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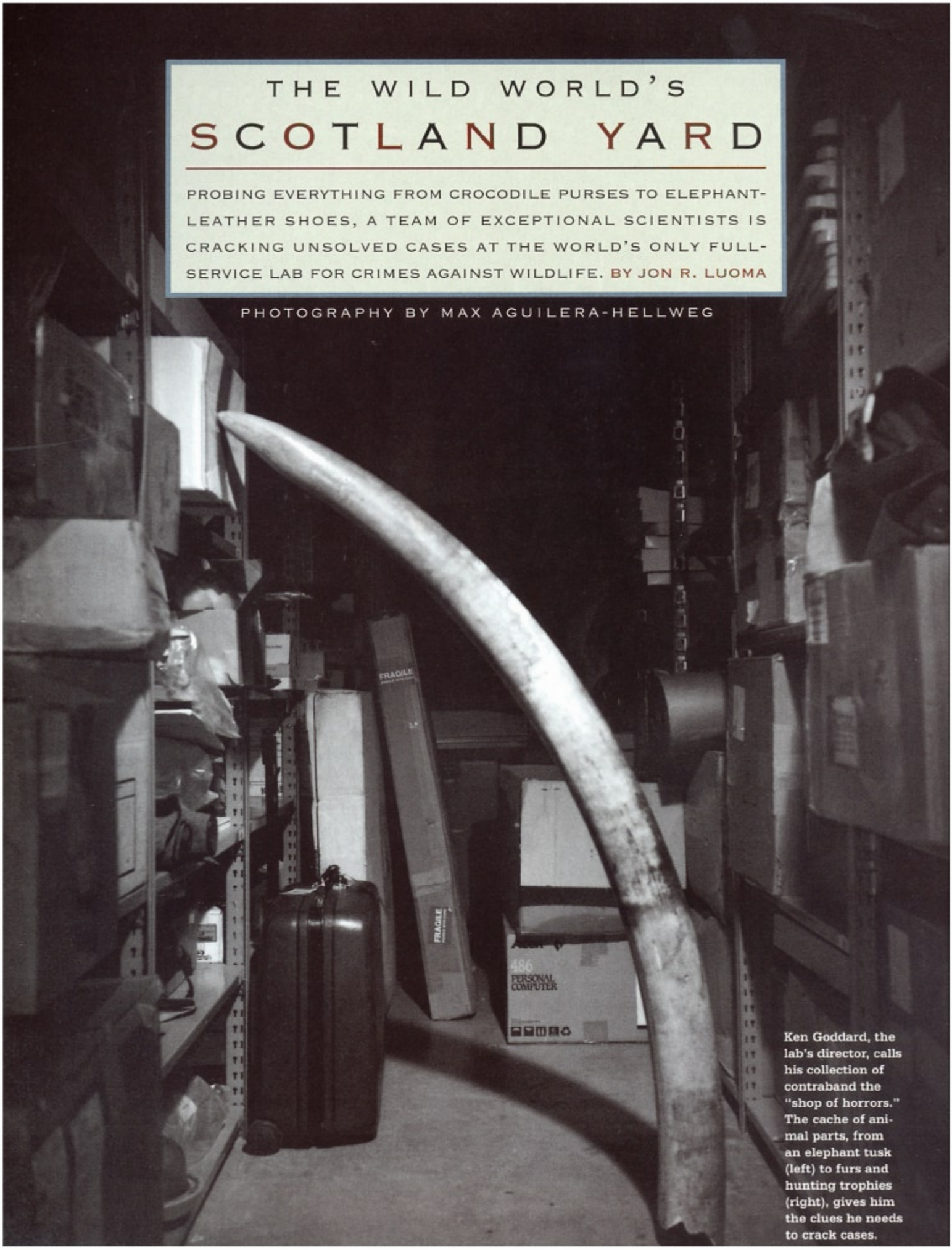
THE WILD WORLD'S SCOTLAND YARD

PROBING EVERYTHING FROM CROCODILE PURSES TO ELEPHANT-LEATHER SHOES, A TEAM OF EXCEPTIONAL SCIENTISTS IS CRACKING UNSOLVED CASES AT THE WORLD'S ONLY FULL-SERVICE LAB FOR CRIMES AGAINST WILDLIFE. BY JON R. LUOMA

PHOTOGRAPHY BY MAX AGUILERA-HELLWEG



Ken Goddard, the lab's director, calls his collection of contraband the "shop of horrors." The cache of animal parts, from an elephant tusk (left) to furs and hunting trophies (right), gives him the clues he needs to crack cases.

One spring day, Bonnie Yates plucked a tiny inch-long hair from a luxurious and elaborately embroidered shawl. Carefully, she placed the hair onto a glass slide, then moved the slide onto one stage of her dual-stage microscope, a favorite tool of scientists who investigate crimes. Next to it she placed a slide bearing another tiny hair, a reference sample she keeps under lock and key in her lab. Peering at the hairs, side by side, through her microscope, she could see that the small, fine strand from the shawl was a perfect match for the reference sample. Both hairs were crinkled, brittle-looking, "zigzagged," as Yates says, "like a French fry." Each hair's inner structure is shaped like a cobblestone path. As Yates knew better than anyone in the world, the hairs proved that someone had committed a crime.

Yates's reference sample was collected from a stuffed chiru, a Tibetan antelope. The hair's shape and appearance are unique to that mammal, meaning that the hair from the shawl could have come only from a chiru, a critically endangered species that's protected by international treaty. While there were as many as a million chirus at the start of the 20th century, the population has since dropped to about 70,000.

In 1998 wildlife agents in Hong Kong had seized the shawl and dozens of others from a dealer, convinced that they were so-called "ring shawls" made of shahtoosh, the luxurious and contraband wool of the chiru. So named because the entire, delicate garment can be pulled through a wedding ring, shahtoosh shawls are typically woven in a northern province of India. Warm but featherweight and supremely soft, they have long been considered the ultimate in luxury and can retail for as much as $15,000.

Traffickers in shahtoosh garments sometimes suggest that the chirus conveniently shed their wool onto bushes. In fact, virtually all the fleece that enters the market is collected with bullets. To get enough shahtoosh for a single ring shawl, poachers mow down and skin as many as five chirus.

YATES IS A FORENSIC SCIENTIST FOR THE CLARK R. BAVIN National Fish and Wildlife Forensics Laboratory, in Ashland, Oregon. Her workplace, a sprawling, nondescript concrete building, is the world's only full-service lab that focuses exclusively on crimes against wildlife, a service it provides not only to agents of the U.S. Fish and Wildlife Service, which runs the lab, but also to state wildlife agencies and foreign governments.

When wildlife agents find an endangered animal that has been shot or poisoned, or if they believe they've caught a poacher, or when customs agents seize a bit of apparent contraband, such as elephant ivory, the evidence is sent here—the wild world's Scotland Yard.

With its small but highly specialized staff of 32 scientists and support workers and an annual budget of $1.7 million, the 10-year-old lab has become central to the prosecution of crimes against wildlife. There is certainly no shortage of crimes. In 1999 the lab handled more than 1,000 cases. Every weekday, a small parade of FedEx, UPS, and Postal Service delivery trucks appear at the lab's loading dock with more evidence. On one recent day, technician Elaine Plaisance unpacked a routine delivery: four large ice chests, each containing a dead, apparently poisoned, bald eagle; a black skull-and-crossbones poison symbol had been stamped on each cooler. From cardboard boxes lined with vinyl sheeting, Plaisance retrieved 80 oil-covered ducks; another box contained a lump of alligator meat. In another she found a wad of tissue that might have been the gall bladder of a bear, an organ so prized in traditional Asian medicine that illegal traffickers can make thousands of dollars poaching bears. The lab has perfected a test that proves that U.S. traffickers often substitute the similar-looking gall bladders of farm pigs, which is not a crime.

Bonnie Yates is renowned for being able to recognize species from fragments, such as this skull of a babirusa pig. An X-ray of a golden eagle (opposite) reveals that the bird was riddled with gunshot.

Most of the mountain of contraband that has come to the lab for analysis over the years is now stored in a Colorado warehouse, although Ken Goddard, the lab's director, keeps a few of the unique samples on display in what he calls the "shop of horrors." First Goddard shows off a tacky caiman purse, complete with the endangered reptile's head and hind legs, and then the "$6,000 version"—sleek and classically styled, its latticed skin dyed a silky black. "I probably shouldn't mention which fancy New York store the agents found this in," he says.

Next Goddard holds up a plaque bearing the head of a green turtle, and a pair of high-top tennis shoes made with the skin of a Russell's viper, both of which are endangered species. Goddard points to a stool made

BEFORE THE LAB OPENED, GAINING A CONVICTION WAS HOPELESS. UNLIKE CRIMES AGAINST HUMANS, CRIMES AGAINST WILDLIFE OFTEN LEAVE BEHIND NO EASILY IDENTIFIABLE VICTIM, ONLY THOSE BAFFLING BITS AND PIECES OF EVIDENCE.

Examining a South American headdress, Pepper Trail (opposite) determines it was made from the feathers of macaws and other birds. The flamingo specimens (above) are used to make comparisons.

from an elephant's foot and then picks up a pair of ordinary-looking shoes. "Elephant leather," he says. And that, he adds, is the essence of the problem that wildlife agents—and the lab—often have to deal with. While the source of the stool is all too evident, only an expert would know that the leather is actually elephant hide.

"If federal agents drag a whole elephant in here, you and I and everyone else would know it's an elephant," Goddard says. "But we almost never get easily recognizable parts, much less a whole animal. Most often we get pieces—bones, skins, feathers, scrimshaw, dried blood, leather. All the things that might tell you 'this is an elephant' aren't there."

That's precisely why, before the lab opened its doors, federal, state, and international wildlife agents often struggled in vain to prosecute crimes against wildlife, including a flood of traffic in endangered species that's estimated to be worth billions of dollars annually. Much of the time, gaining a conviction was hopeless, because unlike crimes against humans, crimes against wildlife often leave behind no easily identifiable victim, only those often-baffling bits and pieces of evidence.

"It's impossible to even begin to express how important this lab has become to us," says Kevin Adams, the assistant director for law enforcement at the Fish and Wildlife Service headquarters, in Washington, D.C. He remembers sometimes begging conventional crime labs to help analyze evidence. "But there are limits to what a guy from the state police whose expertise is in hit-and-run accidents can do. Now we have the world's recognized experts working in our own lab. When it's time to take cases to court, we're getting convictions."

Richard Dickinson, a Fish and Wildlife special agent in Minnesota, cites an extraordinary 1997 case in which a Minnesota man killed a gray wolf, a threatened species. The man insisted that the wolf had been charging his six-year-old son. But since wolves are virtually always afraid of humans, wildlife agents were skeptical.

"You really couldn't tell by a cursory examination of the bullet wound what had happened," Dickinson says. "So before the lab existed, the guy would have probably gotten away with it." But the lab's chief wildlife pathologist, Richard Stroud, and its ballistics team were able to show that, as Dickinson puts it, "debris from the bullet in the wound was flowing from the back of the neck to the front. That meant we could prove in court that the wolf was running away from the guy when he shot it."

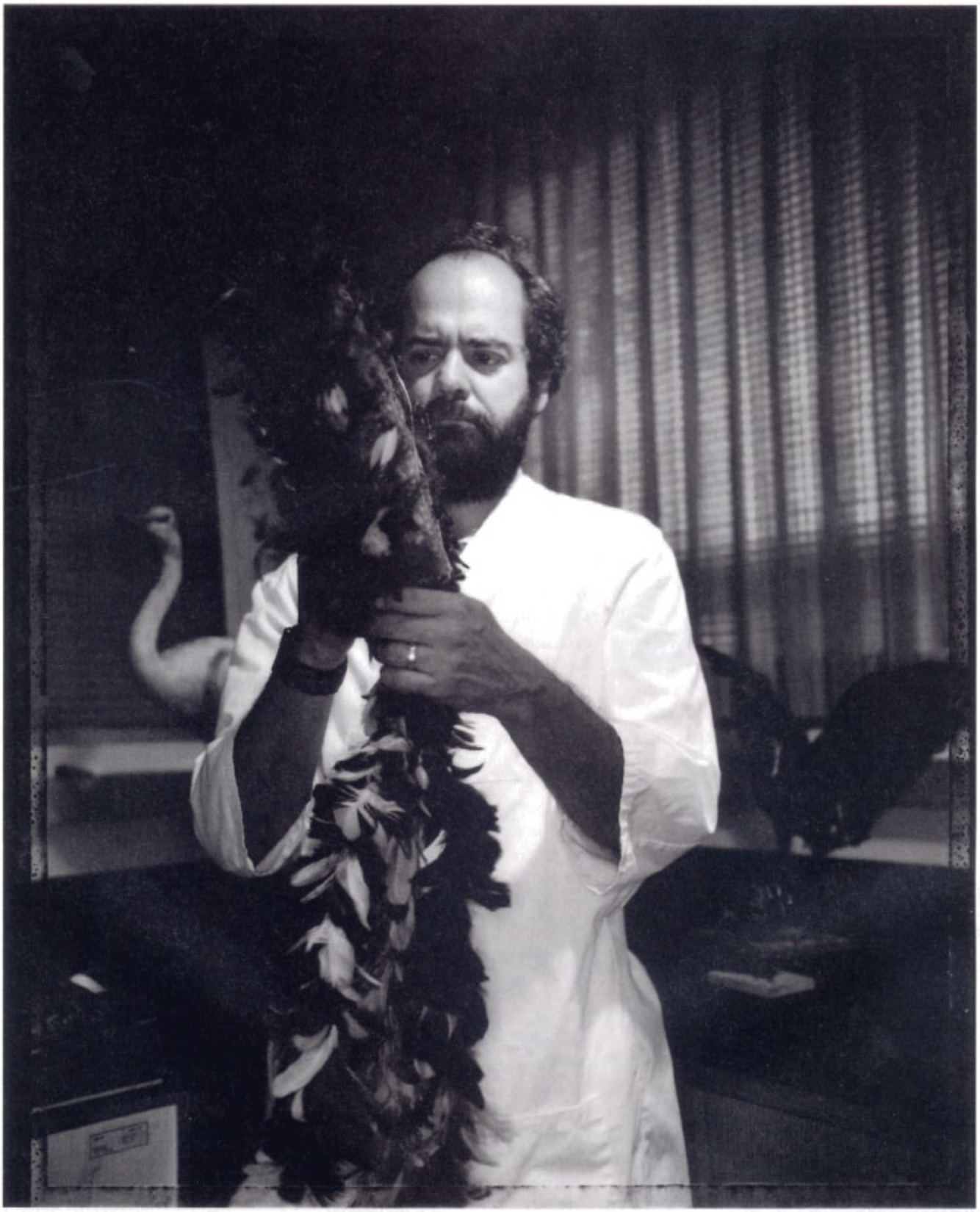
In the past, suspected poachers and smugglers often escaped prosecution simply because no expert could prove conclusively that a sample of bone, skin, or fiber was, in fact, from a protected species. For instance, before Bonnie Yates documented the shahtoosh's microscopic signature in 1996, merely distinguishing that wool from other fine wools, such as cashmere, was nearly impossible.

Not anymore. Early in 1999 Yates flew to Hong Kong to serve as the key expert witness in the high-profile trial of the textile trader whose shawls she had examined the previous year. Hong Kong wildlife agents had seized 130 of the contraband shawls in the trader's luxury hotel room. On the strength of Yates's testimony, the trader was convicted and fined $40,000. This past July Yates's analysis scored another victory, in a federal court in New Jersey, when import-export dealers Linda Ho McAfee and Janet Mackay-Benton pleaded guilty to violating the Endangered Species Act by exporting almost 100 shahtoosh shawls for sale in a fashionable Paris boutique.

According to Fish and Wildlife special agent Tara Donn, who worked on the case, "The defense never even contested the forensic results. The forensic work from the lab really was central to the case." Above all, she says, open trade in shahtoosh has come to a virtual stop in the wake of the lab's discovery, although she suspects that a black market remains active.

PARADOXICALLY, DESPITE THE OBVIOUS AND PRESSING NEED for such a facility, the nation had a wildlife-crime-lab director for a decade before it had a lab. Goddard had spent 12 years as a forensic scientist in conventional crime labs in California before answering an ad to run a national wildlife-forensics lab in 1978. But Fish and Wildlife hired him before it had the funding to build a laboratory, much less hire a staff. The running joke through most of the 1980s was that the national laboratory was located "in Ken Goddard's briefcase."

Partly to vent his frustrations, Goddard began churning out crime novels, full of the kind of grisly violence and police procedure he had been exposed to during his days with the sheriff's department. His first novel, *Balefire,* was a best-seller in 1983. In more recent books, like *Double Blind,* the heroes and villains are wildlife agents, poachers, and radical environ-



"THERE ARE LIMITS TO WHAT A GUY FROM THE STATE POLICE WHOSE EXPERTISE IS HIT-AND-RUN ACCIDENTS CAN DO. NOW WE HAVE THE WORLD'S RECOGNIZED EXPERTS WORKING IN OUR LAB. WHEN IT'S TIME TO TAKE CASES TO COURT, WE'RE GETTING CONVICTIONS."

mentalists. In a sort of *X-Files* turn, Goddard's most recent book features a forensic scientist who receives a sample of tissue from a truly exotic creature; the sample turns out to contain, as he puts it, "DNA, certainly, but not DNA of this world."

After Congress appropriated the funds, the lab finally opened in 1989. Today high-tech gear fills the facility. Moving from wing to wing of the building recently, Goddard waved at gadgets used to replicate and analyze DNA; an enormous scanning electron microscope, based on a design from Scotland Yard, which occupies a small room of its own; supercooled "ultra-freezers" containing about 30,000 samples of known animal tissues that are used to make DNA comparisons; and a gleaming, dishwasher-size device called a gas-chromatograph that's designed to sniff out the chemical makeup of virtually any compound.

But for all the technological wonders, Goddard says he doubts that computers, or any technology, can ever be substituted for human expertise. Pepper Trail, a staff scientist and the lab's ornithologist, taps his head as he puts it this way: "A high degree of computing power from up here is brought to bear on these identifications. This is still the most powerful instrument we rely on here."

Goddard and I find Trail seated on a low stool at a large square table in the busy and cluttered section of the lab devoted to morphology, the branch of biology that focuses on the form and structure of organisms. Here scientists spend their days comparing evidence with the lab's enormous collection of reference samples: feather to feather, skeleton to skeleton, claw to claw, bone to bone.

Trail is examining a collection of wing feathers that arrived in a recent shipment with a request for identification. He has arranged them on a large lab table according to their curvature, and has already concluded that they come from a garden-variety male pheasant.

Victims of fashion: Cobras are killed to make shoes like the ones below; crocodiles and alligators are highly prized for their leather. Sometimes such contraband can even be found in tony stores in New York and Paris.

The morphology section centers around an open, capacious room, brightly lit but ghoulish. Here, on shelves everywhere, on tables, in trays and in drawers and boxes, is a fantastical collection of reference samples: carefully preserved and labeled animal body parts, including bones, skulls, whole skeletons, beaks, claws, and talons, as well as entire stuffed mammals and birds. Surrounding Trail's worktable is tray after tray bejeweled with stuffed and glassy-eyed songbirds. On a shelf are similar-looking skulls, one labeled DOG, the other WOLF. On one table sits the skull of a gorilla, and on another there's a partially dissected wallaby, exuding the pungent odor of a butcher shop.

"I hope body parts don't bother you," says Goddard, who explains that the wallaby died of natural causes in a California zoo and is now in the process of joining the collection of reference skeletons. The skinned carcass, he notes matter-of-factly, will be left for a few days in the company of the lab's resident colony of "very thorough" dermestid, or flesh-eating, beetles, which will produce a clean skeleton.

LIKE ANY MODERN CRIME LAB, THE WILDLIFE VERSION OFTEN uses DNA analysis to identify species, or even individual animals. The lab is able to identify the DNA's unique genetic "fingerprint" in a snippet of tissue. Its DNA work, for instance, helped lead to the November 1999 conviction in a Brooklyn federal court of three smugglers, including the former deputy chief of police in Warsaw, Poland, who attempted to sneak thousands of pounds of sturgeon eggs (caviar) past Fish and Wildlife inspectors at Kennedy Airport. (To protect several endangered species of sturgeon, legitimate caviar importers follow strict permit and reporting regulations.) The case marked the first time that caviar smugglers had been prosecuted since regulations went into effect in 1998; one of the smugglers was fined $25,000 and sentenced to 20 months in federal prison.

Still, DNA analysis has its limits. Unlocking the genetic code of a tissue sample is complex and expensive. And although human DNA is now well characterized, knowledge about animals' DNA is still evolving. Besides, when it comes to the practicalities of dealing with lawyers and

juries, sometimes it's much easier to gain a conviction with lower-tech approaches.

"It's faster and cheaper and easier to explain to a jury," Trail says of the morphological approach. "With complex technology, like DNA, a defense attorney can try to cloud and confuse the issue. But it's a compelling thing when I can hold up one of our known, labeled reference bones, or a feather or a talon, and hold up a matching bone or feather or talon, and show people that they're the same."

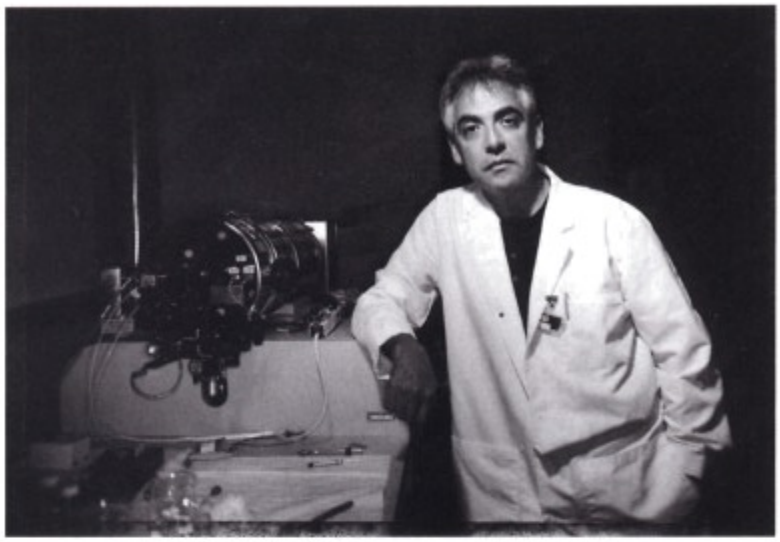
To prove his point, Trail takes a golden eagle foot from a drawer. "This is an easy one," he says. "Nothing else looks like it. It's too big for a hawk and is the only eagle we've got with feathers all the way down."

With a Ph.D. in ornithology and an extensive background in field research, Trail was well qualified when he was hired by the lab in 1998. But, he says, it took months of intensely studying feathers and bones on the job to develop his deep knowledge of the minutiae of bird morphology—enough to sail through the rigorous hands-on tests the lab gives every few months. Trail, for instance, might be given a few claws, feathers, and bits of bone and asked to identify the species they come from. Now one or two feathers is all he needs to identify a bird.

Mammalogist Bonnie Yates is legendary for her ability to recognize species from fragments—often with something as scant as a small piece of a tooth. One day in the lab's DNA section, puzzled scientists were struggling to identify a mysterious lumpy bone. Yates wandered by. "Hey, look at that cool giraffe vertebra," she exclaimed, cracking the case on the spot.

THE FORENSIC LAB HAS BEEN making breakthrough discoveries since it opened, in large part because there are simply so many unknowns. "Wildlife forensics is a science still very much in its infancy," says Edgard Espinoza, the lab's chief of science. "In some ways we're where human forensic science was 100 years ago. But that's what's fun about working here: We have the opportunity to push a new science out to places it hasn't been before."

Indeed, soon after the lab opened, Espinoza and staff scientist Mary-Jacque Mann solved a problem that had long baffled customs and wildlife agents: determining if an ivory artifact is carved from elephant ivory, which is illegal to import, or from woolly mammoth or mastodon ivory, which is legal both to possess and to import. When trafficking in elephant ivory was banned in 1989, poachers began labeling shipments "mammoth." Espinoza and Mann discovered that because of internal structural differences, tiny lines in the ivory vary with absolute consistency between the species. Today any customs agent with a magnifying glass, a plastic protractor, and a copy of the lab's guidelines can tell the difference.



Edgard Espinoza discovered that a device called a mass spectrometer would enable him to identify a species from just a speck of blood.

In recent years the lab's scientists have developed a simple technique for distinguishing the gall bladders of bears from those of pigs by chemically evaluating bile from the organs. And its DNA specialists have found a way to extract the genetic material from rhinoceros horns, even though the horns are essentially composed of keratin, which does not break down easily. The secret: The scientists use liquid nitrogen to supercool the keratin to about minus 60 degrees centigrade, at which point it does break down.

Ballistics experts at the lab are also working on new ways to use computers to digitize images of spent bullets to better analyze their patterns. And in the late 1990s Espinoza himself made a landmark discovery when he found that the chemical composition of the proteins that constitute hemoglobin in blood are unique to each species. In most cases, the lab needs only a small speck of blood to identify a species conclusively.

Espinoza is happy to demonstrate the technique, using samples of dried blood from a loon and an eagle, and then some of his own blood, each captured on bits of gauze. He dissolves the dry samples in solvent in separate test tubes, then quickly separates the solvent containing the blood from the gauze in a whirring centrifuge. One by one, he pops a mote of blood from each test tube into a device called a liquid chromatograph mass spectrometer. For each sample, the chromatograph spits out a chart—an image of peaks and valleys that amounts to a map of the chemicals in the blood. He need only compare each chart with a series of reference charts. The matches are perfect: loon, eagle, and human.

The lab never comments on ongoing cases or on how its work might be used in future prosecutions. But judging by its record, it seems certain that it will keep pushing out new boundaries to put poachers, smugglers, and other wildlife criminals out of business.

Jon R. Luoma, an *Audubon* contributor for 20 years, has also written for *The New York Times, National Geographic,* and many other publications.