a "primitive," "dinosaur vaccine" for the Yanomamo.

Indeed, Edmonston B was not an obvious choice. One of the first measles vaccines, it must be accompanied by a shot of gamma globulin to ameliorate its side effects. In two of three previous studies of measles vaccine in Native Americans, researchers concluded that the risk of severe febrile response was an impediment to the use of Edmonston B. And on 18 January 1968 the Venezuelan government recommended that children in the nation be vaccinated with Schwarz vaccine.





Heart of darkness. Tierney's heavily footnoted book deplores exploitation of Yanomamo.

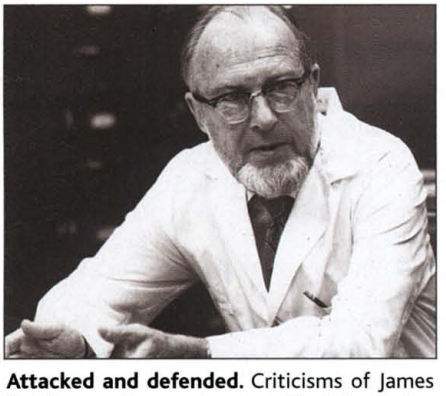
Neel seems not to have written a protocol for his vaccination program, so his rationale for choosing Edmonston B is unknown, and no records that he obtained permission to vaccinate in Venezuela have been found. (In October the Brazilian newspaper *O Globo* reported a similar lack in Brazil, where Neel also worked.) But Francis Black, a retired Yale public-health specialist who long worked with Native American vaccination programs, suggests that Neel may have chosen the older vaccine because he could get it for free. "Because of the gamma globulin, [Edmonston B] was generally more expensive and complicated to administer," Black says. "But we did have 10 years of experience with it, so I felt it was a rational thing to do." In addition, Neel's suppliers, Lederle and Parke-Davis, did not make Schwarz vaccine, which was not yet widely manufactured in the United States, according to Susan Lindee, a historian at the University of Pennsylvania in Philadelphia who has written extensively about Neel's field research.

The 10 years of experience did Neel little good during his 1968 trip. Within weeks of his arrival, as Tierney reports, measles exploded around him. In a nightmarish scenario, the disease felled Yanomamo almost simultaneously at a number of widely spread villages. Working in what seems to have been confusion and near-panic, Neel and his team tried to vaccinate ahead of the disease, creating what he called in his memoirs an epidemiological "firebreak." Meanwhile, they tried to shoehorn in their research, taking thousands of blood samples while Asch shot hours of film.

"Neel is constantly saying [during this period] that there are things that he wants to do but that he can't do to fulfill his production quotas [of blood samples]," Tierney said in an interview with *Science*. "You can sense his agony and frustration. ... He talks about going to these places and helping them out, but he doesn't do it. What he's actually doing is going off with all these blood samples."

At least one vaccinated child subsequently died of measles, Tierney writes. And because measles appeared in the area soon after the team's arrival, he argues that the vaccine itself may have caused the epidemic—or that its side effects, combined with the malaria and viral infections endemic to the Yanomamo, were severe enough to be indistinguishable from deadly wild measles. (Edmonston B's side effects are exacerbated if the recipient has a cold, Black says, and Neel's diary records that he had a "beastly URI" [upper respiratory infection], which he likely passed on.) Asch's audio tapes of the expedition, discovered by Tierney and listened to by *Science*, suggest that expedition members themselves, bewildered by the way the disease seemed to be springing up everywhere around them, wondered whether the vaccine might be a cause.

Vaccine experts argue that the vaccine could not have touched off the epidemic. Measles vaccine co-developer Samuel L. Katz of Duke University says Edmonston B, Schwarz, and other live-virus measles vaccines are extremely unlikely to be transmissible. Surprises can always happen—oral polio vaccine apparently caused an outbreak in the Dominican Republic last summer (*Science*, 8 December 2000, p. 1867)—but both Edmonston B and Schwarz vaccines, Katz says, "have simply never been seen to be transmissible from a vaccine recipient to



Attacked and defended. Criticisms of James Neel's measles vaccination efforts have become a lightning rod for Tierney's opponents.

CREDITS: (YANOMAMO) ANTONIO MARI; (NEEL) UNIVERSITY OF MICHIGAN PHOTO SERVICES

a susceptible contact." The vaccine's side effects may have been severe, especially because the Michigan team was unable in most cases to provide care afterward. Nonetheless, Katz says, "many more would have died if Neel had not been there."

"If Sam Katz had originally told me this vaccine could never start an epidemic, I don't think I would have pursued this study," Tierney says. "Instead he was so amazed by Neel's report [of extremely severe side effects] that he asked me to send him the abstract. ... [The measles researchers'] initial attitudes were very different than what they say now."

Measles may have appeared in the area before the Michigan team arrived, according to evidence that surfaced recently. Documents collected in November by Thomas N. Headland, an anthropologist at the Summer Institute of Linguistics in Dallas, Texas, indicate that the 27-month-old daughter of missionary Keith Wardlaw contracted measles in late August 1967 while being taken to Manaus, Brazil, to treat gum problems. After the Wardlaw family returned to its post on the Toototobi River, about 25 km south of the Venezuelan border, the girl broke out with measles. She became sick, Wardlaw recalled in an e-mail to Headland, just as the local Yanomamo "were having a typical Yanomamo feast" to which "they had invited three neighboring villages"—an estimated 150 to 200 people. "With very few exceptions, everyone of the Yanomamo present at the feast came down with the measles in September or October 1967," Wardlaw wrote. Seventeen died, mostly of secondary infections, despite the Wardlaws' emergency flight to obtain penicillin. Around 13 January 1968, a subsequent article in the missionary journal *Brown Gold* reported, the disease erupted in Tamatama, Venezuela, about 300 km north of the Toototobi villages and 120 km upriver from the Ocama mission, where the Michigan team arrived just over a week later.

As for the taking of blood samples—the main reason for the Michigan team's 1968 visit—Tierney argues that was also problematic. The Yanomamo, he points out, did not give informed consent to the research. At the time, informed consent was a hot issue—a 1966 article in *The New England Journal of Medicine* listing 22 unethical experiments had provoked nationwide controversy. But standards would not become clearer until the 1971 revelation of the Tuskegee experiment, in which syphilis patients were deliberately left untreated, prompted federal regulations 3 years later. "Clearly, you wouldn't do what Neel did today," says philosopher Robert P. Crease of the State University of New York, Stony Brook, who conducts mandatory ethics classes for university researchers. "But the standards were not so clear at the time."

Fecund killers

Although the allegations surrounding the measles epidemic have received the most public attention, Tierney's criticisms of Chagnon's ethnographic studies and the conclusions he draws from them have reopened old wounds in the anthropology community. Chagnon's repeated visits to the Yanomamo, beginning with his work with Neel and continuing sporadically into the 1990s, says UCSB anthropologist John Tooby, produced "one of the only detailed, quantitative data sets we have about small, face-to-face societies. It may sound surprising, but it is very rare for anthropologists to keep careful accounts of births, deaths, and family trees for every person in a village." Chagnon's work is especially important, Harvard biologist Edward O. Wilson has written, because Yanomamo culture may provide "the clearest view of the conditions under which the human mind evolved biologically during deep history."

"That's just baloney to me," says Headland, who put together an AAA session in 1994 about an earlier Chagnon controversy. "The Yanomamo do not give us a view of the way the human mind evolved in deep history. ... They are 20th-century human beings who, it is true, live more traditional lives than we do, but they evolved right along with the rest of us. Their mind and their society is not going to give you a glimpse of our ancestors evolving."

From his first study of "the fierce people," Chagnon has depicted the Yanomamo society—a putative model for early human cultures—as dominated by violence. Indeed, he says, about a third of all adult male deaths among the Yanomamo are due to warfare and homicide. Traditionally, most anthropologists have argued that intergroup conflict is caused by competition for scarce resources, especially food. But in a widely publicized article (*Science*, 26 February 1988, p. 985), Chagnon proposed instead that Yanomamo violence is associated with higher genetic fitness. In this culture, he wrote, men who have killed—*unokai*, in the language—are rewarded by "higher reproductive success," because they have "greater success in finding mates."

Chagnon's *unokai* thesis was quickly denounced by other Yanomamo specialists. In charges that Tierney repeats and amplifies, anthropologist Bruce Albert of the University of Paris contended in *Current Anthropology* that Chagnon's mortality data must come from unrepresentative villages, because his figures for violent death were higher than those from other researchers into Yanomamo society. Albert's colleague Jacques Lizot asserted in *American Ethnologist* that Chagnon's "systematic bias" led him to gloss over the fact that the category of *unokai* is not reserved to men who have personally killed human beings. As Tierney does in *Darkness*, Lizot castigated Chagnon for making it "impossible to determine the precise origin of the quantitative data."

Perhaps the sharpest critique came from R. Brian Ferguson of Rutgers University in Newark, who said in *American Ethnologist* that Chagnon had failed to account for confounding variables. First, many *unokai* were also village headmen, who have been known for decades to "have more wives and more children, regardless of the presence of war." Second, Chagnon's figures on reproductive success did not include dead *unokai*. The obvious question, in Ferguson's view, was whether the greater reproductive success of *unokai* was offset by higher mortality. Responding in *American Ethnologist*, Chagnon calculated the same figures without the headmen and came up with a correlation similar to, although smaller than, his previous figure. But, Chagnon told *Science*, he "didn't record at the time the status of *unokai* men who were killed," which is necessary to respond to Ferguson's second objection. "But from what I know," he says, "it looks as though [Ferguson's] hypothesis doesn't hold up."

"The suggestion that Chagnon is somehow off his rocker ... to believe that [killing

Articles

Life Histories, Blood Revenge, and Warfare in a Tribal Population

NAPOLEON A. CHAGNON

Controversial views. Chagnon's 1968 book depicted Yanomamo as violent; his 1988 *Science* paper argued that killers have greater reproductive success.

is associated with greater fitness] is totally unwarranted," says Hill of New Mexico, who works with the Ache foragers in Paraguay. "That said, most of his demography is pretty crude." Based on his own, similar survey of Ache reproduction, Hill believes that Chagnon may have confounded higher fertility and higher child survivorship. "The same guys who were killers have a lot of other characteristics," he says. "The most important is that they are healthier and stronger than the other men." Because "men who are big and healthy and robust produce kids who are healthy and robust, I don't find it surprising that their children have higher survivorship."

In Tooby's view, many of these criticisms are stand-ins for a deeper objection: an "antiscientific" objection to the intrusion of biology into anthropology. "There's a very fundamental view, basic to the origin of anthropology and sociology, which is that psychology and biology have nothing to do with human behavior," he says. Anthropology is in crisis today, in his view, "because there's an overwhelming body of evidence that this is not correct, of which [Chagnon's] work is a major part."

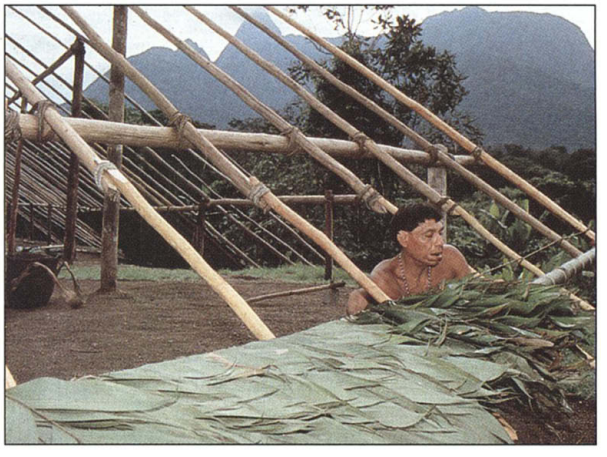
Political correctness?

Tierney, who identifies himself as a human rights activist, is less concerned with Chagnon's scientific role than with his methods and the impact his arguments have had on the Yanomamo themselves. Put briefly, Tierney charges in *Darkness in El Dorado* that Chagnon and Neel were able to obtain blood samples and detailed genealogical data only by going to extraordinary lengths—lengths that Tierney believes not only had a disproportionate impact on Yanomamo culture but that actually led to war.

Yanomamo specialist Good says that the Yanomamo dislike providing blood, because they believe it gives the recipient power over them. As a result, Neel's research, Tierney writes, was "a production-line collection of 12,000 biological samples, each of which had to be purchased by Chagnon with a steel good"—usually a machete, ax, or cooking pot. Chagnon also wanted Yanomamo names. But, as he has written, they do not speak names aloud—especially the names of the dead—because names have powerful magical properties, so he gave out machetes and axes for the information. Showing up with piles of steel tools, Chagnon was, as he wrote in *The Fierce People*, besieged by "incessant, passioned, and aggressive demands" for axes and machetes, to which he often "succumb[ed]." He also explained that he was " 'bribing' children [to tell names] when adults were not around, or capitalizing on animosities between villages" by getting enemies to inform on each other. "It all adds up to this sudden, destabilizing infusion of wealth," Tierney said in an interview.

Metal goods first came to the Yanomamo in the 1930s, but stone tools persisted until the late 1970s, according to Robert Carneiro of the American Museum of Natural History in New York City. In a study by Hill and Hillard Kaplan of the University of New Mexico, Albuquerque, it took up to 60 times longer to cut down trees with stone axes than with steel axes—a ratio that does not include the time needed to find, make, and maintain stone ax heads. So inefficient were traditional tools, Venezuelan anthropologist Marcus Colchester has argued, that before contact, the Yanomamo must have made their living by foraging, rather than agriculture.

The arrival of the Michigan team with large quantities of steel goods therefore "had a huge effect," says William Denevan, an archaeologist emeritus at the University of Wisconsin, Madison, who worked in Amazonia for decades. "Chagnon repeatedly says [in his writings] that he wants to keep these people as free of outside influence as possible. And yet from his own writing it's obvious that through his introduction into the economy of these metal tools he's having a major impact himself, which is completely contradictory."



Traditional technology. Leaf-roofed Yanomamo hut.

CREDIT: ANTONIO MARI

Tierney argues that these goods changed the balance of power among villages. He writes, for example, that a village in which Lizot lived became politically powerful in part because of goods that Lizot bestowed. He alleges that Lizot, a respected researcher who lived among the Yanomamo for 25 years, used gifts to lure young Yanomamo males into satisfying his sexual appetites. (In an interview with Time, Lizot called the charges "disgusting. ... My house is not a brothel. I gave gifts because it is part of the Yanomami culture.") Incredibly, Tierney writes, "Lizot's village" made war on "Chagnon's village"—a settlement that became strong because Chagnon had resided there in the past. (He was not in Venezuela at the time of the war.) Ten people died; Lizot's village was burned to the ground.

"The way entire villages formed around anthropologists and evolved a lifestyle around them is one of the most chilling things I discovered," says Tierney, who spent 15 months in Yanomamo territory. The power acquired by "Chagnon's village" led to constant warfare and death that ceased as soon as he left the field, according to *Darkness*. Little wonder, Tierney says, "I kept hearing people say how much they hated the anthropologists who had studied them."

"People have accused me of being the greatest violator of the Heisenberg Uncertainty Principle in the history of anthropology," Chagnon says. "But they don't mention that the missionaries [in the area] were having a far greater impact than I ever could have." Ferguson agrees that missionaries should share the blame. But because Chagnon, in his quest for large-scale genealogical information, "had to go back and forth between villages and had so many goods to give out, he became a participant in the politics and a source of tension," Ferguson says.

The already heated dispute among anthropologists acquired an additional charge in the late 1980s, when the Yanomamo area was invaded by thousands of gold miners, some of whom cited Chagnon's views as evidence that the Indians were too murderous to deserve protection. Introduced disease killed many Yanomamo; a single massacre left 16 Indians dead. A 1991 congress in Caracas on the Yanomamo was, according to Chagnon, "frequently punctuated with ad hominem denunciations of me." As the battle raged, Chagnon was prevented from visiting Yanomamo territory for years at a time.

One of the few aspects on which all sides agree is that the Yanomamo—along with other relatively unacculturated groups—are in peril of extinction. At the San Francisco meeting, the AAA and its members were charged with failing to come up with ground rules for managing contact with such cultures. "This Tierney business is dreadful for anthropology," says Leslie Sponsel, an anthropologist at the University of Hawaii, Manoa. "But it could force the governments of Brazil and Venezuela to pay more attention to the Yanomamo, and the AAA to professional ethics. I keep thinking there's got to be something good to come out of this. A lotus flower grows out of the muck in a pond, after all." **–CHARLES C. MANN**