Lessons from Molecular Gastronomy

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The tenderness of the cooked egg white depends on the quantity of water trapped (the loss of a part of this water is what makes overcooked fried eggs rubbery and overcooked yolks sandy) and on the number of proteins making up its lattices (more lattices mean that more water is trapped, rigidifying the entire system).

– Hervé This

A typical meal at Ferran Adrià's restaurant, elBulli, consists of about 36 courses and takes about six hours to complete. More than two million requests come in from around the world for the 8,000 seatings available during the dining season (typically from April through October). By most accounts, elBulli is the most important restaurant in the world, and Adrià, the world's greatest chef. The restaurant, located north of Barcelona in the Catalonian city of Roses, overlooks the Cala Montjoi Bay on the Costa Brava, detached from the frenetic competition of the culinary capitals. It is a tranquil and unexpected setting for what has become the most celebrated and controversial practice in the world of cuisine. In cuisine, as in architecture, there is an ever-present debate between the old and the new, and Adrià is now at the center of the exchange. Famous for creations that defy our normal expectations about food, Adrià combines unconventional techniques and current research into food's chemical underpinnings to fabricate his

culinary universe. Some insist that his work violates the sanctity of proud food traditions, while others contend that Adrià's work revitalizes and extends them.[1] The work has been celebrated as a shiny fruit born of scientific progress, while also being attacked as yet another technology fad. Through the unexpected media of food, Adrià has become the perfect lightning rod for the interminable and often acrimonious exchanges between science and art, preservation and innovation, functional necessity and expressive liberation.

Widely recognized as the greatest innovator today in the culinary arts, Adrià is at the forefront of a movement that critics now refer to as *molecular gastronomy*.[2] Though molecular gastronomy is now the most widely used description, many other labels have been associated with this type of work, including science food, space food, future food, and hypermodern cuisine. Consistent with the many labels, molecular gastronomy emphasizes the most contentious aspect of the work. Art and science appear to commingle, inducing both excitement and dismay. Most would not expect the words *molecular* and *gastronomy* to belong together. Just as knowledge of trichology is not a prerequisite for expert hair styling, cooking is not something one would expect to be informed by biochemistry. The suggestion that an activity as personal and intimate as eating is being infiltrated by science draws expected scrutiny from onlookers who never expected such controversy in food.

Mirroring many of the impulses and obsessions of contemporary architecture, Adrià and his fellow molecular gastronomists are radically extending the perceived limits of their practice by embracing attitudes and technologies that were previously considered out of bounds for haute cuisine. Just as exotic technologies have dominated recent experiments in architecture, these chefs have been experimenting with lab technologies and chemical products in their kitchens. Against the grain of popular wisdom, the microwave oven is taken very seriously as a vital tool (versus an expedient), as are induction burners, syringes, liquid nitrogen, and an interesting tool called "The Anti-Griddle" (a device that consists of a cooking surface that cools to -30° F). In addition to chopping and steaming, molecular gastronomists delaminate and aerate. In addition to pepper and butter, in their kitchens one finds liquid nitrogen and alginates. Though they deep fry battered vegetables in a kettle and thicken sauces in a bain-marie, they also use desiccators and centrifuges. The molecular gastronomists work closely with food companies such as Evonik Degussa[3] in order to incorporate new synthetic compounds that manipulate textures and flavors. Illustrating this controversial openness to explorations within a clinical world, Adrià is embarking on a collaboration with researchers at Harvard[4] to further investigate and extend his use of hydrocolloids.[5] Otger Campàs, a postdoctoral fellow in applied physics at Harvard, mentions their mutual interest in "soft condensed matter."[6]

A typical meal at elBulli is a marathon for your senses. As soon as you sit down at the table, a waiter brings a cubic container made entirely of ice. Sitting on it is a small portion of flavored granita topped with a delicate white spume that the waiter calls "salted air."[7] This is your margarita. After your cocktail, you are brought a jar containing what looks like olives. The waiter serves one on a large spoon and leaves the jar with you. What you thought was an olive disappears on your tongue. All that is left is the flavor of olives. Later, you see a frozen foie gras that is shaved into a fine powder and served in a hot consommé. The simultaneous sensation of hot and cold is uncanny. The flavor is intensely familiar, but it comes through an entirely novel and contradictory form. As you prepare for a course of "spaghetti carbonara," the waiter brings a pressurized canister with a thin plastic tube coming out of it, reminiscent of a medical tool, and slowly extrudes into your bowl a long single strand of parmesan flavored jelly. The grotesque sight of a small fried fish carcass encased in fine filaments of sugar is a revelation about

cotton candy and the flavors of Spanish seafood. About three hours into the dinner, you are brought "marble soup" – small globules of coffee and rose water magically suspended in a lychee broth. It is followed by a plate of what looks like soil and pebbles. This "chocolate soil" is composed of high-quality chocolates prepared in a variety of textures and shapes.[8]

A stunning panoply of manipulated sensations, dinner at elBulli exemplifies the molecular gastronomists' scrupulous search for new expressions in the world of food. It is important to recognize this aspect of the work because their astonishing successes can sometimes be eclipsed by the stunning virtuosity at work in their kitchens. Given these fantastic techniques, the molecular gastronomists are not scientists at all, but artists. Scientific knowledge establishes the basis for the theoretical concepts to manipulate and stretch the material limits of natural ingredients; the advanced technologies become the means by which molecular gastronomists transform matter. But they transform matter not for the sake of scientific discovery, but to extend the possibilities of human experience (hence this cuisine is also known as "techno-emotional"). Despite all the attention given to their interest in science and technology, the molecular gastronomists exhibit all the hallmarks of the creative practice. Throughout the work, there is a remarkable absence of a discernible methodology. The work is never procedural, but conducted through trial and error. Rules are provisional and frequently broken. Esoteric intuitions about taste and secret tricks abound. A heightened sense of opportunism pervades the work of these molecular gastronomists as they seek out new sensations by any means necessary. The experiments are prolific and carefully thought out. Every creation precisely targets a possibility latent in the materiality of food to elicit new sensations and unexpected pleasures.

Looking beyond the weird chemical compounds and laboratory gadgetry, the molecular gastronomists are distinguished by their extreme focus on novelty and their constant attention to the delicate relationship between artistic expression and physical sensation. Forgetting about the processes and techniques (and these chefs would prefer that you do) and looking at the end results illustrates their focus on the alteration and reconstitution of food's material properties to open up new possibilities for life. Though they indeed incorporate unexpectedly clinical techniques – such as suspending liquids laced with polysaccharides within sodium chloride baths or using induction chambers into which gelatins are slowly dripped with large syringes – above all, the molecular gastronomists anticipate the pleasure and emotional responses their creations might generate. Adrià represents the general attitude of this movement when he forcefully articulates in every interview that he is primarily interested in pleasing the senses, and that this requires him to deeply question the techniques of cooking. "If you want emotions, big emotions, you need new techniques!" he declares in one interview.[9] Adrià often describes his intentions in such a way that he seems to be searching for ways to scratch an itch on a part of the body that we never knew existed. When successful, the prepared dishes move beyond just tasting good. They become new expressions of life.

Even though great success has come with all of the attention[10], the molecular gastronomists generally abhor the scientific manner in which they have been labeled. Their discomfort with how the work seems to be perceived has led a number of them to write a collective public statement to communicate their values. Adriá, along with Heston Blumenthal (The Fat Duck, Bray, Berkshire, UK), and Thomas Keller (Per Se, New York City, and French Laundry, Napa Valley), published a piece entitled, "Statement on the 'New Cookery'" in 2006 where they attempt to clarify what they understand to be a miscommunication between the connotations of molecular gastronomy and their actual intentions.[11] They point out that they are not against tradition and actively seek to question and evolve our

expectations about what food can and cannot do from within their inherited discipline. They insist that above all, they are focused on excellence and are thoroughly embedded in the expertise of culinary practice. They are doleful in their expressed concern for how the younger generation of chefs might be misunderstanding their work, and worry that young chefs are rallying around the pageant of new technologies without paying proper attention to the deep intelligence and expertise of a thousand-year-old culinary art. They also worry that the next generation is more interested in spectacle and success than in the more fundamental goal of productively extending a very old and important human practice.

Despite the rave reviews of the food experiences produced by Adriá, the measure of success in this practice is both obvious and elusive. We can simply ask if the food tasted good because this is about eating after all. Or we can verify things like blood sugar level after the meal and invent a psychometric chart of some sort to measure the eater's happiness, but these are obviously trivial considerations. As is always the case with an art form, the most important results are not verifiable. Accordingly, it is difficult to apprehend the implications of the more ambitious questions regarding the search for new sensorial territories or to what degree these pleasures are acceptable within a given ethical structure. If this sounds too serious for food, you may consider the fact that these restaurants are some of the most expensive in the world and very few people are able to experience it. There are numerous complaints that molecular gastronomy is ultimately too exclusive and elitist and ignores far more urgent problems regarding hunger and sustainable agriculture. There are complaints that the practices are not respectful of cultural heritage. There are also concerns that these dishes might simply be unhealthy.[12]

At these junctures, the parallels to contemporary debates in architecture are delicious. Just as some in the younger generation of chefs have been labeled "molecular gastronomists," in architecture, we have those in the younger generation labeled "digital architects." We see similar controversies about technology and artistry, questionable forays into the world of science, ambivalence in the face of tradition, and a so-called lack of professional responsibility for providing basic nourishment or shelter. Just as the molecular gastronomists hate the way they have been labeled, the digital architects do as well. In the best cases of both practices, the incorporation of strange new technologies was never something to be celebrated. It was just a means to an end, and though the attention to technique can be useful, the emphasis on processes distracts from the more important goals pertaining to the implications of the work itself.[13]

It is useful to put all of this into perspective. Molecular gastronomy is not the only important emerging practice in the world of food. In a different area of haute cuisine, practitioners are focusing exclusively on the integrity of local traditions and ingredients. Mirroring ecological interests in architecture, Alice Waters has pioneered the organic food movement in California with explicit affiliations to the politics of sustainability (and in Italy there is the Slow Food movement). Multiculturalism, also known as "fusion," is well represented and debated. *Cuisine classique*, which has fascinating parallels with modernism in architecture, continues to be practiced by some of the best restaurants in the world. *Nouvelle cuisine*,[14] a movement that opened the doors to molecular gastronomy, is also alive and well.[15] Beyond the expensive restaurants, there is an endless and beautiful array of traditional ethnic restaurants. And occupying the greatest space in the world of food is the generic, branded, industrially manufactured food that has now become our daily bread.

Molecular gastronomy may sound new, but a quick glance at the ingredients label on any soda can will reveal that it has been with us for a while in a more insidious form. Surprisingly, molecular gastronomy uses food technologies that are already with us, bringing a critical focus to a state of affairs we would

rather ignore. The cultivation and processing of raw ingredients in the field and in the factory remain one of the largest components of the global economy. Clearly, the invention of new ways of working with food, the incorporation of synthetic production, the redefinition of food, and the act of eating, have grave implications for all of us.[16] Yet despite the material repercussions of culinary innovation, the most important contribution of the molecular gastronomist concerns the transformation of our subjectivity. When the eater says, "I've never tasted anything like that before!" we are witness to life redefined. Given that the preparation of food as a practice has been with us since the beginning of civilization, to have discovered a new territory for human sensation is utterly profound. Jean Anthelme Brillat-Savarin, who in the 18th century may have been the first philosopher of food, writes, "The discovery of a new dish does more for human happiness than the discovery of a new star."[17]

Even when made aware of all the reasonable complaints, the general public continues to be fascinated by and celebrates the rarefied practices of these molecular gastronomists. Getting a reservation at elBulli is increasingly like winning the lottery, and Heston Blumenthal's BBC series on his molecular gastronomy techniques, "In Search of Perfection," continues to be a very popular program on the BBC network.[18] Though this type of adulation can be disconcerting at times, it is a beautiful thing to be reminded that our culture continues to value artistic practices that extend the possibilities of the human being. Despite inclinations to rationalize and categorize our nature, we remain majestically indeterminate.

The concerns that revolve around art and science, innovation and preservation, the search for new expressions of life, and the demands for verifiable instrumentalities are now critical issues in every contemporary material practice. To see this play out in the world of food, to have all of these problems and possibilities served on a plate, is wonderful for its immediacy. Savoring the results, we can walk away from the table with a few lessons for architecture.

Lesson 1 – Technique is Promiscuous

There have been numerous recent debates in architecture attempting to identify the core of architecture's expertise and intelligence. When the occasional project expresses its affiliations to such things as cybernetic networks or biological form, we often find detractors who believe that design techniques culled from external disciplines are not properly architectural. One of the most important lessons of molecular gastronomy is that it is hopeless to insist that techniques are native to specific disciplines. In the culinary arts there is evidence all around of just how promiscuous a technique can be.

For example, Ferran Adriá recently achieved notoriety for his spherification technique. The technique produces discrete globules of liquid that seem magical because each globule is held together by nothing but itself:

> *Spherification was an idea I got from a factory visit in 2003. I went there with a friend, and we saw a little glass that had spheres in it. I asked, "What is this?" They started saying it was an alginate solution. "Do you have alginate here? Give it to me," I said. You have to put some calcium chloride in it to get the effect, so we went to the drug store and bought some. We arrived at our workshop and we began to mix things – and the first sphere was made. It was like magic, but we were limited to a small number of products. The moment we put alginate in any liquid that has any acidity or salinity, it will not work. But then we realized that if we made a bath of*

> *this alginate solution and we simply added yogurt, then it reacted because yogurt contains calcium. That's the inverse spherification. Then we discovered calcium gluconolactate. It's a salt which is completely tasteless. We can now construct spheres with whatever liquid we want inside.*[19]

Microbiologists would recognize the phenomena, as they regularly use alginate solutions to suspend cultures in petri dishes. The most commonly used alginate, agar, extracted from seaweed, has been known for 1,000 years in Asia, where it is a common ingredient for making gelatinous soups in China (hot and sour soup for example) or dessert candies in Japan. It is also used to form salt bridges in electrochemistry, and sometimes used by dentists to form dental impressions.

Adriá has also incorporated the technique of spinning cotton candy. Though spun sugar is something that has been known since the Middle Ages (most likely an accidental discovery), the mechanical version of the technique was first invented in 1897 and made famous during the St. Louis World's Fair in 1904 where it was called "fairy floss." Delightful as candy, the mechanical production of unstructured filament networks can also be encountered in more consequential applications. Dupont uses a related technique for producing Tyvek, a fairly common product used mostly as a water barrier in the building industry. Earlier this year, researchers at New York-Presbyterian hospital published a paper describing a technique using a similar technique to that of making cotton candy for growing human tissue.[20] Astronomers at NASA recently discovered that comets are not solid boulders of frozen water but more like cotton candy.[21]

In these and many other similar examples, it is virtually impossible to identify a given technique for manipulating matter as being native to a specific discipline. Further, the expertise and intelligence of a given discipline necessarily evolves beyond its orthodoxies because of the irrepressible promiscuity of techniques.

Lesson 2 – Methodology is an Unnecessary Burden

In architecture, the words *technique* and *methodology* are often used interchangeably. Although it may seem like splitting hairs, it is more accurate and useful to make a distinction between these important words. In short, a technique is a way to do something. In contrast, a methodology is a comprehensive system of techniques governed by a theory about why a way of doing something is the right way. It is important for methodologies to be repeatable and, to a large extent, verifiable, but most important, a methodology puts forward an explicit or implicit theory about why a way of doing something is "the right way." Though as architects we continue to be obsessed with the holy grail of a fool-proof repeatable design process that guarantees success, the intellectual and ethical burdens of possessing a privileged design methodology is largely unnecessary for the development of significant expressions.

There is no way to do full justice to the importance of the distinction between technique and methodology here,[22] but for the sake of clarification, a useful example is the Suzuki Method in music. The Suzuki Method is not merely a way to learn a musical instrument. It is also an idea about educating children in a highly specific way – ultimately, for goals that have nothing to do with learning the violin, but are about transforming the attitudes of children through music. On the other hand, the jazz saxophonist Ornette Coleman is a terrific example of technique developed outside of methodology.

Famous for being self-taught, Coleman developed his unique style at the margins of the music world and eventually developed an unusual set of techniques for playing jazz that were utterly personal. These techniques were perceived by sympathetic observers as unorthodox but compelling, while harsher critics dismissed him as being ignorant about "the right ways to play." Later in his career Coleman tried to formulate a methodology from his techniques called "harmolodics." [23] Notorious for its ambiguity, it hasn't had many adherents, although Coleman has used the formulation of his methodology to make some claims about the ethics of his music.[24]

In the absence of a methodology, whether in music or cuisine, there is nothing but an unfettered opportunism at work in the service of expressive development. Methodologies produce consistencies within a larger group and articulate a greater purpose to the practice, but they also sacrifice the development of new expressions. It is interesting to note that many critics observe that Coleman never seems to be following a methodology himself. He uses the theory of "harmolodics" to explain his goals and his values, but ultimately, all he is trying to do is make real the music that he already hears in his head.[25] Though Adrià has recently published a series of extremely ambitious books in an attempt to outline his methodology, what ultimately separates him from other chefs is his powerful and singular expression as an artist.[26] All of the techniques opportunistically culled from various sources stem from what is now his twenty-six-year obsession with making real the food that he already tastes in his mouth.

Lesson 3 – Technology is Poignant When Sublimated

In the protracted investigation of technology and its role in architecture, many peculiar examples can be found where the technological conditions accidentally became more important than the architectural considerations. Projects became famous and important for being drawn with projective geometry, or for being made out of a steel-frame, or for having been designed on a computer, etcetera. However, the most important projects, the masterpieces of the discipline, share in common the sublimation of their technologies within the more generalized architectural goals. It begs the question whether one would really think a project is great just because it has solar panels on it? Or because it was fabricated with a CNC mill? Or because its form was designed with a computer script?

At elBulli, the technology that goes into producing the work is often extremely complex. However, the staff prefer to keep all that hidden during presentation at the dinner table. They sublimate the technology and the burden of its implications to leave the diner to focus on the sensations alone. The sublimation of technology brings about a magical effect. "How is this done? It seems impossible!" In the sciences, technology is never sublimated within the hypothesis. To do so would obviously obscure the validity of an investigation's results. In the arts, the problems are different. As the material world continues to lose its magic through the knowledge of its causes, it becomes the burden of artistic practices to reintroduce magic into the world by obscuring material causes once again. Otherwise, the scientific mind brings verifiable instrumentalities to our dinner table:

> *We should avoid making the same mistakes that French chemist Marcellin Berthelot made about a century ago [in 1894]: he predicted that the success of organic chemistry would allow us to abandon traditional food and, by the year 2000, eat nutritive tablets instead. He was obviously wrong – humans are living organisms, with an extremely sophisticated sensory apparatus that has evolved over millions of years to detect odour, taste, consistency, temperature and more*.[27]

Always, there is the eventual realization that there was a trick behind the magic. We are painfully aware of how technology inscribes the image of the world today, and as the magic of the artistic practice wanes and the opacity of the creative imagination becomes transparent, the tools of the magician become remarkably poignant.

Lesson 4 – Experience is Multimodal

Just as the eye is said to be dominant in architecture, so is the mouth in cuisine. Adrià and his colleagues however assert that taste is not entirely in the mouth, and it echoes the assertion of many architects that seeing is not entirely in the eye.

Molecular gastronomists continue to develop an approach to food that understands synaesthesia as the rule, not the exception. They insist that taste is a sense that is highly misunderstood. Researchers point out that the 10,000 taste buds on the tongue form an exceedingly complex network of taste receptors, the workings of which are far from being fully understood.[28] They also point out that it is difficult to completely separate how something smells from how something tastes. Further, chefs throughout the ages have always known that what one sees and recognizes on a plate will have a subtle but undeniable influence on how it will taste when put in the mouth.[29] One of Adrià famous dishes consists of a caviar tin served on a plate. Upon opening the tin, you see the familiar sight of dark wet globules of sturgeon roe. When you eat some, you realize that it is not caviar at all, as your mouth fills with the flavor of apples. Made from the essence of apples and suspended in an alginate solution, the dish of tiny globules is one of his more famous magic tricks. Of course, the interesting moment is when the expected flavor of caviar mutates into the flavor of apples. Heston Blumenthal, at The Fat Duck, claims that the most interesting problem of molecular gastronomy is "sensory design" where all the senses have to be coordinated to reinforce or transform the taste of food.[30] Another dish served recently at elBulli consists of a spiral "discovery trail" of 12 different tiny samples of seaweed sequenced according to taste and physical consistencies such as color and texture. It is called "The Sea." It is intended not as a representation of the sea but as a small world, in and of itself, where the experience of the sea returns in a new way.

Design has been heavily influenced by the classification of the senses. The dubious but commonly held notion that each of the senses is an independent pathway has led to a correspondingly dubious strategy for engaging individual senses (most of time, sight) through representations – this smells like, this sounds like, etc. Experience itself is never as simple, and our sensory apparatus is far more complex than is suggested by the widely assumed categories of the senses. Acknowledging that experience is fundamentally multimodal and that the sensory apparatus is a synthetic amalgam of the sense categories, other possibilities may open up for the designer that do not rely as much on strategies of representation.

Lesson 5 – Orthodoxies Must be Challenged

A well-known architect remarks, "Being an expert might just mean you've been doing it wrong for a very long time." It is the tragic fate of important innovations to become dry orthodoxies over time. The only reason to preserve orthodoxies is the belief that we are somehow in the process of completing a systematic encyclopedia of all possible innovations. When that encyclopedia is finished, all we would

have to do to design a project is look up the problem in the appropriate section and follow the rules. If you don't believe that the completion of such an encyclopedia is possible, you have no choice but to continue to innovate and challenge orthodoxies.[31]

Hervé This reminds us that even as recently as 2001, an inspector from the French Department of Public Education claimed during a public lecture that the failure of a mayonnaise to emulsify was attributable to the fact that she was menstruating while making it.[32] The inherited superstitions and irrationally rote procedures in cooking are quite strange at times. Some of these are fascinating when investigated by the scientist. For example, the transformations in the molecular networks of an egg reveal both fascinating confirmations and negations of rules set out in the *Larousse Gastronomique*. Why add eggs to boiling water in order to center the yolk? Why add the meat to a *pot-au-feu* when the water is still cold? Does searing actually seal in the juices when grilling steak? Does cutting off the head of a suckling pig actual make its skin more crispy? Is the gnocchi ready when it rises to the top of the pot? Some of these rules turn out to be true, while others are hopelessly unreliable or inaccurate. For all of the pitfalls in the interactions between art and science, at least in molecular gastronomy, scientific study has opened lines of investigation in the culinary arts that have been closed for a very long time. Similarly, the critical eye will reveal that many of the traditional dictums of architectural composition are superstitious. In architecture, as well as in cuisine, one of the positive effects of technological advancement and scientific understanding has been to destabilize long-held assumptions and engender new understandings of the practice. We may celebrate these new insights into the material substrates of experience just long enough to realize that one hundred years from now, many of these insights will seem absurd.

Lesson 6 – It's All Good.

It is remarkable that when it comes to food and its many manifestations, we are much more tolerant of diversity than in any other material practice. We will comfortably go from a pizzeria to a sushi bar to the establishment of a molecular gastronomist without ever pausing to worry about which is best or right. Is there anything more absurd than thinking about whether or not the food on your plate has a legitimate reason for being? The acceptance of diversity in the food world is both admirable and perplexing when compared to other practices, such as architecture, for example. There are some exceptions, of course, such as restrictions imposed by religious beliefs or certain ethically motivated vegetarian and vegan diets. But for the most part, nothing engages more completely with the beautiful diversity of the material world than the simple act of eating.

This is not so much a lesson about molecular gastronomy as it is about the food world in general. However, we can observe that as an emerging practice, molecular gastronomy has taken the notion of infinite diversity and elevated it to a governing sensibility in the work. It is utterly contemporary in attitude and is cause for some optimism tomorrow.

[1] A caustic public exchange in 2008 occurred between Adrià and one of Spain's most respected traditionalist chefs, Santi Santamaria. Santamaria attacked Adrià work as being sensationalist and incorporating chemicals that were bad for health. Adrià was somewhat diplomatic in his defense, but many chefs have attacked Santamaria accusing him of making the comments out of jealousy. See Ben Harding, "Spain kitchen spat boils over as top chef hits out," *Reuters* (17 June 2008). See http://www.reuters.com/article/lifestyleMolt/idUSL1738681920080617

[2] The term "molecular gastronomy" is first coined by Oxford physicist Nicholas Kurti and the French chemist Hervé This in 1988. Though the term is now generally used to describe an emerging movement in haute cuisine, Hervé This disputes this use of the term. He insists that the term should be used exclusively for the scientific study of food chemistry. See Hervé This, *Molecular Gastronomy: Exploring the Science of Flavor*, trans. Malcolm DeBevoise (New York: Columbia University Press, 2005), 31.

[3] Evonik Degussa GmbH based out of Essen, Germany, is the world's largest producer of specialty chemicals.

[4] See Elizabeth Gudrais, "The Harvard Center for Gastrophysics?" *Harvard Magazine* (March–April 2009).

[5] See Howard Chua-Eoan, "Adria at Harvard: The Top Chef and the Scientists," *Time* (December 11, 2008).

[6] Hervé This observes, "All foods are complex disperse systems, also called 'soft matter'. The simplest of these systems – formerly called colloidal – are well known: emulsions, foams, gels and so forth. However, when food involves more than two phases, this classical description is no longer sufficient to describe something as simple as custard – which is probably why physicists eventually gave up trying to find a global description of complex systems and instead focused on interfaces between different phases. But food needs more than interfaces to describe it; even a simple sauce such as a *béarnaise* consists of three phases: solid matter (microscopic egg-yolk aggregate) and a hydrophobic liquid (oil droplets) dispersed in a hydrophilic liquid (water)." See Hervé This, "Food for tomorrow? How the scientific discipline of molecular gastronomy could change the way we eat." *EMBO Reports*, vol. 7, 11 (2006), 1062–66. See http://www.nature.com/embor/journal/v7/n11/full/7400850.html

[7] See Ferran Adrià, *A Day at elBulli: an insight into the ideas methods and creativity of Ferran Adrià*, (London: Phaidon Press Limited, 2008), 268.

[8] Other than the "salted air," the rest of these examples are taken from Anthony Bourdain's presentation of his visit to elBulli. Towards the end of the meal, Anthony Bourdain narrates, "I sit and eat what is for me by turns a delicious, shattering, wondrous, confusing, strangely comforting, frightening, and always wonderful meal." See *Decoding Ferran Adrià: Hosted by Anthony Bourdain*, DVD-ROM (Ecco, 2006).

[9] Ibid.

[10] In the case of elBulli, the restaurant reputedly does not make any money (turn a profit), whereas the books and lectures do.

[11] See, Ferran Adrià, Heston Blumenthal, Thomas Keller, and Harold McGee, "Statement on the 'new cookery,'" *The Observer* (December 10, 2006). See http://www.guardian.co.uk/uk/2006/dec/10/foodanddrink.obsfoodmonthly

[12] The Fat Duck was closed recently due to a rash of complaints from ill customers … This was later attributed not to the food preparation itself but to an ill staff member.

[13] In addition to the parallels to recent architectural experimentation, there are also comparisons that have been made to recent attitudes in contemporary art culture. EDITORS NOTE: See Richard Hamilton and Vicente Todoli, *Food for Thought,Thought for Food* (Barcelona: Actar, 2009) for a summary presentation of elBulli's appropriation by the art world (artists and curators), and vice versa, including the Cala Montjoi restaurant's inclusion in *Documenta 12* (2007) as Pavilion G. The Artistic Director of *Documenta 12*, Roger Buergel, chose "daily in a random way" two persons amongst the visitors in Kassel and offered them "the possibility of living the unique experience of having dinner at elBulli." (Documenta Press Release) See http://www.documenta12.de/d120.html?&L=1

[14] *"Cuisine classique"* introduced the convention of multiple having courses within the meal. It also inaugurated an important period where the techniques of preparation became more rational and systematic. It dominated much of high haute cuisine in the 20th century until *"nouvelle cuisine"* appeared in the 1960's, challenging the orthodoxies of *cuisine classique*. Though disputed, it is said that the term *nouvelle cuisine* was first used to refer to the meal served on the maiden flight of the Concorde, the first supersonic passenger jet.

[15] See Valeria Criscione, "A League of Extraordinary Chefs," The Wall Street Journal (September 4, 2009).

[16] See Paul Roberts, *The End of Food* (New York: Houghton Mifflin, 2008).

[17] See Jean Anthelme Brillat-Savarin, trans. M. F. K. Fisher, *The Physiology of Taste, Or Meditations on Transcendental Gastronomy* (Washington, DC: Counterpoint, 1999).

[18] A description of the program and episode guides are available on the BBC website. See http://www.bbc.co.uk/food/tv_and_radio/perfection/

[19] From Ewan Calloway, "Science is Vital Ingredient at World's Best Restaurant," *New Scientist* (March 20, 2009).

[20] See Malcolm Ritter, "Cotton Candy Can Help Labs Grow Tissue," *Associated Press* (February 11, 2009). See http://dsc.discovery.com/news/2009/02/11/cotton-candy-tissue.html

[21] See Linda Vu, "Cotton Candy Comet," *Spitzer Science Center* (October 13, 2005). See http://www.spitzer.caltech.edu/Media/happenings/20051013/

[22] It is worth mentioning that this distinction is deeply seated in Western philosophy. See Plato's *Republic*, where the politics of technique and methodology is expounded. See Plato, ed. G.R.F. Ferrari, trans. Tom Griffith, *The Republic*, (Cambridge: Cambridge University Press, 2000), Book X, 606a–607b.

[23] See David Remnick, "The Jazz Life of Ornette Coleman's Harmolodics, at home," *The New Yorker* (June 5, 2000), p. 33.

[24] Coleman's impenetrable theory questions traditional music theory and seeks to combine the problem of melody, harmony, and rhythm into a synthetic whole. See Andrew Purcell, "Free Radical," *The Guardian* (June 29, 2007). In this interview and others, the theory is often conflated with an ethic of radical liberation. It is in a sense, a methodology to do away with methodologies.

[25] This is a very common explanation among Jazz musicians to explain the origination of the improvised music—the music is not the unexpected result of a theoretical procedure but is something that is immanent to the performer. The complex techniques are there to assist the musician in making 'real' what is already there in some sense. This is an important comparison to make with regard to Adrià and his confederates. It emphasizes the molecular gastronomists' strongly held position that the artistic imagination is, in the end, far more important than the procedures themselves.

[26] Adrià's archival volumes are among the most ambitious books published in recent time. See Ferran Adrià, Juli Soler, *ElBulli 1983-1993* (Barcelona: Rba Libros, 2007), Ferran Adrià, Juli Soler, Albert Adria, *ElBulli 1994-1997* (New York: Ecco, 2006), Ferran Adrià, Juli Soler, Albert Adria, *ElBulli 1998-2002* (New York: Ecco, 2005), Ferran Adrià, Juli Soler, Albert Adria, *ElBulli 2003-2004* (New York: Ecco, 2006), and Ferran Adrià, Juli Soler, Albert Adria, *ElBulli 2005* (Barcelona: RBA Libros, 2006).

[27] From Hervé This, "Food for tomorrow? How the scientific discipline of molecular gastronomy could change the way we eat," 1065.

[28] Lauralee Sherwood, *Human Physiology* (Belmont: Brooks/Cole, 2010), p. 229.

[29] The seemingly endless variety of forms for pasta is an interesting example of this point. For more clinical observations on this problem, see Vilayanur Ramachandran, Edward Hubbard, "Hearing Colors, Tasting Shapes" *The Scientific American* (May, 2003). In a reversal of the consideration, also see Mandy Kendrick, "Tasting the Light: Device Lets the Blind "See" with Their Tongues," *The Scientific American* (August 13, 2009). See http://www.scientificamerican.com/article.cfm?id=device-lets-blind-see-with-tongues

[30] See Melinda Joe, "Don't Call It Molecular Gastronomy—It's 'Sensory Design,'" *The Japan Times* (February 19, 2009).

[31] This is also the old argument between "merely building" and Architecture as a Fine Art, as defined in the Renaissance.

[32] Ibid., 1063.