Science & Technology

The Future Tents

Kinetic sculptor Chuck Hoberman expands the boundaries of design.

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On a summer afternoon in 2004, Chuck Hoberman got a call at his small New York design firm from Johnson Outdoors, one of the world's largest recreation equipment companies. Could he create a big, collapsible tent of the sort used by emergency response crews at disaster sites, only easier to deploy?

Hoberman '85SEAS was no tent designer. In fact, he had never developed a utilitarian product that made it to market. Mostly, he earned his living by designing toys. He is an expert, however, at making objects transform. His famous toy, the Hoberman Sphere, a spiky cluster of plastic scissor joints that expands smoothly while retaining its shape, is widely hailed as a marvel of 3-D design, as are his large, kinetic sculptures. He even created a huge, yawning archway that dominated the ceremony stage at the 2002 Salt Lake City Olympics. A mechanical engineer and sculptor by training, Hoberman has always believed that the design principles underlying his inventions could be applied to practical engineering problems. But he'd never had the chance to prove it.

He told Johnson Outdoors on the spot that he wanted the job and set to work immediately alongside his best designer. Last fall, Hoberman Associates put the finishing touches on an emergency shelter whose unusual blueprint, Johnson Outdoors claims, makes it much simpler to deploy than similar tents. (That it looks cool while being pitched is beside the point.) Johnson began manufacturing it earlier this year.

Hoberman, 50, is now trying to reinvent his business on the momentum of that project. He has trimmed back his toy operation to establish himself in areas such as

product design and architecture. A tall, youthful man, Hoberman is unwaveringly modest, but his ideas are anything but: Imagine a retractable roof that can turn a building lobby into an open-air plaza in pleasant weather. Or a surgical tool that enters the body through a tiny incision, and then having expanded to become a small, malleable hand, allows doctors operating it remotely to delicately move vital organs out of their way.

“For a long time I’ve been making gizmos that are successful, in part, because of their novelty quality,” he says. “Now, I’m inspired by solving real-world problems. I want to design things that are useful.To build a better mousetrap.”

Making Connections

Hoberman was living in a rundown apartment in lower Manhattan and feeling creatively stifled at his job as a robotics engineer when, in 1987, the lightbulb went on.That spring, he envisioned the solution to a puzzle he had dreamed up months earlier: What would a spherical linkage system look like that could expand and contract?

The answer came to him on a Buddhist retreat he took with his wife, Carolyn, as he tried to meditate. He envisioned several ring-shaped series of scissor joints arranged in a way such that they connect to one another at right angles, remaining so even as the scissor joints close to become attenuated, allowing the latticework to swell in perfect symmetry.

Everyone who looked at Hoberman’s cardboard and grommet prototype said it was visually stunning. People saw in it a profound expression of harmony. Handling it was addictive. But what was it? After patenting the concept, Hoberman spent years shopping around to various industries what he calls his “transformation technology” — his knack, essentially, for finding algorithms that translate the contours of any surface area into the angles and proportions of a linkage system. But no one knew what to do with it.

So Chuck and Carolyn, banking on the sphere’s pure visceral appeal, launched their own company in 1995 to move it as a toy. To date, they’ve sold more than five million. (Some readers will recognize the sphere from attending a recent event of the Columbia Alumni Association, which has given away small blue and- white

versions. Playing off the toy in its marketing, the new group calls itself an expanding structure linking all graduates.) Chuck also made a splash in the art world in the early 1990s with an 18-foot hanging version of his sphere at Liberty Science Center in Jersey City, and with a model of a retractable roof called an Iris Dome in a MoMA exhibition. Two dozen more expanding sculptures have followed, in an array of sophisticated shapes, commissioned by museums, cultural centers, and malls around the world — and even by Royal Caribbean for three of its cruise ships.

These inventions are remarkable for their combination of engineering know-how and aesthetic pizzazz. With their fluid motions and balanced distribution of load and tension, Hoberman's designs solve a central challenge of mechanical engineering: how to introduce movement in a structure while retaining its stability. The best of his pieces, such as the Iris Dome, whose frame of interlocking spirals closes like an eye's iris to form a rounded roof, do so with uncommon grace. Often inspired by forms in the natural world, they seem not to contend with movement so much as to harness it.

"His works have an innocence, logic, and purity that almost transcend authorship," says Robert Heintges, an architect and adjunct professor at the Graduate School of Architecture, Planning, and Preservation. "They seem to come from nature, and not the hand of man, much less a specific man. Perhaps this is why they are universally appealing."

None of which was of particular interest to Johnson Outdoors when it chose Hoberman to make a tough tent.

The Metamorphosis

The task put before Hoberman by Johnson Outdoors required him to work within stricter parameters than he was accustomed to. He was to develop a 500-square-foot tent that could withstand 65-mile-per-hour winds, 5000 pounds of snow, and a violent whack from a moving vehicle, yet weigh less than 400 pounds and be packed away in the backseat of a pickup. The real trick involved setup time, a critical spec for emergency shelters. The rapidly deployable tents already on the market might take eight minutes for four men to pitch. Hoberman would aim to halve that.

All those other shelters look a bit like something Hoberman would design, with a canopy frame made of collapsible scissor joints. When fully extended, however, the heavy frame needs to be hoisted overhead and secured to support poles, which requires lots of cumbersome hand connections. That’s very un-Hoberman. “Everybody in this field was working off the same small pool of inventions,” Hoberman says. “The market was ripe for a new idea.”

His team’s innovation was to replace the webbed roof with thick support trusses, each of which unfolds initially like a Jacob’s ladder toy and becomes erect in the shape of an arch with the help of a built-in gear and pulley system. When removed from its storage container, the tent goes into position with relatively little force, its weight supported by legs that crawl outward haltingly, spider-like. Then, the toughest labor involves hoisting the tent’s frame waist high and yanking on the pulleys. Four people can pitch it in three minutes.

“We approached this problem as would any engineers, using standard analyses of work and energy,” says Matt Davis, Hoberman’s 30-year-old senior designer. “If there is a unique element to what we do, it’s probably that Chuck and I naturally think in terms of engineering behaviors, or of engineering processes. I’m not sure many other designers would have thought to make a truss move. The whole point of a classic truss structure is that it doesn’t move.”

Hoberman says he learned to attack design problems with a nimble imagination while studying under Ferdinand Freudenstein, in Columbia’s master’s program in mechanical engineering. Freudenstein, the Higgins Professor Emeritus of Mechanical Engineering, is a pioneer of modern kinematics, or the study of motion.

“He showed me that while mechanical engineering is a very rigorous analytical discipline, it retains a certain artful quality,” says Hoberman, who earned a degree in sculpture at Cooper Union prior to attending Columbia.“And that although the discipline is thousands of years old, you can still discover new and surprising linkages and mechanisms. I left his classes believing I could pull a rabbit out of a hat.”

Accidental Toyman

If Hoberman could reinvent the world, the darnedest things would move. Dining tables would fold up into suitcases, sliding walls would create multiuse interiors, roofs would open to the stars. His company's high-ceilinged Tribeca loft space resembles a science museum playroom, with prototypes displayed for luggage, furniture, shelters, and building partitions that twist, turn, slide, or open by Hoberman's signature linkage systems and complex, origami-like folds.

A lot of the ideas have been on his shelf for years. In the late 1990s, Hoberman's toy business took over his life.At its peak, the company brought in $10 million in annual revenue and employed 30 people, handling everything from marketing to distribution to sales. But in late 2004, emboldened in part by the Johnson Outdoors deal, Hoberman signed over to international toy manufacturer Blue Box the rights to the Hoberman Sphere and several other successful toys he had developed, while retaining royalties on future inventions. His outfit is now stripped down to a handful of designers. "The toy business was still viable, but the margins were getting tighter," he says. "I was spending all my time flying to meet Wal-Mart buyers and adjudicating chargebacks from retailers. The Blue Box deal is lower reward, lower risk, and it allows me to stretch into the areas that really fascinate me."

Today Hoberman is courting potential collaborators in several industries. He recently was awarded a small U.S. Army contract to develop a self-assembling protective wall that could be used in lieu of sandbags during combat. He also is discussing with Johnson Outdoors making multiple versions of their collapsible tent, for which he expects to receive royalties on thousands of units this year.

The most exciting work in Hoberman's portfolio, observers say, includes architectural designs, many of which use extendable latticework frames similar to that of the Iris Dome. Hoberman envisions concert pavilions, for instance, whose roofs could close for rain, giving audience members a visual treat as an intricate pattern of sheaths glide shut overhead. "That would be a spectacular event," says Guy Nordenson, a prominent New York architectural engineer."Deployable roofs that exist now, such as in sports stadiums, aren't made part of the show." He calls Hoberman's best work "awe-inspiring" and credits his Iris Dome with having profoundly influenced Santiago Calatrava, the renowned Spanish architect, whose structures often contain moving parts.

Hoberman is also in conversation with vascular biologist Donald Ingber, a Harvard Medical School professor who believes that Hoberman Associates could help

advance medical equipment technology, especially involving stents and other tools for noninvasive or minimally invasive surgery.“Chuck has a very serious understanding of how natural structures change through growth and rearrangements, and of how to translate that into making useful tools,” he says. “I’m convinced that the design principles he has uncovered will be helpful to scientists.”

Governing Principles

Hoberman, whose demeanor is reserved, almost shy, is not a born salesman. When interviewed, he is generous with his answers, yet a bit deliberate and studied, as if touting his own work has required some practice. It is also tempting to regard him as starry-eyed. When asked about the market potential for one of his products, he might shrug, and instead excitedly describe the finer elements of its design. But if Hoberman is guided by a quirky inner vision, he is also fiercely determined to see that his ideas make good.The importance to him of being useful is apparent even in how he discusses his sculptures, whose skeletal metal links, in order to reach a full size of 20 feet or more in diameter, unfold many times, blooming successively like fireworks. The sculptures are carefully customized to their settings, sometimes with music, lighting, and special effects, Hoberman says, to ensure “a sense of wonder that is immediate,” and therefore “public-minded and democratic.” Conversely, he feels that practical engineering projects liberate his creative powers. “Then, the beauty you see in the product isn’t something that I’ve imposed on it,” he says. “Rather, it emerges from the function.”

What Hoberman’s next big break will be he does not know, just that it will come. Could it be for his foldable convention display backboard, whose perforations allow it to morph into a modernist table stand? Could that be cost-effective?

“Look, the design world is big,” Hoberman says,“and I’m not particularly interested in moving toward the mainstream, anyway. That’s the beauty of what I’m trying to do. Look at the toy world. That is a highly commodified market, yet I showed that you can take a smart and educational toy and sell millions of them at Wal-Mart. Ideas do matter. They still have power, and they drive all of this. I believe that.”

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