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Simple Consommé

A consommé is a bouillon that is served, hot or cold, at the beginning of a meal. Simple consommé—a clarified broth made by cooking meat or fish in water—is a staple of home cooking, sometimes supplemented by vermicelli, tapioca, a julienne, croutons, or something else. Double consommé is a more elaborate preparation whose flavor has been enriched by reduction and further clarification.

The chef Jules Gouffé (1807–77), whose cookbooks are notable for their remarkable precision, held that "bouillon is the soul of home cooking."

Yes, it is the soul of home cooking, because it is a liquid that is served every time a pot-au-feu is made; but it is also the foundation of more sophisticated dishes, because it forms the basis for sauces, stocks, demi-glaces, jellies, consommés, and so on.

Many recipes can be made from a bouillon. No dish in a classic cuisine worthy of the name would have been moistened with anything other than a good bouillon: fowl, veal, game, fish, vegetables. In fact, bouillon is nothing more than flavored water—but home cooks sometimes forget that cooking is a matter of giving flavor to foods, not of preserving their "natural" flavor.

In constructing the dishes that constitute our meal, this is an important point, and one that has its counterpart in all the other arts. Musicians? They don't reproduce the sounds of nature; they organize individual notes to evoke the sounds of nature more movingly than nature itself. Painters? They do not reproduce nature; they compose, construct their canvas, creating a foreground and a background, embellishing the image. Photographers? Open any magazine and look at any photograph, and you will see that the aim is not to reproduce what we ordinarily see, but to produce a view of what the photographer wishes us to see. The same is true in literature, in sculpture, in cinema. Generally speaking, amateur photography, amateur painting, amateur music are not very good. Why should amateur cooking be any different?

Professional cooks understand that to give something the flavor they think it ought to have often requires a lot of work, preparation, and seasoning. Pierre Gagnaire, for example, speaks of setting the stage for his ingredients, not unlike a film or theater director.

A Site for Sharing New Ideas

My collaboration with Pierre Gagnaire, the results of which are available on his Web site (www.pierre-gagnaire.com, "Art et Science"), began in 2000. In November of the preceding year, Guy Ourisson, then president of the Académie des Sciences in Paris, invited me to give a lecture there, accompanied by a meal based on the principles of molecular gastronomy. At the same moment, as it happened, Pierre Gagnaire's wife suggested he invite me to help him prepare a special menu for the celebration of the upcoming millennium.

By then Pierre had left Saint-Étienne, where in two different restaurants he had established a reputation for culinary genius. He opened a restaurant in Paris, near the Champs-Élysées on the rue Balzac, that was immediately awarded three stars by the Michelin Guide. There he continued to develop his artistic talents with unremitting originality.

And so it came to pass that the dinner at the Académie des Sciences was planned and prepared by the two of us. A series of working sessions led to a wonderful meal, as well as a new menu featured in the winter of 2000 at Pierre's restaurant—a splendid example of science and art working hand in hand.

We met a few times after that—social encounters, mainly, but nonetheless full of talk about the technique and art of cooking—and finally decided to set up an Internet site where each month we would post an "invention" based on research in molecular gastronomy together with artistic interpretations. I would write a description of the new idea, which Pierre would illustrate with four recipes.

In this way we hoped to follow in the footsteps of the French chemist Michel-Eugène Chevreul, whose work on color a little more than a century ago led to the creation of neo-impressionism, the leading representatives of which included the painters Paul Signac, Camille Pissarro, and Robert Delaunay. Today, the enterprise of placing molecular gastronomy in the service of culinary art is eight years old, and each month fresh applications of research continue to be added to the site's archives. Who says French culinary creativity is dead?

How to Make a Bouillon

Making a stock? It's so simple that it hardly seems worth explaining. One puts meat in water and heats it. Ah, but what sort of meat? From what part of the cow, if it is a beef bouillon? Fresh meat or meat that has been aged? And how much meat for how much water? What kind of water? Salted? Heated in what sort of pot? Earthenware? Cast iron? Stainless steel? Covered or uncovered? Cooked at what temperature? For how long?

HOT OR COLD WATER?

The number of culinary dictums I have collected relating to bouillon is far greater than the number relating to mayonnaise, for example. One finds all sorts of instructions. Some recipes say that the cover of the pot containing the bouillon should be left ajar by the width of two fingers. The majority say that the meat must be immersed in cold water, never in boiling water; but there are nonetheless those who claim the opposite. The cooking time varies, depending on the author, between one and twenty hours—which doesn't give much guidance to the home cook. Some say the cooking temperature must be low; others say that the liquid should never stop boiling, but that, if it does, it should be brought back to a boil gently. Every imaginable recommendation can be found if you look hard enough; and science only confuses matters further, unfortunately, by introducing mistaken notions.

Whereas L.S.R., an anonymous author of the seventeenth century (he is said to have been called "Le Sieur Robert," but this does not help in identifying him) insisted upon placing the meat in boiling water in order to make a good bouillon, many nineteenth-century authors recommended instead beginning with cold water. Surprisingly, the German chemist Justus von Liebig (1803–73), despite his great eminence (he was knighted for his remarkable feats of chemical analysis and for the institute he founded at Giessen, whose students went on to make his influence felt throughout the world), endorsed the majority opinion without offering any justification for it. "If the meat is put into boiling water," Liebig summarily stated, "the albumin coagulates on the surface and prevents the juices from escaping and making a good bouillon."

Why should we doubt Liebig? Because the mission of science is to doubt, and also because the counterindication given here, subsequently repeated by French authors (as a young man Liebig had learned French in the kitchens of Louis I, Grand Duke of Hesse-Darmstadt, before going to study chemistry in France), is, well, doubtful. In fact, meat is not chiefly composed of albumin; or, more to the point, albumin is not what is at issue in this case.

To see why this is so it is necessary to appreciate the fact that meat is a muscle tissue, composed of muscle fibers, which is to say living, elongated cells with contractive properties. When the brain sends the signal, proteins within the fibers (mainly actin and myosin) slip past one another, shortening the muscle and causing it to contract. Additionally, the fibers are sheathed with a tough reinforcing tissue formed from a highly fibrous protein, collagen. The muscle tissue itself also contains fatty deposits and a circulatory system. The blood in this system conveys a number of different proteins, including small globular plasma proteins called serum albumin. There is therefore some albumin in meat, but very little.

Why, then, did Liebig mention only albumin? Because in his time this was a general term, used to refer to the entire class of proteins. The first proteins to be identified were found in eggs. At the turn of the eighteenth century, the French chemist Étienne-François Geoffroy (1672–1731) gave the name *albumin* to the proteins of egg white (or, as we now say, albumen). At the time, albumin was quite a mysterious substance, detectable only by its power to induce coagulation, its tendency during putrefaction to release nitrogenous gases (nitrogen had just been discovered), and its ability to impart a violet color to syrup. Geoffroy soon recognized that certain plants, such as peas, also contained products of the same type, which were called "plant albumin." This was a revolutionary discovery, because now it was understood that the same molecules occur in both the plant and animal realms. Later on, improved methods of chemical analysis made it clear that egg white was composed of many different compounds, and that collagenous tissue, although it contained proteins, was not coagulable, unlike tissue containing actin and myosin. In other words, egg white was not made simply of water and albumin. Gradually the term *proteins* gained currency, with *albumin* being restricted to a class of small water-soluble proteins. Thus eggs contained ovalbumin, and meat, serum albumin.

A SIMPLE TEST

Scientific claims formulated in terms that were current more than two centuries ago are very likely to be inaccurate. And this is why Liebig's account needs to be tested. The relevant experiment is not difficult to perform. Take two pots and fill them with the same quantity of water; bring the water in the first pot to a boil, without heating the water in the second; then put the same amount of meat in each, turning on the heat under the second pot while keeping the first one at a boil, and weigh the pieces of meat in the two pots every minute. What you will find is the opposite of what Liebig had predicted, namely, that after an hour of cooking the meat that was initially placed in boiling water has lost more mass than the meat that was placed in cold water. Eventually, the two pieces of meat come to weigh the same amount, to within a gram of each other, and this mass does not vary no matter how much longer the meat is cooked. The inescapable conclusion, then, is that the meat loses mass during cooking mainly because the collagenous tissue contracts when it is heated. And because it is heated more rapidly in boiling water, it contracts to a greater extent, initially forcing a larger quantity of water into the bouillon. Ultimately, however, it doesn't matter whether one starts out with hot water or cold water.

THE QUESTION OF FLAVOR

The flavor of a bouillon comes chiefly from the slow disintegration of the collagenous tissue. This produces gelatin, which then dissolves in the bouillon. Gradually, the gelatin is degraded by the heat into very flavorful amino acids. Odorant molecules are released as well. These molecules absolutely must *not* be allowed to disperse into the air and disappear—which is why one must make sure that bouillons are not brought to a rolling boil. All chemists are familiar with the technique of extracting water-insoluble molecules, such as those of essential oils, by separating them in gaseous form from water vapor. This separation process has to be avoided at all costs in making bouillon. Hence the importance of keeping a lid on the pot and keeping the temperature low, which will allow the collagen to dissolve and break down into its constituent amino acids, without losing any of the bouillon's wonderful smell. The cooking time? Quite a few hours are needed to extract the maximum amount of gelatin from the meat and to give this gelatin and other proteins time to hydrolize, which is to say break down into amino acids.

A Technical Question

Clarification, which turns ordinary bouillon into a simple (or double) consommé, shows how anachronistic our practices are and how useful applying the principles of molecular gastronomy can be.

The point of clarifying a bouillon in the first place is to make it clear. The turbulent action of boiling the meat frequently extracts particles that make the bouillon cloudy. Clarification produces a limpid, amber liquid, wonderful to behold and delicious to consume. Classically, one begins by allowing the bouillon to rest so that the fat, suspended in the liquid in the form of droplets, has time to rise to the surface, where it congeals in a layer that is easily skimmed off with a spoon (in the old days this fat was kept in a "grease pot" and reserved for further cooking). Elementary physics shows that the speed with which these fatty droplets rise to the surface depends on their size; the smaller the droplets, the more slowly they rise, although they are the ones that congeal first. This means that the bouillon ought not to be cooked too quickly, if you wish to be able to remove a well-formed layer of fat from the surface of the liquid.