Printing in 3-D

BY SCOTT FABER

A new machine called a fabber lets you print out computer graphics in 3-D, make plastic copies of solid objects, and even fax them.

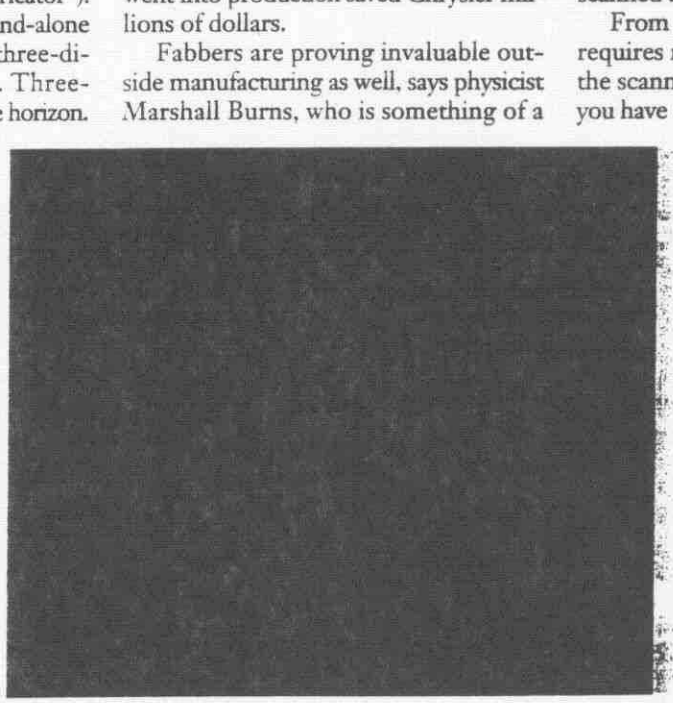
EVER SINCE GUTENBERG first got the presses running back in 1453, people have been spreading their ideas far and wide through printing. Now there is a new type of machine that makes it possible to print solid objects as well. The machine is formally known as a stereolithographer (which means "three-dimensional printer"), but to its friends it is a fabber (which is short for "fabricator"). Fabbers are already in use as stand-alone printers and as the nucleus of three-dimensional copying machines. Three-dimensional faxes are just over the horizon.

A fabber converts a digital computer file into a three-dimensional object by printing the object one two-dimensional layer at a time. Its raw material is a liquid polymer that hardens when a laser shines on it. The laser breaks apart certain molecules in the liquid, converting them into a kind of glue that binds the spaghetti-like polymer chains together, thereby solidifying them.

To print, say, a coffee cup, a fabber trains its computer-guided laser beam onto a vat of the liquid polymer. The laser first scans a solid circular region on the surface of the liquid, hardening it into a disk—the base of the cup. Next the base, which rests on a platform in the vat, is lowered about five-thousandths of an inch, just enough for a thin film of liquid polymer to wash over it. The laser traces a hollow circle over this liquid, forming the bottom layer of the cup wall, which fuses with the base. Layer after layer, the laser traces the cross section of the cup, building it from the bottom up—including the handle. By printing one cross section at a time, a fabber can build objects that are much more complex than a coffee cup.

Since industrial design these days is typically done on computers, fabbers allow manufacturers to convert their designs into prototypes quickly. Using a fabber built by 3D Systems of Valencia, California, engineers at Chrysler recently printed out their design for a new engine block. The 3-D model revealed a mistake: a misaligned hole that had gone unnoticed in the complicated blueprint. Correcting the error before the engine went into production saved Chrysler millions of dollars.

Fabbers are proving invaluable outside manufacturing as well, says physicist Marshall Burns, who is something of a guru to the burgeoning young industry. (Burns also heads his own company, Ennex Fabrication Technologies.) Mathematicians at the University of Massachusetts and a few other institutions have already latched onto fabbers. "They can now hold a model in their hands and physically see what their equations describe," says Burns. "They used to make graphs on a computer screen; now they have three-dimensional computer graphics."



THE FABBED skull at UCLA, showing the fracture on the left side.

Linked to the appropriate type of scanner—any device that maps the shape of an object and stores it in digital form—a fabber becomes a 3-D copier. The UCLA Medical Center uses a 3D Systems fabber with its CT scanner. From a CT scan of a patient's fractured skull, surgeons recently printed out a 3-D model they could use to plan their operation. Similarly, conservators at the Getty Museum in Malibu, California, have laser-scanned artifacts and fabbed copies.

From 3-D copier to 3-D fax machine requires no technological leap at all. "If the scanner and fabricator are far apart, you have a 3-D fax machine," says Burns. With fabbing, transporting and storing solid objects becomes as easy as transporting and storing digital data. At the moment, the objects can be made only of plastic, but various schemes for fabbing things out of metal are under development.

One customer is the Navy. "The warehouse on an aircraft carrier is about half the size of a football field, with a 20-foot ceiling," explains Burns. "Fully half of that stuff is nuts and bolts and cylinders and flanges, stuff that is simple, but if you're in the middle of the ocean and you don't have it you're in trouble. The Navy would like to replace that space with a few fabricators and some bins of steel powder."

Burns predicts that within 15 years, fabbers will be inexpensive enough to have at home as well as on aircraft carriers. (Right now the typical one costs around $200,000.) People will dial blueprints online, he thinks, and fab anything from colanders to bookends. Says Burns, "You won't believe the things you'll see." ◘

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