Pyrotechnical Mastery and Humanization

Amazonian Cuisine, Care, and Craft in Evolutionary and Semiotic Perspective

Chloe Nahum-Claudel

In evolutionary biology, as in Amerindian origin myths, the mastery of fire makes us human. The Amazonian Enawenê-nawê are adept pyrotechnicians. Fire is *the* agent of transformation in their world. They master fire not only to cook food but also to bring health and balance to bodies and to fabricate key items of material culture like ornaments and containers. Demonstrating the analytical productivity of expanding our definition of cookery to encompass craft and care, this ethnographic analysis of fabrication processes suggests that pyrotechnical mastery is a privileged means by which humanity is established in an ongoing evolutionary dialectic between mind and world. This argument is developed through an original reading of Lévi-Strauss's structuralism that highlights commonalities with the semiotic theories of C. S. Peirce. In a broader sense, the article illustrates the potential of semiotic analyses to contribute to the study of evolved human capacities that set humans apart from other species.

Enawenê-Nawê Pyrotechnical Mastery

To be Enawenê is to be constantly involved in the work of cooking with—and in turn being moderately "cooked" by—fire. These Arawakan-speaking horticulturalists living in Brazil's Mato Grosso State prepare for sleep by lighting small hearths in the triangular spaces between slung hammocks in uxorilocal longhouses that extrude like spokes from a sandy circular arena. While women remain dozing, men leave the warmth of their sleeping hearths around 3 a.m. to dance, sing, and play musical instruments in the hours before dawn, circling fires lit in the arena. Men dress in "cooked" ornaments to dance; on their heads they wear yellow-red–colored feather headdresses that are icons of a moderate sun that was domesticated by the cultural hero in origin times; and flowing down their arms and backs are palm silks that have been made by boiling, pummeling, and then sun drying green palm fronds so that they become a bright straw color (see fig. 1).

Around 4 a.m., women serve a warm, nourishing drink, and men break from their nightly musical routine to sip it and talk. Huge amounts of heat are necessary to make a sweet drink from the poisonous juice that women extract from manioc tubers every morning. Fires blazed under pans of bitter manioc juice throughout the afternoon to make the approximately 1,000 L of this drink that circulated most nights in 2008 and 2009 via the dancers to the village's 500 inhabitants. This drink reflects the preference in Enawenê cuisine for complicated, time-consuming recipes that employ large pans and smoking racks, around which the whole domestic architecture is oriented. Through the agricultural season, fires are left perennially burning under these hearth structures so that manioc starch and fiber, separated out from the juice by a process of grating, sieving, and decanting, can be slowly dried, smoked, and then preserved as dry stores. Constant embers also harden clay pots that sit in the ashes of the fire, dry out calabashes that hang above them, and smoke bundles of corn stored in the eaves following harvest (see fig. 2).

In the raw-rotten-cooked triangulation developed by Lévi-Strauss for the analysis of culinary systems, the Enawenê make the "supremely cooked" the apex of their culinary triangle by preferring delayed, moderate processes of cookery that combine smoking, sun, and fire drying.[1] Except for honey, which is found miraculously ready cooked in nature (Lévi-Strauss 1966*b*:152), the Enawenê consume nothing raw (even water), and they also exclude or carefully circumscribe natural transformations induced by rotting and fermentation. For example, although their everyday drink is akin to beer, even though fermentation is key to its making, by reboiling the drink every night it is controlled and curtailed.

Bitter manioc, the Enawenê staple, has a particular affinity with fire, with elaboration, and with the creation of stored surplus. So-called sweet manioc varieties, those with much lower concentrations of cyanide, can simply be baked in the ashes of a fire like sweet corn, yams, taro, or arrowroot and eaten soon after. Little of Enawenê cuisine is of this kind, and indeed very little of this "quick" manioc is cultivated. Most recipes involve large-scale catering to make complete foods that are reconstituted from stores of manioc flours, dried corn, and smaller quantities of fish. Proper cuisine thus involves a long series of

1. In Lévi-Strauss's (1968) words, smoking and fire drying most closely approach the "abstract category of the cooked" (403); they are "a superlative form of cooking" (408).

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Figure 1. Enawenê men exit the flute house dressed in their "cooked" adornments. All photos were taken by the author.

operations including grating, sieving, pounding, fermenting, sun drying or smoking, and then repounding and sieving before combining the ingredients and either baking or boiling them.[2]

Of course, whatever their staple crop, all forest horticulturalists depend on clearing and burning tracts of land, so they must be masters of fire. Again, the Enawenê take this to the extreme, burning vast collective fields, pristinely clearing them of burned remnants, maintaining them weed-free, and giving them over to bitter manioc monoculture. Fire is also a technology for the making of essential tools in forest societies where wood is an abundant material. Think of an old man sitting hunched over a log with a tube to his lips, blowing gently on an ember to control the degree and direction of the heat in order to hollow out a new hardwood mortar to be used daily for food processing by his wife and daughters. Similarly, consider the involved process of making ash salts by burning palm trees, pouring water through their ashes suspended in a basket, and then boiling the resultant solution furiously to distill out a precious residue of potassium salt (see fig. 3).

By presenting some of the ways the Enawenê make the control of fire central to their livelihood strategies, cuisine, and ceremonial life, I intend to introduce the context for this article's exploration of the semiotic and evolutionary significance of "pyrotechnical mastery," by which I mean skill in manipulating fire to transform the material world—food, land, bodies, things. Almost 150 years after Darwin (1871) casually remarked that the control of fire is, with language, humankind's "greatest discovery" (132), there is still heated debate in the evolutionary sciences about when the genus *Homo* seized control of fire and to what degree it was the decisive factor in directing the course of our species' evolution. Wrangham is the most prominent exponent of the "cooking hypothesis" and invites us to understand almost everything that distinguishes us from other apes—for example, bipedalism, hairlessness, small jaws, long lives, earlier weaning of infants, and shorter birth intervals—as the outcome of the control of fire by *Homo erectus* and nearly two subsequent millennia spent adapting to a cooked evolutionary niche (e.g., Wrangham et al. 1999).

This hypothesis is particularly compelling to me because the Enawenê-nawê, with whom I conducted ethnographic research between 2006 and 2013, make pyrotechnical mastery the condition for their distinctive humanity as well. It also intrigues me as an avid reader of Lévi-Strauss, who also claimed that the

2. Ever since manioc was domesticated in southern Amazonia between 8,000 and 10,000 years ago (see Rival and McKey 2008), Amazonian people have selected for preferred traits—in the Enawenê case, large, especially toxic, and juicy tubers—and thus for a particular cuisine (Dufour 1993). Many scholars of Amazonia have been fascinated by the question of why some people prefer manioc varieties that are high in cyanide, even though this makes the process of turning them into food laborious and fire intensive. And many ethnographers have detailed the variations in technological choice and the combination of fermentation, hydrolysation, and application of heat that is employed to make such tubers safe and good to eat (e.g., Dole 1978; Hugh-Jones 1979).

Figure 2. Hearth structure on which corn bundles, manioc breads, starch, and fiber are visible.

control of fire was a central theme in Amerindian people's ideas about humanization and who became the first anthropologist to pay attention to the sensory and material aspects of cookery, arguing that these grounded wider symbolic systems (Lévi-Strauss 1968:411).[3]

Following the leads of both Lévi-Strauss and the Enawenê, I am interested in the symbolic potential of manipulating fire to transform the world. I introduce the concept of pyrotechnical mastery to include the myriad ways that bodies, plants, animals, food, and land are transformed by means of the control of fire, heat, and humors. While culinary processes such as the detoxification of manioc are central to my analysis, I argue that it is necessary to shift from a narrow focus on food to a holistic understanding of the interconnections between cookery, fabrication, and therapeutic practices. Enawenê ethnography suggests that cookery is one aspect of a more encompassing prioritization of pyrotechnical mastery. For example, pet parrots' bodies are subjected to therapies that "cook" their feathers before they are plucked to craft a headdress; manioc fiber is shaped and dried to serve as durable wealth as well as food; and teenage girls' vulnerable bodies are "cooked," decorated, and sealed in puberty seclusion.

My argument is that cookery, craft, and cure are key technologies for regenerating a human and living status in the world, a status that is grounded in pyrotechnical mastery. My use of the term "mastery" rather than the more neutral "control" deliberately implies human ascendancy, including the assertion of health and vitality, wealth and plenty, and strength and stability against threats to these values. That humanness should be at stake rather than constituting a "mere fact of species membership" (Ingold and Palsson 2013:8) reflects the grounding of this research in animist Amazonia. Here humanization is an ongoing "work-in-progress" (Praet 2013) because the boundary between civilized humanity and various opposing categories of sub- or superhuman others (neighbors, spirits, enemies, animals) is constitutively unstable and perspectival.

However, I am not making a regional or culturalist argument here. Contemporary evolutionary theories also promote an understanding of humanity as something that is ongoing rather than emphasizing its achievement in prehistory. Proponents of an "extended evolutionary synthesis" who are forging new research agendas in response to the reductionism of neo-Darwinist paradigms are seeking to bring cultural dynamics, such as those I describe in this paper, into evolutionary theory (Fuentes 2016). Pyrotechnical mastery is an example of a human-made "ecological, technical, and cultural niche" that reciprocally structures and channels human experience and evolution; it is a "fundamental constituent of a human niche" rather than a "veneer laid over a basal set of physiological capabilities" (Fuentes 2016:15–17). The affinity between the animist Amazonian assumption that humanization is an ongoing labor of mastery and contemporary evolutionary theory allows me to connect a conceptualization of pyrotechnicity based on ethnographic analysis and limited regional comparison with wider discussions about how we can understand the control of fire as an evolved humanizing capacity.

My argument draws on two interlinked aspects of Lévi-Strauss's work, of which I offer a new interpretation. First is his focus on the fundamental principles of cookery, that is, the transformation of food by means of fire (variously mediated) and putrefaction, as laid out in the essay on the culinary triangle (Lévi-Strauss 1966*a*) and recapitulated in the third volume of the Mythologiques (Lévi-Strauss 1968:390–411). And the second is in *La pensée sauvage* (Lévi-Strauss 1962), in which he sketched the naturalist epistemology that grounded this work on myth and cuisine, making the case for "the science of the concrete." Lévi-Strauss, I argue, was always concerned with the bridge between the order of the world and that of the mind. This was at the root of his intuition that Neolithic inventions such as pottery and plant domestication must have been reached gradually in human prehistory by means of a continual scientific work of categorization, analysis, and manipulation of the world's properties, as they were perceived and as these perceptions in turn shaped people's

3. I use "Amerindian" in this paper to refer to the indigenous people of the Americas, following Lévi-Strauss's emphasis on the continent-wide connectedness of their mythic systems. I use "Amazonian" to specify the indigenous peoples of lowland South America, following the emphasis on this narrower areal horizon by most anthropologists working in the region today.

Figure 3. Diluted palm ashes boil furiously, resulting in a pile of ash salt.

systems of knowledge, their tools, and, ultimately, the pathways of connection in their minds (Lévi-Strauss 1962:26–28).

I recapture this evolutionary and materialist understanding of structuralism in the light of the adoption of C. S. Peirce in contemporary semiotic anthropology, drawing in particular on Terrence Deacon's efforts to develop an evolutionary synthesis on the basis of Peircean semiotics. Deacon's ambition to theorize the origins of human symbolic thought by combining aspects of primatology, paleontology, neurology, and semiotic analysis takes bold strides toward uniting symbolic and evolutionary concerns beyond anything that Lévi-Strauss was able to achieve as an armchair theorist. Nonetheless, it is my contention that Lévi-Strauss's work should be understood in the spirit of its ambition to conjoin evolutionary and semiotic considerations—a spirit that is happily reignited in anthropology today.

The Cooking Hypothesis Considered

Wrangham dates the control of fire to 1.9 million years ago. This places it at the origin of all significant changes in the anatomy and life-history profile of our genus, displacing tool use, hunting, or bipedalism for the evolutionary gold medal position. His claims challenge the more widely accepted position that the origin of fire occurred only about half a million years ago, when all the most significant physiological adaptations had already been achieved. Wrangham marshals varied data to build his persuasive hypothesis, from primatological observations that great apes chew for a minimum of five hours daily, while a cooked diet allows us to chew for an average of less than one (Wrangham and Carmody 2010:197), to a nutritional study of contemporary raw foodists that demonstrates fertility decline for women following a raw diet (Wrangham 2017:304). Nonetheless, in the absence of consistent archaeological evidence of hearths or of charred animal bones at many sites dated earlier than about half a million years ago, some of Wrangham's colleagues writing in this journal dismiss his theory as a "just-so story" (Milton 1999:583) and "wishful thinking" (Loring Brace 1999:579). Yet Rowlett (1999) claims that various African sites have "removed all doubt that even early [*Homo*] *erectus* had the technological capability of cooking foodstuffs" (584).

In a recent assessment of the status of the cooking hypothesis, Wrangham (2017) presents a series of counterfactual scenarios to place the burden of proof on theorists who continue to ignore his hypothesis and assume that *H. erectus* did not control fire. How did "teeth, jaws, jaw muscles, and mouth size became reduced" (Wrangham 2017:307) if not through adaptation to a cooked diet? And if *H. erectus* was surviving without fire, then it remains to be proved that they were committed fat eaters since a diet of brains, marrow, and guts would be the only calorie-rich, easily chewable alternative to cooked plant foods (Wrangham 2017:305). And how did Lower Paleolithic endurance runners, who must have lost their insulating layer of hair, survive the nights without fire (Wrangham 2017:309)?

This is a stimulating debate for the outsider to enter into, and skeptical colleagues' dramatic tones are probably a reaction to

Wrangham's bold claims and popularizing style. Like other neo-Darwinist popularizers, Wrangham brings adventure, resonant symbols, and a compelling plot to specialized knowledge by blending mythic and scientific sources of authority and persuasion in his writing, as Gregory Schrempp (2016:75) has argued. Wrangham is well aware that by investigating the advent of cookery, he is treading furrows plowed first by mythologists and anthropologists, and he has an overtly sympathetic attitude to such wisdom, reveling in the convergence between his own thinking and that of Lévi-Strauss, insofar as both give a primordial role to the control of fire in humanization (Wrangham 2009:11–12).

In the end, however, Wrangham repeats the trope in which scientific truth displaces its mythic precedents, however ingenious and intuitive the latter may be. So while he largely accepts Lévi-Strauss's summary of the preeminent place of fire in human culture, he now seeks the truth of this bioevolutionary event rather than merely its symbolic or psychological hold on us all (Schrempp 2011:112–113). Along with Schrempp (2016:60), I insist on greater symmetry in the way we parse fact and fiction, science and myth: indigenous accounts of the primordial origins of human difference have evolutionary importance, and origin scenarios like Wrangham's are speculative and partisan. By supposing that the idea that fire made us human was not for Lévi-Strauss and for the people whose myths he collated at the level of the "real," Wrangham spuriously polarizes biological and cultural branches of anthropology.

As Maurice Bloch (2013:148) points out, Lévi-Strauss's core ambition was to hold on to questions about the kind of animal human beings are while approaching them in the context of history and cultural flows. Cookery was an ideal candidate for an anthropological analysis that was grounded in an understanding of our evolution. That was the reason for Lévi-Strauss's interest in a theme that most anthropologists previously had seen as too closely tied to the satisfaction of human needs to be relevant to their concern with "social facts." Of course, Lévi-Strauss was also heir to Durkheim and rejected a one-way determinism that would take the social as an emanation of a biological or psychological real. I suggest that his solution was a dialectical understanding of nature and culture as well as reality and representation that allowed him to explore the role of human semiosis in evolutionary adaptation. In the next section, I propose this evolutionary-semiotic reading by positively connecting the goals of structuralism with semiotic approaches inspired by C. S. Peirce.

Structuralism and Semiotic Anthropology: An Evolutionary Synthesis

Exploring the mind's constitution in the relation between the sensuous forms of the natural world, which are patterned, and human capacities for perception and association, which are pattern seeking, in *La pensée sauvage*, Lévi-Strauss expresses a version of Peirce's conception of the relationship between the world and its representation that I will allow Parmentier, whose own work was pivotal in bringing Peirce into anthropology, to summarize:

> In every mental act some feature of reality . . . is brought into connection with a chain of mental representations that has the unique power of interpreting reality in ways other than it is in itself. But since reality's objects possess the qualities or characteristics they do independently of human representation, the pattern of perception is always "determined" or caused by natural regularities; a resulting cognition is true to the degree that the relations inhering among mental signs match the relations inhering among external signs. (Parmentier 1985:24)

Terrence Deacon's (1997, 2012) work on human symbolic thought and language faculty develops a further evolutionary implication of Peircean semiotic realism. This is that "physical responses, perceptions, and mental categories . . . exist to structure adaptation to the world" (Deacon 2012:482). In particular, Deacon takes Peirce's idea that representation is hierarchical as the basis for a modified human exceptionalism. Iconic and indexical representations, that is, the recognition of resemblances and cause-and-effect relationships, are shared by all living creatures, but humans are unique in the extent to which they depend on symbolic communication that does not refer to things in the world by correspondence but by referring to other symbols that form part of a system (Deacon 1997:99). However, even though we humans largely live in a virtual niche, we also respond, like other animals, to the causal efficacy of pattern and organization in the world. Deacon's hierarchical understanding of semiosis has entered sociocultural anthropology through Kohn's (2013) efforts to refocus anthropology on shared semiotic capacities. As Kohn (2013) puts it, "Via symbols, reference can become increasingly separate from the world but without fully losing the potential to be susceptible to the patterns, habits, forms, and events of the world" (56).

I want to suggest that Lévi-Strauss shared this understanding of the causal efficacy of people's cognition of nature's patterns, understanding symbolism to rest on just such an iconic and indexical infrastructure. In *La pensée sauvage*, he uses an arboreal metaphor to express this continuum between symbolism's relatively motivated or arbitrary connection to the world. If a tree is to stand, he says, the trunk must be vertical, and the first major branches must be close to horizontal, or the tree will fall over, but the upper branches are free to grow arbitrarily (Lévi-Strauss 1962:192). Just as the law of gravity imposes constraints on the tree's form up to a certain point, so do nature's regularities impose constraints on our representations of it since these are always both adaptive and poetic (we may need to climb the tree as well as sing about it).

Transposing this to Deacon's semiotic hierarchy, the trunk would stand for iconicity, which is the perception of a resemblance, however faintly it rises to consciousness—if it does at all. Consider three examples along a continuum: the effect of onomatopoeia, seeing a face in the moon, or a marble bust of

Isaac Newton that shouts, "I AM AN ICON OF THE GREAT MAN." The middle branches stand for indexicality: the leaves rustle, telling us of wind, or a monkey's warning announces the proximity of a predator. The upper branches, though dependent on the trunk and lower branches, are free to grow this way and that—this is the realm of imagination and metaphor.

Kohn's project is to take seriously forms of communication that transcend the human and nonhuman dichotomy in order to correct the anthropological bias for uniquely human symbolic communication. He focuses on signs like animal alarm calls or the presence of certain species that indicate the availability of honey that hunters listening, observing, and waiting in the forest need to interpret to be successful in their quest and whose interpretations respond to those of other sentient beings—for example, their rivals (jaguars) and prey (say, howler monkeys). His wider point is that we are all enmeshed in "the logics of living dynamics" (Kohn 2013:22) as much as in webs of conventional cultural meaning. Reflecting on Kohn's book, Descola (2016) has highlighted the "posthumanist" dimension of Lévi-Strauss's work, with its ambition to understand the world as composed of a vast array of meaningful differences between qualities and beings rather than as "the exclusive playground of humans" (35). As Descola points out, this was implicit in the topics he tackled: systems of marriage, cookery, totemic classification, or astronomy, which connect people to biological and ecological processes that exist independently of cultural conventions (Descola 2016).[4] While Kohn's commitment is to analyzing the role of forms of iconic and indexical representation in interspecies communication (and he largely ignores the evolutionary implications of his analysis), Deacon's goal aligns more closely with that of Lévi-Strauss on two counts. First, he elucidates the iconic and indexical infrastructure of representation to better understand how our physical responses, perceptions, and mental categories structure our adaptation to the world (Deacon 2012:482), and, second, he is interested less in what we share with other species than in how we differ—in grasping the consequences of humans' unique status as *The Symbolic Species*.

One can open up almost any page of the Mythologiques and find evidence of Lévi-Strauss's concern with the constraint that the world imposed on meaning. Take the beginning of *Le cru et le cuit* (Lévi-Strauss 1964), which is directly relevant to my concern in this paper with Amazonian conceptions of the control of fire. In Amerindian myths, the conquest of burning embers allows humans to overcome their original bestial condition at the expense of a representative of another species, who is tricked out of possession. In each case, the adversary species is defined by its diet. By comparing versions of this myth from central Brazil, Lévi-Strauss noticed that speakers of Ge languages won fire from a jaguar, who devours its meat raw, while Tupi speakers stole it from a vulture, eater of rotting carrion. A contrastive triangle between raw-rotten-cooked is thus grounded in indexical associations between jaguars and their raw, fresh, bloody quarry and vultures and their rotting, stinking, fly-covered meals. The different habits of the two species embody contrasting conceptions of nature and animality that inflect specific visions of cooked human culture.

I am suggesting that Lévi-Strauss was centrally concerned with the molding of human perception and imagination by nature's regularities. With its reliance on naturalist observation—from zoological minutiae to astronomy—the Mythologiques represents an extended realization of this point. However, I do not wish to deny Lévi-Strauss's emphasis on the Saussurean upper branches of the semiotic tree, where these individual indexical referential supports are supplanted by a higher-order system of oppositions (Deacon 1997:99), and I am also not claiming that Lévi-Strauss achieved the goals of contemporary semiotic anthropology as it is practiced by Deacon.

In all of Lévi-Strauss's writing, a rationalist and scientific impulse pulls against that of the aesthete, surrealist, and lover of paradox (Viveiros de Castro, Lagrou, and Belaunde 2011:13), and this is nowhere more pronounced than in *La pensée sauvage*, where Lévi-Strauss reads Saussure and Peirce, Jakobsen and Ricouer against the grain of myths and totemic classification systems. Because of this tension and the lack of a rigorously propositional kind of clarity, Lévi-Strauss's legacy has been contradictory. In one reading, human culture is reduced to an epiphenomenon of nature (Turner 2009:13–14), and anthropology is set on the course of seeking naturalistic, cognitive explanations for cultural forms (see, e.g., Sperber 1985), while in a contrary reading, Lévi-Strauss is playing an artistic game of meaning that is ultimately fictitious (Geertz 1973). Today, semiotic anthropologists reading Peirce also claim novelty for their program by dismissing structuralism on the basis that it is committed to a Cartesian conception of arbitrariness in the relation between signs and referents and thus restricts interpretation to decontextualized semantics (e.g., Keane 2003:411–412).[5] On the basis of this reading, which runs counter to my own, they claim to be reinvigorating anthropology by grounding it in the reality of the world and its materiality after decades defined by structuralist idealism (Mertz and Parmentier 1985:2).[6]

4. In fact, Kohn recognizes this affinity, titling his book *How Forests Think* partly in a play on Lévi-Strauss's *La pensée sauvage* (Kohn 2013:227–228) in recognition of the latter's concern with the causal efficacy of nature's patterns.

5. See Ball (2016:54) on revisionist readings of Saussure that allow for a rapprochement with Peirce and a reappraisal of structuralism akin to what I am proposing.

6. In fact, most contemporary readings of Peirce in sociocultural anthropology ignore the evolutionary implications of his semiotic realism that are stressed by Deacon and that, I have suggested, align with Lévi-Strauss's concerns. For example, Keane (2003), Manning (2012), and Silverstein (2006) all use Peirce's conceptual tool kit to better account for the role of extralinguistic signs in the semiotics of religion, food, and drink, but theirs remain culturalist and historicist accounts (see also Kohn 2013:9).

Yet the accusations of abstract and discursive idealism that have dogged Lévi-Strauss from the 1960s onward emerged in an intellectual context in which "materialism" had become a code word for Marxism, potentially leading to a profound confusion of basic categories among different analysts. To give an example that is relevant to this article's concern with the anthropology of food systems and cookery, in the 1980s materialism came to mean food's production, role in sustaining inequality and class, and circulation as a commodity in the world system (Maurer 2013:14). Furthermore, materialism stood for history—the study of causes (Maurer 2013:21). Lévi-Strauss's emphasis on the transformation of matter at the microlevel of actual recipes and their sensory qualities came to seem quaint when politics, economics, and history were pushed to the forefront of an emerging subfield (Mintz and Du Bois 2002). Mintz's (1986) and Goody's (1982) influential books bear this out. Goody read the culinary triangle essay as a classic performance of structuralism's key tenets as they were derived from Saussure: the distinction between sign and world, the arbitrary relation between signs and referents, and the emphasis on the mutual determination of signifiers in a nonarbitrary system of differences (e.g., Goody 1982; see also Leach 1989). In contrast, in my Peircean reading of the culinary triangle, I suggest that there is an implicit claim that the potential universality of the culinary code is grounded in iconic and indexical relations between matter and meaning. Lévi-Strauss, I claim, is interested not only in the contrastive pairs operating in any "system of recipes" (such as between air and water, roasted and boiled) but also in cookery as a symbolic system grounded in the constraints of biochemistry (e.g., rotting, fermentation, drying) and the technologies that manipulate them. This is why the meaning of cuisine cannot be a matter of cultural convention alone and he can claim a degree of universality for his model.

The Culinary Triangle

Lévi-Strauss's proposition was simple: first, cookery is a symbolic system that is carried by a particular material medium—fire and the various technologies that come between it and food. For illustrative purposes, his focus is rather narrowly based on Amerindian cookery—on wood fires, wooden smoking racks, and clay pots. He offers only superficial asides on frying, cheese making, and chopping sushi. In particular, he dwells on the opposition between pot boiling and fire roasting, which he identifies as pertinent in many, if not all, culinary traditions.[7] He starts by noting that a series of Amazonian myths that he has just examined use this contrast, which also figures prominently in medieval French cookbooks alongside others like soft and hard, cold and hot, spices and alliums (Lévi-Strauss 1968:397).

7. It seems likely that, like Michael Pollan (2013, citing Schrempp 2016:53–54), Lévi-Strauss was influenced by pre-Socratic philosophy, in which grilling, boiling, baking, and fermentation correspond to elements recognized by the senses: fire, water, air, and microbial earth.

He shows that boiling and roasting are material processes involving the recognition of resemblances (iconicity) and causation (indexicality). For example, he implies that the widespread association of roasting with primitiveness is given by the lack of mediation or elaboration in this technique, which places meat in direct contact with the flame (Lévi-Strauss 1968:399). The "naturalness" of roasting is indexed in the meat that blackens (burns) on the outside while remaining raw and red inside, carrying the trace of both fire and its original state of bloody rawness. By contrast, boiling is cultured because it necessitates greater elaboration—both the making of the particular pot and the invention of pottery. It is also cultured on an axis of mediation since both water and pot come between fire and food. However, Lévi-Strauss goes on to say, if boiling would seem, to the intellect, to be superior in terms of evolution and complexity, this contradicts what it represents to the senses. Food breaks up and becomes mushy in water. Perversely, boiling induces a process akin to decomposition; that is, boiled food resembles rotting food, food subject to nature's cookery (Lévi-Strauss 1968:399–400). Implicitly, he thus stresses the Peircean point that how physical processes enter symbolism is constrained but by no means transparent, being dependent on the criteria by which they are interpreted.

If Lévi-Strauss intuited that cuisine had both motivated and arbitrary dimensions, he did not formulate this rigorously, jumping from claims to universality to the humble insistence that he was merely illustrating a heuristic for other anthropologists wishing to analyze culinary systems. As such, his essay is incongruous in the way it conflates the culturally specific and the universal. Thus, when Lévi-Strauss mused in passing that boiling may be the most frequent method employed for cooking human meat since it was an "endo-cuisine," one anthropologist sought to test this and found it to be true in only 17 out of the 60 cannibalistic societies sampled (Shankman 1969:63). My more generous reading acknowledges both the heuristic value of the model and its speculative universalism, which have in fact made it the ideal stimulus for analyses of contrasting cannibal feasts and ritual meals (e.g., Vilaça 1992). Indeed, anthropologists working in Amazonia have continued to reaffirm Lévi-Strauss's key insights about the fundamental importance of cuisine in structuring other aspects of experience.

Cookery and Humanization in Amazonia

Like most Amazonian people, the Enawenê tell stories that seem to parallel biologists' evolutionary narratives, imagining a remote past when they lacked both cooking fires and agriculture and lived like beasts, foraging for raw food. This was the time before a celestial ancestor stole the first embers so that the first people could "become human" (*enawenêtwa*). There is no ambiguity about the negative value associated with this tapir-like existence. As people who have long been predominantly agriculturalists, who value productivity and abundance, and who have become increasingly settled over the previous two decades, the Enawenê spoke of epochs of suffering and penury within

living memory as a return to a prehuman bestial state. Elder people had painful memories of a period of destitution in the middle of the previous century when they fled village after village following deadly raids from their cannibalistic neighbors. Leaving canoes and cultigens behind, they trekked to safety, but two elderly women died of thirst on the way, and the remaining survivors were reduced to nudity. This was presented as the lowest ebb of Enawenê history.

During the dry season in 2008, I asked my host whether our extended family could leave the village to spend the remaining dry months gathering honey and forest fruits in the intimacy of a small encampment, as people had tended to do until about 2001. He responded that I should not wish for a return to poverty: "When I was a child," he told me, "we were like poor people, the manioc would finish. There would be no manioc bread or drinks, so we would go away and drink only honey. Two or three moons later, when the corn was ready to harvest, we would return." Now that there was always plenty of manioc, it was good riddance to this seasonal gathering livelihood. As if to constantly defy poverty with its bestial associations, people never drank plain water unless they were desperate. They carried either honey (to be mixed with water) or bottles of cooked drinks whenever they went on any journey—drinks made from pounded, squeezed, fermented, dried, toasted, masticated, and then boiled manioc flours.

Their dissociation from the raw and from necessity extended to delaying consumption, avoiding mention of hunger, and treating unelaborated foods as inedible. Since I was often hungry during fieldwork and liked raw veg, I would sneak mouthfuls of peas and lima beans as I picked them on harvesting trips. My harvesting companions were disgusted by this, and their best insult was to call me "peccary." I also had to learn to eat corn on the cob not by sinking my teeth into it like the peccaries who steal from Enawenê gardens but by picking the kernels off the cob and chewing them individually.

The Enawenê certainly saw themselves as exceptionally civilized, self-controlled, and ascetic people. Their confident superiority in their preference for smoked, dried, and elaborated foods and their negative valuation of rawness and fermentation distinguished them not only from a precivilized, bestial condition associated with tapirs and peccaries but also from neighbors and enemy spirits. They considered their nearest neighbors, the Nambikwara,[8] inferior first because they slept on the ground (traditionally in the ashes of fires) rather than raised up in hammocks and second because, as their "earthiness" would suggest, in the Enawenê's judgment they are "raw" people who eat indiscriminately (lizards, frogs, and tapir blood are some abominations mentioned), hardly light fires, sometimes throw away manioc juice rather than build a fire to boil it, hastily roast and immediately consume their food, have unimpressive gardens, and store little or no surplus.[9]

Other neighbors, the Cinta-Larga, are by contrast respected and feared. It was they who cannibalized numerous Enawenê victims in the 1950s and 1960s. To justify their respectful circumspection, the Enawenê often mention their ample sweet potato crop, which is used to ferment large quantities of strong beer. An elderly woman told me about the uncanny night when two Cinta-Larga couples stayed in the Enawenê's village in the early 1980s. The Jesuit missionaries who assisted the Enawenê after establishing contact in 1974 had arranged the visit to prove to the Enawenê that they were now safe and need no longer avoid fishing, gardening, or gathering in the parts of their territory where they had suffered Cinta-Larga raids. My interlocutor recalled that the whole village had stayed wakeful and vigilant during this conciliatory visit. Central to her account was a description of the visitors' evening meal, which the whole community was able to watch from their encircling dwelling houses because the two couples had been invited to occupy the flute house in the open circular arena.

Earlier in the day, the four foreigners had requested to be shown to the corn gardens, where they took corn and killed a baby monkey. They roasted it in the flute house, giving off a powerful and dangerous stench of blood, which was disgusting to the Enawenê, who are pescatarians. They also asked the Enawenê for manioc beer so that they could dance. They drank copiously and vomited the Enawenê's beer. My storyteller closed her vignette by saying that they knew these guests belonged to the same group who had formerly raided their village and cannibalized their kin because, after the survivors had fled, a woman called Talanero had gone back to spy on the attackers and had seen the Cinta-Larga dancing and playing the Enawenê's bamboo trumpets amid the burned remnants of houses, hammocks, and manioc flour—just as they were now drinking and dancing as guests in the Enawenê's village. That this narrative about an abominable meal should be bookended by confirmations of the Cinta-Larga's predatory status illustrates the centrality of diet, cookery, and table manners to reckonings of alterity.

It is not only in opposition to the cookery and consumption habits of their neighbors and their former selves that the Enawenê construct a civilized human identity but also in relation to their supernatural alter egos. These are the invisible resource owners who cause illness and death in retribution for human appropriation of resources and who are collectively known as the "Killers" (*Yakairiti*). In turn, they are said to call the Enawenê "the dead people" (*mae-nawe*), indicating the mirroring perspectivism between the living and their invisible

8. See a photograph taken by Lévi-Strauss in 1938 that appears on p. 119 of the English translation of his photo memoir (Lévi-Strauss 1995).

9. The Enawenê's name for the Nambikwara, *Kahene*, translates as "earth people." See Nahum-Claudel (2018:154–155) for further contextualization of the hierarchical relationship between the two peoples and Nahum-Claudel (2018:186–188) for a comparison of their cuisines based on Lévi-Strauss's Nambikwara fieldwork in the 1930s.

enemies, who also represent one postmortem destiny for Enawenê people (Nahum-Claudel 2018:198–201). Appropriately, the Yakairiti are said to live in a raw-rotten abomination of the cooked, fire-transformed world of the Enawenê. In their underground domain, drinks are made of earth; they wear live snakes rather than dried silks to dance; they prefer fermented beer and pungent, sour foods that disgust the Enawenê; and they appreciate rotting leftovers from the deliberately superfluous catering of the living.

Distinguishing themselves from the raw, wild, voracious Yakairiti, the Enawenê impose a self-consciously civilized ethos through elaborate cuisine (the careful, staged mediation of fire, storage, and future orientation) and the attendant ideals of delayed, moderate consumption and durable wealth creation. At the same time, their cuisine entertains a subversive counterpoint to these dominant values of pyrotechnical mastery in order to satisfy the Yakairiti. Drinks that have been left to sour are spilled into the ground for them, leftover fish soup is discarded from the backs of houses, breads made of soured manioc fiber litter the ground, and ash salt circulates frenziedly from the palms of hosts to the mouths of men who incarnate the invisible killers (see fig. 4). Thus, the perverse raw-rotten underground domain is a mirror inversion of the cooked, terrestrial one, but the Enawenê must sustain a commensal regime that mediates between the two. This entails a constitutive alternation in Enawenê ritual life between the routinized self-controlled consumption of proper cooked foods coinciding with a civilized regime of decoration and musicality and carnivalesque impersonations of the Dionysian spirits by men disguised in mud and palm fronds who lick salts and spill beer and who are capable of producing only unruly sounds.

Figure 4. To resemble the Yakairiti, an Enawenê man wears palm fronds, genipap dye, and clay, "raw" counterparts to properly human silks and headdresses.

Crucially, the Enawenê stop short of courting alteration—they do not drink the beer themselves, they merely spill it—so that Dionysian alteration is always contained within the civilized regime. This encompassment and the ascendancy of humanizing pyrotechnical mastery over raw-rotten supernatural communion are expressed at a climactic moment of the ritual process when men who have been away on fishing expeditions return disguised as Yakairiti, wearing raw green palm fronds, their skin patterned with black genipap dye, their faces covered with long fringes, their posture a low crouch, and their voices uttering senseless cries. What happens is that, over a 48-hour ritual process, the resident hosts assure their humanization. They are brought up from the water and out of the night, are heated by a huge bonfire that is lit in the center of the village, and have their green palm frond attire displaced by sun-dried equivalents and their harpy eagle feather headdresses replaced by diadems that represent the sun. As this "cooking" occurs, words and songs replace eerie vocalization (Nahum-Claudel 2018:102–111).

I have evoked the Enawenê's commitment to the supremely cooked by exploring their attitudes to the contrastive cuisines, consumption mores, and definitions of edibility of their invisible enemies and two neighboring groups. Much Amazonian scholarship has demonstrated that cookery is a key technology for making and crossing boundaries between humanity and animality, life and death, either to assert one's humanity or to escape it, courting alteration and supernatural communion such that cuisine indexes broader contrasts both within and between societies (e.g., Fausto 2007). As one Amazonianist colleague joked, the Enawenê are the gluten intolerants of the Amazon—even bread for them is potentially poisonous.[10] In terms of Fausto's continuum, they prefer the "anticannibal" pole, using extensive food taboos, elaborate cuisine, lengthy cooking, and the routine shamanic treatment of foods to tightly control the potential for alteration and supernatural communion that they recognize consumption to hold.

In this emphasis, they resemble other priestly, stability-oriented "superordinate societies" of Amazonia (Helms cited in Hugh-Jones 1996:136) who defensively control external powers rather than specializing in their accrual, notably, the Arawak-dominated systems of the Xingu and northwest Amazonia. For

10. In most Amazonian societies, manioc bread and fish are considered inert foods that are ideal for the seclusion diet, whereas for the Enawenê, they are precisely those foods most strenuously excluded as "bloody" and therefore maximally animate (see Nahum-Claudel 2018:210–216).

the Enawenê, as for other southern Arawakan peoples of the Xingu, pescatarianism is a diacritic of identity vis-à-vis predatory others.[11] Indeed, the Enawenê's ancestors would have been part of exchange networks that connected riverine agricultural polities across the southern Amazon fringe (Heckenberger 2005). In this section, I have certainly particularized the Enawenê case by focusing on contrastive culinary regimes rather than on concordances among Arawakan societies. However, my claim is not that the Enawenê are exceptional, even within Amazonia, but rather that theirs is an exemplary case with which to illustrate the humanizing potential of pyrotechnical mastery maximized in cookery, the ritual use of fire, and its control for therapeutic work and craft.

Beyond Cookery: Pyrotechnical Mastery in Craft and Cure

Shifting away from a focus on the transformation of food for consumption, in this section I illustrate the expansive role of pyrotechnical mastery in Enawenê humanization and explore its semiotics through a close analysis of two fabrication processes: the crafting of feather headdresses worn by dancers and the making of calabashes that allow foods and drinks to circulate. Feather headdresses are worn by men or women in alternate seasons of the year for ritual dancing, chanting, and (in the case of men) flute playing. They are paramount symbols of Enawenê identity, worn during rites of diplomacy and not for warfare, and they are among the few inalienable valuables that escape the destruction of personal property upon death. They are owned by the elder men who make them but worn by dancers from other clans, who perform identically attired to represent a perfected version of ancestral humanity. The second fabrication process is the making of containers and drinking vessels from calabashes of the genus *Lagenaria*. Calabashes are the functional equivalents of spoons, mugs, glasses, bowls, and containers, and they are as ubiquitous in Enawenê houses as those items are in urban kitchens.

The headdress is a symbol of Enawenê identity as human, civilized, properly cooked people; it is a symbol of pyrotechnical mastery. As any Enawenê person will tell you, the headdress belongs to the sun (*Kame*) personified as the cultural hero's uncle, *Kaxi*. Just as humans initially lacked cooking fire in the origin times, they also lacked the sun, so the world was in perpetual darkness. The cultural creator Datamale had to transform the coloration of a parrot's feathers, make a headdress from them, and then send his uncle up with it to occupy the sky. I will argue that, during the fabrication of the headdress, these central symbolic values are grounded in concrete iconic and indexical associations. By claiming that the color and form of this headdress gave rise to the characteristic arc and brightness of the sun, the myth invites an interpretation of the headdress in these terms. I will describe how this grounding occurs through the nurture of parrots and the hands-on chemistry that induces a change in their feather coloration. Unpacking the fabrication process sheds light on how metaphysical abstractions to do with the origin of life and humanness rely on an indexical and iconic infrastructure.

Adult women who did the majority of the cooking for communal feasts had the largest and most varied collections of calabashes. They ranged from spoon-sized ones made for babies to play with to 5-L giants used to carry generous portions of drinks to prospective affines. The biggest and most robust—the "fine china"—were darkly smoked from hanging in the rafters over generations and were among those brought down to be dusted, inspected, and admired by groups of women before the start of a new season's hosting obligations, when they would be used nightly. These calabashes are not only essential to everyday feasting and interclan exchange but also are forms of durable wealth used to pay for shamanic services. Just as Enawenê women worked to build up stores of manioc flour, they took pleasure in owning calabashes and living surrounded by them. Their importance clearly exceeded functional considerations since people always ate from the same chipped few that lay around, leaving hundreds of pristine ones hanging unused in the rafters, where they became nesting places for mice and hiding places for teenage vanity supplies.

I suggest that calabashes serve as constant visual evidence of female industriousness and wealth because, like all products of unalienated labor, they index specific human powers. In this case, this is women's patience and industry in drying, sanding, and sealing them and their fertility in growing large and robust calabashes. In the finished calabash, these capacities are realized as wealth and beauty, associated with qualities of abundance, durability, shine, and hardness. Second, calabash fabrication also invites an iconic interpretation since the method of curing calabashes so that they become impermeable containers recalls the process that takes place at first menstruation, when girls' bodies are tattooed, sealed, and purged of impurities in preparation for pregnancy. However, unlike in the case of mythologized headdresses, these indexical and iconic interpretations are not symbolically recoded—no one said that calabash making was like preparing teenage girls for motherhood by purging, wounding, and healing their bellies or that calabashes stood for women's productive and reproductive capacities.

Despite this common grounding in iconicity, the two fabrication processes thus contrast in the extent to which they are symbolically recoded, which seems to occur inversely to their availability to sensory perception. In the case of the headdress, the transformation process occurs within the body of the parrot and is invisible. All men see is the regrowth of the tail feather after the fact. Furthermore, headdress making is the

11. The Enawenê equate hunting and eating terrestrial mammals with cannibalism and warfare so that, when people wanted to impress me with their potential to become warriors, they emphasized that the ancestors of some of the nine clans ate "peccaries, tapirs, and humans" in the past. This occurred in the context of their preparedness to invade a hydroelectric dam construction site in their fishing waters (see Nahum-Claudel 2012, 2018:226–256).

periodic and specialized activity of elder men. By contrast, the changes women effect in calabashes are constantly fed back to them through vision, touch, and smell: calabashes grow extraordinarily quickly, they contain multiple seeds, and their inner surfaces have a veined, placental appearance. Making a smooth, empty, black, hard inner surface from a porous, pithy, white one is a habitual pastime for women of all ages.

Cooking Parrots

Parrots have first to be weaned and domesticated as human similars and then moderately cooked and cured so that their tail feathers turn from green to yellow red and can be assembled to form an icon of a moderate, warming sun. The bird is humanized, cooked, and transformed by means of curative pyrotechnical mastery, and this science of the concrete grounds metaphysical abstractions to do with creation from nothingness and temporality from atemporality. My description is thus an account of how abstract symbolism depends on the causal efficacy of people's activities in the world.

Yellow-fronted Amazon parrots and scarlet macaws are the only pets Enawenê keep. They are captured from their nests when young and then are weaned by their owners on cooked corn, manioc, and tubers. These birds sing, eat cooked garden produce, and live in and around houses so that it is unsurprising that people say that they are "like us." Like most people who keep sociable birds, the Enawenê also talk to them, bring them in to sleep at night, and bury them when they die. The most important use of their feathers is the making of the headdresses from which the sun is said to have originated.

The world was in darkness. First, the creator gave his uncle a brilliant red headdress made exclusively from scarlet macaw tail feathers and sent him up to the sky. With this headdress he sat fixed at noon, emitting a fierce heat that caused the earth to burn and drinks to evaporate as soon as they had boiled. People perished of thirst. Realizing his error and calling on various helpers, Datamale called this first cannibal sun down and trapped and buried him in a big hole. Then he called on his uncle again, now giving him a headdress made from the tail feathers of the yellow-fronted Amazon parrot that he had made by putting feathers of a pure yellow hue toward the outside of the diadem and arranging increasingly red-flecked ones toward its center. Taking this new headdress, the sun rose up in the East, reached the top of the sky at noon, and fell westward in a cooling arc. When men wear these diadems, they are supplemented by two scarlet macaw tail feathers held in place at the back of the head with a comb, right in the center, retaining a flash of the fierce heat of the first sun.

The headdress is made from the moderately "cooked" feathers of parrots who are first adopted and humanized and then undergo a process of cure at the hands of their owners. This process, which Enawenê men must repeat multiple times to make one new headdress, is known as *tapiragem* in Portuguese and is documented with varying recipes across Amazonia (Métraux 1944). It involves inserting powerful substances into the parrot's uropygial gland (located at the base of its tail) so that the feathers change their coloration. In the Enawenê case, the naturally green tail feathers of the yellow-fronted Amazon parrot grow back yellow and yellow streaked with red. I never witnessed this process but gathered a detailed account from a senior man who had made several headdresses. In his account, the change in coloration is the outcome of a therapeutic balancing of hot and cold humors, a treatment that is far from cosmetic since it involves shocking the parrot so that it is weakened and close to death (like a person with fever) and has to be nurtured back to health and life.

A tail feather is removed, and a solution made from annatto dye, a medicinal tree bark, and the poisonous glandular secretions of a toad called *Watala* (possibly the cane toad *Rhinella marina*) is poked into the parrot's uropygial gland. This causes the "green to dissipate" (*hoira tekwa*). *Hoira* is a color property that covers green, white, new, and shiny—young foliage or gleaming new aluminum pans. Yellow, orange, and red, which form a color property and which share the name of annatto dye, *ahete*, which can be pink, red, or orange in color, replace it. In other contexts, annatto is described as hot; for example, mothers warn their daughters that if they use annatto dye to decorate their bodies too habitually, they will burn their skin. The third element of the treatment is a concoction made from boiling a particular tree bark in water. Enawenê people drink tree bark and other plant medicines (*barayti*) as emetics at puberty or bathe in them to treat various ailments. They are always described as "bitter cold" (*tiha*).

My humoral interpretation of this therapy is based on the properties of *ahete* and *barayti* as well as on the general emphasis on humoral balance in Enawenê and wider Amazonian curing practices (see, e.g., Belaunde 2005). It suggests that the balance between hot and cold elements produces a feather coloration that is neither too hot (pure red) nor too cold (green) but yellow red, like the moderate sun. It is less clear that the effects of the toad's secretions are humoral. I was told that they caused the gland to "sneeze" so that the parrot "fell down," its pulse weak and breath shallow. The parrot required feeding with cooked corn to return to health. About a month later, the parrot's new yellow feathers, streaked with red to varying degrees, could be plucked to contribute to the making of a new headdress. The headdresses, joining others like them, would be worn by lines of identically attired dancers, each crowned with an icon of the moderate sun that had been made by working a chemistry of hot and cold humors on a progressively humanized parrot (see fig. 1).

As a finished artifact, the headdress glows as it filters the sun's rays, bringing its light to mind. Regarded as an index, that is, with respect to its correlation with other things with which it is routinely connected, the headdress points to the parrot, to the sky where parrots are typically sighted, and to other qualities of "parrotness," such as voice. The absent parrot may also be apprehended in its difference from its natural green-tailed state. As such, the headdress indexes the parrot's metamorphosis and elder men's capacity to induce it. In this

sense, the headdress perhaps indexes the capacity for symbol construction itself. In fact, when men and women wear headdresses, it is to do symbolic work: to sing poetic versions of creation myths (like the one about Datamale and Kaxi) in order to coerce the cosmos into conforming to its own habits. Thus a symbol of temporality itself, the headdress is worn to dance the day in at dawn and to dance it out at dusk, and, in extremis, upon the event of a solar eclipse, it is brandished at the sky to remind the sun of its proper course.

The Enawenê can ignore the recursive indexical chains that link the headdress with the moderate sun because the myth of the sun's origin, which everyone knows by heart, provides a mnemonic shortcut (Deacon 2012:302). As Deacon stresses, most of the time humans rely on conventional symbolic recodings to represent the world. Nonetheless, it seems to me that the power of making lies in regrounding central values in concrete, efficacious physical processes. By making headdresses, men participate in embodying concepts of creation and experience their own efficacy in doing so. They do not trust in virtual reference alone (Deacon 1997:405).

Curing Calabashes

Calabashes pose a distinct challenge for my interpretation because their making is not symbolically recoded, at least to my knowledge. This means that in my analysis I am engaging in the conventionalizing act of "inventing culture," in Wagner's (1975) terms. Along with Deacon (1997:74–76) and Kohn after him, I understand this lack of exegesis in terms of the absence of interpretive effort that is entailed by iconicity, if we think about the latter as the act of not noticing "differences that would require further interpretation" (Kohn 2013:176). Kohn uses the example of onomatopoeia, whose meaning is experienced sensorially, outside semantics and grammar (Kohn 2013:31–33). Something similar seems to occur when Enawenê women make calabashes and are immersed in the combined senses of smell, touch, and vision, such that when a metallic-smelling, dark-red, tacky dye is painted onto the interior surface of a calabash with the hands, its bloodlikeness receives no comment. I will describe the process from my own point of view as someone who repeated it many times with groups of women who were busy talking but were not interested in explaining the significance of calabash physiology or transformation. I focus on the sensory process of modifying the calabashes, drawing attention to the likeness of calabashes to pregnant bellies and the resemblance of the fabrication process to the tattooing of girls' bellies and breasts at puberty, a process I also witnessed but did not participate in.

For the first three months of my doctoral fieldwork, beginning in January 2008, I did a lot of calabash making. It was an immersive activity that dimmed my anxiety, and it fitted my total lack of understanding of the Enawenê language at that stage. Furthermore, women all around the village had redoubled their industry after one woman's cooking fire had caught the thatch and razed the entire village a few months earlier during a punishingly long and hot dry season. Many valued possessions, among them feather ornaments, aluminum pans, hammocks, and calabashes, had been incinerated. Since then, every household had built separate storage shelters to guard against future losses, and women were busy filling these with hundreds of calabashes.

From my newcomer's perspective, the miracle of calabashes was the speed with which they grew in swampy gardens as soon as the rains began and their hardness, durability, and boundedness despite their growing in contact with the wet earth. For the Enawenê, the qualities desired of calabashes are corpulence (*agotiri*) and strength (*kinata*), which are also the main compliments paid to youthful bodies. Unlike many other people around the world who make calabashes into art objects by elaborately decorating their exterior surfaces with patterns, the Enawenê ignore their outsides. They focus instead on drying, curing, and sealing their inner surfaces, emphasizing the achievement of the qualities of strength, smoothness, blackness, and shine through the repeated application of layers of red dye and black ash and the final gradual drying. This emphasis on shine and blackness in calabash making matches the ideal outcome of tattooing at puberty. Girls lacking in stoicism faced with the repeated pricking of their skin (with tiny thorn pickaxes they make themselves) and the stanching of the profusely flowing blood with the application of black ash would have only faint marks. These two kindred processes achieve the curative cleaning, strengthening, and reestablishment of a body's boundaries.

When the calabashes reached a good size around February, they were cut from their vines and left on the ground to rot from the inside. As long as they were not cracked, their outer casing only hardened and strengthened as their pithy innards rotted away. They were then cut in half with a small steel saw bought for this purpose and were emptied of their contents, which reeked of vegetal putrefaction. Then they were piled into worn-out baskets that had previously been used for harvesting crops and were submerged in a river or stream for a week or so. The current helped to dissolve away all the pith. The baskets of empty calabash halves were then brought into the house and placed above the central hearth to dry thoroughly over several days. Once dry, their inner surfaces were sanded with either purchased sandpaper or dry corn husks.

Finally, the white, porous inner surface was cured and sealed. This was achieved by means of the application of a tree bark dye that had the dark-red color and adhesive texture of congealing blood and that smelled metallic. I asked several times whether it was "like blood," and women agreed but did not elaborate. This bloodlike substance was painted onto the inner surface of the calabash with the hands, and then ash made by burning a particularly lightweight, dry bark was rubbed in on top to soak up the dye (see fig. 5). The aim was for the inner surfaces to become shiny and black, and layers of dye and ash were alternately applied over the course of a few days until this glossy patina was achieved. Finally, women rubbed a round pebble over the surface to harden it further, and the new bundle of calabashes was hung up high above the hearth to dry

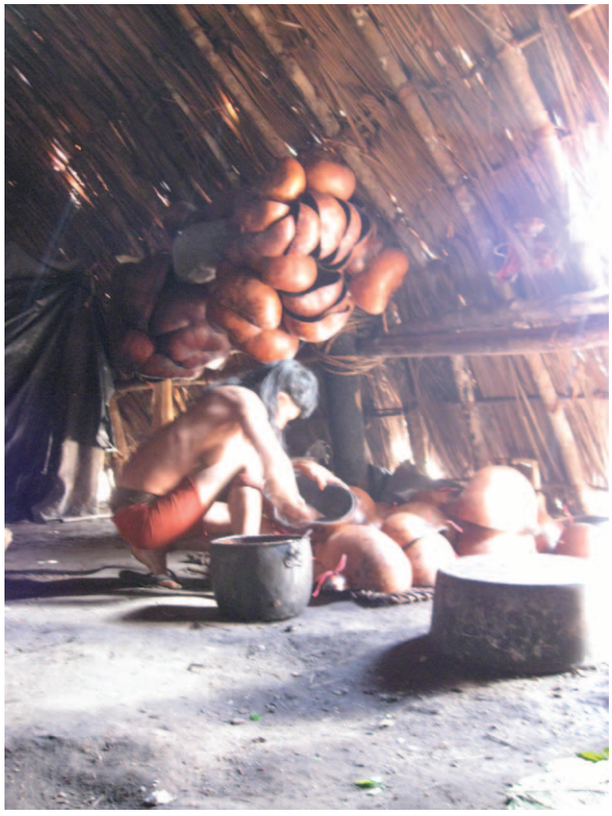

Figure 5. A woman applies ash and dye to the inner surfaces of new calabashes.

again—too close, and the inner surface would crack into an eggshell pattern, ruining the shine.

A soft, porous, and wet gourd that is full of seeds and pith becomes hard, shiny, and black. Women emphasized the qualities of strength, smoothness, and shine achieved through the patient anticipation of rotting and drying then the repeated application of layers of dye and ash and the final gradual drying. They also noted the bloodlikeness of the dye. However, no one directly commented on the likeness of calabashes to pregnant bellies or of calabash making to tattooing.

Just as calabashes are indistinguishable to the untrained eye, though women recognize each one of the 40 or so they use for routine ceremonial distributions by shape and density, women's tattoos are identical: simple curved marks on either side of the belly button and at the top of each breast that accent their curve. Just as calabashes are ready to use when they have thoroughly dried glossy black, girls are ready to emerge from seclusion when their wounds are shiny and black and on the day after they have drunk a bitter-cold tree bark emetic that purges their bellies of impurities. On the basis of the iconism I have made explicit above, the black marks draw attention to the preparedness of a young woman's newly fertile body for sex and maternity, when her belly will swell to calabash proportions. There was one woman who had made an artistic gesture of this iconism by decorating the outside of her largest calabashes with the same simple motif that is tattooed on girls' bellies.

As Lévi-Strauss (1968:416–421) noted, all over the world the boundaries of girls' bodies are controlled during puberty seclusion through strict diets and the regulation of self-touch and movement, and they are cooked and dried by a hearth as if they were themselves preserves. At first sight, this is an odd idea, but in the original Latin, as in English, the verb "to cure" has precisely this dual sense of healing the body and preserving foods. The Enawenê's extensive and highly mediated use of fire for cuisine, craftwork, and therapeutic processes seems to be "curative" in just this double sense. Thus, we find analogies between amassing dry stores of food and wealth, manioc and calabashes by means of a complicated system of recipes and making resilient bodies through seclusion practices, tattooing, and shamanic therapies. That girls' bodies and calabashes alike are cleaned and then gradually healed, sealed, and dried by the Enawenê before they can act as effective containers is one instance of a very general association between processes of making, curing, and cooking as different means to exert mastery in the world. A well-managed harvest, a healthy body, and a balanced cosmos are akin.

The Enawenê are continually engaged in craftwork of the kinds I have described so that they surround themselves with objects that have been invested with the role of stabilizing meaning. Indeed, they live in a large, clear village space, surrounded by objects of their own making and engaged continuously in the symbolic work of ritual whose effect—very like that of making—is to ground metaphysical notions in concrete patterns of indexical association (Deacon 1997:405).

Conclusion

The Enawenê world, body, and the things through which they find themselves and that they use to extend their agency are supremely cooked ones in Lévi-Strauss's terms. Fire and humors are manipulated to cook food, create durable food wealth, bring health and balance to bodies, and fabricate key adjuncts to personhood like headdresses and calabashes. These are all part of an ongoing humanization project that continually cultivates and regenerates a position conquered in origin times against the threat of backsliding to a bestial past, succumbing to the depredations of enemy spirits, or losing a civilized identity. Controlling fire is thus about exercising mastery over the sliding scale between death and life and aspiring to corpulence, strength, vitality, and productivity. As such, pyrotechnical mastery is a privileged means—real because it is semiotic and semiotic because it is real—for the perseverance of human life.

Inventing techniques to detoxify manioc, using toad secretions and medicinal plants to change a parrot's feather coloration, selecting calabashes to make hardy containers, and using plant dyes to seal them are all "arts of civilization." Lévi-Strauss speculated that such inventions would have been reached gradually in human prehistory as people classified and manipulated the world's properties and as their experiences of doing so incrementally shaped their systems of knowledge, physical tool kits, and pathways of connection in the mind (Lévi-Strauss 1962:26–28). His ideological point is well known;

he wanted to affirm the scientific merit of "primitive peoples'" efficacious experiments against their consignment to the realm of magic. However, the speculative evolutionary dimension of this argument has been neglected. The science of the concrete was also a "prior science" or "Neolithic science," and Lévi-Strauss asked how it could be that this prior science was not considered of equal or even greater validity than modern science, given that all of the most significant advances on which our civilization still depends were made by our ancestors long before the advent of modern science with its abstract, distanced grasp of reality (Lévi-Strauss 1962:28–30).

The ethnographic analysis put forward in this paper suggests that Enawenê arts of civilization are modeled on pyrotechnical control. It suggests that wresting control of fire was the precondition for humanization in a more expansive sense than Wrangham imagines with his emphasis on calories, physiology, and stereotypes about hearth sociability, pair bonding, and women being chained to their cookers. It presents us with a vastly expanded appreciation of the role of cookery in humanization that goes beyond the benefits of cookery to a holistic appreciation of how humans manipulate pyrotechnical processes to exert mastery in the world and to represent themselves as doing so.

To end, I would like to anticipate an objection. I have claimed that the Enawenê are preoccupied with "the passage from nature to culture" and the ascendancy of their arts of civilization, precisely the unifying themes that Lévi-Strauss identified in Amerindian myth more widely. I have also suggested that these themes converge with contemporary evolutionary theories about humanization, opening a space of dialogue between anthropological subfields. However, as Viveiros de Castro has stressed, we can also find evidence in myth to support a radical counternarrative to naturalist, evolutionist stories of the ascent of man from animal beginnings. Many myths suggest that "animals are ex-humans, not humans ex-animals" (Viveiros de Castro 1998:472–473). Amazonian mythology, shamanism, and curing practices have all been marshaled to critique anthropology's obsession with what makes humans exceptional. Indeed, Amazonian anthropology has become famous over the previous quarter century for upending nature-culture, human-animal dualisms and, in particular, for providing an animist or perspectival counternarrative to human exceptionalism (e.g., Descola 1994; Viveiros de Castro 1998).

Amazonia has thus provided an indigenous theory to join a mass of quite diverse arguments—both scientific and ethical—for jettisoning human exceptionalism as a pernicious set of blinkers (e.g., de Waal 2016; Haraway 2008). As such, Amazonian anthropologists have been in the happy position of finding themselves close to the center of an emerging zeitgeist. Now, rather than defending Amazonians against the charge of "primitive," "prescientific" animism, we are instead recognizing "how inhuman *we* are for opposing humans to animals in a way they never did" (Viveiros de Castro 1998:475; emphasis in original). Amazonian mythology can be taken to anticipate "fundamental lessons of ecology which we are only now in a position to assimilate" (Viveiros de Castro 1998:475).

Yet myths about human differentiation from animals when they acquired fire and arts of civilization provide "an indigenous theory about nature and the human condition: how men are what they are, why men are what they are" (Viveiros de Castro, Lagrou, and Belaunde 2011:15). That evolutionary narratives and Amerindian myths should dovetail was a deliberate intellectual and rhetorical strategy in Lévi-Strauss's work (Viveiros de Castro, Lagrou, and Belaunde 2011). He sought to think through Amerindian analogs to the central questions of our anthropological tradition. He understood these to be at once evolutionary and semiotic questions, and, aided by Terrence Deacon's reading of Peirce, I have sought to demonstrate why this is no contradiction. I suggest that we need not throw out the anthropological concern with what makes us uniquely human altogether. It is not a concern emanating only from eighteenth-century Enlightenment Europe but one that has analogs, for example, in Amerindian philosophy and praxis.

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Comments

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Fire! A force of destruction, its taming makes of it a mechanism of transformation. Fire! A force of transformation, its taming makes of it a mechanism of destruction. Such is the potential of fire, no less in naturalistic accounts of man's evolutionary conquest of a vital natural element than in Amazonian experiences of the kinds recounted and analyzed here by Nahum-Claudel. As Enawenê-nawê pyrotechnic mastery reveals and as Lévi-Strauss insisted, the mythology of fire, of

whatever, consists in its denotational content in union with its pragmatic embodiment, its role in the practical employment of a concretizing science. The pragmatics of fire, what Peirce would perhaps label its indexical-iconic mode, is crucial to Nahum-Claudel's renvoi with structuralism's articulation of its symbolism. Fire is plastic, malleable to certain ends, its functionality born of human-natural interface. Fire is plastic in its plasmatic evanescence but in more ways than that. As Barthes (1957) surmised, the "miracle" of plastic the industrial product is that "more than a substance, plastic is the very idea of its infinite transformation . . . it is less a thing than the trace of a movement" (97). The plastification of the world is a creative and destructive process made possible by the heat of fire, the vestiges of its movement now populating our lives, homes, garbage dumps, water supplies, bodies.

I write from the Wauja community of central Brazil, not far from Enawenê territory or from Enawenê language and culture, of which the Arawak-speaking Wauja share much. The ubiquity of fire and plastic is evident in the keys I touch, this red chair, the ashes of that hearth, that broom leaning against the wall, these smoked fish, those blue barrels of gasoline. Burning liquid petroleum in combustion engines powers Wauja electricity generators and fuels Wauja voyages in their trucks, cars, motorcycles, and outboard motorboats. As the technological mastery of fire fuels Amazonian indigenous peoples' movement in stewardship of their environment, it also fuels the massive and aggressive agribusiness deforestation of it. Fire in the Amazon is now more than ever a vehicle of transformation and destruction. In this context, Nahum-Claudel poses an enduring anthropological question: What can indigenous knowledge of fire's transformational potential reveal about human-nature relations generally? Furthermore, projecting a bit from her thesis here yet articulated in her other work on Enawenê environmental cosmopolitics (Nahum-Claudel 2012, 2018): How might such knowledge mobilize a counter to the catastrophe of moderns' capitulation to the runaway destructive effects of weaponized fire?

Nahum-Claudel speaks to the first problematic by juxtaposing and integrating the naturalist systems of Darwin, Peirce, and Lévi-Strauss. The downstream connections among these lines of thought that she articulates form a valuable contribution in themselves. Her reading of Lévi-Strauss is the most intimately nuanced, emphasizing, echoing Descola (2016), Lévi-Strauss's commitment to the continuity of the patterns of the natural world and the patterning of human thought. Culture is an immanent transformation of nature articulated within the constraints of the natural, while, at the same time, human thought imaginatively transcends the natural.

Her treatment of Peirce's realism, a commitment to the dictum that generals and not only particulars are real, helps to show how realism is bound to semiosis. If semiosis is the nature of the natural, thought is in signs because the universe is composed of sign processes. For Peirce, these are divisible into Firstness, or possibility embodied in icons; Secondness, or actuality embodied in indexes; and Thirdness, or law and convention embodied in symbols. Peirce's cosmology of "evolutionary love" depicts a universe moving from Firstness, or possibility, to, by pure chance, Secondness, or actuality, and eventually organized by the regularities of Thirdness. We are still on the path to Thirdness, and discovery of what is true, or real, is our collective mantle.

This picture differs from the use of semiotics in evolutionary biology by scholars including Deacon and Fuentes.[12] Deacon's approach would appear to limit semiotics to the living, to biota. Deacon once remarked that, for him as a biologist, semiosis is a feature of life, not nature writ large (Terrence Deacon, personal communication, January 12, 2017). Forests may think, that is, participate in semiosis, but, say, rivers cannot. Kohn does not, as far as I know, exclude nonliving beings from semiosis, and within his framework we may ask whether rivers or fire "think." Perhaps we can take a cue from Nahum-Claudel's anticipatory conclusion about Amazonian perspectivism or multinaturalism's challenge to human, even biotic, exceptionalism.

We may read the diverse examples marshaled by Nahum-Claudel showing Enawenê pyrotechnic mastery, from cooking food to "cooking" diadems, calabashes, and girls in puberty, not as metaphorical or symbolic projections of "real" fire but as simultaneously emergent from competing natures. Naturalism, which would limit fire to a chemical transformation and treat its analogs as merely cultural, in confronting multinaturalism may be subsumed logically by it, relinquishing control over nature to instead manage the incongruities between worlds. For Wauja people, situated like the Enawenê at the southern front of the commercial scorching of the Amazon's forests, fire is alive, at least in some respects. In its daily manifestation, fire is a token (*itsei*), what Peirce called a sinsign (a Second), of fire's spirit owner or master (*Itsei-txuma*), a type or legisign (a Third). *Itsei-txuma* lives in his house, and he walks about, sometimes running or flying. He does not burn what he touches, but his powerful, dramatic, rare appearance as a blazing fireball speaks to Wauja people, portending death. If fire as a being is real, it is so by virtue of its semiotic and communicative capacity to be known and to have effects in our world. This brings us to pose the second question above more specifically: In light of a multinaturalism where fire, mountains (De la Cadena 2010), and so forth are respected as interlocutors, how might we redirect pyrotechnic mastery in the face of our ongoing craven immolation and plastification of the earth?

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Nahum-Claudel's excellent article has an ambitious goal: to establish a resonance between human evolutionary history

12. See Peterson et al. (2018) for explicit discussion of semiotics and the extended evolutionary synthesis.

and the way an Amazonian people constantly produce themselves as humans. The status of this resonance and the way it impacts her conclusions are the sole issues I want to address here. I like bold claims and think that the moment has come for anthropology to start making them again—not in the style of modernist grand narratives but without shying away from setting out larger frameworks for the discipline. Nahum-Claudel is to be congratulated for this effort. As is usual with such efforts, however, some hurdles pop up along the way, some of which I would like to bring to the fore here.

Nahum-Claudel does not make human evolutionary stories resonate with Amerindian myths about the origin of fire but establishes a link between the evolutionary meaning of the control of fire by our ancestors (be they *Homo erectus* or later members of the same genus) and Enawenê practices of what she calls "pyrotechnical mastery." She does not aim to compare scientific hypotheses with Amerindian myths as equally valid ways of narrating a process about which we can make only educated guesses. Nahum-Claudel assumes a realist stance, adopting the kind of semiotic realism identified today with Deacon.

Like many contemporary authors, she strives to recover a certain viscosity of the world in order to "glue" words and things together again. In order to attain this goal, she draws on Deacon's evolutionary synthesis on the basis of his interpretation of Peirce's work. One of the appeals of this synthesis is that it preserves the realm of the symbol at the top of a semiotic hierarchy and, in consequence, the uniqueness of the human species. This is what allows Nahum-Claudel to drag Lévi-Strauss along with her on this path, rereading his work through a Peircean lens and expanding his culinary triangle in terms of what she calls pyrotechnical mastery. I think that she has a point here since Lévi-Strauss struggled throughout his life to bring together the sensible and the intelligible.

Now, let me spell out my main discomfort with her general argument. She correlates the supposed humanizing effect of the control of fire with the Enawenê practice of "cooking" themselves, their pets, and their artifacts by reading both through a tricky dichotomy between civilization and bestiality. Enawenê are described as being in a permanent effort to maintain their civilized humanity "against the threat of backsliding to a bestial past." But what do civilization and bestiality mean to the Enawenê? How can we avoid conflating their narratives with Western ones? Are both similar symbolic elaborations of the same universal sign: "fire"? At best, there seems to be an equivocal compatibility between Enawenê opposition between (civil) humans and (bestial) nonhumans and our evolutionary theory. The question is, how equivocal is such compatibility?

As I work in the Upper Xingu, a multiethnic and plurilingual constellation with an Arawak substratum, Nahum-Claudel's ethnography partially reverberates with my own. There is in fact an interesting parallel between the process of xinguanization (by which a common peaceful regional community was forged out of different peoples) and the way that Norbert Elias describes "the civilizing process" that took place in Europe along with the rise of the absolutist state. In both cases, we observe a remarkable change in diet and ways of eating, the restriction of interpersonal violence and its ritual sportification, the normalization of relations through a new etiquette, and a political form requiring the centralization of power (absolute in the case of Europe, quite relative in the case of the Xingu). Xinguano peoples are proud of their cultural achievements and cast a superior look toward other indigenous people and, until recently, even toward the whites. However, at least in the case of the Carib-speaking Kuikuro, they do not see their own remote past as one of bestiality but as a time "when we were all spirits" (*itseke gele kukatamini*)—and thus endowed with great shamanic power, enabling a sort of free communication among the living. Furthermore, the Kuikuro myth of the acquisition of fire is narrated in a rotten key, just like that of Tupi-Guarani peoples: the owner of the fire is the chief of the vultures, who manages to avoid giving the "true fire" to humans. This means that we humans have an imperfect fire (rather than a moderate one as in the Enawenê myth). The human condition implies a lack; putrefaction haunts our existence. Not by chance, the Tupi-Guarani state of perfection is correlated not with any form of cooking but rather with drying through smoking. Here I would like to see Nahum-Claudel explore more intensively the different ways that the Enawenê cook themselves in comparison with other Amazonian people rather than framing it in the key of civilization versus bestiality. I feel that, by converting culinary fire into a wider pyrotechnical mastery (a move that I find amply justified), she forgets along the way an essential point of Lévi-Strauss's triangle: this is a system of sensible signs in which it is the internal differences among them that produce sense. In her Peircean (anti-Saussurean) account, she loses sight of this point.

Nahum-Claudel gives us an authoritative account of the Enawenê obsession with cooking people and objects—an obsession that stems from the very instability of the human position. Pyrotechnical mastery is thus a way of stabilizing themselves as humans. But one question remains: Why do they perform rituals all the time? Why do they insist on flirting with the "wild side"? I cannot agree with the idea that Enawenê rituals are meant "to ground metaphysical notions in concrete patterns of indexical association." Rituals do much more than that, especially in the case of the Enawenê, who are true ritual freaks. Why would half of the society bother to become "bestial" *Yakairiti* if not to flirt with their chaotic and dynamic potency, not only to tame them but also to capture them to fertilize the human world?

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With great effect, Nahum-Claudel's paper segues between two narratives operating on different timescales within distinct philosophical traditions. The first draws from the author's

observations among the living Amazonian Enawenê-nawê, the second from Richard Wrangham's work on the role of fire in human evolution. The first is framed within the tradition of social anthropology, the second within that of biological anthropology, two fields that have become increasingly distinct and separate. Nahum-Claudel is to be applauded for seeking out some commonality, some shared themes. In this paper, she gives prominence to the theme of fire. Just as use of fire by the Enawenê-nawê distinguishes them from their neighbors and renders them "supremely cooked," so our species' control of fire renders us unique and "supremely human." I shall reflect on these different elements of her paper in turn.

This perceptive account of the Enawenê-nawê provides a rich example of a meal that operates as a performance, its stage elaborately constructed and its performers mindful of their roles. It amply illustrates how recipes are like stories, rich in allusion and meaning, amenable to embellishment and elaboration with each separate telling. Meals simultaneously sustain body and soul and accentuate who the diners are and who they are not. Resonances of the "cooked" are explored in an interesting and productive way, highlighting the interplay between retained heat, complicated recipes, architectural provision, and bodily ornamentation, reminding us that other practices in human life also resemble stories, with themes and meanings that are intertwined.

The paper turns to Richard Wrangham's argument about fire, digestion, and evolutionary changes in the hominid body, connecting with the expensive tissue hypothesis of Aiello and Wheeler (1995). The latter authors argued that brain enlargement requires gut contraction and that small guts need a bit (or a lot) of external help. External digestion translates to cooking, which, for Wrangham, translates to the control of fire throughout the long episode of hominid brain enlargement. His argument has to contend with the paucity of evidence in the archaeological record for adequate traces, before around 50,000 years ago, of managed fire or hearths with which to do enough cooking to feed this expansive genus.

Nahum-Claudel takes inspiration from Lévi Strauss's culinary triangle, which may in turn provide the resolution to the paucity of fire evidence in the first one and a half million years of our genus's evolution. The biological evidence for *Homo* does indeed imply the need for some form of predigestion. That need, however, could be met not just at one apex of the culinary triangle but at two. Rotting, putrefaction, and fermentation all feature in diverse culinary traditions of the world with varying (and sometimes no) dependence on fire. Many species exploit natural breakdown as a form of external digestion, and giving it more prominence in the earlier evolution of *Homo* diets could lead to greater consistency with the extant archaeological evidence base. That could have existed alongside a protracted opportunistic use of encountered wildfire, long before the time when fires could be ignited at will. That particular debate, however, is somewhat tangential to the paper's core proposition, the centrality of fire to becoming human, to which I now return.

Nahum-Claudel acknowledges that looking for difference, human "uniqueness," departure from "nature," and so on is complicated, and those complications connect with how the paths of social anthropology (emphasizing difference) and biological anthropology (emphasizing continuity) have diverged. However, her paper does indicate a number of especially human attributes that might be "grounded in pyrotechnic mastery."

These especially human attributes, illustrated in the context of the Enawenê-nawê, relate to elaborate practices, rich in meaning and cross-reference. In the archaeological record, these can be compared with the intricate multi-ingredient "recipes" that on different occasions might lead to the production of a bow and arrow, an artwork, a woven garment, an elaborate meal, or the closed oven in which the latter was cooked. Taken collectively, such attributes become prominent following what Paul Mellars and Chris Stringer (1989) have described as a modern human revolution, underway around 40,000 years ago. Two key aspects of that revolution are, first, a series of elaborate multistep practices, including art, built space, and multielement tools, and, second, the expansion of *Homo sapiens* at the expense of other species of *Homo* (notably, the Neanderthals), which each head toward extinction. Pyrotechnology, itself an elaborate multistep practice, may be related to the modern human revolution, in the context, however, of both the winners and the losers. Even if Wrangham's longer chronology is questioned, Neanderthals could certainly light a fire.

An enduring cross-cultural project, emerging in many forms and contexts, has been to establish when we as humans turned a corner and "left nature behind" and to identify the trigger. Within fields of archaeology and anthropology, the control of fire has remained a prominent candidate, alongside the command of language, creation of art, creation of a certain tool type, and so on. One of the main contributions of our extinct close relatives, none more so than the Neanderthals, has been to constantly tease the vanity that we have actually turned that corner and to expose the differences between "us" and "them" as complicated and blurred. Each new thing we learn about Neanderthals (and the pace of newly emerging knowledge is truly exciting) challenges something about ourselves we had taken for granted. So the employment of fire to "set humans apart from other species" is certainly an interesting conjecture, but on closer analysis, the boundaries between us and them remain diffuse and complex.

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Nahum-Claudel opens and closes her analysis by juxtaposing bioevolutionary perspectives on the role of fire and cooking (singling out Richard Wrangham) with similar themes as

recounted in mythology, particularly that of the Amerindian Enawenê-nawê. Her analysis can be approached as a new, ethnographically intriguing entry into the long and complicated debate on the relation of science (or its precursor, philosophy) to myth, a relation that begs for reconsideration in light of Wrangham's and other scientists' claims. Social theorists as different as Max Weber and Claude Lévi-Strauss have used two-by-two tables to good effect in comparing theories. Through this device, I offer some comments on the relation of science and myth in the context of the present cooking and fire debate. All four possible permutations between science and myth are relevant to Nahum-Claudel's analysis.

One: science and myth are both right. As regards the significance of fire and cooking in the emergence of humanity, this would seem to be the mutually informative rapprochement Nahum-Claudel seeks, emphasizing convergence on humanization as a dynamic and ongoing process. Two: science is right, and myth is wrong. Nahum-Claudel calls attention to how similar Wrangham's views on the broader social significance of fire are to those portrayed by Lévi-Strauss in his summary of traditional mythologies. And she argues that, in the face of this similarity, Wrangham forestalls synthesis between the science and mythology of cooking and fire by misinterpreting Lévi-Strauss, specifically by incorrectly concluding that Lévi-Strauss regards myth as concerned only with psychological reality and thus as devoid of epistemological realism. As a corrective, Nahum-Claudel offers a reading of Lévi-Strauss through a Peircean lens (mediated by Terrence Deacon), proposing that Lévi-Strauss operates through a multitiered semiotics that not only touches ground but also, arguably, begins and ends there. I largely agree with Nahum-Claudel's corrective, though, in defense of Wrangham, it should be acknowledged (here I may differ from Nahum-Claudel) that Lévi-Strauss's realism is not equally visible through his writings and sometimes turns vaporous for long stretches.

But set Lévi-Strauss aside and consider traditional fire myths themselves. Wrangham opens his book *Catching Fire* (Wrangham 2009) by pointing out that we used to think that we were molded from clay, but now we know that we evolved through natural selection. But since *Catching Fire* is about becoming human through the control of fire, I have to ask why, rather than clay mythology, Wrangham did not open his book with the more obvious choice of fire and cooking mythology? And if he had done so, how could he have started out—other than by saying that we used to think that the human difference was brought about by gaining control of fire? Such an opening surely would have, at the least, complicated his claim on the next page to be offering a "new answer," not to mention his attempt to play the old science-disproves-myth gambit.

Three: myth is right, and science is wrong. If history proves Wrangham right, then, perversely, through the entire course of modern science before Wrangham (and possibly a few precursors), this permutation would describe the state of our knowledge. For mythologies rather steadfastly have recognized the pivotal role of fire and cooking—surely that should account for something—while science has been fumbling around with false claimants such as bipedalism and opposable thumbs.

Four: myth and science are both wrong. This possibility, which we cannot rule out, is also known as the human condition and perhaps amounts to the glass-half-empty version of the possibility that they are both right. What is common to the first and fourth permutations is that both see an overlapping character in mythology and science while not insisting that these are identical or that, in Frazerian fashion, mythology is modern science striving to be born. The popular-culture sense of myth as "fantasy" usually is just not applicable to the mythologies anthropologists study ethnographically. Lévi-Strauss's rechristening of magic as Neolithic science is prescient. Myth does contain important components of science, including careful and astute observation. In the case of fire, the myth formulators have always had at least one important source of empirical evidence that is also important to Wrangham's science, namely, empirical observation of the role of fire in social life. And surely science has mythic moments—most pointedly, I hazard to guess, in those mysterious synthetic leaps through which hypotheses appear, for which accumulated data provide a necessary but not sufficient explanation. Fire and cooking as the origin of humanity is a poetically powerful insight that synthesizes a wealth of observation and experience and that myth (as a story) and science (as a hypothesis) may for the moment share, but I am not convinced beyond a reasonable doubt, by either or both in combination, that we yet know the literal history of our species.

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At a weekend foray and retreat hosted by an Alaska-based mycological association, a fellow ex-Soviet immigrant held up a basketful of *Boletus edulis* mushrooms. "Thirty minutes of hard boiling, and these will be ready for a delicious garlic and butter sauté." "Do not listen to my wife," interjected the spouse of the fortuitous hunter, "for king boletes 15 minutes of boiling will do." Difference of opinion notwithstanding, it did not take a second for the renowned mycologist David Arora (personal communication; see also Arora 1986, 1991; Arora and Shepard 2008; Rubel and Arora 2008), who was leading the foray, to recognize the pervading principle of Eastern European mushroom cookery: always boil first (fig. 6)! Others elsewhere do not boil king boletes before sautéing them; some even eat them freshly sliced, sprinkled with oil and herbs. During our early stages of studying ethnomycology, the proper ex-Soviet Jews in us (Sveta is originally from Belarus, and Igor is from Ukraine) were mortified. And it is not only mushrooms onto which our upbringing dictated the stern boiling instructions. Boiling and prolonged simmering are the prided essentials of the Ashkenazi "distinction" (Bourdieu 1984), which—similar to that of

Figure 6. "Always boil first," by Igor Pasternak.

Chloe Nahum-Claudel's Enawenê teachers—extends beyond the edibles. Growing up, every week we watched our mothers and grandmothers fill up a giant galvanized washtub to boil the linens and undergarments, which they periodically stirred with a long wooden pole.

It was not until we read Nahum-Claudel's multidirectionally inspiring article that we considered the Russian verb that describes the process of laboring toward the equivalent of the Enawenê's "supremely cooked." It is *вываривать* (*vyvarivat'*). This verb adds a prefix and a suffix to the respective ends of the shorter verb *варить* (*varyi*[*t'*]), which refers to the casual, less elaborate modes of boiling. What a bewildering disappointment it was when, upon immigrating to the United States, our elders learned that Americans do not "supremely cook" their bedding or undergarments. Now, thanks to Nahum-Claudel's research, we realize that—at least with regard to this particular domain—our mothers and grandmothers would feel at home in the land of the Amazonian Enawenê-nawê of Mato Grosso.

Our boil-heavy relatives—Nahum-Claudel's Enawenê family and elder kin—are not the only points of appreciation that we appear to hold in common with the author. We too are avid readers of Lévi-Strauss, whose love for mushrooms, cookery, and ethnomycology is the subject of his "Mushrooms in Culture" (Lévi-Strauss 1976). In it, Lévi-Strauss comments with admiration on the trailblazing efforts of Valentina and R. Gordon Wasson (1957), whose work he says he was proud to bring to the attention of the French public. The three decades of correspondence, now part of the Harvard Botany Libraries' Tina and R. Gordon Wasson Ethnomycological Collection, show that Lévi-Strauss was spellbound by the very idea of viewing the role of mushrooms through the lens of anthropology and structuralism. Early into their exchanges, Lévi-Strauss (unpublished letter to R. Gordon Wasson, March 3, 1958) told Wasson, "Beside being an anthropologist, I am also an enthusiast mycophile (and a cook too!)." Finishing the landmark publication *Mushrooms, Russia, and History* (Wasson and Wasson 1957) had prompted Lévi-Strauss (unpublished letter to R. Gordon Wasson, March 10, 1958) to offer a confession: "I feel personally ashamed to have almost completely overlooked ethno-mycology when I was in the field."

Envisioning the fieldwork of Nahum-Claudel, we found ourselves wondering whether at times she wished to be working in tandem with Lévi-Strauss. In our 20-some years of savoring the ever-expanding menu in the world of mushrooms and people (Yamin-Pasternak 2011; Yamin-Pasternak and Pasternak 2018), this is a curiosity we have felt regularly; we have also written in this journal about wanting Lévi-Strauss to have worked in the Bering Strait (Yamin-Pasternak et al. 2014). Just how excited would he be to see us bring home our first harvest of Alaska morels and—per the obligatory Byelorussian-Ukrainian-Russian protocol—boil them for 20 minutes to convert, as we had thought was necessary, this forest-sourced matter into a culinary substance? Would he think back to this episode when over the next few years we met morel lovers from various walks of life, all of whom were flabbergasted to learn that we were guilty not only of the crime of boiling morels but also of discarding the exclusively flavorful broth that results from what would be this mortal sin's only justification? Back in those days, we would have done the same with *B. edulis*, matsutake (with grave apologies to Anna Tsing [2015]), and all other mushrooms because boiling is what it takes to convert an inherently harmful matter into a food substance with further culinary potential—just ask any ex-Soviet or Enawenê.

And just how pleased would Lévi-Strauss be to learn that, through the liberating powers of anthropology, years into our study of human-fungi interactions we were eventually able to overcome and abandon this practice? And perhaps just as he would begin to sketch the mushroom version of his culinary triangle (Lévi-Strauss 1978; perhaps he would not, but we could not help but try; fig. 7), we would remind him of the case of *Amanita muscaria*, the fly agaric. This is one of the mushrooms that actually needs to be boiled, some say twice, in order to become transformed into a culinary substance. The water in which fly agarics are boiled must be discarded (or given to

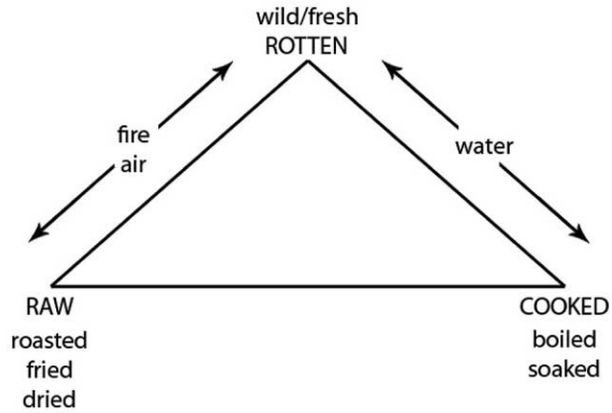

Figure 7. Lévi-Strauss's culinary mushroom triangle, as imagined by the commentators.

someone specifically seeking the effects of muscimol and ibotenic acid); all of the *A. muscaria* constituents that are toxic or have psychoactive properties are water soluble (Rubel and Arora 2008).

Of the many aspects of this work that incite our genuine appreciation, we especially respect Chloe Nahum-Claudel's acknowledgment of having developed her ideas following "both Lévi-Strauss's and the Enawenê's lead." We are grateful for the opportunity to apply the products of this synergy in contemplating the intensities of boiling in our own lived encounters: cross-cultural, intergenerational, and between our ex-Soviet and current understandings.

Reply

In Anglophone anthropology, structuralism has become synonymous with a kind of intellectualism and abstraction that leaves the world behind. Against this stale stereotype, I wanted to recapture its evolutionary and materialist ambition and to demonstrate the enduring analytical potential of a structuralism that "not only touches the ground but also, arguably, begins and ends there" (Schrempp). Though sympathetic, Gregory Schrempp and Carlos Fausto call attention to the partiality of my realist reading. Principally an armchair theorist, Lévi-Strauss was in some ways the archetypal Cartesian scientist, a "bodiless observer" (Latour 1999:4), such that even myths that hinged on toilet humor could be reduced to clean, abstract conceptual oppositions (closed : open). And yet as an amateur naturalist, a keen cook, and—Sveta Yamin-Pasternak and Igor Pasternak inform me now—also a mushroom geek, Lévi-Strauss had a tactile and concretizing imagination that attended to processes of making, tasting, touching, tinkering, or digesting from which systems of meaning arise. Signification did not just happen in incorporeal mental images and linguistic signs. He was committed to and was himself adept at the "careful and astute observation" shared by mythmakers and natural scientists (Schrempp). In the course of open-ended arguments that wade through sensorial intricacies, abstracted binaries like open : closed and raw : cooked are best understood as momentary purifications, resting places.

Reading the Mythologiques before and after fieldwork in Amazonia, as I did together with fellow students at the Federal University of Rio de Janeiro, where I was hosted during my research in Brazil, we took for granted some intuitive version of the semiotic realism that I lay out here and that is well summarized by Christopher Ball: "Culture is an immanent transformation of nature articulated within the constraints of the natural, while, at the same time, human thought imaginatively transcends the natural." We took guides to Amazonian flora and fauna on fieldwork because we would need to be able to identify the species mentioned in myths and understand their habits in order to realize their cultural significance and positional meaning. This discovery process amounts to reverse engineering indigenous knowledge by learning, according to the norms of our own observational sciences, what Amerindians already know and putting all of that knowledge into a relational system. The Mythologiques demonstrated that the discovery process would probably be more important than any abstractions it might generate.

Rather than focusing on myth and classification (despite my best efforts, I had little aptitude for naturalist observation), the mainstay of my fieldwork was the repetitive, immersive, nonlinguistic work of cooking, especially manioc, but also bodies and things. This gave me a special interest in the "pragmatic embodiment" of signs and their "practical employment"—turns of phrase that I appreciate in Ball's comment and that amount to asking: What are people doing when they encounter signs, and, in turn, how are they systematically manipulating matter to create semiotic infrastructures? As Ball and Fausto recognize, my aim is to understand the role of fire in human evolution and adaptation as both meaningful and causative. Sensory ethnography, myth analysis, and evolutionary speculation come together to this end.

One of Lévi-Strauss's claims was that cookery was a privileged symbolic code cross-culturally for signaling the attainment of human culture and, beyond that, civilization. I expand on this claim and give it a specific evolutionary and realist emphasis. First, I show that cookery is more than it seems because cooking food is just one of the ways that an assemblage composing fire and the tools and techniques invented by humans to manipulate it is deployed to transform the world. Ethnographically, I wanted to show the breadth of what I call "pyrotechnical mastery" and to analyze this semiotic technology in detail, taking the fabrication of ubiquitous containers and feather headdresses as case studies to explore the contrasting ways that chains of indexical and iconic relations mediate between the practical and sensory on the one hand and the metaphysical, mythic, or ideological on the other.

I admit that I was initially seduced by evolutionary biologist Richard Wrangham's "cooking hypothesis" because it made fire the pivotal transformation in human prehistory in a way that resonated superficially with my ethnographic experience, and it did so in a way that was "poetically powerful," as Schrempp's own work has brilliantly analyzed (Schrempp 2011). I wonder now whether I can really be so enthused by Wrangham's theory given my argument that pyrotechnical mastery is a privileged means of building symbolic systems. Wrangham's threshold is the origin of the genus *Homo*; the control of fire accounts for physiological fundamentals of *Homo erectus* rather than the uniqueness of a symbolic species. Clearly, Wrangham's "human" is not my own or the Enawenê-nawê's. Now, I would probably put my money on much more recent dates for human pyrotechnical mastery, and I look forward to further archaeological research exploring the link between pyrotechnicity and symbolic behavior.

As archaeologist Martin Jones comments, even as scientific discoveries of, for instance, Neanderthal sophistication or

animal symbol use complicate every new claim for human exceptionalism, there is an enduring fascination with "trigger" questions about when and how our unique species "turned a corner." One of the joys of this review process has been discovering a raft of rigorous work at the interface of evolutionary theory and Peircean semiotics that liberates us from the assumption that, in turning that corner, humanity "left nature behind" (Jones). One of the implications of my evolutionary and realist reading of Lévi-Strauss is that his famous "passage from nature to culture" does not imply that humans are uniquely intellectual animals who dwell in a virtual world composed of and reproduced in the image of their own empowered fictions. Instead, we have a dialectic that is intricate and ongoing, in which nature becomes increasingly mediated by semiotic infrastructures in the course of evolution, and cognitive capacities evolve in a feedback loop with material engagement. I suggest that Lévi-Strauss had something like this in mind even if he did not formulate it with the thoroughness of contemporary biosemiotics.

Fausto regrets that by focusing exclusively on cookery, I forget Lévi-Strauss's essential point that the internal differences in a system produce sense. However, such a characterization rests on a partial reading of my work. The heuristic value of the culinary triangle for me has been precisely to explore the presence in the culinary system of excluded alternatives. In their comment, Yamin-Pasternak and Pasternak vividly conjure for us their ancestors' boiled bedsheets and mushrooms, demonstrating how cookery is naturalized so that migrants experience shock and abomination when exposed to alternatives. Surveying the literature on Amazonian cuisines after fieldwork, I discovered much less elaborate and fire-dependent ways for processing manioc as well as similarly complex recipes that were "unnatural" from my prejudiced Enawenê perspective: a spicy relish made from manioc leaves (considered inedible, let alone as a delicacy) or squeezed manioc pulp that, rather than being fire dried, is fermented underground. Both of these examples are from Christine Hugh-Jones's book, *From the Milk River*, which is *the* ethnography of culinary semiotics. Through such comparisons and guided by the culinary triangle, I discovered Enawenê cuisine to be relatively obsessed with the "supremely cooked," a phrase I take from Lévi-Strauss (1968:403, 408) and redeploy as a shorthand for three interlinked characteristics of Enawenê cuisine: the preference for fire-transformed over raw or fermented foods (this is an energetically expensive regime); the reliance on highly mediated forms of cookery like smoking, fire drying, and prolonged boiling over quicker techniques like roasting; and the elaborateness of recipes, involving the separation of manioc products and their multistep processing to produce dry stores (e.g., fermenting, then sun drying, then smoking) followed by their recombination, rehydration, refermentation, and final stage boiling.

As I think I made clear, this does not mean that the Enawenê are stolidly stabilizing their human position by monotonously consuming supremely cooked foods in civilized moderation. Repudiated corners of the culinary triangle—the raw, rotten, and fermented—were absent presences in ways that became pivotal for my analysis of ritual dynamics. For instance, despite the Enawenê's teetotalism (of a piece with their nonbellicose ethos and ideological vegetarianism), the two drinks that compose the bulk of the Enawenê diet are adapted beer recipes. By modifying their recipes just a little, Enawenê women could make vast quantities of beer of the kind they fearfully watched their erstwhile cannibal devourers drink during the 1980 peacekeeping visit I evoked briefly in the article. Instead, recognizing fermentation as all too close for comfort serves its paranoid avoidance. And yet, during a ritual phase defined by sumptuary excess, the weaker and thinner of the two Enawenê antibeers is left to ferment, and young men incarnating predatory spirits raid houses for it. They make a din with whistles and trumpets, beat the house thatch, and issue jokes and insults. But they only *act* drunk; the beer is spilled to feed the predatory spirits.

Fausto is skeptical that Enawenê ritualism is, as I claim, ultimately humanizing. Why do they perform rituals all the time if not to flirt "with the 'wild side'?" he asks. But then, ritual can also be about embodying perfection and achieving—temporarily and performatively—an exemplary humanity. Indeed, this is one of the ways to interpret *The Hyperwomen* (Fausto, Sette, and Kuikuro 2011), a masterful Kuikuro film that Fausto codirected. One of the fruits of my empirical focus on cookery was the extent to which constitutive alternations in ritual identities and temporalities between, on the one hand, routine, stability, and control and, on the other hand, carnivalesque boundary transcendence are achieved not only through genres of performance and musicality but also by manipulating recipes, adapting food-processing techniques, and adopting wild consumption mores. Rather than escaping the human position by imbibing antifoods with transformative potency—substances like ayahuasca, tobacco, and beer that Amazonia is famous for—the Enawenê (like the Kuikuro, I think) achieve a superhuman supplement to workaday personhood via accelerations and intensifications of ritual experience (see Nahum-Claudel 2018, chap. 3). The boundary that is being stretched, tipped over, and reinvigorated is that between humanity and superhumanity. That is, they are flirting with divinity rather than with nonhumanity or animality (as Fausto's "wild side" would suggest).

Ball and Fausto both raise the question of my assumptions about the "reality" we as anthropologists describe and analyze. Ball offers a multinaturalist reading of my paper, whereas Fausto accuses me of conflating Western and Enawenê concepts of humanization. Ball asks, "Does fire think?" To be clear, I do not claim that fire "thinks" but that it becomes inevitably symbolic when mixed with technique and intention in ways that are nonarbitrary, being constrained by the embodied interface between chemical processes and sensory perception. Even so, Ball reminds me that the scope of pyrotechnical mastery is vaster than I envisage in this article, concerned basically with wood fires and, to a lesser extent, with the sun's heat and the regulation of a humoral body. Mine is an argument rooted in a swidden horticulturalist economy that masters the creative

and destructive potential of burning wood. In 2019, after I wrote it, we all became acutely aware that forest fires are being weaponized against indigenous people in Brazil, and Ball asks what my argument can say to this. To what extent does the Enawenê's emphasis on pyrotechnical mastery come of acute experience of uncontrolled fires and the fear and awe that they inspire, and, mindful of the scorched landscape of Mato Grosso agribusiness, how are Enawenê pyrotechnicians reflecting on their own energetic regime today? I appreciate Ball's encouragement to explore these questions with the Enawenê in the future. Collaborative research centered on the self-reflexivity of indigenous intellectuals can yield extraordinary insights, as exemplified by Albert and Kopenawa's prophetic book *The Falling Sky* (Kopenawa and Albert 2013). At the same time, Socratic methodologies privilege the conscious, reflexive, and rarefied. In this article, I defend an ethnography that dwells in the intricacy of ordinary experience and how that, too, transforms our shared world.

Fausto recognizes that my argument operates not in the domain of ideology (comparing "evolutionary stories" with "Amerindian myths") but in people's practical engagement with the world. Perhaps Ball's multinaturalist reading of my argument is accurate insofar as "perspectival multinaturalism" is another way of recapturing anthropology's realist ambition. One of its diacritics is that consciousness, spirit, and mind are shared by animate creatures who, in some diffuse sense, share the human condition as cultural, representing subjects—they too have a perspective (Viveiros de Castro 1998:479). A correlate of this generic shared humanity is a monumental effort to achieve and maintain a species-specific body through careful eating, body decoration, and other forms of self-molding. Pyrotechnical mastery is how this is achieved in a society that, while it also presupposes the kind of original panspirituality that Fausto draws attention to in Kuikuro origin narratives, places less emphasis on shamanic powers of metamorphosis than on a superhuman's efforts to originate the cosmos according to his own humanizing designs. This is true in everyday practice, ritual life, and origin myth. Datamale, who made the sun from a moderately cooked headdress, is indeed a kind of deity.

—Chloe Nahum-Claudel

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