feature article

Laboratory architecture: Building for an uncertain future

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Three iconic laboratories constructed in 1966 reveal how architectural design and scientific culture can help—or hinder—a building's ability to adapt to the changing discipline it serves.

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"Architecture aims at Eternity," proclaimed revered English architect Christopher Wren, never suspecting how damnably quotable those four words would become. Science also aims at eternity. If the Nobel Prize rewards seminal discovery, the Pritzker Prize, the architectural equivalent of a Nobel, honors timeless style. Both particle accelerators and cathedrals may, as nuclear physicist Alvin Weinberg suggested, be seen as symbols of cultural expression, but they are not equivalent as enduring aesthetic monuments.

By no means does a brand-name architect ensure a good laboratory, as the recent controversy surrounding Frank Gehry's Ray and Maria Stata Center for MIT confirms.[1] For the more than $300 million replacement for Building 20, the original home of MIT's Radiation Laboratory, Gehry sought to recapture some of the celebrated lab's old magic by designing in flexibility and serendipity. He famously, perhaps infamously, looked for organizational inspiration in what he called the "orangutan village" and the "prairie dog town," and wound up with spaces that remind faculty of a disorienting zoo.

All too often, hiring a celebrity architect means that scientists end up, like so many of Frank Lloyd Wright's clients, as guests in their own home. Wright's only laboratory, the S. C. Johnson Research Tower in Racine, Wisconsin, is a telling example. Its dramatic eccentricities—small, cantilevered floor plates that isolated researchers from one another; mezzanines that limited room for scientific instruments; windows of Pyrex tubes that frequently leaked and added a high thermal load; curved walls that required custom cabinetry and lab benches—imposed so many compromises on the scientists that they eventually moved to a reconverted hospital nearby. Wright's tower has long since been abandoned, too difficult and expensive to bring up to modern safety codes, too iconic to tear down. One of the very few laboratories on the National Register of Historic Places, it is a monument to the idea of research. As a place to do chemistry, it was just plain frustrating.[2]

A few laboratories have aspired to both architectural and scientific preeminence, but even the best of them eventually face unplanned obsolescence. As General Electric's research director H. H. Race once explained, "If there is one thing we know, it is that we do not know now what we will be doing ten years from now." Ideally, a laboratory should be as open-minded and open-ended as science itself. In practice, any building will stunt intellectual growth sooner or later, since the scientific philosophy embedded in its design endures even as the laboratory's vision and mission evolve. From the day it opens, a laboratory struggles to keep pace with its own scientific research program as over time it discovers the limits of its own architecture.[3]

Figure 1. Bell Laboratories Holmdel Complex in New Jersey was designed by Eero Saarinen. Once home to more scientists than found at a major university, the building now stands empty. (Photograph by Lee Beaumont.)

Figure 2. The Mesa Laboratory, designed by I. M. Pei for the National Center for Atmospheric Research, was conceived with the surrounding Colorado Rockies in mind. Its founding vision included the notion of small teams and a sense of community, but as climate science grew in complexity, NCAR had to expand beyond its signal lab. (Courtesy of the University Corporation for Atmospheric Research.)

A question of attitude

What, then, is the half-life of a laboratory? Three classic laboratories, all designed by famous architects and opened in 1966, provide some instructive perspectives. Eero Saarinen's Bell Laboratories Holmdel Complex in New Jersey, I. M. Pei's Mesa Laboratory for the National Center for Atmospheric Research (NCAR) in Colorado, and Marcel Breuer's chemistry building for Brookhaven National Laboratory in New York all represented some of the best in modernist architectural thinking, though on entirely different scales and with very different design philosophies.

Holmdel (figure 1), the most elegant of Saarinen's corporate campuses, perfectly captured the spirit of American big business at high tide—prosperous, self-assured, insular, and faceless. Pei's NCAR laboratory (figure 2) was as visionary and idiosyncratic as solar astronomer Walter Roberts, the founding director of NCAR, who commissioned it and who sought to create a place where individual researchers, either alone or in small groups, could follow their muse. It was the perfect setting for the climactic scene in Woody Allen's futuristic farce *Sleeper* (1973), and nearly a half century after the lab opened, it still looks avant-garde. Breuer's Building 555 (figure 3) was anything but the government-issue laboratory its official name implies. In close collaboration with the Brookhaven chemists, Breuer fashioned a surprisingly stylish yet frugal and functional building, all the more striking amid the converted barracks and drearily uninspired architecture surrounding it.

At their best, those signature buildings provided prestige, visibility, and a collective identity for their clients. The buildings—outside and in—brought the organizations to life, both symbolically and pragmatically. They said, this is who we are; this is what we do; this is how we do it. Each of the laboratories, if read carefully, can be a revealing memoir of the organization that commissioned it.

Each laboratory now faces a midlife crisis. Saarinen's Holmdel, optimistically built for the ages, turned out to be as inadaptable to the harsh realities of competitive telecommunications as the monopoly that paid such a premium price for it. Now empty, with weeds growing in its once-stunning atrium, the laboratory that at its peak housed a staff of more than 5000 has become a white elephant so daunting to convert to any other purpose that it appears headed to extinction. In contrast, Pei's Mesa Lab is such an ingrained part of NCAR's persisting culture that its future seems secure, though not necessarily as a working laboratory. Envisioned for small-scale conventional atmospheric chemistry and meteorology, Mesa Lab has had to adjust to the demands of a truly global science and is becoming an increasingly virtual laboratory. The computers required to run ever more sophisticated and complex climate models ended up costing more than the laboratory itself; most of them have been moved to Wyoming, where energy costs are lower. It is Breuer's Brookhaven design, closely attuned to the requirements of its scientists, that may turn out to be the most enduring and influential. Its best features have become such an accepted part of current laboratory architecture that they are more or less taken for granted.

An ongoing challenge for any mature laboratory is whether new science can be done effectively in older buildings. Can modest structural changes enhance collaboration and foster the teamwork needed for a new kind of large-scale, multidisciplinary research? Or will only a newly designed space do? Is adaptation a less costly alternative, or might it actually cost more to outfit the laboratory of the future in an old space? Although there may be no single answer to those questions, the three classic labs provide some guidance: They suggest that flexibility, the mantra of laboratory design since the late 1930s, depends on both attitude and design and that laboratory culture matters as much as the architectural forms that express and constrain it.

Saarinen's "Industrial Versailles"

Saarinen designed the most architecturally distinguished corporate laboratories for the most discriminating corporate clients—General Motors, IBM, and AT&T. In three stunning commissions he reinterpreted the laboratory for US corporations in research centers that dwarfed any university lab. Beginning with the General Motors Technical Center, opened in 1956, and ending with Holmdel, posthumously completed a decade later, Saarinen brought modernist style to industrial research—even if his laboratories ended up as much about corporate image as about scientific breakthroughs.

At Holmdel, Saarinen's challenge was to surpass the most famous industrial laboratory in the world, Bell Labs in Murray Hill, New Jersey. Designed in the 1930s by the architectural firm of Voorhees, Walker, Foley and Smith, the Murray Hill site brought together the biggest and best laboratory of its kind in what lab director Oliver Buckley described as "a single building that retained most of the advantages of separate buildings but assured more intimate contact among departments and discouraged department 'ownership' of space."

Murray Hill's plain buff brick disguised some truly imaginative rethinking of laboratory space. The modular design, with its demountable partitions and "universal space" that could be converted and reconverted to offices and

Figure 3. Building 555, designed by Marcel Breuer, houses chemists at Brookhaven National Laboratory in New York. Nearly 50 years after it opened, the lab is still functionally and technically sound, according to the architectural firm that is currently planning its renovation. (Courtesy of Brookhaven National Laboratory's chemistry department.)

laboratories, would be endlessly emulated in other corporate, government, and academic laboratories over the next half century, though never again on the scale of Murray Hill. Bell Labs scientists themselves contributed a good deal to the design. William Baker, who would serve as Bell Labs president, arrived as a chemist in the first wave of scientists to move into the building in 1941. Seven years later he recalled how much influence he and his colleagues had had on the layout of their laboratory space: "By adding new equipment and designing labs, generations of scientists and engineers at Murray Hill have controlled their own surroundings."

Even some of Murray Hill's less appealing features, including a seemingly endless corridor, ended up having unexpected payoffs. Walking a quarter mile to the library, cafeteria, or auditorium often turned chance encounters into productive collaborations. By organizing the laboratory around problems—the transistor being one notable example—Murray Hill's architecture broke down many of the disciplinary barriers characteristic of universities whose departments are housed in separate buildings.[4]

Instead of Murray Hill's extended H shape, Saarinen designed Holmdel as a set of four identical 700 × 135 foot (215 × 40 meter) rectangular blocks. Each one was six stories high when the basement and its service facilities were included. A vast interior courtyard connected the blocks, each intended to accommodate 1000 scientists, engineers, and support staff: what management considered a "university-sized unit." The main corridors ran around the outsides and insides of the blocks, interior aisles ran through the main halls, and labs and offices occupied each side of the aisles. Researchers had easy access to their own laboratories but little opportunity to see anyone in neighboring aisles, much less in other blocks, except in the great atrium. Holmdel's distinguishing architectural feature was its glass facade, five stories of 6 × 3 foot panes of reflecting panels. Touted as the biggest mirror ever, it dissolved into the sky and landscape by day and brought the interior into striking relief at night. From the exterior corridors, scientists could draw inspiration from a landscape worthy of Versailles itself—hundreds of acres planted in thousands of varieties of trees and shrubs and crowned with a 6-acre reflecting and cooling pool (to the right in figure 1) with fountains and a unique water tower modeled on an early transistor.[5]

Holmdel's primary mission was communications, including the first all-electronic telephone switching system. Paradoxically, though, encouraging communications within the new laboratory turned out to be its most mystifying challenge. Partly that was due to sheer scale, since Holmdel soon overtook Murray Hill as the world's biggest laboratory. Yet Saarinen's design bore some of the blame. It had not allowed for any natural circulation from aisle to aisle or from floor to floor, thus precluding obvious points of contact and isolating research groups from one another. The individual laboratory modules with their partitions may have been flexible, but not the laboratory as a whole. Holmdel traded the warren of Murray Hill for privacy and splendid isolation. It would be hard to find a corporate motto—Reach out and touch someone—more at odds with its own building design. Holmdel, a modern Versailles, may have equaled the original in cost and opulence, but its "hall of mirrors" faced outward, suggesting, perhaps, a belief that everything worth knowing was already inside.

Pei's modern monastery

For NCAR, Pei designed a laboratory to put a new organization on the map while preserving the scientific style of Roberts, its founding director. Roberts had his own vision for the laboratory as a place that would foster individual initiative and small-scale collaborations, something "monastic—that is, ascetic but hospitable." With assistance from local architect Tician Papachristou, who would later join Breuer's practice, NCAR canvassed its staff for ideas and assessed prospective architects, including Saarinen, Minoru Yamasaki, Philip Johnson, and Louis Kahn. In addition to asking for quiet, private offices within convenient walking distance of their colleagues and a room or bench with a view, the scientists asked that nothing mar the natural beauty of the site, a stunning mesa just below the Flatiron Range in Boulder, Colorado. Computer modeler Philip Thompson, the laboratory's associate director, articulated a frankly romantic vision: "The ideal is not a monument or a temple, but a place where a variety of people can meet, privately or semiprivately, can be alone, or can be distracted by a different kind of beauty." After touring a number of new laboratories and inviting a short list of candidates to Boulder for extensive interviews, Roberts selected Pei as the one who best understood his notion of a laboratory where administration would be conspicuous by its absence and where scientists would collaborate in modestly sized groups no larger than 10, gathered around blackboards, "the real instrument of interdisciplinary work."[6]

Pei's first design, a concrete monolith akin to his Earth sciences building then under construction at MIT, seemed entirely wrong to Roberts and his colleagues. They told Pei to

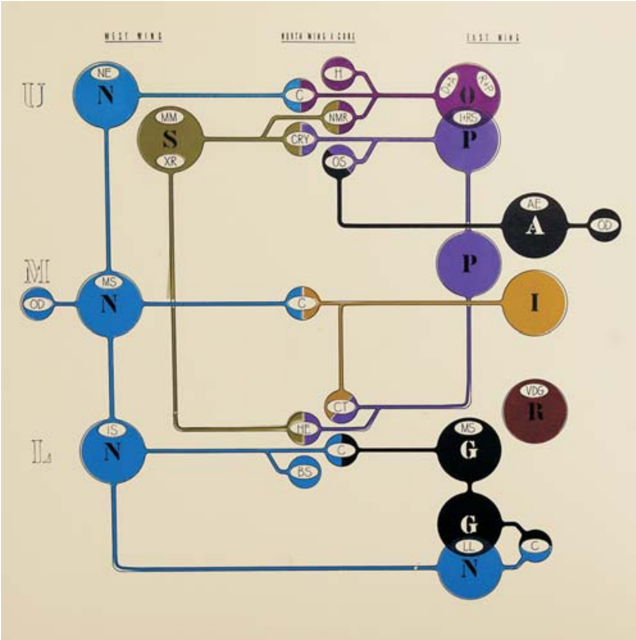

Figure 4. Before designing the new chemistry building at Brookhaven National Laboratory, Marcel Breuer and his assistant Robert Gatje interviewed the chemists at the lab and observed them at work. As a result of that study, they created this graph, which relates chemists of various subdisciplines to each other and to the equipment they use. (Courtesy of Brookhaven National Laboratory.)

avoid "conventional patterns" for organizing a laboratory by discipline or around particular research groups and urged him instead to encourage serendipitous encounters by including "a place to pace" and "nooks and crannies and irregular places where people can wander and sit and think."

Pei rose to the challenge by pulling apart the monolith and reconfiguring it as three five-story towers arranged around a terrace and interconnected by a plaza at ground level, a two-story core building, and a basement. The core building housed communal spaces, including the lobby, the cafeteria, and the library. The towers had laboratories and offices; the two-level basement housed mechanical equipment and laboratories that used heavy machinery. Though coupled at the core level and in the basement, the towers, with their clusters of labs and offices, would be otherwise independent.

In keeping with the NCAR mandate for complexity and surprise, Pei kept the corridors short and grouped small offices, in several sizes, around central space. In a finishing flourish, Pei placed "crow's-nests" atop the towers (one is visible crowning the foreground tower of figure 2); those tiny offices, accessible only by a spiral stairwell, featured full glass fronts and a tiny perch that offered inspiring views and a breath of fresh air. To take further advantage of the site, Pei opened the cafeteria onto an outdoor patio and added a walkway from the staff lounge onto the mesa. Pei considered Spain's Alhambra to be the perfect example of a compact, contemplative space, and he included his own version of the Court of the Lions, complete with a central fountain that led out to a modern-day Court of the Myrtles—a tree-lined plaza suited to private conversations or larger public gatherings.

Budget cuts by NSF forced NCAR to put on indefinite hold the construction of the south tower, which Pei expected would complete the architectural composition and provide room for future laboratory expansion. Nonetheless, Pei brought in the rest of the building on time and under budget, at a no-frills cost of $4.5 million. To economize, all of the wet-lab space went into one tower and the offices in the other—unfortunately compromising future flexibility. Pei's bush-hammered finish gave otherwise ordinary concrete the look of stone and the strong vertical lines he was seeking. By using a pinkish aggregate from a local quarry and sand from the same source for permanent color, Pei skillfully blended the building into the backdrop of the Rockies.

Pei's design certainly met Roberts's expectations. As Roberts told his staff, "I firmly believe our building will prove as functionally excellent as it is architecturally distinguished. . . . The design is austere and yet bold. It has a diversity of heights and scales that gives it a campus-like quality." Architectural critics agreed. One titled his review "High Mountain Monastery for Research." Another called it Pei's "best building to date" and "a sight, as stark and imposing as the view of any medieval monastery on a rock in Catalonia or in Tuscany." Still, not everything worked out according to plan. Buffeted by fierce Colorado winds, the fountain at the center of the Alhambra-inspired courtyard sprayed passersby in summer, left sheets of ice in winter, leaked into the workspaces below, and eventually had to be shut off entirely. What Pei imagined as a vibrant Mediterranean courtyard ended up being deserted most of the time, as were the nooks and crannies. Even the library, a space Roberts thought especially striking, ended up being "grab and go." The cafeteria, on the other hand, provided just the kind of social space for spontaneous conversations Roberts and Pei had thought it would. Roberts deliberately chose a different table for lunch each day to keep abreast of the scientific work of his colleagues.

What Pei and Roberts did not anticipate was how computers and computer modeling would redefine the atmospheric sciences and in turn transform Mesa Lab. As NCAR became increasingly integrated into a worldwide network of global climate science, Mesa Lab had to reconcile Roberts's founding vision of small teams of self-directed researchers with increasing pressure for more tightly focused and formally managed research projects. NCAR also had to grow beyond the limits of its signature laboratory, designed for no more than 300, as it tried to preserve the sense of community the building sought to encourage. The center has now grown to nearly a thousand total staff in Boulder and occupies additional spaces including the Foothills Laboratory and the Center Green Campus. None of those have the architectural character of Mesa Lab—or, for that matter, its double-edged legacy. As meteorologist Robert Fleagle, one-time chairman of University Corporation for Atmospheric Research, the governing body of NCAR, astutely observed, Mesa Lab, "designed around isolated towers, reflects [Roberts's] vision for the institution as a collection of researchers pursuing individual projects of their own choice."[7] Much of NCAR's subsequent history would entail confronting the limitations and pushing the boundaries of that vision.

Breuer's elegant edifice

Oddly enough, the least renowned of the three laboratories, Brookhaven's Building 555, may have the most promising future. Breuer often said he would have been a more famous architect if he had chosen better locations for his best work, although Brookhaven's chemists certainly appreciated what he accomplished there. Chemistry department chairman Alex Harris, who spent the early part of his career at Bell

Figure 5. The stylish lobby of Building 555 boasted furniture by prestigious designers, paneled walls, and a striking stairway. Standing in this 1967 photo is Jerome Hudis, who chaired the lab's chemistry department from 1977 to 1981. Seated is chemist Eena-Mai Franz. (Courtesy of Brookhaven National Laboratory's chemistry department.)

Labs, had been in office only a few days when Jacob Bigeleisen, the former head of the building committee, dropped by to give him an unexpected lecture on his accountability for an architectural landmark as well as for the quality of the science being pursued in it.

Like Brookhaven National Laboratory itself, the chemistry department started out in the most unpromising of spaces: six cinderblock barracks inherited from a former military base and "temporarily" converted to laboratories. A connecting corridor provided makeshift offices. Founding chairman Richard Dodson recruited a staff of Los Alamos and other wartime laboratory veterans, many of whom were trained and ready to explore nuclear chemistry. What the temporary buildings lacked in architectural charm they atoned for by instilling a strong esprit de corps. Shoehorned into a narrow hallway, Brookhaven's chemists could hardly avoid tripping over one another, almost literally, which fostered a remarkably collegial culture. Temporary space can often be liberating space, and Brookhaven's chemists did some of their best work in their improvised quarters. In imagining what a new laboratory should look like, they would draw some valuable lessons from the experience.[8]

Brookhaven's management had considered the chemistry department well-housed, but the chemists knew better. By 1959 they had successfully lobbied for more and better space to accommodate a growing department and its array of sensitive, specialized instruments. In effect professors, Brookhaven's chemists looked to university departments as the appropriate models for their organization. The chemistry building would be an oasis of little science in a place that was inventing big science. The chemists did not set out to isolate themselves from the physicists surrounding them. Rather, they were seeking to establish a distinct collective identity, all the more important at a national laboratory so closely associated with another discipline.

The chemists aspired to something more architecturally stirring than the physics department's Building 510, and they were convinced that a good design would more than pay for itself. They persuaded laboratory director Leland Haworth that a modest appropriation to hire an architectural consultant would be money well spent. The building committee drew up an impressive list of potential consultants in 1959 and began interviewing them. Some, like Paul Rudolph, seemed to understand creative work in the arts but not in the sciences. Others, like Saarinen and Ludwig Mies van der Rohe, seemed more interested in creating architectural showcases than practical scientific workspaces. Had Pei not insisted on retaining exclusive rights to the plans, he would have won the commission. Of the finalists, only Breuer seemed to grasp the full potential of the project as a chance to rethink a fundamentally modern architectural form in collaboration with its future inhabitants. After all, who knew more about how chemists work than the chemists themselves?

To take the measure of the chemistry department, Breuer sent Robert Gatje, one of his young partners, to study the chemists. For several weeks Gatje played amateur anthropologist, scrutinizing the behavior and rituals of the atomic-age tribe. Who talked with whom, and where? Which made more sense, a horizontal or a vertical organization? A few floors or many? What was the appropriate balance between spaces for collaboration and spaces for personal thinking, reflection, and writing? Gatje interviewed technicians, bench scientists, administrators, and administrative assistants. They later recalled his questions and questionnaires as being incisive and insightful. Breuer himself also paid several visits to the laboratory to share ideas with the building committee and other department members.

Back in their New York studio, Breuer and Gatje turned their observations into an architectural program of striking originality. They approached the problem diagrammatically, in terms of the relationships between different subspecialties and their separate and shared tools. So the nuclear chemists, for instance, would need some connection to the inorganic chemists and to the geochemists and access to counting rooms and beta-ray spectroscopy. The radiation chemists, on the other hand, would be essentially on their own with their Van de Graaff generator. Mapping those relationships onto a basic cruciform design provided a starting template (see figure 4). The chemists then added plenty of their own ideas, perhaps none more insistently than the importance of fostering the informality and serendipity that had been so much a part of the temporary labs. As Breuer and Gatje noted in their study for the chemistry building,[8] "The Department believes that not only should laboratories and offices be in close proximity to one another but also that discussion is promoted by easy access to both when viewed from the corridor by passers-by." A compact design with plenty of visibility would invite conversation and collective learning. Having observed that "partitions, once built, are rarely moved," Brookhaven's chemists wisely sought other, cheaper strategies to adapt to changing research programs.

Breuer's concept preserved the principles of little science while also accommodating the essential tools of big science. A three-story design, with administration and support services on the middle floor, gave the building intimacy and a horizontal orientation that kept lines of communication open. Stacked at its core were the counting rooms, shielded by concrete selected by the chemists to ensure extremely low background radiation. For flexibility on a budget, Breuer ran service chases (spaces for gas lines, water pipes, and so forth) between back-to-back laboratory modules. That allowed easy access to utilities without the expense of the interstitial floors being planned for Kahn's Salk Institute in La Jolla, California.

Breuer placed private offices directly across from the laboratories and included adjoining alcoves of open offices for junior staff and postdoctoral fellows. Unlike Saarinen, who thought artificial lighting and modern HVAC made laboratory windows obsolete, Breuer firmly believed that scientists needed access to natural lighting. He glazed the upper half of the laboratory walls to borrow daylight admitted through windows along the alcoves. He also provided for a wide range of choices for laboratory and office configurations, from one-person laboratories to spaces sufficient for three or four researchers—all based on a planning module of 12 × 12 feet. The chemists contributed a number of innovations of their own, including novel adaptations of materials for benchtops, sinks, and drains; a new design for chemical hoods; lab benches that could be rearranged and reconnected quickly and conveniently; and a "once-through" HVAC system that did not recycle contaminated air.[9]

A disappointed Breuer never got the opportunity to construct his own building. Disqualified by the US Atomic Energy Commission, which preferred its own stable of contractors, Breuer could only watch in frustration as another firm brought his ideas to life. To be fair, the architect of record, Wank, Adams and Slavin, after some prodding from the laboratory staff, executed Breuer's plan to perfection. They also brought in the laboratory right at its $6 million budget. With a terrazzo lobby decked out in Barcelona chairs, a Knoll couch, a Noguchi table, custom ash paneling, and a stunning central stairway with blue-tiled, tessellated walls, Building 555 had high style, as figure 5 shows. It made an equally strong scientific statement. Two members of the original building committee earned membership in the National Academy of Sciences: Bigeleisen for his contributions to isotope chemistry and Gerhart Friedlander for his work on the mechanics of nuclear reactions. Raymond Davis Jr won the 2002 Nobel Prize in Physics, a first for a member of Brookhaven's own scientific staff, for detecting the solar neutrino; his discovery was made possible in part by the nuclear counting rooms in the building's core.

Predictably, perhaps, a laboratory designed in 1960 and opened in 1966 has continually had to play catch-up with a fast-moving science. The building does not have the vibration stability required for top-end electron microscopy, appropriate temperature control for lasers, electromagnetic shielding for high-field nuclear magnetic resonance, or enough space for computers. The HVAC now does more harm than good as it spews dust into lab modules, and the once-through ventilation is outmoded and gobbles energy. Cooling water running through 40-year-old pipes has to be filtered to protect expensive instruments. Older hoods, contaminated by radioisotope research, will have to be removed or replaced. Only one research group still uses counting rooms, and demand for wet labs has declined significantly. Lasers, a physics curiosity when the lab was being planned, have become mainstays of chemistry. To accommodate them, the chemists have had to paper over the lab windows. Most challenging of all, new US Department of Energy priorities have forced what had been a fairly self-directed department to seek new collaborative research opportunities in such fields as nanoscience, catalysis, and combustion, often in partnership with scientists in other Brookhaven departments or at other academic, corporate, or national laboratories.

Nonetheless, Breuer's original design, bolstered with a little re-imagining, still presents a surprisingly resilient platform for modern chemistry. In planning for its renovation, Einhorn Yaffee Prescott architects Andy Wong and Robert DeGenova concluded that the laboratory was "functionally, programmatically, and technically" sound, still very much a "high functioning building." If many of the labs are now too small, the non-load-bearing walls between modules can be and have been taken down, just as Breuer and the chemists had anticipated. The office, alcove, and lab arrangement remains as relevant as ever, and it is less contrived than the informal meeting spaces prominently featured in current laboratory designs. Many of Building 555's best features have been updated and improved for Brookhaven's new state-of-the-art Center for Functional Nanomaterials, designed for the interdisciplinary style of science now so much in vogue.

Saarinen's Holmdel reveals the limits of corporate imagination much as Pei's Mesa Lab exposes the limits of personal vision. Breuer's chemistry building demonstrates that given the chance and the right guidance, scientists can design a creative and durable working environment with flair. But science moves at warp speed, and no lab is infinitely adaptable. At some point the tradeoffs intrinsic to updating and modifying become untenable. As Woody Allen once quipped, "Eternity is really long, especially near the end."

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