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Author

Kopp, Judy

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Crosscultural Contacts: Changes in the Diet and Nutrition of the Navajo Indians

JUDY KOPP

Introduction

It is a commonly held notion in the U.S. that transforming an "underdeveloped" society into a more technologically advanced society with a higher economic standard of living results in an improved diet and better nutritional status. This notion, which persists to this day, colored the perceptions of early colonial administrators in America who believed that American Indians starved before the colonists arrived and would have continued to starve were it not for their aid.¹ The colonists chose to believe that their arrival resulted in an improved life for those who preceded them. Yet, historical analysis of the diet of one Indian tribe, the Navajos, suggests that although contact with a more economically developed culture does lead to changes in diet, improvement does not necessarily ensue. In fact, the encounter with European cultures and subsequent economic and social changes was an initial nutritional disaster for the Navajo Indians, and there is evidence that even current Navajo adaptations to white American dietary practices are not consistently an improvement over the Navajos' early pre-Western contact diet.

Although there are difficulties in specifically identifying the early traditional Navajo diet, it clearly included many nutritious

Judy Kopp is Assistant Professor in the School of Social Work at the University of Washington in Seattle. The author wishes to thank Drs. Paul Stuart and Karen Lucas for their support and helpful comments on earlier versions of this manuscript.

items, which easily could have been recommended by Indian Health Service personnel and included in U.S. government food programs for the Navajo. But, unfortunately, federal food programs tend to shun traditional foods, stressing instead those from white culture. The Navajo would have been naturally inclined to eat the traditional foods if readily available and treated as legitimate by outsiders. Importantly, they would have been able to utilize their traditional knowledge of those foods to participate actively in maintaining a nutritious diet, rather than passively following the lead of outside "experts." It is not enough to make available to a people foodstuffs that *if* eaten in balanced and proper proportions would provide good nutrition, unless it is clear that those people have the knowledge, habits, and resources necessary to ensure that they will *in fact* eat the foods in such proportions, and not yield to the temptations of once-unfamiliar sugary and over-processed foods, with their attendant dangers to general and dental health. Food programs that ignore traditional foods and stress outside foods risk violating this common-sense rule for providing good nutrition. Even if there were no question of the superiority of the diet that white culture teaches over the traditional diet, there would still remain the question of whether what the Navajos actually eat regularly (out of what food programs provide and food stamps buy) gives them better nutrition than what they would eat if traditional foods were more readily obtainable and were encouraged as appropriate. Were a wide variety of healthful foods available, along with information on how to choose among them, the Navajo could exercise true self-determination about their diet.

Early Navajo food sources were obtained by hunting and gathering. Planting and herding were added later. Contacts with other groups—Pueblo Indian communities, Spanish colonists, the United States Army, missionaries and traders—introduced or forced dietary adaptations, some of which were nutritionally inferior to the Navajos' traditional diet. The voluntary shift from hunting and gathering to herding and farming, learned from the Spanish and the Pueblo Indians respectively, was less destructive than the Navajos' forced dependence on external food sources during the years of fighting American soldiers, internment, and then relocation to a reservation. Like many traditional cultures, the Navajo slowly abandoned certain nutritious and cul-

turally convenient practices such as breast-feeding, and they replaced some traditional nutritious foods with foods of less nutritional value. Outsiders working in clinics and boarding schools taught that their own modern practices and foods were better, and that traditional Navajo ways were "old-fashioned" or otherwise inferior. This served to undermine confidence in traditional wisdom.

Natural conditions, especially droughts, also contributed to increased dependence on external food sources. Overgrazing, resulting from rapidly increasing herds in the late 1800s and early 1900s, stripped the land of natural plants, nuts, and seeds; erosion, resulting from a combination of factors,² decreased the farming areas. Population growth in the 1900s, aided by the introduction of white medicine, and unmitigated by comparable economic development or land expansion, placed additional strain on the subsistence resources. Navajo living arrangements and subsistence lifestyle make reliance on commercial food sources difficult, if not impossible. Many Navajos live in "camps" of several hogans (one-room octagon homes) scattered throughout 24,000 square miles, an area which covers the northern half of Arizona and the northwestern portion of New Mexico and extends into southern Utah. Close to half the homes still do not have electricity. Thus, even for those with cash incomes, access to a wide range of commercial foodstuffs is uncertain because of the great distances, the limited paved roads, and scarce transportation and refrigeration.

The history of the Navajos' diet exemplifies the effects of contacts with diverse cultures, forced and rapid changes in dietary patterns, transition from a subsistence economy to a money economy, and technological development. I describe here the changes in dietary patterns and, to the extent possible, the nutritional status of the Navajo Indians as well as the relative nutritive values of their foods. The data are drawn from writings of soldiers, missionaries, and traders; from interviews with elders in the 1800s and early 1900s reported in anthropological studies; from nutrition studies; and from extrapolation to past patterns based on study of continuing traditional ways. From these sources I reconstruct general patterns of food consumption, developing a story of changing dietary patterns in response to social, economic, and environmental changes.

DIET HISTORY

Hunting and Gathering

It is unclear exactly when the Navajo Indians appeared in the Southwest; it is estimated that they began living in the area in scattered groups some time between the tenth and fourteenth centuries.³ The first written reference to their existence in northern Arizona appeared in the seventeenth century.⁴ Originally, the Navajos were hunters and gatherers, moving through New Mexico, Arizona, and Utah, relying on natural resources for sustenance. Their earliest known diet consisted of wild plants, seeds, nuts, fruits, and wild animals (except fowl, fish, bear and coyote, all of which were tabooed by Navajo religion). Seeds were ground into meal, from which breads and mush were prepared. Elmore, in an ethnobotany study,⁵ listed 587 different native plants known to Navajo Indians, of which 117 were used for food or beverage, but he asserted that this was only a preliminary attempt to classify the hundreds of plants used by the Navajo. A review of various references on natural foods and their uses yields quite different lists of plants, supporting the notion that a comprehensive list of the hundreds of plants used by the Navajos is yet to be compiled, and it is likely that some natural food resources used in the past were never documented. For example, of the 78 items mentioned to an anthropologist by informants in the 1930s, 40 had not been included in earlier writings.⁶

Farming and Herding

The Navajos probably adapted agriculture from the Pueblo Indians who farmed in the Southwest prior to the arrival of Navajos in the area, and learned sheepherding from the Spanish. Sheep, introduced into the Southwest in the 1500s, became a much-valued dietary staple. The Rabal manuscript⁷ describes Navajos planting corn, beans, pumpkins, and watermelons and owning horses, sheep, and goats in 1706. Another document from the same period states that the Navajos grew corn, beans, squash, and chili.⁸ Yet farming was limited, due to land and water conditions, and the accounts cited above suggest that gathering and hunting continued as planting and herding developed. The

Navajos were skilled preservers of food, both when their economy was based on hunting and gathering and when it was more reliant on farming and herding. They sliced and sun-dried meats, fresh fruits such as melons, and vegetables including squash and beans. Corn was first roasted and then dried.

Corn and sheep apparently replaced wild plants as staples by the early 1800s, and possibly a century earlier. However, the Navajos continued frequent use of native plants. In 1910 Franciscan Fathers⁹ living on the reservation, described four varieties of corn, preparation of seven wild vegetables, and use of a variety of fruits and nuts as well as some use of goat and sheep milk in 1910. The Franciscans also described the Navajos grinding seeds for meal when corn was scarce. In fact, two anthropological studies conducted in the 1930s describe the use of native plants, thus documenting the continuation of traditional dietary patterns while the Navajo were adapting to new food sources.¹⁰ Continuity, however, was given a decisive jolt during the years of fighting United States soldiers and the internment of the late 1800s.

War, Imprisonment, and Relocation

In 1863 Brigadier General James H. Carleton commissioned Kit Carson as field commander and ordered him to subdue the Navajos and move them to a reservation. Starvation was a tactic used to force the Navajos' surrender. The U.S. soldiers burned Navajo corn fields and slaughtered their herds. When the Navajos lost the war with the U.S. soldiers in 1864, some survivors scattered and went into hiding, while others were captured and marched approximately 400 miles to Bosque Redondo near Fort Sumner in New Mexico, where they were imprisoned until 1868. Some 8500 were herded to Fort Sumner on the "Long Walk."¹¹ While in hiding, they ate what was available, including rodents and insects. Elders reported that when the Navajos were hiding from the Spanish soldiers in the 1600s and the U.S. soldiers in the 1800s, "they ate everything—doves, rats, mice, prairie dogs, locusts, porcupine, badger, lynx, three kinds of greens, cactus, seeds, and roots."¹² The efforts of those imprisoned Navajos who were not too disheartened to plant new fields were thwarted by droughts, poor soil, and insects. Thus, reliance on the land was impossible and they were forced to live on army

rations. For the first time, their traditional, preferred foods were not available. While in prison, men, women, and children ate white flour (often infested with vermin), meat (often rotten), coffee, sugar, tea, and lard,¹³ none of which were familiar foods to them. The Bosque Redondo "experiment" was a disaster and was considered too economically costly by the federal government. A meeting was held among military leaders to determine the fate of the Navajos; it was decided that they should return home.

The Treaty of 1868 placed 7,111 Navajos and 30,000 sheep on 3.5 million acres of land. Initially, agricultural production was limited due to droughts, and time was needed for the greatly depleted sheep herds to multiply.¹⁴ Families lived partially on army rations—primarily coffee, flour, and sugar¹⁵—until they were able to raise adequate amounts of food. The white flour and coffee introduced by U.S. soldiers continue to be staples today, especially for families with limited cash incomes.

The Navajo pattern of slow transition and continued use of natural, traditional foods—evident in the change from hunting and gathering to farming and herding, and from total reliance on the land to partial reliance on commercial foodstuffs—is reflected in the diet patterns in the 1930s and 1950s, and probably accounts for the relatively positive findings of a nutrition study conducted in the 1950s.

Diet in the 1930s

In the 1930s, Navajos ate primarily mutton, coffee, wheat flour, and potatoes, with occasional canned or fresh fruits and vegetables. Carpenter and Steggerda¹⁶ estimated the amount of items consumed weekly by a family of six or seven: one sheep or goat, ten kg flour, 2.5 kg sugar, one kg coffee, and fruits and vegetables as available. Some wild vegetables and seven kinds of home-made breads were still in use.¹⁷ Bailey,¹⁸ who interviewed 25 people from three parts of the reservation, found that the interviewees were familiar with 11 of the 21 foods listed as part of a ceremonial in 1902. Seventeen breads were mentioned to her: five made of wheat and corn, five of wheat, and seven of corn. Whole wheat flour was still used in greater quantities than white flour. Homes had grinding stones—metate and mano—and some women continued to grind corn and wheat. The method of

preparation of some dishes, such as blue corn meal with ashes, did not vary from the earliest accounts.¹⁹ Some variance in food preparation and food choice was associated with the individual's chronological age, level of education, and degree of exposure to white culture; however, the typical diet was, as a whole, consistent throughout the reservation.²⁰

Farming had become less important, due to the arid conditions and the fact that the naturally limited land for planting became scarcer still because of gulying and erosion caused at least in part by rapid, heavy rain storms and by increasing herds which required more land area for grazing. Population growth further increased the need for additional land for the maintenance of a subsistence lifestyle. Because sheep wool and woven blankets were important trade items, sheep were probably a more important economic resource than was agriculture from the time the Navajo first became herders. At the same time, although stock provided access to commercial items and provided a higher percentage of total income, in subsistence production agriculture had primary importance. Further, a large percentage of Navajo purchasing power was spent on food, even though in the 1930s home-produced foods comprised the greatest portion of the Navajo diet.²¹ The Navajo tribal chairman offered his perspective on the 1930s diet:

Chee Dodge asserts the Navajos . . . raised corn, wheat, pumpkins and beans but subsisted principally on the seeds of wild plants and weeds which they gathered in the fall and buried in the ground. . . . But when they got sheep, the flocks ate down the plants, so they did not have seeds which had the elements of growth in them. They did not eat bear, turkeys, fish, pork or eggs because of taboos against them, but these are being rapidly forgotten. The substitutes for their old-time foods are chiefly coffee, sugar, canned goods, and white flour pan-bread, with mutton or goat meat.²²

The Navajos' culture reflected the importance of herding. From 1868 to 1920 government agents encouraged the Navajos to increase their herds and thereby flourish. From 1870 to 1930 there was nearly an eight-fold increase in livestock along with significant human population growth—from 9,000 to 48,000—on the

reservation.²³ By 1933 it was clear to federal agents that land preservation and overgrazing were serious problems. The U.S. government's 1933 sheep reduction program was designed to control overgrazing, which was denuding the land of vegetation, and, according to government officials, causing erosion. The Navajos were promised extension of reservation boundaries, wages to compensate for income lost as a result of stock reduction, and irrigation projects to increase land resources for farming in exchange for stock reduction. Believing Commissioner Collier's promises, families complied, only to learn that the promises were hollow. Although Collier attempted to fulfill his promises, in general Congress did not cooperate; only a limited number of jobs were created, additional land was not made available, and, for the most part, irrigation projects did not materialize. Each Navajo was to sell ten percent of his herd. Federal regulations were modified to allow families who owned herds of under one hundred animals to replace disposed-of goats with sheep. However, local police often neglected to communicate this information. Small herders were told to relinquish a higher proportion of goats than of sheep. Many herds were reduced to below the subsistence level. Herd reduction caused especially severe harm to the poorer families who owned a small number of animals. The loss of goats meant the loss of the family's only milk source and, for the poorer Navajos, the loss of their basic meat source. Thousands who could not afford to purchase canned milk were without a milk supply. Goats were a subsistence animal, not a marketable commodity, and for this reason government officials were not able to understand the importance of goats to the Navajos' survival. The Navajos were paid one to three dollars per sheep and one dollar per goat. A dollar, even during the depression years, could not purchase commercial foodstuffs equivalent to one animal. Horses, which were a primary means of transportation into the early 1970s, resources for cultivating fields, and symbols of success, were rounded up and taken off the reservation or destroyed.²⁴ Hundreds of sheep and even more goats were driven into ditches and killed by government officials without giving the Navajos the opportunity to dry and store the meat.²⁵ Thus one problem (overgrazing) was exchanged for another (meat and other resource shortage). The subsistence diet lost its ample supply of animal protein and the minerals from organ meats, which had played a central role in the traditional

diet. Tuberculosis and other illnesses increased among children due, some believe, to inadequate protein and other nutrients from the loss of meat and milk supplies. In the 1950's Mrs. Annie Wauneka, once chair of the Navajo Tribal Council Health Committee, described some effects of the sheep reduction program:

I guess we had some diseases like TB before that. But it seems to me our basic food was taken away . . . all of a sudden. This exposed us to such diseases as TB. From then on the Navajos seemed to have insufficient food and seemed to find that they had TB and other diseases. Before that, we had sufficient food and it seems to me the diseases weren't as common as today.²⁶

Diet in the 1940s and the 1950s

Wholesale destruction of animals, unfulfilled promises, and increases in reduction quotas led to Navajo opposition to the government's continued efforts to reduce herds. The controversy between the Navajos and the federal government over land conservation and stock reduction continued into the 1950s, as did overgrazing. Considering that sheep and goats remained the Navajos' primary economic resource and that stock reduction meant changes in culture and lifestyle as well as in a family's economic status and security, the opposition to reduction was not surprising. Only limited alternative income opportunities in the form of wage work were introduced through New Deal programs. Paid work options increased during World War II as large numbers of Navajo men entered the military and took positions in war industries. Thus, the trend begun in the 1930s toward wage work in place of sheep herding was more evident in the 1940s. World War II jobs away from the reservation also meant adaptation to non-Indian foods. At the same time, compulsory education in the form of boarding schools and day schools introduced children to significant dietary changes.

With the end of the war, servicemen and war workers returned to a reservation where there were few economic opportunities. Some jobs were created through federal allocations for construction projects in the early 1950s, and fortunately, the discovery of

natural resources created additional jobs for tribal members and produced income for the tribal treasury. But given the decreased amount of sheep and goats and the large number of unemployed it is surprising that blatant nutritional problems were not more of an issue in the 1940s and 1950s. There are descriptions of the stark poverty suffered by small herders, especially those in the eastern patch-work sections of the reservation and some of the most isolated families living on the western end of the main reservation; however, no nutrition studies were conducted in the 1940s or 1950s in these sections of the reservation. This was the first time since imprisonment that some Navajo families were completely dependent on federal programs for sustenance.²⁷ Clearly, some families lost their land-based subsistence way of life which, through their ingenuity and hard work, had supported their families for generations. The extent to which traditional dietary practices continued, considering exposure to Caucasian food through off-reservation work and educational settings, is also surprising. Those who had stock continued to trade wool and sheep pelts primarily for food—specifically, sugar, coffee, and canned goods; in other words, the items they had traded for since trading began. These products constituted 68% of the Navajos' trade goods in 1940; clearly, their primary interests were not manufactured products.²⁸

A major nutrition study²⁹ was conducted by Darby and associates in the 1950s in two areas: Ganado, a more acculturated area on the Reservation, and Pinon, a more isolated area assumed to be less acculturated. The original plan to include a 24-hour recall of foods consumed was abandoned; instead the study team collected qualitative estimates of family food resources and use habits, interviewed professionals in the area regarding local diet, analyzed records of trading post purchases, and made a few visits to Navajo homes. The qualitative estimates of food consumption showed that a number of families lacked recommended levels of fruits and vegetables in their diets. Even these low estimates may have been inflated, failing to reveal the true extent of the deficiencies.³⁰ Two-thirds of the study population in Ganado and one-half in Pinon reported consumption of vegetables one to three times per week, with only 8.6% in Ganado and 3.6% in Pinon reporting daily consumption of green or yellow vegetables. Fifty percent of the Ganado families and one-third of the Pinon families ate fruit one to three times per week; 13% and 14%, respectively, reported daily consumption of fruit; and

3% and 30%, respectively, reported no consumption of fruit. Foods eaten daily were tortillas and other breads, coffee, sugary sweets, lard or vegetable shortening, potatoes, cereal such as oatmeal, and, for a majority, milk.

Approximately 60% in Ganado and 44% in Pinon ate meat daily; most of the remaining residents reported eating meat only two to three times a week.³¹ In a summary chart of daily estimated food consumption, Darby reported that a family of means had mutton or mutton stew and tortillas three times a day, plus cereal for breakfast; a moderately well-to-do family had mutton twice a day; and for indigent families, daily consumption was limited to potatoes and tortillas at every meal. Families did continue to eat most parts of the sheep.

Food was obtained from trading posts, from relatives, or from home gardens, although gardening was not a major food source. An analysis of 47 food purchases from local trading posts cannot give quantitative data on food actually consumed, but does reflect the foods that were available. Staples, again, were flour, coffee, cereals, sugar, and lard. Some Navajos also purchased canned milk, peanut butter, canned beans, and baked goods.

Continued use of some native plants was reported; however, the study team concluded that native plants had for all practical purposes been abandoned. Domesticated animals had replaced wild animals; wheat flour replaced corn meal; and coffee, commercial tea, and soda pop were widely substituted for native teas. As in the 1930s, blue corn was still in use, though not on a daily basis; very few families had home refrigeration; and drying and salting were common methods of food preservation for home-grown products.

There did not appear to be significant changes in the Navajos' daily diet from the 1930s through the 1950s. At the same time, in spite of a continued preference for the "traditional" mutton and fry bread diet, the later half of the 1900s saw decreasing reliance on mutton as well as on farming, and increasing food purchases. The unique geography of the land and a unique lifestyle, as well as their dietary traditions, affected the Navajos' transition from reliance on the land to reliance on commercial food products, stimulated by cross-cultural contacts. The Navajo traditionally live in isolated, extended family groups, often miles from their nearest neighbors. The great distances between these scattered groups makes procurement of commercial foodstuffs difficult. It is not unusual for a Navajo woman to walk 20 miles

each way to purchase food from the local trader. Traders stocked limited supplies of canned goods (less than the disappearing urban neighborhood store) and a few staples such as flour, sugar, and coffee; an urban 7-11 is a supermarket compared to most trading posts. Those without cash incomes relied on the high-priced trading posts because traders gave credit and dealt in pawn.³² Five population centers were established near Bureau of Indian Affairs agencies and schools and Indian Health Service medical facilities. Jobs and government housing attracted some Navajos to these five locales, but still, for a majority of the population, the closest stores were (and continue to be) the trading posts, which as a result determined in large part what people ate.

Diet of the Late 1960s

A second major nutrition study led by Rogers of the Department of Community Medicine of the University of Pittsburgh was conducted from December 1968 to January 1969 in the Greasewood area of the reservation.³³ Approximately 600 of the 800 Lower Greasewood Chapter members living in the area participated in the study. Unlike the study by Darby et al., Rogers stated that they actually collected 24-hour food recall data, but even so, this information was not included in the final report. Mutton and corn remained the diet staples in 1968. Most families continued to eat visceral meats and some native plants, such as wild spinach, onion, rhubarb, cactus and yucca fruits, and pinon nuts. On the other hand, dependence on external food sources had increased since the 1950s. Approximately half the children received all their meals at the boarding school, while the others ate lunch at the day school, and 53% of the study families were receiving surplus commodities through a program that had not been available on the reservation at the time of Darby's study. The surplus commodity program was introduced on the reservation in 1958 with four foods—flour, corn meal, rice, and dry milk. In 1965, the number of foods was increased from nine to 12 depending on whether the family lived in the New Mexico, Arizona, or Utah section of the reservation, and in 1971, when the Donated Food Program replaced the commodity program, 20 items were included. Additional foods included sugar, syrup, lard, peanut butter, dried beans, rolled wheat, and in some areas butter and cheese; limited amounts of canned products—fruits, juices, meat or chicken, and vegetables—and

macaroni, cereals, and dehydrated products. Total monthly food allocations could equal about half the family's food requirements. Calloway, Giaque, and Costa³⁴ substantiated that some of the commodity products were inferior to the natural Navajo foods they replaced as a regular part of the subsistence diet. They pointed out that the loss of minerals that occurred when natural products were replaced with refined commodity products possibly could be compensated for by a diet rich in animal foods; however, many families lacked adequate meat sources and therefore were forced to supplement the donated foods with refined cereals and fat (e.g., fry bread) and with protein from plant sources. But at least the commodities, like the trading posts, were relatively accessible. Only those families who owned vehicles could drive to off-reservation communities to purchase groceries of other kinds.

Familiarity with white culture and ability to speak English among the study population ranged from "almost none to a high degree."³⁵ Education ranged from no formal public or private education (35% of the 457 persons over age 20) to some post-high school education (6%). Approximately half of the 400 persons over 17 who were not attending school were employed part-time or full-time. Sixty-three of the approximately 350 families (18%) received Bureau of Indian Affairs or state financial assistance. Forty-four percent still lived in traditional one-room hogans. Electricity and therefore refrigeration were still uncommon (20-23%) throughout the area, and the primary mode of transportation remained horse-drawn wagons. Seventy-one percent raised some of their own food: 46% raised sheep, 41% grew corn, 30% had goats, 21% grew squash, 11% had cattle, 10% chickens, 6% raised beans, 5% potatoes, 4% eggs, and 2% yucca. Thus, many Navajos continued to live a subsistence existence; in general, unlike that of white America, the Navajo economy was in transition and was not a wage-based economy.

The first supermarket on the reservation opened in 1968 in Window Rock, Arizona, the capital of the Navajo Nation. By the mid-1970s, there were two additional large markets and several 7-11 stores. Efforts to establish food cooperatives on the reservation were thwarted because the co-ops, unlike the trading posts, did not allow credit buying or accept silver and turquoise jewelry as pawn, a practice necessary for families without full-time wage work to obtain commercial products. Thus, access to fresh foods was limited and, if purchased, they could not be

stored. As recently as ten years ago, 80% of the population still was without electricity and thus without refrigeration. Transportation and roads also continue to be problems for many Navajos, especially during the winter months. Trucks are highly valued and commonly are the first item purchased by families that have a wage income. In the 1980s, many families have access to modern transportation, but not on a dependably regular basis for all.

Contemporary Diet

The contemporary Navajo diet is almost as difficult to characterize as the diet of the general U.S. population. There are variations in dietary habits depending on income source, exposure to white American culture and adoption of their eating customs, transportation, geographical location, and individual preferences. Some Navajos continue to live primarily from the land, only purchasing such items as white flour, baking powder, and coffee and, to a lesser extent, canned goods, pop, and sweets, whereas other Navajos subsist exclusively on purchased food.

Today what many people mean by "traditional" Navajo food is a diet of mutton, white flour, and limited use of corn meal and native plants, but this "traditional" diet is actually that of the late nineteenth century, following establishment of the reservation. Hence, "traditional" is a relative concept: contact first with the Pueblos and then with the Spanish, followed by subsequent European immigrants, resulted in a series of revolutionary dietary adaptations continuing into the present. A non-traditional diet in the 1980s is a typical white American diet wholly dependent on commercial foodstuffs. Navajo families that have easy access to supermarkets and adequate wage incomes generally eat the transitional traditional foods only at special functions. Mutton stew and mutton meat cooked over a wood fire, blood sausage, the sheep's head and blue corn cake baked underground, melon when in season, fry bread, and blue corn meal mush continued to be served at Navajo curing ceremonies and at other special functions. These foods are relished by most, except those who have been taught to think of them as "backward," and opportunities to attend such functions are rarely missed. If families do not eat these foods daily, it is usually because they do not have immediate access to them or the time to locate and prepare them.

NUTRITION

Descriptions by Mrs. Annie Wauneka and elders interviewed by the Coolidges³⁶ attest to the healthiness and positive nutritional status of the Navajo during the early years of the reservation after the Navajo resumed some traditional eating patterns but nutritional status was not studied systematically until the 1950s. Two major nutrition studies, referred to earlier, were conducted on the Navajo Reservation: one in the early 1950s by Darby and the other in the late 1960s by Rogers. A number of small, topical nutrition studies also were carried out, and hospital records were reviewed for reports of nutritional disorders.

Considering their estimates of daily food consumption, I am surprised that the Darby study team saw only one blatant case of malnutrition—an elderly woman who lived alone. Probably Darby would have diagnosed more cases of malnutrition had he included pre-school children, and if the clinical studies had been conducted during the winter months when food was scarcest. Yet, his findings were consistent with records from a hospital serving the study area that reported 0.2% (112 out of 60,000) cases of malnutrition. On the other hand, the absence of clinical symptoms of blatant malnutrition does not mean that there are not dietary deficiencies that have critical effects on an individual's health.³⁷ Many such effects, e.g. dental problems, may not be reflected in hospital records.

Vitamin A levels were normal in most of the study population, which we can attribute to consumption of animal organ meats, a traditional practice. However, the majority of persons studied, especially Pinon as opposed to Ganado residents, had vitamin C levels below the normal range.³⁸ The most prevalent physical symptom was gingival lesions of the gums, yet individuals with low serum C levels were not necessarily those with gingival lesions; therefore the lesions may have been a consequence of poor oral hygiene and inadequate dental care rather than nutritional deficiency.³⁹ Darby compared heights and weights of the study population to Canadian standards and concluded that Navajo development was normal with respect to those standards. However, a re-analysis of his data, using U.S. (Iowa) standards, supported the conclusion that the Navajo suffered retarded height and weight development at that time.⁴⁰

According to Rogers, in the late 1960s clinical indicators of

specific nutritional deficiency were less common than those reported by Darby, with the important exception of thyroid enlargement; yet, lab reports showed that, even so, from 5% to 40% of the population was below National Nutrition Survey standards for some measures, including serum protein. In addition, the majority of children under one year of age and an even higher percentage of those under four years were below the 50th percentile in height compared to Iowa standards. Their report points out that:

The slower rate of growth and maturation observed in Navajos than in middle-class U.S. whites may be due in part or almost wholly to differences in nutrition. . . . Growth rate may be the crucial evidence of borderline malnutrition.⁴¹

Analysis of daily diet suggested "grossly inadequate" food intakes consistent with dietary etiology of growth retardation. Rogers concluded that the Navajos had better nutrition than they had had 15 years previously, based on comparison of his findings with those reported by Darby et al., but he did see a need for additional improvements nonetheless: ". . . all age groups might benefit from increased dietary iron, children and old persons from increase in total calories, and adults from increased protein and ascorbic acid."⁴²

Rogers and colleagues hypothesized that sanitary conditions, availability of water, family income, medical services, housing, education, and degree of acculturation were related to diet, and thus to nutritional status. But in investigating a number of variables (running water, refrigeration, indoor toilet facilities, ratio of number of rooms to number of family members, education of household head, per capita expenditure for food, and employment status), they found few significant correlations between these variables and individual clinical and biochemical nutritional measures in the hypothesized directions. A number of significant relationships were found that were opposite the hypothesized direction; for example, more children from homes with higher per capita food expenditures had weights below the tenth percentile than did those from homes with lower per capita expenditures. A study by Sarouranian⁴³ found no significant relationship between socioeconomic status and anemia, and McDonald⁴⁴ suggested that diet patterns may be more a consequence of the availability of foods and of cultural patterns than

of income alone. Clearly, the variables that many Americans think correlate with improved diet and better nutrition do not consistently apply to Navajos who are living on their own land. The effects of poverty on nutritional status can vary widely, depending on the nature of customs concerning foods and the available food options.

Although the two major nutrition studies did not find blatant malnutrition, hospital records do report cases of malnutrition. Two studies of the Tuba City Hospital records reported 44 cases of severe malnutrition—marasmus (calorie malnutrition) and kwashiorkor (protein deficiency)—between 1963 and 1967, and 17 cases between 1969 and 1973.⁴⁵ Tuba City, the population center for the western section of the reservation, serves some of the more isolated areas of the reservation, and was included in a 1960s CBS documentary, *Hunger in America*, as one of four areas where Americans were suffering from malnutrition. The Fort Defiance Hospital recorded 87 cases of nutritional deficiency between 1957 and 1967.⁴⁶ The federal food programs increased the availability of food on the reservation, but were not always an adequate substitute for the traditional diet nor a guarantee of good nutrition, though Van Duzen et al., in their 1976 report, attributed the decrease in diagnosed cases of malnutrition and improvement in height and weight gains between their two five-year studies of Tuba City Hospital records to federal food programs.

Topical studies that looked at a particular indicator of nutritional problems in limited population samples, such as comparative height and weight measures, skeletal maturation, age at onset of menarche, presence of infectious disease, vitamin C deficiency, and iron deficiency anemia, report the existence of either primary or secondary deficiencies, but sampling problems, conflicting evidence, and the complexity of establishing nutrition deficits do not permit strong conclusions about the extent of malnutrition.⁴⁷ Van Duzen et al. describe kwashiorkor and marasmus as examples of the synergism between nutrition and infection which is described by Gordon, Ishwari, and Chitkara as "weanling diarrhea."⁴⁸ In some cases, infection appears to dominate, and in other cases symptoms of malnutrition are more pronounced. French⁴⁹ found that breast-fed babies in the 1960s had a lower incidence of diarrhea and better weight gain in the first seven months than did infants weaned within six months of birth, as has been found in non-Navajo communities. She

reported that all infants declined in rate of weight and height gains after seven months of age. In 1968, approximately half the infants in one Navajo community were bottle-fed from birth and most infants were artificially fed by three months of age,⁵⁰ suggesting that malnutrition would be more prevalent in those infants. This is a clear case of departure from a traditional practice (breast-feeding) and promotion by non-Indian professionals of a substance (formula) detrimental to Navajo nutrition and health.

To determine whether, in general, increasing reliance on external food supplies led to deterioration of Navajo nutritional status, one would need comprehensive nutrition studies including dietary studies (analysis of daily food intake), clinical studies (physical examinations), laboratory (biochemical) analyses, and dental studies. Dental studies are often a key to the effects of dietary change on health, with processed and sugared foods leading to a remarkably high incidence of caries and tooth loss when introduced to certain populations unaccustomed to those foods.⁵¹ The Lower Greasewood study came close to reaching some aspects of this goal: quantitative estimates of daily food intake were collected; however, this diet information was not included in the written report, and comparison of clinical and biochemical analyses with actual diet was not described. Further, because it was not common to find low values of different nutrition measures for the same subjects, nutritional problems could not be substantiated clearly.

The puzzle is complex, and cannot be solved unless information on food intake is correlated with individual physical and biochemical findings. This same complexity makes it difficult to draw parallels between diet and/or nutritional status and other health indicators. The problem of relating diet to other health indicators such as disease prevalence and morbidity rates is discussed in the concluding section. The available clinical and laboratory data do not indicate a grossly inadequate diet, although estimates of daily diet suggest few sources of vitamins and minerals. Such deficiencies would surely have some negative health consequences but it also appears that the Navajo supplemented their basic diet of flour, lard, and meat to a greater extent than the published studies report. If they did, and if the diet supplements were traditional foods, these foods—as the next section supports—may well help account for the Navajos faring as well as they did nutritionally in the studies we've examined.

NUTRITIONAL VALUES OF FOODS AND FOOD PRACTICES

Dane and Mary Coolidge summarized the value of the early diet as described to them by Navajo elders in the 1920s:

The old men say they used to be taller and stronger than they are now, because they had abundant deer and antelope meat, corn, and a great variety of seeds and wild plants to eat. They used to have many corn dishes, flavored with wild onions and parsley.⁵²

Scientific studies support such claims about the nutritious content of traditional foods. Bee plant (or wild spinach, which is still gathered), yellow bee plant, sumac berries, Indian millet, blue corn meal, cooked blue corn meal mush, and Indian tea are good sources of vitamin C, B complex, and carotene,⁵³ and parsley is also high in vitamin C. Chili is an excellent source of vitamin C,⁵⁴ as is the fruit of the prickly pear cactus,⁵⁵ which is common on the reservation and can be preserved and stored.⁵⁶ Because the prickly pear was at one time a regular part of the traditional diet, in the past even the poorest Navajo family could obtain adequate amounts of vitamin C.⁵⁷ Now they would only need to be encouraged to return to such local plants. The highest energy values were in meats and in some seeds and berries; fry bread, beans, sunflower seeds, and bee plant contained the highest nitrogen levels.⁵⁸

Religious traditions encouraged the continued use of certain foods which biochemical studies have since proven to be nutritious. According to Navajo religion, some foods are "strong" and others are "weak"; mutton and corn meal, for example, are "strong" foods. Blue corn is believed to be "stronger" than white corn, and Hopi⁵⁹ blue corn (which is similar to, if not the same as, the corn grown by the Navajos) has higher amounts of all minerals than Hopi white corn. The ashes prescribed by religious tradition to be added to blue corn meal in the preparation of a ceremonial mush contain high concentrations of important minerals. It is considered better to make ashes from fresh plants than from dried ones and, since ashes made from fresh plants have higher mineral content than ashes made from dried plants,⁶⁰ this practice makes good sense nutritionally. The Navajo religious dictate that mothers eat blue corn meal mush for the first few days following childbirth to increase their strength is also nutri-

tionally sound.⁶¹ Thus to have encouraged the continuation of this practice would have been wise, even after the introduction of the federal food programs.

There are not, of course, biochemical analyses to support the nutritional value of every religious food practice of the Navajo. Any nutritional advantage of the religious taboos against fowl and eggs, for example, is beyond our current state of knowledge. On the other hand, there is *no* evidence that any religious dictate regarding food consumption was nutritionally deleterious. Traditionally, all parts of the sheep and goat were eaten, except the contents of the digestive tract, the bladder, gall sack, bones and hair, and the heart and third lobe of the liver, which were religious taboos. Biochemical studies consistently point out that consumption of the whole animal provides important nutrients. For example, organ meats contain needed vitamins and minerals. But the more acculturated (as measured by their acquisition of English) Navajos tend to ignore visceral meats.⁶² This is a clear instance of a move away from traditional diet causing the elimination of important nutrients and the neglect of a good source of vitamin A.⁶³ A diet rich in animal foods helped to compensate for the loss of natural minerals from vegetable and plant sources. Some Southwest Indians' old techniques for food processing and preservation were also found to be more nutritionally sound than those of white American culture. For example, after roasting, drying, and boiling, Hopi sweet corn contained 50% more nitrogen and potassium and two to eight times more of all the essential trace elements than is found in commercially processed corn,⁶⁴ though there is some question as to whether all those elements can actually be taken advantage of nutritionally.

Non-Indian Americans introduced to the Navajo canned or commercial food products and the concept of bottle-feeding infants. Navajos, having only canned milk available in trading posts, diluted that milk with water as a "formula" for infants. Bailey, in the late 1930s and Darby et al., in the 1950s,⁶⁵ found some infants were bottle-fed several months after birth with the canned milk "formula." The trend from breast-feeding to bottle-feeding was certainly not a beneficial one in Navajo lifestyle, considering the shortage of cash, the distances to commercial foodstuffs, the limited products stocked by traders, and the lack of home refrigeration. Further, there is a constant threat of infection from unsterilized bottles in communities where

modern conveniences are rare and modern methods of sanitation are either unfamiliar or not accessible. Studies conducted in countries that are not highly developed technologically describe a pronounced rise in malnutrition and infectious disease shortly after infants are weaned.⁶⁶ There is a strong rationale for breast-feeding, especially in cultures where food is scarce and modern conveniences are not common. It was not sensible for Indian Health Service doctors to support bottle-feeding to Navajo mothers, yet only recently did doctors begin to recommend breast-feeding—a return to reason and custom that has occurred too slowly in U.S. contacts with many traditional societies around the world.

The commodity food program, also introduced by the U.S. Government, was initiated on the reservation in 1958, and then replaced by the Donated Food Program in 1971. The foods supplied by these programs were listed earlier. Calloway, Giauque, and Costa compared commodity food products to similar foods produced locally. Both blue corn meal and white corn, heavily used traditionally, were superior to the yellow corn meal distributed through the commodity food program. All the nutritionally essential elements were much higher in the traditional blue corn. For example, blue corn contained twice the amount of iron found in the commodity product (distributed through the Donated Food Program) even though the commodity corn was "iron enriched." Bread made of blue corn meal and ashes contained three times the level of iron specified by federal enrichment standards for the breads and cereals that were now substituted for the traditional foods. In addition, the U.S. Donated Food Program offered only small amounts of animal foods and vegetables. "The poorer quality components of the American diet comprise the commodity offerings (also true of trading post food items); Americans compensate processing loss with high quality foods not included in the Donated Food Program."⁶⁷ But the Navajo of course lacked access to such high quality supplements, and thus they had only the less healthful components. Calloway, Giauque, and Costa agree that the Donated Food Program did not result in the Navajo having the diet they should and could have, concluding:

On the basis of the compositional data only, Arizona Indians appear to have a much better probability of

meeting mineral needs from locally grown and traditionally prepared plant foods than from an isoenergetic amount of most of the commodities that have been given. . . . Each substitution of milled and refined commodities for crude natural foods and traditionally prepared products must result in lowered mineral content of the Indian diet.⁶⁸

But the commodity program did increase the total amount of food available to Navajo people. This was especially important to them during the winter months. At times, heavy snow storms necessitate airlifting food to stranded families for them even to survive. Further, the commodity program was preferred to the Food Stamp Program in a nation where cash, transportation, refrigeration, and commercial, fresh food sources are scarce. The fact that commodities could be picked up at Chapter Houses greatly increased their availability, especially to families without modern transportation or cash incomes. National attention given to hunger in the 1960s resulted in additional federal food programs in the 1970s, such as the Infant Feeding Program, that increased the availability of nutritious foods to Navajo families. Also, federal funds were made available for tribal-run nutrition education programs. Tribal members demonstrated the use of commodity foods and, for the first time, there was formal program support for consumption of traditional foods (e.g., a wild spinach called the bee plant).

Nonetheless, the Caucasian American model—purchased food, purchased or donated processed foods, and bottle-feeding—is not clearly superior to the traditional Navajo diet in nutritional value. So, although relatively recent federal programs increased the availability of needed food, perhaps if more thought and more understanding at an earlier point in time had gone into the selection of foods to introduce to the Navajos, into which of their traditional foods to support, and into planning culturally consistent natural resource preservation, use, and development, even better nutritional results would have been obtained.

Conclusions and Areas for Further Thought and Study

The nutritional status of the Navajos is not clear and there is not one single study that answers all the questions about it, leav-

ing us with the arduous, sometimes confusing task of piecing together material from a myriad of sources. At the same time, it is clear that the Navajos' adaptations to the white man's foods and food sources were not as nutritious as the Navajos' original practices. Data substantiating the nutritional status of the Navajo prior to the appearance of Europeans is not available; therefore, it is not possible for investigators to determine quantitatively how Navajo nutritional status has changed as a result of white influence. However, there is evidence that the foods that constituted the early diet were nutritious. Nutrition studies in the 1950s, 1960s, and early 1970s found some evidence of secondary malnutrition and, to a lesser extent, nutritional deficiencies among the Navajo. Considering the basic diet of the Navajo during those years, it is initially surprising that even more deficiencies were not found. The pattern of slow change and of maintenance of some traditional practices may account for the relative good health of Navajos, especially those who had marginal incomes. Government programs in the 1960s and 1970s increased the amounts of food available, but contributed far less to the Navajos' nutritional status than was possible, and generally failed to build on the nutritional strengths of the traditional Navajo diet.

This paper describes as thoroughly as information and space permit the Navajos' diet from earliest records to current times, and integrates existing knowledge about the Navajos' nutritional status and the nutritional value of Navajo foods. Drawing clear, direct connections between diet and nutritional status proved to be far more difficult than originally predicted. Although several nutrition studies were conducted on the Navajo Reservation, little is actually known about the relationship between food consumed and direct biochemical and physical nutrition measures. As noted earlier, complete information on actual diet was not correlated with individual nutrition measures. I had hoped to relate diet and nutritional status to other indicators of health, including disease incidences, growth rates, and morbidity and mortality rates, however, this proved even more difficult than showing the relationship between an individual's diet and nutritional status, given the limited data and the problem of isolating the independent effects of diet from other factors that affect health status. Validity of health statistics prior to 1955, when the Indian Health Service was created, is questionable and disease incidence rates

are as undependable as the early census data on the Navajos.⁶⁹ Unfortunately, information about health for key transition periods, e.g., pre- to post-reservation and before and after the 1930s, is either not available or unreliable. When valid health statistics are available, substantiating relationships between health indicators and diet is complicated by the fact that changes in disease and mortality rates reflect a complex interaction of factors. In fact, improved health on the reservation is probably more often a function of higher quality, more comprehensive medical services and increased use of these services than of changes in eating patterns.

Although changes in diet—especially drastic, sudden changes, such as those experienced by the Navajos during the “Long Walk” and imprisonment—must have affected their general health, drawing cause-effect relationships or even parallels is generally not possible. Yet, there are some exceptions. Disease in infancy and growth rates, briefly discussed in the paper, are direct indicators of nutritional status as well as of general health. The other health indicators were not discussed, even though nutrition-related health problems such as heart disease, gall bladder disorders, and diabetes, originally relatively rare on the reservation, began to accelerate in recent years in actual numbers, if not in rates.⁷⁰ Age-adjusted death rates for heart disease on the Navajo reservation is one-third the U.S. rate and the incidence of heart disease actually decreased from 1972–3 to 1982.⁷¹ Kunitz thoroughly integrated existing information on the Navajos’ health from 1900 through the 1970s. Using available, often limited data, he analyzed the relative influence of multiple factors on changes in health. He concluded that the reverse in the 1940s of a trend of increased infant mortality rates from 1900 to 1940 is evidence of improved nutritional status, as well as of improved health care.⁷² Kunitz also argued that the prevalence of malnutrition declined from the 1930s to the 1960s and that some evidence suggests a decline from the 1950s to the 1970s.

For the most part, studies designed to assess the relationship between diet and specific disease incidences did not accomplish this goal. For example, Darby’s interest in studying Navajo nutrition was sparked by his hope of finding a relationship between the Navajos’ diet and their low incidence of cancer; yet he drew no conclusions about this relationship.⁷³ In the late 1950s, Fulmer and Roberts studied the Navajos’ diet as well as other fac-

tors, hoping to understand the low incidence of heart disease.⁷⁴ They could not explain the high level of animal saturated fat in relation to the low incidence of coronary heart disease and concluded that the relative absence of heart disease was due to the interaction of a number of factors of which diet was only one.

Disease incidences and ranking of causes of death on the Navajo Reservation continue to differ from the same measures for the U.S. as a whole. Some hypothesize genetic differences⁷⁵ and others suggest differences in lifestyle.⁷⁶ A number of puzzles and questions remain to be answered. It may well be that lifestyle differences such as more exercise explain the Navajos' ability to tolerate high levels of animal fat. Increased movement away from a subsistence economy toward a wage economy coincides with changes in health measures, as well as changes in diet.

It is clear that comparison of pre- and post-reservation dietary patterns indicates the reduction or elimination of foods rich in minerals and vitamins, and chemical analyses of traditional and contemporary foods substantiate the hypothesis that some native foods had superior nutritional value. It appears that the Navajos—without sophisticated knowledge about nutrition—had practiced good nutrition. As they began to use foods from another culture, nutritious foods became less available and the Navajos' lack of sophistication in this area became much more relevant. At the same time, lifestyle differences, as well as the continued use of some healthy foods, may explain why diet changes had less deleterious effects on nutrition and health than might be anticipated. The limited foods available on the Reservation through the army and then through trading posts continue to influence current eating patterns. The Navajos' common reliance on coffee, white flour, and sweets is a reminder of those times when foods were scarce and foods provided by non-Indian Americans offered negative models. One cannot but think that the imposition of ideas from outside the traditional culture interfered with the Navajos' traditional wisdom about good choices of diet. Failure of federal food programs to include or support the continued use of traditional foods undoubtedly contributed to the Navajos' reliance on less healthy foods and on unhealthy models from white culture. Federal food program deficits are indicative of insufficient knowledge of the value and wisdom of the Navajos' traditional diet and of insufficient respect for the need for autonomy and self-determination by the Navajo people.

NOTES

1. R. White, *The Roots of Dependency: Subsistence, Environment and Social Change among the Choctaws, Pawnees, and Navajos*, (Lincoln, NE: University of Nebraska Press, 1983).

2. Ibid.

3. J. Loh, *Lords of the Earth* (New York: Crowell-Collier Press, 1971).

4. *The Navajo Yearbook, 1951-1961: A Decade of Progress*, R. W. Young, ed. (Window Rock, AZ: Navajo Agency, Bureau of Indian Affairs, 1961).

5. F. H. Elmore, "Ethnobotany of the Navajo," *The University of New Mexico Bulletin* (Albuquerque: University of New Mexico Press, 1944).

6. F. L. Bailey, "Navajo Foods and Cooking Methods," *American Anthropologist* 42 (1940): 270-290.

7. Rabal ms., see W. W. Hill's entry in the Swanton volume, *Some Navajo Culture Changes During Two Centuries*, Smithsonian Miscellaneous Collections 100, 1940, cited in *American Anthropologist* 43: 485-587.

8. Letter of Gov. Francisco Cuervo y Valdes, written in Santa Fe on August 18, 1706, translated in C. W. Hackett, *Historical Documents Relating to New Mexico, Nueva Viscaya*, Vol. III (Washington, D.C.: Carnegie Institution Publ. 330, 1937), cited in *American Anthropologist* 43 (1941): 485-487.

9. The Franciscan Fathers, *An Ethnologic Dictionary of the Navajo Language* (St. Michaels, AZ: 1910).

10. T. M. Carpenter and M. Steggerda, "The Food of the Present-Day Navajo Indians of New Mexico and Arizona," *Journal of Nutrition* 18 (1939): 297-305; F. L. Bailey, "Navajo Foods and Cooking Methods," *American Anthropologist* 42 (1940): 270-290.

11. L. C. Kelly, *The Navajo Indians and Federal Indian Policy 1900-1935* (Tucson, AZ: The University of Arizona Press, 1968).

12. D. Coolidge and M. R. Coolidge, *The Navajo Indians* (New York: Houghton Mifflin, 1930), p. 273.

13. C. Kluckhohn and D. Leighton, *The Navajo* (Cambridge: Harvard University Press, 1946); M. Mitchell, *The Navajo Peace Treaty of 1868* (New York: Mason and Lipscomb, 1973).

14. *The Navajo Yearbook, 1951-1961: A Decade of Progress*, ed. R. W. Young (Window Rock, AZ: Navajo Agency, Bureau of Indian Affairs, 1961).

15. F. McNitt, *The Indian Traders* (Norman, OK: University of Oklahoma Press, 1962).

16. Carpenter and Steggerda, "The Food of the Present-Day Navajo Indians of New Mexico and Arizona," 297-305.

17. M. Steggerda and R. B. Eckardt, "Navajo Foods and Their Preparation," *Journal of the American Diabetic Association* 17 (1941): 217-225.

18. Bailey, "Navajo Foods and Cooking Methods," 270-290.

19. Carpenter and Steggerda, "The Food of the Present-Day Navajo Indians of New Mexico and Arizona," 297-305.

20. Bailey, "Navajo Foods and Cooking Methods," 270-290.

21. R. White, *The Roots of Dependency: Subsistence, Environment and Social Change among the Choctaws, Pawnees, and Navajos*, (Lincoln, NE: University of Nebraska Press, 1983).

22. D. Coolidge and M. R. Coolidge, *The Navajo Indians*, p. 273.

23. F. A. Pollock, *A Navajo Confrontation and Crisis*, (Tsaile, AZ: Navajo Community College Press, 1984).

24. Pollock, *A Navajo Confrontation and Crisis*, R. White, *The Roots of Dependency: Subsistence, Environment and Social Change among the Choctaws, Pawnees, and Navajos*, L. C. Kelly, *The Navajo Indians and Federal Indian Policy 1900-1935* (Tucson, AZ: The University of Arizona Press, 1968).

25. G. Boyce, *When the Navajo Had Too Many Sheep: The 1940s* (San Francisco: The Indian Historian Press, 1974).

26. K. Deuschle, "Tuberculosis among the Navajo: Research in Cross-Cultural Technologic Development in Health," *American Review of Respiratory Diseases* 8 (1959): 202; S. J. Kunitz, *Disease Change and the Role of Medicine: The Navajo Experience* (Berkeley, CA: University of California Press, 1983), presents some evidence that cases of tuberculosis and influenza and pneumonia were related to poor nutrition.

27. White, *The Roots of Dependency: Subsistence, Environment and Social Change among the Choctaws, Pawnees, and Navajos*.

28. Ibid.

29. W. H. Darby, C. G. Salsbury, W. J. McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian," *Journal of Nutrition* 60 (1956), Suppl. 2.

30. Navajos are hesitant to tell interviewers what they eat; this is personal information. Moreover, Navajos are aware that their diet differs from the diet of the majority of white Americans and may assume the non-Indian interviewer will perceive their diet as inferior and, therefore, they are likely to be hesitant to reveal their usual, actual diet practices.

31. Darby, Salsbury, McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian."

32. Ibid.

33. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and the United States Public Health Service, Indian Health Service, *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*. The Lower Greasewood study was originally planned to be a pilot study; however, the more comprehensive study was never undertaken. The Lower Greasewood Chapter was chosen because: 1) it was part of the Fort Defiance Service Unit (though located 75 miles from the Fort Defiance Hospital); 2) an Indian Health Service Clinic had recently been opened in Lower Greasewood, providing a place to do the clinical studies; and 3) the population was considered at risk due to their relative isolation and to the poor land resources.

34. D. H. Calloway, R. D. Giauque, and F. M. Costa, "The Superior Mineral Content of Some American Indian Foods in Comparison to Federally Donated Counterpart Commodities," *Ecology of Food and Nutrition* 3 (1974): 203-211.

35. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*.

36. D. Coolidge and M. R. Coolidge, *The Navajo Indians*.

37. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*.

38. Rogers, in critiquing Darby et al.'s (1956) findings, pointed out that while this does not establish deficiency, it clearly does not rule it out (Department of Community Medicine 1969).

39. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*.

40. Ibid.

41. Ibid., pp. 80-81. Comparison of height and weight growth rates of a study population to population norms, such as the Iowa growth standards, is generally thought to produce the most reliable information on nutritional status obtainable from physical examinations. Heights that indicate growth rates below the normal ranges according to repeated measures of the same subjects is often an indication of secondary malnutrition, especially among pre-school aged children. Other useful but less reliable measures are birth weight and infant morbidity and mortality rates. For additional information on measures of nutritional status see P. L. Jackson, "Effect of malnutrition on growth of the pre-school child," in *Pre-school Child Malnutrition: Primary Deterrent to Human Progress*, National Academy of Science, National Research Council, International Conference on Prevention of Malnutrition in the Pre-School Child, Washington, D.C., 1964 (Washington, D.C.: Government Printing Office, Publication 1282.)

42. Ibid, p. 81.

43. G. Sarouranian, "Preliminary Report of Anemia in Navajo Children," unpublished 1958 report of the Navajo-Cornell Field Health Research Project, Many Farms, Arizona.

44. B. McDonald, *Nutrition of the Navajo*, 2nd ed., unpublished monograph (Window Rock, AZ: USPHS, Division of Indian Health, June 1965).

45. J. Van Duzen, J. Carter, P. H. John, B. A. Secondi, and C. Federspiel, "Protein and Calorie Malnutrition among Preschool Navajo Indian Children," *The American Journal of Clinical Nutrition* 22 (1969): 1362-1370; J. Van Duzen, J. Carter, P. H. John, and R. Zwagg, "Protein and Calorie Malnutrition among Preschool Navajo Indian Children: A Follow-up," *The American Journal of Clinical Nutrition* 29 (1976): 657-662.

46. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*. Hospital records are not reliable sources for substantiating cases of malnutrition for the following reasons: 1) they contain only primary and secondary diagnoses; 2) they vary with the diagnostician's familiarity with syndromes, the scope of the examination, and the awareness of the doctor regarding nutritional problems—an area not emphasized in most medical school curriculums; and 3) hospital records reflect only the experience of those Navajos who use medical facilities.

47. See Department of Community Medicine, 1969, for a summary of these studies. The unpublished monograph by B. McDonald, *Nutrition of the Navajo*, also summarizes some studies conducted on the Navajo Reservation including some investigations on the relationship between diseases and nutrition.

48. J. E. Gordon, D. Ishwari, and M. B. Chitkara, "Weanling Diarrhea," *The American Journal of the Medical Sciences* (1963): 129-161.

49. J. G. French, "Relationship of Morbidity to the Feeding Patterns of Navajo Children from Birth through Twenty-Four Months," *The American Journal of Clinical Nutrition* 20 (1967): 375-385.

50. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*.

51. See, for example, studies on the Eskimos such as G. L. Baker, "Nutritional Survey of Northern Eskimo Infants and Children," *American Journal of Clinical Nutrition* 22 (1969): 612-616.

52. D. Coolidge and M. R. Coolidge, *The Navajo Indians*, p. 273.

53. Carpenter and Steggerda, "The Food of the Present-Day Navajo Indians of New Mexico and Arizona," 297-305; Bailey, *Navajo Foods and Cooking Methods*, 270-290.

54. E. Lantz, H. Gough, and M. M. Johnson, "Nutritive Values of Some New Mexico Foods," *Bulletin* 379, 1953, Agricultural Experiment Station.

55. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*.

56. F. H. Elmore, "Ethnobotany of the Navajo," *The University of New Mexico Bulletin* (Albuquerque: University of New Mexico Press, 1944).

57. Darby, Salsbury, McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian."

58. Carpenter and Steggerda, "The Food of the Present-Day Navajo Indians of New Mexico and Arizona," 297-305.

59. The Hopi Indians who inhabited the Southwest before the Navajo, continue to live on mesas located within the geographic boundaries of the Navajo Reservation.

60. Calloway, Giauque, and Costa, "The Superior Mineral Content of Some American Indian Foods in Comparison to Federally Donated Counterpart Commodities," 203-211. Carpenter and Steggerda, "The Food of the Present-Day Navajo Indians of New Mexico and Arizona," 297-305; Bailey, *Navajo Foods and Cooking Methods*, 270-290. Bread made of blue corn meal and ashes contained three times as much manganese, 35 times as much calcium, and twice the amount of iron, zinc, and copper as that found in blue corn meal alone and the bread contained three times the level of iron specified for bread by federal enrichment standards (Calloway, Giauque, and Costa (1974). Another study also found that blue corn purchased on the Navajo Reservation had higher mineral content than white corn (Lantz, Gough, and Johnson 1953).

61. Darby, Salsbury, McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian."

62. Department of Community Medicine, University of Pittsburgh; The National Nutrition Survey; and *The Nutrition Survey of the Lower Greasewood Chapter, Navajo Tribe, 1968-69*.

63. Darby, Salsbury, McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian."

64. Calloway, Giauque, and Costa, "The Superior Mineral Content of Some American Indian Foods in Comparison to Federally Donated Counterpart Commodities," 203-211.

65. Bailey, "Navajo Foods and Cooking Methods," 270-290; Darby, Salisbury, McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian."

66. National Academy of Science, National Research Council, International Conference on Prevention of Malnutrition in the Preschool Child, *Preschool Child Nutrition: Primary Deterrent to Human Progress* (Washington, D.C.: Government Printing Office 1964). Publication 1282.

67. Calloway, Giauque, and Costa, "The Superior Mineral Content of Some American Indian Foods in Comparison to Federally Donated Counterpart Commodities," 203-211.

68. *Ibid.*, p. 209.

69. A number of sources describe the limitations of vital statistics data on American Indian populations. See, for example, *Indian Population in the U.S. and Alaska 1910* (Washington, D.C.: Government Printing Office, 1915) and C. A. Hill, Jr. and M. I. Spector, "Natality and Mortality of American Indians Compared with U.S. Whites and Non-whites," *HSMHA Health Reports* 86 (1971): 229-246.

70. S. J. Kunitz, *Disease Change and the Role of Medicine: The Navajo Experience* (Berkeley, CA: University of California Press, 1983).

71. U.S. Congress, Office of Technology Assessment, *Indian Health Care*, OTA-H-290 (Washington, D.C.: U.S. Government Printing Office, April 1986).

72. S. J. Kunitz, *Disease Change and the Role of Medicine: The Navajo Experience*.

73. Darby, Salisbury, McGarity et al., "A Study of the Dietary Background and Nutriture of the Navajo Indian."

74. H. S. Fulmer and R. W. Roberts, "Coronary Heart Disease Among the Navajo Indians," *Annals of Internal Medicine* 59 (1963): 740-764.

75. *Ibid.*, for example.

76. Kunitz, *Disease Change and the Role of Medicine*.