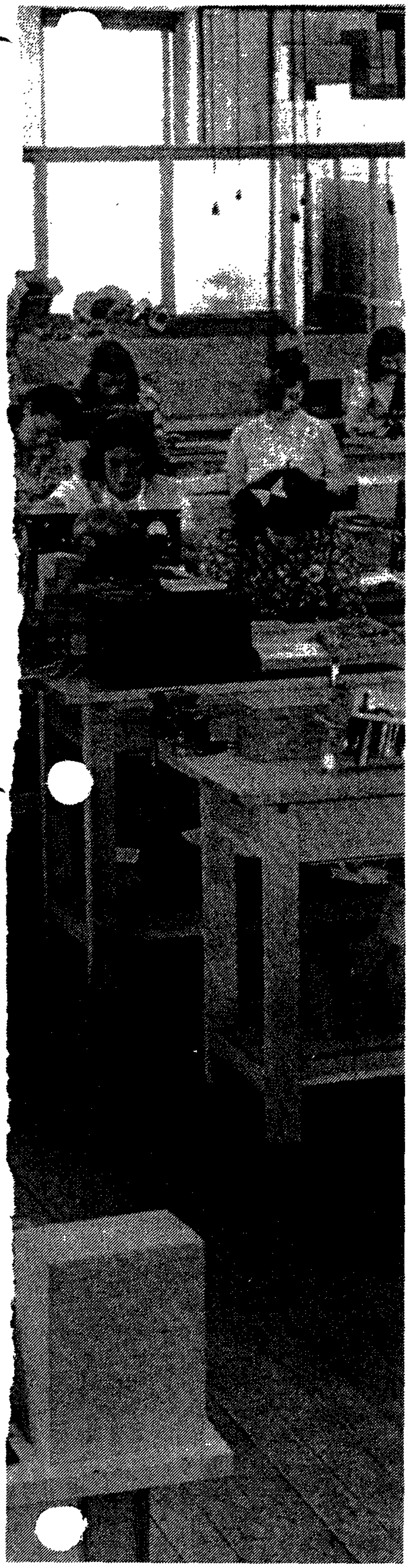
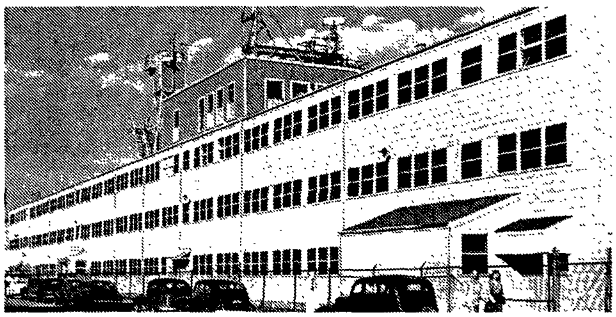


Building 20

The Procreative Eyesore



By Simson Garfinkel, '87

It's an eyesore with a distinguished past and an uncertain future. It's a 48-year-old monstrosity built of plywood, cinder block, and engineers' dreams. It's been the focal point for tales of zaniness and creativity going back more than a generation.

"It's the best building in the place," says President Emeritus Jerome Wiesner, who worked there for more than a decade.

It's Building 20, a three-story, 200,000-square-foot shack built soon after the United States entered World War II. Always intended as a temporary structure, the building evolved through a combination of accident, fate, and providence into a nest of creativity that has few equals in the annals of the Institute.

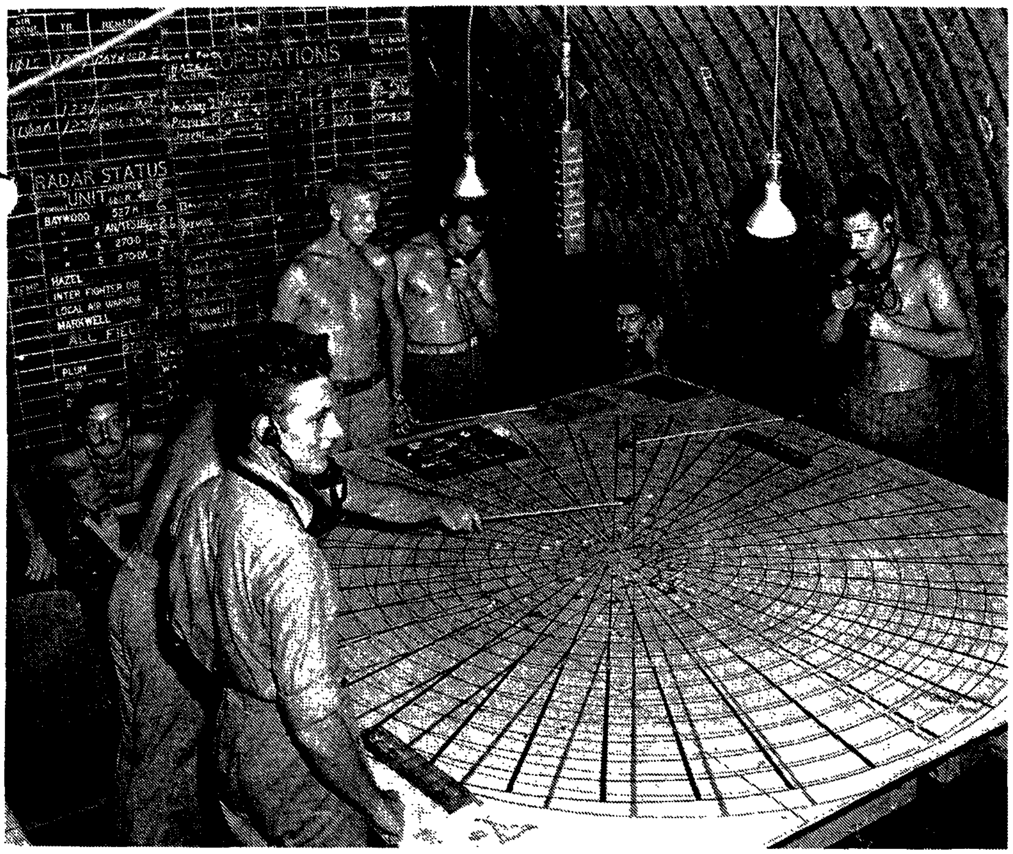
***Building 20** began life as the home of the Radiation Laboratory, where ultimately 4,000 staff members designed, built, and tested radar systems that turned the tide for the Allies in the late years of World War II. This Model Shop, for instance, was a miniature factory where each worker built a complete unit.*

In the spring of 1940, Europe was at war. The United States was officially neutral, but its sympathies clearly lay with the Allies. On a secret mission that spring, Sir Henry Tizard brought the newly perfected magnetron tube to the United States. He hoped to enlist this country's help in developing a system that could use microwaves to detect enemy planes. Four months later, shrouded in secrecy, the MIT Radiation Laboratory set up shop in Building 4. Military RADAR was about to be invented.

The first thing the new laboratory needed was staff. An MIT-hosted physics conference in the fall provided fertile ground. Documents at the MIT Museum tell how the attendees at that 1940 conference were surprised to find that the majority of the papers offered were on the subject of microwave radiation. During the conference, a series of interviews were conducted behind closed doors, and by the end of the week, a cadre of scientists was in place.

The lab quickly outgrew its space in Building 4 and expanded into a three-story tar-paper shack hastily built atop Building 6. Soon other temporary structures started popping up like mushrooms: wooden huts at the west end of campus housed scientists and graduate students; new labs in Buildings 22 and 24 sprung up alongside Vassar Street.

But the ad hoc bits and pieces were not adequate for the more than 1,500 people working for the Radiation Lab by 1942. That spring, physicist A.J. Allen, the first head of Building and Grounds for the project, called Don Whiston, '32, an architect at McCreery and Theriault Architects. Before the end of the day, Allen said, he needed a list of building specifications and preliminary plans for a 200,000-square-foot building. Whiston came through, and Building 20, at 18 Vassar Street, was underway.



Much of the information coming into the communication hut in the Pacific theater (top) was radioed in by the operators of ground-based and airborne radar designed at Rad Lab. The trucks backed up to Building 20 in August 1944 were loading on the first operational microwave early warning (MEW) radar system—all 66-1/2 tons of it—for shipment to England. According to one contemporary report, "One of these sets proved so effective in directing the planes fighting buzz bombs that only Prime Minister Churchill was able to pry it loose from the RAF on the eve of D-Day to send it to Normandy to control General Patton's tactical air support."

Building 20 is really six buildings, each three stories high with no basement. Each section rests on huge wooden beams bolted in place. The rooms were large by MIT standards, but otherwise working in the building was no picnic. It was cold in the winter, oppressive in the summer. The roof leaked. The windows never fit properly. Dust from the construction, then dirt from the wood of the building itself, was everywhere.

The building's roof was covered with gypsum planks, but even so, it was in clear violation of Cambridge building codes, which prohibited wooden buildings in that industrial East Cambridge neighborhood. The only way that MIT could get a building permit at all was by promising that the building would be a temporary structure, to be torn down when it was no longer needed.

By the war's end, more than 4,000 people were working for the Rad Lab, and the U.S. military had pumped in more than $2 billion. Historians looking back described it as "a university in a pressure cooker"; during the Lab's five-year tenure, microwave electronics advanced 25 years.

Engineers perfected the magnetron as well as the associated circuits needed to turn radar from a laboratory curiosity into a war-fighting tool. The Lab developed radars for navigation, weather monitoring, detecting incoming enemy aircraft, directing anti-aircraft guns, and locating enemy U-boats.

The Radiation Laboratory's charter lasted only until the end of the war. "Just like with the senior class, it was announced that people would be available. Companies came around here to hire," remembers Professor Louis D. Smullin, '39.

But to many, breaking up the lab seemed like a waste. "There was an enormous pent-up set of ideas" remembers Wiesner. Physicists wanted to build a new generation of particle accelerators. Electrical engineers wanted to apply radar to communications. Everybody wanted to explore the promise of computers. The military also wanted to see electronics research at MIT continue. Mostly, says Wiesner, they didn't want to shut down a laboratory with a proven track record that might be needed in some future war effort.

And so the Research Laboratory Electronics (RLE) was born. Where to put it? "People were hired right after the war—people like me. We had to have a place to work. We had to have a place to put the students," says Wiesner, who later served as RLE's director. "It would have taken two to three years to build new buildings, and we would have had to raise the money."

With space at the Institute always at a premium, there was only one possibility: the "temporary" Building 20. James R. Killian, Jr., '26, assistant to President Karl Taylor Compton, negotiated with both the U.S. government and the City of Cambridge to transfer ownership of Building 20 to the Institute.

Saddled with the dusty, dingy, poorly ventilated wooden structure, the Research Laboratory for Electronics thrived. It was the Institute's first interdepartmental lab, combining electronics, physics, nuclear science, and acoustics. And while RLE's mix of the best and brightest electronics experts in the world was surely responsible for the lab's success, the building itself was a player as well.

"I think that a lot of things were better because of Building 20," says Wiesner. "You had ample space: a little more than you needed, rather than a little less, which is the normal situation." Best of all, Building 20 was made out of wood. It's a feature that many of the building's occupants have commented on. "You could do anything you wanted within your own confines," says Professor Emeritus Jerome Lettvin who worked in electronics and physiology. "You could put up partitions, take them down, rewire anything you wanted to."

PHOTOS: MIT MUSEUM, CALVIN CAMPBELL/MIT NEWS OFFICE

In 1952 Professor Jerrold Zacharias knocked out two floors of the building to make room for a three-story metal column that became the world's first atomic clock. Professor Walter Rosenblith took out the floors and walls in one lab and made a floating room: Rosenblith was working with hearing and vision and had to measure very small signals without any chance of vibration.

In another part of the building, RLE constructed an entire room out of mu-metal, a substance impervious to electronic noise and magnetic fields. "To get that damn thing in, they had to practically dismantle the corridor," remembers Lettvin. The room was rebuilt around the mu-metal cage, which is still there today.

In one of Building 20's two garages, a group of physicists built a linear accelerator driven by a Van de Graaff generator and microwave electronics. At the time the 17-million-volt accelerator was the most powerful in the world. Once again, Building 20's flexibility came in handy—this time making it easy to construct a concrete-and-lead vault for radiation shielding. "It was just the norm," explains Wiesner. "The whole thing was made of plywood. If you didn't like what you had, you just changed it."

The laboratory was extremely well funded, thanks to a $600,000 annual grant from the Army, Air Force, and Office of Naval Research (ONR). The grant was incredibly open-ended, chartering RLE to "do research in electronics," recalls Wiesner. Scientists at RLE studied control theory, dynamics, cybernetics, cosmic rays, and acoustics, as well as electronics, physics, and nuclear science. The PDP-1, the first transistor-operated computer, was designed in Building 20, as were some of the very first electrocardiograph machines.

When Smullin set up his lab to study microwave tubes, his office mate was Institute Professor Noam Chomsky, then a newcomer to the faculty who was studying language as part of RLE's effort to build computers that could automatically translate natural language.

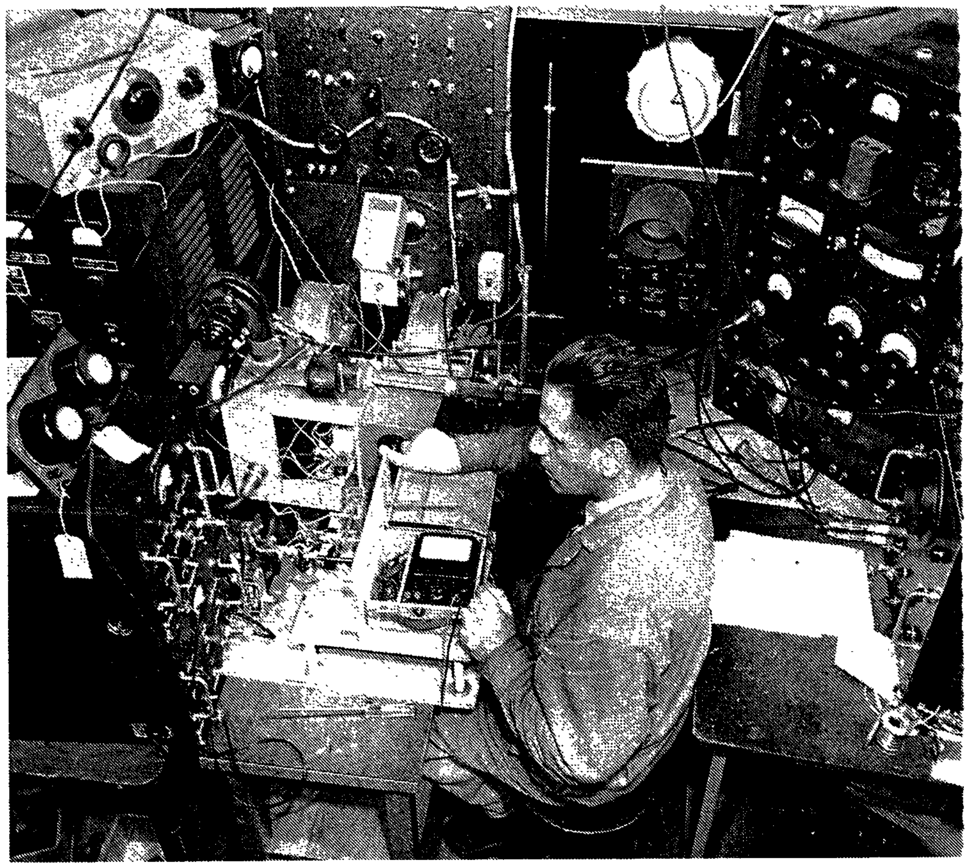
When the lab wanted to set up a section to explore the biology of the brain, Wiesner called the RLE's contract officer, Emmanuel Piore, at ONR: "I said, 'Is it okay to do neurophysiology?' And he said, 'Are there any electrons involved?'" There were, and the section on neurophysiology was approved.

"Ah, Building 20!" sighs Jerry Lettvin, who worked in the plywood palace for more than 30 years before "retiring" to Rutgers. "You might regard it as the womb of the Institute," Lettvin says. "It is kind of messy, but by God it is procreative!"

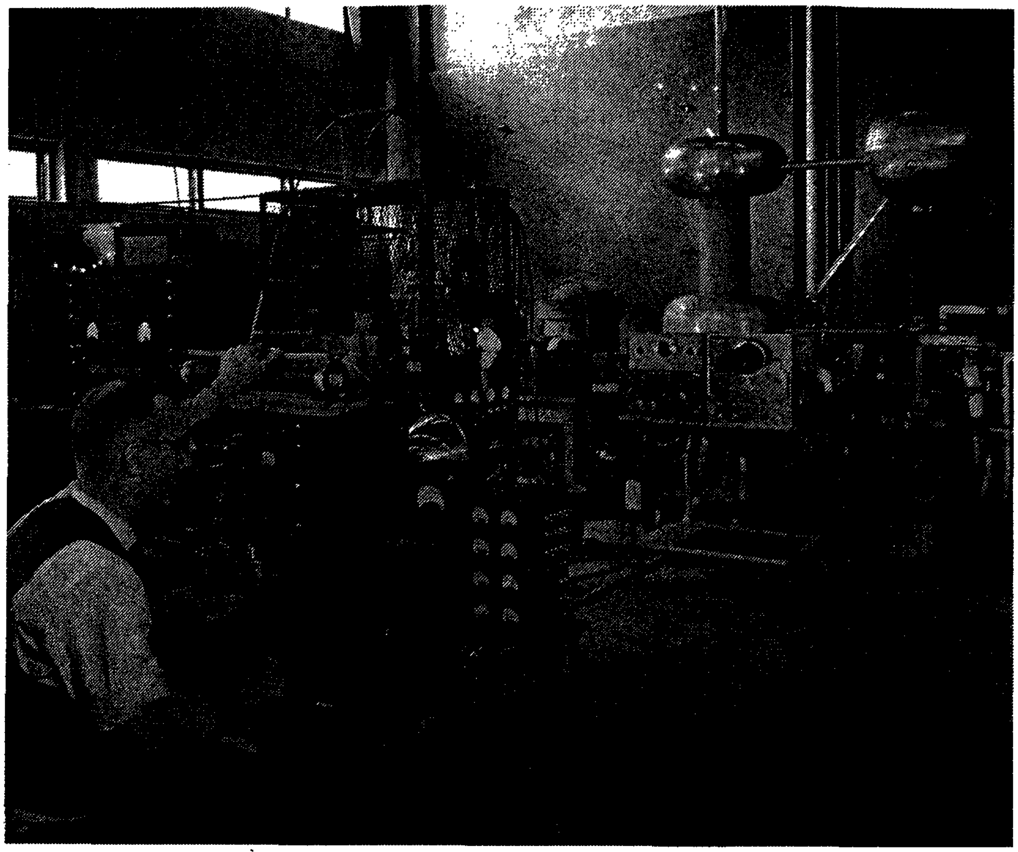
Bolt, Beranek and Newman, the highly successful acoustic and computer consulting firm, got its start in Building 20's Wing F, the home of the MIT Acoustics Laboratory.

So did Bose speakers. In the spring of 1956, Professor Amar Bose, '51, was sitting down to write up his doctoral dissertation on mathematical communications theory. "Relative to doing the work, [writing the thesis] was a boring task, so I decided to buy a hi-fi system," Bose recalls. After spending nine years at MIT, Bose thought he knew everything about amplifiers and sound reproduction, so he went to a number of stores, looked at printed sheets of specifications, and bought the "right" system. "I didn't even bother listening to it, I was so confident that I knew the technology."

But when Bose got the hi-fi home and set it up, it sounded terrible. He graduated that June and spent the summer fiddling with speakers in the old Acoustics Lab, trying to figure out why they sounded so bad. He returned a year later to teach statistical communications, but on the side he pursued his own research in the anechoic chamber. "I can remember so many nights there, not getting out until



Technicians were the mainstay of the Laboratory," said the caption for the top photo when it ran in an illustrated history of Rad Lab. Well, of course. P.H. Bonnet is shown testing magnetrons. Our best guess is that the lower photo is a spoof inspired by Prof. George Harvey's zealous salvaging of what Prof. Emeritus Louis Smullin described as "a gold mine of microwave equipment and instruments," left behind by Rad Lab. Harvey tagged everything in sight, "property of RLE."



In one of Bldg. 20's two garages, a group of physicists built a linear accelerator driven by a Van de Graaff generator and microwave electronics (top, in a 1947 photo). At the time, the 17-million-volt accelerator was the most powerful in the world. The 1949 photo of (l. to r.) Jay Stratton, '23, Albert Hill, and Jerry Wiesner records a lot of Building 20 leadership: the men served in turn, in the order named, as the first three directors of the Research Laboratory of Electronics.

two, three, or perhaps eight," Bose recalls.

Then one day in 1959, Jerry Wiesner saw a strange object in Bose's office: a wedge-shaped contraption with 22 loudspeakers attached. "What does this have to do with statistical communications theory?" he asked. Nothing, of course, but Bose went on to tell Wiesner the results of his clandestine research project: everything in the textbooks about designing loudspeakers was wrong. Bose was trying to find out what was right. With Wiesner's blessing, the loudspeaker research project became official; five years later, with a handful of patents, Bose started his own company to market speakers.

In 1957, RLE started moving out of Building 20 and into more permanent surroundings. Into the space left behind moved a kaleidoscope of different groups, from the Campus Patrol to MIT-Wellesley Upward Bound, a program for disadvantaged high school students. The documentary filmmaker Richard Leacock was based in Building 20, and Doc Edgerton, '27, did basic work in sonar and underwater imaging there. Many of the groups that came to Building 20 "moved there under protest," Lettvin recalls. "After they got there, you couldn't get them out."

Building 20 became a center for MIT's education reform efforts. In the 1960s, it housed Professor Jerrold Zacharias' Physical Science Study Committee and Science Teaching Center, which developed a physics curriculum used by a generation of U.S. high school students. The Undergraduate Research Opportunities Program (UROP), which made pedagogical history by bringing undergraduates into research laboratories, set up shop in there in 1969 and has stayed in Building 20 ever since.

In the mid-1960s, Physical Plant installed a radio paging system for the Institute's janitors. "I used to read EEGs, and Building 20 is made of wood" recounts Steven Burns, technical director of the Harvard-MIT Health Science Program. "Every time they called a janitor, we recorded it on our EEG." Having serious doubts about the need to have radio-dispatched janitors, Burns and his compatriots procured a crystal for the same frequency used by Physical Plant and made a recording of the paging system's call tones. "We figured that jamming wouldn't work, but that they would get pissed off with false alarms," Burns says, with classic Building 20-bred irreverence.

Despite being the home of Army, Navy, and Air Force ROTC, Building 20 never received a bomb threat during the student unrest of the late '60s. "All of the people who were against the war were housed there," says Warren Seamans. "To bomb Lettvin's or Chomsky's office didn't make much sense."

Linguistics Professor Morris Halle scoffs at any attempts to romanticize Building 20. "The most important fact is that it was undervalued space," he says. Because the space was so cheap, he believes the linguistics program was allocated far more turf at MIT than it would have had at any other university.

When Halle came to MIT to set up the program, linguistics was a solitary discipline: graduate students would see their professors and classmates infrequently, spending most of their time in the library. Roomy quarters in Building 20 meant being able to revise the curriculum completely, emphasizing group discussion and work. "In order to have research as a social activity, you need space where you do it," he says, and the research they did revolutionized the field.

A 1979 survey of Building 20's occupants found mixed feelings about their accommodations. Researchers liked the fact that the wooden building was spacious, informal, intellectually stimulating, and, most important, "mutable." But people complained about temperature problems, dirt, and isolation. One professor wrote about being "put in storage" in Building 20; another said that the Building 20 assignment was a form of "punishment" by the administration.

It's not hard to understand the divergence of views. "Building 20 is great because it has no pretenses at all," says Gill Pratt, a research assistant at the Laboratory for Computer Science who spent more than a decade in Building 20. It appeals to people who don't care about appearances. He says the denizens of Building 20 "cooperate and work because of joy. Nowhere[else] can you find an atmosphere where none of the other trappings of academia exist."

Building 20 is showing its age. Every few years, physical plant workers have to tighten the bolts on the beams holding the building together, and a window or two gets blown out by hard winter winds. Of course, the fact that it is not only standing but useful is pretty impressive. It's the only surviving member of its class of WW II buildings.

Some of Bldg. 20's contemporaries have burned: a wooden cottage on the west end of campus went up in flames, taking with it the only copy of one graduate student's PhD thesis. Most of the other buildings were torn down to make room for more permanent structures.

"Everybody says that Building 20 is a fire trap. Obviously it isn't, because it is still here," says Smullin. In the 1970s, the city of Cambridge began pressuring MIT to have the building demolished. "The city used to complain that we had overstayed our leave," says Wiesner. But MIT was reluctant to tear it down because of the enormous amount of functional office space that it represented. "Nowadays, a building with 200,000 square feet is an $80 million building, so it is not an easy thing to replace." he says, smiling.

The pressing problem with Building 20 is not fire but asbestos: the building is filled with it. It turns out that Building 20's famed plywood walls are really a composite material impregnated with asbestos fibers, which have been implicated in a variety of lung diseases. As a result, what some people have called Building 20's best feature—that it is easily reconfigured—is now gone.

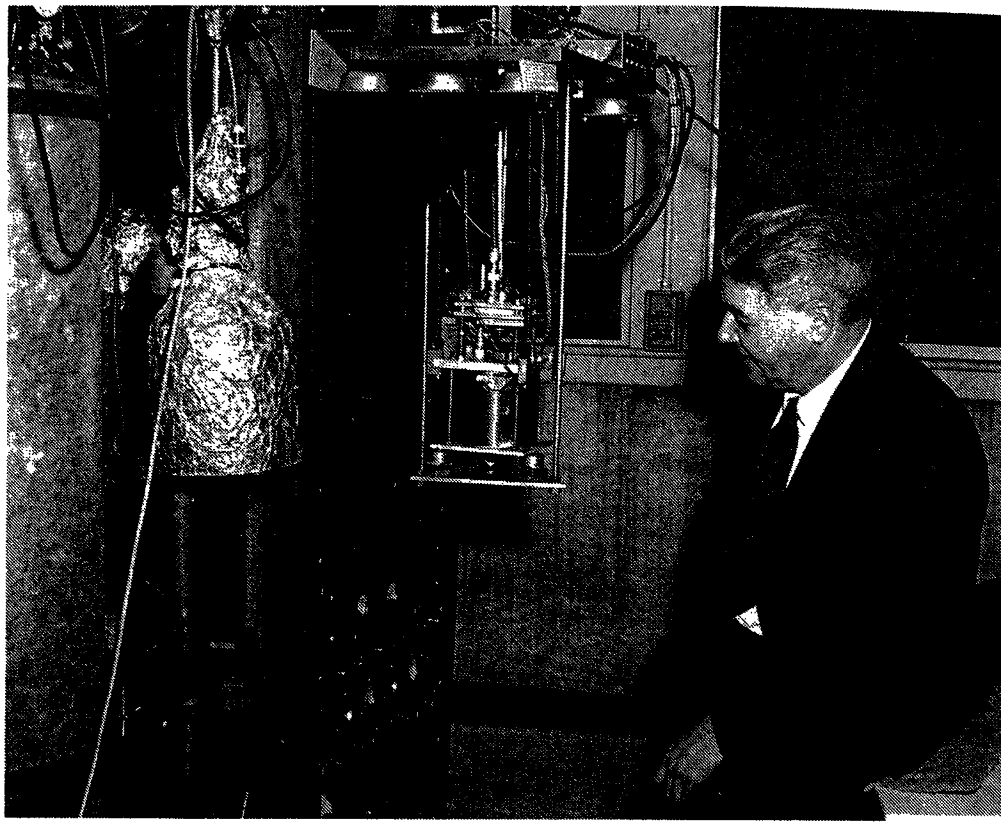
"We broke a wall here some years ago," remembers Morris Halle. "They had to bring in fans. We weren't permitted back in until they cleared the area. They took it very seriously." Another time, when a workman mistakenly drilled through a wall to pull a wire, the area had to be cleared for five days until it was decontaminated.

"The building will ultimately be replaced as part of the overall campus plan," says Robert Simha, director of MIT's Planning Office. The plywood palace will probably come down in sections to make room for modern steel, concrete, and glass constructions with six or eight stories. But, concedes Simha, "I would not hold my breath."

"The reality is that Building 20 is fully occupied and we can't do anything with it before significant pieces are relocated," says Simha. Right now his office is focusing on the construction of the new biology building, Building 68. Once that is completed, groups moving into Building 68 will free up labs and offices in other parts of campus. At that point, parts of Building 20 might start getting cleared out.

The trick will be to keep another round of entrepreneurial technologists from moving in. □

Simson Garfinkel, '87, is an editor at Next World *magazine. He writes often on science for the* Christian Science Monitor, *and his book on security for UNIX systems was published by O'Reilly & Associates in August.*



The charm of Bldg. 20 has been its mutability: in 1952, Jerrold Zacharias knocked out two floors of the building to make room for a three-story metal column that became the first atomic clock (top). And the building is big, offering lots of cheap space for for projects like UROP, a daring experiment at the time of its founding. Jeffrey Shooker (bottom right) was a freshman when UROP gave him the chance to work on holograms in a laser lab.