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THE DEMOGRAPHY OF TWO TRIBES OF PRIMITIVE, RELATIVELY UNACCULTURATED AMERICAN INDIANS*

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Repeatedly in the past 50 years, concern has been expressed over the possible adverse genetic implications for our species of certain demographic trends and differentials. Our relative ignorance of the degree of association between genetic attributes and reproductive attributes has permitted a wide diversity of opinion. In this confused situation, knowledge of primitive man's demographic structure should provide a helpful perspective. Specifically, since the demographic structure of a human population places definite boundaries on its response to selection, how different is our present demographic structure from that obtaining during the period when man was evolving to his present physical and intellectual state? Should it prove possible to couple the answer to this question with data on the genetic component in attributes determining survival and reproduction in primitive man, and should we obtain similar data on various groups of civilized man, then for the first time we would begin to possess the perspective thus far so difficult to obtain.

The approaches to understanding the demographic structure of our remote ancestors are chiefly two. Firstly, something can be learned of the age and sex structure of early human populations (and, by inference, of reproductive patterns) through the study of skeletal remains. Secondly, one can turn to intensive studies of the scattered, surviving groups of so-called primitive man, on the assumption that the reproductive performance of these groups is a reasonable approximation to that obtaining during long periods in human prehistory.

Primitive groups undergo rapid demographic changes subsequent to their contact with technologically more advanced cultures. Some of the reasons for this are obvious--introduction of new diseases; restriction of tribal territory, with changes in nutritional patterns; changes in ancient mores with contact with Christian missionaries—but there remain additional, poorly understood reasons. Be this as it may, there is at best a brief period during which the observer can obtain a reasonably accurate view of the precontact demography, and, even then, collecting data of the requisite accuracy is rendered difficult by the lack of written records, short life spans, and, frequently, a reluctance to mention dead relatives. Furthermore, of course, there is no assurance that the pattern of the surviving primitives is typical of our ancestors. But if, on the other hand, there are demographic similarities between all or most such groups that clearly set them apart from civilized man, one can have confidence in the emergence of certain common denominators.

During the past five years, we and our associates have undertaken a broad-based investigation, which includes demographic studies, of two tribes of South American Indians, the Xavantes of the Brazilian Mato Grosso and the Yanomama of southern Venezuela and northern Brazil. The former enjoyed a brief period of peaceful contact with Brazilian soldiers and colonizers in the late

eighteenth century, followed by a period of bitter enmity persisting until 1946. The latter did not enter into any sustained contacts with non-Indians until 1950, and even now, although the majority of the tribe has seen Caucasians, most of their villages have not yet been visited by one. The economy of both tribes has rested until very recently on hunting, gathering, and simple agricultural practices, the reliance of the Yanomama on a slash-and-burn type of agriculture being greater than that of the Xavante. However, the latter, under the instruction of missionaries and Indian agents, were rapidly adopting the pattern of subsistence agriculturalists at the time of our field work. We wish to emphasize that we do not present the demographic findings on these two tribes as characteristic of the uncontacted, unacculturated Indian, but only as the best approximation to date. Since both groups have recently been the subject of extensive monographs,[1–3] we will not stop to characterize them further.

The Data.—The demographic data on the Xavante were collected in 1962 and 1964, and have been the subject of a recent publication.[4] The demographic data on the Yanomama were collected by the junior author in four villages (Ora-tedi, Koro-tedi, Monou-tedi, and Patanowa-tedi) in three field trips during 1964–1965, 1966, and 1967, and have not been previously presented. Since neither group has a counting system, all ages are estimated. The lack of recorded events around which to construct a "village calendar" has complicated age estimation. Although in the case of the Xavante direct interrogation of persons regarding reproductive history and genealogy was feasible, for the Yanomama social conventions rendered this largely impractical, necessitating the use of third-person informants and constant cross-checking. We realize how woefully small our sample is by demographic standards, but direct attention to a variety of difficulties in amassing extensive data on such groups.

Age and sex structure: As Table 1 reveals, these are "young" populations, only about 13 per cent of the population being "post reproductive" (≥ 40 years), and the mean age being about 18 for the Xavante and 22 for the Yanomama. In both tribes, there is an excess of males over females in the 0–14 age group, not significant for either tribe but significant for the combined data. It seems

Table 1. *The age and sex structure observed in villages of the Xavante and Yanomama Indians.*

Tribe	Age Interval (years) 0–14	15–30	31–	Unknown	Total	Estimated mean age ($M \pm \sigma$)
Xavante						
Males	172	130	58	66	426	17.4 ± 13.1
Females	139	127	65	39	370	18.3 ± 14.2
Total	311	257	123	105	796	
	(39.1)	(32.3)	(15.4)	(13.2)		
Sex ratio	123.7	102.4	89.2	169.2	115.1	
Yanomama						
Males	72	94	44	—	210	20.8 ± 15.3
Females	56	91	43	—	190	23.4 ± 16.4
Total	128	185	87	—	400	
	(32.0)	(46.3)	(21.7)			
Sex ratio	128.6	103.3	102.3		110.5	

very likely that among the Yanomama, the cause is a tendency to select more females than males for infanticide.[3] For the Xavante, the cause is not equally clear.[4] The equilization of the sex ratio during adult life is probably a reflection of the more hazardous existence of the male.

Marriage patterns: First marriages are for the most part contracted very young (usually prepubertally) and "arranged" by parents and other relatives. A small fraction of wives are obtained through raids on other villages. All postpubertal women have been married at least once. In the event of the death of a husband, women usually remarry almost immediately. Both the Xavante and the Yanomama are polygynous, the favorite form of polygyny being sororal. Men continue to acquire wives as long as they are vigorous adults. Thus although only 50 of 105 adult males in the four above-mentioned Yanomama villages were polygynous at the time of our study, many with only one wife will acquire an additional wife later. Of the 50 polygynous males, at least two of their wives were related as sisters or half-sisters in 19 instances. Similar data have already been published for the Xavante.[4] We will in this paper consider only the reproduction of females, leaving the matter of male-female differences and the possible significance until later.

Sterility: Among the Xavante, all of 35 women of estimated age 40 or greater had borne a child, and, in fact, only one out of a total of 195 women over the age of 20 for whom accurate data were available had not borne at least one child. For the Yanomama, one of 34 women aged 40 or greater was childless. On the basis of these limited data, childlessness is thus uncommon and since marriage is universal, with rare exceptions all females who reach the age of reproduction contribute to some extent to the next generation. This may be contrasted to the current situation in such a country as the United States, where in 1960 among women in the 45–49 age group, 6.5 per cent were single (and essentially nonreproductive), and 18.2 per cent of those married were childless.[5]

Completed fertility for individuals reaching the age of reproduction: Data on completed fertility have been compiled by a careful questioning of women aged 40 or older, plus an attempt to reconstruct the reproductive histories of women who in the recent past had died in the childbearing period, and whose spouses and/or sisters were still available to provide histories. This is the best approximation possible under the circumstances to defining the reproductive performance of a cohort of women reaching the childbearing age. The age of 40 was chosen as a cut-off point because of an impression, not yet well substantiated, that the menopause occurs earlier in this culture than in our own.

The mean number of live births among women who have completed their reproductive performance, by virtue of age or death prior to age 40, is shown in Table 2. Both sets of figures, viewed in a world-wide context, are relatively low, that for the Yanomama almost unbelievably low. It is very probable there has been a measure of underreporting. In particular, among the Yanomama, where infanticide as well as abortion is regularly practiced, we suspect that children killed immediately following delivery (which is the type of infanticide usually practiced by this group) would not be reported as live births by their

TABLE 2. *Number of liveborn offspring to Xavante and Yanomama females whose reproduction had been completed either because of age (>40 years) or death after reaching adulthood but prior to age 40.*

Tribe	Number of women	Number of Children: 0	1	2	3	4	5	6	7	8	9	10	11	Mean number of children	Variance (σ^2)
Xavante															
Alive (>40 years)	35	—	1	—	6	3	9	7	1	4	1	1	2	5.7	5.5
Dead (est. <40 years)	25	—	6	4	3	5	2	2	3	—	—	—	—	3.4	4.3
Total	60	—	7	4	9	8	11	9	4	4	1	1	2	4.7	6.1
Yanomama															
Alive (>40 years)	33	1	1	5	7	10	4	3	1	1	—	—	—	3.8	2.9
Dead (est. <40 years)	31	8	12	5	3	2	1	—	—	—	—	—	—	1.4	1.8
Total	64	9	13	10	10	12	5	3	1	1	—	—	—	2.6	3.7

TABLE 3. *Surviving offspring for Xavante and Yanomama females whose reproduction was complete.**

Tribe	Number of individuals	Number of Children: 0	1	2	3	4	5	6	7	8	Mean number of survivors	Variance (σ^2)
Xavante												
Alive (>40 years)	35	1	7	4	6	5	5	3	3	1	3.6	4.5
Dead (est. <40 years)	25	2	8	6	2	3	3	1	—	—	2.4	2.9
Total	60	3	15	10	8	8	8	4	3	1	3.1†	4.2
Yanomama												
Alive (>40 years)	33	2	1	7	13	4	3	2	—	1	3.2	2.7
Dead (est. <40 years)	31	12	12	2	2	3	—	—	—	—	1.1	1.6
Total	64	14	13	9	15	7	3	2	—	1	2.2	3.3

* Data based on living individuals age 40 years and older, plus recently deceased individuals for whom information was supplied by surviving spouse.

† There is a discrepancy between this figure and that previously published.[4] This is due to the inclusion of data on 16 additional deceased women in this calculation, previously omitted because of uncertainty whether they fell within the cohort. We now feel that they should be included.

mothers. Assuming these women to be continuously exposed to the risk of pregnancy between the ages of 15 and 40, this is an average of one live birth every 4.4 years among the Xavante and every 6.6 years among the Yanomama. During the course of the field work, physical examinations were conducted on 62 Xavante women and 137 Yanomama women in the estimated age range 15–40.[6] Nine of the Xavante women and 10 of the Yanomama were found to have uteri at or above the level of the umbilicus. Assuming the uterus to be in this position between lunar months 7 and 10 of pregnancy, this implies approximately 27 pregnancies a year to the Xavante women and 30 a year to the Yanomama women. On an annual basis, this would correspond to one birth every 2.3 and 4.9 years, respectively. The differences parallel the data obtained by history, but in both instances the implied birth rates are higher than the histories indicated. In the case of the Xavante, the marked discrepancy is due primarily to the findings in the village with the longest history of outside contacts (São Domingos). Although the samples are small and the higher fertility suggested by the physical examinations than by history may result from chance fluctuations, at least two other explanations, not mutually exclusive, must be considered, namely, (1) the reproductive histories are incomplete, and (2) the recent changes in their way of life have already had an impact on their reproductive pattern. The control of fertility implied by these data is achieved by a combination of postpartum intercourse taboos, prolonged lactation, abortion and infanticide, and, possibly, early menopause.

Mortality prior to the age of reproduction: The estimate of mortality during infancy and childhood (prior to age 15) is based primarily on the difference between number of liveborn children (Table 2) and number of surviving children reported by women aged 40 or over, or by the relatives of recently deceased women dying during the reproductive period (Table 3). The per cent mortality among liveborn children prior to an estimated age of 15 is 33 and 16 for the Xavante and Yanomama, respectively. On a world-wide perspective, these are relatively low percentages. We recognize compelling reasons for regarding these as underestimates of prereproductive mortality, since in addition to unreported births and deaths, some of the children on whom the estimate is based are still young, and a proportion will die before the age of 15. While the differences between Xavante and Yanomama in mortality are of dubious statistical significance, especially in view of the inadequacies of the data, several considerations suggest that they may be meaningful. There is clear evidence from the reports of Indian agents and missionaries that measles and pertussis have recently reached the Xavante with high case fatality rates;[4] this is borne out by the results of our studies on serum antibodies.[7, 8] Thus, it seems likely that mortality rates, especially among children, have increased recently among the Xavante. This is consistent with the fact that older women report less mortality among their children than younger women do (although faulty recollection may also be involved). In contrast, antibodies to measles have been detected among only 3 of 98 sera tested from inhabitants of the villages on whom the Yanomama vital statistics are based.[9] The smaller proportion of Yanomama in the 0–14 age interval, and the higher mean age for the Yanomama, are indirect

confirmation of the lower birth rates and infant-and-childhood mortalities reported by this group in contrast to the Xavante. There is also some direct evidence substantiating these low infant and childhood mortality rates among the Yanomama. Various members of the Unevangelized Field Mission have attempted to keep birth records for those villages of the Brazilian Yanomama with which they are in close contact (these are *not* the villages on which our statistics are based). We are indebted to Miss Sue Albright and Mr. Rodney Lewis for the information which enables us to state that among 76 live births recorded between 1959 (when the Mission began its activities) and 1965, 17 failed to survive the first year, 4 of these because of infanticide. Thus, infant mortality from natural causes by direct observation is 18 per cent. Although these are, of course, high mortality rates by the standards of the United States and Europe, they are well below the mortality obtaining until recently in many tropical agricultural societies.

Discussion.—These statistics are presented with some diffidence. There has almost certainly been underreporting of births and deaths. Studies are now in progress which should result in a considerable refinement in the estimates on the Yanomama. However, while the details may alter, the data are internally consistent, and we feel confident that additional field work will not drastically change the picture of "intermediate" *effective* fertilities and infant-and-childhood mortalities among this group. We use the qualifying adjective "effective" to recognize the role of abortion-infanticide in limiting the entry of children into the population, and realize the ambiguity in the use of the term "fertility" in the present context, i.e., a population would be considered to have a low effective fertility in which each woman averaged ten conceptions of which eight terminated in induced abortion-infanticide.

The very limited data available on the demographic structure of other primitive groups, as summarized by Krzywicki,[10] are in agreement in all essential respects with the results reported herein. This structure would appear to differ significantly both from that obtaining until very recently in most tropical and semitropical populations practicing settled agriculture and from that of the contemporary industrialized, urbanized, and sanitized countries of the West. Table 4 summarizes some representative data on this point. These data suffer from various imperfections, for which correction is impossible. None of the estimates is based on a true cohort approach; all the studies are cross-sectional, with (as in our own data) fertility and mortality estimates thus based on successive generations. Unlike our data, no attempt has been made in the other studies to obtain data for women dying during the childbearing age. Such data are essential in the accurate derivation of certain genetic indices, to which we will come shortly. Their omission is of relatively little importance in low-mortality populations such as the United States, but possibly of major importance for the other data. The five sets of data for agrarian societies may be regarded as reasonably representative of the limited literature.[11] Incidentally, the available statistics for the United States in the eighteenth century are very similar to those for these agrarian societies.[12]

These and other data suggest the propriety of recognizing three principal

BLE 4. *A comparison of certain vital statistics in diverse types of populations.**

		"Early Man"		Agricultural Man					Contemporary U.S.[18]	
		Xavante	Yanomama	Uganda, Banyoro Bantu[14]	Uganda, Basoga Bantu[14]	Nagasaland, Yao[15]	Gold Coast, Ashanti[16]	E. Pakistan, 2 villages[17]	White	Nonwhite
an live births per female, reproduction omplete ($M \pm \sigma^2$)	Living only	5.7 ± 5.5	3.8 ± 2.9	3.7 ± 7.4	7.0 ± 7.2	5.4 ± 9.7	6.5 ± 10.1†	7.0 ± 10.9	2.2 ± 4.3	2.7 ± 9.8
	All females reaching adulthood	4.7 ± 6.1	2.6 ± 3.7							
an (maximum)number f children urviving to dulthood, for emales with completed reproduction ($M \pm \sigma^2$)	Living only	3.6 ± 4.5	3.2 ± 2.7	1.4 ± 1.2	2.5 ± 1.7					
	All females reaching adulthood	3.1 ± 4.2	2.2 ± 3.3							
imated percentage dying prior to age 15		*ca.* 0.33	*ca.* 0.18	*ca.* 0.63	*ca.* 0.64	*ca.* 0.24	*ca.* 0.44	>0.31‡	*ca.* 0.03	*ca.* 0.05
dex of potential selection	I_m	0.49	0.22	1.70	1.78	0.32	0.79	0.45	0.03	0.05
	I_f	0.41	0.66	1.46	0.42	0.43	0.43	0.32	0.92	1.41
	I_t	0.90	0.88	3.16	2.20	0.75	1.22	0.77	0.95	1.46

* Data based on women of estimated age over 44 except for "early man," where reproduction judged complete after age 39. The estimate of proportion dying ore age 15 is obtained by the difference between live births and survivors for the first four populations but by an independent estimate for the remainder.
† Includes miscarriages and stillbirths; based on women over age 45.
‡ Apparently based on all living women in two villages, and thus more of an underestimate than the other figures, based on women over age 39 or age 44.

demographic stages in relatively recent human history and prehistory. The first, characteristic of contemporary primitive man (and perhaps of primitive man for an extended period of human prehistory), is a period of "intermediate" *effective* fertility and early mortality. With the advent of agriculture, and the ascendancy of religions emphasizing fruitfulness, a period of higher fertility with a corresponding increase in prereproductive mortality was introduced. Now, with industrialization and urbanization, there is a strong trend towards relatively low fertility but even lower mortality.

Crow[13] has developed an index of selection intensity (I_t) based on demographic data such as have been presented. It is

$$I_t = \frac{V}{\bar{w}^2}$$

where V is the variance in the number of children per female ever born and $\bar{w}$ is the mean number. This index has two components, I_m, due to mortality prior to the age of reproduction, and I_f, due to fertility differences among women reaching the age of reproduction. I_m equals P_d/P_s, where P_d is the proportion of all births dying before the reproductive period, and P_s the proportion surviving. Ideally, P_d should include all zygote loss between conception and reproduction, but measurements of the early loss, between fertilization and seven months' gestation, remain so unsatisfactory that no investigator has yet attempted to introduce early loss into his calculations. I_f equals $(V_f/\bar{x}_s^2)/P_s$, where $\bar{x}_s$ is the mean number and V_f is the variance in the number of births per woman reaching the age of reproduction. (I_f has, with Crow's concurrence, been slightly modified from the original definition.)

Table 4 also presents the results of applying this calculation to the various sets of data contained therein, utilizing for the Xavante and Yanomama the data on "all females" rather than "living only." These calculations must, both because of the limited data available and the deficiencies in these data, be regarded as first approximations. As already mentioned, the omission from all of the series on agrarian populations of data on women dying during the child-bearing period may be a considerable source of error; their inclusion, which would lower the mean but increase the variance, would increase I_f for these groups. We note, first, the high value for the Banyoro Bantu. But since the mean number of surviving children is below replacement, a situation which can only lead to extinction, we conclude that this population must be excluded from consideration in any general treatment. Second, the I_t's for the two most primitive groups are among the lower rather then the higher values. If these I_t's are similar to those of most primitive groups and permitted human evolution, then theoretically there may be adequate provision in our present population structure for continuing evolution of some sort. Third, the values for I_t in agrarian societies are reasonably similar to those in the contemporary U.S. population. Finally, then, we note that fertility differentials make a larger contribution to I_t in the United States than in the primitive groups. The manner in which in the Indian societies polygyny alters the I_t will be treated in

As Crow emphasized, this is an index of *potential* selection. Its genetic significance and usefulness are proportional to the genetic component in the phenomena on which it is based. It seems clear that both I_m and I_f result from a mix of both genetic and nongenetic factors, but the precise proportions and how they may have changed during human evolution will remain debatable, and prime targets for investigation, for some time. There are some interesting possibilities to be looked into. For instance, in both U.S. white and nonwhite populations, some 20 to 25 per cent of women reaching adulthood fail to reproduce. The difference, if any, between the biological attributes of this group and those having children is unknown. Should this be to some extent a biologically disadvantaged group, then this may be a group in which in a harsher environment there would have been a disproportionate number of deaths, or a lower net fertility. In this case, the structure of natural selection could have changed relatively little. If, on the other hand, this is a group with special attributes not related to mortality, then there has indeed been a change in selective determinants.

In view of the perennial interest in the genetic implications of demographic differences between ethnic groups in the United States, it is pertinent to view them from the perspective of the index of selection intensity. The indices for U.S. whites and nonwhites are also given in Table 4. There is a striking similarity in the small contribution of mortality to the index of both groups. On the other hand, the variance for the nonwhite live births is greater than for white, the I_f for U.S. nonwhites in fact exceeding all other acceptable values in Table 4. The biological weight to be attached to the difference in I_t depends on the degree to which selection works through mortality as contrasted to fertility differences, for if it is primarily through the former, then the U.S. white and nonwhite groups are the most similar in the table. As Kirk[19] has shown, the U.S. white population seems to be moving rapidly towards a lower variance for completed fertility, with a correspondingly lower I_t. It seems highly probable that given social and economic justice, the nonwhite segment of the United States would decrease the variance of its fertility at a similar rate, so that the I_t's for both groups could shortly be lower than any other values in the table.

Summary.—Demographic data on two tribes of primitive, relatively unacculturated Indians reveal relatively low fertility and prereproductive mortality. It is suggested that there have been three principal demographic stages in human history and prehistory, namely, a period of "intermediate" fertility and prereproductive mortality, characteristic of (recent?) primitive man; a period of "high" fertility and mortality, characteristic of agrarian societies; and a period of "low" or "intermediate" fertility and "low" mortality, characteristic of contemporary industrial societies. Some possible genetic implications of these changes are explored.

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