Faux caviar made with apple juice from El Bulli restaurant in Spain.
Photo © Maurizio Borgese/Hemis/Corbis

BY GRACE S. YEK and KURT STRUWE
Molecular gastronomy was born in 1988, when two scientists, Nicholas Kurti and Herve This, created a new scientific discipline to investigate culinary transformations, specifically the chemistry and physics behind the preparation of food (This, 2006). Gastronomy was defined by Jean-Anthelme Brillat-Savarin (1825) in the Physiology of Taste as, “everything connected with the nourishment of man.” Alternately, Merriam Webster defines it as “the art or science of good eating.” As clear as the founding fathers of molecular gastronomy were that it was to be a science, the very definition of gastronomy lies in a nebulous terrain that is not strictly science but one where the vein of the culinary arts runs squarely across.

Kurti and This organized the first “International Workshop of Molecular and Physical Gastronomy” in 1992 in Erice, Italy, and invited both chefs and scientists to advance the dialogue of this new science. When Kurti died in 1998, This shortened the name to the “International Workshop of Molecular Gastronomy.” It remains a biennial invitation-only gathering of notable chefs and scientists (This, 2006).

Five Goals of Molecular Gastronomy
When This presented his Ph.D. dissertation “Molecular and Physical Gastronomy” at the University of Paris in 1996, he identified five goals of this new science: “(1) to collect and investigate old wives’ tales about cooking; (2) to model and scrutinize existing recipes; (3) to introduce new tools, products, and methods to cooking; (4) to invent new dishes using knowledge from the previous three aims; and (5) to use the appeal of food to promote science” (This, 2006). Of the original five goals, only the first two corresponded to science. The other goals were application and educational offshoots of the science of molecular gastronomy.

Today, molecular gastronomy still creates uncertainty. The chimerical food creations we witness today—fruit caviar, hot ice cream, and foam sauces—are creative kitchen applications of the science. The many names given to capture this kitchen approach, ranging from molecular gastronomy to culinary alchemy, fundamentally refer to the same idea: Tapping into science to improve cooking processes and expand culinary innovation. Harold McGee (2004), an award-winning food writer and eminent contributor to the field, perhaps said it best with the words “the science of deliciousness.” Peter Barham, a polymer physicist at the University of Bristol in the U.K., and a prolific contributor in the field, noted the interdisciplinary nature of the new science of molecular gastronomy. It encompasses a wide variety of topics, which includes understanding the effect of...
cooking methods on the attributes of food, the investigation of new cooking methods to improve and create new experiences in food, and the cerebral and sensorial interpretation of foods (Barham, 2008). Thus, it is no wonder that a new crop of avant-garde chefs (i.e., practitioners of the molecular gastronomy movement) seek not only to delight the guests’ palates, but also evoke emotion and stimulate all other senses, making their food nothing short of a performance.

It is also interesting to note that the early history of molecular gastronomy coincided with an American cultural phenomenon, the Food Network cable television station. The Food Network, launched in 1993, popularized the idea of food to the masses on an unrelenting 24/7 basis. The increasing media spotlight we see on molecular gastronomy in the United States—the recent episodes of “Gourmet’s Diary of a Foodie: The Science of Deliciousness” (Gourmet, 2008) and “Gourmet’s Diary of a Foodie: Avant-garde A la Carte” (Gourmet, 2008), feature articles in Popular Science magazine (2007) focusing on the new science of food, and coverage in The New York Times newspaper comparing chefs to chemists (Chang, 2007)—is perhaps no accident but the inevitable intersection of science and popular culture, held together by the fascination with food.

While molecular gastronomy is most developed in Europe, it is still considered a new science. With the exception of a few Ph.D. programs in Europe, getting a degree or carving out a career in molecular gastronomy is still hard to do (Pain, 2007). In the United States, the Research Chefs’ Association pioneered the field of Culinology®, which blends equal parts of food technology and the culinary arts. While only an approximation to molecular gastronomy, it is a field that offers viable higher educational degrees and career paths.

**Chefs and Restaurants**

Sometimes called the “Salvador Dali of the kitchen,” chef Ferran Adria has popularized the molecular gastronomy movement worldwide with his foams and faux caviar. Best known for his culinary foams, stabilized with gelatin or lecithin, Adria does not use the term molecular gastronomy, and says, “There isn’t a molecular cuisine. There’s a molecular movement, the molecular gastronomy, where some scientists cooperate with the world of cooking” (eG Forums, 2004). Adria’s place in culinary history began in the 1980s when he was promoted to head chef of a traditional French restaurant located on the Catalonian coast of Spain, north of Barcelona, named El Bulli (Moore, 2008). Today, El Bulli is a three Michelin star restaurant, which Restaurant magazine recently ranked No. 1 in the world for the past three consecutive years (Harding, 2008).

Whether chefs made the term molecular gastronomy famous or the term made them famous, it’s sometimes taboo to use the term to describe their work. Another chef who has played a major role in developing the movement is Heston Blumenthal, chef of Fat Duck, in Bray, England. He said, “the term creates artificial barriers” (The Observer, 2008). Known for its bacon and egg ice cream, the Fat Duck earned three Michelin stars in 2004, and has been named one of the top three restaurants in the world by Restaurant magazine since 2004 (Harding, 2008).

Some of his popular dishes—snail porridge and salmon poached with licorice—excite the senses, and sometimes, challenge the palate.

Grant Achatz, whom many consider a true American pioneer in this movement, calls the food “progressive American” at his Alinea restaurant in Chicago, Ill. While tapping into science to create his foods, he distances himself from molecular gastronomy, which he notes, feels like a science class. Achatz wants his restaurant to
feel more like the “performing arts” (savorycities, 2007). Known for its innovative approach to dining, Alinea’s customers may experience a floral or herbal aroma-filled pillow to complete the experience of the food on their plate. Achatz’s formula for success is undeniable; Alinea was named the “Best Restaurant in America” in 2006 by Gourmet magazine.

Also leading the American charge are Wylie Dufresne of WD-50 in New York, N.Y., and Homaro Cantu of Moto in Chicago. These chefs continue to inspire and fascinate, as they create from the crossroads of culinary arts and science.

Applications of Food Science
While food science is part of molecular gastronomy, its main application has traditionally been to provide safe and nutritious food for the masses in the most efficient and economical manner possible. As the Institute of Food Technologists (IFT) defines it, food science is “the discipline in which biology, physical sciences, and engineering are used to study the nature of foods, the causes of their deterioration, and the principles underlying food processing” (IFT, 2007). Furthermore, the application of food science—food technology—is defined as “the application of food science to the selection, preservation, processing, packaging, distribution, and use of safe, nutritious, and wholesome food” (IFT, 2007). Neither the science nor the technology is geared toward the study of restaurant cooking processes or the creation of new dishes in the kitchen.

Molecular gastronomy has helped bring the tools and technology that are commonplace in the food industry to the restaurant kitchen. Take, for example, the technique of spherification, where round “pearls” of gel with liquid centers (“caviar”) are created by dropping a flavorful base mixed with sodium alginate into a calcium chloride solution. Upon contact with the calcium ions, gelation occurs from the outside in. The longer the pearls remain in the calcium solution, the firmer and less liquid the centers become. While this is a fairly new application in the kitchen, alginites are well established as an ingredient in food manufacturing. The thickening and gelling properties of alginate have long been used in sauces and re-formed products such as restructured fish fillets, onion rings, and herb-flavored alginate gels used to stuff olives (McHugh, 2003).

Maltodextrin, a product of partial starch hydrolysis, is another crossover from food science. An ingredient used to transform oil to powder in the molecular kitchen, it is a staple ingredient in food processing used to disperse dry ingredients, stabilize high-fat ingredients, and a source of carbohydrate in high-energy drinks.

Recognizing the potential in bringing food science applications into the kitchen, Inicon, www.inicon.net, a European technology transfer program, was created in 2002 to impart knowledge from the science and food industry to the kitchen, and close the technical gap between the two.

Preparation and Cooking Techniques
Foams and airs, forms of foods that are certainly not new, were made fashionable in fine dining by chef Adria of El Bulli with his arsenal of hydrocolloids and nitrous oxide. One of his famous creations is “warm gelatin,” to which he adds agar (a seaweed powder) to stabilize warm beef gelatin (The New York Times, 2008). Another of Adria’s signature creations are foams, which are stabilized sauces aerated with nitrous oxide.

Lecithin is a staple ingredient used to emulsify sauces like mayonnaise and vinaigrettes. Soy lecithin, in particular, avoids concerns of cholesterol when compared to the traditional use of egg yolk for emulsifying power. The emulsifying properties of lecithin also make it a popular ingredient to create airs and foams. Chefs today are magically transforming liquid oils into powder, sometimes even replicating the flavor complexity of a whole course. The “secret” ingredient is tapioca maltodextrin. In the avant-garde restaurant kitchen, highly flavored oil is blended with tapioca maltodextrin to transform the oil from liquid to powder.

“Powder oil,” having a high affinity for water, pleasantly coats the mouth while releasing the potent flavors of the oil. Some chefs have used this ingredient to turn peanut butter into a granular powder that reconstitutes in the mouth.

Methylcellulose is a thermoreversible gelling agent. When heated, the methylcellulose transforms into a gel, and as it cools, it starts to liquefy. A popular use for this “upside-down” ingredient is hot ice cream, a new breed of ice cream that gets firmer at higher temperatures.
Heston Blumenthal intends to complement his recipes with sections of science, ranging from ice cream to meat science (Gourmet, 2008). Grant Achatz, when considering the history of gastronomy, speaks of the “explosion of new techniques for the first time in years and years” (Gourmet, 2008).

Recognizing the synergy between the culinary arts and food science and technology, the Research Chefs’ Association champions this hybrid approach to food. The increasing number of students in Culinology is perhaps indicative of the future generation of culinary practitioners, a generation which views the coexistence of the culinary arts and technology as second nature.

We are witnessing a fundamental shift in how we think of cooking. The distinguished contributors of this field—Ferran Adrià, Heston Blumenthal, Thomas Keller, and Harold McGee—who recognized the rapid and sometimes misguided development of this “new cookery” collectively authored an article on “Statement of the ‘new cookery.’” The Guardian. Dec. 10, 2006.


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1. Three basic principles guide our cooking: Excellence, openness, and integrity.

2. Our cooking values tradition, builds on it, and along with tradition is part of the ongoing evolution of our craft.

3. We embrace innovation—new ingredients, techniques, appliances, information, and ideas—whenever it can make a real contribution to our cooking.

4. We believe that cooking can affect people in profound ways, and that a spirit of collaboration and sharing is essential to true progress in developing this potential.

While the article reflects the thoughts and principles of the authors, it is also indirectly a blueprint for the future of this new movement in cooking. Often loosely referred to as molecular gastronomy, it has now emerged in the restaurant kitchens of pioneering chefs. Contrary to what some might believe to be a fad, this new approach to food has the potential to be nothing short of a revolution in cooking.

Chef Kurt Struwe (right) and student Ross Kuchta experiment with pastries on the anti-griddle, which chills food to -30°F, at Southwest Minnesota State University’s Culinology program. Photo courtesy of Jonathan Chapman Photography LLC.