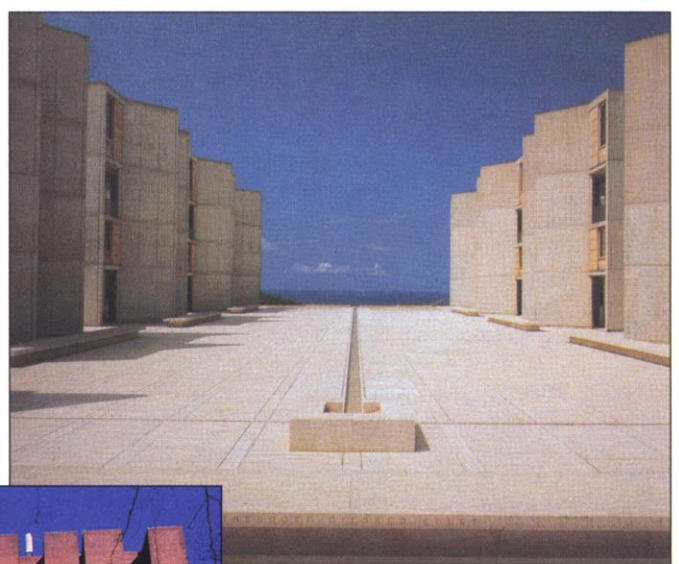
Lured by a surge of funding and the growing prestige of science, world-famous architects, in partnership with special lab consultants, are changing the public face of research

Designer Labs: Architecture Discovers Science

At lunchtime on 23 September, the University of Cincinnati marching band, trumpets blaring and drums banging, strutted its stuff in front of a few hundred people who had gathered to celebrate a new building on campus. A troupe of modern dancers, toting red and black balloons that had been twisted into double helices, also entertained the crowd, as did a string quartet, a choir, and a fireworks show. Had the new building been, say, a museum, a library, or a sports arena, this extravaganza might not have seemed unusual. But this dedication ceremony was for a laboratory.

Laboratories, especially those on university campuses, have long been the plainest of buildings, emphasizing function over form to a fault. Cincinnati's new $46 million Vontz Center for Molecular Studies, however, is anything but plain. Designed by Los Angeles architect Frank Gehry, who recently won acclaim for his Guggenheim museum in Bilbao, Spain, the Vontz veritably dances at the entrance to the school's medical center. In what has become the signature Gehry style, the 13,935-square-meter Vontz looks more like a sculpture than a building, with its collection of curvaceous brick structures of different heights, accented by wavy sheets of glass, blending into a single breathtaking composition. "It's the most successful laboratory, architecturally, since the Salk," says James Ackerman, a Harvard University historian of architecture.

"The Salk"—shorthand for The Salk Institute for Biological Studies in La Jolla, California—has wowed the worlds of science and architecture for nearly 35 years. Yet architect Louis Kahn's concrete, marble, and teak masterpiece overlooking the Pacific Ocean did not trigger a rush by other "signature" architects to build labs. Now, designer labs are suddenly hot. During the past few years, Gehry and a dozen of the world's most accomplished architects—several of whom, like Gehry, have won the Pritzker Prize, architecture's equivalent of the Nobel—have signed up to do laboratories for academia, industry, government, and philanthropists. Lesser known firms that specialize in laboratory architecture have recently designed stunning workplaces for scientists, too.



Kahn's creations. Louis Kahn's Richards building (*left*) won praise from architects but not from its occupants; the Salk Institute (*above*) was loved by both.

This new marriage between science and architecture is especially evident in California. In the San Francisco Bay area, for example, renowned Mexican architect Ricardo Legoretta recently designed a lab for Chiron Corp., Pritzker laureate I. M. Pei crafted the just-opened Buck Center for Research in Aging, Stanford University will soon have a new clinical sciences research center designed by England's Sir Norman Foster (1999's Pritzker winner), and the University of California, San Francisco, this summer selected Connecticut-based Cesar Pelli to build a neuroscience research center on its new Mission Bay campus (*Science*, 24 December 1999, p. 2445). Further south in Pasadena, the California Institute of Technology in February chose James Freed, architect of the much celebrated U.S. Holocaust Memorial Museum, to build a new biology lab. In La Jolla, New York's Tod Williams and Billie Tsien a few years ago designed the widely praised Neurosciences Institute. Outside California, two impressive labs designed by New York–based architect Rafael Viñoly are now going up: the Bernard and Gloria Salick Center for the City University of New York in Flushing, and the Van Andel Institute in Grand Rapids, Michigan.

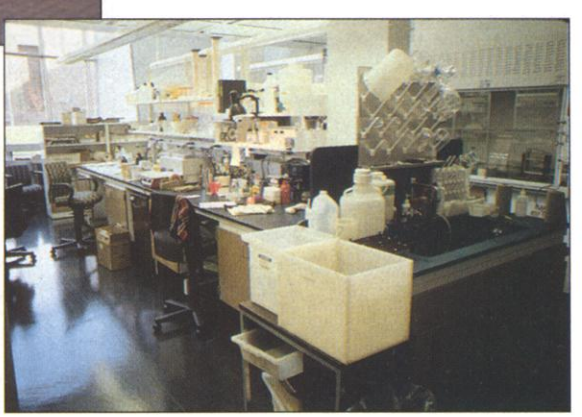
Money is the matchmaker. Universities, philanthropists, governments, and businesses have been on a spending spree in the past few years, building new labs at an unprecedented rate. But Harvard's Peter Galison, a historian of science who co-edited a collection of essays published last year called *The Architecture of Science*, sees more than just money talking: "Our recent history is one in which the laboratory is consistently in the news and the economic eye of the storm," says Galison. "It has a philosophical, symbolic importance that's important to architects." Galison also points out that fancy surroundings are becoming more important as scientists increasingly interact with the business world by starting their own biotechnology and electronics outfits, joining pharmaceutical companies, and aggressively patenting their discoveries. And in that moneyed world, cracked linoleum, bad lighting, lack of privacy, and chipped iron

CREDITS: (TOP TO BOTTOM) THE SALK INSTITUTE; GREGORY BENSON

banisters don't cut it.

More than appearances are involved in this coming together of science and architecture, however. Many of the handsome new labs now going up aim to create environments in which scientists from different labs—and even different disciplines—interact, while providing private space. How these goals are achieved often depends largely on a new breed of architects and engineers who specialize in laboratories and offer their services to the likes of Gehry, Viñoly, Foster, Freed, and Pei. These consulting architects often have different ideas about what constitutes good functional design and how best to achieve the right blend of interaction and privacy.

Even though these partnerships are producing stunning designs and innovative working environments, as a recent University of Cincinnati symposium on science and architecture revealed, there still is much debate about whether the quality of the architecture really enhances the quality of the science (see sidebar). And some of the signature architects who are putting their stamp on the scientific workplace wish their ultimate clients had more appreciation for the impact that a building has: Scientists, says Gehry, "are, for the most part, not interested in architecture." Too often, he complains, researchers want an architect to "just get it functional, spend the money on just solving the functional problems." Such "a sweatshop mentality," he says, ignores "the human needs [for] changing light, space, and the ability to make it personalized."



Shell shock. Frank Gehry designed the stunning overall structure, or shell, of the Vontz Center; consultant Earl Walls designed the labs themselves (*right*).

CREDIT: DAVID DAVENPORT/UNIVERSITY OF CINCINNATI-MEDICAL PHOTOGRAPHY

Two cultures

To most scientists, changing light and space mean little unless they fit in with the way a lab functions. Louis Kahn found that out the hard way in the 1960s with two labs that in some ways foreshadowed today's designer labs. The first, completed in 1962, was the Richards Medical Research Laboratories at the University of Pennsylvania. Kahn came up with an eye-catching design: 10-story stacks of "studios" that he framed with even taller brick "service" towers. "It was a complex greatly admired in the literature of architecture for its imposing presence and imaginative presentation of space and structure," says architectural historian Ackerman. "It appeared to be an inspired innovation—and actually it was a near disaster. The scientists, who hadn't been particularly accommodated in discussing the design, were really hampered in their research."

Arnold Levine, now president of The Rockefeller University in New York City, was one of the scientists who first moved into the Richards. "While it looked beautiful, it really wasn't very functional," says Levine, who was then a graduate student in microbiology. "We got into a horrible fight with Louis Kahn." The scientists groused about exposed pipes that collected dust and the shortage of wall space for refrigerators, but they had particular trouble with Kahn's extensive use of windows. "The sunlight came in blindingly and melted the ice in our ice buckets," recalls Levine. The researchers fashioned curtains out of newspaper comic strips, which Kahn ordered the janitors to tear down. Next, they tried hanging silver foil over the windows, thinking that would appease the architect because pop artist Andy Warhol recently had received attention for covering the windows of his studio that way. Levine came in one morning and found a man ripping down the foil. "I asked him who the hell he was," says Levine. It turned out to be Kahn himself. Kahn finally agreed to hang shades over the windows. "I'm always amazed that he did the Salk, and it's such an extremely beautiful lab."

The Salk, completed in 1965, quickly became the world's most celebrated lab. Kahn often recounted that when Jonas Salk first approached him, Salk said, "I would like to invite Picasso to the laboratory." So Kahn designed a lab where he imagined Picasso would feel comfortable working. Kahn also sought advice on building a place in which scientists would feel comfortable working, bringing in Earl Walls, an engineer who subsequently founded a San Diego–based firm that has grown into one of the world's largest lab consulting businesses.

The Salk's exterior has become an icon. Its centerpiece is a rectangular, travertine marble courtyard flanked by two mirror-image, concrete and teak buildings that jut into milk-carton angles. Water coursing down a gutter that cuts through the courtyard splits into four waterfalls that appear to spill into the Pacific. At sunset, when amber and rose rays drench the marble, water, and concrete, Kahn's mix of laboratories and offices shows off the two elements that mattered most to him: light and silence.

The institute's interior may be less recognizable but, unlike the Richards, it has won plaudits for being functional. Walls hatched the idea of creating a 2.7-meter "interstitial" space atop each of the three stories of labs to house plumbing, air conditioning, heating, ventilation, gas lines, and electrical wires. This makes it easy to relocate a lab bench—and flexibility is essential to the fast-changing world of science—or to update the mechanical equipment. A system of trusses in the interstitial space also holds up the ceiling in the lab below and supports the floor in the lab above; as a result, the labs have no load-bearing walls, allowing researchers to configure and reconfigure lab

Architecture and Creativity: Does Beauty Matter?

At a symposium on science and architecture held last fall at the University of Cincinnati, a high-profile panel wrestled with the ultimate question: Does the architecture of a laboratory influence a scientist's creativity and productivity? The short answer is, it depends on whom you ask.

The discussion, led by television talk show host Charlie Rose, included architect Frank Gehry, lab consultant Earl Walls, architectural historian James Ackerman, and Nobel Prize winners Paul Berg and Ferid Murad. No one made the case for ugly spaces. But Berg, who worked with the firm MBT Architecture in the design of the Beckman Center for Molecular and Genetic Medicine at Stanford University, said scientists often romanticize bad working conditions. "For a very long time, people thought you had to work under extreme, trying conditions in order to be creative—the image of the artist who works in the garret, cut off from all the finer things of life," said Berg. "I think that was a persistent attitude among many scientists." Although Berg conceded he could not prove that elegant settings enhance the quality of research, he argued that it certainly doesn't inhibit it. "I've yet to see anybody whose creative capacities diminished when placed in pleasant surroundings or a congenial atmosphere," said Berg.

Murad, who has done pioneering work on nitric oxide at the University of Texas Medical School at Houston, had many reservations about linking his creativity to the architecture of his workplace. Murad said some of his most inspired scientific thoughts have occurred in the most unlikely places. "I honestly don't know where I collect and collate information," said Murad. "It can be bumping into someone in the elevator or the hallway or some international meeting or whatever." But new insights often come when he's away from work, "days or weeks later ... when my mind is clear and I'm under the car or I'm digging up a tree or beating on boards out in the garage."

Walls, who makes his living designing laboratories, said he is on the fence about whether a pleasant working environment improves creativity. "It's such a personal thing that I'm not sure I could ever say anything but maybe, maybe not," says Walls.

Gehry was not so equivocal. "If you keep out the light, mice are dwarfed," said Gehry. "So are people." He, of course, expects that the new Vontz Center that he designed for the University of Cincinnati will have a positive impact on the scientists who work there. "They can turn out the lights and put a sack cloth around their heads if they want to suffer a little bit, but they are, over time, going to experience a richness," said Gehry. "They will start to see how the sun falls in the atrium and how it plays with those curves. They'll start to see how the brick color was selected because at certain times of the day it has a pink glow and it's very pronounced and very interesting. They will understand that those curved walls are nicer for a person to stand against than a big brick straight wall. So this building will unfold and have a human relationship and will enrich them."

Donald Harrison, the University of Cincinnati provost who oversaw the building of the Vontz, offered a different reason why architecture should matter to scientists. "I do think [the Vontz Center] will help attract scientists here to the Midwest," said Harrison, emphasizing that Cincinnati does not have the climate of the West Coast or the intellectual mass of big cities back East. So, if the Vontz does foster creativity and productivity, the design of the building itself may have less direct impact than the fact that creative and productive scientists want to work inside it. –J.C.

space as they see fit. Different principal investigators share floors, creating labs that blend into one another. "Our students and postdocs mingle," says Walter Eckhart, a cancer researcher who has been at the Salk since its completion. "It's like one lab. That would be difficult to do in a conventional setting where the laboratories are divided by walls and doors. Here, it's like moving from room to room in a house."

Marriages of convenience

In spite of the Salk's instant acclaim, few other major architects followed Kahn into the lab design business. (One exception was Pei, whose much-praised National Center for Atmospheric Research—a concrete structure designed to blend into the Rocky Mountains near Boulder, Colorado—opened in 1967.) But in the early 1980s, Princeton University took Kahn's idea of hiring an engineer to help design the lab space one step further: It commissioned Robert Venturi, who later would win the Pritzker, to design the outside, or "shell," of its new molecular biology lab, while Boston's Payette Associates handled the interior.

The resulting four-story structure won praise from architects and scientists. The shell, a checkerboard pattern in brick and stone mixed with a generous use of casement windows, gives the building a distinctive, postmodern look. Some labs use the open plan of the Salk, while others have more traditional walls separating researchers. A wide central staircase encourages the staff to mingle, as do two lounges on each floor that have built-in seating and blackboards. The design provides "the warmth and open feeling that we requested," says Levine, who was then the chair of Princeton's molecular biology program.

Many of the new designer labs are products of Venturi-Payette–style marriages. "Laboratory consultants can make any architect a laboratory architect," says Tully Shelley III, president of MBT Architecture in San Francisco. MBT, which has built everything from Hawaii's W. M. Keck Observatory to the award-winning technology center for Palo Alto biotech company Genencor Inc., is now consulting with Norman Foster on Stanford's new research center.

Walking through the Vontz Center's labs and the interstitial space, Walls, who designed the interior, points to details that he suggested to make the labs function. The Vontz's lab spaces branch off the building into rectangular wings, each filled with rows of lab benches that run perpendicular to a large window on one side and core facilities—like equipment rooms and darkrooms—on the other. In the afternoon, electrically operated black mesh screens drop in front of the windows to cut the glare.

Gas and water piping make "umbilical drops" down to the lab benches every 3.5 meters. "We prefer to feed down," says Walls. "It's much easier to patch a ceiling than a floor." The benches themselves sit on tall legs, making it easier to clean under them. In addition to a full sink at the end of each bench, there's a "cup sink" in the center for pouring out chemicals and the like. Suspended shelving above the benches is cantilevered, making chemicals, books, and equipment easier to reach. Principal investigators have individual offices that line the exterior of the main building, separating them from the distractions of the lab. Each office is uniquely shaped, a notable contrast to the cookie-cutter look of the labs themselves.

The new Life Sciences Center at Chiron Corp. in Emeryville, California, shows that mergers between design architect and lab consultant are also dramatically changing the look of industrial labs, which have their own peculiar needs and vanities. In keeping with Legoretta's signature style, the 26,500-square-meter Life Sciences Center includes courtyards, roof-decks, balconies, a variety

CREDIT: (TOP) DAVID DAVENPORT/UNIVERSITY OF CINCINNATI; MEDICAL PHOTOGRAPHY

of window shapes, sculptures, fountains, a grand atrium, and liberal use of yellow, purple, and orange paint. Translucent sconces made from Mexican white onyx cast soft light on the hallways. A special paint technique gives a concrete floor the appearance of worn-in leather. Tiny lights line the inside of the lantern-shaped cupola that caps the atrium. Refrigerators are built into the walls rather than cluttering hallways. Chiron researchers "fight to get into this building," says William Rutter, a co-founder of Chiron who worked with Legoretta, Walls, and "architect of record" Flad and Associates.

Chiron's philosophy about how the company's scientists should interact drove the design of the building's interior. Unlike in an academic setting, no one person lords over a laboratory. "They're open, so the ebb and flow of scientific work is not associated with territoriality," explains Rutter. Situated on the building's exterior to take advantage of the natural light, the labs typically accommodate 18 researchers who share three 7-meter-long islands. Rutter stresses that the scientists "work" in many other parts of the building. "The old idea of having laboratory benches where people stay is passé," he says.

The building provides private space for biologists and chemists to do calculations, computer searches, and the like in banks of offices that have glass doors and face the atrium. Each office is a mere 2.5 meters by 3 meters. "We emphasized small offices and large meeting rooms," says Rutter. To further encourage mingling, several "fellows' rooms" are scattered about that have furniture designed by Legoretta, the latest journals, and nearby coffee and copying machines.

As Rutter proudly leads a tour of the lab, he explains that Chiron did not make this $87 million investment—about $3300 a square meter, almost exactly the same cost as the Vontz—simply to support the arts: "You have to present to the board of directors that this capital cost, which takes away from earnings, is worth the expense." The Life Sciences Center is a useful recruiting tool, says Rutter, but employees also enjoy working in it so much that they stick around longer. "We like to see people working not 40 hours a week, but 80 hours a week," says Rutter, who helped genetically engineer the first hepatitis B vaccine.

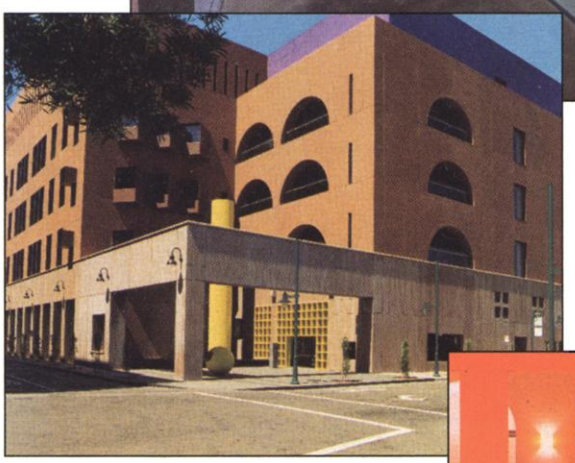
Thirty miles northwest of Chiron in Novato, a small city in Marin County, stands the Buck Center for Research in Aging, another new lab designed by a combination of signature architect and lab consultant. But this time the money came from a philanthropy, which had its own distinct reasons for wedding famed architect Pei with lab specialist Kenneth Kornberg.

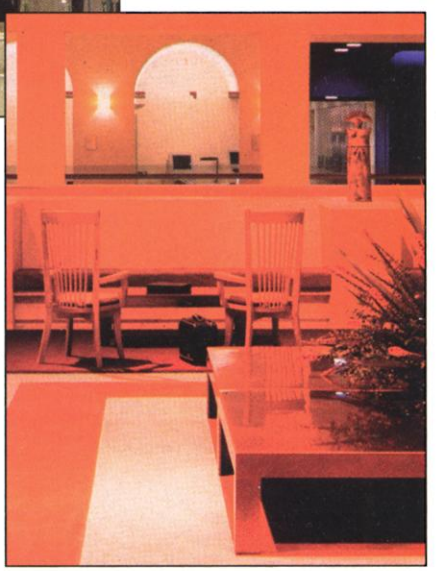
Money for the Buck Center came from a trust set up by Beryl Buck, an oil heiress who lived in Marin County until her death in 1975. When the trust's administrators announced plans to build an aging research laboratory more than a decade ago, they met resistance from Novato residents and outside environmental groups. The trust turned to Pei, hoping that a renowned architect would help quell the criticism.

The choice of Pei did little to mollify residents, 52% of whom voted against the center in a referendum held in 1995. Still, the project proceeded and the center opened last July. Crafted entirely from blocks of travertine marble, the Buck features the triangles and atria that Pei has become famous for in buildings such as the East Wing of the National Gallery of Art in Washington, D.C. Indeed, the Buck could easily be mistaken for a museum. Even the interior of the main lobby is museum-quality space, with a vast atrium flanked by tall windows—and not a lab bench in sight. "I can't help but enjoy this kind of architecture," says Kornberg, who designed the interior. "It's marvelous. My only regret is that I didn't have [Pei's] budget to do the labs."

What Kornberg did in the labs, though, is remarkable in its own right. Unlike most lab architects, Kornberg "grew up in science." His father, Arthur, won a Nobel Prize, and he has two brothers who are leading researchers. So he has strong feelings about what makes labs work. "Ninety percent of labs I see are a huge barn where you have to walk by everyone," says Kornberg. "If you're trying to do your work, and every 15 seconds people are walking by and you have to acknowledge them, you can't get anything done. ... You've got to have interaction, but not at your lab bench.'

Kornberg created privacy at the Buck by having lab benches form what amount to cul-de-sacs, with each bench running all the way up to a window. The window end of each bench features a





Beautiful biotech. Ricardo Legoretta's design for Chiron's Life Sciences Center features courtyards, balconies, and a variety of window shapes; Earl Walls designed the open labs (*above*). Researchers have small offices and communal "fellows' rooms" (*below*).

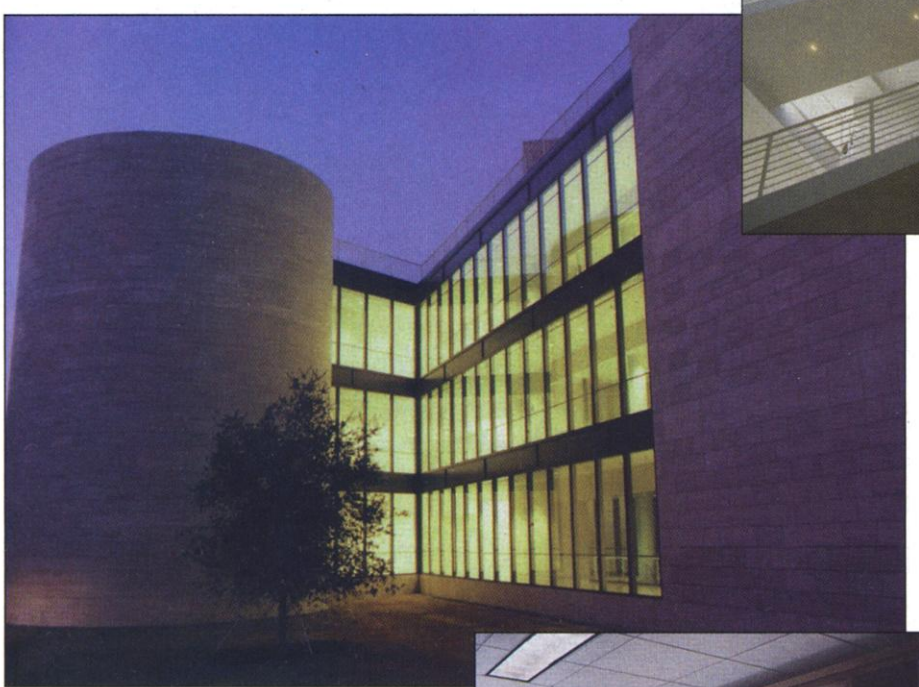
ARCHITECT OF RECORD: FLAD AND ASSOCIATES; DESIGNER: RICARDO LEGORETTA; PHOTOGRAPHERS: (TOP AND CENTER) LOURDES LEGORETTA, (BOTTOM) JOHN SUTTON

lowered desk, providing a private space. "Nobody goes by you," says Kornberg. "If you're sitting there figuring out how many grams of this or milliliters of that, you need a quiet place."

Small details shape the unique character of the lab space. Kornberg rounded off the ends of the lab benches to make it easier to roll carts around the lab. Cabinetmakers used distinctive anigre wood from Africa. Lab floors are black rather than the more traditional white. "If you ever go into a building with white floors, people are squinting," says Kornberg. "In a lot of labs, you have eyesore by the end of the day." And many of the walls are painted bright colors. "Labs get very cluttered and very messy," he says. "If you leave the walls white or bland, the clutter takes over and you lose the architecture of the place."

Kornberg says he enjoyed working with Pei, but that they had "different views of what the labs should be." Pei first designed three triangles with labs around atria. "I thought it was important when coming out of the lab to face people," says Kornberg. Pei's "circulation" idea initially prevailed, but the building, which went through several iterations because of objections from environmentalists, ultimately has the labs open to hallways rather than atria. Indeed, Kornberg—who mostly designs entire buildings, not just interiors—says collaborations between brand-name architects and lab consultants can be "the toughest way to do a lab building."

Gehry, who worked closely with Walls and university scientists in designing the Vontz, says such collaborations are valuable, but he wishes the labs themselves offered more "individual expression" to people who work at the benches. "There isn't enough idiosyncratic behavior possible in these labs," says Gehry. For example, he says, he would like labs to have enough flexibility for people to move a bench so that the light best suits their needs, or to accommodate personal furniture.



Bucking convention. I. M. Pei's signature triangles and atria define the Buck Center; Kenneth Kornberg's lab design provides privacy, benches that are easy to navigate around, and black floors.

CREDIT: BUCK CENTER

Other architects also have mixed feelings about assigning one group to do a shell and the other an interior—even though, like Kornberg, they often seek these jobs themselves. "It's difficult if the idea of how a building works and its [design] architect aren't truly connected," says Terry Sargent, a lab architect based in Atlanta, Georgia. Sargent led the Lord, Aeck & Sargent team that designed all aspects of the Georgia Public Health Laboratory in Decatur, a stunning building that features granite piers and awnings made from thin-gauged copper wire. He notes that none of the firm's other buildings look anything like this lab, and he is particularly critical of the notion of hiring famous architects to "brand" buildings with a recognizable style. "The building needs to be responsive to its environment and the people who use it," says Sargent. "If they're all different, that's the best."

Ugly truths

Curiously, many of the scientists promoting the new trend of labs as architectural statements rose to the top of their fields while working in typical ungainly spaces. When Rockefeller's Levine left the Richards building, for example, he moved to old labs at Princeton that were so ugly his mother suggested he return to school and earn a medical degree. "I was devastated," says Levine. Chiron's Rutter says his old labs at the University of California, San Francisco, where he did pioneering cloning research, similarly were "terribly designed."

Why, then, do they put such stock in the value of beautifully designed labs? "Troglodytes did OK working in caves," says Rutter. "You pay very little delta for exceptional space, and the little you pay brings you exceptional rewards." Levine says one of these rewards is the quality of the work: "The most important variable is still the person and not the architecture. But I really do believe that you can do better science if you're in a better building."

Gehry is optimistic that more scientists will come to similar conclusions. Says Gehry, "If they invest just a little bit of time, a little bit more energy, and just a tiny bit of money—it's not that much—it'll pay off in ways that they haven't thought of."

–JON COHEN