Selected Press Clips

MOTO Restaurant

2005 – Present

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The New York Times

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When the Sous-Chef Is an Inkjet

By DAVID BERNSTEIN

HOMARO CANTU'S maki look a lot like the sushi rolls served at other upscale restaurants: pristine, coin-size disks stuffed with lumps of fresh crab and rice and wrapped in shiny nori. They also taste like sushi, deliciously fishy and seaweedy.

But the sushi made by Mr. Cantu, the 28-year-old executive chef at Moto in Chicago, often contains no fish. It is prepared on a Canon i560 inkjet printer rather than a cutting board. He prints images of maki on pieces of edible paper made of soybeans and cornstarch, using organic, food-based inks of his own concoction. He then flavors the back of the paper, which is ordinarily used to put images onto birthday cakes, with powdered soy and seaweed seasonings.

At least two or three food items made of paper are likely to be included in a meal at Moto, which might include 10 or more tasting courses. Even the menu is edible; diners crunch it up into a bowl of gazpacho, creating Mr. Cantu's version of alphabet soup.

Sometimes he seasons the menus to taste like the main courses. Recently, he used dehydrated squash and sour cream powders to match a soup entree. He also prepares edible photographs flavored to fit a theme: an image of a cow, for example, might taste like filet mignon.

"We can create any sort of flavor on a printed image that we set our minds to," Mr. Cantu said. The connections need not stop with things ordinarily thought of as food. "What does M. C. Escher's 'Relativity' painting taste like? That's where we go next."

Food critics have cheered, comparing Mr. Cantu to Salvador Dali and Willy Wonka for his peculiarly playful style of cooking. More precisely, he is a chef in the Buck Rogers tradition, blazing a trail to a space-age culinary frontier.

Mr. Cantu wants to use technology to change the way people perceive (and eat) food, and he uses Moto as his laboratory. "Gastronomy has to catch up to the evolution in technology," he said. "And we're helping that process happen."

Tucked among warehouses and lofts in the Chicago meatpacking district, Moto attracts a trend-conscious crowd. Some guests leave scratching their heads; others walk away spellbound by a glimpse of Mr. Cantu's vision of the future of food.

William Mericle, 41, described recent meal at Moto as "dinner theater on your plate." He did not care for all 20 small dishes he sampled, but he said he liked most of them. He found Mr. Cantu's imagination appealing. "He's mad-scientist-meets-gourmet-chef," he said. "Like Christopher Lloyd from 'Back to the Future,' if he were more interested in food than time travel."

Mr. Cantu believes that restaurant-goers, particularly diners who are willing to spend $240 per person for a meal (the cost of a 20-course tasting menu with wine at Moto) are often disappointed by conventional dining experiences. "They're sick and tired of steak and eggs," he said. "They're tired of just going to a restaurant, having food placed on the table, having it cleared, and there's no more mental input into it other than the basic needs of a caveman, just eat and nourish."

At Moto, he said, "there's so much more we can do."

Mr. Cantu is experimenting with liquid nitrogen, helium and superconductors to make foods levitate. And while many chefs speak of buying new ovens or refrigerators, he wants to invest in a three-dimensional printer to make physical prototypes of his inventions, which he now painstakingly builds by hand. The 3-D printer could function as a cooking device, creating silicone molds for pill-sized dishes flavored, say, like watermelon, bacon and eggs or even beef Bourguignon, he said, and he could also make edible molds out of cornstarch.

He also plans to buy a class IV laser to create dishes that are "impossible through conventional means." (A class IV laser, the highest grade under the Occupational Safety and Health Administration's classification system, projects high-powered beams and is typically used for surgery or welding.)

Mr. Cantu said he might use the laser to burn a hole through a piece of sashimi tuna, cooking the fish thoroughly inside but leaving its exterior raw. He said he would also use the laser to create "inside out" bread, where the crust is baked inside the loaf and the doughy part is the outer surface. "We'll be the first restaurant on planet Earth to use a class IV laser to cook food," he said with a grin.

He is testing a hand-held ion-particle gun, which he said is for levitating food. So far he has zapped only salt and sugar, but envisions one day making whole meals float before awestruck diners.

The son of a fabricating engineer, Mr. Cantu got his start as a science geek. "From a very young age, I liked to take apart things," said Mr. Cantu, who grew up in the Pacific Northwest. "All of my Christmas gifts would wind up in a million pieces. I actually recall taking apart my dad's lawnmower three times to understand how combustible engines work."

When he was 12, he took a job as a cook and busboy, mainly to earn money for remote-controlled airplanes and helicopters that he then took apart. But the restaurant business rubbed off on Mr. Cantu, and after high school he attended culinary school at Le Cordon Bleu in Portland, Ore. A series of jobs followed, nearly 50 in all, Mr. Cantu said. He worked as a stagiaire, or intern, in some of the top kitchens around the country, eventually talking his way into a job at Charlie Trotter's, a well-known restaurant in Chicago. He became a sous-chef there before opening Moto last year.

Mr. Cantu has filed applications for patents on more than 30 inventions, including a cooking box that steams fish. The tiny opaque box, about three inches square, is made of a superinsulating polymer. Mr. Cantu heats the box to 350 degrees in an oven and places a raw piece of Pacific sea bass inside it. A server then delivers it to diners, who can watch the fish cook.

Assisting Mr. Cantu with what he calls his " 'Star Wars' stuff" is DeepLabs, a small Chicago product-development and design consultancy. Mr. Cantu meets weekly with the crew of aerospace and mechanical engineers, programmers and product designers at DeepLabs for brainstorming sessions.

"I tell them I want to make food float, I want to make it disappear, I want to make it reappear, I want to make the utensils edible, I want to make the plates, the table, the chairs edible," Mr. Cantu said, "I ask them, what do I need to do that?"

Ryan Alexander, an industrial graphic designer at DeepLabs, said he and his colleagues at the company, which has designed more conventional products for Motorola and Home Depot, are enthusiastic about Mr. Cantu: "We don't say no," he said.

Using engineering, graphics and animation software, DeepLabs designers have begun to turn Mr. Cantu's dreams into realties.

They have created mockups of his all-in-one utensil, a combination fork, knife and spoon, as well as utensils with pressurized handles that release aromatic vapors. The latest prototype is a

utensil with a disposable, self-heating silicone handle that can be filled with liquefied or pureed foods. A carbon-dioxide-based charge heats the food (soup, for example), and the diner squeezes the handle to release it onto a spoon. Mr. Cantu envisions many applications for such a utensil, from military meals to cookouts.

Mr. Cantu said his experiments and kitchen inventions could one day revolutionize how, where and what we eat. "This will tap into something," he said. "Maybe a mission to Mars, I don't know. Maybe we're going to find a way to grow something in a temperature that liquid nitrogen operates at. Then we could grow food on Pluto. There are possibilities to this that we can't fathom yet. And to not do it is far more consequential than just to say, hey, we're going to stick with our steak and eggs today."

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Fast Company Cover Story – May 2006

Weird Science

By Jennifer Reingold

It may be freezing outside on this wintry March morning, but deep in the bowels of one of the most elegant--and possibly strangest--restaurants in Chicago, it's getting hot fast. It's the weekly chef's brainstorming meeting at Homaro Cantu Jr.'s Moto restaurant, and Cantu and his passel of wacky young chefs are coming up with fresh ways to tweak the restaurant's wildly innovative menu at a rate that would make a corporate creativity consultant lose his lunch--or, perhaps, clamor to eat another one.

Even before the session begins, there are a few clues that this is not your average fine-dining establishment. Start with the Class IV laser, normally used for surgery, on prominent display in the dining room. At Moto, it's an important cooking tool. Then there's the huge tank of industrial-use liquid nitrogen in the backyard, used to freeze things that are normally hot and to mold foods into wholly unnatural shapes. Finally, there's the huge photo of Salvador Dalí, mounted prominently above the stairs leading into the basement kitchen. Printed on the photo is a quote: "The only difference between a madman and me is that I am not mad."

That is not immediately obvious as the meeting gets started. Ben Roche, Moto's 23-year-old pastry chef and resident science geek, describes a current project: "I'm trying to make a scoop of ice cream that you cook at a low temperature so it shatters into a powder when you eat it."

Cantu, a tall 29-year-old whose black hair, pale skin, and devilish smile gives him a faint resemblance to Eddie Munster, nods encouragingly. "What else?"

Darryl Nemeth, a Moto line cook, pipes up, "One idea I had was making ketchup fryable, in a form that was cuttable, with waffle-fry sauce."

"Like a cross-cut dealy? You get ketchup and fries all in one? That's cool," says Cantu, his face lighting up. "That's a great idea. I think you could do it with tapioca. The only issue is whether the tomato sugar would burn."

The meeting turns to what the chefs ate on their days off, a regular source of new ideas. One chef fesses up to eating Hot Pockets, those soggy, microwavable excuses for stromboli that are more suggestive of a date with bad reality television than a gourmet restaurant whose 18-course grand tasting menu goes for $160 a head (wine not included).

But not for Cantu. He is so excited, he can barely sit still. Finally, a flavor and a concept for the "lava lamp" drink he has been yearning for, with solid pieces that slowly turn into liquid. Says Cantu: "Okay, so it comes in a glass and there are little pockets inside that are actually hot, and the whole thing is hot, then gets cold as you drink it. That's a no-brainer."

"Are you sure that wouldn't creep people out?" the Hot Pocket eater ventures.

"Any idea's a great idea as long as it tastes great," Cantu says.

There are people who play it safe and people who just can't. Cantu is the latter, a rosemary-wielding rebel who loves to challenge a diner's assumptions about how food should look, taste, and feel. "He's an inventor who accidentally ended up as a chef and is returning to being an inventor," says Wylie Dufresne, chef-owner of WD-50, a New York restaurant known for a similarly technomodern approach. "But his food is good and tasty."

It is this quirky lust for the unexpected--the desire to push the culinary envelope by combining flavors, textures, and temperatures in previously unimagined ways--and his general irreverence for the accepted parameters of food and fine dining that have suddenly propelled Cantu into the role of the restaurant world's enfant terrible. In just two years, this young chef has drawn attention from *The New York Times* and *Gourmet*, had the Who's Who of modern gastronomy in to sniff (and taste) around, and scored an invite to cook a dinner for Nobel Prize winners. He has made many more-traditional chefs nervous--and been called everything from a faddish flavor of the month to a creative genius.

But while Cantu is most certainly a chef, he is also someone whose approach to innovation has relevance far beyond the kitchen. He is the classic mad scientist, a Stephen Hawking acolyte with a basement filled with gadgets, robots, and gazillions of inventions aching for just a little bit more time and attention. Unburdened by pesky details such as practicality or resources, he's the type of guy who reaches for the nightstand at 4 a.m. with yet another nutty thought (his wife, Katie, bought him a tape recorder to mutter into). And despite the accolades, in his mind he is just getting started. "This isn't just gimmicky s--t," he says. "There is a point to this."

Cantu wants to use his self-taught rocket science and culinary training to change how the world thinks about food. "He's an inventor who accidentally ended up as a chef," says a colleague.

The point, for Cantu, is simple yet starkly, almost insanely, ambitious: He wants to use his strange brew of self-taught rocket science and professional culinary training to change the way

the world thinks about food--which has barely evolved, he says, while everything else has advanced at warp speed. "What is cooking? 'Cooking' is a loose term. It's understanding energy or the lack thereof," he says. "People are afraid because their mentality as a whole has been held back with food and pushed forward with everything else around them." Cantu hopes to commercialize some of his inventions, with the ultimate aim of improving the lot of man. "My main goal here is not to wind up on aisle seven at Safeway. I don't want to be the guy doing the bottled hot sauce. We're changing the way humans perceive food."

And although some people think Cantu is talking a big game to get more people to his restaurant, there is a clear method to his madness. While Cantu refers to Moto, a slick minimalist spot in Chicago's meatpacking district, as his "test kitchen," he is also expanding beyond it--not with a chain of Motos in Vegas and beyond, the traditional route for a name-brand chef, but rather with a new business, Cantu Designs. He hopes to license such patent-pending inventions as his "food replicator," a tricked-out printer named in homage to *Star Trek* that creates "edible surfaces" such as paper flavored like cheesecake or a mojito; new utensils, which he hopes will change the way people eat; and his polymer cooking box, which allows food to continue cooking even after it is removed from a heat source.

If it's not so easy to find the link between edible paper and world salvation, a few hours with Cantu will at least get you thinking differently about the possibilities. He's a strange and paradoxical combination of idealist and cynic, a guy who in one breath talks about working with the U.S. government to help revolutionize the MRE (meals ready to eat) system and in the other proclaims he'll never be able to work for "the man." But working with contradictions is exactly what Cantu's all about. Others' obstacles are his possibilities.

To change the world for the better--not to mention run a restaurant that is quickly becoming a temple for science-based gastronomy--is a hell of an ambitious goal for a self-proclaimed screwup. Cantu was a troubled kid from the Pacific Northwest, with a mother who drifted in and out of homelessness. He narrowly avoided a trip to juvie for setting a huge fire in a field next to an apartment complex when he was 12. In school, he routinely slept through class. In fact, he had only one discernible passion: taking things apart. There was the lawn mower, the remote-controlled cars, the transistor radio. Although he took a job at a fried-chicken joint when he was 12 (he said he was 16), Cantu saw food more as sustenance than the source of a career until the owner decided to bring in a tandoori oven and Cantu realized that there was more to chicken than McNuggets.

As high school ended, Cantu found himself with no place to live. Fortunately, he connected with a couple named Bill and Jan Miller, who sometimes took in troubled teens. They offered him a couch in their living room on the condition that he go to culinary school. He did--and found his calling. "He came home with a Charlie Trotter [the famous Chicago chef] cookbook one day and said, 'One of these days, I'm gonna have a book just like this,' " remembers Jan. "You know what, he probably was the most ambitious, determined young man we have ever met." Says Cantu: "If it hadn't been for them, I'd probably still be struggling as a line cook somewhere."

Cantu determined that the only way to learn how to be the best was to work with the best. He decided to take the traditional "stage," the free internship most would-be cooks do for a few

weeks or months, and turn it into a way of life. He spent about two years traveling up and down the West Coast, knocking on the back doors of some 50 bistros, organic cafés, and fusion restaurants that he thought could teach him something and offering his services for free. Through this hands-on form of benchmarking, Cantu began to develop his own style and became more determined than ever to open his own place.

In February 1999, when Cantu was 22, he decided that Trotter, whom he idolized for his beautiful presentation and use of the best ingredients, would be his next stop. Arriving in Chicago armed with nothing but a stereo and a backpack, he went straight to Trotter's and scored a meeting for the next day. Trotter told him it was rude to show up without an appointment. Cantu was unfazed. "Sometimes I just want to do things," Cantu responded, "and right now I want to work at this restaurant, and that's the only thing I want to do." Trotter hired him, and Cantu spent the next four years climbing the ranks to sous chef. "It was a tough kitchen," he says. "Some people call it hell. I call it a character-building experience."

All the while, Cantu spent his days off tinkering with his own creations, imagining startlingly original ways of presenting and reconstituting food. What his ideas had in common was the combination of the fresh and the familiar--the deconstruction of a comfortable, memory-evoking food and its resurrection in a totally different presentation.

"This guy comes in with these little glasses, he looks like an accountant, and he starts talking about levitating food," says the restaurateur behind Moto. "I said, 'Wow, that's a lot to take in.' "

In late 2003, Cantu heard about an opening for a chef at a new restaurant called Moto. The backer was a young restaurateur named Joseph De Vito, whose earlier food forays consisted of a burger joint and a classic red-sauce Italian spot. De Vito wanted something different, perhaps Asian fusion. Cantu wanted something really different. "This guy comes in with these little glasses, he looks like an accountant," laughs De Vito, "and started talking about levitating food. I walked away saying, 'Wow, that's a lot to take in.' "

Cantu then asked to cook for De Vito and his wife. The seven-course meal was unlike anything De Vito had ever tasted. It included a spring roll with a shot glass holding a ravioli--whose spring-roll-flavored liquid center just "exploded in your mouth"--and a piece of fish cooked at the table in Cantu's polymer box. "Maybe this could work," De Vito remembers thinking. "I always wanted a chef who was going to run with the ball. I think the key to success in this business is to find the right people and let them be creative."

Creative, yes, but what Cantu called creative other people called bonkers. There was the edible menu, a soy-based concoction with vegetable ink spread out to resemble a soft piece of parchment; synthetic champagne injected into your glass with a giant black medical syringe; and flapjacks sizzling on a "griddle" frozen to -273 degrees. When Moto--which in Japanese has many meanings including "idea," "taste," and "desire"--opened in January 2004 offering only a tasting menu with little explanation, people were confounded. "They would ask for sushi, and you'd hit them with this degustation menu," says De Vito, "and then they'd get up and walk out."

Those with the guts to stay were in for a bizarre-yet-tasty combination of food and science, of high and low culture, of the comfortable and the absurd. Case in point: Surf & Turf, which combined a Hawaiian sea bass and duck cooked *sous vide* (in a vacuum), with mushrooms, a foamy puree of foie gras, and apple butter. Accompanying the dish was a sketch inspired by M.C. Escher, the mind-bending surrealist, depicting a sea that morphs into a sky. "And please eat the drawing," a server would say. "It's flavored on the top like a bird and on the bottom like a sea."

Eventually, Moto was discovered by foodies, who came to admire Cantu's strange combination of childlike playfulness, all-American flavor, and haute cuisine. There is, for example, the Donut Soup, an elegant espresso cup containing a few ounces of liquid that tastes exactly like the inside of a Krispy Kreme doughnut, chemical aftertaste and all. Or the sweetbreads and cheese grits, served on a spoon over white-corn-and-goat-cheese grits. Next to the spoon is goat-cheese "snow," which has been zapped with liquid nitrogen. Diners were asked to abandon their preconceptions about food and just put themselves in Cantu's calloused hands. His only promise was that the food would actually taste good. "Wow, this is so much better than Chuck E. Cheese's," joked one recent guest. The restaurant began to turn a profit, helped along by Moto's cheap rent and high prices.

It's a big night at Moto, because Ferran Adrià is coming to pay his respects. Adrià is the famous Spanish chef behind El Bulli, the restaurant outside Barcelona that in the 1980s became the first to successfully mine the vein between science and food, between perception and reality, in what is often dubbed "molecular gastronomy." Cantu, irreverent as ever, pretends it's not a big deal, flippantly answering "Pizza Hut" on the kitchen phone before realizing that it is Adrià's friend and equally esteemed colleague, José Andrés, confirming the reservation. But he clearly wants to impress. "We've gotta blow this guy away!" a note reads on the schedule downstairs.

Adrià, who was intrigued by a presentation Cantu gave in January at Madrid Fusión, a chef's conference, says he isn't going to drink wine until the end of the meal. "I want to concentrate," he says. And concentrate he does, his brow furrowed as he tastes bison with the aid of Cantu's aromatic utensils--forks and spoons with corkscrew handles that hold sprigs of thyme and rosemary--and watches him use his laser to burn a hole in a vanilla bean, whose fumes are used to enhance the flavor of the beef dish he is serving. Neither Adrià nor Andrés will comment directly on the meal, but they both clean their plates. "One of the things left in cooking today is to find out what is the limit--what is cooking, what is not cooking," says Adrià. "It is clear that Homaro is a chef with that capacity."

Testing those limits, in fact, is what gets Cantu's juices flowing. But with more attention and accolades, he has faced the challenge of continuing to innovate, a classic business problem faced by any idea-driven company, from Apple to General Electric. Today, Moto's menu still changes frequently, sometimes every week. Often, it's a result of suggestions from his staff, almost all of whom both wait on tables and work in the kitchen, an unusual arrangement Cantu prefers because it lets them both interact directly with the customer and earn a share of tips.

But the innovation process at Moto and at Cantu Designs, although self-created, is one that closely tracks the approach of such design groups as Ideo. Every week, Moto's maniacs

brainstorm new ideas, create prototypes, test, and then tweak them until they hit the (often literal) sweet spot. Failure is expected and welcomed, though it can be dangerous, such as the time the kitchen staff played with tobacco-infused custard and came down with acute tobacco poisoning. (The dish never made it to the menu.) "You have to be fearless," says Roche, Cantu's chief experimenter. "A lot of times it doesn't work, sometimes you create something completely different, and sometimes it works. There are no boundaries at all."

The same approach applies at DeepLabs, the funky, secretive Chicago product-design firm that works with Cantu and Linda Kawano, Cantu's vice president of new business development, to create utensils. The group's goal is to change the way we think about how we consume food by improving on a system that has barely evolved in hundreds of years. Who's to say that a fork, knife, or spoon, not to mention a chopstick, is the ideal implement? "[Cantu] is very different from a chef in that he's [operating] more from a technology and futurist standpoint," says Bart Brejcha, DeepLabs' founder.

In addition to Cantu's corkscrew fork and spoon, DeepLabs has a prototype for the Serrator, a combination fork-spoon-knife that was inspired by the spork (that sad plastic thing you get at KFC) but actually works. There's also a utensil that could deliver an entire dish from within its handle with the push of a button. It could be used in space or even as a baby-food delivery system. "We want to prove to companies like Target that this is not just a trend, but taking human dining to the next level," says David Mazovick, a DeepLabs consultant.

Cantu is obsessed with patenting his ideas in a world in which the battle for intellectual property can make or break a business. With the help of his patent attorney, Charles Valauskas, a partner at Baniak Pine & Gannon, he has 12 patents pending, including the polymer box, the utensils, and the edible paper, with many others on deck. He makes his staff and virtually anyone who visits the kitchen sign nondisclosure agreements, and he favors sentences, usually uttered with a wink, like "I'd love to tell you, but it's top secret."

"He just disgorges inventions," Valauskas says. "A typical session lasts about three hours, and after that I'm exhausted and he's ready to go, with two pads of paper filled."

Llllleeetttt the battle begin!"

We're on the set of *Iron Chef America*, the campy Food Network cult hit, and Cantu is about to pull out the big guns in his battle with "Iron Chef Japanese" Masaharu Morimoto. Dressed in green to promote Cantu Designs, he calmly prepares a cocktail flavored with *horchata*, a rice-based beverage, pours it into three glasses for himself and his two sous chefs, and then, with the aid of the digital camera rigged up to his foil-covered "food replicator," takes a picture of the group clinking glasses. Next, he takes the drink and pours it into the machine. Soon, the replicator spits out the horchata-flavored picture, which is served to the perplexed judges along with a dessert of Mexican chocolate pudding with beets and caramelized popcorn. Jeffrey Steingarten, a cantankerous *Iron Chef* judge and noted food writer, professes himself charmed and delighted. "Some of us love eating paper," he says with only a touch of irony. "Because that makes the dish." The show will air in July.

While that's certainly an attention-getting novelty on a show like *Iron Chef*--"We've never seen anything so wildly original," says the show's host--it's Cantu's "edible surfaces" that may offer the best opportunity for achieving his global ambitions. He believes that they could be used to feed people on long space missions, for military MREs, or even as a way to get long-lasting food to people in refugee camps. "My goal with this is to deliver food to the masses that are starving," he says. "We give them something that's healthy, that has an indefinite shelf life, and that is supercheap to produce. A guy like Paul Allen could take this thing and wipe out world hunger if he wanted to."

Already, Cantu is part of a group working with the Institute for Advanced Concepts, the futurist arm of NASA, to help rethink notions of food in space. Paolo Gaudiano, CTO of Icosystem Corp., a Cambridge, Massachusetts-based applied research company that has received a seed grant to explore the concept, says Cantu helped his company understand the various ways to manipulate food. "We showed NASA the edible paper, and they thought that was an extremely exciting idea," says Gaudiano. Icosystem is now applying for a Phase Two grant to study the idea further.

A bit closer to home, it's not hard to see how the paper could be used as a marketing or advertising tool by anyone hoping to sell food. "We think there's a real big commercial opportunity here," says Michael Preston, the chairman of Fuse Marketing Group, a Canadian company that works with such clients as Kellogg's and Lindt and is exploring a partnership with Cantu Designs. "We were quite mesmerized by this. Imagine if a dispenser gave you a sample [to taste]?" Fuse is currently preparing pitches to several clients and hopes to have feedback soon. Already, Cantu says he is consulting for several *Fortune* 500 companies, although he won't name names.

Cantu's creations have attracted the attention of top executives at places like Burger King. A team from the fast-food chain left Moto "floored" by his edible paper and carbonated fruit.

Cantu's creations have also attracted the attention of top executives at places such as Burger King Brands. Denny Marie Post, SVP and chief concept officer, sent a team to dine at Moto. They came back "floored," not only by the edible paper but also by Cantu's carbonated fruit, which had been stored in a pressurized chamber filled with carbon dioxide. When you bite into an orange or pineapple, you instantly feel a bubbly fizz on your tongue. "There's tremendous potential in this offering," says Post. "Wendy's offered fruit and failed. This, to me, is just a brilliant way to differentiate fruit."

Post was also intrigued by edible paper, but added an important reality check to some of Cantu's goals. "It's a neat idea," she says. "But our customer base isn't wildly experimental. Kids are much freer to use things, so maybe there's a way to use it in a kid's meal. But it depends entirely on how consistently it could be commercialized, and that is really his challenge."

Cantu admits that the cost of full-scale production is the $64,000 question, but he and Preston believe it's certainly attainable, if not now, then soon. "I've been losing money on my inventions for 5 years and will go another 20 if I have to," he says. "That's how much I believe in them." Yet he is hardly the first one to think about the applications for edible paper. Listerine breath

strips use a flavored film, many pharmaceutical companies are working on delivery systems for medicines that don't involve swallowing pills, and a company called First Flavor claims to have patented the use of a similar film for the specific purpose of taste sampling. "[Cantu's] technology is a wonderful way of getting people's attention," says Jay Minkoff, First Flavor's president and CEO. "But there are hundreds of patents out there."

Although Cantu says he can deliver nutrients on the paper, he can't yet create the feeling of fullness. But that is hardly a deterrent to someone who thinks as he does. "This is where we get into nanotechnology," he says, warming up again. "Just look at those little dinosaur sponges in your bathtub. We're not that far away. If you have time-release pills, you could have time-release expanding cheesecakes." Paper cheesecakes that then expand to fill your stomach? Sure… but before you can explore the concept further, Cantu's attention-deficit disorder kicks in and he's off on another tangent, an application for edible paper that will help avoid identity theft. "Okay, check this out. A whole stack of edible ATM cards. You slide it into the ATM slot, authenticate it (with a thumbprint and unique bar code)… and the flavor is your PIN." When you're finished, you simply eat the card. Far-fetched? Well, yes. But when it comes from the strange yet wonderful mind of Homaro Cantu, you can't help but think: Why not?

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Gourmet Magazine Cover Story – October 2006

Chefs Like Us

By Robert Sietsema

....Cantu himself grew up in poverty in Oregon, where he "ate a lot of hot dogs and government surplus food." Asked if he was interested in science as a kid, he replied, "only if it involved an explosion."

Moto is as much think tank as restaurant. Pictures of food printed with vegetable inks on modified food starch (an idea that evolved from a digestible picture of a maki roll wrapped around an actual maki roll) may serve as an edible menu or as a course (for example an amuse of creamy risotto). He also uses the food starch sheets to produce nonillustrated foods, or as ingredients to be sprinkled over other dishes. And the chef's newly formed Cantu Designs has set his sights on feeding the Third World with paper images of food that contain the same flavor and nutritional value as the originals.....

....Finally, Cantu offeres a super - sweet cotton candy liquid truffle as well as an ingenious recipe that we loved; He grabbed a box of doughnuts off the supermarket shelf and transformed them into sumptuous pancakes, which he serves with a sauce that combines coffee and fresh strawberries. Weird, perhaps, but delicious. And, best of all, as with the other intriguing oddities that follow, you can - and should - try this at home.

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Caption: Chef Homaro Cantu of Moto in Chicago munches on a photo of himself printed on edible paper. The cookie's fortune is edible, too.
By H. Darr Beiser, USA TODAY

USA Today – December 5, 2005

Incredible & Edible: In search of extreme cuisine

By Jerry Shriver, USA TODAY

Simply having a healthy appetite doesn't cut it anymore for diners at some of the country's cutting-edge restaurants. They also need a Harry Potterish sense of wonder, a taste for the absurd and a fat wallet.

Clothing that resists dribs of bacon-horseradish sorbet and drabs of fried mayo wouldn't hurt, either.

Around the world, a handful of kitchen counterculture chefs are playing with food in ways that probably make their mamas queasy. Some are trying to harness science and technology to better feed the masses, while others simply want to goose the gizzards of the meat-and-potatoes crowd. But they're all committed to reinvigorating the art of eating.

The movement has spread from Europe to these shores, where the following bits of gastronomic theater might be staged on any given night:

• At Homaro Cantu's Moto restaurant in Chicago, diners order off the menu. Then they eat the menu. The sheet is made of parmesan-flavored rice paper imprinted with edible soy ink and is framed by puffed rice and freeze-dried shallots and sits atop a bed of crème fraîche. Stir it all up after the waiter leaves, and it tastes like risotto.

• Nearby, at Grant Achatz's 8-month-old Alinea, customers keep their hands folded in their laps as they lean forward and use their lips to pluck a square of pomegranate gelatin and Explorateur cheese from the tip of an elegant, antenna-like prong. Later, another dish will arrive on a pillow filled with anise-scented air.

• A few blocks away at the luxurious Avenues, Graham Elliot Bowles presents a slice of $40-a-pound foie gras atop a spiced Rice Krispies treat and adds pulverized Altoids mints to the lamb *jus* to boost the minty effect.

• Cocktailians at José Andrés' MiniBar in Washington, D.C., can spritz a mojito into their mouths from a tiny canister while they nibble on a bar snack of flash-fried beet strands shaped like tumbleweeds.

• In Los Angeles, Ludovic Lefebvre of Bastide tosses Pop Rocks into strawberry-gummy-bear soup and tops panna cotta with caramel *coulis* and a quenelle (a delicate dumpling) of oscetra caviar.

• Wylie Dufresne of WD-50 in New York invites his audience to ponder the marriage of slow-poached oysters, celery root, mustard purée and dried banana chips at the *start* of his 15-course tasting menu. At the end, there are divine cocoa-cotton balls.

And what did *you* have for lunch today?

These chefs work independently of one another, but they seem to share a boredom with traditional cooking and a propensity for letting their freak flags fry. Their individual styles are diverse, and they use various terms to describe their approach, including "post-modern," "molecular gastronomy," "avant-garde," "progressive American" and "laboratory cooking." Also cropping up among food critics: "silly," "weird," "gimmicky" and "brilliant."

Cooking up an experience along with dinner

What unites them is a desire to question and reinterpret every aspect of food preparation and dining, down to the design of the restaurant doors (Alinea's open mysteriously via a hidden sensor) and the lighting (opaque, pitch-black rooms are big in Berlin). Their culinary bag of tricks may include sprays, mists, foams, gels, deconstructions, hot and savory ice creams, sculptured dishware and cutlery, and odd flavor combos — plus dollops of theater, art and hucksterism. Their kitchen tools may include lasers, centrifuges, gas canisters and pots of liquid nitrogen.

In some of these chefs' hands, a night on the town becomes a dizzying journey between yuck and yum. Fruit infused with CO^2 may bubble and hiss (Moto), the caviar might be made of sweet peas (MiniBar), the squab breast could be dehydrated (WD-50) and the olive oil may be frozen and served skewered on a pin (Alinea).

Most of the experimenters in the USA have received formal training and have worked in the kitchens of such progressive American master chefs as Chicago's Charlie Trotter and Napa

Valley's Thomas Keller (The French Laundry). But they also are inspired by artists and food writer/scientist Harold McGee, whose *On Food and Cooking: The Science and Lore of the Kitchen* is a classic of the "molecular gastronomy" movement.

All say they owe a debt to chef Ferrán Adrià of El Bulli near San Sebastian, Spain, and to Heston Blumenthal of the Fat Duck outside London. Both run laboratories where they explore technology and cooking concepts and mentor up-and-coming chefs.

Adrià's legacy is "Be free! Be open!" says Andrés, who worked at El Bulli and now runs six non-experimental restaurants in Washington in addition to MiniBar (which is a six-seat area inside another restaurant). "Adrià says, 'Have technique, understand the basics, use common sense, use your eyes and tongue, but be free!' It's that simple."

Andrés and his peers say they feel free to conceive of their fanciful concoctions because modern kitchen technology allows them to. The past decade has seen revolutionary advances in tools and techniques that are being employed throughout the industry. Chefs can cook vacuum-packed meats at precise low temperatures for hours, thus preserving flavors and texture to an unheard-of degree. Ingredients can be frozen instantly using liquid nitrogen. Dehydrators can preserve flavors and alter textures of fruits and vegetables. Centrifuges can clarify juices. And overnight delivery ensures supplies of the world's finest and most esoteric ingredients, while the Internet allows easier exchanges of ideas.

When technology frees up time for creativity, and when customers provide the financial incentive, that's a recipe for red cabbage gazpacho with grain mustard ice cream, vanilla pods dipped in pine sherbet, parsnip cereal, granulated olive oil and paper-like wisps of chocolate toffee.

"I got really bored with cooking because it's been the same forever," Cantu says. "Put a pan on a burner and cook something inside of it. So who says I can't use a laser?"

"A small group (of chefs) is saying, 'Hey, look at what we can do with this stuff,' " adds Achatz, 31. "These chefs are looking at the dining experience on a broader scale with the objective of crafting an experience rather than crafting a dinner. While dishes are supposed to taste good, a larger part of their enjoyment comes from emotional triggers like humor or surprise or intimidation."

Be prepared for 20 small courses, high prices

The pursuit of that enjoyment may try the patience of some diners, however. Many of these creations are presented as part of tasting menus that embrace 20 to 30 small courses and are paired with a dozen or more beverages. And such decadence doesn't come cheap: Twenty courses at Moto costs $160, and two dozen courses at Alinea is $175, and neither of those prices includes an optional beverage selection, which can run $60 or more. To keep things accessible, most chefs offer several tasting menus of varying lengths and prices. Some, including Bowles, Lefebvre and Paul Liebrandt of the soon-to-open Gilt in New York, may offer a few experimental dishes among conventional courses.

"If it's done correctly, experimentation is a wonderful element to use in cooking," says Liebrandt, whose menu will blend classic French dishes and some flights of fancy, including creations that incorporate aged oolong teas. "But New York diners like stuff they can recognize."

Predictably, the reaction to these high-tech, high-concept high jinks is all over the plate. *Gourmet* editor Ruth Reichl feels the idea of cooking outside the box "is really exciting. We have some people doing wonderfully creative stuff like nothing we've ever eaten. At the same time we have people going back to the farm in search of the perfect pea. So we may get to a point of finding the perfect pea *and* doing something mind-blowing with it."

But John Mariani, who writes about the culinary world for *Wine Spectator*, *Esquire* and his own online newsletter, says "mindless" and "overblown" are more appropriate descriptions.

"There is an enormous distinction between innovation and something that is deliberately eccentric," he says. "If Thomas Keller innovates, he'll find a way to make a roast chicken more delicious than any you've had, and he has done so. But he won't pump it full of nitrogen. That's the definition of a great chef."

In response, the chefs argue that boundary-pushing always has been a part of culinary evolution.

Without it, "we would be eating rotting meat without the fire," says Andrés. Without it, they say, there would be no cotton candy, puff pastry, Cheez Whiz or those chocolate desserts with molten centers.

"It's easy to criticize novel cooking," Dufresne says. "But all cooking that is now considered classic was at one time considered wacky and off-base.

"Anytime someone bucks the system and does things people don't understand, there will be criticism."

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New Scientist Cover Story – August 18, 2005

The amazing food replicator

By **Hazel Muir**

"TEA. Earl Grey. Hot." If only astronauts on the International Space Station could summon their creature comforts as easily as Jean-Luc Picard on *Star Trek*'s starship Enterprise. After six months on the ISS, watching the sun rise 16 times a day, astronauts have eaten more than 500 tedious meals of dehydrated, long-life food. Who wouldn't give their right arm for a pizza bubbling with browned mozzarella or a fresh cream bun?

The wacky "food replicator" in Star Trek was pure make-believe. It stored 3D scans of the molecular structure of drinks and meals, then miraculously assembled individual molecules into these foods in seconds. That technology is way beyond our horizons, but a NASA-funded study is about to look into a simpler option - a compact cooking machine that will create a larderful of familiar foods from a limited range of space-friendly ingredients.

The idea is that you could request a sherry trifle, for instance, from a computer. That request would be translated into mathematical instructions controlling a food processor. A network of pipes and chambers would mix, heat and cool the ingredients to make a dessert that looks and tastes like a real trifle - even if it is made from unconventional ingredients.

On a Mars mission, the food could be 3 to 5 years old by the time the crew eats it

Back on Earth, such machines could also invent foods to tickle the taste buds by "evolving" recipes. "That would be a completely new approach to food design," says Eric Bonabeau, chief scientist at Icosystem, a strategy research firm in Cambridge, Massachusetts. "I think this project could have great potential not just for space, but for the food industry as a whole."

Space food has come a long way since John Glenn squeezed apple sauce out of a tube during his pioneering three-orbit Project Mercury flight in 1962. But there is still plenty of room for improvement. Neither the space shuttle nor the ISS has a fridge or freezer, so the vast majority of food is not fresh. "The foods have to be able to last at ambient temperatures for fairly long lengths of time," says Vickie Kloeris, NASA's manager for shuttle and ISS food at the Johnson Space Center in Houston, Texas. "For the station, everything needs to have a 12-month shelf life."

Drinks are powdered, while most of the food is either freeze-dried or the equivalent of canned food that can be sealed in lightweight pouches and heated in an on-board microwave oven. Astronauts have about 300 items to choose from, and the menus repeat every 10 days. That is dreary enough on a six-month mission to the ISS, never mind future manned trips to Mars, which could take years. "On a Mars mission, the food could be 3 to 5 years old by the time the crew eats it," says Kloeris. "We have a few products which last that long, but not many. We couldn't yet provide sufficient nutrition and variety."

NASA is researching ways of extending the shelf life of food for a Mars mission, and ways of growing fresh food in space. But Bonabeau suggested something more ambitious to the agency's Institute for Advanced Concepts (NIAC). Why not turn fiction into reality, and design a food replicator?

The idea occurred to Bonabeau last year when he was talking to his friend Hervé This, a physical chemist and food specialist at the College of France in Paris. Along with the late University of Oxford physicist Nicholas Kurti, This developed the field of "molecular gastronomy", which aimed to give cookery a scientific framework and debunk culinary myths. He works with top Parisian chef Pierre Gagnaire to come up with an innovative cooking concept or recipe every month.

It is part of a wider trend for creating exotic new foods made famous by trendy restaurants such as El Bulli, north of Barcelona in Spain, and the Fat Duck in Berkshire, UK. At the Fat Duck, chef Heston Blumenthal serves up a 16-course tasting menu that you will never forget. First comes a green tea and lime mousse that the waiter rolls around in a frothing pail of liquid nitrogen until it's crisp. It collapses in your mouth as a fog of nitrogen puffs out your nose. Then comes a host of eccentric combinations that confuse and surprise the senses: snail porridge, caviar on white chocolate, bacon and egg ice cream.

In the course of his research over the past few years, This has started to develop a symbolic language to describe food (see "Mathematical recipes"). He and Bonabeau reckon that by extending this language to fully describe a recipe, then feeding the formulae into high-tech, automated food processors reminiscent of those in Roald Dahl's *Charlie and the Chocolate*

Factory, it should be possible to generate millions of new and interesting foods without much manual labour.

Hoping that such a machine could open new avenues for space food, NIAC has given the green light to the project. With $75,000 in funding, a six-month feasibility study will begin in September. The first goal will be to create a mathematical "grammar" to describe a food completely, by developing This's textural descriptions to include details such as step-by-step cooking instructions. The grammar for a chicken pie, for instance, could include the instructions for mixing the dough ingredients, making a gravy separately, then bringing half-cooked pastry, gravy and chicken together for a final baking to deliver a steaming hot pie.

Computers could use the language of food to invent hundreds of new dishes

Next, Bonabeau and his Icosystem colleague Daphna Buchsbaum will use design software to create a virtual food machine. They hope to find the best networks of pipes and chambers, storage vats, ovens and fridges to execute the cooking instructions. A user might request food at a computer keyboard, and then a stack of five ingredients, say, could be processed up through a pyramid of nine different chambers that can perform 10 different functions - for instance, mix, whip, fold, decant, bake, grill, pressurise, quench, cool and freeze. That network would have 1 billion function configurations.

For extra flexibility, the chambers could be connected by closed pipes or open conveyors that themselves alter the food, perhaps by heating or chilling it. And loops could be added to repeat steps, such as whip, heat, cool and whip again. While Bonabeau and Buchsbaum work on possible designs, researchers at Squid Labs, an engineering company in California, will study the feasibility of building an actual machine. They will look at ways to overcome the mechanical hurdles, such as finding ways to clean and maintain the machine.

If it was on a space station the machine would have to be compact, perhaps the size of a domestic fridge. That means it would have to work with a small range of long-life ingredients, yet still make recognisable foods from them. Bonabeau hopes to identify the minimum basic ingredients, or food "phonemes", from which you can make decent replicas of many familiar foods. He has no idea yet what those ingredients would be. Ideally, though, it would be possible to make a product that looks and tastes like puff pastry, for instance, but contains no fresh butter. That's going to require some ingenious thinking.

And work by Homaro Cantu, head chef at a Chicago restaurant called Moto, is helping to make this a reality. Cantu has devised some ingenious tricks, including making a Canon ink-jet printer dispense fruit and vegetable "inks" onto edible paper (*New Scientist*, 12 February 2005, p 23). He prints out sushi that looks and tastes like the real thing, but contains no fish or seaweed. Bonabeau hopes to pick up a few tips from him, though Cantu has not yet divulged the secrets of his techniques.

Bonabeau is not sure if it's possible to develop a useful food replicator. NIAC funds ambitious projects that few commercial organisations would contemplate, ideas that push the limits of

science and technology but are unlikely to succeed within a decade. "These grants are for exciting technologies that are maybe 40 years in the future," Bonabeau says.

Taste exploration

But a food replicator could be a godsend not just to space travellers but to the food industry as well. The machines could turn up on street corners and aboard aircraft, or even dollop out lunch in school canteens - following strict nutritional guidelines, naturally. And a ground-based food-replicating machine could be large, complex and use any number of ingredients. It could invent all kinds of foods with textures and tastes never explored before.

The key lies in the mathematical descriptions. As well as using these to describe familiar foods, computers could use the language to generate hundreds of new ones. A chef could taste the food and select the best to be "cross-bred" and "mutated" to evolve improved edible "offspring" - just like Darwinian evolution. Cross-breeding might involve splicing the mathematical formula of one promising food onto another. Random mutations in the formulae that tweak ingredient amounts, mixing processes or cooking times would increase diversity.

"What's special about this kind of interactive evolution is that a human being plays God, deciding which 'creatures' will make it into the next generation," says Bonabeau. "You don't need to justify or qualify your decision: you can direct the evolution without ever having to express why you're selecting what you want."

The sheer number of foods involved in such an evolutionary process might pose a problem. "We want to create many generations, but there's a limit to how much food someone will want to taste," says Buchsbaum. She hopes to design intelligent software that can identify different food qualities. Then the machine could mathematically evolve several generations of new foods, making its own decisions about which food is "fittest". As it needs no verdict from the chef, it wouldn't even have to make the food.

Eventually, the machine could cook its new recipes and then seek the chef's approval. "I'm not convinced that this will replace the need for chefs and handmade food," says Buchsbaum. "But you're opening a new avenue for exploration."

Chef Blumenthal thinks the food replicator is a great idea, on paper. "If it was doable, it would be a fantastically exciting piece of kit," he says. He'd like to use it to test ways of engineering foods that dramatically change taste every few seconds as you chew them - a bit like Willy Wonka's three-course-meal chewing gum. "You could almost have a whole meal in one mouthful," says Blumenthal.

He would also love to use the machine to create experimental tastes and textures that tease out the deeper workings of our food psychology: "That's what really fascinates me," he says. "How much of flavour perception is related to the physiology of the food you eat and how much is a psychological thing?"

But Blumenthal suspects the machine won't be practical. Bonabeau agrees it's early days and there are still hundreds more questions to answer. How would you interact with the machine, for instance? Would it understand spoken requests, such as "Give me a cream cake", in multiple languages? And which foods would be subjected to Darwinian evolution first?

"To be honest, we haven't put much thought into these things yet," says Bonabeau. "It's all fun, but we're putting a lot of cart before the horse here." Still, he can't resist speculating. Perhaps the food replicator should not only understand speech, but even read your mind, he says. And as to the first food: "I think it would have to involve chocolate. Yes...it will be something to do with chocolate."

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