made more sense for large-scale applications (schools, factories, office buildings, hotels). Twenty-four bulbs were placed on a home in Corning, New York. Total price for the installation: $2,500. Considering the going rate of fuel oil (close to $1 a gallon), after ten years those tubes will pay for themselves in fuel savings.

Sunpak, Owens-Illinois, Inc., P.O. Box 1035, Toledo, Ohio 43666.

The Total Solar Home

In a rural town outside of Cincinnati, down a winding state highway and off a new road the local farmers haven't even heard about yet, there stands a house that may signal a revolution in American home life. If the testimony of its architect and occupants is to be believed, the 4,000-square-foot structure stays warm in subzero conditions and cool in summer heat without the assistance of any furnace, stove, or electrical appliance.

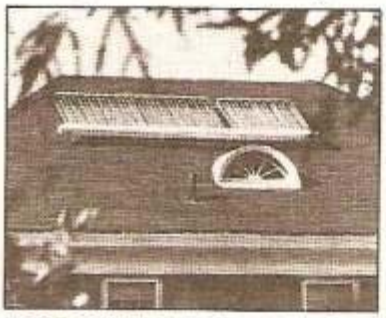
The ground around the house is still in a state of post-construction upheaval, but since the Morgans moved in last January they've had little time for landscaping. They get over twenty calls a day requesting visits, and those are booked up for months. Despite the scores of tours she's given already, Jeanie Morgan is still radiantly evangelical about her home, and indeed, after a short stay, I wondered why Washington's number-one energy crusader had yet to make a well-publicized pilgrimage to the Morgan house.

The key to its heating-and-cooling process is what 39-year-old architect Lee Porter Butler calls a "thermal envelope." In effect, the house is one well-insulated box surrounded by another. A cavity extends around the inner structure, maintaining its temperature at a constant level. Just over a foot wide between the two walls on the home's north side, the gap goes down under the basement, over an exposed stretch of earth, up the south side, where it widens into a solarium, and then between the roof and ceiling. Through the force of convection—where hot air rises and cold air sinks—air inside the envelope is constantly circulating, evenly heating or cooling the interior living space. On winter days air is warmed in the solarium on the home's sunny south side. It rises over the ceiling and drops on the colder north side. As it passes under the basement, the earth warms it, pushing the air back into the solarium. During the summer, cool air is drawn in under the house through an underground tube, sucked up into the solarium and between the north walls and out through vents opened in the roof.

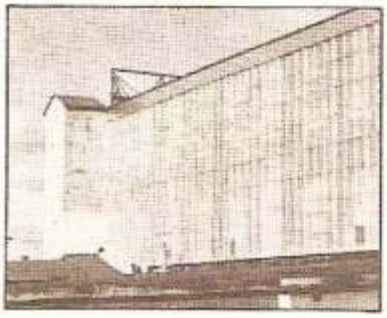
Physicists are mystified by the fact that the house keeps a steady temperature between 65 degrees and 74 degrees Fahrenheit even during weeks of cold, cloudy weather. Butler, the system's inventor, admits that many of his design innovations were arrived at "intuitively" and through "happy accidents." On paper, his homes don't make much sense to physicists. "They plug my design specifications into their equations and come up with inside temperatures of 42 degrees." Butler has his own theories why that isn't actually the case. Simply stated, he believes there are layers of circulating air in the envelope, spinning at different rates and combining to form a super-shield of insulation. The exposed earth below the house acts as a stabilizer. "It doesn't want to change temperature," Butler explains, "and stays near 50 degrees year-round."

The earth bank has another effect that's noticeable as soon as you enter the house. The air smells neither dank nor musty but fresh, like just-washed linen. It is also kept at moderate humidity, a factor, Butler contends, that contributes greatly to comfort.

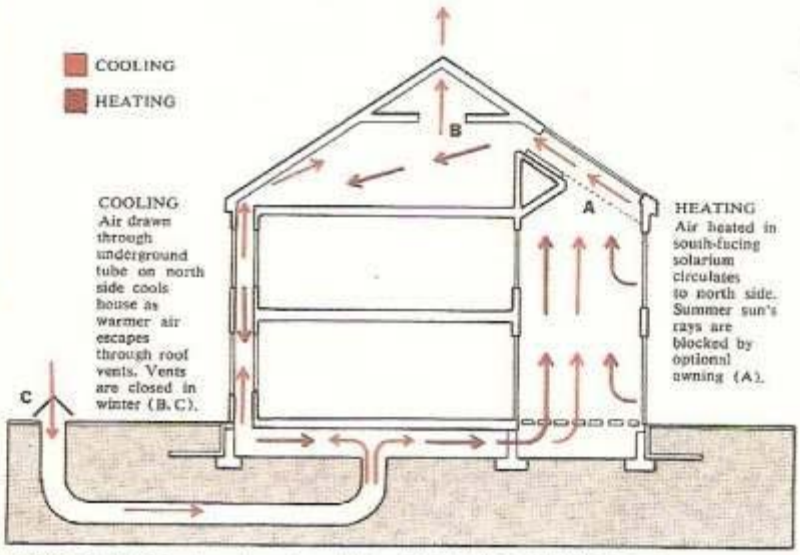
A native of Tennessee, Butler has been building and designing solar homes since 1966. When asked why his passive system has yet to receive nationwide acclaim, he replies that the solar-energy field is currently dominated by graduates of the big eastern architectural schools, who are not about to give credence to "some nobody from the backwoods of Tennessee." He continues, "We have nine of these houses up, and they're working. I'd like to see the federal government take some of the money they're throwing away on test projects and monitor



HOME COMFORT: *Twenty-four glass bulbs on the roof of this home in upstate New York provide all the family's hot water (80 gallons a day). The total cost of installation was $2,500.*



MONEY-SAVER: *An entire side of this Manchester, New Hampshire, warehouse (left) was painted black and covered with fiberglass. The solar heat absorbed into the building by the system saved up to 25 gallons of fuel oil a day last winter.*



THERMAL ENVELOPE: *Tennessee architect Lee Porter Butler's breakthrough design (diagram above) for a total solar home is a house within an outer shell. Using a solarium, a double north wall, an underfloor space, and vents, he surrounds the living area with a pocket of air at a constant temperature year-round.*

"...Physicists are mystified but the 'total solar home' keeps a steady temperature even during weeks of cold, cloudy weather..."

something that's already built and proven." (Brookhaven National Laboratory, in conjunction with the Department of Energy, has recently decided to do just that with a Butler house.)

Twenty-five Butler homes are under construction, including one in Westchester County. Currently, one of the biggest drawbacks to his design is finding a contractor to build it. The housing boom has not yet cooled off enough to interest the average builder in an unconventional blueprint. Butler argues that his houses are simple rectangles and that the double north wall only means "an extra row of two-by-fours," but the Morgans' experience is not encouraging. Local builders offered such inflated bids they decided to subcontract themselves and brought the house in for under $75,000—$50,000 less than the lowest bid. The final price is deceptive since Roy Morgan, an electrical engineer, did the wiring and took a ten-week vocational-school course so he could do the plumbing. There were further troubles with the banks, which were reluctant to provide a mortgage for a house without a back-up heating system.

Today, when Jeanie Morgan sits in her sun-dappled solarium, her home seems worth all the tribulations. An economist, she has calculated a 30-month payback for all the construction extras demanded by Butler's design. But fuel savings aside, she adds, "you can't live in this house without its being a religious experience. Finally I feel in harmony with all of nature's elements."

To spread the word, Butler has formed a company called Ekose'a (Greek, meaning "from the essence"). For $24.95 he sells a book, *Ekose'a Homes*, explaining his system and offering ten sample designs. For a further fee, he'll advise your architect on how to modify the plans to the demands of your site.

Ekose'a, 573 Mission Street, San Francisco, California 94105.

Solar Energy for the Masses

During the coming months in the metropolitan region, two government-funded programs will demonstrate that solar energy can be brought to the average- or below-average-income family.

One program is guided by the Energy Task Force, an organization which provides technical assistance to low-income-housing groups. The most famous ETF project is 519 East 11th Street, an abandoned tenement rehabilitated by tenants and fitted with a wind generator and solar water-heating system.

ETF architects have now completed designs to supplement multi-family brownstones in Harlem, East Harlem, and Bedford-Stuyvesant with solar air and water heating. HUD funding is in the pipeline for the Harlem project, and the others are nearing the end of the approval process. All of the systems will use rooftop collectors (two will use additional collectors on the south wall) and provide over half of the buildings' heating requirements. In one system, hot air from the roof will be ducted to rock bins in the basement for storage and later circulated by a fan. A most important aspect of each rehabilitation will be energy conservation: adding storm windows, flow reducers to all faucets, and foam insulation around the outside of the building. The work on each location should take a little over four months to complete.

This fall, the Department of Energy will build one, maybe two homes on Long Island to test whether passive solar techniques can be incorporated into standard, low-cost, single-family housing.

The blueprints were prepared by Total Environmental Action of Harrisville, New Hampshire—the Northeast's foremost architectural firm. Computers at Brookhaven National Laboratory simulated prospective energy requirements. The tests concluded that the three-bedroom, 1,800-square-foot home that the group designed would have burned only $50 of natural gas last winter.

While devising those plans, the TEA-Brookhaven team "went back to zero," according to TEA-project architect Paul Pietz. "We had to ask, What are the properties of thermal storage, and how do they apply to the materials available?"

Much of the heating will come from the home's south side, using glass on dark brick and a solarium. Computer studies showed less glazing than anticipated was necessary if the house was well insulated. All windows will have three panes of glass, and the brick will be unbroken by wiring or plumbing.

During the planning process, a builder's needs were given ample consideration. Nothing in the house should present him any difficulty, and some of the innovations will even save some money. The first home will go up in Upton, at the Brookhaven Laboratory. Monitoring devices should inflate the cost of construction to $70,000, but Brookhaven-project manager Ralph Jones estimates the house could be built for less than $60,000. He is also considering releasing the blueprints to the public.—H.L.

For Further Information

Total Environmental Action, Inc., a company already renowned for innovative solar architectural designs, has also earned a reputation for disseminating information. Group architects and visiting experts teach monthly seminars that range from thermodynamic theory to basic do-it-yourself courses. Most sessions cost $35. TEA also puts out *Solar Age*, the industry's most highly regarded periodical. A yearly subscription costs $20.

The Department of Energy offers a solar-information service free of charge. The number for that is (800) 523-2929. The service is called the National Solar Heating and Cooling Information Center. It tries to keep up with solar-energy developments around the country. The people answering the phone are also versed in what systems qualify for federal tax credit. As of now, up to $2,200 can be written off as long as the system serves no other structural purpose. This would eliminate most passive designs, but the IRS is still modifying its interpretations of those regulations, and the Carter administration has already proposed deductions for passive systems.

Before tenants make any structural changes in their apartments, they should first check with their landlord. If New York City's landlords and homeowners decide on solar installations, designs must be submitted to the borough office of the Buildings Department.

Total Environmental Action, Church Hill, Harrisville, New Hampshire 03450.