

Osteology of a Slave Burial Population From Barbados, West Indies

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ABSTRACT A unique seventeenth–nineteenth century slave cemetery population from Newton plantation, Barbados, allows examination of craniodental characters in relation to ethnohistorical data. Age-at-death estimates suggest life expectancy at birth of 29 years and low infant mortality; historical demography, however, suggests life expectancy of 20 years and very high infant mortality. Tooth decay, bilateral tooth loss, periodontal disease, root hypercementosis, and severe enamel hypoplasia are high in frequency. The teeth yield evidence of such cultural practices as pipe-smoking and incisor mutilation. Several skeletal features reflect periodic near-starvation. Directional and fluctuating dental asymmetry, relative tooth size, and hypoplasia distribution suggest slaves experienced considerable weaning trauma; metabolic stress at this time exceeded that of prenatal and immediate postnatal periods. Odontometrics and dental and cranial nonmetric traits indicate that modern Blacks are intermediate between the ancestral slaves and modern Whites but more similar to the latter, suggesting effects of environmental covariance exceed those of genetic admixture. Nonmetric trait distributions show nonrandom patterns according to area of burial in the cemetery, a possible result of family segregation.

By the end of the seventeenth century, the tiny southeastern Caribbean island of Barbados had become England's richest colony in the New World. This wealth derived from the production of sugar, largely cultivated on large-scale plantations by tens of thousands of African-born slaves and their New World descendants.

Archaeological investigations in Barbados during the early 1970's formed one phase of a larger ethnohistorical project concerned with reconstructing the social and cultural life of the island's slaves from the middle of the seventeenth century to emancipation in 1834. This ethnohistorical project aims to understand the processes by which Africans and their descendants in the New World lost, modified, or retained their cultural heritages and created new cultural systems adaptive to environments

characterized by colonialism and plantation slavery (Handler, 1970b).

The archaeological research, designed to raise new questions and stimulate fresh perspectives on slave life (Handler, 1972; Handler and Lange, 1978), ultimately focused on a slave cemetery at Newton plantation. Newton still operates as a sugar plantation today, and has a history that extends deep into the seventeenth century. Newton was chosen as a site not only because of the availability of extensive historical documentation on the plantation, but also because it contained a known slave cemetery, permitting excavations in relatively undisturbed contexts.

In all major physical, agricultural, social, labor organizational, and demographic charac-

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teristics of its slave population, Newton typified medium- to large-scale Barbadian sugar plantations (Handler and Lange, 1978:58–102). Because the plantation and its slave community so well reflected island-wide characteristics, major features of the analysis of Newton's slaves can be generalized to other plantation slave populations on the island.

Virtually all of the artifactual materials recovered archaeologically from Newton have now been analyzed (Handler, *in press*; Handler and Lange, 1978, 1979; Lange and Handler, *n.d.*; Handler et al., 1979). Although brief attention was paid in an earlier publication to the skeletal remains (Handler and Lange, 1978:158–168), these remains were not systematically analyzed nor properly interpreted in an ethnohistorical framework. Many of the bones were poorly preserved owing to burial near the surface and the depredations of a tropical environment; in addition there were many multiple interments with commingling (for more details, as well as an ethnohistorical picture of slave mortuary patterns, see Handler and Lange, 1978:108–132, 171–215). Because of the poor state of bone preservation plus budgetary limitations, most bones and postcranial fragments were carefully reinterred at the site. However, some long bones and semicomplete cranial materials, as well as all dental materials, were transported to Southern Illinois University where they were ultimately subjected to the analysis reported here.

As with most slaves imported to British Caribbean and mainland colonies during the seventeenth and eighteenth centuries, Barbados' slave population originated from a wide coastal stretch in West and West Central Africa, ranging from the Gambia region to Angola. Both North American and Barbadian slaves derived, though not in equal proportions, from a large, culturally and linguistically diverse spectrum of parent demes (Handler and Lange, 1978:20–29; Klein, 1978:121–174; Curtin, 1969:127–162). Thus, the Newton skeletal sample and its African ancestors came from African components broadly comparable to those from which the slave ancestors of modern American Blacks originated, prior to the admixture that today characterizes the latter.

The skeletal population recovered from Newton represents 101 individuals (nine more than originally reported; Handler and Lange, 1978) including interments from about 1660 to 1820. Laboratory analysis resolved any uncertainties concerning the racial affiliation of the skeletons. All the remains are of Blacks, based on universally flat nasal sills and slight sub-

nasal grooves, wide nasal apertures, broad foreheads, wide interorbital regions, and characteristic alveolar prognathism.

This population constitutes not only the largest excavated group of African and African-descended slaves, but perhaps the earliest. For example, a Virgin Island collection of 15 skeletons has a median date of 1780 (Dailey, 1974, *pers. comm.*), one of 20 individuals from Virginia dates from the late 1700s (Hudgins, 1977; Angel, 1977), and 32 skeletons from Maryland date from 1790 to 1840 (Burnston, 1980a,b). Thus, the Barbados collection is unique; combined with other archaeological data and a relatively rich array of historically-derived information, the collection offers a singular opportunity to investigate various problems associated with slave life.

The existing literature on slave osteology is very sparse. There are two straightforward descriptions of small samples, one of undocumented Blacks from the Virgin Islands (Dailey, 1974), and one of presumed slaves from Colonial Williamsburg (Hudgins, 1977). Ubelaker and Angel (1976) described two isolated probable slaves of unknown date from the Virgin Islands, and the remains of two antebellum Black individuals, discovered in coastal Georgia, were analyzed by Thomas et al. (1977). Angel (1976) provided osteometric data from American Blacks from several small samples, and he briefly reported on 25 individuals from the Catoctin Furnace cemetery (Angel, 1980; Burnston, 1980a). Aside from Higman's (1979) analysis of slave stature and growth from historical data, we can still repeat Dailey's (1974:11) comment that "we know virtually nothing about the stature, diseases and non-metrical variations of black populations during the slave period." These limitations led Saksena (1974) to use a collage of modern coastal West African skeletal samples as representatives of the ancestral stock, and to compare them to American Blacks and Whites along an osteometric continuum.

In this paper we utilize the Newton plantation skeletal materials as fully as possible to describe the general skeletal biology of the slaves. We also consider some implications for the evolution of the modern American Black population in relation to the larger surrounding White gene pool.

MATERIALS AND METHODS

Laboratory analysis first involved an estimate of sex and age. The former was attempted by the usual methods of general robusticity, and superciliary and mastoid morphology when

there was adequate representation of cranial bones (only two skeletons could be sexed from postcranial bones). However, the frequency of confident sex determination was so low (ca. 50%) that we lumped the entire sample for descriptive statistics; other (modern) samples for comparison were likewise combined, with the numbers of each sex kept roughly equal. Both the sexed remains and the historical data for Barbados and Newton (Handler and Lange, 1978) suggest a roughly equal sex ratio of slaves ($50 \pm 5\%$).

Age was estimated primarily from dental calcification and eruption until young adulthood, then through use of a tooth-wear scale calibrated against tooth eruption and mesial-distal wear gradient. In only about five cases did epiphyseal and cranial sutural fusion, and general appearance come into use. Therefore, the descriptive demography of the adult sample is unavoidably subjective, and after age 30 estimates were made to the nearest five years. For comparison there are excellent historical demographic data from Barbados, as well as Newton plantation in particular (Handler and Lange, 1978:68-72, 282-284). We use life-table parameters calculated after Ubelaker (1974) for descriptive demography.

Skeletal and dental pathological observations were next recorded. We looked for trauma, osteoporosis, periodontal destruction, caries, dental hypoplasia, root hypercementosis, malocclusion and traumatic occlusion, and such cultural practices as tooth mutilation and pipe-stem wear.

Of necessity dental measurements constitute a major part of this investigation. Crown length and breadth measurements were taken with sharpened dial calipers to 0.05 mm; the length is the maximum in the mesio-distal axis between mesial and distal contacts with adjacent teeth, and breadth the maximum perpendicular to this. The Newton incisors were not measured since we found them only occasionally present and often fragmentary, intentionally mutilated, or showing extensive pipe-wear facets in both sexes. We computed bilateral dental asymmetry as a measure of probable prenatal stress, using root mean square of difference (RMS) and correlation methods (Bailit et al., 1970; Garn et al., 1966).

We recorded the following qualitative dental traits: Carabelli cusp and fissure, premolar and molar cusp number, and incisor-canine cervical lingual tubercles (presence in any anterior tooth was treated as one trait). All the temporal bone and lower facial nonmetric traits studied by Corruccini (1974) were scored, using

the same definitions, from these relatively commonly preserved areas.

Our primary source of modern comparative data (of all types) is the Terry Collection, dissecting-room Black skeletons from St. Louis, collected mostly between 1920 and 1950. Partial records indicate that most (68%) of these individuals were born in rural areas of the Deep South. Dental size means for these Blacks and the contemporaneous Terry Whites are from Henderson (1975), with whom one author (R.S.C.) could compare and standardize techniques.

Admixture is a vital consideration for our study. We contend that by comparing divergence between slaves (i.e., presumably unadmixed ancestors), modern Blacks, and Whites relative to known genetic admixture rates, a unique approach can be taken to measuring morphological heritability. For instance, cranial epigenetic traits have long been considered highly heritable. This was based on laboratory mouse studies, but verification in humans has been impossible due to lack of family skeletal series.

Genetic marker studies indicate white genetic admixture among present-day American Blacks of about 10% in rural areas to about 20% in urban ones (Johnston, 1966; Glass and Li, 1953; Workman et al., 1963; Roberts, 1955; Howells, 1970; Adams and Ward, 1973; Reed, 1969; Pollitzer, 1958; Basu et al., 1976). In view of the largely rural origin of the circa-1930's St. Louis Black skeletons, we consider 15% a good admixture estimate. Admixture in the Terry Whites is probably not an issue, as the morgue describers, following conventional American cultural perceptions of racial distinctions, took any indications of Black heritage to merit classification as Black. Historical evidence indicates some extent of admixture among Newton's slaves: in the last years of the eighteenth century about 10% were described as "mulattoes" or "colored," and 15% were so designated in the first two decades of the nineteenth century (Handler and Lange, 1978:160). Furthermore, it can be fairly assumed that the percentage of European admixture was much less in earlier periods and that during the seventeenth century it was virtually, if not entirely, nil. Assuming that persons visually identified as "mulattoes" in the historical sources represented a 50% white genetic background, we take 5% as a liberal admixture estimate for the slave skeletal sample as a whole.

The phenetic affinities of modern American Blacks can be placed along a continuum from the Newton slave to the American White mean

phenotypes (Saksena, 1974) and the results compared to what we expect based on genetic admixture. This expectation is for divergence of modern Blacks from slaves amounting to 10–20% of the slave-to-White divergence, if the morphological traits directly reflect underlying gene frequencies. This reasoning necessarily assumes polygenic, equally-additive inheritance of the morphological features. After every individual feature is thus analyzed, a simple form of multi-trait similarity analysis (the Q-mode correlation coefficient) will be performed to separately compound the results for all odontometric traits, dental nonmetric traits, and for the cranial nonmetric traits.

Finally, we seek skeletal evidence for certain selective burial practices. Handler and Lange (1978:108–132) document a nonrandom concentration of burials over the Newton cemetery area. Two primary skeletal clusters, one of 17 burials and the other containing over 40 (Handler and Lange, 1978:112–116, 117–123 [unit 30N9W and Mound 2]) exist amid the randomly scattered (and sampled) remainder. If these clusters represent traditional family burial plots (a practice whose possibility of existence among Barbados slaves is suggested by West African ethnographic materials), we would expect these concentrations to exhibit nonrandom trait patterns, especially lowered variability, which would indicate family segregation. Using Fisher exact tests or, where sample distribution allowed, χ^2 , we tested nonmetric trait incidences within the two clusters against each other as well as against those of the remaining, random accumulation. The samples are small, the traits might show varying penetrance, and gene linkage and out-marriage would obscure observable segregation. Therefore, we accept a 10% critical probability for the null hypothesis of no segregation, using these relatively weak nonparametric statistics.

RESULTS

The most important and interpretable demographic features are relative mortality and age-specific life expectancy, with survivorship considered less reliable (Ubelaker, 1974; Swedlund and Armelagos, 1976). In terms of relative mortality, the sample seemingly indicates low infant mortality, increasing steadily with age with sharp increases at ages 30 and 50 (Fig. 1). Historical data on Newton's slaves help evaluate the demographic patterns from skeletal remains, and show vastly greater infant and child mortality, stability with relatively

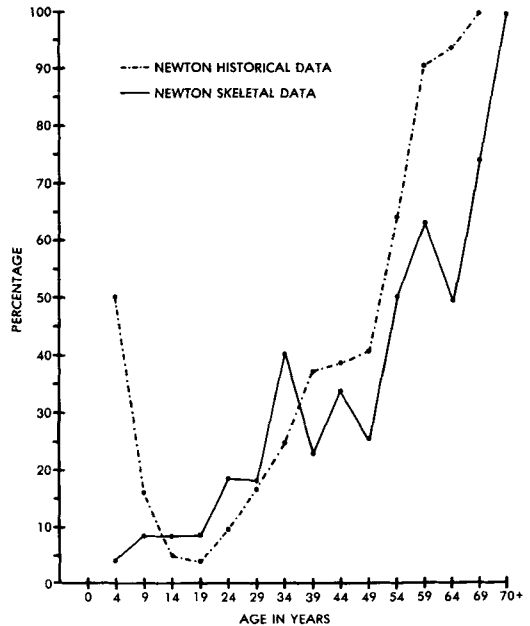


Fig. 1. Estimated age-specific relative mortality in Newton skeletal population as compared with historical age-at-death data (the ages signify the endpoint of the interval beginning with the previous age).

low mortality ages 10–35, then consistently greater mortality by age 40 than is indicated by skeletal aging (Handler and Lange, 1978:286).

Average Newton skeletal life expectancy at birth is 29 years, roughly comparable to the 31 years for Colonial Virginia (Hudgins, 1977) and the 35 of the Catoclin Furnace population (Angel, 1980). Expectancy at Newton decreases gradually and consistently, but there is a sharp difference between the skeletal and the historical mortality data; the latter indicate expectancy at birth of 20 years, a sharp rise in expectancy with child survivorship, and a higher expectancy compared to the skeletal estimation from about the age of 5 onward (Fig. 2).

Survivorship is a parameter of little value as it is influenced throughout by inaccurate archaeological estimates of infant mortality. The historical and skeletal data from Newton are very dissimilar, and the former is undoubtedly more accurate. Historical data on slave deaths indicate much less infant survival (50%) than is indicated by the bones (95%), and somewhat less child survival; relative survival rates become roughly equivalent at age 40.

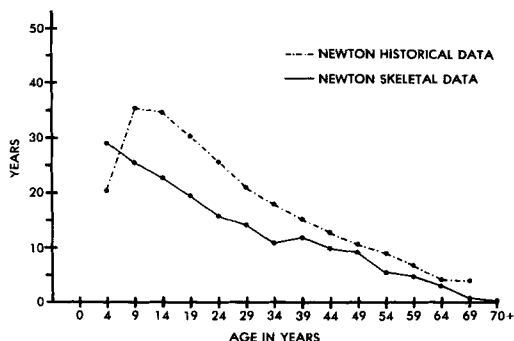


Fig. 2. Skeletally-estimated age-specific life expectancy contrasted with historical data.

Most recorded items of pathology are, of necessity, dental. Occlusal surface caries (Table 1) are rare in the sample, 20% of the individuals being affected. Interproximal decay is much more frequent (57%). Very few individuals (4%) show caries in all their preserved teeth. Antemortem tooth loss was very frequent (Table 1) and 28 of the 55 individuals with the most complete jaws lacked at least one tooth; this is a very conservative estimate owing to partial preservation of so many skeletons. A great majority of occurrences are bilateral (21/28), a highly nonrandom distribution that might suggest human intervention in the pattern of tooth loss.

A pervasive pathology affects the postcanine tooth roots. Many molars are affected by a total hypercementosis causing extra large, bulbous, remodelled, and frequently fused roots. The condition is probably not periapical condensing osteitis or cementoma osteitis, resulting from calculus (Neill, pers. comm.) and usually associated with clenching, physical trauma, or bruxism. Bruxism causes root resorption and tooth movement (Hylander, 1977), not observed in the slaves, and it always affects the molar region. The incisors and canines are the teeth slaves habitually used for pipe-clenching. The hypercementosis we observed is most likely related to periodontal degeneration and malnutrition. Since many teeth remained in their sockets and we did not extract them, the statistical impression of this condition's frequency is clearly underestimated.

Enamel hypoplasia is a useful indicator of prenatal developmental stress or metabolic insult, although its exact etiology is unclear. In a population of early slaves one might expect

TABLE 1. Occurrence of pathologies and cultural alterations of teeth

Trait	occurrences/n ^a
Occlusal surface caries	19/94
Interproximal caries	54/94
Tooth loss	28/55
Hypercementosis ^b	11/21
Anterior tooth enamel hypoplasia	66/68
Posterior tooth enamel hypoplasia	93/94
Intentional mutilation	5/60
Pipewear facets	25/60

^an is the number of adequately preserved individuals for the trait.
^bVery conservative estimate.

very high levels of this anomaly (regardless of whether it results from nutritional or infectious stress). In fact, such high levels were observed (Table 1). There are two distinct types of hypoplasia. In one, multiple light enamel deficiency bands or wrinkles occur (e.g., Fig. 3). These faint encircling bands or microdefects may not be highly indicative of differing stress levels since both American Whites and Blacks show a high frequency (El-Najjar et al., 1978). A second type also occurs in the Barbados population, where hypoplasia is of an extreme form (Figs. 4 and 5) resulting in a deeply indented, palpable horizontal depression all around the tooth. These are genuine growth arrest lines (Angel, 1976, pers. comm.). We also observed disturbed enamel formation near the cervix resulting in deep pitting (Fig. 6).

Growth arrest lines are generally considered to indicate extreme dietary deficiency or starvation, which causes growth to cease for a relatively prolonged period. On the other hand, dentists often consider lighter hypoplasias as "fever lines," resulting from brief infection-related metabolic disturbance (Neill, pers. comm.; also Rose et al., 1981; Rudney, 1981). In the Barbados slaves the enamel structure above and below the severe lines is good and there is no pitting or mottling as often occurs with lighter hypoplasia, perhaps increasing the probability that growth arrest lines relate to a nutritional episode.

In the slave dentition individuals showing growth arrest lines evidently underwent only one period of severe nutritional stress in childhood, as there is rarely more than one line per tooth and the affected portions of tooth crowns calcify at the same age (e.g., Fig. 7). There is no consensus, however, on hypoplasia etiology, and the subject is in an unresolved state (Good-

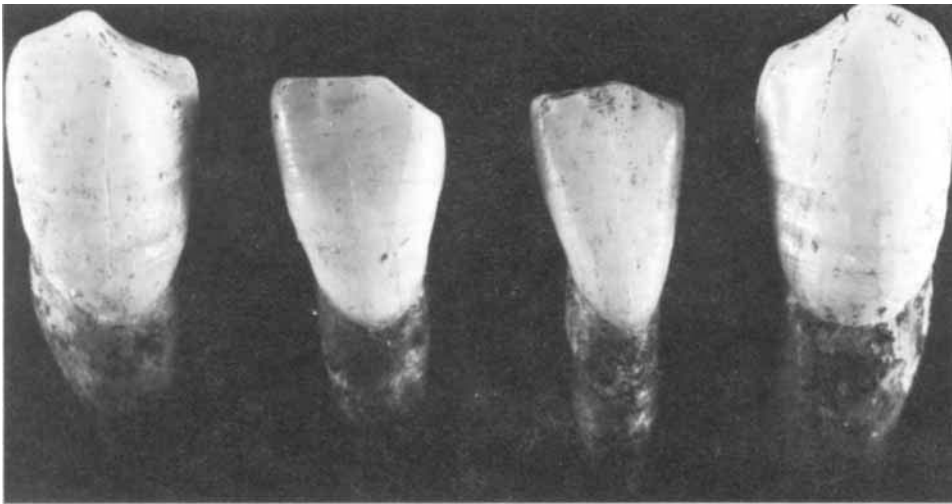


Fig. 3. Enamel microdefects in mandibular anterior teeth of burial 78.

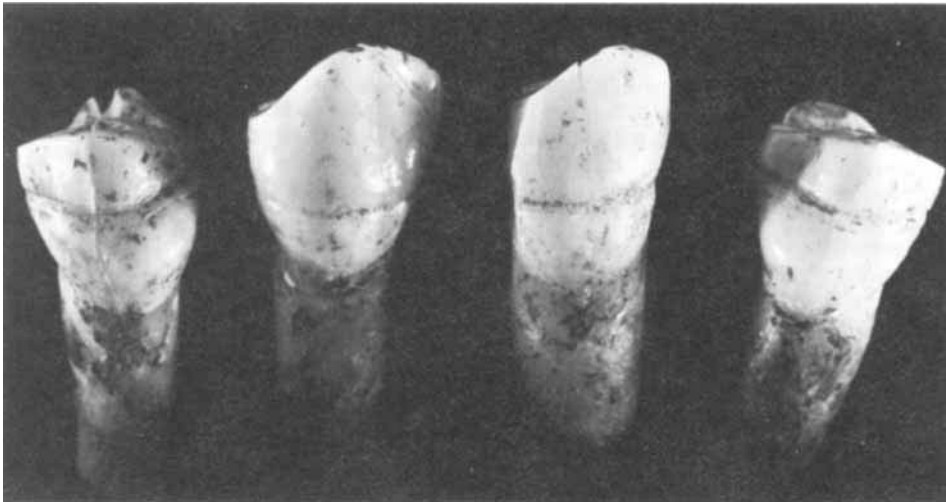


Fig. 4. Growth arrest lines in maxillary canines and third premolars of burial 83.

man et al., 1980; El-Najjar et al., 1978; Cook and Buikstra, 1979). We saw no circular caries (Cook and Buikstra, 1979). Whatever their cause, in the Barbados slaves dental growth arrest lines show an extent and frequency of development beyond that known from the literature or examination of any other group. It

is not approached in any American collection with which we are familiar: Amerinds, Terry Collection Whites and Blacks, and Colonial Blacks from Clifts Plantation.

The Barbados hypoplasias do not follow a random pattern. Their interpretation lies in the age of calcification of the banded crown

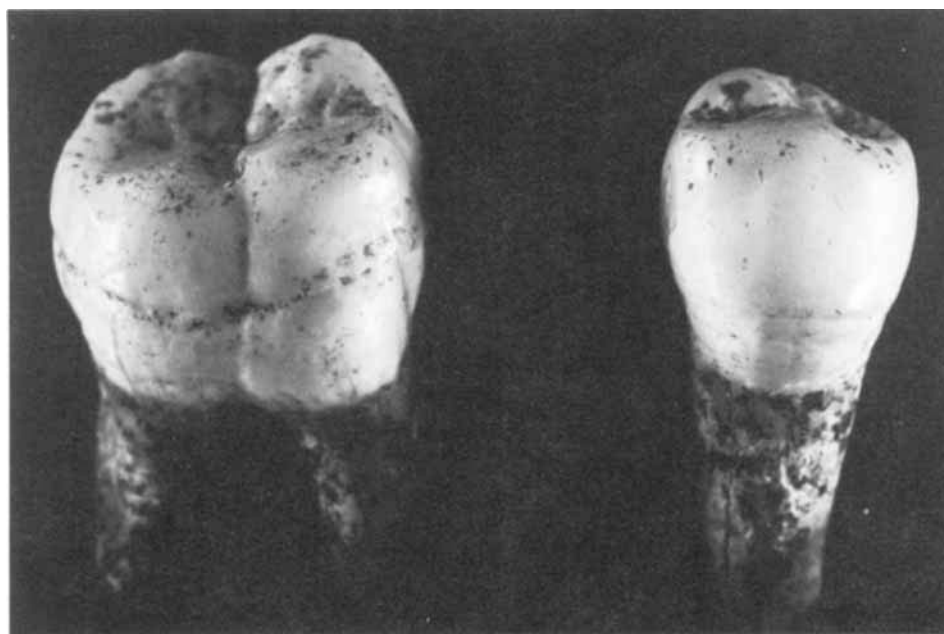


Fig. 5. Growth arrest line on mandibular second molar; burial 36.

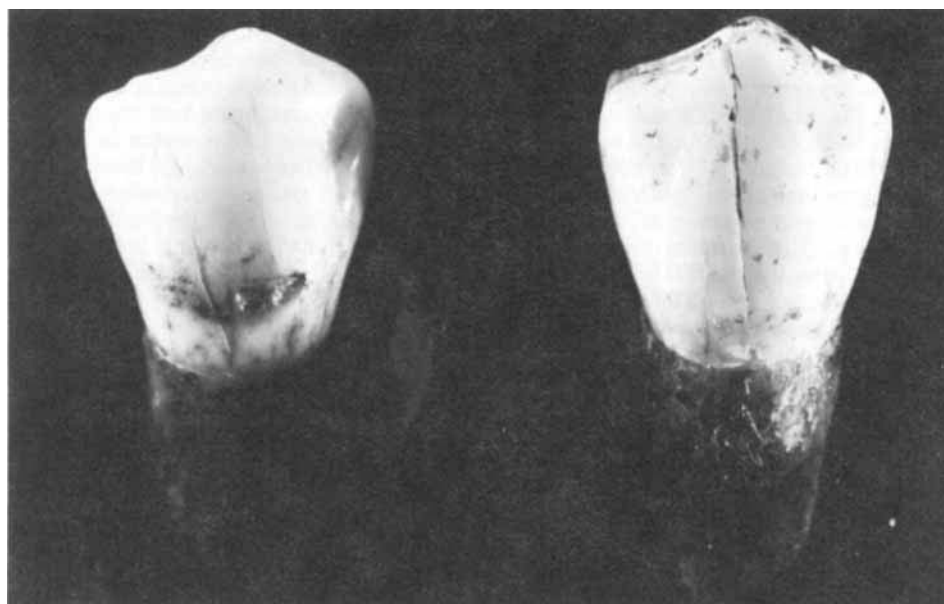


Fig. 6. Cervical pitting form of enamel hypoplasia; burial 62.



Fig. 7. Growth arrest lines in mandibular teeth of burial 83, formed at one point in time during calcification.

part. One age of banding per affected individual always extends across all teeth that calcified at the same period (e.g., Fig. 7, indicating an age of 3 or 4 years for the event). The sample is unrepresentative of certain tooth classes, however, so statistical statements are tentative. For example, incisors were difficult to observe, but they calcify almost synchronously with M1, on which we saw little banding. Selecting just the severe growth arrest lines, about 85% of the occurrences are on permanent teeth (C, P4, and M2) that calcify and erupt later, rather than teeth erupting in the early phase (I1–2 and M1). Adjusting for different frequencies of presence of the tooth classes, this disproportion allows rejection of the null hypothesis of no age difference in distribution ($\chi^2 = 4.64$ Yates corrected; $p < 0.05$). This is not merely an artifact of age differences in attrition, as molar wear rate was such that, for example, only the most coronally situated lines in the most elderly individuals would be obliterated on M1. Furthermore, among late-erupting teeth, the mode or peak occurrence lies in the basal canine and cervical half of P4 and M2. Although the inconsistent tooth presence pattern renders all this tentative, the mode indicates a peak age of risk of about 4 years (cf., Goodman et al., 1980:Fig. 1) for the conjectured severe metabolic insult.

Pipewear facets were a regular feature (Table 1) in the anterior teeth of male and female slaves. A description and historical interpre-

tation of slave pipe use is given elsewhere (Handler, in press; Handler and Lange, 1978:133–135, 199–200).

Intentionally mutilated incisors occur in five cases, the largest sample of Black tooth mutilations in the New World. These cases are described in detail, and the historical and ethnological implications of dental mutilation among Barbados and New World slaves in general are treated elsewhere (Handler et al., 1982).

We recorded a wide range of individual pathologies. Two specimens had mastoid bone infections, and one had a severe infection in the auditory meatus causing its blockage (by cancellous bone) and certain deafness. No cranial osteoporosis or porotic hyperostosis was observed, perhaps indicating lack of infectious blood-borne disease or anemia. There was one peg incisor, and in another individual an occurrence of possible shovel-shaping of a maxillary incisor. The latter was the only hint we noted of possible Amerindian admixture. (A very small Amerindian slave population existed in Barbados during the seventeenth century and early eighteenth; see Handler, 1969, 1970a.) One fourth premolar was anomalously reduced. Five unassociated third molars were misshapen—conceivably the result of childhood growth disturbance and posterior jaw underdevelopment.

Two jaws evince possible incisor evulsion, and there are only three cases of elderly complete edentulism. Cases of unilateral edentul-

ism are accompanied by size reduction of the contralateral mandibular fossa and condyle. Occlusal disequilibrium and malocclusion are suggested by asymmetrical wear facets in 14 individuals, two of which have rotated and crowded teeth. Posterior crossbite is indicated in three jaws, and another case has mandibular incisor overjet (relatively frequent in modern Black as opposed to White youths; Kelley and Harvey, 1977). Two mandibles, with unusually strong pterygoid markings, have flattened condyles and arthritic indications of complete loss of temporomandibular cartilage.

Periodontal disease is almost always observed in our adequately preserved specimens. The consistency of periodontoplasia is indicated by interseptal bone deterioration and cortical plate absence from the septae (Costa, 1976), and bone loss in the alveolus, increasing the liability to bacterial invasion. The Barbados sample contained no well-defined periapical abscesses, and the fragments show little evidence of trauma. Two individuals seem to have healed coronoid process fractures with coronoid hypotrophy and probable severance of the temporal muscle; these are accompanied by hypertrophy of the pterygoid insertion area. One lesion of the ascending ramus was observed as were two cases of mandibular exostosis.

Two of the more completely preserved jaws are noteworthy. One is a 40-year-old female showing indications of unusual developmental disruption in the teeth; the posterior part of the mandible is underdeveloped, the corpus shallow, the ramus anomalously short, the M_2 impacted under M_1 , and M_3 crowded and rotated. Evidently bone growth stopped somewhere between the ages of 10 and 15, with incomplete rehabilitation and inadequate jaw growth to accommodate the normal-sized teeth. This individual probably represents a case of severe starvation with results highly similar to the undernourished animal study of Tonge and McCance (1965, 1973; McCance et al., 1968). Another individual is an 18-year-old of uncertain sex with very defective teeth, tooth root underdevelopment, and (probably) decelerated posterior jaw growth. Two other, less well-preserved individuals, also have the malerupted and impacted M_3 seen above.

Although there were very few completely recovered jaws, the above cases and other instances of misshapen M_3 's suggest that this syndrome may have been fairly frequent in surviving Barbados-born slaves (c. 40%). Such distally concentrated malocclusion is dissimi-

lar to types of modern urban malocclusion, and indeed any malocclusion is very rare in non-industrial societies (see Corruccini and Whitley, 1981, for review). The syndrome is probably indicative of near-fatal or chronic starvation (Tonge and McCance, 1965, 1973).

Fisher exact tests and χ^2 were used to examine relations between variables that might indicate admixture effects. Using Carabelli cusp as a possible indicator of white genetic admixture, there were no associations with such time-progressive mortuary features as coffin presence/absence or body orientation. On the other hand, Carabelli occurrence correlates negatively with individual age at death. Older dying individuals have fewer cusps, as theoretically expected, since African-born slaves were mostly young adults when imported and therefore at, or past, the mortality midpoint for Barbados-born slaves. Anterior tooth tubercles correlate positively with age, again supporting the inference that older individuals include a higher frequency of the African-born. The anterior tooth and Carabelli tubercles did not correlate with each other; possibly they could be used as independently segregating admixture indicators.

The basic descriptive odontometric data and some comparative data for present-day Whites and Blacks are presented in Table 2. As might be expected, the Barbados slaves have consistently larger teeth, but there is patterning to the difference. The C, P3 and M1 are relatively larger in slaves, and these are the earlier-calcifying permanent teeth; teeth erupting slightly to much later (P4, M2 and M3) are, in that order, increasingly smaller in slaves relative to modern Blacks. The relative variability in the tooth classes does not follow a remarkable pattern.

Bilateral dental asymmetry is described in Table 3 and Figures 8 and 9. Asymmetry study is invited not only by the relative abundance of dental remains, but also because the slave population may have experienced prenatal developmental stress near the human maximum. Table 3 shows matched-observation tests of consistent side difference, necessary to determine whether the asymmetry is "fluctuating." Significant results are concentrated in the distal molars (lower third and upper second). Some asymmetry is directional, but there is some question as to whether such side-specific asymmetry (left smaller than right) is not also an indicator of developmental disruption (Potter et al., 1976; Boklage et al., 1979; Corruccini and Potter, 1981). In comparison with other

TABLE 2. Odontometrics (in mm) of mesiodistal (L) and buccolingual (B) diameters

Tooth measure	Newton		U.S. Blacks		U.S. Whites	Admixture
	\bar{X}	CV	\bar{X}	CV (max)	\bar{X}	
C ₁ L	7.49	7.4	6.93	6.3	6.67	0.68
C ₁ B	8.00	8.7	7.75	6.3	7.63	0.68
P ₃ L	7.52	6.8	7.36	6.7	6.85	0.24
P ₃ B	8.40	7.4	8.24	6.8	7.62	0.21
P ₄ L	7.64	7.4	7.46	7.4	6.99	0.28
P ₄ B	8.54	7.7	8.55	6.2	8.14	0
M ₁ L	11.62	6.7	11.31	6.1	11.01	0.51
M ₁ B	10.79	5.4	10.46	5.8	10.26	0.62
M ₂ L	11.21	6.0	11.24	8.0	10.71	0
M ₂ B	10.58	5.6	10.59	6.1	10.10	0
M ₃ L	11.10	6.6	11.53	8.9	10.73	0
M ₃ B	10.36	6.4	10.65	7.4	10.03	0
C ¹ L	8.06	8.4	7.67	7.5	7.63	0.91
C ¹ B	8.66	8.7	8.53	6.8	8.19	0.28
P ³ L	7.49	6.7	7.29	6.5	6.81	0.29
P ³ B	9.77	7.0	9.64	7.2	8.95	0.16
P ⁴ L	7.04	7.5	6.85	7.5	6.56	0.40
P ⁴ B	9.69	6.9	9.71	6.3	9.15	0
M ¹ L	10.70	6.4	10.41	6.4	10.41	1.00
M ¹ B	11.68	5.3	11.42	5.2	11.35	0.79
M ² L	10.15	5.4	10.22	7.7	9.65	0
M ² B	11.84	6.2	11.97	6.2	11.47	0
M ³ L	9.09	7.8	9.22	9.1	9.01	0
M ³ B	11.43	7.8	11.56	8.2	10.97	0

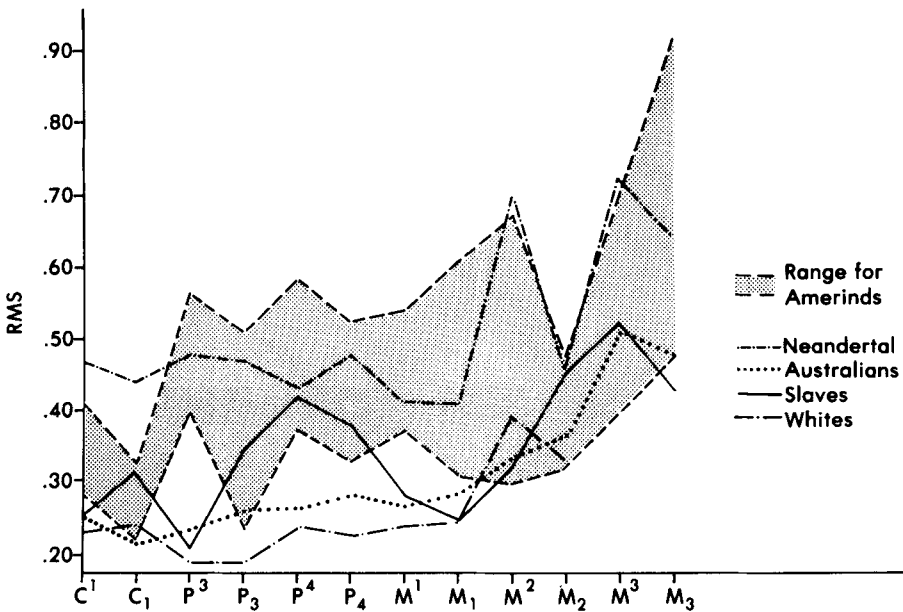


Fig. 8. Root mean square fluctuating dental asymmetry in slaves (Newton) compared with Neandertals (Suarez, 1974), Australian aboriginals (Townsend and Brown, 1980), American Whites (Garn et al., 1966), and various Amerinds (Harris and Nweeia, 1980; Doyle and Johnston, 1977). Mesiodistal and buccolingual values averaged for each tooth.

asymmetry studies, this amount of nonrandom side difference in the postembryonically calcifying teeth is high.

Fluctuating asymmetry levels (RMS: Fig. 8; correlation: Fig. 9) in the slaves are not particularly remarkable. The slaves are much more asymmetric than American Whites, but roughly equal to a variety of anthropological populations, and only slightly more asymmetric than modern Blacks.

TABLE 3. Matched-observation tests of side difference (directional asymmetry) in teeth (right minus left) for mesiodistal (L) and buccolingual (B) diameters

Tooth	t	
	Mandibular	Maxillary
C L	1.12	-0.80
C B	1.95	-0.71
P3 L	0.65	1.27
P3 B	0.34	-0.17
P4 L	0.58	0.46
P4 B	0.55	1.57
M1 L	-0.07	0.88
M1 B	-1.34	1.25
M2 L	0.29	2.60*
M2 B	-0.07	-1.07
M3 L	11.04*	0.75
M3 B	11.29*	-1.40

*Left side is significantly smaller.

Table 4 shows dental trait incidences and cranial discontinuous trait frequencies. Results agree with what would be expected of a population with higher frequencies of phylogenetically primitive traits: a high frequency of four-cusped upper and five-cusped lower molars, and many incisor-canine tubercles. The Carabelli trait is unexpectedly frequent. Also observed are the expected high incidence of extra infraorbital foramina and uniformly rounded anterior-inferior nasal margin; exostoses are rare.

Tables 2 and 4 present "admixture" estimations along with the other data. These estimates are actually phenetic convergence ratios, but can be considered proportional to allelic intermixture, assuming polygenic and equally additive trait determination. This assumption is probably valid for the metrical traits, but it may be inappropriate to the threshold mechanism modelled by Berry and Berry (1967) for skeletal nonmetric traits. The odontometric characters vary considerably in terms of the position of the admixed modern Blacks, the late-calcifying teeth again showing a very different pattern from anterior teeth (Table 2); admixture averages 29.4% while 10-20% was expected. Environmental covariation might be invoked to explain the higher figure. Dental traits (Table 4) have an average 38.3% phenetic convergence of modern Blacks on Whites,

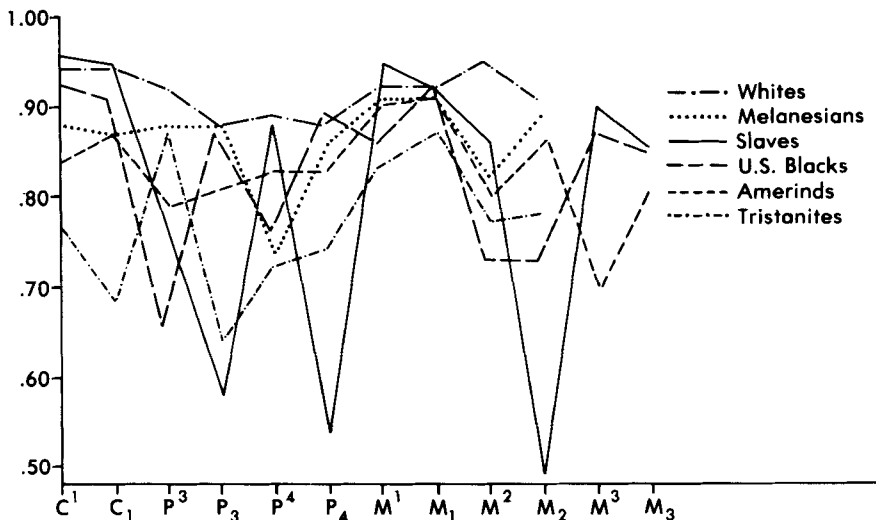


Fig. 9. Correlations between left and right teeth, mesiodistal diameter only, for Newton slaves compared with Tristanites, Kwaio and Nasioi Melanesians, and Boston Whites

(Bailit et al., 1970), Amerinds and American Blacks (Perzigian, 1977). The data of Bailit et al. exclude the M3. Slaves attain extreme values in lower postcanine teeth.

TABLE 4. Frequency of occurrence of cranial and dental nonmetric traits

Trait	(Occurrence/n)	Newton	Blacks	Whites	Admixture
Mental f.	(10/85)	.118	.181	.111	0
Mandibular torus	(0/58)	0	.066	.073	.90
Mylohyoid bridge	(10/64)	.156	.104	.112	1.00
Maxillary torus	(0/22)	0	.119	.067	1.00
Palatine torus	(0/12)	0	.158	.249	.64
Palatine bridge	(5/18)	.278	.224	.069	.26
Nasal sill sharp	(1/31)	.032	.250	.841	.27
Infraorbital f.	(3/15)	.200	.098	.098	1.00
Infraorbital sutural	(1/15)	.067	.209	.298	.62
Mastoid groove ^a	(4/63)	.063	.912	.805	1.00
Mastoid notch ^a	(12/56)	.214	.278	.265	1.00
Mastoid f. ^a	(20/32)	.625	.845	.805	1.00
Mastoid exsutural ^a	(6/20)	.300	.598	.654	.84
Huschke f. ^a	(6/64)	.094	.307	.232	1.00
Carabelli cusp ^b	(13/59)	.220	.118	.351	0
M ¹ 4-cusped ^{a,b}	(103/104)	.990	.953	.938	.71
M ² 4-cusped ^{a,b}	(44/84)	.524	.328	.294	.84
M ₁ 5-cusped ^{a,b}	(81/89)	.910	.936	.874	0
M ₂ 5-cusped ^{a,b}	(28/85)	.329	.250	.112	.36
P ₄ 3-cusped ^{a,c}	(13/72)	.181			
M ₃ 5-cusped ^{a,c}	(35/68)	.515			
M ³ 4-cusped ^{a,c}	(22/53)	.415			
I-C tubercles ^c	(24/67)	.358			

^aScored bilaterally.

^bComparative White and Black data from Wajeman and Levy (1979) and Hanihara (1967).

^cSuitable comparative data could not be found.

a sharper deviation from general expectations. Cranial nonmetric traits are much more consistently convergent; a 75.2% admixture rate in Blacks would have to be invoked to explain their similarity to Whites if the trait frequencies were directly responsive to genetic distance.

These average admixtures are not entirely reliable since negative numbers were considered zeroes in the tables. Another approach involves combining all traits of a given kind into a summary measure of phenetic similarity. Figure 10 contrasts correlation results for metric and nonmetric traits (the latter include dental traits). Modern Blacks are almost equidistant from the hypothetically ancestral slaves and the modern Whites; metrically this requires an admixture rate of 48% that again is untenable. Furthermore, the slaves are nearer Whites than Blacks. This convergence is a result of shared third molar reduction that is probably an evolutionary genetic phenomenon in Whites but an environmental hypotrophy in Black slaves. Nonmetric trait distance at least places modern Blacks in an intermediate position, as is logical, but to explain their proximity to Whites requires a 62% admixture rate.

The final analysis separated each nonmetric character according to one of three mortuary concentration areas, and tested for association

that would have resulted from slave family segregation in burial plots. Cusp number on M₁, M₂, and M³, Carabelli cusp, incisor tubercles, and mastoid notch show enough nonrandom clustering to reject the null hypothesis. This number of tests is significantly more than would be expected merely from sampling error, since the traits are independent. The biological traits show indications of segregation that could result from biological relationships.

DISCUSSION

The osteological demographic data from Newton plantation cemetery are typical in that almost all the infant mortality is missed (exaggerating survivorship for the entire curve), and individuals over 40 are consistently underaged. These are precisely the systematic errors inherent in mortuary demography emphasized by Weiss (1973), who discusses infant underenumeration and age underestimation of the elderly in a wide range of archaeologically-based studies. In the Newton case, detailed historical data on the slave population are available as a unique control; these validate Weiss's generalizations.

For example, in an earlier publication Handler and Lange (1978:282-284) estimated that over 1000 slaves died at Newton between 1670 and 1833; this figure is nearly double the num-

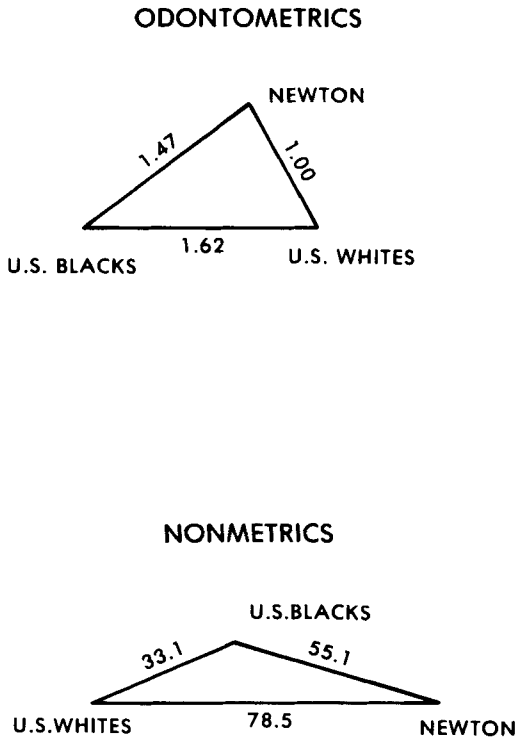


Fig. 10. Representations of multi-trait correlation similarity, given as percent unshared variance ($1 - r^2$), over all mean odontometric variables and over all cranial and dental nonmetric trait frequencies.

ber of interments projected for the total cemetery population on the basis of the excavated skeletal population. Even allowing for errors in these estimates, the archaeological data indicated that a significant number of the plantation's slaves who died over the period were missing from the cemetery. Among other things, it was concluded that interment in the cemetery was selective, and that most infants and small children were interred differently or buried elsewhere.

This conclusion was independently supported by correlating historical data on age at the time of death with the relative age groups that were determined for the skeletal population. Qualitative historical evidence from Barbados in general indicates that the mortality rate of slave infants and small children was high, and that newborn infants were particularly vulnerable to death during their first month (Handler and Lange, 1978:285, 302). Quantitative historical data on Newton in par-

ticular reflect this general pattern and give concrete expression to it. Specific age at death data are available from plantation documents for 232 of the 314 (73.8%) plantation slaves who died over a 33-year period, from 1796 through 1832 (Handler and Lange, 1978:285-286). At least 41.8% of the deaths were in the age five and under group, many of these being infants (roughly under two). Another 5.1% were 6 to 10 years old. Infant mortality was probably higher in the earlier periods of the plantation's history. For the skeletal population, individuals aged 10 and under are considered as infants and small children. Of the 101 excavated skeletons, 9 could be assigned a relative age as small children or infants; only two skeletons could clearly be identified as under age 5. Thus, the population profile reconstructed from the excavated interments reveals a very low percentage of infants and small children, certainly much lower than the number of deaths in these groups that would be expected as gleaned from the historical record. Many infants and small children must have been excluded from the cemetery.

Over the duration of the slave period (1627-1834) the vast majority of Barbados's slaves were buried on plantations, in specific burial grounds that were set aside for slave interments. The historical sources on Barbados slave mortuary practices in general implicitly or explicitly refer to the burials of adults, and the general pattern of disposal of infants and small children is unclear. As indicated above, historically derived and archaeological data suggest that infants and small children were buried apart from the main designated burial areas, even though the historical documents are silent as to where these interments took place.

African ethnographic materials suggest what may have happened at Newton (and, presumably, other Barbados plantations). The slave mortuary complex manifested many West African influences (Handler and Lange, 1978:208-215), and in West African cultures small children and infants were generally buried apart from adults or their bodies were merely cast into the bush. It is reasonable to assume that, especially in the earlier years of the slave period, African traditions also influenced the disposition and burial of small children and infants: most may have been buried in a special area of Newton cemetery not encountered through random sampling; in an area bordering the cemetery; in an area relatively distant from the main cemetery or the slave village;

or they may not have been buried. Whatever the case, all evidence indicates selective interment procedures. The possibility of differential treatment of small children and infants, especially as projected from archaeologically recovered skeletal remains, is supported on a more general level by a wide range of cross-cultural data (e.g., Weiss, 1973:12).

The above illustrates that regardless of the care and intensiveness of archaeological recovery of skeletons, cultural practices may lead to infant underenumeration, with a resultant demographic inference of low infant mortality (cf., Lovejoy et al., 1977). Techniques that adjust for infant numbers (Angel, 1971; Swedlund and Armelagos, 1976) fail to circumvent the problem at the other end of the age scale with the older individuals; here we have also specified underenumeration in the traditional osteological method. In sum, Weiss's (1973) arguments are sustained and perhaps nothing is learned demographically from Newton's skeletal remains that is not more accurately inferred from historical sources on the plantation.

The skeletal evidence indicates much developmental disruption, no cranial porotic but much periodontal infection, and some severe trauma such as results from blows to the side of the head. There was some malocclusion, most of it probably relating to malnutrition rather than reduced dietary consistency; the slave temporomandibular joint shows no size reduction such as that in modern-day American Whites and Blacks resulting from reduced chewing forces and a soft, processed diet (Corruccini and Handler, 1980).

All the physical and ethnohistorical evidence indicates that the Barbadian skeletal population would be among the most metabolically insulted on record (cf., Dirks, 1978). Bilateral dental asymmetry, however, is not extraordinary, although it is probably slightly greater than average. Using the RMS statistic, there are indications that slave asymmetry is extreme in the mesiodistal dimensions of lower postcanine teeth (Fig. 8).

The postnatally calcifying teeth (M2-3) show an entirely different pattern from the more mesial teeth in odontometric size, variation, and asymmetry. They display significant laterality (an indication of intrauterine competition stress, for example, in twins), and are less developed than in American Whites with their reduced distal molars. Sofaer and MacLean (1972), Garn et al. (1965), and Siegel and Doyle (1975a,b) show that distal molars are under less genetic

control, are more variable, and develop later than mesial teeth. This contrast helps delimit prenatal from postnatal environment influences; slaves clearly experienced greatest stress during the latter period.

Enamel hypoplasia in the slave population most likely resulted from nutritional and not infectious factors, and is best interpreted in age-specific terms (Clarke, 1980). Most populations show a hypoplasia peak from age 2 to 3 (Black, 1979; Clarke, 1980). Clark (1980) convincingly argues that the peak corresponds to the immediate postweaning period of nutritional stress. The slave growth arrest lines indicate that the postweaning period of growth disorder took place most commonly at ages 3 and 4.

With respect to other skeletal populations reported in the literature, the Barbados slave growth arrest lines are of unprecedented severity as well as frequency. They consist of deep bands, followed by normal enamel deposition with no permanent disruption or mottling on the crown. From the demographic distribution we see no evidence of the postweaning mortality peak that occurs following the postnatal mortality peak in other well-documented populations (Swedlund and Armelagos, 1976). This is probably due to inaccurate representation in the Newton cemetery. It may be that the skeletal sample is predominantly composed of survivors of the period of postweaning stress. At any rate, no previously described population, including Colonial U.S. slave remains compared in the National Museum of Natural History (R.S.C., pers. obs.; J.L. Angel, pers. comm.) seems to equal the Barbados slaves in intensity of growth arrest lines.

We examined the possibility that some slaves at Newton developed family burial areas, and concluded that at least one such area probably existed. Ethnohistoric sources favor this interpretation over one of tribal or ethnic affinities. The family similarity in physical traits by burial area, however, could theoretically have resulted from environmental similarity in families just as much as from heredity. Indeed, we would argue from distribution of traits between Barbados slaves and modern U.S. Blacks that these discrete traits are under greater environmental influence than is commonly believed. However, further testing of mortuary patterning is needed in other larger and less disturbed cemetery areas in order to deal with this issue conclusively.

The Barbados slave characteristics offer a different perspective on the genetic distances

that are commonly constructed in comparative skeletal studies. We have remains of early relatives of the African ancestral population (the Barbados slaves), modern descendants (U.S. Blacks), and the adjacent source of gene flow (U.S. Whites). The two U.S. populations share a climatological, social, and technological environment that is very different from Barbados. Comparison between these three groups is one proper method to assess genetic influence in morphological trait distances. In general, our results (Tables 2, 4) do not strongly confirm any class of data, but discontinuous traits, in particular, are curiously distributed in terms of known genetic relationships. No trait class correlates with genetic admixture, which would cause modern Blacks to converge only 10–20% on modern Whites. Environmental parallelism among U.S. Blacks and Whites appears to be the strongest influence; there is also convergence among Barbados slaves and U.S. Whites in posterior molar reduction. This is not to say that genetic influence over the traits is lacking; rather, it indicates that really extreme environmental differences need to be controlled in making genetic comparisons. Underlying genetic factors seem to be diluted in large-scale, cross-continental racial comparisons of discrete trait frequencies (e.g., Berry and Berry, 1967), while genetic effect is more noticeable in local or microevolutionary comparisons (Kaul et al., 1979).

The odontometric distances between Barbadian slaves and U.S. Black and White populations are also discordant with expected genetic distance. Garn et al. (1979) have recently dissented from the longstanding anthropological confidence in dental dimensions, and stress the importance of hidden prenatal influences. These influences have been mistaken for genetic covariance rather than environmental covariance in, for example, twin studies, especially when effects are unequal for mono- and dizygotes (Potter et al., 1979; Boklage et al., 1979); thus spuriously high heritability coefficients have been achieved. Again, this does not imply that the traits are not genetic, but that they should be compared within samples from environments that are no more variable than those which characterize the populations originally yielding evidence for the trait heritability. For example, a trait that has been judged inherited, based on studies within homogeneous urban Whites may nevertheless primarily differ environmentally between Whites and Blacks—as attested by the IQ controversy.

One example of postnatal functional environmental covariance in a skeletal trait complements the evidence for prenatal covariance in dental traits. The nasal sill flatness trait is a traditional marker of Black genetic background, but it is functionally related to alveolar prognathism and general aspects of midfacial growth (J.L. Angel, pers. comm.). U.S. Blacks are convergent on Whites to a degree in excess of genetic admixture because both groups share a diet of processed and soft foods that lack elements that require transmission of stresses from vigorous mastication to the bone. Chewing stress and dietary consistency has an effect on the entire maxillo-facial area (cf., Beecher and Corruccini, 1981), and this may have led to the shared change in nasal form.

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