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A Peculiar Population: The Nutrition, Health, and Mortality of American Slaves from Childhood to Maturity

RICHARD H. STECKEL

The debate over the health and nutrition of slaves has focused on the typical working adult. Height and mortality data, however, indicate that the greatest systematic variation in health and nutrition occurred by age. Nourishment was exceedingly poor for slave children, but workers were remarkably well fed. The unusual growth-by-age profile for slaves has implications for views on the postwar economic fortunes of blacks, the interpretation of findings of other height studies, and conceptions of slaveowner decision making, the slave family, and the slave personality.

Controversy over the health and mortality of slaves began during the abolitionist era when critics of slavery included charges of poor living conditions and poor nutrition as part of their attack.[1] Although claims of neglect and abuse were secondary issues in the campaign against the institution in the United States, the charges nevertheless defined many questions for later research. Virtually all comprehensive twentieth-century works on slavery address the issues of health and nutrition.

The most substantial investigation of health and diet was undertaken in *Time on the Cross* and its aftermath. Robert Fogel and Stanley Engerman employed the disappearance method to estimate food consumption for adults as the difference between food production and nonslave utilization on large southern farms located at least fifty miles from a city and argued that the diet was substantial calorically and exceeded recommended levels of the chief nutrients.[2] Critics examined every step of this procedure and raised questions about methods of food

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[1] Theodore D. Weld, *American Slavery as It is: Testimony of a Thousand Witnesses* (New York, 1839), pp. 27–35.

[2] Robert William Fogel and Stanley L. Engerman, *Time on the Cross: The Economics of American Negro Slavery*, 2 vols. (Boston, 1974).

preservation and cooking, the adequacy of the diet for blacks, and whether the diet was sufficient for the work effort required of slaves.[3] Richard Sutch criticized the Fogel and Engerman estimates as too generous, especially for important nutrients but concluded that without question the diet was sufficient to maintain the slave's body weight and general health. Kenneth and Virginia Kiple emphasized nutritional deficiencies, evident in the poor health of children, exacerbated by a biological heritage that was adapted to African conditions.[4]

Recently, height data that are measures of net nutrition—that is, actual diet minus claims on the diet made by maintenance, physical activity, and disease—have been brought to bear on the nutrition, health, and living standards of various populations.[5] Although adult height estimates suggest slaves eventually achieved reasonably good health, final heights represent the end result and therefore tell us little about the course of health by age.[6] Here I extend work in the area by combining height data from slave manifests, mortality data from plantation records, and growth curves for eighteenth, nineteenth, and poor twentieth-century populations to investigate determinants and consequences of slave health from early childhood to maturity.

I. HEIGHT BY AGE

In 1807 Congress passed legislation designed to prevent smuggling African slaves but permit interregional transportation of American slaves through the coastal and waterways trade.[7] The law required ship

[3] Richard Sutch, "The Treatment Received by American Slaves: A Critical Review of the Evidence Presented in "Time on the Cross," *Explorations in Economic History*, 12 (Oct. 1975), pp. 335–438; Richard Sutch, "The Care and Feeding of Slaves," in Paul A. David, Herbert G. Gutman, Richard Sutch, Peter Temin, and Gavin Wright, eds., *Reckoning with Slavery* (New York, 1976), pp. 231–301.

[4] Kenneth F. Kiple and Virginia H. Kiple, "Slave Child Mortality: Some Nutritional Answers to a Perennial Puzzle," *Journal of Social History*, 10 (Spring 1977), pp. 284–309. Other recent discussions of the diet can be found in Leslie Howard Owens, *This Species of Property: Slave Life and Culture in the Old South* (New York, 1976), pp. 50–69; and Todd L. Savitt, *Medicine and Slavery: The Diseases and Health Care of Blacks in Antebellum Virginia* (Urbana, 1978), pp. 86–98.

[5] The early works involving heights and economic history emphasize methodology. See Richard H. Steckel, "Slave Height Profiles from Coastwise Manifests," *Explorations in Economic History*, 16 (Oct. 1979), pp. 363–80; Lars G. Sandberg and Richard H. Steckel, "Soldier, Soldier, What Made You Grow So Tall? A Study of Height, Health, and Nutrition in Sweden, 1720–1881," *Economy and History*, 23 (1980), pp. 91–105; and Robert W. Fogel et al., "Secular Changes in American and British Stature and Nutrition," *Journal of Interdisciplinary History*, 14 (Autumn 1983), pp. 445–81. Richard H. Steckel, "Height and Per Capita Income," *Historical Methods*, 15 (Winter 1982), pp. 1–7 discusses heights and other measures of living standards.

[6] Steckel, "Slave Height Profiles"; Robert A. Margo and Richard H. Steckel, "The Heights of American Slaves: New Evidence on Slave Nutrition and Health," *Social Science History*, 6 (Fall 1982), pp. 516–38. The disappearance method of estimating food consumption tells us little about age patterns of health.

[7] Charles H. Wesley, "Manifests of Slave Shipments Along the Waterways, 1808–1864," *Journal of Negro History*, 27 (Apr. 1942), pp. 155–74.

captains to prepare duplicate manifests that described each slave by name, age, sex, color, and height. One copy of the manifest was lodged with the collector at the port of origin, and the other was delivered by the captain to the collector at the port of destination. The data I use consist of 10,562 manifests and 50,606 slaves transported primarily between 1820 and 1860.[8]

The profiles of height and velocity (change in height between successive ages) calculated from the raw data resemble those for carefully-conducted modern studies.[9] Age and height heaping suggest, however, that some of the data were approximated. Variations in the distribution of exact ages for those of a particular age at last birthday may also have produced gyrations in the mean heights.

The height-by-age data can be smoothed to obtain more accurate estimates of the true mean heights. This approach also furnishes point estimates of useful measures such as the age of peak height velocity during adolescence. These point estimates facilitate comparisons across populations. The second column of Tables 1 and 2 present estimates of slave heights obtained by fitting the Preece-Baines Model 1.[10] The estimated values are generally close to the raw values: in comparisons the differences at a particular age exceed one-half an inch in only two instances for both sexes, and exceed one-quarter of an inch in only eight instances. The average deviation (in absolute value) across all ages is approximately 0.16 inches. As one would expect from a smoothing procedure, the deviation between the estimated and the raw values tend to alternate between positive and negative as age increases.

The estimated velocity profiles, given in the third column of Tables 1 and 2, closely resemble the pattern characteristic of modern growth

[8] The data are housed in Record Group 36 of the National Archives and include 1,442 manifests and 16,099 slaves discussed in Steckel, "Slave Height Profiles," plus all the manifests lodged under the port of Savannah. The slaves in this collection originated primarily from Baltimore (5.5 percent), Charleston (33.2 percent), Jacksonville (3.0 percent), Mobile (6.8 percent), New Orleans (4.4 percent), Norfolk (3.7 percent), Richmond (2.1 percent), and Savannah (26.8 percent).

[9] The raw data are published in Margo and Steckel, "The Heights of American Slaves," p. 518 (ages 8 and above), and in centimeters (ages 4 and above) in Richard H. Steckel, "Depression and Recovery: The Remarkable Case of American Slaves," *Annals of Human Biology* (forthcoming).

[10] Research on mathematical methods of description and analysis of the growth curve extends back to efforts by Quetelet in the early nineteenth century; see James M. Tanner, *A History of the Study of Human Growth* (Cambridge, 1981), pp. 130–36. The goals of this work have been mathematical parsimony—that is, the capacity to summarize large amounts of growth data using few parameters—and to discover functional forms whose parameters have a clear meaning. However, the complexity of the shape of the growth curve has frustrated many approaches, and until recently efforts concentrated on portions of the curve. Preece and Baines propose and estimate a family of functions that describe the whole growth curve, and which satisfy the constraints of fitting better than previous models and have no more than 5 or 6 parameters. Ultimately they recommend "Model 1" on the basis of robustness and simplicity. See M. A. Preece and M. J. Baines, "A New Family of Mathematical Models Describing the Human Growth Curve," *Annals of Human Biology*, 5 (Jan. 1978), pp. 1–24. R. L. Mirwald kindly furnished the computer program used for estimation.

TABLE 1
ESTIMATED SLAVE HEIGHTS OF MALES COMPARED WITH MODERN STANDARDS

Age	Estimated Slave Height	Velocity[a]	Modern Standard[b]	Col. (4) Minus Col. (2)	Standard Deviation of Modern Standard[c]	Standard Deviations Below Modern	Centile of Modern
4.5	35.70	2.85	41.34	5.64	1.94	2.91	0.2
5.5	38.42	2.62	43.90	5.48	2.07	2.65	0.4
6.5	40.93	2.41	46.30	5.37	2.20	2.44	0.7
7.5	43.26	2.24	48.58	5.32	2.30	2.31	1.0
8.5	45.42	2.10	50.75	5.33	2.38	2.24	1.3
9.5	47.47	2.00	52.87	5.40	2.47	2.19	1.4
10.5	49.45	1.96	54.84	5.39	2.60	2.07	1.9
11.5	51.42	1.99	56.97	5.55	2.80	1.98	2.4
12.5	53.44	2.08	59.17	5.73	3.02	1.90	2.9
13.5	55.59	2.21	61.73	6.14	3.30	1.86	3.1
14.5	57.85	2.31	64.57	6.72	3.35	2.01	2.2
15.5	60.15	2.26	66.97	6.82	3.02	2.26	1.2
16.5	62.29	1.97	68.31	6.02	2.68	2.25	1.2
17.5	64.04	1.51	68.70	4.66	2.62	1.78	3.8
18.5	65.30	1.02	68.78	3.48	2.62	1.33	9.2
19.5	66.11	0.63	68.78	2.67	2.62	1.02	15.4
20.5	66.59	0.36	68.78	2.19	2.62	0.84	20.0
21.5	66.86	0.20	68.78	1.92	2.62	0.73	23.3
Adult	67.17		68.78	1.61	2.62	0.61	27.1

[a] Value of the first derivative of the Preece-Baines function at exact age shown. This is an "instantaneous" measure of velocity.
[b] From J. M. Tanner, R. H. Whitehouse, and M. Takaishi, "Standards from Birth to Maturity for Height, Weight, Height Velocity, and Weight Velocity: British Children, Part II," *Archives of Disease in Childhood*, 41 (Dec. 1966), pp. 613–35.
[c] Augmented to compensate for aggregation of exact ages according to M.J.R. Healy, "The Effect of Age-Grouping on the Distribution of a Measurement Affected by Growth," *American Journal of Physical Anthropology*, 20 (Mar. 1962), pp. 49–50. This adjustment is particularly important for ages at which growth is rapid.
Source: Calculated from Appendix Table 1 (available on request).

studies.[11] The estimates decline uniformly for several years after age 4.5, reaching a preadolescent minimum around age 9.5 in females and age 10.5 in males. The adolescent growth spurt is clearly visible in both sexes, and growth continued on average into the late teens or early twenties. In accordance with modern studies, slave girls matured more rapidly than the boys.

The nutritional requirements for growth increase substantially during adolescence, and growth may be retarded at these ages depending upon the nature and extent of deprivation during adolescence and during earlier years. Thus the age at which the peak of the adolescent growth spurt is reached is a useful index of health and nutrition. Recent studies of well-nourished populations place these values in the range of 11.5 to

[11] Many examples are given in Phyllis B. Eveleth and James M. Tanner, *Worldwide Variation in Human Growth* (New York, 1976).

TABLE 2
ESTIMATED HEIGHTS OF FEMALES COMPARED WITH MODERN STANDARDS

Age	Estimated Slave Height	Velocity[a]	Modern Standard[b]	Col. (4) Minus Col. (2)	Standard Deviation of Modern Standard[c]	Standard Deviations Below Modern	Centile of Modern
4.5	35.90	2.77	40.87	4.97	1.94	2.56	0.5
5.5	38.53	2.51	43.43	4.90	2.07	2.37	0.9
6.5	40.93	2.29	45.83	4.90	2.20	2.23	1.3
7.5	43.12	2.11	48.11	4.99	2.30	2.17	1.5
8.5	45.16	1.98	50.31	5.15	2.40	2.15	1.6
9.5	47.12	1.93	52.56	5.44	2.50	2.18	1.5
10.5	49.06	1.99	54.92	5.86	2.68	2.19	1.4
11.5	51.13	2.16	57.52	6.39	3.04	2.10	1.8
12.5	53.39	2.38	60.04	6.65	2.93	2.27	1.2
13.5	55.84	2.46	62.17	6.33	2.65	2.39	0.8
14.5	58.18	2.16	63.43	5.25	2.45	2.14	1.6
15.5	60.04	1.53	63.78	3.74	2.38	1.57	5.8
16.5	61.24	0.90	63.86	2.62	2.36	1.11	13.4
17.5	61.91	0.46	63.86	1.95	2.36	0.83	20.0
18.5	62.24	0.22	63.86	1.62	2.36	0.69	24.5
19.5	62.39	0.10	63.86	1.47	2.36	0.62	26.8
20.5	62.46	0.05	63.86	1.40	2.36	0.59	27.8
21.5	62.49	0.02	63.86	1.37	2.36	0.58	28.1
Adult	62.51		63.86	1.35	2.36	0.57	28.4

Notes: See Table 1.
Source: Calculated from Appendix Table 1 (available on request).

12.0 years among girls and 13.0 to 14.0 years among boys.[12] Point estimates for slaves obtained from the Preece-Baines model are 13.27 years for girls and 14.75 years for boys, and consequently adolescent growth among slaves was retarded by 1 to 1.5 years compared with modern standards.[13] Comparisons with populations in the past and with poor populations of the twentieth century are discussed later.

Growth is ordinarily a process in which events occur in a well-defined sequence. A sequence that has implications for historical and economic questions is the fact that menarche in girls usually occurs within 1 to 1.5 years following the peak of the adolescent growth spurt.[14] The point estimate of the age at peak velocity of 13.27 years for girls affirms the conclusion reached in earlier work that female slaves could have given birth by approximately age 17 on average. The average age at first birth among slave women was about 19.8 to 21.6 years, depending upon

[12] Eveleth and Tanner, *Worldwide Variation*, p. 165.

[13] The age for girls is similar to that reported from a smaller data set and a different procedure in Steckel, "Slave Height Profiles," of 13.34 years and in James Trussell and Richard Steckel, "The Age of Slaves at Menarche and Their First Birth," *Journal of Interdisciplinary History*, 8 (Winter 1978), pp. 477–505, of 13.20 years. The age for boys is about 1 year less than reported in Steckel, "Slave Height Profiles."

[14] Trussell and Steckel, "The Age of Slaves," pp. 498–501.

plantation size. Since it is likely that slaves did not practice family limitation, these data suggest that most slaves abstained for a period of time after they were sexually mature.[15]

Columns 4 through 7 in Tables 1 and 2 present data essential for converting the average slave heights into centiles of modern standards. On average slaves were roughly 5 to 5.5 inches below modern standards as children. The gap exceeded 6 inches during the years of the growth spurt of the standard population and then gradually declined by adulthood to 1.61 inches for males and 1.35 inches for females. The standard deviations of modern standards rise continuously with age during childhood, peak during the peak adolescent growth spurt, and then decline to 2.62 inches for adult males and 2.36 inches for adult females. Heights and other characteristics of development are most diverse during adolescence because different individuals may begin the growth spurt and other processes of maturation at substantially different chronological ages. Column 7 displays the number of standard deviations that average slave heights were below modern standards, and the last column converts this information into centiles of modern standards on the assumption that heights were normally distributed.

The stature of young slave children would trigger alarm in a modern pediatrician's office. At age 4.5 boys on average reached only centile 0.2 and girls attained only 0.5. Progress was slow for many years thereafter. Upward movement through the centiles, or catch-up growth, occurred after age 4.5, but the first centile of modern standards was not reached until age 6.5 in females and age 7.5 in males. The apparent reversal, or downward slide through the centiles, that occurred following age 11.5 in girls and age 13.5 in boys is largely attributable to the fact that the adolescent growth spurt begins 1 to 2 years earlier in the standard population. Sustained catch-up growth took place after age 13.5 in girls and about age 16.5 in boys, and by adulthood males reached centile 27.1 and females reached 28.4.

II. COMPARISONS

Slave labor operated under legal and social arrangements that differed considerably from those for free labor. In recent decades an extensive literature has emerged over how these arrangements affected slaves. This literature is inevitably comparative, and the free population and other slave regimes have been employed as backdrops against which American slavery has been compared and contrasted on issues of methods of production, work requirements, culture, material conditions

[15] Ages at first birth and other aspects of slave fertility are discussed in Richard H. Steckel, "The Fertility of American Slaves," *Research in Economic History*, 7 (1982), pp. 239–86 and in Richard H. Steckel, *The Economics of U.S. Slave and Southern White Fertility* (New York, 1985).

of life, and demographic behavior. It is therefore natural to seek perspective on patterns of American slave growth.[16]

The most noticeable feature of slave growth is the remarkable climb from below the first centile of modern height standards in early childhood to approximately the twenty-eighth centile as adults. Poor populations of developing countries provide valuable comparisons because the growth studies were carefully conducted according to modern methods and with modern equipment and because it is possible to study influences on growth and development in these populations.

The most comprehensive source of growth data for the mid-twentieth century is Phyllis Eveleth and James Tanner, *Worldwide Variation in Human Growth*. According to these data, young slave children fell among or below the poorest populations of developing countries. At age 3, for example, children from urban areas of Bangladesh attained centile 0.3 as males and centile 0.4 as females, and those from the slums of Lagos, Nigeria reached centile 12.1 as males and centile 6.4 as females. American slaves had an exceptionally poor start in life.[17]

Developing countries that had relatively small children also had relatively small teenagers and adults. In other words, it was unusual, if not unique, to achieve the catch-up growth of slaves. A regression of height relative to modern standards at older ages on height relative to modern standards at young ages gives a sense of the extent to which slaves were different. The following equation was estimated:

$$LRHTA = \underset{(-1.17)}{-0.0138} + \underset{(5.61)}{0.8575}\, LRHTC;\ N = 39,\ R^2 = .46$$

where *LRHTA* is the natural log of relative height as adults or older teenagers (ages 16 through 18) and *LRHTC* is the natural log of relative height as children (ages 3 through 8); *t*-statistics are given in parentheses.[18]

The extent to which slaves fit the pattern for developing countries can be assessed by substituting the relative height of slave children into the equation. At age 4 slaves attained 87.4 percent of modern standards (average for males and females), which implies an estimated relative

[16] Comparisons involving Asians versus Europeans and Africans should be made cautiously because of the possible role of genetic factors. This point and references to the literature are discussed in Richard H. Steckel, "Birth Weights and Infant Mortality Among American Slaves," *Explorations in Economic History*, 23 (Apr. 1986), fn. 2.

[17] Additional comparisons with poor populations are available in Steckel, "Birth Weights," table 3.

[18] For purposes of this analysis it is desirable to have measurements throughout the growing years. However, studies generally focused on an age block within the growing years, and the youngest and the oldest ages within the block were used for the regression. Studies lacking measurements below age 9 or above age 15 were ignored. Similar results were obtained using a simple linear functional form. The regression includes only those populations that attained no more than 98 percent of modern height standards as children. The modern standards are from J. M. Tanner, R. H. Whithouse, and M. Takaishi, "Standards from Birth to Maturity for Height, Weight, Height Velocity, and Weight Velocity: British Children, 1965, Part II," *Archives of Disease in Childhood*, 41 (Dec. 1966), pp. 613–35.

height as adults of 87.9 percent of modern standards. An 80 percent confidence interval for the predicted value of relative adult height is (81.7 percent, 94.5 percent). Yet slaves reached 95.1 percent of standard height at age 17.5 and 96.2 percent of standard height at age 18.5. In contrast with American slaves, the conditions that produced low heights for children in developing countries tended to persist throughout the growing years.

Populations that were contemporary or approximately contemporary with slaves are a second source for comparisons. Table 3 displays the centiles of modern height standards attained from childhood to maturity for a variety of American, European, and Caribbean slave populations that lived during the nineteenth and the late eighteenth centuries. This table confirms that American slaves had an unusual growth pattern. As young children American slaves were smaller than any of the populations. However, the advantages of Caribbean slaves and German peasants were slight (or nonexistent as in the case of Trinidad males ages 6.5 and beyond). Yet by age 16.5 American male slaves were taller than factory workers and laboring classes in England, the poor of Italy, students in Habsburg military schools, the middle class of Stuttgart, German peasants, and factory workers in Russia. As adults they also exceeded the aristocrats of Stuttgart, Moscow middle school pupils, and were about one-half inch below the Swedish schoolchildren, and less than one inch below the nonlaboring classes in England. At age 17.5 American female slaves exceeded Boston women of American or Irish parents, factory workers in England or Russia, and the upper class in Italy and were slightly more than one inch below the tallest group (schoolchildren in Sweden). In contrast with slaves, the centiles for free populations followed a more pronounced U-shaped pattern, ultimately attaining levels near those of childhood.[19] Exceptions to the symmetric pattern, such as the nonlaboring classes in England, had catch-up growth considerably below that for American slaves. Caribbean slaves also had much less catch-up growth.[20]

[19] The raw data were smoothed using the Preece-Baines Model 1. Steckel, "Growth Depression and Recovery," gives the estimated heights. The results for the school studies should be viewed cautiously because sample sizes tended to diminish beyond age 15. A selective process of retention may have operated at the older ages. If wealthier families sought relatively more education for their children, for example, then catch-up growth may be exaggerated. The heights tended to increase over time, yet there was considerable variation within a time period. The differences by social class within central Europe during the late 1700s, and within England, Italy, Russia, and the United States may reflect the distribution of income or living standards within these populations. Overall the American populations generally did well whereas the slave populations of the Caribbean, factory workers in England, the lower class of Italy, and the German peasants did poorly. Research that may explain these patterns of growth and other height data in terms of causal factors such as income, disease, diet, work effort, and other phenomena is at an early stage of development. The height data will be most useful when assembled to confront specific hypotheses about differences and time profiles in living standards.

[20] Point estimates of the ages at which velocity peaked were 14.3 and 12.4 years for males and females, respectively, in St. Lucia, and 15.0 and 13.5 years among males and females, respectively,

Before examining the implications of the unusual growth pattern—or of any pattern of evidence that is unusual or different—it is important to ponder whether the results are credible or plausible. One approach leans on the raw data. Were the measurements and other data accurately taken and were the slaves involved in the coastwise trade generally representative of the slave population? An appendix available upon request discusses these questions and argues that it is probably safe to take the data at ages 3 and above at face value.[21]

Are the slave growth patterns plausible given medical evidence on the determinants of growth? Specifically, is it possible for a population that was so deprived in childhood to recover to such an extent? Although a definitive answer cannot be given, studies of human populations and experiments with animals suggest a remarkable power to recover depending upon the timing, source, duration, and intensity of the insult and especially the circumstances after the period of deprivation. Consumption of alcohol and smoking by the mother during the fetal period, for example, may permanently stunt the child's growth.[22] On the other hand, studies of infants and young children and of young monkeys that endured episodes of severe malnutrition showed complete or almost complete recovery to the heights and weights of control groups.[23] Because the slave experience appears to have been so unusual, however, it may not be possible to conduct the appropriate experiment. While the present state of medical knowledge may not be able to confirm

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in Trinidad. With the exception of St. Lucia females, these values are close to those estimated for slaves in the United States. The value for St. Lucia females is about one year below the value for the United States, yet postadolescent catch-up growth was much less for the Caribbean slaves. A poorer diet, heavier postadolescent work requirements, more infections, and especially alcohol consumption by Caribbean slaves during pregnancy may have contributed to the contrast in growth patterns. Tanner notes that in modern data marked stunting with only a minor degree of delay is associated with pathology before age 1, the classic case being pathology of the placenta caused by consumption of toxic substances; see J. M. Tanner, "The Potential of Auxological Data for Monitoring Economic and Social Well-Being," *Social Science History*, 6 (Fall 1982), p. 576. Alcohol consumption by Caribbean slaves is discussed in Barry W. Higman, *Slave Populations of the British Caribbean, 1807–1834* (Baltimore, 1984), p. 205; and John James McCusker, Jr., "The Rum Trade and the Balance of Payments of the Thirteen Continental Colonies, 1650–1775" (Ph.D. diss., University of Pittsburgh, 1970). In contrast, Crawford finds from interviews with ex-slaves that fewer than 10 percent of slaves in the United States consumed alcohol on a regular basis. See Stephen C. Crawford, "Quantified Memory: A Study of the WPA and Fisk University Slave Narrative Collections" (Ph.D. diss., University of Chicago, 1980).

[21] Slaves transported by ship were probably drawn substantially from coastal areas, where a poor disease environment may have reduced heights. On the other hand, plantation size in the South increased over time through sales from small to larger units and slaves from areas of small plantations tended to be taller. Although the net effects are unknown at present these data are interesting historically, regardless of the net effects, because a large share of slaves lived near coastal areas.

[22] J. M. Tanner, *Fetus Into Man: Physical Growth from Conception to Maturity* (Cambridge, Mass., 1978), pp. 46–47; E. L. Abel, "Consumption of Alcohol During Pregnancy: A Review of Effects on Growth and Development of Offspring," *Human Biology*, 54 (Sept. 1982), pp. 421–53.

[23] Tanner, *Fetus Into Man*, pp. 131–37. High mortality rates, shown in Table 4, may have claimed relatively more of those who adapted poorly to deprivation. Survivors may have been more efficient at utilizing a given amount of nutrition for growth.

TABLE 3
ESTIMATED CENTILES OF MODERN HEIGHT STANDARDS ACHIEVED BY VARIOUS POPULATIONS BY AGE

Location and Group	Date(s)	Sample Size	Sex	4.5	5.5	6.5	7.5	8.5	9.5
Stuttgart, aristocrats	1772–94	1,465	M					16.5	12.2
Stuttgart, middle class	1772–94	2,769	M					5.3	4.2
Germany, peasants	1790s	1,145	M			2.7	2.1	1.6	1.1
Habsburg, military schools	1800–04	6,638	M			3.6	2.4	1.6	1.1
Trinidad, Creole slaves	1813	2,083	M	0.4	0.6	0.8	0.8	0.8	0.8
		2,187	F	0.8	1.1	1.3	1.4	1.3	1.0
St. Lucia, Creole slaves	1815	2,196	M	0.8	1.0	1.1	1.1	1.0	0.9
		2,119	F	3.1	3.1	3.1	2.8	2.4	2.0
England, factory workers	1833	420	M						1.8
		651	F						2.8
Boston schools, American parents	1875	4,327	M		14.0	15.6	15.8	15.2	13.8
		3,681	F		17.3	17.4	16.4	14.9	13.1
Boston schools, Irish parents	1875	5,235	M		11.3	11.9	11.5	10.6	9.2
		3,623	F		13.5	13.2	12.1	10.9	9.2
England, nonlaboring	1870s	6,402	M						16.1
England, laboring	1870s	14,988	M		8.6	8.2	7.2	6.0	4.7
Italy, upper class	1870s	374	M					12.2	8.1
		336	F					10.4	9.7
Italy, poor class	1870s	453	M					1.2	1.2
Milwaukee schools, American parents	1881	404	M		17.2	19.8	20.8	20.7	19.3
		472	F		18.7	17.5	16.3	15.8	15.6
Milwaukee schools, German parents	1881	2,780	M		18.2	17.1	15.3	13.4	11.3
		2,577	F		9.4	12.4	13.8	14.0	12.8
Sweden, schools	1883	14,590	M			42.4	35.5	28.9	22.2
		3,209	F			23.4	20.7	18.2	15.3
Denmark, schools	1880	17,595	M			10.7	10.4	9.5	8.1
		11,646	F			18.9	14.1	10.7	7.8
Russia, factory workers	1880s	29,353	M					5.7	3.8
		22,122	F					6.8	6.2
Moscow, middle schools	1889–90	6,659	M					27.2	22.8
North America, urban schools	Late 1800s	45,151	M		15.8	14.5	14.6	13.9	12.4
		43,298	F		17.2	15.2	14.8	13.8	12.1

[a] For populations with data through ages 18 (females) or 20 (males).
[b] Based on 7 observations.
Source: Richard H. Steckel, "Growth Depression and Recovery: The Remarkable Case of American Slaves," *Annals of Human Biology*, forthcoming.

TABLE 3—continued
ESTIMATED CENTILES OF MODERN HEIGHT STANDARDS ACHIEVED BY VARIOUS POPULATIONS BY AGE

Age											
10.5	11.5	12.5	13.5	14.5	15.5	16.5	17.5	18.5	19.5	20.5	Adults[a]
10.2	8.6	7.8	7.2	5.4	3.5	3.6	7.1	11.7	15.1	17.0	18.7
3.8	3.2	2.7	2.1	1.1	0.4	0.3	1.4	4.3	8.4	11.7	15.9
0.9	0.8	0.7	0.6	0.3	0.1	0.1	0.6	1.7			
0.9	0.8	0.8	0.7	0.4	0.1	0.09	0.5	2.7			
0.9	0.9	0.9	0.8	0.4	0.09	0.04	0.2	0.6	2.3	2.9	3.8
0.9	1.0	0.4	0.2	0.2	1.1	3.6	7.3	10.3			13.5
1.0	1.1	1.1	1.1	0.6	0.1	0.06	0.2	0.6	1.2	1.8	3.1
1.8	1.9	1.0	0.4	0.4	1.1	2.5	4.2	5.4			7.0
1.9	1.8	1.5	1.1	0.7	0.4	0.5	0.8	1.1			
1.9	2.1	1.3	0.6	0.6	1.5	3.4	6.0				
13.8	13.3	13.8	14.4	13.4	11.5	12.3	18.0	23.0			
12.3	13.2	12.2	10.9	11.5	15.3	18.4	20.3	21.1			21.6
8.7	7.8	7.2	6.3	4.6	3.2	4.6	12.3	23.0			
8.1	8.0	5.9	4.2	4.9	9.1	14.1	17.9	19.9			21.8
17.0	16.0	14.8	13.0	10.7	9.6	13.4	23.4	31.1	35.1	36.6	37.5
4.0	3.2	2.5	1.8	0.9	0.3	0.3	1.3	4.1	7.4	9.7	11.9
6.1	4.7	4.3	4.8	5.5	5.4	5.7	7.8	9.5	10.3		
7.6	6.0	3.8	4.3	7.5	10.5	11.4	11.7	11.8			11.8
1.3	1.2	1.2	1.0	0.5	0.1	0.04	0.07	0.1	0.2		
18.7	16.5	14.3	11.8	9.1	8.9	19.2	46.6[b]	67.6[b]			
16.7	18.7	17.5	15.0	15.4	20.8	25.8	29.1	30.8			32.2
10.6	9.6	9.1	8.2	6.1	4.0	4.5	9.8	17.1			
11.4	10.5	7.7	5.9	7.6	14.9	23.2	29.1				
17.8	13.1	9.5	6.6	4.0	2.8	4.8	13.8	24.0	29.8	32.2	33.6
13.1	12.2	9.5	7.8	10.2	18.9	28.5	35.2	38.8			42.1
7.4	6.3	5.5	4.9	4.0	3.8	6.6	14.7	21.9	25.7		
6.0	5.5	3.6	2.7	4.4	12.9	27.0					
2.9	2.1	1.5	1.0	0.4	0.1	0.1	0.8	2.7	4.7	5.9	6.7
4.7	3.3	1.2	0.3	0.3	1.1	3.1	5.1	6.1			6.5
20.3	17.3	15.9	15.5	14.5	13.0	13.4	17.5	20.7	22.4	23.1	23.4
11.9	10.9	10.3	9.9	8.6	7.9	9.6	20.3	28.1			
11.0	11.0	9.2	8.2	10.6	18.1	25.1	29.6				

that it could happen, it certainly does not deny that it could not happen. The available evidence suggests that the slave growth pattern is plausible.

III. EXPLANATIONS

If the height data are credible, then why were young slave children so small? The origins of poor health can be traced to difficult periods of fetal and infant growth.[24] Slave newborns probably weighed on average fewer than 5.5 pounds or 2,500 grams compared with modern standards of 3,450 grams. Conditions may have improved temporarily for those infants who survived the early neonatal period. Although direct information from instructions to overseers and other sources is scanty, breast milk was probably the most important, if not the only, source of nutrition early in infancy. Breast milk is nutritionally ideal, provides some immunity, and is clean, but this source is ordinarily insufficient for normal growth by age 4 to 6 months. However, the number of pounds of cotton picked per day attained normal levels within 3 months after delivery, which suggests that supplementation began earlier. The transition away from breast milk and toward solid foods and manual feeding must have been a difficult adjustment accompanied by elevated rates of illness and mortality. Manual feeding introduced unsanitary implements and contaminated food or liquid, and the diet emphasized starchy products such as pap and gruel. This diet lacked sufficient protein and was probably deficient in iron and calcium. It is not surprising that the postneonatal infant mortality rate was as high as 162 per thousand in a sample of plantation records.[25] Moreover, the average rate of loss was nearly 50 percent higher in months 1 through 4 compared with months 5 through 8, which agrees with other evidence that breastfeeding may have been attenuated in early infancy.

Why was catch-up growth so slow from early childhood to early adolescence? Earlier I noted that heights are a measure of net nutrition: that is, actual diet minus claims on the diet made by illness, physical effort, and maintenance. Although the incidence of illness is difficult to measure, the mortality data in Table 4 suggest that sickness decreased during childhood. Slave mortality rates declined sharply after age 5, and fell below 10 per thousand after age 6 (based on data for individual years of age). The excess mortality of slaves compared with the entire U.S. population was concentrated before age 5, and the excess infant

[24] Steckel, "Birth Weights"; Richard H. Steckel, "A Dreadful Childhood: The Excess Mortality of American Slaves," *Social Science History*, 10 (Winter 1986), forthcoming.

[25] Steckel, "Birth Weights." The poor health of slave children was exacerbated by the synergistic interaction of infection and malnutrition. On this interaction see Nevin S. Scrimshaw, "Interactions of Malnutrition and Infection: Advances in Understanding," in Robert E. Olson, ed., *Protein-Calorie Malnutrition* (New York, 1975), pp. 353–67.

TABLE 4
MORTALITY RATES PER THOUSAND BY AGE FOR SLAVES AND THE ANTEBELLUM POPULATION

Age	Slaves	United States
0	350	179
1–4	201	93
5–9	54	28
10–14	37	19
15–19	35	28
20–24	40	39

Sources: Age 0 (slaves): Richard H. Steckel, "A Dreadful Childhood: The Excess Mortality of American Slaves," *Social Science History*, 10 (Winter 1986), forthcoming, fn. 5 and 17; Richard H. Steckel, "Slave Mortality: Analysis of Evidence from Plantation Records," *Social Science History*, 3 (Oct. 1979), p. 92; Michael R. Haines and Roger C. Avery, "The American Life Table of 1830–1860: An Evaluation," *Journal of Interdisciplinary History*, 11 (Summer 1980), p. 88 (average for the Model West and the logit tables).

mortality was nearly as large as the infant mortality rate for the U.S. population.[26]

It is also unlikely that work effort made an important claim on the diet before late childhood. Interviews of ex-slaves suggest that the transition to the adult labor force was gradual and may have begun in some instances as early as age 6 or 7.[27] However, slave children did not produce enough, on average to more than cover their maintenance costs until about age 10.[28] If the judgments about the decline in sickness and lack of work effort are correct, the conclusion that the diet remained poor is inescapable.

There is independent evidence, however, that the childhood diet was poor. Slaveowners frequently discussed the care and feeding of slaves among themselves and within southern agricultural journals. It is clear that deliberations focused on working slaves. One planter stated that "a negro deprived of a meat diet is not able to endure the labor that those can perform who are liberally supplied with it."[29] Others usually stated allowances of meat, corn, and other foods in terms of working or laboring hands.[30] If children were mentioned at all, they usually received "proportionally less." Proportional to what? The emphasis in these recommendations on the labor force suggests that "proportional

[26] Table 4 approximates the desired comparisons of slaves and whites. The excess mortality is understated by use of data for the entire United States; however, slaves comprised only 12.6 percent of the population in 1860. On the other hand, the slave mortality rates beyond the neonatal period (the first month after birth) are drawn from the records of large plantations and losses tended to increase with plantation size. Steckel, "A Dreadful Childhood," discusses the causes of excess mortality at young ages.

[27] Crawford, "Quantified Memory."

[28] Fogel and Engerman, *Time on the Cross*, p. 76.

[29] James O. Breeden, ed., *Advice Among Masters: The Ideal in Slave Management in the Old South* (Westport, 1980), p. 94.

[30] Ibid, pp. 92–109.

to work effort" was the operative assumption. In addition, the allocations were frequently made to families and the vagueness or lack of specifics about nonworkers conveys no information about actual consumption by children. Meat was scarce—a half a pound of pork per day was a typical recommended ration for a worker—and was probably regarded as a luxury. Parents and other workers in the family may have claimed meat and other nutritional foods at the expense of children. This behavior has occurred repeatedly during hard times within developing countries. Children suffered during a mild subsistence crisis in Sweden at the middle of the nineteenth century.[31] The emphasis by owners on the labor force could have given legitimacy to reallocation within the family, especially during hard times.

The descriptive literature contains evidence of malnutrition among children. Slaveowners discussed the shiny bodies and plump bellies of their young slaves and some travelers interpreted the glistening ribs of pudgy youngsters as signs of good health. These are signs of malnutrition, especially a protein deficiency.[32]

Slave mortality rates changed little after age 7. If the mortality rates are accepted as an index of illness, then variations in the incidence of disease by age had little influence on the course of net nutrition during the remaining years of growth. What was the interplay of diet and physical exertion on growth during these years? Tables 1 and 2 make clear that most of the absolute difference between slave heights and modern standards was made up during the late adolescent and postadolescent period.[33] Although the upward climb through the centiles is dramatic at these ages, the foundations of this achievement should be sought in earlier years.

Comparisons with the Bundi people of New Guinea, shown in Table

[31] John Bongaarts and Mead Cain, "Demographic Responses to Famine," in Kevin M. Cahill, ed., *Famine* (Maryknoll, 1982), pp. 44–59; Graeme Hugo, "The Demographic Impact of Famine," in Bruce Currey and Graeme Hugo, eds., *Famine as a Geographical Phenomenon* (Boston, 1984), pp. 7–31; Lars G. Sandberg and Richard H. Steckel, "Overpopulation and Malnutrition Rediscovered: Hard Times in Nineteenth-Century Sweden," *Explorations in Economic History* (forthcoming).

[32] Kiple and Kiple, "Slave Child Mortality," p. 289.

[33] No more than a small portion of the dramatic rise in slave heights relative to modern standards can be attributed to the selectivity of survival with respect to height. According to Gerald C. Friedman, "The Heights of Slaves in Trinidad," *Social Science History*, 6 (Fall 1982), p. 500, the difference in average heights between survivors and nonsurvivors over a one-year period was about 0.63 inches among nonadults. During the period of roughly 7 years between adolescence and the attainment of adult heights, American slaves gained about 5 inches relative to modern standards. If the average annual mortality rate was no more than 10 per thousand at these ages, as suggested by Table 4, then selectivity could explain no more than about $[(7 \times 0.01 \times 0.63)/5.0] = 0.88$ percent of the height gain.

Comparisons of centiles at ages 15, 16, and 17 indicate that girls recovered more rapidly and to a greater extent than boys. Although girls tend to be more resistant to deprivation, it is also possible that tasks were lighter and that work affiliated with domestic activities, such as food preparation, provided a better diet for girls.

TABLE 5
ESTIMATED CENTILES OF MODERN HEIGHT STANDARDS ATTAINED BY AGE, BUNDI OF NEW GUINEA

Age	Males	Females
4.5	0.3	0.4
5.5	0.2	0.2
6.5	0.08	0.1
7.5	0.04	0.08
8.5	0.02	0.05
9.5	0.008	0.02
10.5	0.006	0.01
11.5	0.005	0.02
12.5	0.005	0.003
13.5	0.005	0.0002
14.5	0.001	0.0008
15.5	0.00009	0.0008
16.5	0.00002	0.01
17.5	0.0003	0.07
18.5	0.006	0.2
19.5	0.04	0.4
20.5	0.1	0.5
Adult	0.3	0.7
N	654	657

Source: Calculated using Preece-Baines Model 1 from L. A. Malcolm, "Growth and Development of the Bundi Child of the New Guinea Highlands," *Human Biology*, 42 (May 1970), pp. 293–328.

5, are instructive. The Bundi have a poor disease environment, suffer from severe protein-calorie malnutrition throughout their growing years, and have the slowest rate of growth of any population studied by auxologists.[34] At ages 4 and 5 the Bundi heights are comparable to slaves, but by ages 7 and 8 the differences are noticeable and by age 10 the difference is substantial. The relative improvement for slaves occurred at ages when slaves entered the labor force. Other things being equal, net nutrition should have deteriorated for slaves at this time. The point is that other things were not equal; there must have been an improvement in the diet sufficient to offset the additional requirements of physical activity and to allow a small amount of catch-up growth. The emphasis by slaveowners on meat for workers is consistent with this pattern.

The modest decline through the centiles that occurred for slaves after age 13.5 in males and after age 11.5 in females does not signify a decline in net nutrition. Heights accelerated at these ages in the standard population due to an earlier growth spurt. Indeed, the facts that the ages of the peaks of the adolescent growth spurts were only about 1 to 1.5 years behind the standard population and that the peak velocities were

[34] L. A. Malcolm, "Growth and Development of the Bundi Child of the New Guinea Highlands," *Human Biology*, 42 (May 1970), pp. 293–328.

nearly as high among slaves are strong evidence of a good diet that continued during adolescence. In contrast, poor nutrition for the Bundi continued through adolescence, their growth spurts were 1 to 2 years later than slaves', and their peak velocities were only about 80 percent as large.

Although the rapid rise through the centiles after adolescence and the emphasis on protein for laborers suggest that the diet remained good during these years, it is also possible that improvement occurred in part through learning to be more efficient at field work. Slaves in their early teens who were expected to keep up with adults faced two disadvantages: one was energy requirements for growth and the other was inexperience. If slaves gradually accumulated skills that reduced energy requirements for a particular task, then more energy from a given diet would have been available for growth.

IV. RATES OF RETURN

Slaveowners expressed and debated convictions on desirable feeding practices. One of these convictions—or at least a widespread practice—excluded meat from childrens' diets. How was this decision reached?

Even though slaveowners lacked the rudiments of scientific understanding of nutrition and health, knowledge about desirable feeding practices could have accumulated through a long process of trial, error, observation, and adjustment. By the late antebellum period planters had considerable experience with the institution of slavery. Is it possible that slaveowners had discovered through trial and error that feeding meat to children was unprofitable? The fact that the growth profile of slaves was so different from those of free populations enhances the prospects for this line of reasoning. Moreover, planters had considerable experience with the feeding of slaves and livestock and had reasons to suspect a connection between diet and growth.[35]

Feeding meat to slave children can be considered as an investment. The net income was negative during the early years of the investment period because meat was costly and children did not work. However, children fed nutritionally adequate amounts of meat emerged taller and stronger once they entered the labor force. What was the rate of return on this type of investment? Some assumptions, which are appraised in footnote 41, are necessary to make the problem tractable. The growth profile was the outcome of an investment strategy that excluded meat from the diet before age 10, at which time children entered the labor

[35] It is possible that slaveowners merely followed dietary practices for children that resembled those in Africa. However, substantial amounts of meat for workers signals a departure from African customs. According to one planter, "a boy or girl ten years old or over, who is healthy and growing rapidly, will eat quite as much as a full grown man or woman." (Breeden, *Advice Among Masters*, pp. 97–98).

force and received one-half pound of pork per day. It is assumed that this ration was sufficient to maintain modern height standards. In other words, the growth spurt was delayed, and slaves failed to achieve modern standards as adolescents and adults because they were underfed as children. An alternative strategy, the one for which the rate of return is sought, was to feed children adequate amounts of meat beginning at age 1. Suppose the second strategy would have produced workers who first entered the work force and who attained modern height standards at exactly age 10 and maintained them thereafter. The amounts of meat necessary to achieve this are a function of the protein deficits of children. The actual deficits are unknown, but height data, dietary studies for developing countries, and animal experiments suggest that a 50 percent deficit is a reasonable first approximation.[36] Based on the protein content of pork and the price of pork during the late antebellum period, annual outlays per child sufficient to cover the deficit would have ranged from about $3.80 at age 1 to $5.90 at age 9.[37]

Data assembled by the Union Army on contraband and runaway slaves during the Civil War show that the value of slaves—and presumably their net earnings—increased by 1.375 percent (relative to the mean) per inch of height.[38] Table 2 gives the increment from actual height to modern standards, and net earnings estimates by age are available from Fogel and Engerman.[39] For the purpose of these calculations the investment period ended when final adult height was reached; the present value of the additional net earnings at and beyond this age was estimated from the higher price implied by the increase in

[36] Although protein and calorie shortfalls often occur together, at least in developing countries, the investment problem is cast in terms of a protein deficiency because owners recommended that little meat be fed to children, protein was relatively expensive, and because growth in height is "the best anthropometric indicator of discrimination among different levels of protein inadequacy." See Lawrence Malcolm, "Protein-Energy Malnutrition and Growth," in Frank Falkner and J. M. Tanner, eds., *Human Growth*, (New York, 1979), vol. 3, p. 366. On dietary studies, animal experiments, and anthropometric measurements, see Nevin S. Scrimshaw and John E. Gordon, eds., *Malnutrition, Learning and Behavior* (Cambridge, Mass., 1968); Adolfo Chavez and Celia Martinez, *Growing Up in a Developing Community* (Mexico, 1982). The dietary standards for high quality (complete) protein per day used in the calculations are 16 grams at ages 1–3, 20 grams at ages 4–6, and 25 grams at ages 7–9. Based on a medium carcass and data in Bernice K. Watt and Annabel L. Merrill, "Composition of Foods—Raw, Processed, Prepared," U.S. Department of Agriculture, Agriculture Handbook No. 9 (Washington, D.C., 1950), p. 40, sufficient pork to make up for a 50 percent shortfall in protein would have provided 308 calories at ages 1–3, 384 calories at ages 4–6, and 480 calories at ages 7–9. Recommended calorie intakes are 1,360 at ages 1–3, 1,830 at ages 4–6 and 2,190 at ages 7–9. The recommended intakes are from R. Passmore, B. M. Nicol, and M. Narayana Rao, *Handbook on Human Nutritional Requirements* (Geneva, 1974), table 1.

[37] Watt and Merrill, "Composition of Foods," p. 40, specifies that the protein content of a medium carcass of pork is 11.9 percent. The average wholesale price of mess pork at New Orleans was 7 cents per pound from 1840 to 1860 as calculated from Arthur Harrison Cole, *Wholesale Commodity Prices in the United States, 1700–1861* (Cambridge, Mass., 1938).

[38] Margo and Steckel, "The Heights of American Slaves," p. 531.

[39] Fogel and Engerman, *Time on the Cross*, p. 76.

the slave's height at this age.[40] Probabilities of survival were calculated from the source reported in Table 4. These sources and methods produce a negative rate of return amounting to −1.7 percent (average for males and females). In other words, the present value of expected outlays exceeded the present value of expected returns. Therefore, it was profitable to exclude meat from the diet of slave children.[41]

V. IMPLICATIONS FOR RESEARCH

The findings of this paper have implications for research on the postbellum, southern economy. Work in this area has generally recognized the effects of slavery on factors such as literacy and occupations and has incorporated economic, social, political, and educational discrimination after the war, but the poor nutrition of slaves as children may also have been relevant.[42] Recent studies establish that moderate but chronic nutritional deprivation during early childhood temporarily retards the acquisition of motor skills and permanently stunts mental development.[43] The nutritional legacy of slavery may have impeded black economic progress after the war.[44]

[40] The calculations assume that adult height was reached at age 22.

[41] This conclusion is reasonably robust to the assumptions and methods. If the protein deficit was 30 percent, the rate of return would have been 2.5 percent. The improved diet would have reduced the incidence of illness and mortality during childhood; however, a reduction of 50 percent in the mortality rates increases the rate of return relatively little—from −1.7 percent to −1.1 percent. As a result of improved feeding, slaves may have entered the work force earlier, yet the rate of return is −0.3 percent if children began work at age 9 and is 1.2 percent if they began work at age 8. If the protein deficit was 30 percent, mortality rates were reduced by 50 percent, and children began work at age 9, the rate of return is 4.5 percent. In contrast, the average rate of return on the market price of a slave was about 10 percent (Fogel and Engerman, *Time on the Cross*, p. 70). The estimated rates of return are about 2 percentage points higher for males compared with females.

In view of the poor disease environment, slaves may not have been able to achieve modern height standards despite the improved feeding. In other words, infections and intestinal parasites may have claimed some of the better diet. This difficulty, sometimes called the "leaky nutritional bucket" (see Asok Mitra, "Making Hard Choices Between Cost-Benefit Streams of Health and Nutrition Programs," *PAG Bulletin*, 5 (Mar. 1975), pp. 36–44), would have reduced the estimated rate of return to feeding meat. More complex formulations of the decision problem may suggest other insights into behavior. The diet could be examined in the context of an optimal control problem, for example.

[42] Robert Higgs, *Competition and Coercion: Blacks in the American Economy, 1865–1914* (Cambridge, Mass. 1977); Roger L. Ransom and Richard Sutch, *One Kind of Freedom: The Economic Consequences of Emancipation* (Cambridge, Mass., 1977). Robert A. Margo, "Educational Achievement in Segregated School Systems: The Effect of 'Separate but Equal,' " NBER Working Paper No. 1620 (Cambridge, Mass., 1985).

[43] Unless malnutrition is severe, ordinarily brain damage is relatively unimportant for behavior because the brain has a large functional reserve. Instead, malnutrition limits the energy that children can expend on exploration, play, and other sources of stimulation that are important for cognitive development. Moreover, poorly-fed children seek and receive less stimulation from parents and other adults. The results of recent research in this area are discussed in Chavez and Martinez, *Growing Up in A Developing Community*; and Josef M. Brozek and Beat Schurch, eds., *Malnutrition and Behavior: Critical Assessment of Key Issues* (Lausanne, 1984).

[44] Study of wealth accumulation by birth cohort may provide insights into this question. To

The nature and determinants of the slave personality have been widely debated in the literature on slavery. One view portrays the typical plantation bondsman as Sambo, who was "docile," "humble," and "childlike."[45] The extent and form of slave resistance to bondage have also been debated.[46] This literature generally ignores the possible role of nutrition on behavior, possibly because perceptions of the typical diet were reasonably favorable. Yet there is considerable evidence that nutrition influences personality development. Moderately malnourished children are apathetic, emotionally withdrawn, less aggressive, and more dependent.[47] The finding that children were poorly nourished should be integrated into research on the slave personality.

Investments in good nutrition for slave children would have had low rates of return, yet free populations tended to invest relatively more in the growth of young children. Why is this so? One possible explanation hinges on the crucial nature of nutrition in early childhood to cognitive skills; planters may have valued only the physical development of raw labor whereas free populations also valued (or valued relatively more) mental development because it promoted success in a competitive market environment. Another is altruism. It is possible that slaveowners cared relatively little for slave children, whereas free parents were willing to transfer resources toward young children.[48]

Whatever the reasons for the relatively poor health of slave children, the height data imply that certain conceptions of slave childhood should

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control for other effects that slavery may have had on economic performance, the cohorts compared should be those born just before and just after slavery ended (this assumes that childhood nutrition improved after slavery).

A glance at the evidence on wealth accumulation tends to support, or at least does not contradict, the hypothesis. The rates of increase in black wealth were larger during the late 1800s and early 1900s compared with the years immediately after the war, and yet Jim Crow laws and other forms of discrimination were prevalent near the turn of the century. On wealth accumulation see Robert Higgs, "Accumulation of Property by Southern Blacks before World War I," *American Economic Review*, 72 (Sept. 1982), pp. 725–37; Robert A. Margo, "Accumulation of Property by Southern Blacks before World War I: Comment and Further Evidence," *American Economic Review*, 74 (Sept. 1984), pp. 768–76.

[45] Stanley M. Elkins, *Slavery: A Problem in American Institutional and Intellectual Life* (Chicago, 1976), p. 82.

[46] Raymond A. Bauer and Alice H. Bauer, "Day to Day Resistance to Slavery," *Journal of Negro History*, 27 (Oct. 1942), pp. 388–419; Kenneth M. Stampp, *The Peculiar Institution: Slavery in the Antebellum South* (New York, 1956), pp. 86–92, 109–19; Eugene D. Genovese, "Rebelliousness and Docility in the Negro Slave: A Critique of the Elkins Thesis," *Civil War History*, 13 (Dec. 1967), pp. 293–314; George M. Frederickson and Christopher Lasch, "Resistance to Slavery," *Civil War History*, 13 (Dec. 1967), pp. 315–29.

[47] Chavez and Martinez, *Growing Up in a Developing Community*; Brozek and Schurch, *Malnutrition and Behavior*.

[48] Analysis of evidence gathered under the direction of the Commissioner of Labor in 1889/90 and by the Senate for hearings in 1907 suggests that parental altruism was weak among late nineteenth-century industrial families. See Claudia Goldin and Donald O. Parsons, "Parental Altruism and Self-Interest: Child Labor in Late Nineteenth Century U.S. Families," (unpublished manuscript, University of Pennsylvania, 1985).

be redrawn. Eugene Genovese, for example, portrays these ages as "protected years" that provided a "foundation of physical health," and that it was a "time to grow physically" and to "parry the most brutal features of [their] bondage."[49] Instead, poor nutrition restricted exploration and play and retarded growth. Actually children may have sought to escape childhood and to join the labor force because of the nutritional rewards.

If slaveowners used food to promote the work ethic, it may have been done partly at the expense of the slave family, at least as it influenced interaction between children and working-age slaves. Slave workers generally had breakfast and lunch in the fields, and may well have eaten after the children during the evening. Discussions by slaveowners suggest that children were often fed separately.[50] Working adults may have had relatively little time to spend with young children on a regular basis. Under these conditions grandparents or other older slaves may have played the most important role in socializing young slave children. After emancipation parents in nuclear families may have been poorly equipped, through lack of experience, to train young children.

It is doubtful that populations of the past could have been much, if any, worse off than slaves as young children. Yet Table 3 shows that many populations of the past emerged smaller than slaves as adults. Although different environmental insults early in life that had lasting effects could have been involved, it seems likely that adult heights were substantially influenced by conditions during and after adolescence. This finding helps to resolve some of the identification problems that surround the interpretation of fluctuations or differences in adult heights that are now emerging from this proliferating area of study.[51]

VI. CONCLUSIONS

American slaves began early childhood at levels of net nutrition that approximated those of the slowest growing population ever studied by auxologists. Yet catch-up growth that was gradual during later childhood and rapid during late and post-adolescence eventually brought slaves to approximately the twenty-eighth centile of modern height standards. This remarkable pattern of growth, related information on mortality rates, and dietary recommendations of owners establish that slaves were poorly fed as children but extraordinarily well fed as workers. The departure from adult standards was small compared with

[49] Eugene D. Genovese, *Roll, Jordan, Roll: The World the Slaves Made* (New York, 1974), pp. 504–5.

[50] Breeden, *Advice among Masters*, pp. 281–88. See also Genovese, *Roll, Jordon, Roll*, p. 507. If young children ate at the same table, it is clear that they had a separate diet.

[51] In addition to work already used or cited in this paper, height studies are underway or planned for Canada by Trevor Dick, Ireland by Joel Mokyr and Cormac Ó Gráda, England by Roderick Floud and Kenneth Wachter, Central Europe by John Komlos, and Japan by Ted Shay.

the recovery, which suggests that African adaptations played at most a supporting role in slave health.

Much of the debate over slave health and nutrition has gone forward in the context of the "typical" slave. By treating many individuals as a single entity, disappearance methods are incapable of identifying food allocations within the unit. The fact that young children were poorly nourished compared with working adults demonstrates the limitations of the method. Attempts to discover and explain the diversity of health among slaves have focused on the roles of main crop, plantation size, region, and time period. My results suggest that the greatest systematic variation in slave health occurred by age.