A new group of “landscape-immersion” zoo designers are trying to break down visitors’ sense of security by reminding them that wild animals really are wild

NO RMS, JUNGLE VU

by Melissa Greene

“T he Egyptians have been civilized for four thousand years... my own ancestors probably a lot less,” Jon Charles Coe says. “We evolved over millions of years in the wild, where survival depended on our awareness of the landscape, the weather, and the animals. We haven’t been domesticated long enough to have lost those senses. In my opinion, it is the business of the zoo to slice right through that sophisticated veneer, to recall us to our origins. I judge the effectiveness of a zoo exhibit in the pulse rate of the zoo-goer. We can design a zoo that will make the hair stand up on the back of your neck.”

A revolution is under way in zoo design, which was estimated to be a $20 million business last year. Jon Coe and Grant Jones are the vanguard. Coe, forty-six, is a stocky man with a long, curly beard. He is an associate professor of landscape architecture at the University of Pennsylvania and a senior partner in the zoo-design firm of Coe Lee Robinson Roesch, in Philadelphia. Grant Jones, a senior partner in the architectural firm Jones & Jones, in Seattle, is at forty-eight a trendsetter in the design of riverfront areas, botanical gardens, and historical parks, as well as zoos. Coe and Jones were classmates at the Harvard School of Design, and Coe worked for Jones & Jones until 1981.

Ten years ago in Seattle they created the Woodland Park gorilla exhibit in collaboration with Dennis Paulson, a biologist, and with David Hancocks, an architect and the director of the Woodland Park Zoo. The exhibit is still praised by experts as the best ever done. Dian Fossey, the field scientist who lived for fifteen years near the wild mountain gorillas of Rwanda before her murder there, in December of 1985, flew to Seattle as a consultant to the designers of Woodland Park. When the exhibit was completed, Johnpaul Jones, Grant Jones’s partner (the two are not related), sent photographs to her. She wrote back that she had shown the photos to her colleagues at the field station and they had believed them to be photos of wild gorillas in Rwanda. “Your firm, under the guidance of [Mr.] Hancocks, has made a tremendously important advancement toward the captivity conditions of gorillas,” Fossey wrote. “Had such existed in the past, there would undoubtedly be more gorillas living in captivity.”

“Woodland Park has remained a model for the zoo world,” says Terry Maple, the new director of Zoo Atlanta, a professor of comparative psychology (a field that examines the common origins of animal and human behavior) at the Georgia Institute of Technology, and the author of numerous texts and articles on primate behavior. “Woodland Park changed the way we looked at the zoo environment. Before Woodland Park, if the gorillas weren’t in cages, they were on beautiful mown lawns, surrounded by moats. In good zoos they had playground equipment. In Woodland Park the staff had to teach the public not to complain that the gorilla exhibit looked unkempt.”

“As far as gorilla habitats go,” Maple says, “Cincinnati’s is pretty good; San Diego’s is pretty good; Columbus’s has a huge cage, so aesthetically it loses a great deal, but socially it’s terrific; San Francisco’s is a more technical solution, naturalistic but surrounded by walls. Woodland Park’s is the best in the world.”

In Woodland Park the zoo-goer must step off the broad paved central boulevard onto a narrow path engulfed by vegetation to get to the gorillas. Coe planted a big-leaf magnolia horizontally, into the bank of a man-made hill, so that it would grow over the path. (“People forget that a landscape architect not only can do this,” he said on a recent tour of the exhibit, indicating a pretty circle of peonies, “but can also do this”—he pointed to a shaggy, weed-covered little hill. “I designed that hill.”)

The path leads to a wooden lean-to with a glass wall on one side that looks into a rich, weedy, humid clearing. Half a dozen heavyset, agile gorillas part the tall grasses, stroll leaning on their knuckles, and sit nonchalantly among clumps of comfrey, gnawing celery stalks. The blue-black sheen of their faces and fur on a field of green is electrifying. The social organization of the gorillas is expressed by their interaction around a couple of boulders in the foreground of the exhibit. All the gorillas enjoy climbing on the boulders, but the young ones yield to their elders and the adult females yield to the adult males, two silverback gorillas. The silverbacks drum their chests with their fists rapidly and perfunctorily while briefly rising on two feet—not at all like Tarzan. The fists make a rapid thudding noise, which seems to mean, “Here I come.” Each silverback climbs to his rostrum, folds his arms, and glares at the other. As in nature, their relationship is by turns civil but not friendly, and contentious but not bullying.
The zoo-goers in the lean-to, observing all this, feel fortunate that the troop of gorillas chooses to stay in view, when it apparently has acres and acres in which to romp. Moss-covered boulders overlap other boulders in the distance, a stream fringed with ferns wanders among them, birds roost in the forty-foot-high treetops, and caves and nests beyond the bend in the stream are available to the gorillas as a place of retreat. “Flight distance” is the zoological term for the distance an animal needs to retreat from an approaching creature in order to feel safe—the size of the cushion of empty space it wishes to maintain (about a third of an acre), which is generous but not limitless. The arrangement of overlapping boulders and trees in the distance is meant to trick the eye. There are no fences or walls against which to calculate depth, and the visitor’s peripheral vision is deliberately limited by the dimensions of the lean-to. Wider vision might allow a visitor to calculate his position within Woodland Park, or might give him an inappropriate glimpse—as happens in almost every other zoo in the world—of a snowshoe rabbit or an Amazon porcupine or a North American zoo-goer, over the heads of the West African gorillas. Coe measured and calculated the sight lines to ensure that the view was an unorthodox one, a place of retreat. “Flight distance” is the zoological term for the distance an animal needs to retreat from an approaching creature in order to feel safe—the size of the cushion of empty space it wishes to maintain (about a third of an acre), which is generous but not limitless. The arrangement of overlapping boulders and trees in the distance is meant to trick the eye. There are no fences or walls against which to calculate depth, and the visitor’s peripheral vision is deliberately limited by the dimensions of the lean-to. Wider vision might allow a visitor to calculate his position within Woodland Park, or might give him an inappropriate glimpse—as happens in almost every other zoo in the world—of a snowshoe rabbit or an Amazon porcupine or a North American zoo-goer, over the heads of the West African gorillas. Coe measured and calculated the sight lines to ensure that the view was an unorthodox one, a place of retreat.

In fact the gorillas in Woodland Park do not have so much space to explore. The exhibit is 13,570 square feet (about a third of an acre), which is generous but not limitless. The arrangement of overlapping boulders and trees in the distance is meant to trick the eye. There are no fences or walls against which to calculate depth, and the visitor’s peripheral vision is deliberately limited by the dimensions of the lean-to. Wider vision might allow a visitor to calculate his position within Woodland Park, or might give him an inappropriate glimpse—as happens in almost every other zoo in the world—of a snowshoe rabbit or an Amazon porcupine or a North American zoo-goer, over the heads of the West African gorillas. Coe measured and calculated the sight lines to ensure that the view was an unorthodox one, a place of retreat.

The boulders themselves contain a trick. Coe designed them to contain heating coils, so that in the miserable, misty Seattle winter they give off a warm aura, like an electric blanket. The boulders serve two purposes: they help the tropical gorillas put up with the Seattle winter, and they attract the gorillas to within several feet of the lean-to and the zoo-goers. It is no coincidence that much of the drama of the gorillas’ everyday life is enacted three feet away from the lean-to. The patch of land in front of the lean-to is shady and cool in summer. The gorillas freely choose where to spend their day, but the odds have been weighted heavily in favor of their spending it in front of the lean-to.

“Their old exhibit was a six-hundred-square-foot tile bathroom,” says Grant Jones, a tall, handsome, blue-eyed man. “The gorillas displayed a lot of very neurotic behavior. They were aggressive, sad, angry, lethargic. They had no flight distance. The people were behind the glass day and night, the people poured on the glass, the gorillas were stressed out, totally, all the time. Their only way to deal with it was to sleep or to show intense anger. They’d pick up their own feces and smear it across the glass. They were not interacting with one another.

“My assumption was that when they left their cage to enter their new outdoor park, that behavior would persist. On the first day, although they were frightened when they came into the new park, they were tranquil. They’d never felt the wind; they’d never seen a bird fly over; they’d never seen water flowing except for the drain in the bottom of their cubicle. Instantly they became quiet and curious. The male was afraid to enter into the environment and stood at the door for hours. His mate came and took him by the hand and led him. They only went about halfway. They stopped at a small stream. They sat and picked up some leaves and dipped them in the water and took a bite of the leaves. They leaned back and saw clouds moving over. It was spellbinding. I assumed they would never recover from the trauma of how they’d been kept. It turned out to be a matter of two or three days.”

“Picture the typical zoo exhibit,” Jon Coe says. “You stroll along a sidewalk under evenly spaced spreading maples, beside colorful bedding plants. On your right is a polar-bear exhibit. There is a well-pruned hedge of boxwood with a graphic panel in it. The panel describes interesting features of the species, including the fact that polar bears often are seen swimming far out to sea. In the exhibit a bear is splashing in a bathtub. Very little is required of the viewers and very little is gained by them. The visitor is bored for two reasons: first because the setting is too obvious, and second because of a feeling of security despite the close presence of a wild animal.

“When planning this exhibit, we learned that in the wild, gorillas like to forage at the edge of a forest, in clearings created by tribal people who fell the trees, burned off the undergrowth, farm for a couple of years, then move on. After they move on, the forest moves back in and the gorillas forage there. We set about to re-create that scene. We got lots of charred stumps, and we took a huge dead tree from a power-line clearing a few miles from here. The story is plant succession, and how the gorillas exploit the early plants growing back over the abandoned farmland.”

Coe relies on stagecraft and drama to break down the zoo-goer’s sense of security. When walking through a client zoo for the first time, long before he has prepared a master plan, he offers a few suggestions: Get rid of the tire swings in the chimp exhibit. Get rid of the signs saying NIMBA THE ELEPHANT and JOJO THE CHEETAH. Stop the publicized feeding of the animals, the baby elephant’s birthday party, and any other element contributing to either an anthropomorphized view ("Do the elephants call each other Nimba and Bombo?") or a view of wild beasts as tame pets.

“How can we improve our ability to get and hold the attention of the zoo-goer?” he asks. “We must create a situation that transcends the range of stimulation people are used to and enhances the visitor’s perception of the animal. A zoo animal that appears to be unrestrained and dangerous should receive our full attention, possibly accompanied by an adrenaline rush, until its potential for doing us harm is determined.”
For ten years Coe and others have been experimenting with the relative positions of zoo-goers and zoo animals. Coe now designs exhibits in which the animal terrain surrounds and is actually higher than the zoo paths, so that zoo-goers must look up to see the animals. The barriers between animals and people are camouflaged so effectively that zoo-goers may be uncertain whether an animal has access to them or not. In JungleWorld, the Bronx Zoo's recently opened $9.5 million indoor tropical forest nearly an acre in size, conceived by William Conway, the director of the zoo, a python lives inside a tree trunk that apparently has fallen across the zoo-goers' walkway. "We made the interior of the log brighter and tilted the glass away from the outside light to avoid all reflections," says Charles Beier, an associate curator. "It's an old jeweler's trick. When people glance overhead, there appears to be no barrier between them and the snake." The screams of horror provoked by the python are quite a different matter from the usual conversations that people engage in while strolling past rows of terrariums with snakes inside.

"We are trying to get people to be prepared to look for animals in the forest, not have everything brightly lighted and on a platform in front of them," says John Gwynne, the deputy director for design of the New York Zoological Society, which operates the Bronx Zoo. "We have lots of dead trees and dead grass in here. It's actually very hard to train a gardener not to cut off the dead branches. We're trying to create a wilderness, not a garden—something that can catch people by surprise."

ON COE AND GRANT JONES KNEW, WHEN DESIGNING FOR Woodland Park, what few previous designers of a gorilla habitat had known: how gorillas live in nature. They and their contemporaries are heir to the surprisingly recent discoveries of field scientists like George Schaller, Jane Goodall, and Dian Fossey, who have spent much of their lives in the wilderness studying wild animals. Their findings began to be widely published only in the 1960s. Before that, knowledge of great-ape ecology was spotty, and was held by only a handful of isolated scientists.

The approach of the Woodland Park gorilla exhibit is called "landscape immersion" by the designers, because zoo-goers are "immersed" in a realistic wild landscape. "Landscape immersion" describes what is revolutionary in modern zoo design. The idea has influenced the new exhibits at a dozen zoos nationwide in the past eight years, and its influence may spread to twenty more zoos by the turn of the century. It has rendered the beautiful, conventionally designed exhibits of America's most famous zoos obsolete. Suddenly the historically great zoos have discovered that the experience they offer the zoo-goer is not necessarily the most exciting available. The zoos in San Diego, the Bronx, St. Louis, Pittsburgh, and Cincinnati are all investing heavily in innovative naturalistic exhibits.

The Miami Metrozoo is the newest in the country, constructed from scratch six years ago on a 740-acre flat, emp-ty parcel of land. Although the zoo's designers were committed to creating cageless outdoor exhibits, a rush to complete the project led to the use of a small number of conventional exhibit ideas—moats and grass and artificial rockwork—over and over throughout the park with a few exceptions. "The problem with Miami is that they had a huge project and a real killer of a deadline, so they had to systemize everything," Coe says. "They just stamped it down: four of these, lion, tiger, bear, gorilla; four of those, elephant, hippo, rhino, and so forth. It appears to be a kind of pre-fab approach, with little appreciation of differences in animal habitats." Ted Finlay, a researcher with Zoo Atlanta, describes Miami as a golf course. "You could take a nine iron and hit a ball from exhibit to exhibit. The animals live on perfectly manicured putting greens." Today, with most of its exhibits complete and its popularity assured, the zoo has the leasure to concentrate on one new exhibit at a time. The administration has begun to experiment with approaches that are more complex. The newest exhibit, Wings of Asia, is a one-and-a-half-acre walk-through rain forest exhibit and aviary, with hundreds of plant and bird species.

The San Diego Zoo lives in the mind of the public as the finest zoo on earth, but many experts would rate it only tentatively in the top ten. "The San Diego Zoo is so popular," Grant Jones says, "because it has an incredible collection, the animals are displayed in a beautiful botanical garden, and you're in shirt-sleeves weather. The sun is shining, the flowers are blooming, you're on vacation! And yet San Diego knows, the staff knows, that unless it's updated, it will no longer be a great zoo. They are working at an incredible pace and have made a huge commitment to change it." San Diego recently opened a landscape-immersion exhibit for small mammals, consisting of a landscape of giant rock outcroppings, called kopjes, found in East Africa. It was designed by Grant Jones and members of the zoo staff including David Rice, the director of architecture, and James Dolan, the director of animal collections, and was one of two winners this year of the Exhibit Merit Award from the American Association of Zoological Parks and Aquariums (AAZPA).

"We designed a whole acre of rock masses that rise thirty to forty feet up, lushly planted, providing a habitat for a lot of small animals thought to be very boring," Grant Jones says. "There was the rock hyrax, a distant relative of the elephant's, about the size of a loaf of bread, and the klipspringer, a tiny, agile antelope. Some board members were skeptical of our ability to do anything new for their zoo. They let us know we would get this one chance on these not-very-exciting critters and snakes. But the public loves it. They get lost among these boulders and have dramatic encounters with the animals. The barriers are invisible: glass kick-tails with herbage around them. It's been so popular the board asked us to reconceive and design the zoo's wild-animal park in Escondido."

"San Diego has always been sort of a botanical garden, but it was never done in the way we're doing it now,"
James Dolan says, "It's not just a question of plunking some animals down without fencing. A number of other things are taken into consideration: the integration of the proper plants with the animals, the mixture of appropriate species, and the introduction of the zoo visitor into the exhibit. The kopje exhibit is total immersion. People get in there and they are in another world. They see animals living on rock piles or cliffs, where they normally live. I like to wander around in the kopje exhibit every so often myself."

The landscape-immersion exhibits resemble actual locations in so many particulars that one could practically pinpoint them in an atlas. The gorilla exhibit at Woodland Park, for example, is based on a section of the upland forest in the granitic highlands of Rio Muni, West Africa. The waterfowl exhibit there is a re-creation of a Pennsylvania marsh, and the lion-tailed macaque exhibit is a series of rocky islands in a cascading stream modeled after topography found in the hill forests of India. The voters of the City of Seattle and King County last year approved a $40 million bond issue to complete the entire master plan prepared for Woodland Park by Jones & Jones, which will include bogs and mountaintops and tundra.

The Louisiana swamp exhibit in the Audubon Zoo in New Orleans—created by the design firm of Cashio, Cochran & Torre, and the winner of several prestigious professional awards when it opened, in 1985—is a working swamp. Alligators, black bear, cougars, raccoons, otters, turtles, and fish live there as if their families had been there forever. Migratory birds land there regularly, as part of their route. The swamp goes through natural cycles: duckweed covers it in winter, and water hyacinths in summer. Zoo-goers walk among cypress and wax myrtle trees on a winding boardwalk, buy jambalaya and gumbo from a hut with a corrugated metal roof, and leave when they can bear the mosquitoes no longer.

The behavior of the captive animals in the new exhibits is so much like it would be in the wild that students of zoology and animal ecology are setting up field research stations inside the zoos. The Yerkes Primate Research Center of Emory University, in Atlanta, has for twenty years protected its precious gorillas from the public; its entire facility is fenced off from the rest of the grounds of the university and is patrolled by security guards. In an unprecedented agreement between a private research facility and a public zoo, Yerkes has agreed to lend most of its collection of eighteen gorillas to Zoo Atlanta upon the completion, in the spring of 1988, of a $5.8 million Gorillas of Cameroon exhibit, designed by Coe, where their scientists may observe the gorillas in a wild setting.
The profession of zoo design is a relatively new one. In the past, when a zoo director said that a new lion house was required, the city council solicited bids and hired a popular local architect—the one who did the suburban hospital and the new high school—and paid him to fly around the country and get acquainted with lion houses. He visited four or five and learned design tips from each: how wide to space the bars, for example, and how thick to pour the cement. Then he flew home and drew a lion house.

“As recently as fifteen years ago there was no Jones & Jones or Jon Coe,” says William Conway, of the Bronx Zoo. “There were very few architects around then who had any concept of what animals were all about or who would go—as Jon Coe has gone—to Africa to see and sketch and try to understand, so that he knew what the biologist was talking about. The problem of the zoologist in the zoo was that, in the past, he was very often dealing with an architect who wanted to make a monument.”

“The downfall of most zoos has been that they’ve hired architects,” says Ace Torre, a designer in New Orleans, who holds degrees in architecture and landscape architecture. “Some of the more unfortunate zoos hired six different architects. Each one made his own statement. As a result, the zoo is a patchwork of architectural tributes.”

In 1975 the City of Seattle asked Grant Jones, whose firm had restored the splendid Victorian copper-roofed pergolas and the elegant walkways and the granite statuary of the city’s Pioneer Square Historic District, to design the Woodland Park Zoo gorilla house. The City of Seattle—specifically, David Hancock, the zoo director—had made a novel choice. Jones was an anomaly in the world of architecture in that he prided himself on having never designed anything taller than three stories. Most of his buildings were made of wood, and they tended to be situated in national parks. Instead of making a grand tour of gorilla houses, Jones consulted field scientists and gorilla experts who had seen how gorillas lived in the wild.

“When they asked me to design a gorilla exhibit,” Jones says, “I naturally rephrased the problem in my own mind as designing a landscape with gorillas in it. In what sort of landscape would I want to behold gorillas? I would want to include mystery and discovery. I’d like to see the gorillas from a distance first, and then up close. I’d like to be able to intrude on them and see what’s going on without their knowing I’m there. I’d want to give them flight distance, a place to back off and feel secure. And I would want an experience that would take me back to a primordial depth myself. How did I spend my day some millions of years ago, living in proximity to this animal?”

“We asked Dian Fossey to visit Seattle,” David Hancock says, “and she became the most crucial member of the design team. We had so many people telling us we were being very foolish. A zoo director on the East Coast called to say he’d put a potted palm in a cage where a gorilla had lived for fifteen years. The gorilla pulled it out by the roots, ate it, and got sick.”

“Driving in from the airport, we asked Fossey what the rain forest looked like,” Jon Coe says. “She kept turning this way and that way in her seat, saying, ‘It looks like that! It looks just like that!’ Of course, Seattle is in a belt of temperate rain forest. Fossey was in an alpine tropical rain forest. The plants are not identical, but they are very similar. We realized that we could stand back and let the native plants take over the exhibit and the overall effect would be very much the same.

“And there were trees, forty-foot-tall trees, in the area slated for the gorillas. What to do about the trees? No zoo in the world had let gorillas have unlimited access to trees. We thought of the gorilla as a terrestrial animal. The wisdom at the time said that the trees had to come down. We brought George Schaller, probably the world’s preeminent field scientist, to Seattle, and asked him about the trees. His response was, ‘I don’t know if they’re going to fall out of them or not, but somebody has to do this.’

“They didn’t fall out of the trees,” Jones says, “but Kiki [one of the silverbacks] escaped. We’d brought in some rock-climbers to try to get out of the exhibit when it was finished, and we’d made a few modifications based on their suggestions. Jon figured out an elaborate jumping matrix: if a gorilla can jump this far on the horizontal, how far can he go on a downward slope, etcetera. The problem is, you can’t program in motivation. At some point the motivation may be so great that you’ll find yourself saying, ‘Whoops, the tiger can jump thirteen feet, not twelve. Guess we should have made it wider.’

“We had planted some hawthorn trees about four to five inches in diameter, ten feet high, and had hoped they were large enough that the gorillas would accept them. They accepted everything else, but these trees were standing too much alone, too conspicuous. Kiki pulled all the branches off of one, then ripped it out of the ground. It stood by itself; the roots were like a tripod. He played with that thing for a number of days.

“The keepers were aware of how we must never let them have a big long stick because they might put it across the moat, walk across it, and get out. They saw that tree but it was clearly not long enough to bridge the moat. We all discussed it, and decided it wasn’t a problem. During that same period Kiki began disappearing for three hours at a time, and we didn’t know where he was. It’s a large environment, and he could have been off behind some shrubbery. One of the keepers told us later that he’d seen Kiki sitting on the edge of the big dry moat at the back of the habitat. One day Kiki climbed down into the moat.

“I imagine he took his tree with him to the far corner, leaned it up against the wall, and considered it. At some point he must have made a firm decision. He got a toehold on the roots, pressed his body to the wall, lifted himself up in one lunge, and hung from the top of the moat. Then he pumped himself up and landed in the rhododendrons. He was out, he was in the park.”
"He was sitting in the bushes and some visitors saw him," Coe says. "They raced to the director's office and reported it to Hancock's. His response was calm, according to Coe. Anxious visitors often reported that there were gorillas loose in the trees. "The gorilla's not out," said Hancock. "The exhibit, you see, is called landscape immersion. It's intended to give you the impression that the gorillas are free."

The visitors thanked Hancock and left. He overheard one remark to the other, "Still, it just doesn't seem right having him sit there on the sidewalk like that."

"Sidewalk?" Hancock said.

"We called the police," says Hancock, "not to control the gorilla but to stop people from coming into the zoo. Jim Foster, the vet, fed fruit to Kiki and calmed him down while we tried to figure out what to do. We put a ladder across the moat and Jim climbed on it to show Kiki how to cross. Kiki actually tried it, but the ladder wobbled and fell, and he retreated. It was getting dark. We finally had to tranquilize him and carry him back."

"It's been seven years since," Jones says, "and Kiki never has tried again, although he clearly knows how to do it. He doesn't want to leave. In fact I am frequently called in by zoos that are having problems with escape. They always want to know, Should we make the moats wider? The bars closer together? Should we chain the animal? Yet escape is almost never a design problem. It is a question of motivation. It is a social problem."

"One of the roles a silverback has in life," Coe says, "is to patrol his territory. Kiki wasn't escaping from something. He was exploring outward from the center of his territory to define its edges."

"If Kiki had escaped from a conventional ape house, the city would have panicked," Hancock says. "But in the year or two the exhibit had been open, Seattle had lost the hairy-monster-of-the-ape-house image, and saw gorillas as quiet and gentle."

Shortly after, one of the local papers carried a cartoon of Kiki roller-skating arm-in-arm with two buxom beauties through the adjacent Greenlake Park, and another had a cartoon of him pole-vaulting over the moat.

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The previous revolution in zoo design—what became the "moated" revolution—began soon after the turn of the century, near Hamburg, Germany, in the private zoo of a man named Carl Hagenbeck. He set free mixed species of animals in beautifully landscaped panoramas, with waterfowl in the foreground, hoof stock in the center, and large carnivores or alpine goat species on rocky cliffs in the distance. "Hagenbeck came up with the concept of moats, of not keeping animals behind bars," says Steve Graham, the director of the Detroit Zoo. "He was aware of sight lines, which designers are talking about today, where not only do you look into a single exhibit but you look across layers of exhibits, so that you see a broad panorama of a fairly natural setting. Hidden moats may separate the hippos from the giraffes, and the zebras from the monkeys, but when you look across a broad field, they appear to be sharing the landscape. I strongly suspect that Hagenbeck was aware of the issue of cross-viewing, as well—that is, when you look across a landscape, you don't want to see other groups of people moving through it, you want to see the animals."

Hagenbeck designed a moated exhibit for the St. Louis World's Fair, in 1904. "That exhibit is said to have featured a polar bear, a walrus, and an Eskimo," Coe says. Hagenbeck inspired the designers of the Denver Zoo and Chicago's Brookfield Zoo, who then produced America's first bear grottos and realistic-looking artificial rockwork. In the 1920s members of Hagenbeck's family firm traveled to America and designed the Detroit Zoo and exhibits for the St. Louis Zoo. "Carl Hagenbeck discovered all the principles long ago," says William Conway, who is the general director of the New York Zoological Society as well as the director of the Bronx Zoo. "It's astonishing to go back and see that he set forth the example of quite exciting outdoor exhibits, yet he was completely ignored by the vast majority of European and American zoos until the 1930s."

Early critics of the moated exhibits protested that the uncaged animals were too far away. "I think that the St. Louis Zoological Society is making a great mistake in putting all of its money into costly piles of rock and concrete to shelter far distant animals," William Hornaday, the first director of the New York Zoological Society, wrote. But zoo-goers loved seeing animals out under the open sky. In the late 1930s and early 1940s, San Diego, the Bronx, the National Zoo, and Chicago Brookfield created cageless exhibits. By the 1960s nearly every zoo in the country had "naturalistic" moated exhibits. The "naturalism" in these later exhibits was modified by modernist tendencies in art and architecture, and approached nature in an abstract way: white marble slabs suggested glaciers, for example, and etched cement sculptures looking like giant hands suggested trees. "Many of these exhibits took their forms from some abstract characteristic of the animals displayed," Coe says, "but they were more successful as sculpture than as habitat, and totally dominated their small occupants."

Hagenbeck may have aspired (there is some dispute) to represent the natural habitats of the animals he freed from cages. "Hagenbeck was attempting to convey an African feeling," Conway says. "He couldn't grow acacias in Germany, so he used locusts, but I believe the intent was there." Coe thinks instead that Hagenbeck's intention was to create beautiful Romantic landscapes, after the style of Romantic European painters such as Claude Lorraine, Nicolas Poussin, and Salvator Rosa. "His emphasis was more on creating a Romantic visual spectacle, with its poetic disregard for reality, than in showing ecological relationships," Coe says. In either case, most of Hagenbeck's inventions were lost, ignored, forgotten.

Now Hagenbeck is being rediscovered. In 1982 Steve Graham became the fifth director in ten years of the floun-
dering Detroit Zoo. He was on the verge of hiring zoo designers to come up with a new master plan when a zoo director in Australia wrote to him about the Detroit Zoo's history. "A man who'd visited the Detroit Zoo in 1930 had taken snapshots of it," Graham says. "He gave them to my colleague in Australia, who sent them on to me. I went out through the park with the snapshots and discovered the original sight lines for panoramic views of exhibits designed by the Hagenbecks. As the zoo matured and the trees grew, we lost that aspect." The Detroit Zoo's recent renovations have consisted to a large extent of excavating and restoring what was designed sixty years ago.

Not everything will be exactly as it was, however. Hagenbeck worked in the early years of the century, when man's knowledge of the rest of the animal world was scanty, veterinary medicine was primitive, and landscape design was in its infancy. "We didn't have epoxy and fiber glass in the old days," Conway says. "You couldn't build an epoxy baobab. St. Louis built concrete trees. They looked like concrete trees. The ideas were there, but they didn't have the skills to do it. Other than the big cats, the animals Hagenbeck worked with were easy. He didn't work with primates. He did his exhibits with hoofed animals. It was like keeping goats, sheep, cows, and horses. We knew how to do that, even in 1907. The rest of the animals were still in cages. Hagenbeck's great gift was that he paid attention to the way the environment should look; he began to pay attention to nature. What we are doing today will surely look primitive to the people who follow us in four or five decades—but not so primitive, because we have gotten over the hump of ignorance."

The current revolution in zoo design—the landscape revolution—is driven by three kinds of change that have occurred during this century. First are great leaps in animal ecology, veterinary medicine, landscape design, and exhibit technology, making possible unprecedented realism in zoo exhibits. Second, and perhaps most important, is the progressive disappearance of wilderness—the very subject of zoos—from the earth. Third is knowledge derived from market research and from environmental psychology, making possible a sophisticated focus on the zoo-goer.

Zoo-related sciences like animal ecology and veterinary medicine for exotic animals barely existed fifty years ago and tremendous advances have been made in the last fifteen years. Zoo veterinarians now inoculate animals against diseases they once died of. Until recently, keeping the animals alive required most of a zoo's resources. A cage
whose habitat is disappearing under farmland, villages, or cities. The word *ark* is used with increasing frequency by zoo professionals. In this country, zoos house members of half a dozen species already extinct in the wild, and of hundreds more on the verge of extinction. Zoo-goers are confronted by skull logos denoting vanishing animals. The new designers like Coe and Jones, and directors like Conway, Maple, Graham, Dolan, George Rabb, at Chicago Brookfield, and Michael Robinson, at the National Zoo, belong as no designers or directors ever before belonged to the international community of zoologists and conservationists who have as their goal the preservation of the wild.

“T is a desperate time,” William Conway says. The New York Zoological Society, under his leadership, also operates one of the largest and oldest wildlife-conservation organizations in the world, Wildlife Conservation International, which sponsors sixty-two programs in thirty-two countries. Conway is a slender, distinguished, avuncular gentleman with a pencilled-line moustache. For him it seems quite a personal matter, a subject of intense private distress, that the earth is losing its wildlife and he doesn’t know how many species are going, or what they are, or where they are, or how to save them.

“We are certainly at the rate of losing a species a day now, probably more,” he says. “Who knows how many species there are on earth? Suppose, for the sake of argument, there are ten million species of animals out there. If we have one million in the year 2087, we will be doing very well. The human population is increasing at the rate of a hundred and fifty a minute. The tropical moist forest is decreasing at the rate of fifty acres a minute. And there is not a hope in the world of slowing this destruction and this population increase for quite some time. Most of the animals we hold dear, the big, charismatic mega-vertebrates, almost all of them will be endangered within the next twenty years. The people who are going to do that have already been born.

“And the destruction is being effected by some poor guy and his wife and their five children who are hacking out a few acres of ground to try to eat. That’s where most of the fifty acres a minute are going: forty-eight that way and two to the bulldozers. In Rwanda there is a mountain-gorilla preserve that supports two hundred and forty gorillas. It recently was calculated that the park could sustain two thousand human families, people with no other place to live, no land. Now, how can you justify saving the land for two hundred and forty gorillas when you could have two thousand human families? That’s one side of the story. Here’s the other: if you were to do that, to put those two thousand families in there, the mountain gorilla would disappear completely, and that would take care of Rwanda’s population-expansion needs for slightly less than three months. It’s a very discouraging picture.”

Michael Robinson, the director of the National Zoo, is a rotund and rosy-cheeked Englishman. “I have spent twenty years in the tropics, and it is difficult to talk about them in a detached, scientific manner,” he says. “They are the richest ecosystem on earth. They have been here for millions of years. Perhaps eighty percent of all the animals in the world live there and have evolved relationships of breathtaking complexity. The northern hardwood forests have perhaps forty species of trees per hectare. The rain forest closer to a hundred and fifty to two hundred species per hectare. Once the rain forest is cut down, it takes about a hundred years for the trees to grow back. We estimate that it would take at least six hundred years before the forest has returned to its original state, with all the plants and animals there.”

“The American Association of Zoological Parks and Aquariums Species Survival Plan has only thirty-seven endangered species,” Conway says. “We should have at least a thousand. How are we going to do it? My God, there are only one thousand seven hundred and eighty-five spaces for big cats in the United States. One thousand seven hundred and eighty-five. How many races of tigers are out there? Five or six. Several races of leopards, to say nothing of snow leopards, jaguars, fishing cats, cheetahs, and so on. And you have to maintain a minimum population of two to three hundred animals each to have a population that is genetically and demographically sound. What in bloody hell are we going to do?”

Zoos in America are doing two things to try to save the wild animals. The front-line strategy is conservation biology and captive propagation, employing all the recent discoveries in human fertility, such as in vitro fertilization, embryo transplantation, and surrogate motherhood. Zoos around the world have hooked into a computerized database called ISIS, so that if a rare Indian rhino goes into heat in Los Angeles—or, for that matter, in the wilds of India—a healthy male rhino to donate sperm can be located. The second-line strategy is to attempt to save the wilderness itself through educating the public. Zoo directors and designers point out that there are 115 million American zoo-goers each year, and that if even 10 percent of them were to join conservation organizations, to boycott goods produced from the bones, horns, organs, and hides of endangered species, to vote to assist poor nations that are attempting to preserve their forests (perhaps by allowing debt payments to be eased in proportion to the numbers of wild acres preserved), their strength would be felt. The point of the landscape-immersion exhibits is to give the public a taste of what is out there, what is being lost.

It is dawning on zoo professionals that they are, in part, responsible for the American public’s unfamiliarity with ecology and lack of awareness that half a dozen species a week are being driven into extinction, and that the precious tropical rain forest may vanish within our lifetime. “By itself, the sight of caged animals does not engender respect for animals,” the environmental psychologist Robert Sommer wrote in 1972 in a pioneering essay titled “What Did We Learn at the Zoo?” “Despite excellent
intentions, even the best zoos may be creating animal stereotypes that are not only incorrect but that actually work against the interests of wildlife preservation." Terry Maple says, "Zoos used to teach that animals are weird and they live alone."

In the past the only zoo people who paid much attention to zoo-goers were the volunteers assigned to drum up new members. The question they usually asked about zoo-goers was, Can we attract ten thousand of them in August? rather than, How have we influenced their attitudes about wildlife? With the decline of the wild and the dedication of zoos to educating the public, zoo professionals have grown curious about zoo-goers. What do they think? What are they saying as they nudge each other and point? Why do they shoot gum balls at the hippos? What exactly are they learning at the zoo? In search of answers to such questions, behavioral scientists are strolling through zoos around the country. They clock the number of seconds zoo-goers look at an exhibit. They count how many zoo-goers read the educational placards. They record the casual utterances of passers-by. And they note the age and gender of the zoo-goers who carve their initials on the railings. (They excite the envy of their co-equals in the science-museum world. "Researchers [at zoos] can linger for inordinate amounts of time at exhibits under the guise of waiting for an animal to do something," Beverly Serrell wrote in Museum News in 1980. "Standing next to a skeleton doesn't afford such a convenient cover.")

A fairly sharply focused portrait of the average North American zoo-goer has emerged. For example, data col-

**SUMMER'S CHILDREN**

we do not know who chose us  
but we are the chosen  
we were chosen not to be you  
we enter your cities like fog  
with our bedrolls and our portable lives  
our ragged coats always too big  
the better for sleeping in  
we follow summer  
and we all look alike to you  
with our uncombed hair  
we look like winter  
when we are young we look older  
when we are older we begin to look young  
you do not want to look at us  
and since we are invisible to you  
we can urinate anywhere  
we are not lost we know where we are  
but our itinerary is chance and weather  
we do not believe in destinations  
and we are in no hurry  
we have learned patience  
from statues in a thousand parks  
and joy from dogs without collars  
we envy you nothing you want  
we can live on what you throw away  
we envy only birds of passage  
their ability to fly  
sometimes we ask for your spare change  
but never your credit cards  
otherwise we keep our distance  
avoiding the germs of your misery  
the wolf does not come to our doors  
we have no doors  
we have lost our names somewhere  
and are required to sign nothing  
we do not pay taxes we feed the birds  
we do not vote why should we vote for you  
we do not join the army  
we are an army  
and we will not fight in your wars  
we have lost our return addresses  
our forwarding addresses  
our social security numbers  
and are secure in our own society  
we leave messages to one another  
on the undersides of bridges  
in a code you cannot decipher  
but we plot to overthrow nothing  
we escape we are summer's children  
born into your winter  
we are not  
a problem we are a solution  
to a problem you are the problem

—Richard Shelton
lected by the Smithsonian Institution at the National Zoo in 1979 revealed that zoo-goers arrive at the gates in any one of eighty-four “visitor constellations.” One of the most common constellations is one parent accompanied by one or more children. On weekdays mothers predominate. On weekends fathers are sighted. In another study Professor Edward G. Ludwig, of State University College at Fredonia, New York, observed that the adult unaccompanied by children seemed to have “an aura of embarrassment.” A survey published in 1976 found that zoo-goers tend to have more education and larger annual incomes than the population at large, and a 1979 survey found that zoo-goers are ignorant of basic ecological principles much more than are backpackers, birdwatchers, and members of wildlife organizations.

In a group of four zoo-goers, it’s likely that only one or two will read an informational sign. Nearly all conversation will be confined to the friends and family members with whom the zoo-goer arrives. The most common form of conversation at the zoo is a declarative sentence following “Watch!” or “Look!” The second most common form is a question. Robert Yokel, in Miami, believes that the two questions asked most frequently by zoo-goers are “Where is the bathroom?” and “Where is the snack bar?” Zoo-goers typically look at exhibits for about ninety seconds. Some never stop walking. Ludwig found that most people will stop for animals that beg, animals that are feeding, baby animals, animals that make sounds, or animals that are mimicking human behavior. People express irritation or annoyance with animals that sleep, eliminate, or regurgitate.

Zoo visitors do not like to lose their way within a zoo, and they get disgruntled when they find themselves backtracking. “We do not enjoy walking in circles and we invariably do,” said one of the 300 respondents to the Smithsonian study. “Then we get irritated with ourselves.”

Jim Peterson, a senior partner in the natural-history exhibit design firm of Bios, in Seattle, has identified the “first-fish syndrome.” Within twenty feet of the entrance to an aquarium, visitors need to see a fish or they become unhappy. They will rush past the finest backlit high-tech hands-on exhibitry to find that first fish. Similarly, Peterson has noted that visitors in zoos can tolerate only fifty feet between animals. Any greater distance inspires them to plow through foliage and create their own viewing blind.

Most “noncompliant behavior,” such as unauthorized feeding of animals or attempting to climb over barriers, comes from juveniles and teens in mixed-gender groupings and children accompanied by both parents. A 1984 study by Valerie D. Thompson suggested that two parents tend to be involved with each other, freeing the children to perform antisocial acts, and that among teenagers there is “a close tie between noncompliant behavior and attempting to impress a member of the opposite sex.”

Ted Finlay, a graduate student working with Terry Maple at Zoo Atlanta, wrote a master’s thesis titled “The Influence of Zoo Environments on Perceptions of Animals,” one of the first studies to focus on zoo design. Finlay majored in psychology and animal behavior with a minor in architecture, with the intention of becoming a zoo psychologist. For the research for his dissertation he prepared a slide show of animals in three environments: free, caged, and in various types of naturalistic zoo exhibits. Two hundred and sixty-seven volunteers viewed the slides and rated their feelings about the animals. The free animals were characterized as “free,” “wild,” and “active.” Caged animals were seen as “restricted,” “tame,” and “passive.” Animals in naturalistic settings were rated like the free animals if no barrier was visible. If the barrier was visible, they were rated like caged animals—that is to say, less favorably.

The zoo-goer who emerges from the research literature—benighted and happy-go-lucky, chomping his hot dog, holding his nose in the elephant house and scratching under his arms in the monkey house to make his children laugh—is a walking anachronism. He is the creation of an outmoded institution—the conventional zoo—in which the primates house, carnivore house, and reptile house, all lined with tile, glow with an unreal greenish light as if the halls were subterranean, and in which giraffes, zebras, and llamas stand politely, and as if on tiptoe, on the neatly mown lawns of the moated exhibits.

Once it was education enough for the public to file past the captive gorilla in its cage and simply absorb the details of its peculiar or frightening countenance. “One ape in a cage, shaking its steel bars,” Terry Maple says, “was a freak show, a horror show, King Kong! You’d go there to be scared, to scream, to squeeze your girlfriend.” Despite gilded, or dingy, surroundings, a tusked creature in eighteenth-century Versailles, or downtown Pittsburgh, had the aura of a savage, strange, flowered wilderness.

“Pee-you!” is the primal, universal response of schoolchildren herded into an elephant house. Adults more discreetly crinkle their noses, turn their heads, and laugh. The unspoken impressions are that elephants are filthy, tread in their own feces, attract flies, require hosing down, eat mash, and no wonder they are housed in cinder-block garages. These are not the sort of impressions that might inspire a zoo-goer to resist—much less protest—the marketing of souvenirs made of ivory.

Moated exhibits display animals in garden-like settings, with bedding plants along cement walkways. A koala seats alone in the branch of a single artificial tree above a bright-green lawn looks as if he’d be at home in a Southern California back yard, next to the patio. The visitors looking at such exhibits appreciate the animals in them more and pronounce them “beautiful” or “interesting,” but the subliminal message here is that animals are like gentle pets and thrive nicely in captivity. The visitors are hard pressed to explain what the big deal is about the rain forest or why zoologists talk about it, their voices cracking, the way twelfth-century Crusaders must have discussed the Holy Land.
ON MAY 7, 1984, TWINKLES THE ELEPHANT DISAPPEARED FROM THE ATLANTA ZOO. HER KEEPERS WERE INFORMED THAT SHE HAD BEEN SENT TO A FARM TO RECUPERATE FROM SEVERE MUSCULAR PROBLEMS. ON MAY 11 TWINKLES DIED IN CHERRYVILLE, NORTH CAROLINA, WHILE ON DISPLAY WITH THE JULES & BECK TRAVELING CIRCUS, AND THE ATLANTA ZOO SCANDAL BEGAN. OVER THE NEXT FEW MONTHS JOURNALISTS AND ZOO COMMITTEES AND HUMANE-SOCIETY INVESTIGATORS DESCENDED ON THE ZOO AND PUBLISHED OUTRAGED REPORTS OF SICK ANIMALS LYING IN EXCREMENT, OF ANIMALS LENT OUT TO UNACREDITED ROADSIDE ATTRACTIONS AND "EUTHANIZED" THERE, OF CITY MAINTENANCE WORKERS POURING CEMENT INTO PRAIRIE-DOG HOLES. THE ZOO VETERINARIAN HIMSELF WAS ON PROBATION WITH THE STATE BOARD OF VETERINARY MEDICINE.

"THE SCANDAL PRECIPITATED A MAJOR CLEANUP ALL OVER THE COUNTRY," JON COE SAYS. "THE CARE AND QUALITY AT THE ATLANTA ZOO WAS REALLY NO WORSE THAN A THIRD OF THE ZOOS IN THE COUNTRY, IF NOT HALF. THE FACT THAT ANIMALS WERE DISAPPEARING WAS NOT COMMON, BUT THE BUILDINGS AND MAINTENANCE WERE TYPICAL." OF THE 300-PLUS ZOOS IN AMERICA (THE NUMBER IS IMPRECISE, BECAUSE IT CAN BE DIFFICULT TO SAY WHETHER SOME PARKS ARE FLEA-BITTEN PRIVATE ZOOS OR ROADSIDE TOURIST traps with animals), PERHAPS HALF WERE CONSTRUCTED WITH WORKS PROJECT ADMINISTRATION MONEY IN THE 1930S, AND FORTY MORE WERE FOUNDED EARLIER. STEVE GRAHAM, THE DIRECTOR OF THE DETROIT ZOO, SAYS, "OUR LOCAL NEWSPAPERS AND TELEVISION STATIONS TRIED TO COMPARISON THE PROBLEMS IN DETROIT TO THE PROBLEMS IN ATLANTA. THE SAME THING HAPPENED IN EVERY CITY IN THE COUNTRY. WE WERE NOT VERY INTERESTED IN BEING TARRIED WITH THAT BRUSH, BUT BELIEVE ME, EVERY ZOO DIRECTOR FELT FOR ATLANTA." IN 1984 NINE OTHER CITIES JOINED ATLANTA ON A LIST OF TEN SUBSTANDARD ZOOS DRAWN UP BY THE HUMANE SOCIETY OF THE UNITED STATES AND PUBLISHED BY PARADE MAGAZINE. THE LIST INCLUDED NOT ONLY SMALL CITIES LIKE RICHMOND, INDIANA; BAR HARBOR, MAINE; SUSSEX, NEW JERSEY; MELBOURNE, FLORIDA; AND SINTON, TEXAS; BUT ALSO MAJOR CITIES LIKE BOSTON, BROOKLYN, SCRANTON, AND OAKLAND.

Atlanta's planned gorilla exhibit, which will include the gorillas from the Yerkes center, will be the first to expand upon and surpass the Woodland Park model.

City officials across the country have realized that a desolate zoo has the power to become national news and tarnish the city's name. Others surmise that a great zoo might actually add to the city's allure and help attract conventions. Look at San Diego's tourist industry, for example. Hundreds of cities and counties have in the past five years voted on bond issues or engaged in fundraising to pay for face-lifts for their local zoos. Last year all 118 zoos accredited by the AZA listed capital improvements. They spent a total of $218 million dollars on their physical plants, two thirds of it local tax dollars.

City councils that have voted to restore their financially troubled zoos rather than close them have been startled by what the new zoo designers tell them. Those designers include not only Jon Coe and Grant Jones and their partners but also Ace Torre, of Cashio, Cochran & Torre; John Nightingale, of Bios; Becca Hanson and David Roberts, of The Portico Group; and Peter Chermayeff, of Cambridge Seven. Bearded men in flannel shirts and argyle socks and pony-tailed women wearing hiking boots and silver Native American earrings arrive at city council meetings, turn off the lights, and present slide shows on the African rain forest and lectures about tribal architecture. The renovations they propose have nothing to do with re-seeding the south lawn, hosing down the artificial rockwork, or importing a kangaroo. Instead, the old zoo buildings are to be torn down and replaced with underground holding facilities. Concession stands are to be given thatched roofs. Sidewalks and fencing will be ripped out. Grassy slopes where families once picnicked will be allowed to go to seed, and moats will be filled with pond water, cattails, and water lilies.

John Nightingale, now a senior partner at Bios, helped design a "salmon ladder" for the Seattle Aquarium. Fixed to the plate-glass rear wall of the aquarium, the ladder is a series of open-ended boxes that ascend like stairs and have water flowing through them. Initially, salmon eggs were taken from Puget Sound and allowed to hatch on the roof of the aquarium. The salmon fry leaped down the squarish, graduated waterfall and into Puget Sound; and when it was time for the mature salmon to spawn, they swam home to the aquarium, leaped back up the "ladder" in full view of the public, and left the second generation of eggs on the roof.

In the "Toledo Zoo a new hippo exhibit includes a tremendous pool for underwater swimming. Zoo-goers enter underground for a view. "Underwater, the hippos are unbelievably graceful, like Esther Williams," says Becca Hanson, who was a designer of the Toledo exhibit when she was with Jones & Jones and is today a partner in The Portico Group. "Remember the scene from Walt Disney's Fantasia where the hippos are ballerinas, wearing tu-tus?"

Landscape-immersion exhibits currently open include the gorilla, marsh, swamp, and African savanna exhibits at the Woodland Park Zoo, in Seattle (designed by Jones & Jones, with Jon Coe); the African kopje exhibit at the San Diego Zoo (Jones & Jones); JungleWorld and the Himalayan highlands exhibit—which shared the AZA design award this year with San Diego's kopjes—at the Bronx Zoo (designed in-house); the North Carolina Zoological Park, in Asheboro (in-house); the cascade stream and pond exhibit at the Portland, Oregon, Washington Park Zoo (Jones & Jones, with Coe); the polar-bear exhibit and the rocky-shore marine-mammal exhibit at Point Defiance Zoo, in Tacoma (Jones & Jones); Wings of Asia at the Miami Metrozoo (in-house); the Louisiana swamp exhibit at the Audubon Zoo, in New Orleans (Cashio, Cochran, & Torre); the Hippoquarium at the Toledo Zoo (Jones & Jones and The Portico Group); the Siberian tiger, white rhino, lion, leopard, and African plains exhibits at the Pittsburgh Zoo (Jones & Jones, with Coe); the red-panda exhibit at the Cincinnati Zoo (in-house); the Arizona-Sonora Desert Museum, in Tucson (in-house); and the predator-ecology exhibit at the Chicago Zoological Park in Brookfield (in-house). They all attempt, in different ways, to hew to the new standard, the new ideal—that metropolitan Miami, downtown Toledo, midtown Atlanta, and all of the Bronx should disappear from the backdrops of the zoo exhibits and, for at least a few moments, from the minds of the zoo-goers.

One evening, just at dusk, Coe hurried alone through the Woodland Park Zoo. He'd worked late on some sketches and the zoo had closed. He would have to let himself out. The lions in the Serengeti Plains exhibit galloped back and forth through their yellow grass, whipping their tails. They ran and ran and pulled up short at the brink of their hidden moat, panting, their nostrils flaring. Coe just happened to be passing by. One of the dun-colored male lions approached and crouched at the very edge of the moat, and growled. Jon Coe froze. Now, Coe had designed the exhibit. He knew that he was looking up at the lion because he'd elevated its territory to instill fear and respect in the zoo-goer. He knew that he seemed to be walking beside the wild, dark African plains because he'd considered issues like sight lines and cross-viewing. He knew that a concealed moat lay between him and the lion, and that the width of the moat was the standard width used by zoos all over the world. But he also knew that you can't program in motivation. The lion looked at him and crouched; he could hear it snorting. Then it growled again—king of the darkness on the grassy plain. The hair stood up on the back of Coe's neck.