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and Anthropological Theory**

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The traditional English folktale “Jack and the Beanstalk” recounts the experience of a young boy who, after purchasing a handful of broad, flat beans at the market, embarked on a journey away from his provincial life and into a land of fantasy:

Jack liked going to market to sell the cow very much; but as he was on the way, he met a butcher who had some beautiful beans in his hand. Jack stopped to look at them, and the butcher told the boy that they were of great value, and persuaded the silly lad to sell the cow for these beans.

* * *

What was his amazement to find that the beans had grown up in the night, and climbed up and up till they covered the high cliff that sheltered the cottage, and disappeared above it! The stalks had twined and twisted themselves together till they formed quite a ladder.

'It would be easy to climb it,' thought Jack.

And, having thought of the experiment, he at once resolved to carry it out, for Jack was a good climber. (Heiner, 2003)

It has been suggested that the beans Jack purchased were fava beans, characterized by their size and strong stalk. Scholars have argued that this story, in addition to many other superstitions and folk tales, are significant of the fact that the fava bean was both practically and symbolically important in traditional English society (Katz, 1987). Folk tales from a multitude of cultures reveal that the fava bean has played a central role as both symbol and foodstuff in cultures around the world.

This paper will discuss how scholastic conception of the importance of the fava bean has changed recently due to advances in biological science. New information has prompted social scientists to expand their models of the role this bean has played in human history. Today, amidst a growing pool of knowledge regarding the fava bean and cultural tradition, we find ourselves faced with conflicting hypotheses—based on different anthropological theories—about

the role of this bean in population genetics and cultural practice. This paper will evaluate two dominant threads of theoretical work on the role of fava beans in human biology and culture. After a consideration of constructivist and structuralist arguments for food taboos, I will explore a possible synthesis of disparate hypotheses attempting to explain the phenomena surrounding the fava bean. Through this analysis of food taboo, I will consider the importance of food taboo research in advancing the evolving biocultural model.

Favism and G6PD Deficiency

During the mid-nineteenth century, medical scientists identified an illness brought on by the consumption of fava beans, labeling the illness *favism* (Simoons, 1998). Favism most often affects young children, and is characterized by symptoms including jaundice, weakness, pallor and haemoglobinuria (Belsey, 1973). Favism is found in populations throughout the Mediterranean and in Europe (Katz and Schall, 1979).

In subsequent years, physicians issuing anti-malarial drugs to soldiers during the Second World War realized a link between certain plant allelochemicals and a genetic condition labeled G6PD deficiency. These chemicals included vicine and convicine. Thereafter, through scientific investigation, a link between favism and G6PD deficiency was established via chemical comparison of fava beans and antimalarial medications. The following is a description of the genetics of G6PD deficiency and the biochemistry of favism.

G6PD, or glucose-6-phosphate-dehydrogenase, is a cytoplasmic enzyme that performs vital maintenance functions within all cells of the human body (Greene, 1993). As part of a side chain of the main glycolytic pathway, G6PD oxidizes glucose-6-phosphate, resulting in the production of NADPH which fuels cellular activities and also in the production of GSH, the

enzyme which is capable of reducing strong oxidants which threaten the chemical balance inside the cell (Green 1993; 155). The glycolytic pathway is illustrated in Figure 1.

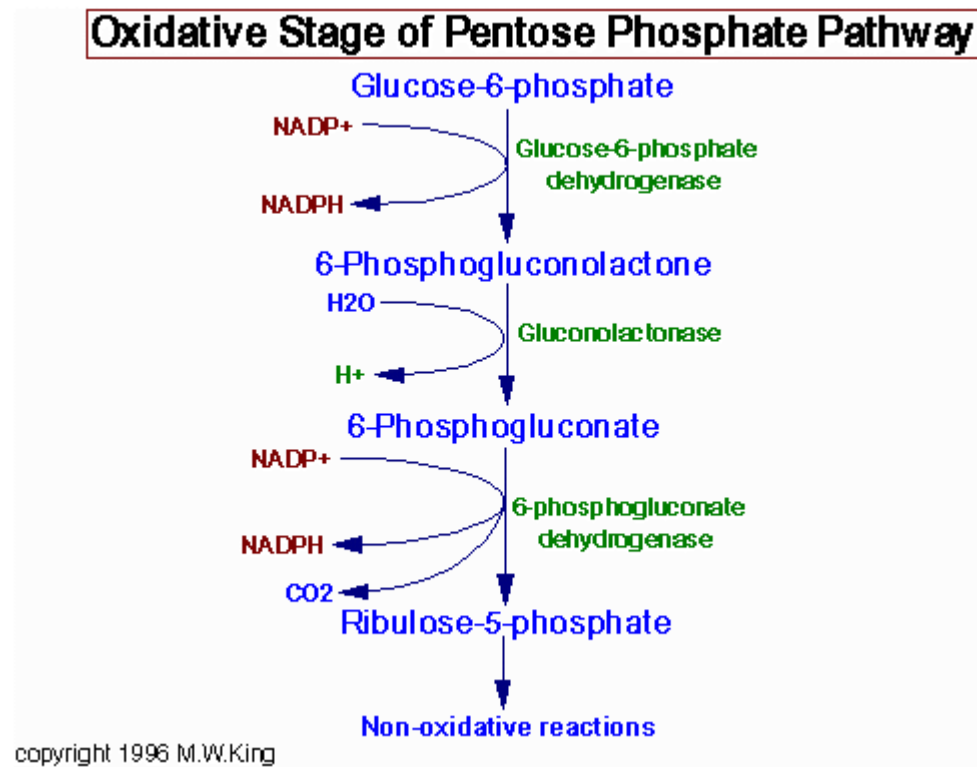


Figure 1.
The main glycolytic pathway, demonstrating the role of G6PD in synthesizing NADPH. (King, 2003).

The G6PD enzyme is instrumental in the function of the erythrocyte because, lacking a nucleus and mitochondria, the red blood cell faces constraints on cellular metabolism. One such constraint is the inability to reduce dangerous oxidants by any means except the production of GSH. In normal red blood cells, the function of the G6PD enzyme can be accelerated during periods of high oxidant stress. In G6PD deficient individuals, this enzyme function fails to meet the demands of this stress. The GSH is soon consumed, the concentration of oxidant in the cell increases, and the result is cellular hemolysis and cell death (Green, 1993).

Hundreds of mutations have been associated with G6PD deficiency in humans; the G6PD locus is the most polymorphic of all loci in the human genome. Of these polymorphisms, 11 alleles have been demonstrated to result in normal G6PD function, while at least 66 alleles result in decreased activity and are therefore called deficient (Green, 1993). The nature of the deficiency varies with the location of the mutation. Variants of the deficient allele are classified as fast, normal, and slow according to the enzymatic activity of the affected cell (see Figure 2).

Four most common variants out of 300+ known		
Gd ^B	Normal Activity	All World Populations
Gd ^A	Normal Activity; Aspartic acid substituted for asparagine at position 126, Guanine for adenine at DNA position 376	Africa (most common variant)
Gd ^{A-}	8 - 20% Normal Activity; Methionine for Valine at position 67 and Aspartic Acid for Asparagine at position 126, Adenine for Guanine at position 202 and Guanine for Adenine at position 376	Africa
Gd ^{Med}	< 5% Normal Activity; Phenylalanine for Serine at position 188; Thymine for Cytosine at position 563	Iran, Iraq, India, Pakistan, Greece, Sardinia

Figure 2.
Four most common variants of G6PD locus with affect on cellular activity (Bindon 2003).

The frequencies of these alleles vary by population. The allele which leads to the greatest deficiency (less than 5% of normal function) is found in highest frequency in Mediterranean populations—hence the label Gd^{Med}.

Fava bean consumption disrupts cellular function in G6PD deficient individuals because the beans contain strong oxidant pyrimidines, including vicine, divicine, and isouramil (Katz,

1987). These pyrimidines, when metabolized, produce high oxidant stress within the cell.

Hydrogen peroxide, a product of oxidant stress, builds up inside cells which are poorly equipped to handle such stress due to low levels of GSH. High oxidant stress in G6PD deficient cells causes erythrocyte hemolysis, which results in a variety of systemic illnesses.

G6PD Deficiency and Malaria

Research has found that G6PD deficiency has beneficial affects on populations, thus allowing the frequency of such deficient alleles to increase despite favism.

It has been demonstrated that the same reaction that causes hemolytic illness in deficient individuals also promotes those individuals' ability to survive malarial infection (Katz, 1979, 1987; Greene, 1993). This is due to the fact that the byproducts of the metabolic functions of the malarial parasite produce severe oxidant stress on red blood cells. G6PD deficient erythrocytes expire under such parasitically-induced oxidant stress, effectively interrupting the breeding cycle of the malarial parasite and leading to an overall reduction in the severity of systemic illness. Therefore, mild G6PD deficiency can confer malarial resistance in some individuals.

As a result of natural selection on gene pools, a dynamic balance between G6PD deficient allele frequencies in populations and the severity and frequency of malarial infection, favism exists in at its highest frequencies in equatorial populations of the world. The distribution of G6PD deficiency, fava bean cultivation, and malaria is represented in the following figure (Figure 3).

Distribution of G6PD, Fava Beans, and Malaria

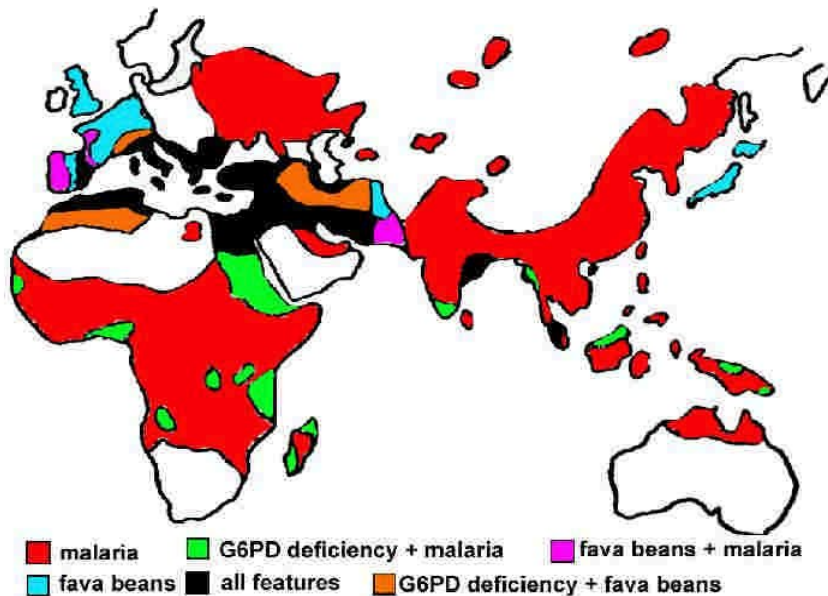


Figure 3.

The distribution of fava bean consumption, malaria and G6PD deficiency throughout the world. (modified from Katz and Schall, 1979:page number).

Fava Bean Consumption, Malarial Resistance, and Advances in Culture Theory

Discovering a link between fava bean consumption, favism and malaria led researchers to pursue a new line of investigation regarding fava bean taboos. From the turn of the 20th century into the 1950's, fava bean taboos had been linked to magico-religious belief systems and totemism, in the spirit of cultural evolutionary work completed by L.H. Morgan (1858), and meaning-centered analyses of magic and ritual pursued later by E.E Evans-Pritchard (1937). However, by the mid 1960's, genetic research was being incorporated into anthropological work, and these theories of fava bean taboos were dismissed with the inception of biocultural anthropological theory. Renewed interest arose through attempts to understand why some populations with high frequencies of G6PD deficiency continued to rely on the fava bean as a food source, and how fava bean consumption was patterned spatially and temporally. The

biocultural argument for fava bean taboo seemed satisfactory until two decades later, when Simoons sought to reconsider the biocultural argument and reassert meaning-centered approaches in at least some cases.

In the following portion of this paper, I will review one example of fava bean taboo referenced by Katz (1987): that of Pythagoras. I will then trace Simoon's argument against the utilization of this example in a biocultural analysis of food taboo. Finally, I will consider the theoretical quandaries that arise when hypothesizing the origins and functions of food taboos in populations. I will review a few prominent anthropological schools of thought and explore more recent theories that allow for the positing of new hypotheses regarding the role of food taboos in society.

Food Taboos in Society

In this paper the term *taboo* is used intentionally. I am not speaking of food *avoidance*, the act of refraining from consuming a food because it is obviously detrimental to one's health (*i.e.* a poison berry that always causes vomiting upon consumption). Rather, I am referring to a food avoidance that results from the institutionalization of belief about a food item. This kind of food avoidance, on a cultural level, is usually based in a magico-religious belief system, wherein adherents understand the food item to contain some kind of spiritual or magical power (Fieldhouse, 1996).

Fava Bean Taboos: The Case of Pythagoras

Andrews, in a comprehensive review of “The Bean and Indo-European Totemism” (1949), provides a detailed description of the rules of broad bean use in antiquity, referring explicitly to Pythagoras. The broad bean is referred to in both ancient Greek and ancient Roman literature. Its name, *faba* (translated as *round*), refers to its shape—the bean common at that time was much smaller and rounder than the fava bean we know today (Simoons, 1998). The fava bean was one of the earliest cultivated plants, and was central in many rites and ceremonies throughout the ancient world (Andrews, 1949). The bean played an important role in religion, philosophy, magic and dietetics throughout antiquity. Many ancient societies considered the bean to possess spiritual and magical properties, and the ancients felt a combined respect and dread toward it (Andrews, 1949). Not surprisingly therefore, the bean was often the target of specified taboo, although the explanations for the taboo varied (Andrews, 1949).

Pythagoras was an important political figure in the 6th century B.C. who has been credited with issuing a ban on the consumption of fava beans among the population he governed in Croton, Greece. The sayings of Pythagoras are grouped under the label *acusmata*; the ban on fava beans is a part of this series of teachings issued by Pythagoras and practiced by his followers (Simoons, 1998).

Iamblichus, writing of Pythagorians around 250-330 AD, explains Pythagoras’ philosophy of food and the sacredness of animal flesh. He mentions that “beans were . . . interdicted, due to many causes, physical, psychic, and sacred.” (Guthrie, 1987). Pythagoras’ ban on fava beans is explained by Iamblichus by way of the perceived relationship between the flesh-like food and sacred human organs. Pythagorians argued that the beans contained the souls of the dead. Because the beans possessed human souls, they were like human flesh. Therefore,

because the consumption of living, soul-inhibited flesh was prohibited in Pythagorean teachings, so was the consumption of fava beans (Andrews, 1949).

The ban on fava bean consumption can be traced to other cult groups in early history as well: Pythagoras was not alone in his proscriptions against them. For example, fava beans were banned among the cult of Demeter and among the practices of the Orphics and the Romans (Simoons, 1998).

Early Interpretations of the Fava Bean Taboo

Andrews (1949) evokes both cultural evolutionary and symbolic magical perspectives in his analysis of the fava bean taboos in antiquity as he explains the many metaphors used by early men to deduce the magical properties of the beans. For example: “the soul is air; beans produce air; therefore souls are in beans. So phrased, it represents . . . the kind of thinking one would expect to find in early society” (Andrews, 1949:286). Andrews concludes that these beliefs do not constitute a system of totemic beliefs in early Indo-European society, but nonetheless remarks that “indeed, no plant or animal known to the Indo-Europeans produced a more luxuriant growth of beliefs” (Andrews, 1949:290). Andrews views Pythagoras’ fava bean taboo as one manifestation of the general conceptualization of the spiritual or magical power of the beans shared by an entire society from the time of early prehistory.

Biocultural Study of Favism by Schall and Katz

Andrews’ explication and explanation of the fava bean taboo fit a particular, historical mode of anthropological inquiry. However, as time passed and the discipline evolved, new information called previous conclusions into question. In the middle of the 20th century, genetic

research was advancing at a quick pace, and anthropologists recognized the utility of the new data. In the 1970's, there evolved an interest in the relationship, or interaction, of population genetics and cultural practice, thus labeled the biocultural approach. Henceforth, evidence regarding favism and G6PD deficiency called old conceptions of fava bean taboos into question.

The work of a University of Pennsylvania graduate student in 1979 began a revival in interest in fava bean taboos that lasted for the following two decades. In consideration of the connection between malaria, G6PD deficiency and favism, Schall and Katz (1979) sought to explain fava bean consumption patterns by way of a system of selection pressures and adaptation—a system which would optimize the fitness of the greatest number of individuals within a population. This hypothesis, taken up by Katz, stands in stark contrast to the meaning-centered approach taken by previous theorists of food taboos. Katz and his researchers created an elegant biocultural model with which to understand the concurrence of fava bean consumption restrictions and G6PD deficiency in world populations. The research sought to understand how cultures negotiated the use of potentially deadly but nonetheless essential food sources.

Katz defines biocultural evolution as the process by which “biological evolution and adaptation is supplemented and complemented by a variety of cultural adaptations” (1982:172). He elaborates upon this definition, stating: “biocultural evolution involves a reciprocal feedback process between biological needs and cultural responses in which an effective dynamic equilibrium with environmental resources is established over time” (1982:172-173). He explains: “in order to take this biocultural evolutionary approach further, we have been attempting to develop models and hypotheses about how food practices influence specific genetic characteristics” (1987:133). Katz was primarily interested in pursuing the relationship

between cultural practice and genetic adaptation, and assumed that genetics played a formative role in culture while culture, in turn, impacted biology.

Katz' theory assumes that throughout history, there have been culturally specific adaptations to changes in the degree and severity of G6PD deficiency in populations, primarily in regard to fava bean consumption. Based on the model of biocultural evolution, "potent food aversions" including taboos against consumption of fava beans should be considered adaptive responses to human biology. He states:

The aim . . . is to exemplify the utility of this approach for examining the interface between biological evolution and adaptation and the cultural beliefs and practices that shape human food behaviors, using fava beans as an example of a most unusual, important, and often deadly food resource. (Katz, 1987: 138)

Essentially, population genetics (one kind of external and at times constraining structure of social life) can play a determinative role in cultural practice, although there is constant feedback and interaction between cultural constructions and biological selective pressures. Culture is not lost in this model, but rather it is subordinate to biological constraint.

Katz, citing Arie (1959), uses as an example of adaptive cultural practice the ban on fava bean consumption issued by Pythagoras in ancient Greece. Katz argues that this theory is supported by the high prevalence of G6PD deficiency in contemporary Greek populations.

Rebuttal by Simoons: Pythagorean Ban Poor Example of Biocultural Evolution

In response to the hypothesis promoted by Katz which suggests that Pythagoras and his followers were G6PD deficient, Simoons offers a detailed review of historical data in order to argue that this ban was rooted in magico-religious beliefs, and nothing more.

In order to test the claim that magico-religious beliefs alone substantiated and can substantiate a ban on the consumption of fava beans, Simoons reviews data regarding the incidence of G6PD deficiency in such populations alongside historical documentation of illness.

Simoons notes a study by Stamatoyannopoulos of Greeks from Samos—the origin of Pythagoras’ parents—finding no G6PD deficiency at all (1998). Furthermore, current studies of populations in Italy in Greece find incidences of G6PD deficiency ranging from zero to 35 percent, including mild to severe forms of the deficiency (Simoons, 1998). Based on correlation between descent lines and geography, Simoons posits that the incidences of G6PD deficiency among Greek males in Magna Graecia at the time of Pythagoras averaged 2-4 percent, and asserts that only around 13 percent of these individuals would develop favism (Simoons, 1998). Based on these data, Simoons concludes that favism would have been a rather rare problem which would not have adequately founded strict taboo of fava consumption.

Simoons concludes that G6PD deficiency was not frequent in any populations during Pythagoras’ time; furthermore, there is no account of favism in the medical records, despite common knowledge of malaria and its symptoms (1998). Therefore, the restrictions against fava bean consumption were most likely linked solely to cultural meaning:

The richness of ancient views surrounding the bean—in terms of death and the underworld, decay, spirits of the dead, flatulence, meat eating and cannibalism, sex and regeneration, and purity and impurity—makes Pythagorean revulsion at the thought of eating beans all the more understandable. . . . [T]he powerful magico-religious motives reported in both Greece and Rome were quite sufficient to have brought on the bans of fava beans all by themselves, without implicating favism at all. (Simoons, 1998:215)

This situation presents a challenge to Katz’ theory which suggests: 1) that food taboos are necessarily biologically adaptive, and 2) that aversions to fava beans are a response to the prevalence of favism in a population. As Simoons explains:

Indeed, it is difficult to escape the conclusion that the favism hypothesis . . . is a form of medical materialism, in this case reflecting an all-too-ready tendency of present-day people to explain the origin of a food ban in terms of concern with health and disease, even though historical evidence is scanty or lacking altogether. (Simoons 1998: 249)

Problems with Food Taboos

Simoons demonstrates that the Pythagorean ban on fava beans may not serve as an appropriate case of food taboo to which a biocultural approach can be applied. However, the reevaluation of the fava bean taboo sparked by Katz and Schall brings to light an interesting theoretical challenge in anthropology. The arguments of Andrews and Simoons, in contrast with that of Katz and Schall, mirror larger theoretical paradigms that have served as foundations of hypotheses related to food taboos. Such taboos remain poorly understood in the anthropological literature. The following will include a discussion of anthropological theory, once again evaluating the applicability of materialist and meaning-centered approaches toward food taboos. I have so far asked, Are taboos outgrowths of magico-religious belief systems, adaptive responses to human biology, or both? I will suggest that the cultural and biological levels of human existence intersect at the point of food consumption, and that the food taboo is an important phenomenon to study when attempting to uncover the link between culture and biology, construction and structure. I will present one Anthropologist's attempt to illustrate this point.

New Interpretations: Harris, Douglas

Before evaluating a recent attempt at biocultural synthesis, I will review the materialist and the meaning-centered approaches mentioned above. Representing the structuralist approach is a paradigm labeled cultural materialism. In the "Theoretical Prolegomenon" of his book *Food and Evolution*, Marvin Harris argued in favor of a cultural materialist approach toward understanding food practices. Harris explains:

Cultural materialist strategies are based on the assumption that biopsychological, environmental, demographic, technological, and political-economic factors exert a powerful influence on the foods that can be produced and consumed by any given human population. However difficult to measure, there are nutritional needs that must be satisfied and psycho-chemical limits of taste and toxic tolerances that must be observed. . . . To operate on the

assumption that [generalizations about food consumption] are not discoverable in any given instance of a preference or aversion seems justified only as a paradigm of last resort . . . (Harris, 1987:58)

Harris ultimately seeks a theoretical perspective that allows for rigorous scientific testing of hypotheses. He argues that “the more complex and interesting generalizations concerning similarities and differences in food patterns should be discoverable” (1987:58). Harris sought to demystify cultural practice, and his cultural materialist perspective provided for an approach that would address the relationship between biology and culture while taking a multitude of other influences into account before assuming explanation. It is from this paradigm that Schall and Katz’ biocultural theory of food taboo evolved.

Harris’ theory is more inclusive than that of Katz and Schall, as it allows for the consideration of a multitude of structural factors. As Armelagos explains: “Although Harris accepts the possibility of biocultural explanations, he argues that they must be interpreted in cultural materialist as well as biological materialist terms” (1987:589). In other words, Harris argues that biocultural interactions should be considered when looking at foodways, but generally other influences including political economic and ecological influences may outweigh the influence of natural selection on food behaviors. Ultimately, the cultural materialist approach of Harris focuses on social and biological structures to explain cultural practice, in which case cognition or cultural construction—while operating in a sort of continuous dialogue with structural constraint—is secondary.

Douglas offers an explanation of food taboos from quite a different perspective. In “Purity and Danger” (1966) she adopts a meaning-centered approach to explain foodways, focusing on the relationship between ambiguity and danger as determinants of food taboo.

Douglas argues that taboos are enforced to reduce ambiguity in a system—for ambiguous or liminal objects, and associated objects, are imbued with a threatening nature. Douglas argues

that cultural belief systems evolve to reduce ambiguity and maintain a perceived order in the world. Thus, food taboos are enacted in the case of structurally ambiguous food items—like the pigs of Leviticus (Douglas, 1966). This approach would posit that the structural ambiguity of the flesh-like food items would elicit a cultural reaction in the form of food taboo, thus the restriction on fava bean consumption in ancient societies. In this case, culturally shared conceptions of meaning and symbols shape cultural practice, and social and biological structures have less significant influence on behavior and knowledge.

New Synthesis: Laderman and Humoral Philosophy

Neither the cultural materialist nor the meaning-centered approaches outlined above completely assimilate the individual meaning world with the collective culture and ultimately the biological aspects of human being. If we are to understand the relationship between food taboos, especially in cases similar to favism, we must find a way to trace the link between natural selection (human biology) and group or individual behavior (cultural practice).

A problem raised by the biocultural model is that it does not aptly describe the mechanism by which biological adaptation finds its way into cultural practice; in other words, it does not sufficiently reconcile the conflict between materialist (structuralist) and ideationalist (constructivist) theories of culture. Laderman, in “Symbolic and Empirical Reality: A New Approach to the Analysis of Food Avoidances” (1981) has responded to the problem presented by these conflicting explanatory models. In this study of humoral pathology among the Malays, she “assume[s] a multivalent nature of cultural patterns” (1981: 468). Laderman suggests that biological codes guide the decision-making process regarding food choice, but do not determine this process. She suggests that the web of cultural meanings in which food beliefs are suspended should not be considered superfluous to human biology but rather essential to it. Laderman

attempts to maintain an appreciation for ideationalist approaches toward understanding food conventions while considering the role that human biology may play in molding them.

Through an analysis of humoral beliefs and diet among the Malay, Laderman finds that the concept of *bisa*—utilized to explain fish food item avoidances—is neither completely symbolic or completely pragmatic, but rather:

The Malay humoral system and the concept of *bisa* exist on a number of interpenetrating levels, ranging from the most abstract to the most concrete. On the most abstract level, the system reflects and gives symbolic coherence to the Malay world view . . . On a more concrete level it refers to an intensifier which exacerbates whatever disharmonies are already present . . . On the most concrete level, that of direct sensory experience, the system is reinforced by moorings in empirical reality . . . (1981:488-489).

Laderman is suggesting that these levels do not only coordinate, but arise one as necessary to all the others. Pragmatic action would have no meaning without the symbolic structural support, and symbolic meaning would not remain if it were not for the reinforcing empirical experiments. Laderman attempts to merge the realm of cultural construction with the realm of constraining structure in her explication of *bisa*. She observes that an individual's experience affects his continuously reforming interpretation of the world, and the aggregate of these individual variations in experience and belief merge into one cultural construction which at once reflects structural realities as well as culturally conditioned cognitive processes.

Applying this approach to fava bean consumption restrictions, a model quite different from Andrews' and Katz' emerges. Taboo is no longer the manifestation of a lone religious belief system, the result of empirical observation and natural selection, or the result of a feedback loop between the two. Rather, fava bean taboos would be seen to evolve from the "interpenetration" of these levels of human experience, from abstract to concrete (to use the terms of Laderman). This revised conceptualization of the meaning of a biocultural synthesis

promises to fuel exciting new work in the field of food practices and biological constraints in Anthropology.

Conclusions

In this paper, I have reviewed the favism ↔ malaria ↔ G6PD complex, and evaluated it in terms of the biocultural evolutionist approach toward understanding food taboos. I have examined a case study which does not support the biocultural evolutionary model, and discussed possible alternatives. My main concern has been to develop a new model that explains the possible link between human biology and cultural practice without privileging one level of operation over the other. Laderman has progressed in developing a theory regarding the relationship between biology and culture in regard to food consumption patterns. I assert here that the issue of fava bean taboos has not been laid to rest, that Katz' model is problematic, and that further research must be completed in order to build a new foundation on which theories of food consumption restrictions can be established.

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