KERBY SMITH

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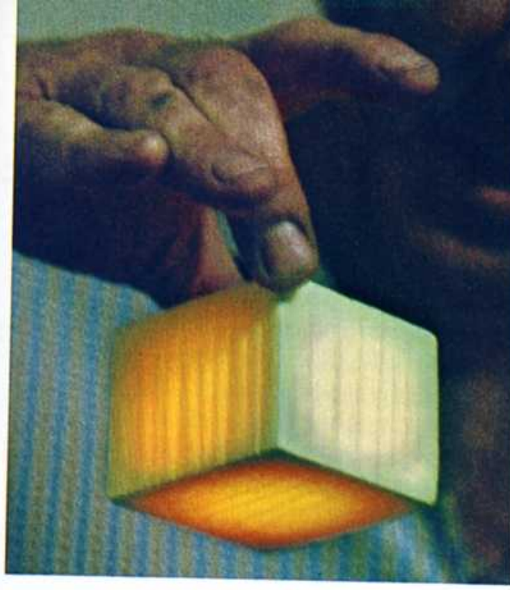
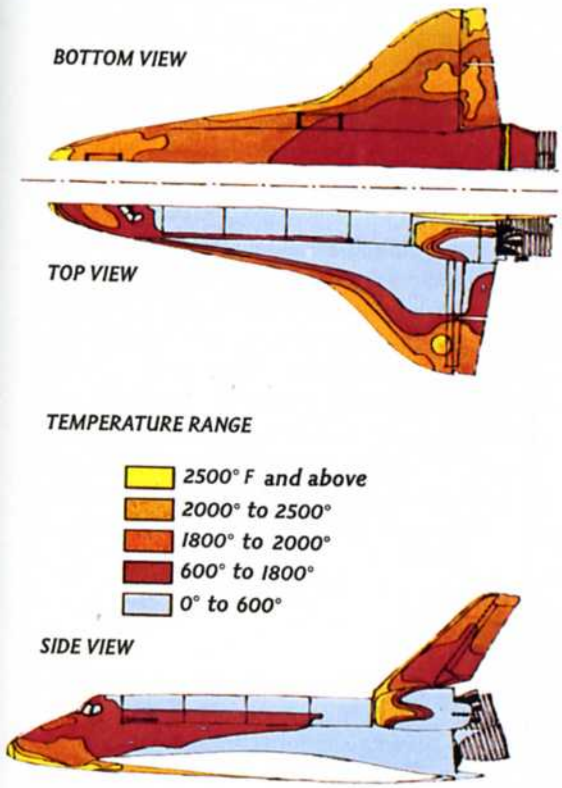





*Relatively cool cargo bay doors are covered with fireproof felt. Tiles take over the middle range up to 2300°F. Heated in a kiln beyond this temperature, a cube releases interior heat so slowly that it can be held at the corners* **(top)**. *Reinforced carbon protects the nose and wing edges where temperatures higher than 2500°F are expected.*

*(Continued from page 321)* No throttle back. That has been fine for launching warheads, but not for the subtleties of manned space flight.

On the shuttle the solid rockets are there just for the muscle. Two are bolted onto the external tank, and for two minutes they provide 5.3 million pounds of thrust. That is about what it would take to get 25 fully loaded 747s airborne. Once the solid fuel is exhausted, explosives fire the rockets away, to be recovered by a ship off Florida for reuse.

### Finding the Orbital Flyway

So that is the system. One orbiter, one external tank, and two solid-rocket boosters, all taking off at the same moment. Two minutes after launch the solid rockets drop off. A few moments before reaching orbit, the orbiter sheds the external tank. Then it fires up two secondary engines, called the orbital maneuvering system (OMS), which put it in revolution around the earth.

During its orbital flight and later descent, these OMS engines and 44 smaller thrusters placed strategically along the spacecraft enable the orbiter to turn over or to straighten up, to change orbits or to rendezvous and dock. They also make the precise adjustments needed to take the orbiter out of orbit, to bank and swerve it safely through the intense heat of reentry.

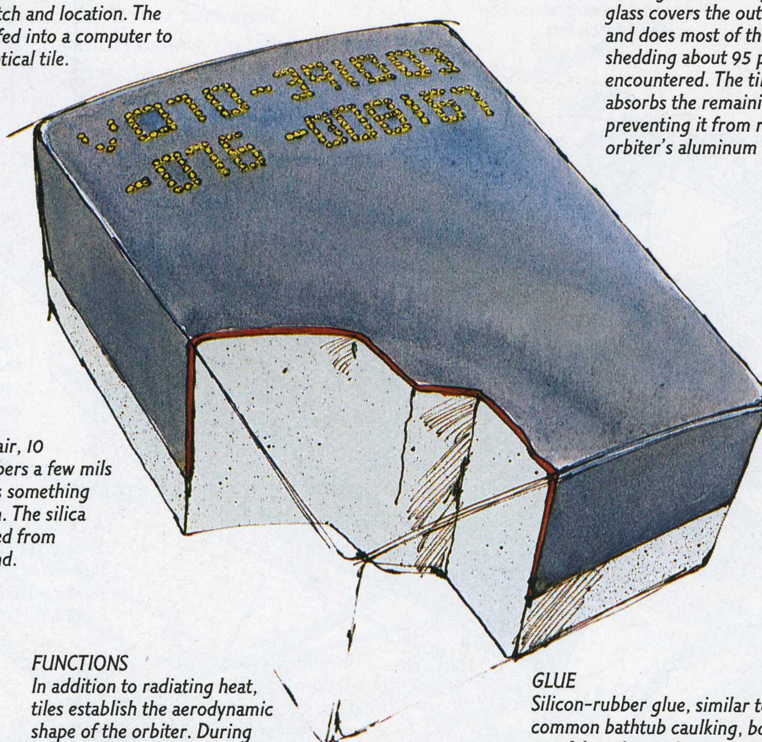
In April of 1978, when I first saw the orbiter *Columbia* taking shape, there was still hope that it would fly the next year. In its huge hangar at the Rockwell Corporation Facility in Palmdale, California, the *Columbia* looked much like any large aircraft under construction. Its green-coated shell sat amid scaffolding, with men by the score crawling around the sides and in and out of cavities in the fuselage. Men welding. Men wiring and inspecting. Men scratching and often shaking their heads.

All these wires would later be hidden, but at this stage the *Columbia* was like a body with its skin off and its nerve ends showing. This nervous system is one of the hallmarks of the orbiter.

Nothing as big as the *Columbia* has ever been put into orbit, and nothing with wings has ever flown anywhere near the 17,500 miles an hour the orbiter must encounter. It is, nevertheless, the orbiter's brains as much

*IDENTIFICATION*
*Different for each tile, an identification number tells batch and location. The number can be fed into a computer to produce an identical tile.*

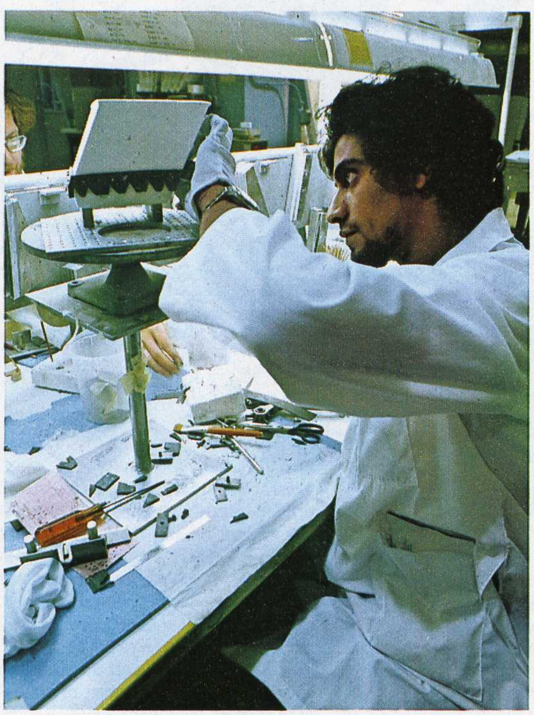
*COATING*
*Black-glazed coating of borosilicate glass covers the outer portion of a tile and does most of the cooling job, shedding about 95 percent of the heat encountered. The tile's interior absorbs the remaining 5 percent, preventing it from reaching the orbiter's aluminum skin.*



*COMPOSITION*
*Ninety percent air, 10 percent silica fibers a few mils thick, a tile feels something like plastic foam. The silica fibers are derived from high-quality sand.*

*FUNCTIONS*
*In addition to radiating heat, tiles establish the aerodynamic shape of the orbiter. During launch they will undergo severe acoustic vibration, many times greater than a thunderclap.*

*GLUE*
*Silicon-rubber glue, similar to common bathtub caulking, bonds a tile to a felt pad, not shown, that is in turn bonded to the orbiter's skin. The felt absorbs the stresses of airframe bending that could damage the rigid, brittle tiles.*



# Those incredible, troublesome tiles

*LIKE AN UNFINISHED jigsaw puzzle, heat-dissipating tiles line the underside of "Columbia" (**right**). Without them, the orbiter would burn up on reentering the earth's atmosphere. Approximately 34,000 tiles cover about 70 percent of the orbiter's surface.*

*At a Lockheed Missiles and Space Company facility in Sunnyvale, California (**left**), a technician exhibits surgeonlike concentration as he masks a tile before a ceramic coating is applied. The coating enables the tiles to withstand temperatures up to 2300°F.*

*Computer-controlled machines cut the tiles; no two are exactly alike. Installation and testing difficulties made them one of the major elements in the shuttle program's delay.*