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Nalini Nadkarni studies the forest canopy from the top down

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NORTHWEST LIVING

Fall on Lake Chelan

BY PAULA BOCK
PHOTOGRAPHED BY
HARLEY SOLTES

Up There

Twenty stories above the forest floor, this Olympia scientist is at the top of her field

When Nadkarni ascends into the treetops, she leaves behind the daily grind of grant proposals and academic politics, her mind instead gurgling with questions about trees, epiphytes, the atmosphere.

TWO HUNDRED FEET ABOVE THE FOREST FLOOR, WEARING PURPLE socks and 20 pounds of climbing gear, Nalini Nadkarni perches on a dry branch at the tip of a Douglas fir. At this height, higher than the ravens fly, the tree trunk is skinnier than a telephone pole. It sways unpredictably in gusts of afternoon wind, needles and lichens crackling.

Nadkarni, not surprisingly, is experiencing fear flashes that make her grip the rough bark a little tighter. Still, she has no problem talking. Observations, glimmers of inspiration, questions about why this, what if that flow out of her mouth in complete cogent sentences.

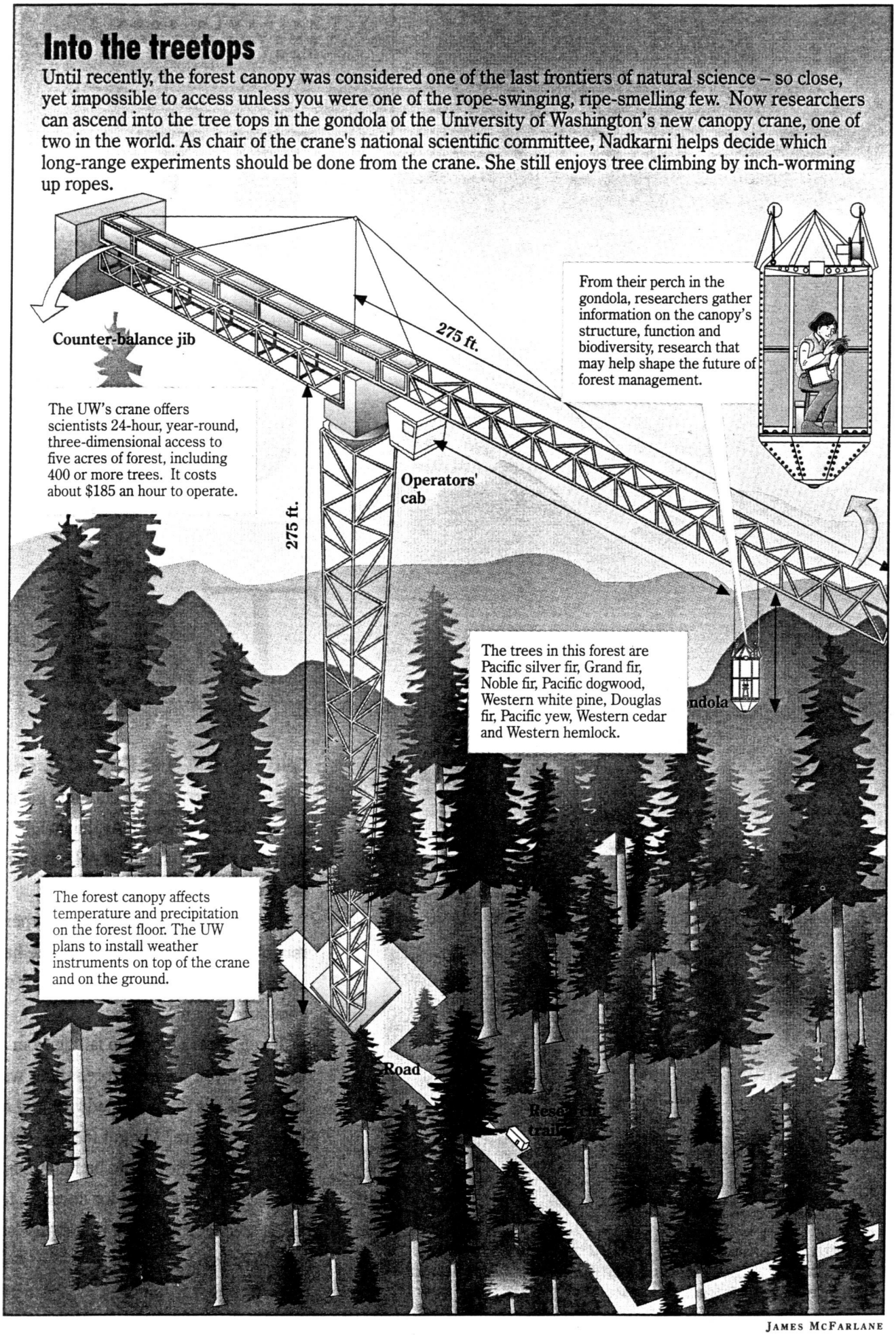
If you were a raindrop falling from the sky, Nadkarni wonders aloud, what's the likelihood you'd hit the forest floor without intercepting vegetation? And look at all these mosses intermingled with the needles on this branch! How do you suppose they got up here? My gut feeling, she confides, is that they grew up with the tree. Which means they could be hundreds of years old. Did you know that dehydrated moss can stay dormant for decades, for centuries, and spring to life again with a little rainwater? Listening to her, the landscape somehow becomes both clearer and infinitely more complex.

Nadkarni is a scientist, explorer, professor, dancer and mother who has made ➢ her living, among other ways, prospecting for gold, driving a Yellow Cab in Washington, D.C., studying beetles in Papua New Guinea, and pointing out good fishing spots in the Kenai National Moose Range. She has hitchhiked solo between Alaska and Seattle, twice, and lived, at various times, in an artist's garret in Paris, a converted chicken coop in Costa Rica and a tent on the tundra north of Nome. Every summer, she takes her family to study treetops in Costa Rica's Monteverde Cloud Forest. The rest of the time, home is in Olympia, where Nadkarni teaches at Evergreen State College and lives with her two small children and her husband, Jack Longino, an entomologist who fell in love with Nadkarni when she taught him to climb trees so he could study ants. He eventually discovered and named a species of canopy ant after his wife: *Procryptocerus nalini.*

Nadkarni is in her element crawling around in the forest canopy. This is where the earth's atmosphere first touches the planet's growing things. Half of the world's insect and animal species live at this level, many still unidentified, as well as hundreds of plant species that pull their nutrients from the air rather than from the ground. Until recently, the forest canopy was considered one of the last frontiers of natural science — so close, yet impossible to access unless you were one of the rope-swinging ripe-smelling few.

Fifteen years ago, Nadkarni was a swashbuckling pioneer who climbed into the treetops despite graduate advisers' warnings that serious scientists keep their feet on the ground.

In the Hoh Rain Forest, on a branch 60



JAMES MCFARLANE

feet above the forest floor, Nadkarni noticed some stringy roots growing in a mat of moss, decaying leaves and accumulated soil. Whose roots are these? she wondered. Fern roots are pudgy. Mosses don't have roots. The following week, she climbed the tree again, this time with a chain saw to cut samples to send to root experts around the world. Turns out the roots belonged to the big-leaf maple she had just climbed, and they were sucking nutrients and moisture from canopy debris, in effect, taking a nutritional short cut. Nadkarni's discovery was significant. It swayed her stolid graduate committee and became the basis of a cover article in the prestigious journal Science. Nadkarni named the tree Glyph because it was a mystery, and dedicated the Science article to A.M. Glyph *(Acermacrophyllum* is the scientific name for big-leaf maples). "It's fun to do goofy things in science," she says. "Everyone takes themselves too seriously."

'Academics tend to be conservative people. You tend to do what other people have done and when you stray from the path you don't stray very far. Nalini strays all over the place . . .'

JERRY FRANKLIN
UNIVERSITY OF WASHINGTON PROFESSOR

University of Washington professor Jerry Franklin, a forest-ecology guru who knew Nadkarni back then: "Academics tend to be conservative people. You tend to do what other people have done and when you stray from the path you don't stray very far. Nalini strays all over the place . . . She gets into interfaces between disciplines where the innovations tend to take place. She's a leader of her generation."

Or, perhaps, a yenta of the intellect. Nadkarni's latest push is to introduce computer-illiterate canopy ecologists to database nerds in hopes they'll get together and produce three-dimensional forest maps.

Now 41, Nadkarni is known as the mother of canopy science. She is co-editor of the first textbook about forest canopies (published this summer), and co-founder of the International Canopy Network, the first scientific association to focus on the treetops. The field, meanwhile, is settling into a comfortable middle age marked by hydraulic cranes, computer analysis, satellite photos, tree platforms, hot-air balloons and floating rafts. Physical access is no longer so much of a problem, but barriers to understanding the treetops remain. Most of them, Nadkarni says, are in the mind.

NADKARNI IS A PETITE woman who does not appear particularly athletic until you notice how gracefully she moves. Her limbs seem light; she easily lifts her own body weight, about 115 pounds, when inch-worming up ropes and maneuvering between closely spaced branches. Her energy is phenomenal. She multi-tasks, always doing several things simultaneously: grocery shopping, outlining a grant proposal, entertaining in-laws, driving, assembling climbing gear, picking up her son from school, throwing a lab lunch for a departing student. Mark Sumera, the student, calls his adviser "a squirrel, because she is always so active and in the treetops, overseeing things." Nadkarni herself says she borders on manic without the depressive, and adds that women, in general, can get a lot done at once. Someone, she says, should figure out if this is genetic or the result of environmental demands or what. Nadkarni's husband, who prefers to do one thing at a time, jokingly attributes his wife's energy level to "hybrid vigor," a genetics term for particularly healthy offspring produced when pure genetic lines are cross-bred.

Nadkarni's father was a research pharmacologist from a traditional Hindu family in India; her mother was raised in an orthodox Russian Jewish family in Brooklyn. They fell in love as graduate students in Iowa, married and wound up raising five children on curried bagels in the suburbs of Washington, D.C.

Nadkarni was the middle child, the one who organized the other kids to make a raft out of milk cartons, to burn out a log in the back yard for a dugout canoe. "She always had plans and was liking to tell people what to do," her mother says. "In a family that's not always very constructive, but later in life I think it serves her well."

She climbed the flag pole in elementary school; in high school, she danced atop the balustrade of a church altar during a liturgical dance performance. "My whole idea about dance was to encourage them to be creative," says Nadkarni's modern-dance teacher Erika Thimey. "If they were able to do things their own way, they got more praise, and oh boy, she responded to that!"

A few of Nadkarni's one-of-a-kind inventions, all things she actually made.

* Fern-iture: a bed of living mosses and lichens gathered from the Hoh Rain Forest floor and laid on top of a blue fiberglass toboggan purchased at a Fremont garage sale. Nadkarni slept on the moss bed for a year and a half, no sheets, outliving the slugs and bugs that crawled around the first few months. When Longino showed up and couldn't fit on the moss mattress, they turned it into a ➢

swinging sofa.

* Nose puffs for recreational smelling: ("We have art for the eyes, music for the ears, why not something for the nose?") Cotton balls soaked in fluids scented by chocolate-chip cookies, distilled pine needles and vanilla, rigged to a funnel contraption that releases a puff of aromatic air into a small balloon for later sniffing.

* Dashboard garden: plastic funnel purchased in a beer-making supply store and attached to car dashboard with a suction cup. (Mosses and lichens misted with rainwater thrived, regular plants fried).

* Epi-jewelry: small clumps of delicate chartreuse *usnea*, wolf lichen, dangling from earring backs. Popular at elementary-school talks about the forest canopy. When the earrings dry out, Nadkarni takes them for walks in the rain.

When Nadkarni says her mind works differently from most people's, it is not hard to believe. She craves awareness and is paranoid about losing it. As a child, Nadkarni would purposely rub her hand over rough wood to get splinters, let them fester for a few days until they were really painful, then take them out so she could marvel how great it felt not to have splinters. Much later, toward the end of her senior year at Brown University, she hid in a bathroom stall when the science library closed so she could spend an entire night alone among books in the tallest building on campus.

"I said to myself, 'Well, there's more, you know. And yeah, there are other libraries, but even those aren't infinite. Not everything is known here. The scientific world could not fit into this building or any building. I felt very young, like I had so much to learn, but I still knew there was room to contribute."

So it was decided. Except. Nadkarni also loved to dance. Field biology? Dance? Which would it be? She needed to live in a big city to dance; in a remote habitat to do field work.

She decided to try each for six months and then choose. A bunch of letters to biological field stations around the world yielded one invitation from an old beetle taxonomist in Papua New Guinea. Then off to Paris to dance. Every day she wrote in her journal, eventually filling five spackled composition books. Finally, she brought the diaries to a neighborhood cafe, sat at a small table and read through them as if she were Margaret Mead studying somebody else's life. It took all day and 18 cups of tea to decide she was happier in the field than in the dance studio. Dancing was fun, but there was something about living in the city that seemed almost unbearable at times, something about the way Parisians trimmed the chestnut trees so precisely. Besides, it seemed a field biologist could contribute more to world knowledge.

EPIPHYTES ARE PLANTS that live on other plants. They are not to be confused with parasites, which steal nutrients from their host. Epiphytes usually live in the forest canopy and get their food from mist and dust motes dissolved in rainwater, converting sunlight and air into energy. In many cases, they capture and store nutrients that rain would otherwise leach out of poor soil. Orchids are epiphytes, as are mosses, lichens, some ferns and bromeliads. All told, there are more than 30,000 species of epiphytic plants in the world. This accounts for almost a quarter of the botanical diversity on earth. The Hoh Rain Forest, for example, has only a dozen or so types of trees but more than 300 species of epiphytes.

They come in many forms. Nadkarni's favorite is *Satyria,* an epiphytic shrub in the blueberry family with leathery green leaves and elegant coral bells from which hummingbirds sip nectar 100 feet above the forest floor. There are also several species of orchid smaller than a fingernail and one, *Euglossine orchid,* favored by male bees that scrape its petals for fragrance which they later transform into a pheromone perfume to attract female bees. *Polypodium,* an epiphytic fern common in the Pacific Northwest, has fat roots that smell like licorice; some tropical ferns are a filmy two-cells thick and dry down to nothing until rehydrated with mist or rain. Bromeliads, which often resemble pineapple crowns, trap water even in the middle of the dry season; snakes cruise bromeliad ponds on branches 40 feet up, looking to snack on insects and frogs. And then there's always *Lobaria oregana,* a lettuce-green lichen found among the Northwest's towering hemlocks and yews; it is fabulously rich in nitrogen, sort of a brie cheese for the trees.

To the unpracticed eye, many epiphytes appear sort of scuzzy, like dark scabs upholstering tree trunks, tangled tufts of hair drooping off branches. To a forest ecologist such as Nadkarni, who specializes in epiphytes, their beauty lies in their role as nutrient keepers of the forest. She also loves their mystery.

In the 19th century, European ex-

plorers trained monkeys to collect samples of exotic air plants that grew out of reach. For more than a century after that, the forest canopy was studied mostly by examining debris that fell on the ground. The treetops were pretty much left alone until the early 1970s, when scientists in Oregon were trying to figure how much nitrogen, the lifeblood of growing plants, was in old-growth forests. When they realized they couldn't make accurate calculations until they knew what was going on in the treetops, they adapted mountaineering techniques to hoist themselves up with spikes and pitons. Soon, their climbing methods were refined so as not to damage trees. Nadkarni, for example, uses a powerful slingshot to shoot a weighted fishing line over a high sturdy branch, then she hauls up a parachute cord, then a strong rope, and finally, she climbs the rope using a hip harness, webbed foot loops and special hand grips.

As ascending into the treetops became safer and easier, the number of scientific articles about the forest canopy also climbed. In 1970, there was virtually no published research about the canopy; 20 articles were published in 1980, 90 a decade later. Still, so little is known. Fewer than 100 people in the world actually call themselves canopy scientists. Another 700 researchers do some kind of work in the forest canopy, but as a group, canopy researchers have had no official scientific journal, no umbrella organization.

Nadkarni is trying to change that. This year, she and graduate student Joel Clement began to distribute an international newsletter about canopy research to 400 people on the Internet and 900 people through the mail. In the highly political atmosphere surrounding trees, Nadkarni is open about her desire to preserve forests. Rather than chaining herself to a tree trunk, she says, her style is to educate people, get them excited about forest biota so they'll be motivated to save and study the ecosystem.

The newsletter also allows canopy biologists to exchange information and ideas. Tarzans of ecology will no longer be able to make major scientific progress by swinging solo in the branches with plant clippers, Nadkarni says. Like early settlers working together to set up schools and stores, forest ecologists need to collaborate with each other and with statisticians and computer wonks. "Suddenly, there's a bunch of nerds out there studying canopy biology! And we need them."

These days, in order to ask good questions about the forest canopy, Nadkarni says you have to think like a bird, an ant, a rain drop, a strand of moss.

IT IS HARD TO understand three-dimensional space. In the three dimensional forest, even simple questions become complicated. For instance, how far between bird nests? Should you measure the distance birds fly? Or the distance an ant would travel along a branch up the trunk?

These days, in order to ask good questions about the forest canopy, Nadkarni says you have to think like a bird, an ant, a rain drop, a strand of moss. As terrestrial creatures who walk on land, we think of the forest floor as a safe place. But if you were an epiphyte, the ground would seem dark and nasty; you'd die there. Why? Lack of light? Moisture? Wind-borne particles? Maybe a low-lying pathogen that infects and kills you?

Answering questions like these could someday help ecologists improve the health of tree farms. Or maybe increase crop production. Or perhaps just add to the scientific store. "We never know what will help us or when," Nadkarni says. The key to curbing a second-growth forest infestation could lie in a bug description buried in 19th-century German literature. The more scientists know about how an ecosystem works, particularly if it's working well, the better the chance of fixing problems when something goes wrong.

For the moment, from her high perch, Nadkarni simply enjoys listening to the music of the trees — wind rustling through tiny white pine cones and shimmering black cottonwood and long lacy mosses. The forest is like a dance, she says. Trees strong and flexible, rainwater whirling, questions leaping, their answers just out of reach. P

Paula Bock is a writer for Pacific Magazine. Harley Soltes is Pacific's photographer.

Suspended from the new Wind River Canopy Crane in Gifford Pinchot National Forest, Nalini Nadkarni uses $5 worth of plastic tubing, funnels and plant misters to figure out whether nutrients leach out of mosses and lichens when splashed by raindrops on the way to the forest floor.