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GEOPHAGY: ADAPTIVE OR ABERRANT BEHAVIOR

David E. Engberg

Geophagy, clay or dirt eating, is a worldwide phenomenon of long historical precedence. Historically perceived as an irrational behavior, today, growing evidence supports the contention that earth eating has adaptive value. Case studies from Africa and the United States illustrate the practice. A literature review shows that three primary explanations have been offered to account for the presence of geophagy in human populations. The first argues that geophagy has medicinal value as an anti-diarrheal and as a dietary supplement in vitamin and mineral poor environments. The second contends that geophagy is a culturally transferred practice. The third states that earth is eaten as a means to detoxify certain plant species and increase diet breadth. This paper suggests that geophagy can be best understood within the broader context of human behavior when viewed from both a cultural and biological perspective.

And ye shall eat the fat of the land (Genesis 45:18)

Well it was when we were little, just about everybody in our family like the sisters and stuff ate dirt... We just started eating it. I don't know how we just did it. It taste pretty good and when it rained... if it was real hot or a real dry day... just the aroma like that dusty smell and it just... I don't know it just did something to you... you just liked dirt. (Excerpt from an interview with a 42 year old woman. Forsyth 1988:64)

Geophagy, day or dirt eating, is a phenomenon of long historical precedence. Culturally and regionally ubiquitous, examples of this curious practice have been recorded in a wide variety of contexts. Among some societies, geophagy is considered a normally prescribed behavior. In others, it is seen as an unhealthy aberration. In nearly all cases, it is most common among pregnant women and children.

Confusion regarding geophagy's etiology is long standing. A variety of explanations have been offered to account for its practice, but remain as yet largely unsubstantiated. A review of the literature on geophagy shows that three explanations are especially robust. The first explanation stresses geophagy's medicinal efficacy. Proponents of this idea hold that geophagy is a rational behavior for people living in environments and social situations that do not otherwise adequately accommodate their vitamin and mineral requirements. They also point to its effectiveness as an anti-diarrheal. The second explanation posits that geophagy is a culturally promoted and generationally diffused behavior that offers its practitioners psychosomatic benefits.

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The final explanation argues that geophagy is practiced as a means to increase diet breadth by detoxifying certain plant species.

The purpose of this paper is to suggest that geophagy can be best understood within the broader context of human behavior when viewed from both a cultural and biological perspective. To accomplish this, I will document historical references and contemporary case studies of geophagy in order to construct a framework for understanding its spatial and temporal distribution, then flesh out the afore-mentioned explanations by surveying the research that resulted in their formation. Finally, I will critique the explanations in terms of their relative adaptive value and conclude by suggesting future research questions that might help fine-tune our understanding of geophagy.

Historical Diversity and Distribution of Earth Eating

Geophagy is "a special case of pica, the habitual consumption of items not commonly considered to be food or the compulsive consumption of otherwise normal food items" (Reid 1992:337). Many reviews of pica (magpie in Latin) have effectively traced its contemporary and historical incidence and distribution (Laufer 1930; Cooper 1957; Halstead 1968). It has been observed in various forms among modern populations in northern Europe, the Mediterranean, Africa, North and South America, Australia, East Asia, and the Pacific Islands (Frate 1984:34). Its wide spatial distribution suggests a similarly broad

historical distribution. According to Laufer, it is not a universal behavior, but occurs "sporadically almost everywhere" and "has nothing to do with race, creed, culture, area, or a higher or lesser degree of culture" (1930:23).

In the seminal work on the subject, Cooper reports that the earliest mention of geophagy comes from the written accounts of sixth century Roman healers (1957). Aëtius, for example, in attempting to rationalize the craving of dirt among pregnant women, attributed the condition to "a suppression of the menstrual flow, due to pressure by the foetus" (Cooper 1957:5). He believed bloody humors attacking the stomach were responsible for the subsequent craving of odd foods (Cooper 1957:5). Another Roman doctor, Aegineta, argued that pica "occurs most frequently about the third month after conception because the foetus, being then weak, cannot consume all of the aliment which is brought to the uterus, and hence various superfluities are collected in the stomach; and therefore they have a desire for complicated and improper articles such as extinguished coals (charcoal?), Cimolean earth, and many more such things" (Cooper 1957:5). He recommended moderate exercise, and a restricted diet of savory foods, astringent wine, and starch as a cure "for those who crave earth" (Cooper 1957:6). Nearly a millennium later, in 1562, a German author named Hubright recommended treating geophagy by substituting black, twice-baked bread for earth, and starch for clay (Cooper 1957:6).

The age of discovery saw many reports of geophagy. For example, traveling in parts of South America between 1799 and 1804, Humbolt reported that "clay was eaten at all times by the Otomac tribe along the Orinoco, but during the two month season when the river overflowed and food was scarce they seemed to subsist almost entirely on fine, unctuous clay containing oxide of iron" (Cooper 1957:19). A robust and hardy people, he noted that they seemed to suffer no ill effects from this practice (Cooper 1957:19).

In more recent accounts, Lausch described the practice of mixing bread dough and dirt during the Thirty Years War (1898), Blair cited the extensive use of a dirt lick near Lake Chad in Africa by animals and local inhabitants (1926), Hooper and Mann detailed the prevalence of geophagy in both historic and colonial India (1906), and Hunter noted that "infusorial earth" was sometimes mixed with bread flour in nineteenth century northern Sweden (1973:171).

Geophagy Among the Ewe of Togo

Conducting research among the Tiv of Nigeria (1966) and the Ewe of Ghana (1971), Vermeer found geophagy to be an active component of their cultural matrix. The situation among the Ewe is especially intriguing; not only do they consume clay, they also produce and market it for large-scale consumption.

The Ewe tribe occupies the Volta region of southern Togo (Vermeer 1971).

Proof that geophagy is a firmly ensconced local behavior is evidenced by the wide variety and volume of nonfoods they mine and eat. One particular kind of clay, *eye*, is especially popular, and is extensively mined from the hills behind the village of Anfoega (Vermeer 1971). Raw clay is bought by local women at the Anfoega pithead, then processed and sold at markets to wholesalers for regional distribution. The following passage not only illustrates the *eye* production and processing procedure, but also suggests that the practice of eating earth has resulted in the creation of an important local cottage industry.

Shales from the pits are placed in water, and the unwanted gritty portions and reddish iron oxides are removed. Thereafter the shales are placed in a container and pounded with a pestle normally used for pounding foodstuffs such as yams and cassava. The fragments of the shale are sifted, often through part of a wicker basket, to insure a reasonably uniform texture. The finer material and powder are collected and mixed with water to form a cohesive, doughy mass. Small amounts are taken from the mass, roughly shaped, and set out to dry in the sun. Within a few hours, the plastic clays can be shaped to final form resembling an egg; this is accomplished by rolling and rubbing each piece on a smooth surface, commonly the back of a small porcelain cover for a pan. Once again the finished product is sun dried for a few days prior to movement to the markets for sale (Vermeer 1971:61)

In the three villages surveyed, Vermeer estimated the annual production of *eye* to be approximately 300 tons. He reported that 14 percent of Ewe men, 46 percent of Ewe women, and 63 percent of the pregnant Ewe women were confirmed clay eaters, and suspected that the actual percentages may have been greater still.

Within Ewe culture, clay is openly purchased, openly consumed, and culturally sanctioned (Vermeer 1971).

Geophagy in the United States

Evidence of geophagy has been extensively documented in the United States. In contrast to the previously mentioned African cultures, however, its practice has not met with the same social acceptability. Kiple and King show that antebellum physicians throughout the South were fascinated by geophagy as a medical curiosity because it appeared almost solely among black populations (1981). Plantation owners were terrified by geophagy for the same reason. Rumors routinely circulated about its reputation as a slave killer, and they feared it would have a deleterious effect on their labor pool (Kiple and King 1981:119). Ultimately however, only eighty-three deaths were attributed to geophagy, and doctors eventually recognized that an improved diet alleviated cravings for dirt and resulted in a generally healthier work force (Kiple and King 1981:119). Later literary references to American geophagy include a 1942 survey of black Mississippi school children which showed that 25 percent had eaten dirt at some time during the ten days prior to the study (Dickens and Ford), and Clayton's observation of rural children eating earth with spoons while sitting around a clay hole (1965).

In the early 1980s, Frate located and interviewed a number of earth-eating black women in the rural South (1984). His conversations with them revealed that certain soils were considered far superior

to others. "Sandy loams and other coarse varieties" he writes, "are rejected in favor of fine-grained clays, prized for their distinctively sour taste (Frate 1984:35). Consequently, favorite sites sometimes became so popular that they were quickly mined to exhaustion unless their location could be kept secret. He describes a typical dirt collection scenario as follows:

A heavy rainfall in central Mississippi almost invariably brought with it a puzzling spectacle. Soon after the downpour had drawn to a close, cars would pull over and park at certain choice locations on country roads. The passengers - black women, usually - would get out and walk to the edge of the thoroughfare, where the dirt-and gravel roadbed met a steep earthen bank. There, using kitchen utensils, they would extract golden-brown clay, spoonful by spoonful, and deposit it in shoe boxes, grocery bags, or bowls.

Anyone curious about the ultimate cause of this raw material could find the answer by strolling through nearby hamlets on a pleasant day, an hour or two before sunset. On a front porch here and there would sit two middle-aged women, relaxing in rocking chairs and exchanging reflections on everyday life. Occasionally one would reach into the paper bag between them, grab a small handful of dirt, and eat it. (Frate 1984:34)

As with the Ewe, correct processing of the earth was also an important institution. One survey revealed that two-thirds of the respondents either cooked their clay and dirt on stove-tops or baked it in ovens (Frate 1984:37). Sometimes salt or vinegar were added for flavor. In another study, Johns (1991:39) reported an instance of dried clay being sprinkled on ice cream.

Frate believes the practice of geophagy is decreasing in the United States (1984). Because of its prevalence, primarily among poor, rural, black

populations, pejorative images continue to be associated with its practice. As a consequence it has been pushed "underground", and the cultural patterns that have historically transferred it from one generation to the next have begun to atrophy and disappear.

Geophagy as a Response to Nutritional Stress and Diarrhea

A number of studies have focused on geophagy as it relates to nutritional stress (Cooper 1957; Vermeer 1966, 1971; Hunter 1973; Kiple and King 1981; Hunter and De Kline 1984). They conclude that the consumption of dirt and clay should be viewed as a rational behavior in environments otherwise unable to meet the vitamin and mineral requirements of the people living there. They additionally show that in cross-cultural samples, women (especially when pregnant) and children are most often found to be practicing geophagy. Considering that it is among these demographic groups that malnutrition is most likely to occur, it is logical to assume that they would exercise creative options to increase their mineral intake.

In order to determine its nutritional value, Hunter collected samples of the clay being sold in markets in Ghana (1973). Subsequent analysis proved the presence of trace amounts of iron, calcium, potassium, phosphorous, magnesium, copper, zinc, manganese, nickel, cadmium, and chromium (1973:177). Even though the nutritional benefit of geophagy cannot be accurately predicted until it is known exactly what

proportions of the nutrients are actually absorbed and used by the body, his test samples still suggested average iron and calcium mineral levels that would provide approximately 15 percent of the recommended dietary allowances for pregnant women (1973:178) (Table 1). In a parallel study conducted in Latin America, Hunter and De Kline found that the consumption of locally produced clay tablets provided women with 9 percent of the Recommended Daily Allowance (RDA) for iron and calcium, 7 percent of the RDA for magnesium, and up to 3 percent of the RDA for copper, zinc, and potassium (1984:166).

Vermeer also analyzed soil samples. His results showed a low-level presence of sodium and potassium, and considerable amounts of magnesium and calcium (1966:202). From these findings he concluded that "[t]he unusually high calcium content of [the] samples and the fact that more of the calcium is releasable to the human system upon digestion than is available to plants, suggest that these geophagial clays have nutritional value to Tiv women" (1966:202). This is especially telling in light of the fact that the Tiv are non-milk drinkers and their dietary intake of calcium through food crops is minimal.

In his work among the Tiv, Vermeer also found that geophagy among children of both sexes was commonly practiced as a remedy for diarrhea (1966). According to the women he interviewed, children were fed earth to "make the waist strong" or to "make the back strong" (Vermeer 1966:200). This notion is lent further support by an analysis of Nigerian clay conducted by Vermeer and Farrell (1985). Their

**Table 1. Mineral Supplements During Pregnancy and Lactation in Africa and the United States.
(Adapted from Hunter 1973:180)**

Elements	Mineral Supplements From African Clays (30 mg a day) (mg a day)			Mineral Supplements From United States Pharaceutical Products From Seven Companies: Elements and Assimilable Compounds (mg a day)							US Recommended Dietary Allowances During Pregnancy (mg a day)	% of Recommended Allowances in African Clays (mg a day)		
	Lowest	Median	Highest	A	B	C	D	E	F	G		Lowest	Median	Highest
Phosphorous	0.12	0.6	3.36	190					450		1200	0	0.1	0.3
Potassium	1.5	3.9	7.5		>1.67				10		6000	0	0.1	0.1
											2000	0.1	0.1	0.4
Calcium	3.45	33.99	45.48	250	>350.00	300	750	425	580	100	1200	0.3	2.8	3.8
Magnesium	0.51	9.93	16.44		>1.67	5	4.98	0.2	27	1	450	0.1	2.2	3.7
Copper	0.06	0.3	0.66				1.02	0.2	1	2	2	3	15	33
Zinc	0.36	0.45	0.9		>0.10		1.5	0.2	2	1.5	10 to 15	2.4	3	6
												3.6	4.5	9
Manganese	0	0	0.42	0.12	>0.33		1.02	0.2	2	1				
Iron	1.2	2.85	11.79	>6.00	>42.00	40	15	>33.3	20	45	18	6.7	15.8	65.5

• The symbol > indicates milligrams of an element within the larger mass of a compound.

research adduced that one of the clay's active ingredients was kaolinite, the same material used in the Western anti-diarrheal Kaopectate (1985).

Interestingly, the tendency to see earth-eating as an instinctive and rational response to nutritional stress and diarrhea has also been accompanied by the notion that it is an unhealthy and aberrant behavior (Frate 1984). Fecal impaction, tooth abrasion, anemia, colon perforation, parasitic infections, poisonings, and other maladies have all been suggested as possible deleterious by-products of its practice (Frate 1984; Reid 1992). Most of these suggestions, however, come from isolated medical cases that do not effectively demonstrate that geophagy is solely responsible (Reid 1992).

Geophagy as a Culturally Driven Behavior

Research has shown that the historical origin of geophagy may be originally tied to biological drives triggered by vital minerals in the substances being consumed. Still, in interviews with practitioners, many scholars have found that its contemporary practice seems to be the result of nurture, not nature. Their responses seem to indicate that instead of fulfilling nutritional needs, geophagy is being practiced for psychosomatic reasons.

Research by Frate (1984) supports this notion. He concluded that "[y]oung children pick up the habit from their mothers, who consider soil a convenient pacifier" (1984:37). In other studies, pregnant women interviewed by Johns

(1991:42) and Vermeer (1966:200) said they were "taught" to eat clay because it settles the stomach and reduces the nausea and vomiting associated with morning sickness. Other responses were more ambiguous. In a study conducted by Hunter, people said that they ate earth because "earth is good for you"; "it tastes good"; and, "it is sour like a lemon" (1973:192). And, as the following interview excerpts indicate, "craving" and "need" also seem to be common reasons for the ingestion of earth (Forsyth 1988:64 - 65):

I don't know it's just crunchy, its satisfying, it's like a craving or something you get used to it like a candy bar or something like that you really like and you get used to it and there is nothing else that will surpass that taste you just have to have it and if it rains it really makes it especially if it's real dry. That smell I can't explain it. I don't know." (woman, age 62)

"I used to eat it when it would rain you know it's just the smell. I go out under the clothes line and get good black dirt and it tasted so good." (woman, age 53)

"I have it up there at the head of my bed. I just don't know what I'd do without the dirt... looked like it made my food digest right. Sometime I feel like I could just eat dirt." (woman, age 56)

Ten of twelve women interviewed by Forsyth report that cravings "occur when they are confronted with the smell of wet dirt" (1988). Another of his respondents when asked why she ate dirt replied with the following logical supposition (1988:65):

When I was very small in the state of Mississippi I would become with cuts and things like that and I used dirt because at that time we didn't have such

things as go to the doctor. It was healing... so whenever it happen... I would use dirt... If it heals the outside, maybe it heals the inside and I see other people eat dirt... now I eat it all the time... because I want to..." (woman, age 68)

Forsyth concluded that very few of the clay and dirt eaters interviewed acquired the taste without the influence of other individuals (1988:63).

The exclusive presence of geophagy among black populations in the United States has fueled speculation that its practice was culturally transferred from Africa to North America during the slave trade (Hunter 1973:192). Further support for this hypothesis comes from Hunter and De Kleine's study of Black Caribs in Belize (1984). They show that local geophagy is intimately connected with the spiritual and religious beliefs, and ceremonies of the Black Christ cult of Santiago de Esquipulas (1984:157 - 159). White clay tablets (*benditos*) stamped with pictures of saints and the Virgin Mary and blessed by Roman Catholic church representatives before sale, are believed to have special health-giving properties and are distributed and consumed widely (1984:59). In a similar tradition, Laufer noted that Pakistani Muslims ritually eat gray, flat cakes made from the dust of local Prophet's tombs (1930). The metaphorical nature of this practice suggests that some sort of religion-based psychological benefit is associated with the cakes' consumption and further supports the assumption that geophagy may be culturally propagated.

Geophagy as a Detoxicant

Recently, research by Johns has proposed that "the adoption of geophagy as a general response to toxins allowed people to make wider use of natural resources" (1991:42). To support this hypothesis, he presented evidence collected in South America. Working among indigenous Peruvian peoples, he discovered that they frequently dipped potatoes in a clay-water "soup" before eating them. When asked why, informants noted that the potato clays eliminated bitterness and prevented nausea (1991:40). Further investigation resulted in an explanation for this behavior. Johns (1986, 1991) found that the potatoes in question were laden with toxins called glycoalkaloids. Because clays bind well with such organic compounds, he determined that dipping them in the clay-water mixture was an adaptive behavior that served to lower their toxicity to edible levels. In a similar study, he found clays to reduce toxins in acorn meal by one-fourth (Johns 1986, 1991). Moran also notes that certain cultures are known to add lime to manioc and corn recipes for the same reason (1982:93).

Evidence of clay's efficacy as a detoxicant is available from the biological studies of other species as well. Rats have been shown to adopt clay eating as a means to combat chemical toxins, and the clay from termite mounds is often eaten by chimpanzees and other primates as a way to detoxify the plant materials in their diets (Johns 1986, 1991; Reid 1992). This knowledge provided Johns with sufficient grist to hypothesize that

"[i]f early human foraging was analogous to the feeding of modern nonhuman primates, then food procurement by humans must have been subject to the constraints imposed by plant defensive compounds. Geophagy is a behavior with antecedents that are certainly prehuman, and higher primates, including humans, have apparently maintained it as a mechanism for dealing with naturally occurring toxins" (1986:643).

Discussion

Three explanations have been identified and discussed as possible causes for geophagy's presence in human populations. The first sought to explain the phenomenon in terms of the nutritional and anti-diarrheal value its practice provides. Independent tests showed some geophagial earth to be rich in the trace vitamins and minerals important for healthy human nutrition. Studies detailing the prevalence of dirt and clay consumption especially among disadvantaged women and children suggested that it was being eaten as a nutritional supplement. Evidence showing an increased incidence of earth eating during pregnancy when mineral and vitamin needs are heightened lends this explanation further support. However, while it is true that certain edible clays provide valuable nutrients, separate studies have shown that not all of them do (Johns 1991). This has led Johns (1991:42) to conclude that "from a nutritional point of view clay eating does

not [by itself] confer a clear evolutionary advantage to its practitioners".

The second explanation attempted to rationalize geophagy in terms of its cultural transmission. Some researchers have argued that geophagy is simply a learned behavior passed from one generation to the next. Indisputable evidence supports the notion that geophagy is culturally propagated, but this explanation fails to explain how and why earth eating originally became culturally manifest. It also fails to account for the fact that women eat earth proportionately more than men. If one assumes that mothers equally pass on advantageous behaviors to both sons and daughters, then why is geophagy consistently practiced by higher proportions of adult females than males?

The third explanation contended that geophagy is an adaptive behavior practiced by certain populations to detoxify food stuffs and thereby extend diet breadth. Evidence linking earth eating to a variety of other animal species was presented in support of this contention. By focusing on its resource enhancement value, this explanation also speaks to how and why our species, and others, may have atavistically navigated through a potentially threatening dietary environment, and thus provides a reason for its apparent longevity and cultural distribution. Larger data samples and more in-depth, multi-species diet studies are necessary to substantiate this explanation.

Conclusion

Most researchers, in spite of their differing explanations, agree that geophagy's widespread presence in human populations is reflective of some sort of intrinsic adaptive value. Their conclusions support the contention that geophagy is not an haphazard or aberrant behavior, but is instead a multi-causal phenomenon with both biological and cultural underpinnings. Its longevity and cultural importance alone are certainly compelling indicators that its practice infers some sort of adaptive benefit: in many parts of the world geophagy was and continues to be a richly structured custom, deeply embedded in well-defined systems of belief and ritual (Frate 1984:35).

Hunter believes geophagy to be "a cultural institution that has evolved through stages as a behavioral response to the physiological imperative; namely, that, over a long period of time, a cultural practice subconsciously responds to, and gradually gives institutionalized form to, the physiological needs of the body under stress" (1973:184-185). This is a productive way to think about such an involved phenomenon because it allows one to borrow and combine elements from each of the aforementioned explanations and direct the best of these ideas into an understanding of geophagy which incorporates both biological and cultural perspectives. Unfortunately, no research to date has effectively done this. And, as a result, geophagy remains a largely misunderstood area of scientific inquiry.

After compiling an impressive corpus of data about geophagy from a variety of ethnographic studies, Vermeer (1971:197) proposed that "[g]eophagy can be understood properly only by considering it in the context of the societal system in which it is operative." This is sound advice, and, considering the paucity of historic and prehistoric information available to researchers and the problems associated with extrapolating from cross-cultural data of dubious quality, the only reliable means with which to presently further our understanding of this topic. To gain a clearer picture of geophagy's function in human populations additional research must be conducted.

To accomplish this, a few avenues of approach readily present themselves. For example, specific data is needed on the environmental and the cross-cultural settings in which geophagy occurs. Questions to ask might include: What is the exact chemical breakdown of the earth being eaten in each part of the world? How do different samples compare? How do the geophagic samples in an area correspond to the specific dietary deficiencies experienced by the people eating dirt? What values and beliefs currently support geophagy's practice? To what extent is geophagy age- and sex-specific? What selection criteria are used to select one type of earth over another? How do wealth, population density, and subsistence economy affect its practice? Are there behaviors that replace geophagy for separate religious or economic groups within the same society?

As the most scientific of the humanistic disciplines and the most humanistic member of the social sciences, anthropology is well-equipped to provide better guesses about phenomenon that incorporate both cultural and biological elements of human behavior. Combining long-term participant observation data with knowledge derived from intensively collected samples would undoubtedly result in a more "fine tuned" appreciation of geophagy. To date, empirical evidence supports the notion that geophagy has adaptive value. Perceptions of it as an aberrant behavior are therefore either uninformed or ethnocentrically grounded. Our understanding of this complex behavior will be improved only when we approach it from a perspective that combines the biological and cultural elements involved in its propagation.

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