Food Patterns in Agrarian Societies: The "Core-Fringe-Legume Hypothesis" A Dialogue

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The "Core-Fringe-Legume Hypothesis"

A Dialogue

Sidney Mintz

In 1989, I was invited to present a paper for food history scholars at the University of Basel's Historisches Seminar.[1] I took as my theme a commonly voiced (if unapproved) generality about food habits in large, old, agrarian societies. I did not mean it to apply to societies that lived primarily by hunting or fishing or gathering, or to those pastoral societies that relied primarily on domesticated animals. I had in mind only stable agrarian peoples, with farming skills of long standing. In such societies, I argued, meals commonly consisted of a starchy "core," which was complemented by a "fringe" of foods; and this "fringe" consisted of substances that made the "core" more palatable and appetizing—that led people to eat more "core."

As one colleague said to me recently, such an idea is "merely conventional wisdom." It certainly is not very original. But it can be elaborated. Depending on who is doing the generalizing, one, two, or more features may be added to this idea of core-plus-fringe. For example, I make no place for lipids (fats/oils) in this scheme—though they certainly could be added. In my version, I did add a legume as a third feature of such a "typical" or "representative" meal. I had been thinking for a long time about combinations of complex carbohydrate and fringe or "relish," and had actually referred to these twinned food categories in print—without mentioning the legume—some years earlier.[2]

I will return to the triad, core-fringe-legume. But it may be good to point out first that in speculating this way, I was not thinking primarily about nutrition; I was thinking instead about what people consider "real food," about meals, about food systems, and about appetite. I had been rereading a wonderful monograph on an African agricultural people known as the Bemba, in which author Audrey Richards describes what Bemba people regard as food. Food for the Bemba is not, as it happens, everything they eat, but just some things. Richards points out how the Bemba make the centerpiece of their diet a nearly solid sorghum gruel. Richards's description makes it sound anything but appetizing; yet the Bemba consider it absolutely delicious.[3] Nevertheless, they say, they cannot eat it without flavoring—"meat, fish, caterpillars, locusts, ants, vegetables (wild and cultivated), mushrooms, etc.,"—foods Richards puts in a category she calls "relish."[4] It's what I call the "fringe"; and in Richards's description, the core and the fringe stand out clearly.

In my definition of the "core," it is always a complex carbohydrate, but it can be either a tuber (e.g. potatoes, taro, yams, cassava) or tuber product, such as cassava meal or poi; or a cereal (e.g. maize, rice, barley, wheat) or cereal product, such as polenta or pasta. Typically, the core is carefully prepared, eaten at most meals, homogeneous in texture and color, bland in taste, and consumed in bulk. In contrast, the fringe can consist of many different things—animal, vegetable, mineral, fresh or preserved, hot or cold, liquid or solid, etc. (Although the modern typical meal in the West is emphatically *not* what I meant to describe, by way of illustration things like pickles, ketchup, mustard, chili sauce, and horseradish could be considered fringe-like.) The fringe enhances the core, "helps it go down," enlivens it; and anyone who has tried, even when very hungry, to eat a whole plateful of potatoes, pasta, or kasha without any accompanying flavor– such as oil, salt, garlic, pepper, cheese, olives, mushrooms, mustard, salad greens, cured fish, or anything else—will understand immediately what the fringe does to make the core more appetizing.

In my argument, adding a legume category to the pattern I was trying to generalize was based on additional inferences from my fieldwork and reading. The role of lentils in Indian food, of red beans in Mexico, of chickpeas in the Middle East, and of soyfoods in Asia is, I think, hard to ignore. This becomes even more telling when one thinks in terms of actual foods on the plate—that is, of the meal itself. One is used to seeing tortillas with beans, Middle Eastern meals with

Left: *Preserved vegetables and rice, China.*
PHOTOGRAPH BY REINHART WOLF/BILDERBERG

hummus or a legume (often, bean) equivalent. Chinese meals do not always include bean curd. But if one removes soy sauce, bean sprouts, red bean desserts, and all bean-curd products—fresh, dried, and fermented—from Chinese cuisine, it significantly narrows that cuisine, enormously rich though it remains.

In other words, legumes appear repeatedly, and often conspicuously, in the cuisines of large agrarian societies. Nutrition scholars have long commented on how the nutritional benefit of both the starch food and the legume is enhanced by their combination. Was this simply a lucky accident? I suspect that the wide presence of legumes is a function of a social evolutionary process—that agrarian societies[5] lacking a legume were at some comparative disadvantage which, in successful instances, was redressed over time by the diffusion to them of legumes and legume products.

But my interest in the distribution of legumes among agrarian peoples arose from an additional, and different, thought. If we exclude pastoralists, hunters, and fishing peoples, and omit modern societies of the Western sort, animal protein is revealed as an often rather scarce food, relative to other foods. It was not available enough in the old agrarian systems to be eaten often, by everybody, or in large quantities.[6] The typical agrarian society of the past and, to a large extent, even of the present, is one in which the overwhelming majority of the people get hardly any animal protein in the form of meat year-round, and eat little or none on a daily basis. Hence, it is common for meat to be featured on ritual occasions, but for animal protein to appear in other forms, such as cheese, or only more or less "symbolically," in everyday diet. Even today, cereals and legumes provide more than two-thirds of the dietary protein humans eat worldwide,[7] and the West, of course, consumes a disproportionate fraction of the world supply of available animal protein.

Thus considered, the foods that compose the fringe in the diet of large agrarian societies are additionally valued, because of the taste contrast they provide to large quantities of the core. Legumes can be seen either as a third element, as in my formulation, or as some sub-category of fringe foods. I prefer to distinguish the legumes from other foods because of their specific protein contribution, which is augmented synergistically when they are consumed regularly with complex carbohydrates. But I am anxious to make clear that I consider their presence neither an accident nor the supposed wisdom of the body in action.

Because legumes are often highly contrastive in taste to the core (sweet, salty, sour, bitter, "hot," pungent, etc.), dark in color, and presented in smaller quantities, they may also function tastewise as part of the fringe. But there is, I think, an additional reason for setting legumes apart in my little typology. In some world areas, and particularly in Asia, legumes have received special treatment. Mung and soy beans, lentils, and add-ons such as peanuts (*Arachis hypogaea*, which is a New World cultigen) are processed in a variety of ways, and from these legumes, used as raw materials, there are then made additional foods, with different tastes. Such foods may fit within the same core-fringe-legume pattern I am describing, but they come to play quite varied roles in the meal. If one thinks of bean-thread noodles, soy sauce, bean curd in its many forms (fresh, dried, pressed, fermented), fermented black beans, hot bean paste, sweet bean paste, and sweet bean soup dessert in Chinese cuisine—again, *only for example!*—one can see instantly how many different roles these special products play. How and why such proliferation came about cries out for explanation.

I have long wondered whether agrarian states were not always or almost always typified by a siphoning upward of animal protein, such that vegetable protein—especially convenient in the form of legumes—became a nutritionally important or possibly essential feature of the popular cuisine. Can we hypothesize that one reason why legumes got such loving attention in some places was because the powerful got to eat most of the animal protein? This, at any rate, was what helped me decide to include this third feature in my core-fringe-legume pattern (CFLP).

Three other participants in the seminar, Professor Emeritus Markus Mattmüller, Professor Anne Murcott, and Dr. Daniela Schlettwein-Gsell, offered papers that built upon my presentation.[8] All made good use of my paper; but I was surely the person who learned the most. What follows, as part of this dialogue, is a translation of Schlettwein-Gsell's contribution. It offers, I think, a refreshingly original reinterpretation and broadening of my argument, as well as considerable ethnographic material from the writer's own experiences in the field.

Schlettwein-Gsell's attempts to explain the meal pattern are quite different from my own. She sees things more as a nutritionist, with more confidence in the body's inner nature, than I who am an anthropologist. But what she has done that is of substantial importance, irrespective of our hunch-playing (theorizing), is to show that certain striking uniformities may typify the quite different diets of many peoples. By "uniformities" I do not mean that they eat the same things, but that they eat foods that fit in the same categories. In doing so, she provides us with two different and valuable insights. The first is a methodological device that could be employed in the study of local diet in other cultures. The second is theoretical, and for me at least, even more impor-

tant. If we find repeatedly that agricultural peoples around the world all rely fundamentally on a mix of complex carbohydrate, legume (or other rich protein source), and a fringe of flavors to enhance the carbohydrate; and if, as Schlettwein-Gsell appears to demonstrate, the quantities required for survival turn out to be about the same in every case, we will know a great deal more about regularities in the social evolution of our species than we ever knew before.

Daniela Schlettwein-Gsell

When I first learned about Sidney Mintz's "core and fringe" model, I wanted to calculate the nutrient content of a series of real-life cases, to see whether a nutritional pattern might actually be hidden behind the model itself. My reasons for wanting to attempt this deserve an explanatory word. Sociological and anthropological studies of dietary patterns rarely include data from nutritional physiology in their presentations, and they hardly ever provide calculations of the nutrient content of an ethnographically defined "real meal." The absence of such information may be the logical consequence of the conviction that "the social and the biological do not explain each other"[9]—that culturally specific behaviors are not linked to a biological underpinning. Mintz points to the high-energy value of the carbohydrates that constitute the "core," and to the protein content of the legumes that typically accompany them. But he does not refer to vitamins, minerals, trace elements, and fats in his paper. He describes the "fringe" in regard to taste, color, acceptability, and even luxury—but not with respect to nutritional value. Indeed, in some instances he hardly even treats these substances as food. In contrast, workers in nutritional research usually confine themselves to calculations of nutrients, measurements of blood values, and other physiological measures. More often than not, the nutritional researcher does not even know the nature of the food or meal pattern actually accountable for the nutritional situation he is trying to investigate. It is in light of such deficiencies that Mintz's "core and fringe model" seemed to offer a unique opportunity to combine two different approaches to food studies and to seek to analyze a *sociologically* defined pattern from a *nutritional* point of view. I admit that this intention on my part was accompanied from the start by a certain hope—even if only unconscious—of illuminating those perspectives according to which "culture is more or less *equated with* nature."[10]

The calculations presented in this paper are based on the hypothesis that the "core," as Mintz uses the term, provides a daily intake of 1650 kcal, or two-thirds of the 2500 kcal recommended as nutritionally adequate for young male adults. Calculations were carried out with the help of food composition tables[11] and included estimates for protein, calcium, iron, vitamin A, vitamin B1, vitamin B2, vitamin B6, and vitamin C. In order to present the content of these different nutrients in a manner facilitating comparison, all values have been plotted as percentages of the allowances recommended for young adult men.[12]

While there is no indication that this method of calculation may *overestimate* the nutritional content of a "core and fringe" diet, it seems important to mention at the outset two reasons why this method might *underestimate* it. First, in most diets the core supplies *more* than two-thirds of the required energy. Second, the recommended allowances are calculated so as to include substantial safety margins and correspond to up to twice the amount actually required for physiologically balanced nutrition. We thus can assume, albeit somewhat cautiously, that the following graphs illustrate the nutrient content of the different diets.

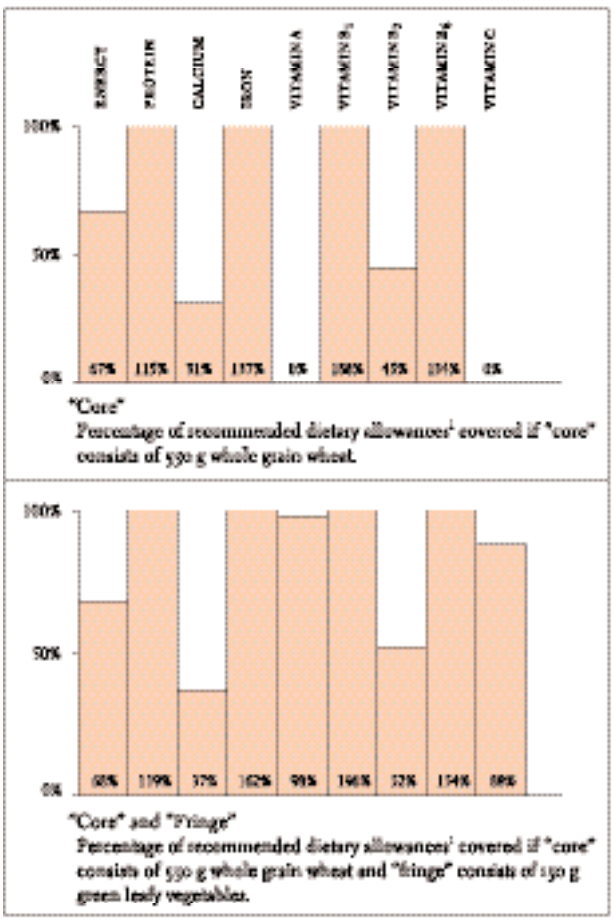
Grains as "Core"

Figure 1 shows the nutritional content of a diet in which the core consists of grain. If we assume that whole-grain wheat is consumed, then 550 g of wheat are required to supply 1650 calories. This quantity of wheat will also provide the recommended quantities of protein, iron, vitamin B1, vitamin B6 and nearly half of the daily allowances of calcium and vitamin B2. Wheat as core obviously supplies not only energy but also an essential proportion of six of the eight most important nutrients. At the same time, Figure 1 also demonstrates that wheat as core signifies a total absence of vitamin A and vitamin C.

A nutritionist is tempted to complement such a "wheat as core" diet with a "fringe" that contains especially high amounts of vitamin A and C and, at the same time, as little as possible of the other nutrients, so as to avoid overdoses or imbalances. Food-composition tables clearly show that there is only one category of foods that satisfies this specification: dark green vegetables, either leafy (such as spinach, field salad, beet greens, parsley, and cabbage), or fruiting vegetables, such as green peppers.

In the lower portion of Figure 1, a quantity of 150 g of dark green leaves has been added to the "core" of 550 g whole-grain wheat. This amount covers the recommendation for vitamin A and vitamin C and raises the intake of calcium and vitamin B2 by another twenty percent. A combination of wheat and dark green leaves thus results in an all-around sufficient diet.

Figure 1. Different grains as "core"



[1]Recommended allowances: energy 2500 kcal, protein 55 g, calcium 800mg, iron 12 mg, Vit. A retinol equivalent 1.0 mg, Vit. B1 1.4 mg, Vit. B2 1.7 mg, Vit. B6 1.8 mg, Vit. C 60 mg.

When I plotted this graph for the first time, my inner eye was recalling the face of an old woman in Lugnez, a remote valley in the Swiss canton of Grison, where we carried out a survey for the Federal Health Office in 1959.[13] This woman showed me how to prepare *capuns*, a local specialty. She wrapped a tough dough that had been made out of whole meal and thin milk in dark green beet leaves, poached these dumpling-like *Klösse* or *boulettes*, and then tossed them with a tiny bit of butter and grated cheese. While I was calculating the nutrient intake of a diet with grain as "core" and green leaves as "fringe," I realized that exactly this tiny bit of milk in the water, and of butter and grated cheese, would fill the still-empty rows for calcium and vitamin B2 in Figure 1.

One doesn't have to be an epicure to name some of the many other traditional dishes based on combinations of grain and green vegetables: green lasagne or tagliatelle, the *pizzocheri* of the southern Alpine regions (buckwheat and spinach), *dolmades* in Greece (rice wrapped in grape leaves), peppers stuffed with rice in Austro-Hungarian cuisine, or *nori-maki* in Japan (rice wrapped in dried seaweed). Barley soup, a specialty of the Swiss mountains still served today, always contains green vegetables, and barley gruel, the main dish of medieval Europe's rural population, was always prepared with vegetables. Similar recipes have been discovered for European almshouses of the early eighteenth century,[14] and comparable observations have been reported from nineteenth-century England.[15] It is not even too far-fetched to include in this list the standard food of the Russian peasant and the Soviet prison camps: bread and cabbage soup.

Table 1 summarizes the nutrient content of different types of grains. There is clear consistency, in that wheat, rye, barley, oat, millet, rice, and corn contain no vitamin C and, with the exception of a small quantity present in corn, also lack vitamin A. On the other hand, all of these grains contain high quantities of vitamin B1, vitamin B6 and, again with the exception of corn, iron as well. In some instances a "core" that provides a daily intake of 1650 calories will exceed recommended allowances for these substances by more than two hundred percent.

Maize (*Zea mays*), or corn, also contains rather low quantities of niacin. Not without reason was the classic niacin-deficiency disease, pellagra, called *Maiserkrankheit* ("maize-eater's illness") throughout much of Switzerland at the beginning of the last century. From a nutritional point of view, the appropriate "fringe" to a "core" of grain should therefore contain vitamin A and vitamin C, but no vitamin B1 or vitamin B6. Green vegetables meet these expectations and are obviously widely used in traditional dishes. The "fringe" to a "core" of corn should additionally supply niacin and iron, which is the case if mushrooms or beans are served with corn—both being combinations with long traditions (think of Native American succotash). Of special interest is the observation that when coffee beans are well roasted, the amino acid tryptophan is converted into niacin.[16] Could this be linked to the fact that in corn-eating societies (for example Italy and the countries of Central America) coffee is typically dark-roasted? Tryptophan also releases niacin when corn is treated with lime, a process typical of indigenous Native American societies long before the introduction of the first food-composition tables.[17]

Tubers as "Core"

In Figure 2 the same calculations are repeated for a diet where the "core" consists of potatoes. In order to ingest 1650 calories one has to eat 2230 g of potatoes; and Figure 2 shows that this quantity also covers the recommended allowances

Table 1. Different grains as "core"

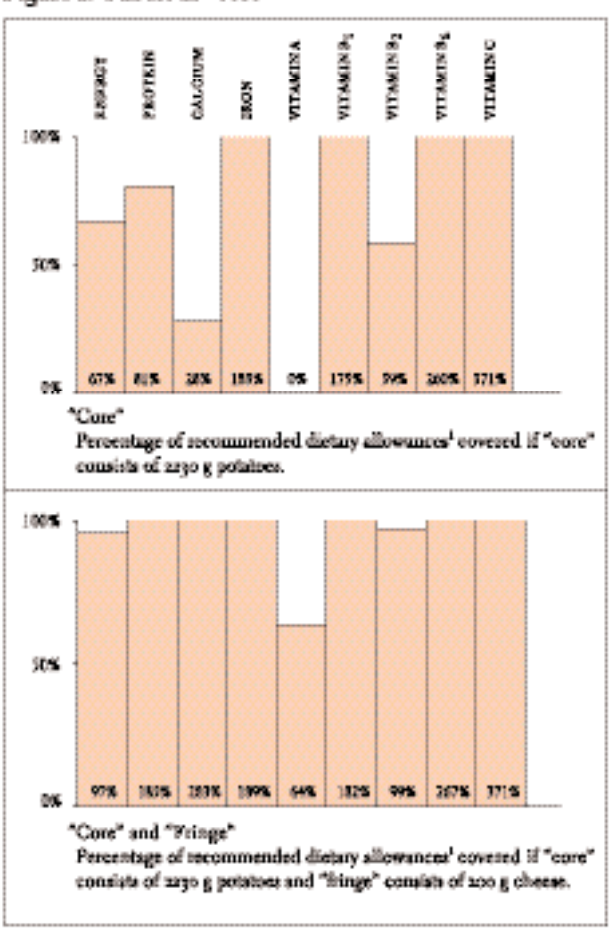
NUTRIENT	RECOMMENDATION	PERCENTAGE OF RECOMMENDATIONS COVERED BY						
		WHEAT whole grain	RYE whole grain	BARLEY whole grain	OAT whole grain	MILLET sorghum	RICE unpolished	CORN whole grain
		545 g	620 g	570 g	460 g	530 g	475 g	500 g
calories	2500	67	67	67	67	67	67	67
protein	55 g	114	98	109	105	106	64	84
calcium	800 mg	31	50	29	46	17	12	9
iron	12 mg	136	237	132	230	119	105	42
vitamin A	1.0 mg	0	0	0	0	0	0	30
vitamin B1	1.4 mg	186	157	171	171	128	136	128
vitamin B2	1.7 mg	47	59	59	47	32	25	59
vitamin B6	1.8 mg	133	100	178	244	—	183	111
vitamin C	60 mg	0	0	0	0	0	0	0

of iron, vitamin B1, vitamin B6, and—in contrast to a grain "core"—also of vitamin C. Just as in the case of grain, vitamin A is lacking completely; and protein, calcium, and vitamin B2 are supplied only in sub-optimal quantities.

This means that a diet with potatoes as "core" will have to be complemented with a "fringe" rich in vitamin A, protein, calcium, and vitamin B2. Food-composition tables show that dairy products are the ideal—indeed, the only—food group rich in all of these nutrients. A second graph in Figure 2 adds 200 g of cheese to the 2230 g of potatoes, which means that recommended allowances are met in a nearly optimal manner; the seemingly smaller column of vitamin A adequacy is of relative importance. Dairy products contain vitamin A in the definitive form, and not only as provitamin or carotene. Recommendations for vitamin A are generally rather high.[18] Like the combination of grain and green vegetables, the combination of potatoes and dairy products represents a wide range of traditional dishes: boiled potatoes with cheese (a popular evening meal in the Alpine regions); fried potatoes and milky coffee (the traditional breakfast of Swiss peasants described in the novels of Jeremias Gotthelf); mashed potatoes in German or Anglo-Saxon regions; and *gratin dauphinois* in parts of southern Europe—to give only a few examples.

Table 2 compares the nutrient content of four of the most widely consumed tubers: potatoes (*Solanum tuberosum*); taro (*Colocasia esculenta*); yams (*Dioscorea spp.*); and cassava (*Manihot esculenta*). None of these tubers contains vitamin A, but all have a high content of vitamin C. Taro, yams, and cassava contain less protein, vitamin B1, and vitamin B2 per gram of weight than potatoes, but at the same

Figure 2. Tubers as "core"



[1]Recommended allowances: energy 2500 kcal, protein 55 g, calcium 800mg, iron 12 mg, Vit. A retinol equivalent 1.0 mg, Vit. B1 1.4 mg, Vit. B2 1.7 mg, Vit. B6 1.8 mg, Vit. C 60 mg.

Table 2. Tubers as "core"

		PERCENTAGE OF RECOMMENDATIONS COVERED BY			
		POTATO	TARO	YAM	CASSAVA
Nutrient	RDA	2230 g	1540 g	1660 g	1240 g
energy kcal	2500	67	67	67	67
protein	55 mg	83	56	60	22
calcium	800 mg	15	58	31	—
iron	12 mg	148	128	92	—
vitamin A	1.0 mg	4	2	2	6
vitamin B1	1.4 mg	278	132	107	53
vitamin B2	1.7 mg	38	317	29	22
vitamin B6	1.8 mg	545	—	147	—
vitamin C	60 mg	450[1]	80	150	300

1. For all of the Vitamin C values, 50% has been deducted for losses during storage and preparation.

time they supply more energy by weight. This means that it is enough to consume 1200–1600 g of these tubers in order to ingest 1650 calories—notably less than the 2250 g necessary in the case of potatoes—but the protein and vitamin B content will be even lower.

In regions where cassava, taro, and yams serve as "core"—mainly in the tropics and subtropics of South America, the Pacific, and Africa—milk products are not common, and milk as such is usually not even tolerated. Tubers are served with a sauce, which contains vegetables (often green leaves from cassava or okra) and, if available, legumes, nuts, mushrooms, or insects, or at times meat or fish. Under optimal conditions, these additions may contain enough nutrients to complement the tubers with a nutritionally adequate "fringe." We all know, however, that conditions are often not at all optimal, and that protein, vitamin A, and vitamin B2 deficiencies are typical in these regions.

Mintz has speculated that political reasons, among others, may explain a shift from tubers to grain; but there may be physiological reasons instead (or as well). Not only does this shift increase protein and vitamin B2 content; it also entails smaller absolute quantities of food: 470 g of rice instead of 2230 g of potatoes in order to get 1650 calories. "Fringes" that ideally complement the "core" from a nutritional point of view, and that correspond to traditional food combinations familiar to the anthropologist, obviously can be found for a tuber "core" as well as for a grain "core." In what follows we aim to determine whether these observations also hold for those small population groups to whom Mintz refers, who use other foods as their "core."

Meat or Milk as "Core"

Mintz, who is concerned primarily with old agricultural societies, implies that among peoples who live by hunting, fishing, or herding, meat or milk can serve as the equivalent of the "core." Though he is not interested in these cases, I wish to add something about them here.

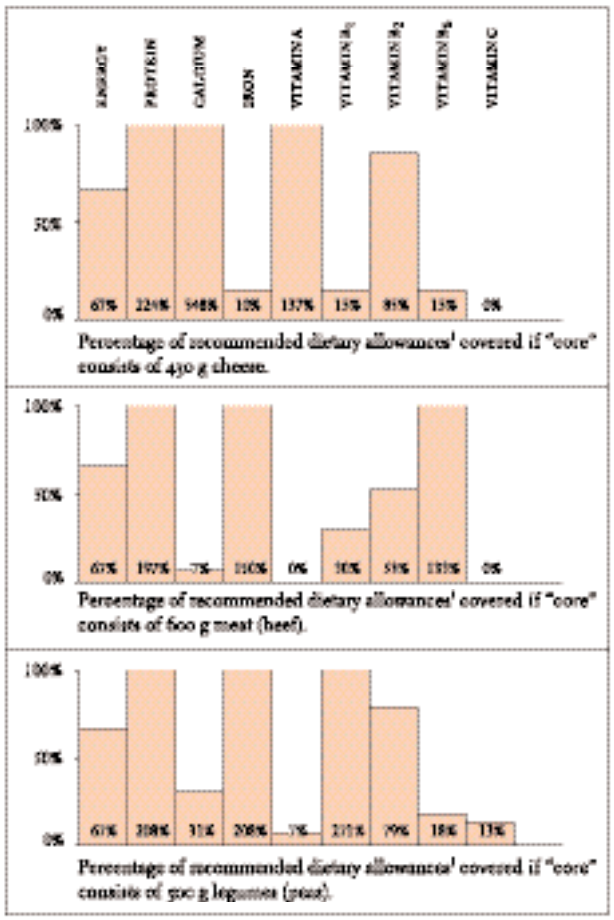
Figure 3 illustrates the amount of nutrients covered by cheese and meat, if these foods supply two-thirds of the energy required (1650 calories) as presumed in the previous calculations. The most obvious difference from grains or tubers, where the majority of nutrients were covered to about the same degree, is the imbalance in the nutrient content of these foods. Some nutrients are supplied in quantities that are probably too high, from the physiological point of view: in the case of cheese, this could be true for protein, calcium, and vitamin A. In the case of meat, intake may be too high for protein and iron and, to a lesser degree, also for vitamin B6, a water-soluble substance that is easily excreted.

For both cheese and meat, an extraordinary amount of energy intake will be covered by fat. Fat is not included in the graphs of Figures 1–3, as recommendations for fat intake are not discussed on the basis of recommended allowances, the general practice being to warn against a fat proportion exceeding 35% of energy intake.

A "core" based on cheese, as in our example, would consist of about 75% fat, a "core" consisting of medium-quality beef of at least 66% fat. But not only fat content is obviously too high in a meat or cheese "core"; protein content as well is higher than generally recommended (29% in meat and 31% in cheese, instead of 12–14%). It seems quite possible that this is one reason why these foods are usually not consumed as "core." Arguments proceeding from agricultural and economic reasoning may seem more plausible, but we would argue nevertheless that, at least unconsciously, the nutritional situation has been the driving force. Is it not more probable that agriculture and economy would have shifted in other directions if this food as "core" had proved to be better suited nutritionally?

In his description of what he has called "the simple meal,"[19] Gerd Spittler observes that "you cannot eat that much cheese [enough to cover your energy needs]"; with this remark, he seems to imply that milk products do not qualify as "core." Still, there are small groups who lived primarily on milk products, and it is necessary to describe the "fringe" that formed part of their diet. The Masai of Kenya, in their traditional dietary patterns, were a group who lived mainly on milk. It is known that they regularly drank a quantity of blood from their animals, which supplied them with iron and vitamins of the B group. Even the deficit of

Figure 3. Other foods as "core"



[1]Recommended allowances: energy 2500 kcal, protein 55 g, calcium 800mg, iron 12 mg, Vit. A retinol equivalent 1.0 mg, Vit. B1 1.4 mg, Vit. B2 1.7 mg, Vit. B6 1.8 mg, Vit. C 60 mg.

vitamin C might have been compensated for to some degree by this practice. It is, however, more probable that these people also consumed certain local herbs. A good example of the dietary impact of such a habit on vitamin C intake has been found in the Swiss Alps. As late as the 1960s, local herdsmen were observed habitually chewing on pine buds.[20] These buds are especially rich in vitamin C, and in some remote valleys they were used to make jam and jelly.[21]

Swiss herdsmen remain in the Alps with their animals for several months during the summer and even today may do so in places where no car or helicopter can supply them with food. Their traditional provisions are dry, dark bread and air-dried meat, both very rich in iron and vitamins, and thus an ideal "fringe" to their core of "milk," eked out with the herbs and wild greens they gather, or sometimes even cultivate, around their huts.

Meat as "core" is known from the equestrian Huns, who are said to have tenderized pieces of meat by putting them under their saddles while riding westward into Europe. We can assume that they consumed most of the offal of the animals they fed on, from which they got iron, vitamin A, and vitamins of the B group. Though all of the capsicums are of New World origin, it is said that the Huns brought the paprika pod to the Austro-Hungarian plains, thus introducing an essential ingredient in goulash, the national dish of Hungary. Peppers contain 140 mg of vitamin C per 100 g; a 7 g piece is enough to provide the vital supplement of 10 mg. This definitely makes peppers an ideal "fringe" to a "core" of meat.

In more modern times we would look for meat-eaters among the *estancia* dwellers of Argentina. A variety of accompanying fruit and vegetables is available in this region, but no clear pattern has evolved. The regularity with which hamburger is accompanied by *pommes frites* (vitamin C) and a milk shake (Vitamin A) must also be mentioned in this context. (The negative aspects of the fat content of this diet need not be discussed here.)

There is no doubt that an adequate "fringe" is eaten by those small human groups who subsist on meat or dairy "core" diets. Even Asterix and Obelix, who live on wild boar meat, eventually needed drinks of medlars and mistletoes, which among other virtues contain vitamin C.

The Physiological Impact of Legumes

Mintz originally proposed a "core-fringe-pattern" (CFP), which he later enlarged into the "core-fringe-legume-pattern" (CFLP). This later version includes the observation that ancient agrarian societies always have a legume accompanying the "core." For explanatory purposes here, I examine the possibility of legumes being a core, rather than accompanying a carbohydrate or other core food.

In Figure 3, peas, used as an example for legumes, are plotted as "core," and it can be seen that, like a "core" of meat or cheese, legumes supply more than twice the recommended amount of protein. The really interesting point about legumes, however, is the quality of their protein.

It is generally agreed that the quality of a protein can be expressed in terms of its lysine content, since lysine, an essential amino acid, is the limiting factor for most proteins. Egg protein is used as the standard. Table 3 lists the lysine content of different foods. Meat and fish have a slightly higher lysine content than egg, and the lysine content of legumes is nearly as high as that of eggs. Grains, on the other hand, have a very low content, and the combination of grains and legumes markedly increases the quality of the protein.

It is remarkable that foods as rich in energy and protein and as easy to grow as legumes have never served as a "core," not even among marginal groups.[22] Meat and cheese

Table 3. Protein and Lysine Contents of Different Foods

FOOD	PROTEIN g/100g	LYSINE mg/100g	LYSINE mg/g protein
Egg	12.9	890	69
Meat (beef)	18.1	1900	104
Fish (cod)	17.7	2050	115
Legumes, beans	33.1	2930	86
Legumes, lentils	23.5	1890	80
Rice	7.0	310	44
Millet	10.6	300	28
Maize	9.2	310	33
Rice + Lentils 1:1	15.2	1100	72
Millet + Chickpeas 1:1	15.2	840	55

also supply excessive amounts of protein, and yet they may become "core" foods under special conditions. Legumes contain toxic substances such as the Latyrus factor, which has to be eliminated in food preparation. However, the same is true for manioc (cassava), which in spite of complicated cooking rules is widely used as a "core."

While no explanation can be found for this obvious reluctance to make legumes the centerpiece of the meal, it seems even more remarkable that the combinations of legumes and grains can be found all over the world, even among dishes recognized for their culinary excellence: rice and lentils form the Indian *kedgeree*, millet and chickpeas the North African *couscous*. Corn and beans were traditionally combined in Native American diets, and barley and peas were the ingredients of the porridge on which the masses of the seventeenth and eighteenth centuries in Europe lived.

Today vegans have to be told to mix grains and legumes in order to guarantee the quality of their protein intake. One is tempted to ask who could have informed the peasants in India, North Africa, South America, or early Europe of the importance of this combination.

Specification and Interchangeability

The description of the different forms of "core" has shown that considerable differences exist with respect to the nutrient content not only between the food groups (e.g., grains versus tubers), but also within the food groups (e.g., corn versus rice or potatoes versus cassava). In order to supplement these "cores," in an adequate way, the "fringe" has to be specific as well. The examples from traditional diets on different continents show that such specifications can actually be documented in past and present food combinations. Core-fringe combinations have a specific form; that populations are usually loath to change their basic consumption patterns may have a physiological explanation. Each change of a "core" will eventually lead to a change of "fringe," and thus implied modifications of the entire consumption system, until a new balance is established.

Mintz mentions that people are often reluctant to change and are usually faithful to their traditional food habits. He advances political and economic reasons to explain such reluctance. The triggering release behind these sociological arguments, however, might be a partly unconscious desire not to jeopardize a nutritional equilibrium of long standing.

The wish to maintain a well-established balance can assume emotional proportions, as is beautifully expressed in Flora Nwapa's "Cassava-Song."[23] She praises the mother-like nurturance cassava gives to its cultivators and consumers and warns against imports of rice, out of fear she will see living standards deteriorate. In her song she literally alludes to the interdependency of "core" and "fringe":

You can eat cassava fufu
or yam fufu
with any kind of soup.
Not rice
There must be stew…

There are examples of populations who have protested against the introduction of rice or potatoes, but to my knowledge, nowhere has the introduction of legumes led to protest. It would be difficult to explain this difference using political or economic reasoning, but physiological interrelations offer a plausible alternative explanation.

From the nutritional point of view, the traditional specification of any core-fringe combination is not just a happy accident, but a purposeful and determined inclination to combine food groups of differing nutritional content into a physiologically adequate diet. This inclination even seems strong enough to minimize the differences among ethnic groups. Pygmy groups who hunt exclusively will cooperate with exclusively horticultural peoples to form a viable symbiosis.[24] It is important to realize that the combinations encountered in traditional cuisines meet the most modern standards of recommended dietary allowances.

The Qualitative Adequacy of Food

It is an open question as to whether successful combinations of "core" and "fringe" are the result of trial and error by

populations who have evaluated their diet along the lines of mortality, morbidity, and fertility over generations, or whether there exists a direct sensitivity to the quality of the diet. There is general agreement that most human groups are able to judge the quantity of food needed for their well-being. Whether they are also able to judge the qualitative adequacy of food is still being debated.

My conclusion focuses on this point as I present three examples of culinary specialties in relation to the nutritive balance of traditional cuisines. I will then calculate the nutrient intake of some human groups who subsist on very few different food items. Finally, I'll offer examples of the sensory capacities that physicists have established to differentiate measures.

Culinary Traditions

The previous sections explored the nutrient content of "cores," then searched for adequate "fringes." I think I have showed in each case that there exist real-life examples upon which my theoretical position can rest. Hence it seemed promising to turn things around, to analyze to what degree cuisines, or culinary traditions, meet nutritional adequacy.

I was tempted to calculate the nutrient content of a local specialty when I asked a young Ticino girl about the recipe for *polenta con funghi* (cornmeal with mushrooms) and was told *"Funghi, panna e prezzemolo-ma nient' altro"* ("Mushrooms, cream and parsley, but nothing else"). I wondered what the "nothing else" might be warning against. In Figure 4, the nutrient content of this dish is plotted using the same method as in the previous figures. A serving of this dish obviously supplies about half of the allowances of all the different nutrients, hence exhibiting a remarkably balanced nutrient density. Calculating the nutrient content of pizza (Figure 5) leads to a similar result: balanced adequacy of nutrient supply and—even more interesting—no excessive amounts of any of the calculated substances. Might this observation explain the "but nothing else" in the young woman's answer?

Similar pictures result if the nutrient content of other traditional dishes is calculated: Anglo-Indian *kedgeree*, North African *couscous*, Swiss *raclette*, Chilean *empanadas*, and so on. It can become a sort of intellectual game to estimate the nutrient content of specialties in foreign countries. A balanced content is in most cases an indication that the dish belongs to an old tradition. Later, the *haute* and *grande* cuisines codified the rules that determine which foods go well together.[25] One of the first German gastronomes, C. von Rumohr, wrote as early as 1832: "…vegetables, with the

Figure 4. Nutrient content of traditional dishes: Polenta con Funghi

Percentage of recommendations covered

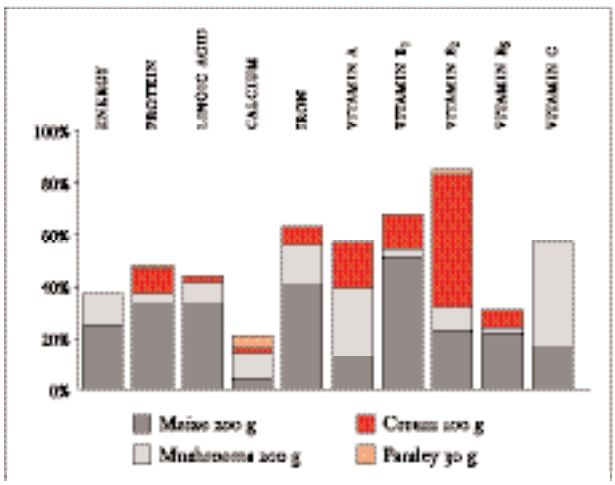
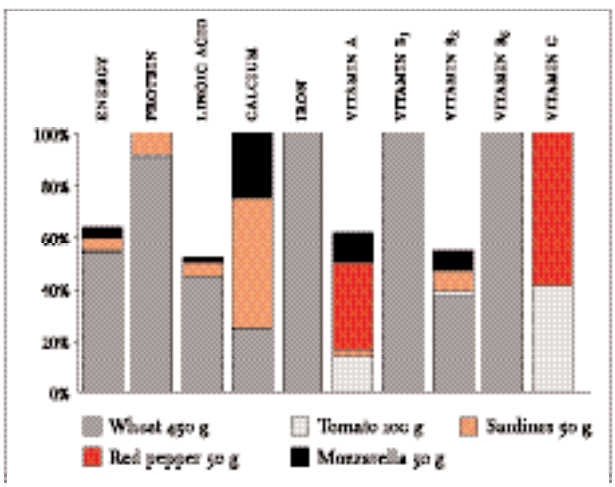


Figure 5. Nutrient content of traditional dishes: Pizza

Percentage of recommendations covered



exception of dry legumes and mealy tubers, are not nourishing. In combination with more substantial food, however, each of them will influence the body in a specific healthful way..". More than 170 years ago, von Rumohr extolled the benefits of combining "core" and "fringe."[26]

Modern cooking, *la nouvelle cuisine*, is not concerned primarily with how foods are combined. Instead, improvisation and experimentation are key, along with an awareness of healthful properties of different foods. However, when specific foods are considered healthy, it results in plates filled with dozens of totally unrelated foodstuffs, which complement each other neither in taste, texture, nor nutrient density.

Groups of healthy people who live with restricted numbers of food items provide a different approach to the question of whether the body has an innate capacity to sense adequate nutritional quality. A showpiece for these groups is the Tuareg of North Africa, whose "simple meal" has been described by Spittler.[27] The Tuareg live on millet, goat milk, and dates, and during their lifetime may never encounter other foods. A chemical analysis would be necessary for a detailed evaluation of their diet, especially since the vitamin C content of dates can only be estimated. The nutritional status of a population is also dependent on non-food influences such as sunlight, soil, hygiene, and other environmental factors, which cannot even be guessed at without a visit. Nevertheless, the chart in Figure 6 gives the picture of a nicely balanced diet.

The Tuareg enjoy their food, eat it again and again, and engage in gastronomical discussions about the properties of millet or dates from different fields. The fact that they do not ask for other food items has been described by Spittler as culturally specific. It can also be interpreted as evidence that their bodies sense the balanced quality of their food and do not "ask" for other substances.

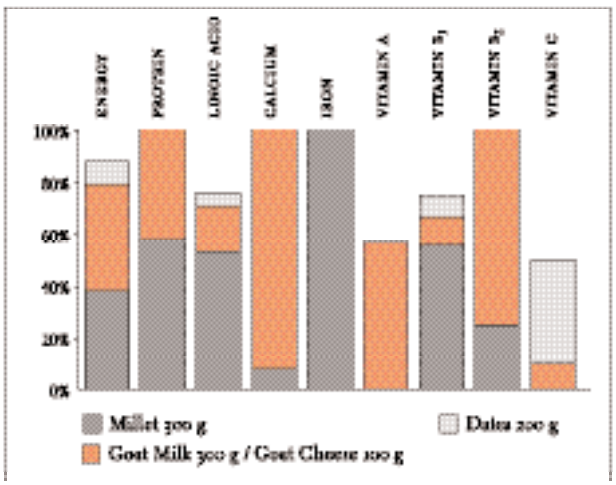
Another group of people living on a simple diet over a long time are the peasants in remote mountain villages of the Alps. As recently as the 1960s I found old men and women in Switzerland living in huts accessible only by foot, whose meals consisted of not more than four or five food items: milk and cheese, dried bread, dried meat, herbs, perhaps coffee—and they told me often enough that they looked forward to their meals, and would not prefer anything else.[28] Their astonishing physical strength and endurance made me believe that they actually did not need anything else. Their meals often resembled celebrations and reminded me of the dignity with which the "Alpöhi," the grandfather of the famous Heidi, melts the cheese for the evening meal.[29]

The fact that no desire is felt for other food is good evidence for the existence of some inner sense for the nutritional adequacy of the diet. Simple and "monotonous" meal patterns are found in many agrarian societies and usually are the reason for sub-optimal or deficient diets. Contrary to the groups described above, however, these people are not content with their food. They long for additions—a chicken on Sunday, sweets, fruit—and accept indiscriminately whatever they are offered by the industrialized food system. This can be understood as indirect proof of the existence of a sense for quality—much as the presence of pica, or geophagy, is commonly agreed to reflect iron and/or calcium deficiency.

To conclude, let us look in a more general way at the senses able to detect measures which physicists have defined. A good example is the musician whose sharp hearing is

Figure 6. The simple meal (Spittler 1991)

Percentage of recommendations covered



matched by absolute pitch, who can detect the exact number of physical oscillations. This capacity is rare—most of us just hear some indefinable sound. Rare as well were those architects who built by eye along the rules of the classical golden section, without even knowing the measures. We are all pleased by harmonious proportions, but most of us are not able to judge, unaided by measures, the necessary number of centimeters. Color perception might provide yet another example, but in this case, the physicists have not yet determined what is absolute red or blue.

Given the distribution of such rare but real endowments, why shouldn't some of us be able to taste what is really good for the body and can be calculated as nutritionally adequate, while the rest of us remain quite incapable of appreciating the difference? Any gourmet should find this quite computable balance of different cuisines thought-provoking. Could it be that a "real" cook senses the nutritional adequacy of his masterpieces, tasting the quality not only with the tongue but also with the body? Would this mean that disciples of gastronomy on their pilgrimages to the "chef" expect not only delicacies, but also warranties of good health? The great cooks of French cuisine considered themselves artists and called their works *l'art culinaire*. Seen from this perspective, those who prepare good food deserve the status of artist, even more so since some part of being a great chef does not seem to hinge on learning. Could this mean that those peoples who have discovered the "simple meal" for themselves are masters in the art of living? If we remember the important role of the environment in determining food quality, this art would require a bit of luck. But then, every *maestro* needs a bit of luck.

Calculations of the nutritional content of examples for "core" and "fringe" show the complementary qualities of such combinations. It is difficult to understand the balanced density observed without accepting the concept of a sense for nutritional adequacy. If these days health parameters direct food habits by means of modern communication technology, in pre-technological times food habits may well have been directed by means of subconscious clues. This adds a new dimension to the manifold forms in which "core" and "fringe" appear in meal patterns and food attitudes around the world.

Sidney Mintz

In responding to Schlettwein-Gsell's paper, I will follow loosely her line of thought. I have already described my own paper; it would be impractical to reprint it. But Schlettwein-Gsell's commentary revolves around it.

I wrote my paper with one kind of society in mind. Though I didn't belabor the point, I had in mind relatively complex societies, perhaps particularly those that had evolved a state level of political organization. I was uninterested in cases of hunters, gathers, fishermen, pastoralists—not because those are uninteresting, but because I saw the mix of complex carbohydrate, legume, and fringe as central to my argument.

I hypothesized that agricultural societies lacking legumes, or unaware of their importance, would acquire them by borrowing from others. Foods, and the techniques of their production, were diffusing long before the dawn of written history. I guessed that agricultural societies that did not have legumes or acquire them would be at a serious disadvantage. I supposed that the reason legumes are so widespread was because societies without them *were* disadvantaged. I don't think that the wisdom of our bodies thought us into eating legumes, but that legumes were diffused to borrowing societies, and then producing and eating them turned out to be advantageous. This view is different from Schlettwein-Gsell's and emphasizes cultural processes more than individual sensitivity, or the body's wisdom.

Schlettwein-Gsell raises the intriguing possibility of legumes as core and discovers no cases. She notes that legumes do pose problems for human diet – some contain toxins, all can produce considerable flatulence, and so on. But H.T. Huang, whose remarkable study of Asian foodstuffs and fermentation should be must reading for every serious student of food history, believes that soybeans (*Glycine max*) may once have been an important exception to the rule. Of soybeans he writes: "…in ancient China these were eaten as grains in much larger amounts than other legumes, which were eaten as vegetables."[30] But the relative unsuitability of soybeans as human food may have been a major reason for the invention of so many processes by which to transform them into alternative food sources.[31]

Schlettwein-Gsell goes on to make an important point concerning the patterning of core, fringe, and legume. I heartily concur with her assertion that people eat culturally, hedonically and nutritively coherent complexes of foods. Hence changing the core—from, say, potatoes to rice—will affect what the fringe and legume should be, or could be, in terms of the nutritional character of the core item. She is suggesting that my concern with social and political reasons for the persistence of a core food may be misplaced—that changing the core entails changing the rest of the pattern. While I continue to maintain that something other than nutrition as such explains why people stick with their traditional foods, I certainly agree that foods form *meals*, and meals are *patterns* in stable societies.

Schlettwein-Gsell suggests that populations may either have "evaluated their diet along the lines of mortality, morbidity, and fertility over generations," or that there may be "a direct sensitivity to the quality of the diet." If I understand this part of her argument, I have to express my reservations about both alternatives. I do not believe populations do such evaluations—or perhaps better said, that those societies that can do them, such as ours, don't seem able to use what they learn to act effectively on their own behalf. But neither do I think that there is direct sensitivity to the quality of the diet, if by that it is meant that people *know by how they taste and feel* whether they are eating well or badly. She seems to be suggesting that there are two sorts of societies, those that eat well because they listen to their bodies, and those that are corrupted or ruined by outside influences. I don't think we can divide up the world that way (though I guess I wish we could). My view of food history rests on different premises, in which human interest in food is in some important sense not "natural" at all, but cultural in nature—*historical, rather than natural-historical*. Foods, food habits, and preferences can diffuse and be borrowed, and these are ancient processes. While individual sensibilities of every sort vary tremendously, I do not believe the diet of any people is ever formed by such sensibilities, but by social, economic, and political forces, which set the limits within which individual variability and sensitivity have play.

In this connection, and to conclude, I am struck by the use Schlettwein-Gsell makes of Flora Nwapa's wonderful poem about rice and cassava. For her, it is testimony to the close culturally specific connection between core and fringe; I share her belief that people don't eat single foods so much as "meals," and that food systems are patterned. But we

need also to notice that Nwapa's defense of cassava against rice is a traditionalist plaint, whereas cassava is a relatively new African food. Many West African food systems rested on the cultivation of yams, millet, and other indigenous plants for many centuries before extensive contact. But cassava is a New World cultigen, and was added to the African repertory only in the last few centuries.[32] I am quite prepared to imagine that several centuries ago another poet wrote a plaint defending yams or millet against cassava with every bit as much traditionalist passion. I don't think cassava replaced yams and millet because it tasted better. More likely it was easier to grow, and resisted insect pests better; it spread rapidly in West Africa. That rice is now replacing it probably owes to greater ease of preparation, more women working outside the home, and prestige factors. In other words, I am slow to accept explanations based on bodily wisdom or individual endowments. Yet none of this gainsays Schlettwein-Gsell's insightful reworking of a crude idea of mine, for which I remain deeply grateful.

NOTES

1. Sidney W. Mintz, "Die Zusammensetzung der Speise in frühen Agrargesellschaften," in Martin Schaffner, ed., *Brot, Brei und was dazugehört* (Zürich: Cronos, 1992), 11–28.

2. Sidney W. Mintz, *Sweetness and Power* (New York: Viking Penguin, 1985), 9.

3. In this connection, the Kel Ewey Tuareg, whom Gerd Spittler studied, bear mention. They eat the same simple food every day, and find it quite delicious. Among the Kel Ewey, two meals daily are eaten, a breakfast and a supper. Both are simple in character. The Kel Ewey have high standards for how each such simple meal should taste. Simplicity of cuisine does not equate with any lack of standards of preparation or taste. Spittler suggests that the search for novelty in foods, so often thought to be a universal human characteristic, is in fact culturally specific. Gerd Spittler, "Lob des einfachen Mahles," in Alois Wierlacher et al., eds., *Kulturthema Essen* (Berlin: Weinheim, 1992).

4. Audrey Richards, *Land, Labour and Diet in Northern Rhodesia* (London: Oxford University Press, 1939), 49.

5. Charles B. Heiser, Jr., in *Seed to Civilization* (San Francisco: W.H. Freeman and Company, 1981), writes: "Not only are the legumes high in protein, but their amino acids neatly complement those of cereals…; if we eat legumes and cereals together, we obtain a far more complete protein than from eating any plant food alone. Thus wheat plus peas, maize plus beans, or rice plus lentils come close to filling our protein needs. But in a way, the domestication of complementary food plants must be partly a 'happy accident,' because primitive people knew nothing of proteins or amino acids, only that the seeds satisfied their hunger." (p.128) I don't think mere coincidence is enough to explain the world distribution and consumption of domesticated legumes. Lawrence Kaplan writes: "The close relationship between beans and corn in the indigenous diet of the populous cultures of Mesoamerica and the Andean region is, like other traditional dietary combinations, no accident." (Lawrence Kaplan, "Ethnobotanical and Nutritional Factors in the Domestication of American Beans," in Earle C. Smith, Jr., ed., *Man and his Foods* [Tuscaloosa: University of Alabama Press, 1973], 75) Heiser himself says that the early domestication of legumes "…can hardly be an accident." (*Seed to Civilization*, p.128).

6. Sidney W. Mintz, *Crops and Human Culture*, Southwest History Center, Society for the Study of Local and Regional History (Marshall, Minnesota: Southwest State University, 1994), 14.

7. Most readers who can recall their grandparents' food habits may surprise themselves by thinking back to "what sat in the middle of the plate" when their grandparents ate. It was likely to be a complex carbohydrate, and it would often have been adorned with a legume.

8. Markus Mattmüller, "Zur Dreiteilung der Nahren in Schweizer Agrarregionen der frühen Neuzeit," in *Brot, Brei und was dazugehört*, 67–76; Anne Murcott, "Das Core-Fringe-Leguminosen-Modell: Überlegungen zum Fall England," in ibid., 29–44; Daniela Schlettwein-Gsell, "Zum Nährwertgehalt con 'core' und 'fringe'" in ibid., 45–66.

9. S.W. Mintz, "Author's Rejoinder," in Symposium Review of *Sweetness and Power. Food and Foodways* 2 (1989), 191.

10. "According to this perspective, culture is more or less equated with nature, more or less artificial, more or less corrupt. Perhaps we are thus all prisoners of the ambiguously hierarchical image of the culturally embroidered biological base, wherein the biological, having been placed at the bottom of the ladder, takes its revenge on the symbolic by reducing it to a superficial fantasy." M. Aymard, C. Grignon, and F. Sabban, "Food Allocation of Time and Social Rhythms, Introduction." *Food and Foodways* 6 (1996), 161–185.

11. Deutsche Forschungsanstalt für Lebensmittelchemie, *Der kleine Souci-Fachmann-Kraut* (Stuttgart: Wissenschaftliche Verlagsanstalt, 1987).

12. Deutsche Gesellschaft für Ernährung, *Empfehlungen für die Nährstoffzufuhr* (Frankfurt: Umschau-Verlag, 1984).

13. F. Verzár and D. Gsell, *Ernährung und Gesundheitszustand der Bergbevölkerung der Schweiz* (Bern: Eidgenössisches Gesundheitsamt, 1962), 104.

14. M. Mayer, *Hilfsbedürftige und Deliquenten, die Anstaltsinsassen der Stadt St. Gallen 1750–1798.* St. Galler Kultur und Geschichte, Bd. 17, (1987), 160.

15. Murcott, "Das Core-Fringe-Leguminosen-Modell."

16. R. Develey, "Über den Kaffeeverbrauch in der Schweizerischen Bergbevölkerung," Dissertation, University of Basel, 1962.

17. Harold McGee, *On Food and Cooking* (New York: Fireside, 1984), 243.

18. R.M. Russell and P.M. Suter, "Vitamin Requirements of Elderly People," *American Journal of Clinical Nutrition* 58 (1993), 4–13.

19. Gerd Spittler, "Das einfache Mahl: Kost der Armen oder Ausdruck des feinen Geschmacks," in *Geschmackssache*. Kunst-und Ausstellungshalle der BRD (Göttingen: Steidl, 1996), 140–158.

20. D. Schlettwein-Gsell, "Suboptimal Vitamin Intake," *Vitamins* (Basel: Hoffmann La Roche, 1967/8), 85–96.

21. Prof. H. Bansi of Hamburg, a specialist in gastrointestinal disease and veteran of the Russo-Finnish War, told me in 1976 that he had met Russian soldiers who had been punished because they were found with bleeding gums, even though they had been told to suck on pine needles.

22. The lonely figure of Bud Spencer feeding on white beans will have to be dealt with in a special study.

23. F. Nwapa, "Cassava Song," in *Enugu* (Nigeria: Tana Press, 1986).

24. L.L. Cavalli-Sforza, "African Pygmies: An Evaluation of the State of Research," in L. L. Cavalli-Sforza, ed., *African Pygmies* (New York: Academic Press, 1986), 361–426.

25. E. Barlösius, "The History and Culture of Food and Drink in Europe (France)", K.F. Kiple and K.C. Ornelas, eds., *The Cambridge World History of Food* (Cambridge: Cambridge University Press, 2000), 1210–1216.

26. C.F. von Rumohr, *Vom Geist der Kochkunst*, 2nd ed. (Wels, Austria: Borowsky, 1832), 201.

27. Spittler, "Das einfache Mahl."

28. D. Gsell, "Untersuchungen über die Nahrung von alten Menschen," *Gerontologia* 2 [Basel] (1958), 321–356.

29. J. Spyri, *Heidi's Lehr- und Wanderjahre* (Zürich: Benziger, 1976), 25.

30. Hsing-Tung Huang, *Fermentations and Food Science (Biology and Biological Technology)*, vol. VI, part V of Joseph Needham, *Science and Civilisation in China* (Cambridge: Cambridge University Press, 2000), 292.

31. I cannot pursue this theme here. It will be taken up in future publications. See Mintz and Chee Beng Tan, "Beancurd Consumption in Hong Kong," *Ethnology*, in press.

32. John Frecchione, "The Root and the Problem: Cassava Toxicity and Diffusion to Africa," in Leonard Plotnicov and Richard Scaglion, eds., *Consequences of Cultivar Diffusion*. Ethnology Monographs no. 17 (Pittsburgh: The University of Pittsburgh Press, 1999), 43–53.