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DILEMMAS OF DEVELOPMENT IN SOUTH ASIA

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It was perhaps no accident that chess originated in India. Chess is a game of almost infinite combinations of moves, and strategies for play. No one player can know and foresee every possibility of every conceivable game. The game is played with a few types of chessmen organized into a hierarchy of importance. A few simple rules organize the chessmen into an exceedingly complex system. Because of its complex simplicity chess has remained much the same for centuries, while never failing to intrigue, stimulate, and challenge the mind of novice and grand master alike.

India is a country of seemingly endless variability and complexity. The constitution of India recognizes fourteen languages, and the Indian census records over sixteen hundred mother tongues. India's religions include Hinduism, Islam, Sikhism, Zoroastrianism, Buddhism, and Christianity. Its people live in groups, called castes, whose number is said to be over three thousand, and its population is now over 680 million.

India, too, is a land of great contrasts. Bullocks draw hand-hewn wooden plows alongside noisy Russian tractors; potters turn wheels and weavers work looms in the shadow of atomic energy plants and modern steel mills; and urban squatters live in gunny sack shacks in the backyards of palatial high rises inhabited by rich industrialists and bankers.

Rule of Hierarchy

Hierarchy means that all things in the phenomenal world—gods, animals, metals, and humans—may be ranked according to their inherent qualities. Indians categorize human beings into castes (jatis), groups that are unequal, separate and different but related in terms of relative rank in a system. Relative ranking is expressed in terms of the concepts of purity and pollution, a language for talking about differences between groups of people and other things, just as color is a language for talking about putative differences among social categories in the United States. The rule of hierarchy, expressed through the language of purity and pollution, is fairly simple, but its implications for the way in which Indians think and behave are many.

Because each caste (jati) is understood to be different in inherent quality, (jatiharma), the moral character and behavior of each is expected to be different. Behavior is in part a function of inherent quality. A Rajput not only has an inherent quality to rule, but also a predisposition to aggressive behavior, as well as to eating meat and drinking liquor. In this sense truth (satya) may be multiple and vary by time, place, and especially caste. India, then, has great tolerance for social differences and great capacity to integrate them. To be an Indian is to be a particular kind of Indian; to be an American is to be everyone American.

Differences among castes (jatis) in inherent moral qualities, make mixing of their qualities through marriage, or through giving and taking of things especially food, undesirable. Members of a jati generally marry only other members of the same jati.

Foods differ in the quality of purity and pollution that they carry. Raw food such as grains, vegetables, and unpeeled fruits are least polluting and may be accepted by all; palka food or food cooked in clarified butter remains pure when exchanged among castes of the same relative rank; kachcha food, or food boiled in water may be accepted only from one of the same or very close rank; and jhut food left over from the plates of others is so polluted that only the lowest untouchables will accept it.
themselves. Thus, a Brahman from a south Indian jati, whose food and language are quite different from that of a north Indian Brahman, can, upon moving to New Delhi, find acceptance as a Brahman, not as an Untouchable.

Finally, the varna theory provides not only a model of reality, but also a model for reality. Following the rule of interdependence the many castes in an Indian village have been organized into a coordinated and cooperative system, often called the jajmani system. In Indian villages various caste members, called kinsmen work for landowners called jains. For example, the carpenter provides tools and plows; the washerman washes the jain's soiled clothes; the potter provides cooking and drinking vessels; the leather worker tans hides and labors in his jain's fields; and the priest officiates at rituals for his jain's family.

In return for these goods and services, the jain oversees the farming of his land, and gives harvest grain and other gifts to his kinsmen. The harvest share is generally at a traditionally assigned rate varying according to caste rank rather than labor done. The higher castes most often receive more and the lower castes less. The jain and his clients generally are bound to one another through inherited ties. Each of the client castes also provides political support for their jain as well as ritual services at various ceremonies. The system, then, is economic, ritual and political at the same time.

**Consequences of the Caste System**

The caste system has had profound consequences for the Indian way of life. One consequence is emphasis on the group rather than the individual. A person's identity and place in Indian society are very much given to him through his inherent jati quality. Socially jati quality is more important than one's qualities as an individual.

Another consequence is centuries long perdurance of the system and its inequalities. The system has survived because it has worked successfully. This is so despite repeated invasions, rule by colonial powers, and recurrent famines, droughts, and natural disasters. Indians are not so quick to tear things down and forget traditional ways. They have a healthy respect for their tradition and culture, especially in village India where eighty percent of the population lives. Americans are, perhaps, too quick to criticize India's living working tradition as a dead weight from the past.

The final and perhaps most important consequence of the caste system is replication (Moffat 1979). The rules of hierarchy and interdependence are fairly simple, yet in every Indian village they allow the caste system to replicate itself whether there be twenty jatis or two. India's languages may be many, its jatis thousands, but the rules and the system they create are easily replicated throughout the continent. The ease of replication enables the tremendous diversity of South Asia to exist within a single set of rules. The system replicates itself not only in villages but also at regional and often statewide levels. The landowning castes in a region also tend to become the dominant caste in that region. In traditional India politics and power were largely a matter of dominace within the regional caste system.

In summary, the caste system at the village level provided a means of exploiting the land for the survival of all, the enrichment of some, and the exploitation of others. It created a division of labor for the inheritance and maintenance of various skills vital to the village economy, and it organized these skills into an interdependent whole or society. It further provided a locus of authority in the landowner and legitimated his authority through the varna theory ritually reinforcing theory through village festivals and ceremonies. Finally, it offered a religious explanation for origin of society and a justification for its hierarchical organization.

**Peasant Pragmatism and Population**

The Indian villager living in the caste system has not only a healthy, often fearful, respect for the authority of the dominant caste and his jain, but also a deep knowledge of nature. Living close to the land the villager knows the various kinds of soils and their potentialities. He knows when to plant, weed, fertilize, and irrigate, and what are the different varieties and possibilities of seeds for a single crop.

To the Westerner the cow is often seen as a parasite on the Indian landscape. Yet the villager knows that the cow's dung is the most important source of fertilizer for his fields and, when dried, is an important source of fuel to cook his meals; its tanned hide can be fashioned into shoes and sandals; its
themselves in many forms and incarnations and are graded in a hierarchy from the benevolent and powerful to the malevolent and demonic (as are the devils in Christianity). Some, such as Lord Krishna, are especially beloved and Indians pay him great devotion (bhakti). In the sacred book, the Bhagavad Gita, Krishna gives advice for proper living. Many Indians read, or hear it recited, and take solace and inspiration from its deeply spiritual message, the quintessence of which is found in book 11 verse 30, “He who does My work, who is devoted to Me and loves Me, who is free from attachment (to worldly things) and from envy to all beings goes to Me, Son of Pandu” (Edgerton 1972).

Life in India, as elsewhere, is full of hazards, obstacles, unforeseen events, and the paradox of disorder in a seemingly orderly universe. Generally the monsoons come and bring a bountiful harvest, but occasionally they fail and the spectre of famine raises; women bear children and in life survives, but sometimes a woman dies in childbirth or a child is born still; one man is successful and becomes wealthy, but another who works just as hard remains penurious. In such situations the Indian prays to his gods for help and solace in adversity, for good fortune in the future, and for guidance in uncertainty. Sometimes the gods possess and speak through men, just as the Holy Spirit through his gifts might do for the Pentecostal Christian today and as the voice of god spoke through his prophets in the Old Testament. Miracles are possible, because god exists.

Religion and belief in heaven, then, add a dimension of meaning and a sense of purpose to Indian life. Yet the Indian is not blind to scientific explanation. Indeed, most Indians are as ready to accept a modern medical cure to disease as are most Americans. But modern medicine can only explain how diseases are caused in general, it cannot explain why a certain person contracted a particular disease at a particular time in his life. Religion supplies the reason why. Indians are “resigned realists,” they accept the pleasant, as well as the unpleasant, realities of life and give them meaning in their religious cosmology (Babb 1975:245).

The law of karma is perhaps one of the least understood and most misunderstood ideas of Indian religion. Karma, the result of an individual’s good and bad deeds in his past life, determines his state of life and fortune in this life. Thus, it is said that Indians accept with fatalistic resignation all that happens to them in this life, because they are powerless to change it; karma determines it. But karma plays little part in the ordinary Indian’s life and is usually involved, if at all, in post facto explanations of unpredicted events, much as a Christian in similar circumstances might say it was “God’s will.” Most Indians are much concerned with the present and the future. They seek the favor of the gods to make life auspicious and predictable, and to avoid punishment for misdeeds.

Many Indians feel that there is justice in the world and that the gods watch over it. The rich may oppress the poor, and the merchants may cheat the innocent, but then out of the blue the rich man suffers disaster and the merchant disgrace. Even the mighty are vulnerable before the justice, if not the wrath of the gods. Thus, dharma for the ordinary Indian means right, correct, moral conduct, that may bring merit (punya). Not to show proper respect for one’s parents, or to cheat or rob another is sinful (papa). Religion not only provides meaning for life and rules for moral conduct, but also offers models for behavior and food for the imagination. After Lord Rama’s banishment from his kingdom, his wife Sita, followed him into exile and served him faithfully. Even after abduction by the wicked Ravana, she remained pure and faithful to her husband. Today she is the model of nobly conduct for Indian women. Hanuman, the monkey god, was also Rama’s devotee and followed him through thick and thin. Hanuman, a celebrate but most athletic god, is the patron of wrestlers who seek to imitate his Spartan way of life.

Religion, too, is perhaps the major source of recreation and edification in India. In a village scarcely a day passes without some religious ceremony. (Indians probably spend no more time in religious ceremonies, than Americans do in watching TV, and going to sports events.) Sometimes these ceremonies unite all villagers of all castes in honor of the village deity and in reaffirmation of their bonds to one another as a village unit. At other times, people visit pilgrimage centers such as Benares, Hardwar, Mathura or Madurai where after worshipping the god and seeking his blessings, they enjoy sights of the town and the attractions of the bazar. Indians believe that if death comes in a sacred pilgrimage center, such as Benares, then they will directly achieve salvation. Often, after a hard days work, devotional hymns (bhajans) are sung. Even the illiterate villager relishes the poetic fancy and colorful imagery of these hymns; indeed, Indians of all classes and castes are connoisseurs of the verbal arts. In bhajans Indians
and economic equality must be created before legal equality can be realized. It also implies that granting of legal equality alone does not eliminate the problem. Most importantly, the policy of protective discrimination departs from the nineteenth century liberal notion that advancement must be on the basis of individual merit assuming that equality of opportunity exists. Protective discrimination moves toward a notion of social equality through unequal treatment of socially disadvantaged groups (Katzenstein 1980).

The policy of protective discrimination is threefold. It consists of elected political offices, preferential employment, and educational benefits. Concerning elected political offices, the constitution mandates that one in seven seats in the central and state legislatures be reserved for members of the Scheduled Castes. In a reserved constituency only untouchable candidates, regardless of party, may stand for election, although electors are from both Scheduled Caste and non-scheduled castes. One problem with reserved seats is that the majority of Scheduled Caste people live outside of reserved central and state level constituencies. Thus, non-scheduled caste legislators represent the majority of Scheduled Caste people, while a small minority of non-scheduled caste people find that they must turn to a Scheduled Caste legislator for assistance. In 1977 only two Scheduled Caste candidates were elected to Parliament from general constituencies, few if any Scheduled Caste candidates would be elected.

Reservation of seats in the legislatures is, then, the most important part of the protective discrimination policy, because without it, untouchables would have little or no voice in government and all other policies to help them would probably disappear. The initial ten year mandate for reserved constituencies has been renewed three times since its inception, indicating once again India's commitment to finding solutions to the problem of untouchability.

In terms of education, the protective discrimination policy provides tuition, books, and sometimes meals at the state level, and mostly college scholarships at the central government level. Scheduled Caste literacy increased from 10.3 percent in 1961 to 14.7 percent in 1971 (Joshi 1979). The program has resulted in the creation of a cadre of educated untouchables willing to represent and fight for untouchable rights. Many have also been helped to get and keep better jobs.

Finally in terms of employment, the policy reserves positions in the central and state civil services for untouchables in proportion to their population in the nation and the various states. This arm of the policy has worked to some extent, but mostly at the lower clerical and service levels. Untouchables are still greatly underrepresented in the higher level administrative jobs, while they are scarcely employed at all in the private sector.

An Uncertain Future

Protective discrimination exists against the great resistance, resentment, and hostility of the non-scheduled castes. In recent years reported atrocities against Scheduled Castes have greatly increased, despite new laws for their protection. The problem is difficult. The government feels that it is moving as fast as it can without tearing the nation apart; the untouchables feel that it is moving much too slowly. Nevertheless, 90 percent of India's untouchables live in rural areas where discrimination is greatest and government protection weakest. In 1964, 34 percent of rural untouchables were landless agricultural laborers, while in 1971 they were 52 percent (Joshi 1979). This seems to indicate a worsening of their condition.

In some regions of India, untouchables have become enlightened, politically conscious and politically active. The Mahars of Maharashtra and the Jatavs of Uttar Pradesh are politicized and devoted followers of the late Dr. B.R. Ambedkar, a great untouchable leader. Dr. Ambedkar studied abroad earning a doctorate from Columbia University and a law degree from London University. Prime Minister Nehru made him the First Minister for Law in India and in this capacity Ambedkar was largely responsible for drafting the Constitution of free India. Today untouchable Ambedkarites reverence him as the Father of the Constitution. In 1956 just before his death, Dr. Ambedkar converted to Buddhism as a protest against the inequalities of Hinduism. Buddhism in Ambedkar's version was an indigenous Indian religion of equality. Many untouchables have followed Dr. Ambedkar in this path. In following his teachings, they feel that they are fighting for the rights guaranteed to them by the Constitution.

Just as untouchable castes have become more politicized, so too have non-untouchable castes. Castes in India, like ethnic groups in the U.S.A., have become like vote banks forced to compete with one
zamindars, slowly concentrated landownership in their hands. According to Kusum Nair, in 1947 before independence, "57 percent of the privately owned land was under the zamindari system and highly concentrated in the hands of a few zamindars. In Uttar Pradesh, for example, 1.49 percent of zamindars owned nearly 58 percent of the land" (Nair 1979:195).

Many zamindars were not from traditional agricultural castes, so they preferred to be absentee landlords, leaving cultivation of their land to tenants or laborers. Their only interest was collection of rents not improvement of land or increase of agricultural production.

After Independence India tried to do away with this system and each state passed its own laws abolishing zamindari landlords. To date the new laws have been unsuccessful, and distribution of land to poorer laborers and tenants has been nugatory. Significantly the laws still uphold the right to private ownership of land. Some zamindars have retained their lands and avoided legal limits on land ownership through such maneuvers as putting their land in the names of relatives. Others have evicted their tenants, even though they had been holders of traditional rights in tenancy.

Castes, who in return for traditional services had hereditary rights to a share in the harvest from their{jagman}, have been slowly reduced to wage laborers paid in cash. Their position is now worse than it was under the traditional caste system. In some states, such as Punjab and Rajasthan, the local dominant agricultural castes have been able to wrest the land from the zamindars, but this has not improved the condition of the laboring and service castes. Today landowners also prefer to go to nearby cities where they can buy mass produced factory goods rather than use goods made locally by the service castes.

While the rule of hierarchy remains to separate and rank castes, the rule of interdependence in the caste system has begun to wither and be replaced by a cash nexus with a market economy. The chess game has become a monopoly game in which the basic rule is that money can buy power through the private ownership of land. Additionally, many of the state legislatures are controlled by the dominant landowning castes. They have been reluctant to tax themselves, so agriculture remains a highly privileged and protected sector of the economy; it contributes little surplus capital for development.

The government of India has also made great efforts to increase agricultural production through extending irrigation facilities, expanding fertilizer production, making credit more easily available, and improving the quality of seeds. High yielding varieties of seeds, particularly wheat, have created what is known as the "Green Revolution" in India. An important result of the Green Revolution and other development programs concentrating on production is that distribution of wealth has suffered. In search of efficiency under laws that favor private ownership of property, landholdings have become larger, tractors have replaced human labor, and profit has become the only motive. This has tended to exacerbate the results of zamindari abolition and increased the army of landless laborers, many of whom come from the Scheduled Castes. The growth of industry, while great, has not been sufficient to absorb the growing army of unemployed. Thus, progress for the few has increased poverty for the many.

India, then, while respecting private ownership of property and encouraging increased production to feed its growing population, is faced with the dilemma of doing this at the cost of increased pauperization of the masses whose condition it is also committed to improve. As a democracy, India has found difficulty in balancing respect for individual rights, such as private ownership of property, against needs of social justice, such as a living wage, an adequate diet, and security in old age for all citizens.

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A USE-WEAR ANALYSIS OF SEDALIA LANCEOLATES: 
THE LOW-POWER APPROACH

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Over the last twenty years microwear analysis has been used with varying degrees of success to determine the functions of prehistoric stone tools. A successful microwear study should look at the microscopic wear patterns not in isolation but as a resource to be used in conjunction with information gleaned from the morphology of the tool and from the archaeological situation of which the tools are a part. Although the particulars continue to be debated, use-wear analysts agree that several types of wear are generated by tool use. The utility of each type of wear in contributing to the determination of stone tool function is largely dependent on the type of laboratory equipment available to the analyst. Microwear analysts have concerned themselves with four types of use wear: striations, polish, rounding, and scarring.

Types of Use-Wear

In his seminal study of use-wear on lithic tools, Semenov (1964) was concerned primarily with the linear patterning of striations on the used portions of tools which regularly reflect the kinematic motion of the hand, thereby indicating the direction of the movement used in working with the tool (Semenov 1964:16-21). Keeley (1980; Keeley and Newcomer 1977), using slightly higher magnifications than Semenov (up to 400x), has relied on distinctions between types of polish generated on stone tools by working different materials. Particular polish types are described in terms of the amount of light reflected (i.e., brightness or dullness), roughness or smoothness, and by distinct topographical features such as the presence or absence of pits or undulations (Keeley 1980:22-23). For example, polish generated by woodworking "is very bright...and is very smooth in texture. The polish surface, once it becomes visible, is very rarely a flat plane but is commonly gently curved or dowed on the high points of the microtopography...When the polish is intense, after prolonged use, it will show gentle undulations on its surface, with the lines of the "troughs" and "crests" running in the general direction of use" (Keeley 1980:39).

In relying on polish for the determination of stone tool functions it is necessary to make a clear distinction between abrasion and microwear polishes (Keeley 1978; 1980). Microwear polishes result from materials softer than the raw material of the stone tool being worked under pressure against the tool, whereas abrasion is the result of a material as hard as or harder than the stone from which the tool is manufactured coming into contact under pressure with the tool. Abrasion is more highly reflective than any kind of microwear polish other than sickle gloss. Abraded portions of a tool are often accompanied by "parallel-running deep tracks and sometimes have the appearance of being 'gouged' out of the flint surface" (Keeley 1978:167).

The distinguishing features of polish types (e.g., hide polish or bone polish) are visible only with high magnification (beginning at around 200x). Under low magnification the only distinction that can be made is between matte polish and "true" polish. The differences in these two types of polish are simply relative differences in intensity. Matte polishes appear flat or dull while "true" polishes appear highly reflective with a greasy or smooth texture (Brink 1978).

Rounding, which is also referred to as abrasion or smoothing, is a fine attrition or a wearing down of the rock surface through the gradual removal of fine particles or single grains, the truncation or smoothing of grains, or a powdering of a portion of the tool while in contact with another object...The physical observation of rounding rests upon the recognition of a reduction in angularity, especially at edges and along the ridges of flake scars and other protrusions" (Brink 1978:47).

The type of use damage most commonly observed by analysts using low power magnification (up to 50x) is microfracturing (also called microscarring (Odell 1975) and microscarring (Tringham et al. 1974)). Two aspects of scarring are used to elicit information concerning tool function: the frequency of particular types of scarring and the patterns of these scars along an entire edge or used surface (Brink 1978; Odell 1975). Types of microscarring are generally distinguished by their shape, size, and depth (Brink 1978; Keeley and Newcomer 1970; Keeley 1980; Odell and...
Eight of the ten implements in the study sample were manufactured on coarse white Burlington chert. The remaining two tools were manufactured on heat treated Grimes Hill chert. In its natural form Grimes Hill chert is superior in quality to the white Burlington chert. There is little difference in the amount of pressure required to fracture natural and heat treated coarse white Burlington chert. However, when finer grained varieties of Burlington chert, such as that of the Grimes Hill formation, are heat treated, less force is required to fracture the materials (Rick 1978:45-46). When coarse white Burlington chert is heat treated, its color is altered to a pale pink and there is only a small increase in reflectivity (Rick 1978). The colors of heat treated Grimes Hill chert are vibrant and vary from deep pinks and oranges to yellows and browns. Heat treated Grimes Hill chert is highly reflective, taking on a fluid-like luster (E. Boesch, pers. comm.). The Grimes Hill chert may have been heat treated for one of two reasons. Firstly, the workability of the raw material would have been enhanced. However the morphological appearance of some of the tools manufactured on the coarse white Burlington chert is equal in quality to that of the heat treated Grimes Hill specimens. Perhaps the manufacturers of these tools heat treated the Grimes Hill chert to increase its aesthetic qualities by bringing out its vibrant colors and fluid-like luster.

Method: The Low-Power Approach

Microwear analysis was performed using a low power (7-30x) binocular microscope with incident light. That is, the analysis was conducted using what is referred to as the “low-power approach.” The study specimens were scanned at 7x. Identification of scar types was made with magnifications between 20x and 30x. In the descriptions which follow, the parts of the tools are identified according to the terminology set forth by Tixier (1974) (Figure 2). The ventral surface is the planar surface which was attached to the core. It is evidenced on the Sedalia lanceolates by a slight bulge which is the cone of percussion. The other surface is the dorsal surface. On two of the Sedalia lanceolates in this study the ventral and dorsal surfaces are indistinguishable. In these cases the surfaces are arbitrarily numbered (1) and (2). Although the tapered end of the Sedalia lanceolates was sometimes formed at the end of the blade which bears the bulb, i.e., the proximal end according to Tixier, for the sake of consistency in the descriptions which follow, the tapered or pointed end will be called the distal end and the opposite end will be called the proximal end. The right edge and left edge are defined when looking at the dorsal surface (if this is unidentifiable, when looking at surface (1)) with the proximal end downward.

Observations

83.2/487 (Figure 3): This specimen is the distal portion of a Sedalia lanceolate manufactured on heat treated Grimes Hill chert. The proximal portion and the tip of the distal end were broken off prehistorically.

The ventral surface of the right lateral edge is lined with piles of medium and large hinge scars running parallel to and slightly away from the edge. On the ventral surface of the left lateral edge there is a pile of small hinge scars and a pile of two large hinge scars near the distal tip, and a few isolated medium and small hinge scars near the protrusions on the edge. The ventral surface is marked by a few large shallow hinge fractures, while the bulging dorsal surface is marked by several large deep hinge fractures.

Because the heat treated Grimes Hill chert is shiny, no polish of any kind is visible at low magnifications. Rounding is isolated to a small number of protrusions on the lateral edges of the tool and to one ridge near the edge of the ventral surface.

83.3/404 (Figure 4): This is the proximal portion of a Sedalia lanceolate. It is flat with no obtrusive protrusions. The distal end was broken off prehistorically. There is recent damage in the form of a large notch knocked out of the right edge of the dorsal surface.

The left lateral edge of the dorsal surface is marked by a preponderance of clusters of small hinge scars in all of the small indentations. The same types of clusters are also evident in a few places on the left lateral edge on the ventral surface. The right lateral edge on the ventral surface is battered in two places and shows a few small and medium hinge fractures. There are several large hinge scars on the highest portion of the ventral surface. On the dorsal side of the proximal edge there are a couple medium hinge fractures and several clusters of small and minute hinge fractures running parallel to the edge.
material are shiny. In the center of the ventral surface the lithic material is rough and grainy; on the highest ridges of a large protrusion on the central axis a matte polish is discernible. On the edges of the left lateral corner of the proximal end there is also a defined matte polish.

Rounding is evident along most of the dorsal surface of the left lateral edge, but only on the protrusions on the ventral surface of the same edge. Protruding portions of the distal tip are rounded. The raised bulbous area in the center of the ventral surface is well-rounded as are the long large ridges which run parallel to both lateral edges.

83.2/418 (Figure 9): There is recent damage to this otherwise intact Sedalia lanceolate in the form of a large step flake knocked out of the distal tip. The pressure flaking used to manufacture this tool produced remarkably jagged edges.

The depressions on the ventral surface in the bulging portion of the left lateral edge are marked by large hinge scars with smaller hinge, step, and feather scars in the depressions left by the hinge flaking. The jagged right lateral edge displays hinge and step fractures on the ventral side beginning at the central portion of the tool and continuing down to the proximal end of the tool. The dorsal surface of the right lateral edge is marked by hinge scars of all sizes and configurations beginning near the distal tip and extending to about 2 cm from the proximal end. The dorsal side of the bulging portion of the left lateral edge is marked by large and medium hinge scars parallel to and slightly back from the edge. The proximal edges which angle inward toward the proximal end show large and small hinge scars parallel to the edge. There are a few medium and large hinge and step scars on both surfaces near the proximal end. There are two large hinge scars at the distal tip. The bulbous portions of the ventral surface are marked by large hinge and step scars.

The raw material of this tool is fairly smooth and shiny. Therefore the matte polish does not appear as developed as on the tools made on rougher material. There are fewer protrusions and ridges on this tool's surface for the worked material to have rubbed against. A light matte polish is visible on most of the arrises defining the large manufacture flake scars.

Rounding is emphatic on the protruding portions of the lateral edges of the proximal end of this implement. Protruding portions of the central portions of the lateral edges are also rounded. The large bulbous area in the center of the ventral surface is rounded as are the most pronounced ridges on both surfaces of the proximal third of the tool.

83.3/467 (Figure 9): This is a complete Sedalia lanceolate made of heat treated Grimes Hill chert. It is remarkably flat and smooth. The manufacture scars are fluid-looking and rippled.

The most distal protrusions of both lateral edges exhibit hinge and step scars of all sizes on the ventral side. Lateral edge scarring on the dorsal surface consists mainly of large hinge and large step scars. There are three piles of medium hinge scars near the most convex portion of the left lateral edge. The distal tip of this tool is flat and thick, not pointed. There is a cluster of small hinge fractures in the center of the distal tip. There are medium and large step and hinge scars on both sides of the proximal end.

Because the heat treated raw material is fluid-looking and shiny, no polish of any kind is discernable at low magnifications. Rounding is found on the protrusions of the jagged edges, particularly on the proximal third of both lateral edges and the proximal edge itself. It is of note that there is rounding on a small section of both lateral edges on protrusions slightly above the midsection of the tool. There is also distinguishable rounding on the thin left corner of the distal end.

83.2/515 (Figure 10): This is a complete Sedalia lanceolate. There is recent damage in the form of large hinge scars on the left side of the ventral surface near the proximal end of the tool.

Use scarring on the lateral edges consists mainly of hinge scars. On the left lateral edge of the dorsal surface scarring begins about 2 cm from the distal tip and continues all the way to the proximal area. On the right lateral edge of the dorsal surface scarring begins about .3 cm from the distal tip and continues to about 2.5 cm from the proximal end. The area on the right lateral edge which is not scarred is slightly incurvate. There is more scarring on the right lateral edge than the left lateral edge on both surfaces. The scarring on the ventral surface of the right lateral edge is isolated to ridges on the
distinguishable on seven specimens, is always in the form of matte polish. Although the matte polish is most developed on proximal edges and surfaces, raised central axes, and the bulging central portion of excursive edges, it often extends over large portions of the tools' surfaces. Most of the protrusions of the jagged lateral edges and most bulging areas on the tool surfaces are rounded. The proximal ends of the tools are all rounded on both lateral edges, corners, and the proximal edge itself. The only parts of the proximal ends of the tools which are not rounded are incurvate or indented portions of the edges and depressed areas of the surfaces.

Mode of Use of the Sedalia Lanceolates

From the patterns of use-wear observed on these Sedalia lanceolates it seems apparent that they were used as hafted knives. The notion in which a tool was used is indicated by the distribution of flake scars on the surfaces and edges of the implement. When inferring the method of use, the general shape and size of the tool must also be considered. When cutting or sawing any material with a two-way movement, scarring occurs on both surfaces of the edge that is used (Keeley 1980; Odell and Odell-Vereecken 1980; Tringham et al. 1974). If the tool is used enough, rounding will become evident, first on projections and then on extensive areas contiguous to the edge (Odell and Odell-Vereecken 1980). Polish will develop on both surfaces of the edges. The effect of the macroscopic morphology of the implement is such that edge curvature prevents uniform continuous contact between the working edge of the tool and the worked material. The result is an uneven degree of use damage along the edge of the tool (Tringham et al. 1974).

Sedalia lanceolates were used in a two-way movement and were held at a roughly ninety degree angle to the material being worked. More succinctly, the Sedalia lanceolates were used as knives.

Hafting

When an implement is hafted it is logical to conclude that polish and rounding will develop on the portions of the tool in contact with the hafting. No matter how firmly a tool is bound, it will move around in the hafting. This rubbing against the hafting will generate both polish and rounding on the hafted portion of the tool. In addition, if the tool bumps up against a hard handle, whether the handle is made of wood, bone, or antler, scarring will occur on the tool. Extrapolating from the extensive rounding and matte polish observed on the proximal ends of the Sedalia lanceolates, and the flake scars apparent at the proximal edges of the tools, it is likely that the proximal ends of the Sedalia lanceolates were inserted into hard handles and bound with a softer material (Figure 13).

Material Worked

The question remains of what material these Sedalia knives were used to cut. Although Brink (1978) claims success in distinguishing specific worked materials with low magnifications, most microwear analysts have found that observation with low magnifications allows only the distinction of broad categories of worked materials based on relative degrees of hardness of the worked materials (Keeley 1980; Odell and Odell-Vereecken 1980; Tringham et al. 1974). Odell and Odell-Vereecken (1980) and Tringham et al. (1974) distinguish the following patterning of use damage according to hardness of the material worked. Working soft materials produces scalar shaped shallow feather scars. If the tool was used long enough, polish will be apparent. Working hard materials generates medium and large step scars. Polish and rounding do occur but are frequently removed by the heavy scarring. Once the working edge is stabilized, however, rounding does occur. Working materials of medium hardness (i.e., woods (Tringham et al. 1974); woods, fresh stalks, soaked antler, fresh bone (Odell and Odell-Vereecken 1980)) produces hinge scars characterized by finely abraded edges.

Most of the use scars on the Sedalia knives are hinge scars with worn down (abraded) overhangs. In
Keeley, L.H.

Kealey, L.H. and M.H. Newcomer

Klippel, W.E.

McElrath, D.L. et al.

Odell, G.H.

Odell, G.H. and F. Odell-Vereecken
1980 Verifying the reliability of lithic use-wear assessments by 'blind tests': the low-power approach. Journal of Field Archaeology 7:87-120.

Rick, J.W.

Semenov, S.A.

Tixier, J.

Tringham, R. et al.

Turner, R.

Witthoft, J.
Figure 5. 83.2/421

Figure 7. 83.2/486

Figure 6. 82.2/643

Figure 8. 83.2/418
<table>
<thead>
<tr>
<th>#</th>
<th>Right Lateral Edge</th>
<th>Left Lateral Edge</th>
<th>Distal</th>
<th>Proximal Edge</th>
<th>Proximal Center</th>
<th>Distal</th>
<th>Proximal</th>
<th>Dorsal</th>
<th>Ventral</th>
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<td>n/a hinge rounded</td>
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<td>hinge</td>
<td>n/a crushed hinge rounded</td>
<td>hinge n/a</td>
<td>n/a crushed hinge rounded</td>
<td>abraded(?) abraded(?)</td>
<td>abraded(?) abraded(?)</td>
<td>abraded(?) abraded(?)</td>
<td>abraded(?) abraded(?)</td>
</tr>
<tr>
<td>83.3/403</td>
<td>battered hinge rounded</td>
<td>battered hinge rounded</td>
<td>hinge</td>
<td>n/a hinge rounded</td>
<td>n/a hinge rounded</td>
<td>n/a hinge rounded</td>
<td>n/a hinge rounded</td>
<td>n/a hinge rounded</td>
<td>n/a hinge rounded</td>
</tr>
<tr>
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<td>hinge rounded</td>
<td>hinge</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
</tr>
<tr>
<td>83.2/418</td>
<td>hinge step rounded</td>
<td>hinge step rounded</td>
<td>hinge</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
<td>hinge rounded</td>
</tr>
<tr>
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<td>hinge</td>
<td>hinge</td>
<td>hinge rounded</td>
<td>hinge</td>
<td>hinge rounded</td>
<td>hinge</td>
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<td>hinge</td>
</tr>
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<td>rounded hinge rounded</td>
<td>hinge</td>
<td>hinge</td>
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<td>hinge</td>
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<tr>
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<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
</tr>
<tr>
<td>83.2/457</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
<td>hinge</td>
</tr>
</tbody>
</table>

Table 1. Summary of location and type of use-wear on each Scolicia lanceolate.
A. boisei material from the Omo provides the earliest and latest record of the robust australopithecines. Specimens originating from MB. E of the Shungura Fm. (Howell 1978) date to the interval between Tuff E (4.2.4 Myr) and Tuff F (2.36 +/- 0.05 Myr) (Brown et al. 1983). Additional material from older Omo sediments, including the type specimen of Paraustralopithecus aethiopicus" (Arambourg and Coppens 1967, 1968) may also belong to the A. boisei hypodigm. Thus, WT 17000 confirms the late Pliocene presence of the A. boisei lineage as early as 2.5 Myr, although this datation should offer no surprises given the suggestive material from the Omo. Grine (1985:154) claims the presence of A. boisei in Mbs. D-G and L of the Omo Shungura Fm., a temporal span of ca. 4.5 to 1.0 Myr.

The Australopithecus robustus sample comprises specimens from Swartkrans (Broom 1949; Brain 1976), and Kromdraai, South Africa (Broom 1938; Vrba 1981). Lacking sediments conducive to radiometric techniques, Swartkrans and Kromdraai have proven difficult to assess temporally. Using biozonal correlation of cercopithecids, Delson (1984) placed the australopithecine-bearing member (Mb. 1) of Swartkrans into the time frame of 2.0-1.75 Myr., and Kromdraai B into a later time slot of 1.75-1.5 Myr. Vrba (1982) found the Kromdraai B fauna "ambiguous" and cautiously assigned an age range of 2.0 to 1.0 Myr, believing this site to be slightly older than Swartkrans Mb. 1, dated to between 1.8 and 1.5 Myr.

Even before the discovery of WT 17000, the apparent temporal range of A. robustus fell completely within that of A. boisei, and A. boisei material already established temporal antecedents to the southern African robust australopithecine record (Figure 2). It is worth noting that known time ranges for species stand vulnerable to revision with intensified field efforts, and therefore cannot be thought of as equivalent to the actual time of existence. For this reason, phylogenetic reconstruction should avoid primary reliance on the element of time.

Systematics

Classification: Taxonomic assignment of WT 17000 should follow one of two options: placement within the species Australopithecus boisei, or designation as a new species unit within the A. boisei lineage. Walker et al. (1986) weighed each alternative without making a formal commitment to either one.

As discussed above, WT 17000 shares a number of characteristics with A. boisei, especially in facial morphology and position of the solar danum relative to g. massetek (see Rak 1983). Most of the "primitive" features of WT 17000 may be highly variable in expression (e.g., the posterior fibers of g. temporalis, cranial capacity, subnasal prognathism. The hypodigm of A. boisei could, then, be expanded to accommodate WT 17000, treating the "primitive" features of WT 17000 as acceptable new intraspecific variants.

If the combination of characteristics exhibited by WT 17000 proves unique and outside an acceptable range of variation for A. boisei, then the allocation of WT 17000 to a new taxon is valid. Walker et al. (1986) and others (Johanson 1986; Johanson and White in Bower 1987) recognize an apparent distinctive morphology in WT 17000, and favor the species designation "Australopithecus aethiopicus," after Paraustralopithecus aethiopicus Arambourg and Coppens, 1967.

A number of problems were noted in reviewing the initial discusant papers on WT 17000. These problems are addressed to clarify methods of classification and phylogenetics for students of hominin systematics.

(a) The use of species names in isolation (e.g., "afarensis" but not "Australopithecus afarensis" or "A. afarensis") when referring to a species unit is an unfortunate shorthand practice that violates the spirit and letter of the principle of binomial nomenclature (International Code of Zoological Nomenclature 1985). Lucas (1986) has called attention to common errors of this type in nomenclature syntax, and recommended precise usage to avoid ambiguity.

(b) Determining the relationships of WT 17000 through the use of cladistic methods has been troubled thus far by an unfamiliarity or uncertainty with that methodology. Especially symptomatic is the confusion of the role that "primitive" characteristics play in relationship construction, and the comparative listing of hominid traits that are then considered "primitive" or "derived" partly on the basis of the temporal position of the taxon. Transformation of phenetic comparison into more rigorous cladistic analysis requires sorting of homoplasy from homology, and then further sorting of homologies into morphoclines. This remains to be satisfactorily accomplished for early
number of adaptations for powerful chewing, apparent even at 10 (+/- 2) years of age (Rak and Howell 1978). These features include: extreme overlap of the temporal squamae on the parietals, determined by the condition of the striae parietals; marked prominence of the inferior temporal and superior nuchal lines (anticipating a compound temporo-nuchal crest in the adult stage); coarseness of the nuchal plane and prominence of tori and protuberances. The anticipated adult form foreshadows the later adult male A. boisei crania of the Pleistocene (e.g., OH 5; KMN-ER 406).

(e) No reasons exist for continued acceptance or use of the name "Australopithecus aethiopicus" (Arambourg and Coppens, 1967) for the isolated Omo mandible (Omo 18) from Unit C-9 of the Shungura Fm. The specimen preserves a robust corpus with wide extra-molar sulci, roots of most of the dentition, strong superior and inferior transverse tori, and evidence of considerable size reduction in the canine-incisor region. The ram is missing. Arambourg and Coppens (1967) diagnosed the specimen as a new genus and species (Paraustralopithecus aethiopicus) on the grounds of its combination of characters differing from all other congeners of the same (australopithecine) group. Howell (Howell and Coppens 1976:525) states that "dimensions and proportions contrast with robust australopithecines and are most comparable with homologues from Sterkfontein) or A. africanus."

However, the preserved morphology of Omo 18 departs significantly from the A. africanus condition. The very small size of the incisors and canines (contra Howell in Howell and Coppens 1976), the massiveness of the corpus, dimensions of corpus height and width, the inferred molar and premolar sizes, the strong expression of transverse tori, and the deep, large genioglossal fossa support alignment of the specimen with A. boisei. The small size of the mandible and its V-shaped internal mandibular contour resemble the condition in KMN-ER 1482 (Figure 3). Because of their small size relative to large A. boisei mandibles (e.g., KMN-ER 729 A; Penin), both the Omo 18 specimen and ER 1482 have been misdiagnosed (see Wolpoff 1980:162). Both specimens are small in corpus height and width at MB, and in other dimensions, when compared to mandibles in the A. boisei hypodigm (Figure 4; Table 1). However, in robusticity (corpus width/height x 100 at MB; Table 1), ER 1482 and the Omo mandible fit well within the A. boisei range. A. boisei is known to be a highly sexually dimorphic taxon (e.g., KMN-ER 406, male, versus KMN-ER 732, female, crania). Both Omo 16 and ER 1482, in overall morphology and robusticity, can be accommodated with A. boisei as female specimens.

Because the morphology of the Omo 18 mandible does not differentiate the specimen from A. boisei (see Howell 1978), and because of the inadequacy of using a fragmentary, toothless mandible as a type specimen, it is recommended that Paraustralopithecus aethiopicus Arambourg and Coppens, 1967 (and hence "Australopithecus aethiopicus") be abandoned. The senior name, Australopithecus boisei (Leakey, 1959), has priority and is morphologically appropriate for Omo 18.

WT 17000 may be a new form of robust australopithecine; however, it is advisable to employ a name other than "A. aethiopicus" in any formal designation of the specimen into a new taxon.

Phylogenetic Trees: The most striking repercussion of the discovery of WT 17000 has been the extensive revision of early hominid phylogenetic trees, and the attendant re-thinking of the pattern of ancestry and descent of these hominids.

It must be cautioned that any construction of phylogenetic history remains speculative (and perhaps wishful) until basic analysis of the polarity of character states, clade determination, and alpha-level taxonomy is accomplished.

A review of the new phylogenetic trees, revised to account for WT 17000, reveals details similar to all of them: (1) A. africana is recognized as the stem ancestor, from which all other hominid lineages ultimately proceed; (2) WT 17000 is placed as the basal member of the A. boisei lineage; (3) A. boisei and A. robustus are no longer considered lineally related, but as co-evolving in parallel.

The position of A. africanus remains in contention, as either the ancestor to A. robustus (Johanson 1986), or ancestral to the Homo-lineage (Delson 1986); this debated point highlights the intractability of addressing phylogenetic position in the absence of comparative sorting of character states.

Rak's (1983) model of the genesis of hyper-robust facial architecture, via evolutionary transformation of facial structures in the sequence A. africanus-A. robustus-A. boisei, appears to have suffered summary dismissal by many. Removal of A. robustus from the ancestry of A. boisei relies on the arguments that A. robustus was too recent and too derived (relative to WT 17000) to have produced A. boisei as a descendant.
Bishop, W.H., A. Hill, and M. Pickford

Boucot, A.J.

Bower, B.

Brain, C.K.

Broom, R.

Brown, F.H., R. McDougall, T. Davies, and R. Maier

Darwin, C.

Delsol, E.

Eldredge, N.

Eldredge, N. and J. Cracraft

Gowlett, J.A.J., J.W.K. Harris, D. Walton, and B.A. Wood

Grine, F.E.

Howell, F.C.

Howell, F.C. and Y. Coppens

Ride, W.D.L., C.W. Sabrosky, A. Bernardi, and R.V. Melville (eds.)

Isaac, G.L.

Johanson, D.C.

Johanson, D.C. and T.D. White
Figure 1. Distribution map of robust australopithecine sites.
Om=Omo; ET=east Lake Turkana; WT=west Lake Turkana;
C= Chesowanja; P=Peninj; O=Olduvai Gorge; S=Swarthkrans;
K=Kromdraai

Figure 2. Known temporal ranges for australopithecine taxa.
Ar=Australopithecus robustus; Ab=A. boisei; Aa=
A. africanus; A afa=A. afarensis; star=WT 17000
<table>
<thead>
<tr>
<th>Taxon and Specimen #</th>
<th>Symphysial Height</th>
<th>Corpus Height at HZ</th>
<th>Corpus Width at HZ</th>
<th>Robusticity Index H/H x 100</th>
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<tbody>
<tr>
<td>A. boisei</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>KNN-ER 729A</td>
<td>46.3 mm</td>
<td>44.2 mm</td>
<td>28.9 mm</td>
<td>65</td>
</tr>
<tr>
<td>Peninj</td>
<td>47.7</td>
<td>36.8</td>
<td>29.5</td>
<td>80</td>
</tr>
<tr>
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<td>--</td>
<td>50.5</td>
<td>34.0</td>
<td>67</td>
</tr>
<tr>
<td>KNN-ER 801A</td>
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<td>39.4</td>
<td>28.6</td>
<td>73</td>
</tr>
<tr>
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<td>--</td>
<td>e.42.3</td>
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<td>70</td>
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<tr>
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<td>30.9</td>
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<td>32.8</td>
<td>28.4</td>
<td>87</td>
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<tr>
<td>KNN-ER 1482</td>
<td>34.0</td>
<td>e.28.1</td>
<td>e.20.8</td>
<td>74</td>
</tr>
</tbody>
</table>

"A. aethiopicus"

Ono 18             | 35.0             | 33.0                | 26.0               | 79                          |

A. robustus

Sk 12              | 46.0             | 37.0                | 34.5               | 93                          |

Sk 23              | --               | 35.7                | 25.0               | 70                          |

A. boisei range, robusticity index= 65-87
\[ \bar{X} = 82.4 \]

Table 1. Selected mandibular corpus measurements for robust australopithecines. KNN-ER=Kenya National Museum, East Rudolf (Turkana); Sk=Swarthrans; e.=estimated. All measurements taken from casts. See: Fig. 3
organizational characteristic of Pueblo thought. Moreover, because this was "the dominant idea of Zuni culture" and as such affected all aspects of Zuni life, Cushing posited that it would be evident in the archaeological record. Further, he thought that through examination of other archaeological data this concept would be found to be common to all sedentary tribes in Western America (Cushing 1888:151; Mark 1980:111).

Emil Haury's Evaluation

In 1945, Emil Haury reexamined the Expedition's field notes and the artifacts recovered during the excavations. Widespread attention was again directed toward Cushing and his role in the Expedition. Trained at a time when speculation and social historical reconstruction were considered anathemas in American archaeology, Haury severely criticized the Honorway Project. He ridiculed Cushing's "working hypothesis," his premise that earthquakes had destroyed Los Nortes, and his hypothesis that a class system accounted for the differences in material culture in associated house remains (Haury 1945:3).

Despite Haury's disdain, these ideas are not preposterous. Earthquakes have been recorded in the Southwest; and the communal effort necessary for irrigation and canal building has long been thought to require a ranked social organization (Willey and Sabloff 1980:151). Cushing supported this contention through examination of mortuary remains and use of direct analogies with the Zuni. He distinguished a cremation-inhumation dichotomy in the mortuary remains. He proposed that the few who were buried inside "temples" were of a higher rank than those found outside the communal dwellings. Higher ranked burials contained intact grave goods including "paraphernalia of a sacerdotal character" while lower ranked cremated remains were associated with punctured or broken cooking pots or drinking bowls (Cushing 1888:172-174).

Cushing explained the presence of punctured vessels by analogy with the Zuni custom of killing vessels to release their souls. He claimed that medicine men were buried with intact grave goods because they were purportedly able to control the vessels' power. However, some children were buried inside high status "temples" with broken vessels. Cushing explained this discrepancy by saying that while the child was of high rank, his grave goods were broken because he had "not been sufficiently initiated to understand fully the use of his supposedly semi-inherited occult powers" (Cushing 1888:174).

Here Cushing can be seen as a transitional figure in the history of archaeology. At an early date he recognized that burial treatment varies with individual social status and he speculated as to how such status was assigned in a society. In so doing, he attempted to explain the presence of broken grave goods through the use of ethnographic analogy. However, Cushing's explanations were later proved invalid when the differences in burial practices were attributed to the presence of two separate cultures, the Mohokaw and the Pueblo (Haury 1945:3). It may be that Cushing was so thoroughly grounded in the traditional view of the unilinear evolution of culture, that he could not see that two cultures had existed contemporaneously.

Even so, the working hypothesis stated in "Preliminary Notes" (Cushing 1880) is remarkable for its supposition that the Zuni, like the Victorians, imposed a certain order on every aspect of their lives. If Cushing believed that each society is organized around its own principles, then he came close to renouncing the nineteenth century concept of culture as a virtual synonym for civilization. He approached the more modern usage that defines culture as a way of life, as something internalized, integrated and relative. In fact, it was in "Preliminary Notes" that Cushing used the noun "culture" in the plural for what may have been the first time (Mark 1980:109-112). The use of the plural term cultures aided the destruction of the notion of unilinear evolution, because it emphasized that each culture had a history and customs of its own.

In his review of "Preliminary Notes," Haury (1945) never acknowledged Cushing's anachronistic use of culture. This oversight can be attributed to the atheoretical attitude prevalent among archaeologists during the early twentieth century. Like others working after 1914, Haury was not concerned with analyzing Cushing's ideas about the nature of culture or the testing of ethnological premises. Rather, he concentrated on material objects; his hypotheses dealt with "taxonomic and temporal relationships and seldom with more intricate cultural inferences" (Taylor 1954:567).

As concern with establishing accurate chronology became archaeology's dominant strategy, Haury and his contemporaries stressed care and exactitude in field procedures (Willey and Sabloff 1980:127). Haury
label and analyze the entire collection..." he died before he could accomplish this aim (Gilliland 1975:5).

There may be other explanations for the many unidentified artifacts and the gap in the records. Many of the field reports appear to have been lost. Gilliland acknowledges that there are no existing reports recorded by the field secretary, Irving Sayford, and that fully one half of the correspondence from the field is missing. Moreover, there are repeated references to what may be a lost final report. Cushing and others refer to the "more than 1000 closely typed pages of manuscript" on Key Marco, some of it with accompanying illustrations and half of it ready for publication. Gilliland hopes that this will be found among the papers of Wells M. Sawyer in the National Anthropological Archives (Gilliland 1975:24; cf. Green 1980:32).

The lack of detailed recording by the expedition may also be attributed to the difficult field conditions. The task of digging "inch by inch and foot by foot, horizontally through the sump and rich lower strata, standing or crouching while in puddles of mud and water" (Gilliland 1975:185, quoting Cushing) must have made adherence to the site's grid system difficult. Maintenance of a strict sense of stratigraphy was probably impossible. However, there is evidence that Cushing did use a loose kind of stratigraphic description; the location of some objects is identified as 'the first relic bearing stratum' or 'second relic bearing stratum' (Gilliland quoting Cushing 1975:26). It is likely that Cushing defined each stratum not by arbitrary measurements--as would most early archaeologists--but by visibly separate levels. He described the characteristics of several strata to reporters:

The entire tract...was overgrown with a heavy forest of mangroves, and overlaid with a uniform covering of black spongy peat some two feet in thickness. Underneath this in turn was a stratum of peaty, foul-swelling tremulous, blue-gray marl, more and more solid as the depth increased until at about five or six feet below the surface in the center of the basin, it merged into a compact mass of tough blue clay (Cushing 1896 quoted in Gilliland 1975:18).

The most important reason for the expedition's lack of systematic description may be attributed to the state of the discipline in 1896. Given the late nineteenth century theoretical stance of a universal culture that moved through progressive stages (Hinsley 1981: 28-29), it was unnecessary to document and analyze details of artifact provenience and association. Stratigraphy was largely ignored because specific chronologies and small-scale culture change were considered unimportant within the larger evolutionary scheme. Sites were excavated for the collection of artifacts, not for examination of context. This emphasis in research remained unchanged until Boas demolished the concept of unilinear evolution and pointed out the errors of speculative historical reconstruction (Stocking 1974:1-20).

Walter Taylor's Review

In a paper on Southwestern archaeological history and theory, Walter Taylor (1954) does not simply focus on Cushing's most outlandish errors and greatest weaknesses. Taylor's explication is more insightful than those which simply work with Cushing's data because he explains the views of the archaeologist within a historical frame of reference. However, Taylor's final analysis of Cushing is somewhat limited; because the scope of this paper lies in Southwestern theory, Taylor relies entirely on the Hemenway Expedition for his examples. Nevertheless, his account of the theoretical underpinnings of archaeology during the period from 1880 to 1910 is well worth repeating to better understand Cushing's adherences to and breaks from late nineteenth century concepts of culture.

Taylor (1954:561-575) notes five major characteristics that stem from the belief in unilinear evolution:

1. The objective to connect living Indian peoples with their archaeological antecedents.
2. The failure to recognize the multiphyletic nature of the archaeological evidence. Observed differences were considered of little importance or attributed to environmental factors working upon a single, unitary culture.
3. The lack of concern with temporal distinctions and the concept of time in general.
4. The effort to obtain only spectacular and artistic objects for collection.
5. The lack of formal, academic, anthropological
inaccurate. Gilliland (1975) has made it clear that at least on his expedition to Kaye Marco Cushing did not overlook commonplace artifacts. Gilliland's assessment was based on analysis of the hundreds of pounds of floral and faunal remains, and fragments of cordage, wood and shell recovered by the Pepper-Hearst Expedition.

Cushing as Scientist: Fieldworker and Philosopher

To be sure, Cushing was not a model of scientific discipline and methodological precision. But even Haury had to acknowledge that "it was Cushing's desire to amass a group of artifacts which by careful notations concerning the manner of occurrence should be capable of teaching a maximum of facts..." (Haury 1945:3; emphasis added). Apparently, Cushing did not always achieve this goal, but he came to the discipline with scientific objectives. As early as 1876, he complained that "America has no Science of Ethnology or Archaeology, and (I may add) that every Boer who has correctly or incorrectly described an arrowhead or a simple mound, is at once considered an archaeologist and styles himself, 'Professor'" (quoted in Hinsley 1981:193).

Despite his uncompleted work and notoriety, Cushing was honored in his lifetime for his exceptional blend of intuition, technical ability and powers of observation. Cushing did not stop at mere observation and simple description. He offered detailed interpretations of human behavior and explanations for social change. These speculations may have rested on the unseen—the "wood of Mind" and the "dominant Idea"—but he attempted to test his idealist hypotheses through examination of the material clues and patterns found in archaeological remains.

Cushing wanted to explain the structure and development of particular societies and to discern general laws and principles.

He was busy, not with externals merely, but rather, as he has said of his work, 'as to how and why they became at all,...of the laws and principles which have governed man's development under all sorts of circumstances and in every age and land' (Fletcher 1900:370).

Cushing realized that before he could explain the internal and the unseen he had to delve into the realm of the material. He felt that before he could comprehend the principles governing society's development he had to understand the primitive mind. As early as 1879, when Cushing accompanied the first collecting expedition for the National Museum to Hopi and Zuni villages, his assigned role was that of a special investigator of a single Pueblo. His task was to collect not material objects, but data on life in Zuni society (Hinsley 1981:194). Cushing expected to be in the field for only three months (Mark 1980:98), but after sensing the complexities of Zuni life and its significance for understanding archaeological evidence he chose to remain.

As gradually their language dawns upon my inquiring mind not the significance of these ceremonials alone but many other dark things are lighted up by its meanings. They are the people who built the ruins of Canon Bonito. In their language is told the strange history of these heretofore mysterious remains each one of which has its definite name and story. The handworks on the rock face and the pictograph of a 'Primitive Civilization' in the light of this language and tradition reveal their mysteries at once with their proof (February 1879, letter to Baird; quoted in Hinsley 1981:195).

Clearly Cushing came to see these people as much more than simple savages. He surrounded "primitive civilization" with quotation marks and remarked that "perhaps not a more conventional people may be found that these Pueblos" (Ibid.).

Cushing elaborated on his idea of "convention." He wrote to Baird that all of Zuni culture—its arts, industries and ceremonies—is directed by rigid rules and patterns. He later developed this realization into the Hemenway Expedition's working hypothesis. It is likely that Cushing wrote this letter with hopes of soon being able to describe these patterns for at about this time Cushing was initiated into the lowest rank of the Sacred Order of the Priests of the Bow. He had successfully completed the trials of silence, fasting, motionlessness and dancing to exhaustion to gain access to the mysteries of Zuni life (Green 1980:9). However, his initiation did not make the Zuni any less "mysterious;" it simply made obvious how much he did not understand (Hinsley 1981:195-196).

Cushing remained at Zuni for several years. In doing so, he broke ground for a new kind of investigation—the participatory method. In his quest
Palaeolithic objects. He identified "several fine and well-worn flint-presses, a flaker or two, and reproductions of even one knapper of horn" (Ibid.). He claimed the "experience in making any one of them would have given birth to the notion of making and applying a hundred flaking tools" (Ibid.).

In an analogous situation some fifteen years later, Cushing found reason to "call attention to facts not generally known or believed, and to evidence how far the most advanced of our aborigines north of Mexico had carried the arts of metalworking" (Cushing 1894:97). In this instance, a meeting had been called at the Anthropological Society in Washington to discuss whether the copper objects excavated from the Hopewell mounds were of European manufacture. Cushing offered his opinion based on his experience at Zuni and his efforts at "experimental reproduction."

Having practically and thoroughly learned the art of metal working as practiced by the Zuni Indians...I joined the discussion, representing that...none of the forms were impossible of production by a people actually limited to the resources of the stoneage...but it was objected by others that the Zuni people could hardly have possessed a knowledge of annealing so essential to the process of copperbeating, etc. described by me. Thus the question was left indeterminate (Cushing 1894:93-94).

Cushing's Rejection

While Cushing's belief in the existence of advanced civilizations and complex cultures in Native America eventually would be accepted by his colleagues, his reliance upon the "manual-method of true divination concerning the lost arts" caused concern among his contemporaries (Cushing 1892:309). However, Cushing was not insensitive to the revolutionary nature of his method and to the skepticism it would engender.

He began cautiously—his study was to be considered from "a standpoint of investigation," its goal being to contribute "to the needs of our science" and to establish "universally applicable conclusions" (Cushing 1895:309). However, he soon abandoned constraint and stated his conviction that "the single arts and phases of humanity" should be studied "subjectively rather than objectively" (Ibid.). He continued

If, moreover, I am at times seemingly too personal in style of statement, let it be remembered that well-nigh all anthropology is personal history; that even the things of past man were personal, like as never they are to ourselves now. They must, therefore, be treated and worked at, not solely according to ordinary methods of procedure or rules of logic, or to any given canons of learning, but in a profoundly personal mood and way (Cushing 1895:310).

In making this statement, Cushing excluded himself from the rush to make anthropology an exact science with an objective methodology; he disqualified himself from remaining within its pantheon of intellectual leaders.

Already suspect as a scientist for his faith in the intuitive method and his propensity to entwine observations with imagination, Cushing's reputation suffered further when he did not fulfill his responsibilities and complete his reports. Moreover, two accusations of falsifying archaeological data put his integrity in doubt. Cushing maintained almost no long term professional ties or loyalties. He never aligned himself with a single institution and he tended to embroil himself in petty controversy with his colleagues. In short, Cushing's unprofessional behavior served to alienate him from anthropologists' circles. After his death, he was left behind by the professionalization of the discipline.

Conclusion

My objective is not to present F.H. Cushing as a preeminent archaeologist; rather, it is to consider him within the historical context in which he worked. Cushing can be treated as a transitional figure in American archaeology. While his breaks with evolutionary tradition may seem negligible when viewed in isolation, seen together they constitute significant events in late nineteenth century theory and methodology.

Cushing's archaeological approach reflects his ethnographic experience and his personal philosophy. Cushing was one of the first to recognize the importance of archaeological context. He based conclusions on the placement and association of skeletal material and objects, and attempted to construct a loose stratigraphy. Cushing was sensitive
Longacre, W.A.

Lowie, R.H.

Mark, J.

Olson, A.P.

Stocking, G.W., Jr. (ed.)

Taylor, W.W.

Tylor, E.B.

Willey, B.R. and J.A. Sabloff
is more resistant to the endocrine or nutritional demands that readily affect lamellar bone physiology (Frost 1972).

These special features make woven bone well-suited for embryological, fetal and early postnatal skeletal development. The properties of woven bone allow for the development of a structure that is resistant to a minimal amount of biomechanical forces, but suitable for the rapid bone turnover associated with growth and remodeling (Ogden 1980). The requirements of the immature individual at early stages of skeletal development favor rapid growth ability over structural strength. However, with increasing age, biomechanical forces increase, and long-term architectural support eventually assumes more importance than the ability for rapid growth (Hancoc 1972).

The mechanisms that bring about this transformation are unknown, but they appear to be under strong genetic control. All woven tissue remodels to lamellar bone, regardless of whether formation is the result of developmental or abnormal circumstances. Even immobilized bone (due to fracture casts, paralysis, etc.) undergoes the conversion, for biomechanical stresses (or lack thereof) have no obstructive effect on the turnover process. Once woven bone is replaced by lamellar tissue as part of the ontogenic process, it will not revert back to its woven state, unless called upon by a postnatal osteogenic event such as callus formation, osteosarcomas, etc. (Hancoc 1972).

In sum, woven bone is a provisional tissue whose unstructured orientation is conducive to rapid bone turnover required in the developing skeleton. Its replacement by lamellar bone probably is controlled by a genetic component because environmental regulatory factors, such as hormones, nutrition or biomechanical forces, have little effect on the transformation.

For the physical anthropologist who is studying immature human remains, an understanding of woven bone tissue is important to comprehend the bony changes in a skeletal specimen. A high percentage of this tissue is normal in the very young, although one would expect to see the ratio of woven to lamellar bone decrease as the individual nears two to three years of age. Woven bone tissue will be present after this age, especially in the metaphyseal end of the growth plate, but the overall skeletal percentage should decrease. If it does not, a skeletal disturbance, such as trauma or infection, may be stimulating woven bone production in excess of normal parameters.

Thus an awareness of woven bone's function in an ontogenetic context provides the anthropologist with a qualitative guideline for assessing normal or abnormal bony changes in the growing skeleton. By correlating the age of the immature individual with the distribution of woven bone, one can distinguish between developmental process or a possible disease state. Eventually, when the rates and locations of the woven-to-lamellar transformation are documented, a powerful standard for gauging woven-to-lamellar ratios could be calibrated, allowing anthropologists a quantitative means to assess this parameter.

Bone as a Developing Organ

Growth mechanisms involved in the development of bone as an organ are also important for correct interpretation of normal/abnormal distinctions. These mechanisms are diverse, and perhaps best understood by reviewing growth plate functions and the vascular supply of bone. Disruptions in either of these systems result in changes that anthropologists frequently encounter in their examination of bone specimens.

The growth plate is the structure responsible for controlled, rapid, longitudinal growth in the skeleton. A cartilaginous disc or sphere, the plate serves as a preform for enchondral ossification. Disc-shaped plates generally are found between the epiphyses and metaphyses of long bones, while the spherical form surrounds the small carpal and tarsal bones. Plates are classified further according to the biomechanical forces affecting them. Thus "pressure" plates are those subject to the compressive weight and muscle forces on long bones, and "traction" plates are found in regions of muscular and ligamentous attachments (Siffert 1969).

Several models have been devised to understand the processes that occur at the growth plate during enchondral ossification. These models provide artificial designations for processes that are not clearly demarcated, but the model used by Rang (1969) does eluciate growth plate changes by dividing the plate into various functional zones. The first zone, called the "Zone of (Cartilage) Growth" is located near the epiphyseal end of the growth plate, and contains germinal chondrocytes which proliferate and divide. As the cells increase in number they become wedge-shaped and divide transversely, forming columns of cells that are called "palisades." The cells below the palisades begin to hypertrophy at the expense of
The periosteal vessels form a complex network extending the entire length of the bone. They provide a rich blood supply for circumferential growth that occurs through periosteal apposition. These vessels branch into smaller extensions that penetrate the outer cortex, bringing blood to the inner third of the cortex (Brashear 1983).

Because the vascular pattern of the immature skeleton is organized to route extensive blood supplies to areas of intensive growth, vascular disruptions will visibly alter normal bone development. Obstructions in the nutrient artery will lead to necrosis of the endosteal area, while severance of periosteal vessels will affect the outer cortex. If metaphyseal vessels and terminal branches of the nutrient artery are disrupted, enchondral ossification will halt and metaphyseal necrosis may ensue. Epiphyseal vessel obstruction will disrupt chondrogenesis and cause the growth plate to close prematurely (Brashear 1983).

Some bones have precarious vasculature by virtue of their shape and form. The talus, scaphoid and femoral head have large portions of their surfaces encapsulated by impermeable articular cartilage. Blood vessels enter these bones through limited-access areas that are not covered by this cartilage. If these regions are traumatized and their vasculature severed, epiphyseal necrosis will ensue (Trueta 1968; Brashear 1983).

Bone vasculature functions as an efficient transport system that supplies bone cells with nourishment needed for growth. However, this same system also provides an efficient means for transporting infectious processes. Osteomyelitis commonly develops in this way. Technically, osteomyelitis is an "infection of bone," but the primary etiology is bacterial entry (usually staphylococci) into the blood system. The extensive vascular "loops" at the metaphyseal end slow blood circulation in this region, creating an environment receptive to bacterial lodging. Large-molecule immunoglobulins cannot enter these minute vessels to attack the lodged bacteria, which continue to proliferate. Eventually the bacteria cause a thrombosis in the vessel, and subsequent necrosis of the surrounding bone. Exudate secretion may occur and exit the bone through multiple foramina or cloaca. Often the secretion lifts the periosteum from the shaft, severing its vasculature and initiating massive osteoblastic activity. Woven bone is deposited, and in severe instances, may encase the entire shaft (involucrum). In very young individuals (under one year in age), the infection may spread to the epiphysis, resulting in septic arthritis. Thus the highly-structured vascular system necessary for growing bone also can be a potential pathway for disturbance (Brashear and Wilson 1983).

In sum, bone vasculature and growth plate development are primary factors in understanding bone as a developing organ. Growth plate function controls longitudinal growth, while bone vasculature provides the nourishment necessary for continuation of that growth. Disruptions in growth plate development occur within various functional zones and are internal (e.g., congenital, hormonal) or external (e.g., biomechanical, physical trauma) in nature. Often the primary disruption is vascular in etiology. Immature bone has a highly-structured vascular organization that provides nutrition to areas of active growth. Disruptions in the vascular system can destroy previously existing bone, and obstruct new bone formation. Moreover, the vascular system provides a pathway for transmission of bacterial agents, often resulting in grossly-observable bony changes.

Anthropologists who analyze immature skeletal remains can benefit from understanding these components of bone as a developing organ. Although the growth plate usually is not preserved in skeletal populations, the metaphysis and epiphysis provide hints about its function. Normally these articular areas have a furrowed, bevelled appearance characteristic of the uneven bone deposition that initially occurs in enchondral ossification. Alterations in this appearance may indicate growth plate dysfunction. Rickets, for example, produces "cupped" or "flared" metaphyses (Steinbock 1976:255). Solitary lesions on the articular surface may have a cystic etiology, whereas multiple lesions may represent the early stages of infection (Rang 1969). Abnormal growth patterning from one area of the skeleton to another may have a congenital basis (e.g., achondroplasia) or may be a "sympathetic" response on the part of adjoining bones (Rang 1969).

The presence of excess woven bone, or the absence of previously-existing areas of bone, may indicate vascular interference or insufficiency. While some metaphyseal woven bone is a normal result of enchondral ossification, excessive deposition can occur from vascular disruption (e.g., periosteal stripping) or blood-borne pathogen (e.g., osteomyelitis). Infectious processes in immature human bone would begin in the metaphysis and spread
in the adult) due to large, abdominal viscera (especially the liver) that push upwards and small lungs that do not fill out the cage (Sinclair 1978:121). The sternal ends of each individual rib also appear distorted, with their wide, flared and uneven appearance. Despite the general "distorted" appearance of the rib cage region, the individual ribs are distinctly formed, and the characteristic R1, R2, R10, R11, and R12 are easily distinguished.

Another unusual aspect of immature skeletal morphology is apparent in the morphology of the newborn skull. Proportionally, the skull constitutes one fourth of the infant's total height (versus one eighth in the adult) (Sinclair 1978:122). Growth occurs superiorly and laterally at the sutures, transforming a single-layered cranial vault into a double-layered diploic form. Dramatic changes occur in both skull size and shape during the first two years in response to the rapid expansion and increase in brain size that occurs at this time (Sinclair 1978:73).

Skull development also depends on muscle forces that are at work in the region. The newborn does not use its cranial musculature extensively until approximately three months of age, so prominent muscular landmarks (such as nuchal and temporal crests, external occipital protuberance, and mastoid processes) are not present until after this time. As growth proceeds, skull contours are altered. For example, bactrocephaly (an occipital bulge near the parietal articulation) and parietal bulges are two instances that have no adult parallels because these features remodel and change with cranial expansion (Sinclair 1978:72-77; Marcoteaux 1979).

The large cranium appears more disproportionate when articulated with the small bones of the newborn face. Facial growth depends upon tooth, sinus, and masticatory muscle development. In the first year of life, the face begins to "fill out" with the development of the frontal, ethmoid and sphenoid sinuses. However, normal proportions are assured only after the maxillary sinus expands following the eruption of maxillary dentition. Mandibular growth also is affected by tooth eruption, but the development of muscles associated with mastication and suckling (temporal, masseter, facial muscles) have a greater impact on the size and shape of the body and rami (Frazekas and Kosa 1978:170; Sinclair 1978:777). Both maxillary and mandibular alveolar processes remain irregular well after birth, due to remodeling associated with tooth eruption.

In sum, newborn skeletal morphology varies substantially from the adult form. Proportional differences are apparent throughout—between upper and lower limbs, pelvic and shoulder girdles, head and body lengths, and cranial and facial size. Other differences are due to the immature development of organs (e.g., rib cage, cranium), or are associated with behavioral changes (e.g., vertebral curvatures, mandibular growth).

When examining immature skeletal remains, these morphological differences reveal a great deal of information. Hints of biomechanical influences associated with behavioral change should become evident at various ages. For example, development of cranial muscle landmarks and cervical convexity would indicate increased neck use associated with lifting of the head. The presence of lumbar convexity and iliac thickening may indicate a sitting posture, while sacral concavity, acetabular depth and femoral shaft curvature would suggest bipedalism.

In addition, the disproportions seen in the morphology of the newborn skeleton should diminish with age, although the timing for various skeletal segments will vary. Facial growth, for example, will not "catch-up" significantly with cranial size until tooth eruption is nearly complete. Similarly, the lower limbs may begin "catching-up" only after the infant begins walking, because the constant, compressive forces associated with this behavior stimulate increased growth plate activity in the region.

Bone Development in the Prenatal and Postnatal Period

The prenatal and postnatal periods provide the context for viewing genetic and environmental influences that affect normal bone development on a variety of organizational levels. Under normal conditions, the prenatal environment is a stable setting for fetal development, providing nourishment and protection via the placental link. Growth is highly dependent on genetic controls. Certain aspects of bone development, such as tissue differentiation, ossification and architecture, have strong genetic determinants (Altman 1979). Further evidence of genetic control is apparent in fetal skeletal morphology: bone formation occurs in a weightless uterine environment, but its development is morphologically preadapted to a gravitational setting (Altman 1979:349).
If the entire periosteum is involved, woven tissue forms and distributes rather evenly around the bone. The macroscopic result is thickened cortices and an overall heavy, thick appearance to the bone.

Morphological changes in the fetal skeletal system include a reduction in skeletal size because of the condition's effect on enchondral ossification. Long bones appear distorted in shape due to irregular metaphyseal flaring that results from incomplete osteogenesis at the growth plate. Asymmetry in bone development—a common sight of "stress" in development—also may result.

Infectious processes that occur in the prenatal environment elicit greater active bone involvement at the tissue, organ and system level than genetic errors or anomalies. The latter are characterized more by gross morphological distinctions such as aplasia or asymmetry than by tissue turnover rates. Also, infectious disruptions that occur prenatally usually are less severe than those that occur postnatally, because of the relative protection afforded by placental barriers. If evidence of a severe infectious process is present on fetal bone, it indicates not only a disturbance to the fetus, but also reflects poor maternal health.

Bone development in the postnatal environment is subject to a wider variety of insults than its prenatal predecessor because of increasing synergistic interactions. For example, the association of malnutrition with very young infants and children (Gordon et al. 1957) is complex, for malnutrition is a syndrome of varying nutrient deficiencies complicated by acquired infections or illness. To isolate its affect on bone is difficult, since physiological changes vary with the severity and involvement of the malnourished state.

The body responds to undernutrition by sacrificing the growth process for overall organism integrity. In terms of bone development, this sacrifice means a slowdown in enchondral ossification because of a concomitant slowing in chondrogenesis at the growth plate. Osteoporosis results because of increased rates in bone resorption. If the malnourished state is severe and prolonged, bone loss occurs throughout the skeleton, and the appearance of secondary ossification centers is delayed (Huss-Ashmore et al. 1982).

The bone changes that result from these processes are variable. Woven bone production may be normal, but resorption rates rise because of increasing osteoclastic activity. Longitudinal growth slows or ceases due to interrupted enchondrogenesis and the late appearance of secondary ossification centers. Cortical thinning results from osteoporosis, making the bones lightweight and fragile in appearance. If infectious processes are concurrent with a malnourished physiology, these macroscopic bony changes may be more obscured by more reactive bone activity (i.e., periosteal lesions, osteomyelitis, etc.).

These skeletal markers define the pattern that may "logically" ensue in a nutritionally-deficient individual. However, these markers are too broad to use for differential diagnosis without additional population and ecological data. Correlations need to be drawn between remodeling and growth rates, and nutritional availability. The interaction of malnutrition with disease must be examined in environmental and social situations, and correlated to the period and location of the skeletal population. In sum, malnutrition will not have a "classic" etiology-effect response on bone because it is too complex a process to isolate.

Malnutrition is only one of many disruptions in the postnatal period that requires additional "non-bone" data to pinpoint its effect on bone. In general, disturbances in the postnatal environment represent a variety of insults that rarely occur as singular entities. Therefore, it is hazardous to assume that postnatal bone abnormalities will have one etiology.

Conclusion

The anthropological study of human skeletal remains has a long-established history of research (Armelagos et al. 1982); thus it is surprising that immature skeletal material has received so little attention in the anthropological literature. Assessments of "normal" bone development and morphology in particular have been ignored, and guidelines for analysis have not been established. Studies of immature skeletal remains must recognize that developing bone does not function or respond like adult bone. The differences need to be refined and clarified, so pathological states can be correctly inferred.

To understand the "normal" manifestations of bone
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