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A CRITIC AT LARGE

INCREDIBLE EDIBLES

The mad genius of “Modernist Cuisine.”

BY JOHN LANCHESTER

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In 2004, Nathan Myhrvold, who had, five years earlier, at the advanced age of forty, retired from his job as Microsoft’s chief technology officer, began to contribute to the culinary discussion board egullet.org, on the subject of a kitchen technique called “sous vide.” The French term means “under vacuum,” and it refers to a process that has been around since the nineteen-seventies but has, in recent decades, become a favorite technique of the cutting-edge professional kitchen.

In sous-vide cooking, ingredients and flavorings are prepared and put in a plastic bag, from which all the air is subsequently extracted by suction. The food is then cooked in a circulating water bath at a highly precise temperature—and this precision is what chefs love. A sous-vide steak, for instance, is not cooked rare or medium rare; it is cooked to 126 or 131 degrees Fahrenheit, respectively. At these low temperatures, cooking times can be as long as seventy-two hours, and the results are often extraordinary. As David Chang puts it in his cookbook “Momofuku,” “If you know what temperature you want the thing to be, just cook it at that temperature for long enough to bring the whole thing up to that temperature and presto! It’s like magic: you’re not sitting there poking or prodding the meat or worrying that it’s rare or raw or overcooked.”

Myhrvold is fascinated by invention and innovation. He is the founder and C.E.O. of the company Intellectual Ventures, which has developed hundreds of patents. He is also a serious amateur cook, trained at La Varenne cooking school, in Burgundy, and a member of a team that won several prizes in a 1991 world barbecue championship. He is the “chief gastronomic officer” of Zagat Survey, the company that publishes the eponymous restaurant guides. At the time he grew interested in sous vide,



Nathan Myhrvold and his culinary colleagues love to cut things in half—like this traditional pot roast—and show cross sections.

there was no book in English on the subject, and he resolved to write one, incorporating primary research on the science of the technique, especially as it bore on the question of food safety.

Safety is a concern with sous vide. Because the technique cooks things low and slow, food can spend a long time in the bacteria-friendly zone above fridge-cold and below oven-hot. For that reason, health officers are sometimes wary of the technique. (The health department in New York is notoriously so.) At some point in his studies, Myhrvold was approached by Sean Brock, a chef in South Carolina, for assistance in convincing his local food inspector that sous vide was safe. A few days later, the food inspector got in touch: he found Myhrvold's information so interesting that he wanted to know if there was any more where that came from. Myhrvold broadened his idea of the book to include food safety more generally, then broadened it further to include information about the basic physics of heating processes, then to include the physics and chemistry of traditional cooking techniques, and then to include the science and practical application of the highly inventive new techniques that are used in advanced contemporary restaurant food—the sort of cooking that Myhrvold calls “modernist.”

He hired two chefs who had worked in the kitchen of the Fat Duck, the science-minded experimental restaurant in Bray, England, and got busy. The result is an astounding magnum opus, “Modernist Cuisine: The Art and Science of Cooking” (The Cooking Lab; \$625), which was written by Myhrvold and his chefs Chris Young and Maxime Bilet, and “required the combined efforts of several dozen people over the span of three years.” This isn't how most cookbooks are produced, but, as the authors point out, “that level of effort is the norm for a major reference work or college textbook.” The book consists of five thick, thirteen-by-eleven-inch volumes and a ring-bound volume of recipes, and comes in at twenty-four hundred and thirty-eight pages. In its packed state, it weighs forty-six pounds. The scale and ambition of the project—and maybe at least one of the egos behind it—are Pharaonic.

One of the most useful things about the project is its title. The fact that there is something new going on in fancy restaurants has been evident for some years, with the Fertile Crescent of the new cooking being the Spanish chef Ferran Adrià's restaurant elBulli, in the Catalan seaside town of Roses. Adrià, who began working there in 1984, closed his restaurant for six months each year to develop new ideas, and published updates on his progress every year, setting an unmatched standard for authority and innovation. The range of techniques used by Adrià was considerable—one of them involved making a tomato explode with a bicycle pump—and many had a basis in the laboratory.

Following Adrià's lead, other chefs began to take an interest in the new possibilities. Heston Blumenthal, who runs the Fat Duck, began working with scientists to come up with new ideas for the kitchen. He developed a showstopping palate cleanser at the start of his set menu, in which the waiter dropped a mixture of lime juice, egg white, green tea, and vodka (out of what looked like a can of

shaving foam) into a bucket of liquid nitrogen, at minus 321 degrees Fahrenheit. A few seconds later, it emerged as a frozen meringue. Liquid nitrogen became a new standby for the gastronomic avant-garde. Grant Achatz, at Alinea, in Chicago, invented a transparent rosewater envelope. Wylie Dufresne, at wd-50, in New York, invented deep-fried hollandaise, foie gras tied into a knot, and instant tofu noodles. Science suddenly seemed to be in the forefront of what was happening in advanced kitchens. Everywhere you went, there were newfangled foams, gels, “airs,” and “soils,” and ingredients doing impossible things.

Intertwined with this novelty-obsessed culinary movement was the field of kitchen science, which sought to figure out the chemistry of even the most ordinary forms of cooking. That field has been a lively one since the late nineteen-sixties, kick-started by a famous public lecture given by the Hungarian-British physicist Nicholas Kurti. He was a specialist in low-temperature physics who for many years held the record for having created the lowest temperature ever achieved—a millionth of a degree above absolute zero—and who was also a keen amateur cook. In 1969, Kurti gave a Royal Institution lecture, broadcast on television, during which he cooked a soufflé bristling with heat probes, and asked, “Is it not quite amazing that today we know more about the temperature distribution in the atmosphere of the planet Venus than that in the center of our soufflé?” Interest in the field grew, and fifteen years later Harold McGee, an American with degrees in astronomy from Caltech and English literature from Yale, published “On Food and Cooking: The Science and Lore of the Kitchen,” an encyclopedic survey of kitchen science, and a work revered by chefs. In 1992, a conference on the subject was held at a scientific center in Erice, Sicily. Someone—credit is usually given to Kurti, though the origin myth is as disputed as most origin myths are—came up with the term “molecular gastronomy.”

There are many troubles with that label. For a start, as a culinary designation it doesn’t mean anything. All cooking is molecular; Colonel Sanders’s cooking is just as molecular as Ferran Adrià’s. Furthermore, much of the scientific work being done in the area is not on new techniques but on the science of what cooks are already doing. The concise summary of this research is that there is a remarkable amount of scientifically sound practice involved in the traditional kitchen. Harold McGee, for instance, discovered that the practice of whisking egg whites in copper bowls takes advantage of the fact that copper ions have a stabilizing effect on the resultant foam—a remarkable thing for cooks to have figured out by the eighteenth century. The science of the ordinary kitchen is a particular interest of Hervé This, one of the French pioneers in the field, and, as far as he’s concerned, that’s what molecular gastronomy actually means. Finally, chefs have come to dislike the term “molecular gastronomy,” on the ground that it is alienating and makes what they do sound like scientific party tricks. Much of the new cooking has nothing to do with the lab. Grant Achatz’s signature amuse-

bouche of a deconstructed peanut-butter-and-jelly sandwich, for instance, is a cutting-edge classic with nothing “molecular” about it.

That is why the term “modernist cuisine” is so handy. When modernism arrived in the arts, it marked a dual break: a rupture within the history of the art form and a splitting off between advanced practitioners and the general public—between the popular and the serious. That’s what is happening in cooking, and the idea of it as a modernist revolution is a clarifying one, not least because it helps explain a distinction in the high-end restaurant business. Many of the world’s best restaurants are not modernist: Thomas Keller’s Per Se and the French Laundry, for instance, serve superbly executed versions of food that is still attached to the historic traditions and techniques of the kitchen. Myhrvold and his colleagues call this “New International” cooking, which is a good way of pointing to the distinction between it and the new new thing. New-international cuisine stands in the line of descent from the French chef Antoine Escoffier, whose “Le Guide Culinaire” (1903) imposed an intellectual order on the classical kitchen that has lasted ever since.

One of the lessons of modernism, in all fields, is that to break with the past you first have to understand it. Members of the “Modernist Cuisine” team do that through a brash, thrillingly thorough, firsthand exploration of all sorts of culinary basics: grilling, barbecuing, baking, roasting, frying. They study these at length, accessibly, and with liberal use of truly gorgeous photography. Some of these photographs are of food pathogens—the things we eat that make us sick. The discussion of food safety comes in the first volume, not long after our introduction to the wonders of the new cooking, and there is something amusing and disconcerting about flicking a few pages on from the double-page spread of famous modernist dishes—carrot air with mandarin and bitter coconut milk, cèpes in amber—to huge pictures of *E. coli* and salmonella, and a voluptuous but revolting full-page photograph of a trichinosis worm inside a pork cyst. It turns out that *E. coli* has dreadlocks, and trichinosis is a remarkable-looking beast. It’s one of the few pathogens that we don’t ingest by accidentally eating excrement. The discussion of poo-eating in “Modernist Cuisine” is exhaustive, convincing, and gag-inducing. According to the microbiologist Philip Tierno, “We’re basically bathed in feces as a society.” “Bathed in feces”—not words you often read in a cookbook, but apparently poo-eating accounts for about eighty per cent of all food-related illness. Also, cat litter in the kitchen? Bad news. *Toxoplasma gondii*, a species of protozoa present in cat litter, kills three hundred and seventy-five Americans a year, and perpetuates itself through cat feces in a freaky way: when rodents eat toxoplasma, their brain chemistry is changed so that they develop an attraction to the smell of cats. There’s no happy ending.

The discussion of pathogens is fascinating, but it’s something of a relief to move on to the cooking. One of the coolest things the “Modernist Cuisine” team does is to cut stuff in half, then take a picture

of it. The cross-sectioned objects include barbecues, broilers, controlled-vapor ovens, woks, frying pans, hot-water baths, ice-water baths, saucepans, steaks, and consommés, most of them in mid-cooking. The resulting photos-with-explanation are admirably clear, which is a good thing, because a significant amount of what the team has to say is novel. Notwithstanding its title, “Modernist Cuisine” contains hundreds of pages of original, firsthand, surprising information about traditional cooking. Some of the physics is quite basic: it had never occurred to me that the reason many foods go from uncooked to burned at such speed is that light-colored foods reflect heat better than dark: “As browning reactions begin, the darkening surface rapidly soaks up more and more of the heat rays. The increase in temperature accelerates dramatically.” The science is obvious, once it’s pointed out.

Much of the rest of the science is a lot less obvious. For instance, in baking, the oven temperature is measured by a dry bulb, and can, in a domestic oven, go to about 475 degrees Fahrenheit, whereas the interior of whatever is being cooked is much cooler. In fact, because most of what we eat is largely water, the internal wet-bulb temperature of the food never goes above the boiling point of water. This simple fact has many consequences, and the authors have a compelling account of the three phases undergone in traditional baking. (By “baking,” they mean cooking in a closed oven—as with what’s conventionally called a “roast,” say. They don’t discuss cakes, breads, or any other “baked goods.”) They stress the importance of the humidity level within the oven, and the fact that most of the inside of the food is heated by conduction. Browning requires the creation of what they call a “desiccation zone,” in which the water has evaporated. By their account, “As moisture evaporates from the desiccation zone, juices slowly wick up from below, pushed by diffusion and pulled by capillary forces. The trickle of juices provides a continual supply of sugars, peptides, and oils that chemically rearrange to create the characteristic color, tastes and aromas of baking food.”

They also offer a detailed comparison between baking in New York City and in Mexico City. Water boils at a cooler temperature in Mexico City—twelve degrees Fahrenheit cooler—owing to the higher altitude and lower air pressure. The New York oven starts out hotter (as measured by the all-important wet-bulb temperature), is overtaken by the Mexican oven after 17.5 seconds and falls as much as nine degrees behind, stays there for eighteen minutes, and then overtakes the Mexican oven so that, after an hour, the New York oven is seven degrees hotter, and after three hours is ahead by eleven degrees. That is a complicated matrix of differences for cooks to manage.

And how about braising and stewing? The guys say that differences in the shape and color of a pan can cause variations in cooking temperature of up to thirty-six degrees, and that differences in atmospheric humidity can cause fluctuations of up to eighteen degrees. So a different pan and different weather can cause a variation of fifty-four degrees. No wonder stews, in theory such a forgiving form of cooking, are in practice so easy to screw up.

The theme that runs through this discussion of traditional cooking techniques is their underrated complexity and the resultant variability of their outcomes. Hence the team's affection for sous vide. If this six-volume, million-word-plus book had to be summed up in three words, they would be "Sous vide rocks." We're back with the question of control and precision, which is one of the things deeply loved by modernist chefs. Another thing they love is magic—and recent culinary discoveries have opened up extraordinary possibilities for the chef to serve things that the customers had never thought were possible. Foods that change temperature when you eat them, a cup of tea that is cold on one side and hot on the other, an edible menu, a "Styrofoam" beaker that turns into a bowl of ramen when the server pours hot water over it, edible clay and rocks, a pocket watch that turns into mock-turtle soup, a bar of soap covered in foam that is actually a biscuit with honey bubbles, a milkshake volcano—these are the kinds of thing with which the modernist chefs amaze their audience.

Such feats are enabled by a range of new ingredients that make their way into foams, gels, and emulsions—the mainstays of the traditional kitchen. (Most batters are foams; milk and Coca-Cola and mayonnaise are emulsions.) Ingredients such as low-acyl gellan, N-Zorbit, and carboxymethyl cellulose make all sort of tricks possible. Methyl cellulose, for instance, is liquid when cool and solid when warm; modernist chefs have lots of fun with that. ("Meth cell," as the modernistas call it, also has the property of passing through the human system undigested, and is a principal ingredient in some personal lubricants and laxatives—but let's not dwell on this.) As for the gadgets, they offer at least as much entertainment. Water baths and vacuum sealers (for sous vide) and combination ovens (for wet-bulb temperature control) are basic, but there's so much more, from Dewar flasks for liquid nitrogen to centrifuges for separating ingredients to rotor-stator homogenizers to Pacojets for making sorbet out of pretty much anything.

At this point, the home chef—sweating over a partner's birthday dinner, or harassedly feeding small children, or reheating yesterday's casserole, or muttering in front of an empty fridge—will be inclined to ask, What's in it for me? The answer is that the work does contain quite a few tricks and useful pieces of know-how. The "Modernist Cuisine" authors argue, contrary to the received wisdom, that the best way to cook a steak is to flip it every fifteen seconds: they say it's quicker, more even, juicier, and needs less resting time. (They also claim to have a way of improving wine by "hyperdecanting" it via sixty seconds in a blender—the idea being that it will benefit from the oxygenation and outgassing effects. My solemn, taking-one-for-the-team experiments with red wine have partly confirmed this for Schwarzeneggerian young reds.) For the most part, though, the take-home message of the modernist revolutions seems limited. Contemplating a barbecue? The "Modernist Cuisine" mavens have much to say about regional variations in barbecue, and then give a recipe whose suggested equipment includes a smoker, a sous-vide bath, a centrifuge, a rotary evaporator, and liquid

nitrogen. Similar demands are made by most of the book's inventive, thoughtful, beautifully reproduced recipes: their net effect will, if anything, widen the gap between ordinary and professional cooking. The truth is that this stuff is for the pros.

I speak with feeling, because I've spent quite a bit of time over the years doing mad-scientist experiments of a budding modernist type, and inflicting the results on my family. I've fooled around with cooking at very low temperatures, both in a traditional oven and via the kitchen-sink method that David Chang calls "ghetto sous-vide." I've bought a nitrogen-powered siphon and used it to make elBulli-type experimental foams. My Christmas present two years ago was a Spherification kit from a company called Texturas, part owned by Ferran Adrià. It had a set of tools to make spheres out of stuff—modernists are big on spheres—and a leaflet of not especially helpful recipes.

Armed with my new kit, I set out to make reverse-spherical mozzarella balls. These are made from a blend of whole mozzarellas, chopped mozzarellas, and mozzarella water mixed with a modernist-favored ingredient called Algin, which instantly gels any material containing calcium. The idea is essentially that you deconstruct mozzarella, then put it back together, and graciously accept the public's applause. The results looked all right. The problem was pointed out by my son, and, once pointed out, was very hard to ignore: the reconstructed reverse-spherical mozzarella had the texture of snot. As for the taste, well, let's just say that it wasn't the opposite of snot—more a cross between snot and mozzarella water. My turn to go fetch the takeout.

The other techniques offered some successes: slow-and-low is a great way to cook beef, as long as you can spare the time, and can go to the trouble of making a sauce separately. The most instructive dish, however, was one of the failures, a slow-and-low chicken, cooked for several hours and served when its internal temperature had hit 149 degrees Fahrenheit. The problem was that, with all its juices still inside, it tasted far too chickeny. If you oven-roast chicken the regular way, you get used to the drying effect of the heat, and to the fact that some juices go into the pan and are recycled as gravy. With this version, the bird was so moist that its texture was almost jellied, the flesh was a faint pink, and the chicken-explosion of flavor was overwhelming. In a sense, it was too good. My roast-chicken-obsessed children threw down their cutlery in protest after a single mouthful.

The lesson was that no taste is inherently better than another: within certain physiological constraints, tastes are not innate but learned, and the acquisition of tastes is a kind of dance between the person at the stove and the person at the table. The dance between the cook and the eater goes on longest at home, which is why we grow up loving a food from our first and most sustained encounter with it: nothing will ever beat your mom's chicken, or meat loaf, or whatever it was. No food can ever mean as much to you as that food once did. That is why most of all the cooking in the world is comfort food. It is food designed to remind us of familiar things, to connect us with our personal histories and

our communities and our families. That has always been true and it always will be true.

This doesn't mean that all food must be comfort food, everywhere and always. Ambitious chefs do a version of what Wordsworth was said to have done in his poetry, which set out to "create that taste by which its productions are to be appreciated and admired." The chefs whose taste creation has been the most influential in recent years are those, led by Alice Waters, who have stressed the primacy of ingredients and the connection between the farmer and the cook. There was a time when that emphasis on ingredients seemed quaint; now it is at the center of what chefs do, and it has also had a big impact on the way ordinary cooks think, shop, cultivate, and prepare food, from the elementary-school kitchen to the White House garden. Perhaps the best thing about this movement is that we can put it into daily practice for ourselves.

Modernist cooking is different from that: instead of inviting us to think about what we can do at home to copy the model offered by the best restaurants, it enacts a break between the high end of cooking and the levels below. In return, it proposes all kinds of new possibilities for food that takes us beyond familiar sensation and familiar language; food that is, to some deliberate extent, uncomfortable. In the dance of cook and eater, some cooks have some new moves. Thanks to modernism, we can look toward tasting things we didn't know before, even things whose existence we didn't begin to suspect. The restaurants that are inviting their customers to follow them down these unfamiliar paths will always and necessarily be a little bit ahead of us. "Modernist Cuisine" is going to be the definitive reference point for this new cooking for many years to come. There's something exciting about that, and there's a sense of loss in it, too—a little like the nostalgia we feel for the time when the most advanced composers alive wrote tunes that anyone could hum. ♦

PHOTOGRAPH: COURTESY THE COOKING LAB

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