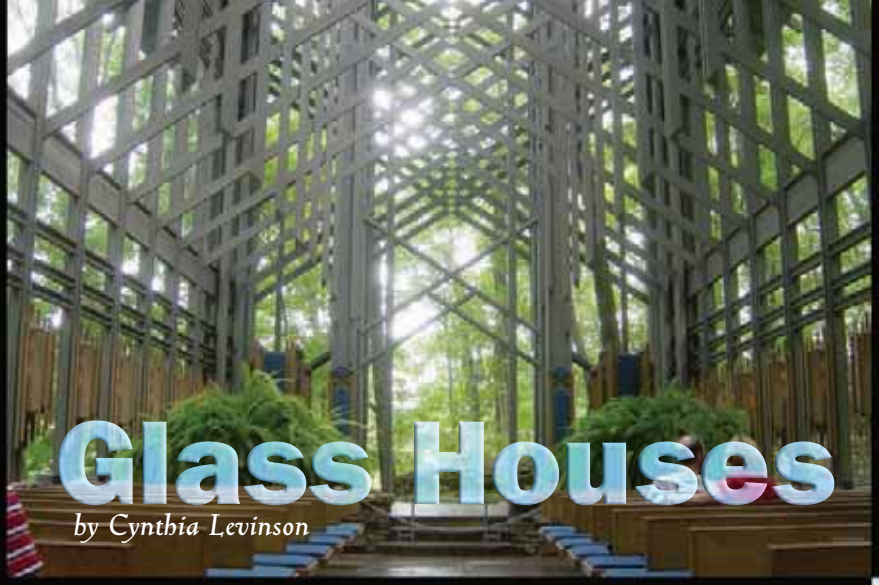
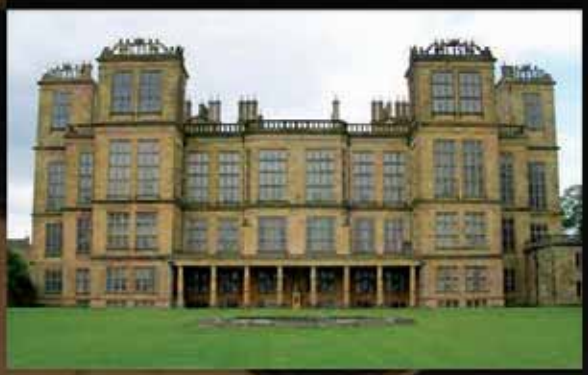
Glass Houses and Other

by Cynthia Levinson



Light sparkles through Thorncrown Chapel, Eureka Springs, Arkansas.

GLASS FACT:
The British terms for **greenhouse** are "glass house" and "conservatory." The French say **"orangerie"** or "conservatoire."



Hardwick Hall, built in 1590, was said to have "more glass than wall."

These amazing glass structures in Valence, Spain, are called City of the Arts and the Sciences.

BUILDINGS MADE OF GLASS SHOULDN'T WORK. Unlike steel, glass breaks into treacherous shards. Unlike stone, it melts in fires. Unlike wood, it pops out when not properly sealed. Unlike brick, it conducts heat and cold, turning interiors into ovens or freezers. Unlike concrete, it reflects sunlight, blinding passersby. And unlike opaque materials, its transparency limits privacy. On top of all that, glass needs frequent cleaning.

"Impossible" Structures

So why would anyone want to build, live or work in, or even walk near a glass building?

Architects pay special attention to two factors: space and light. Glass creates a sense of spaciousness. And it gives builders almost endless ways to let in, deflect, or dim light.

Since 1590, when Robert Smythson designed England's Hardwick Hall, described as "more glass than wall," many architects have tried to replace opaque materials with as much glass as possible. Physicists, chemists, and engineers have developed techniques to overcome the limitations of glass and take advantage of its structure and beauty.

Greenhouses and Orangehouses

Interest in glass buildings, especially greenhouses, took off in the 16th and 17th centuries when Dutch and English explorers returned with tropical plants they wanted to nurture, despite chilly climates back home. In fact, nature encouraged construction of greenhouses in two ways — through people's desire to eat oranges year-round and through the design of the buildings themselves.

English architect Joseph Paxton noticed that the rigid ribs of Guyanese lily leaves intersect with flexible cross-ribs. This "natural feat of engineering," as he called it, inspired his design for the Great Conservatory, the world's largest glass structure when it was built at Chatsworth in 1837. He adapted the pattern fourteen years later for the Crystal Palace. Covering an area one-third of a mile long and 450 feet wide, the roof and walls of this soaring exhibit hall in London's Hyde Park contained 3,000,000 panes of blown plate glass, each set into an iron frame. It was a glittering architectural marvel, for which Queen Victoria knighted Paxton.

He might have used fewer, larger panes, but no one knew how to blow glass wider than four feet. Nineteenth-century technology also restricted glass buildings to one story.

Drawn, Rolled, and Tempered

Inventions of the early 20th-century overcame these limitations and moved glass buildings beyond parks. Belgians and Americans discovered that molten glass drawn across or between rollers produced sheets up to seven-and-a-half feet wide. As a result, an eight-story San Francisco office building, constructed in 1918, boasted the world's first *curtain wall*. People no longer had to peer through a window cut into a wall. The wall was all-window.

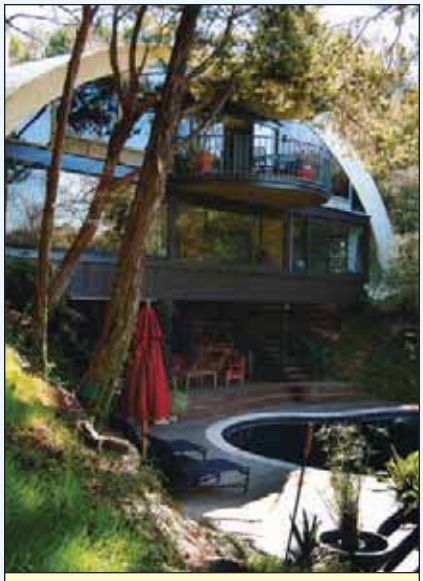
Then, the French, who had invented *plate glass* in 1688, figured out how to prevent glass from splintering. By quickly chilling heated glass plates with cold air blown onto both sides, they produced "tempered" glass that's four times stronger than *annealed* glass and that crumbles safely when shattered.

Mies van der Rohe, Le Corbusier, and other architects built skyscrapers with tempered glass, tinting them green with iron oxide or bronze with selenium. Coated with metallic films, glass buildings became giant four-sided mirrors.

Tempered glass also gave homes huge picture windows, curving walls, and translucent bricks. The simplest, built in New Canaan, Connecticut, in 1949, was Philip Johnson's Glass House, which is a completely transparent rectangle. (The bathroom is hidden in a brick cylinder.) John Watson lives in a "glass cave" with glass sides and a domed *gunite* roof. Fay Jones built the glass-encased Thorncrown Chapel in the woods near Eureka Springs, Arkansas, in 1980.

Though beautiful, some of these buildings have had problems. The mirrored surface of Boston's John Hancock Tower, built in 1972, reflects a nearby church built 100 years earlier. But when 65 windows crashed to the ground and had to be temporarily replaced, it was nicknamed Plywood Palace. Engineers figured out the windows broke because they were soldered too tightly to expand and contract with temperature changes.

Also, single-pane glass turns interiors into hothouses in summer, and ice can form inside windows in winter. Insulated glass, made by separating double panes with a pocket of air, gas, or gel,



WHAT'S IT LIKE TO LIVE IN A GLASS HOUSE?

John Watson, who lives in the "glass cave" shown above, warns, "Many glass houses do not provide a sense of shelter, especially at night" when passersby can see inside.

Yet, Cami Jones, who grew up in a glass house, says, "I love it! You can really see nature — birds, squirrels, butterflies. My favorite time is when it storms; it's exciting and scary. As a result of growing up in a glass house, it's hard for me to be anyplace without a window. I get claustrophobic."

Curtain wall — A wall that is not load-bearing but is attached to columns that support a building

Plate glass — Glass formed into large thin sheets

Annealed — Glass produced through gradual, even heating and cooling

Gunite — A mixture of cement, sand, and water sprayed over reinforcement structures, such as steel rods or mesh, and used as a lightweight concrete construction material

reduces temperature transfer, as does laminating glass with film. Solar glass goes further by collecting and distributing energy, redefining "green" house.

What Else? What's Next?

Glass pyramids, made from special sand to ensure the best transparency, light the Louvre Museum in Paris. Five layers of tempered glass on the Grand Canyon Skywalk, which reaches 70 feet beyond the cliff-edge, are all that separate you from the Colorado River, 4,000 feet below (see Science Scoops, p. 4). A snaking glass roof arches over London's Waterloo train station.

This versatile substance also provides protection. Laminates can make glass bullet- and explosion-resistant. Borosilicate glass doesn't melt or burn in fires.

Soon, "smart windows" will darken or lighten, depending on sunlight, and, like sunscreen, protect inhabitants from solar radiation. A window could deflect light at different angles, making molecular "venetian blinds" possible. Or, you could watch television on windows composed of liquid crystal displays (LCDs) (see Ask Dr. Cy Borg, p. 47). But, then, you might wonder, why have windows?

Cynthia Levinson lives in Austin, Texas, and Boston, Massachusetts, and writes for *ODYSSEY* and other Cobblestone publications.

WHAT DO *YOU* THINK IS THE BEST USE OF GLASS IN BUILDINGS?

Email your response to odysseymagazine@caruspub.com or write to: BUILDING BEST WITH GLASS, *ODYSSEY*, 30 Grove Street, Suite C, Peterborough, NH 03458. We'll publish some of your responses in a future issue.

The Louvre Museum, Paris, France, first opened to the public in 1793. Its latest addition includes these beautiful glass pyramids.