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The Influence of Cultural Factors on the Demography and Pattern of Gene Flow from the Makiritare to the Yanomama Indians ^{1,2}

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ABSTRACT A single village of Yanomama Indians was found to have frequencies of D_i^a of 0.06 and of A_p^a of 0.08, in contrast to 40 other villages where D_i^a was absent and A_p^a quite rare. The source of these genes was identified as a village of Makiritare Indians, but the two allele frequencies were approximately the same or even higher in the Yanomama than in the Makiritare village. Demographic, social and cultural parameters affecting marriage and reproduction in the two tribes explain this. Genealogical relationships and informants' accounts collected in the field, when viewed against the traditional marriage practices, reproductive advantages of headmen, and differential treatment of captured women, indicate that the mating and reproduction parameters inherent in tribal social organization of this kind constitute an essential part of the explanation of the genetic findings. It is argued that mating systems of this sort are such that the probability of a new gene introduced by a captive surviving in the recipient population is a function of the sex of the initial carrier. The implications for tribalization and potentially radical changes in allele frequencies are briefly explored by considering aspects of settlement pattern and population fissioning known to characterize the tribes in question. Finally, it is shown that genetic sampling from a single location can and does result in unrepresentative allele frequencies when this single sample is taken to characterize the tribe as a whole.

The question of the extent to which the gene frequencies for a population, however defined, are the result of deterministic as opposed to random genetic forces is, of course, one of the central issues of population genetics. In the past, two kinds of random events have been commonly recognized, namely, the founder effect, the luck of the draw when a relatively small group which is to serve as an ancestral population separates from a much larger group, and genetic drift, *sensu strictu*, the random walk of gene frequencies in successive generations of a small population. Recently we have recognized, under the term "lineal effect," a third kind of event, random in the genetic but not in the social sense, and especially applicable to human populations (Neel, '67; Arends et al., '67). This effect is based on the observation that the social structure of tribal populations

usually ensures that break-away groups contain many related persons, so that in such a group the number of independent genomes is well below the numerical count of individuals.

In the present communication we propose to begin to define a fourth type of event, more properly, a group of social phenomena, which although "random" in the genetic sense is, like the lineal effect, inherent in the social organization of many tribal populations. Specifically, we shall, on the basis of a concrete example, begin to explore the genetic consequences of the socially-conferred reproductive advantages of headmanship and the differential fer-

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tivity of abducted women. At the same time, we shall present a very concrete illustration of how gene flow occurs between two tribal populations of American Indians. While it would obviously be unwise to generalize from a single anecdote such as this, the changes in gene frequencies with which the population geneticist deals are, in the final analysis, based on such grass-roots events as these; our formal treatments can be no better than our knowledge of the detailed events upon which our assumptions depend.

The populations

The tribes on which this study of gene flow and socially-influenced gene frequency changes are based are the Makiritare and Yanomama of southern Venezuela and adjacent portions of Brazil (see fig. 1). The

former is a Carib-speaking group of some 2,000 individuals whose population is distributed in numerous villages along the upper reaches of the navigable rivers that drain the border mountains between Venezuela and Brazil. They are a "canoe" people and have been known to take long river journeys to European settlements on which they have traditionally depended for steel tools, firearms, salt and glass beads. Their villages range in size from 50 to 150 inhabitants. Economically, the Makiritare rely principally on the slash-and-burn cultivation of bitter manioc, which they refine into manioc flour or cassava bread, especially the latter.

The Yanomama, by contrast, are a "foot" people, avoiding larger rivers for lack of a watercraft tradition. Their palisaded settlements are found deep in the tropical

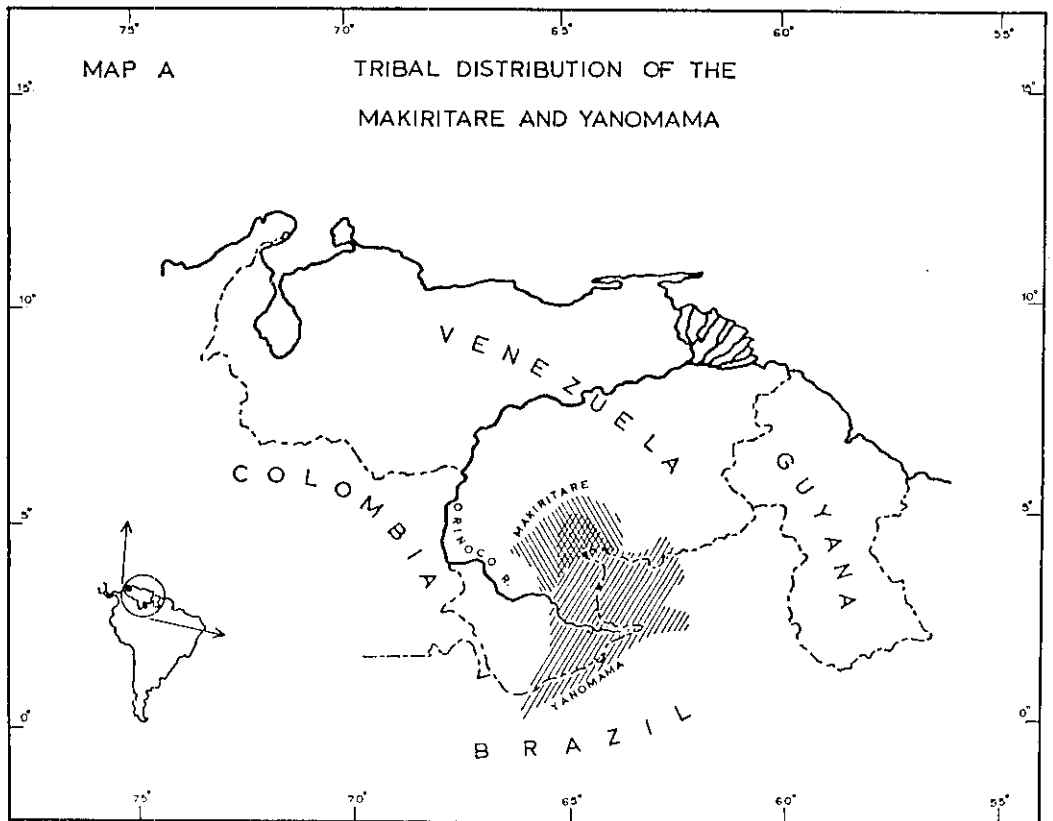


Fig. 1 Tribal Distribution of the Makiritare and Yanomama. The villages discussed in this communication are found at the southeastern corner of the area commonly held by the two tribes.

forest. Thus, where their territory overlaps with that of the Makiritare, villages of the two tribes tend to be in complementary distribution. Like the Makiritare, the Yanomama also are slash-and-burn cultivators, but the staple food in this case is now plantains, a post-Columbian introduction (Reynolds, '27; Zerries, '58; Simmonds, '59; Becher, '60; Chagnon, '66, '68b, in press). Both groups hunt, fish and collect wild foods to supplement their agriculture, but neither group can be called a "hunting and gathering" tribe. The number of Yanomama has been roughly estimated at 10,000 (Chagnon, '66, '68b), but our recent work in several large, uncontacted areas leads us to believe that the total population may be even larger (Chagnon, N. D.). The Yanomama are divided into some 125 villages that range in size from 40 to 250 inhabitants. They are more aggressive than the Makiritare and still retain their aboriginal warfare pattern (Chagnon, '66, '68a,b).

The two tribes live contiguously, sharing a common border (fig. 1). At a number of points the Yanomama, in the process of expanding away from their tribal center (Chagnon, '68a), have within the past several generations forced the Makiritare out of their old territory. On the other hand, recently, with some 20 years of peaceful relations between the two tribes, Makiritare villages have moved deep into Yanomama territory, to be near missions. In some areas the two groups have now established such amicable relations with each other that they live in mixed villages.

In the course of field work among the Yanomama and Makiritare in 1967, we sampled one Yanomama village in Brazil, Borabuk ($2^{\circ}45'N$; $62^{\circ}05'W$, see fig. 2) that differed from the some 40 other Yanomama villages on which we now have blood group frequency data, including the ten villages in which we have previously reported (Arends et al., '67). The village in ques-

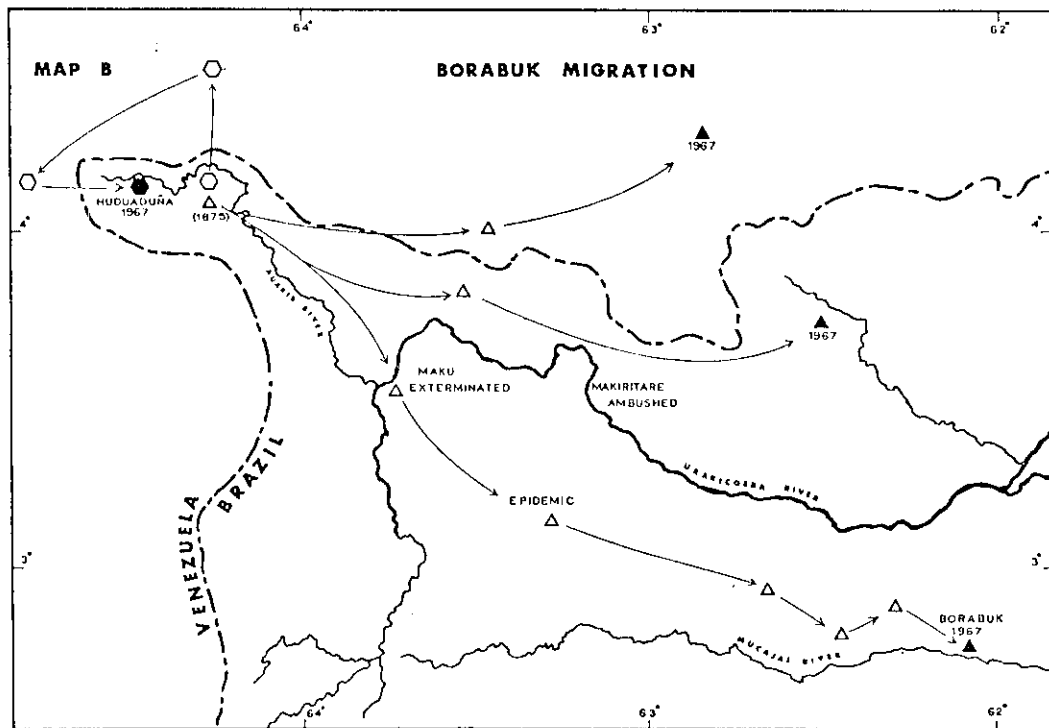


Fig. 2 The Borabuk Migration. The two villages discussed originated in the upper left-hand corner of the diagram, our informants accounts of village history and migration going back to about 1875. Makiritare villages are indicated by hexagons and Yanomama villages by triangles. Present ('67) locations are indicated by shading. The locations of the epidemic and the conflict with the Makú are approximate, as are abandoned village sites.

tion was characterized by modest frequencies of Diego a-positive and erythrocyte acid phosphate type A-positive individuals and, in one family, a rapidly-migrating serum albumin variant (Weitkamp and Chagnon, '68). The first and third genetic traits had not previously been encountered in the Yanomama and acid phosphatase type A in only four other villages, all in the northern portion of the tribal distribution, contiguous to the traditional distribution of the Makiritare. However, the D_i^a and A_p^a genes do regularly occur in the Makiritare villages studied to date (Layrisse and Wilbert, '66; Gershowitz et al., in press; Weitkamp and Neel, in press). At the time of this study, the nearest Makiritare village, Huduaduña, was located on the Auaris River ($4^{\circ}10'N$; $64^{\circ}20'W$) some 200 miles to the northwest of the village of Borabuk (fig. 2). The albumin trait was found in an abducted Makú woman and her progeny then living in Borabuk, being thus far unknown in either the Makiritare or the Yanomama tribe.

Our field work procedure and method, in addition to collecting biological specimens, involves the systematic interviewing of as many villagers as time permits for the purpose of establishing recent village histories, settlement pattern and genealogies. By this means we learned that the Borabuk and Huduaduña populations lived contiguously on the Auaris River for some time prior to turn of the century in a mixed village, and that some intermarriage took place between them. Informants in both the Makiritare and Yanomama villages independently corroborated this, and genealogical data explicitly show some of the intermarriages. Indeed, a sizeable fraction of the current population of the Yanomama group reckon descent from a deceased headman and his two brothers whose father was Makiritare and whose mother was Yanomama. (See discussion of genealogy, below).

The laboratory analyses of the blood samples thus confirmed the village histories and pedigree information, but in a somewhat puzzling manner: the Yanomama village was characterized by approximately the same or even higher frequencies of D_i^a and A_p^a than was found in the present population of Huduaduña, the Makiritare village from which the two alleles were most

probably introduced. Specifically, among 91 individuals, 12 were Diego positive and 16 were, on electrophoresis, erythrocyte acid phosphatase type AB, a D_i^a gene frequency of 0.06 and an A_p^a gene frequency of 0.08. Layrisse and Wilbert ('66) had previously established that in a pooled sample gathered from two Makiritare villages, the D_i^a gene frequency was 0.17. In subsequent work, we (Gershowitz, Layrisse, Neel, Brewer, Chagnon and Ayres, in press) have encountered D_i^a frequencies between 0.02 and 0.52 in seven Makiritare villages, and in addition (Weitkamp and Neel, in press), A_p^a frequencies from 0.00 to 0.13. In the Makiritare village of Huduaduña the D_i^a gene frequency among 71 persons was 0.04 and the A_p^a gene frequency, 0.05. Thus the frequency of the D_i^a and A_p^a genes was approximately the same or even higher in the Yanomama village of Borabuk than in the Makiritare village from which the genes were probably introduced.

The explanation of the situation appears to rely in large part in the socio-cultural practices relating to reproduction in the Yanomama mating structure, particularly those having to do with the prerogatives of headmanship in the context of polygyny and in the differential treatment of female captives from non-Yanomama groups. Secondly, the demographic structure of the Yanomama population must be considered in interpreting the marriage practices and how these relate to the probability of retaining an introduced allele, a probability that, when the gene is introduced by a captive, varies with the sex of the introducer, as will be shown in the discussion of tribal marriage practices below.

Village histories

Before turning to the discussion of the mating structure a brief resumé of the village histories will be in order to give some idea of the general cultural milieu within which the mating structure operates. Prior to 1900 both the Borabuk (Yanomama) and Huduaduña (Makiritare) populations maintained contiguous villages on the upper reaches of the Auaris River (fig. 2). The histories of the respective groups are not known prior to this point in time, so there is a possibility of earlier intertribal admixture in either or both groups previous

to ca. 1875, the approximate date that the two groups are estimated (by inspection of genealogies and informant's accounts) to have lived contiguously.

The Makiritare have long had contact with the more remote colonies of European settlers and through these they acquired steel tools and glass beads. Even at the present time the village of Huduaduña obtains glass beads that originate in Guyana; these are traded westward in a network of several intermediate tribes, processed manioc and dugout canoes being exchanged for them. The fact that the Makiritare have established and maintained this relationship with European settlements has given them a trading hegemony over the Yanomama, who have remained isolated and thereby avoid direct contacts with outsiders. The Yanomama have traditionally relied on the Makiritare for steel tools, which according to Yanomama informants as far away from this point as the upper Orinoco (Chagnon, '66) eventually reached very remote Yanomama villages via a long, inter-village trading network. (Until the advent of missionary activity in this area, 1955-1960, the Yanomama relied exclusively on the Makiritare for their supply of steel tools.) It is for this reason that groups of Yanomama periodically take up temporary residence with the Makiritare: they work for them in order to obtain the necessary and extremely desirable steel tools that make their agricultural economy more efficient.

Although both the Yanomama and Makiritare have very low opinions of each other, the fact that the Makiritare have a monopoly on steel tools, which they jealously guard, has given them the advantage in the various social relationships that emerge in mixed villages. One way in which this advantage is expressed is that Makiritare men (in mixed villages) demand and usually obtain sexual access to Yanomama women. If intermarriage or semi-permanent co-residence does take place, it invariably involves a Makiritare man with a Yanomama woman. The issue of these unions are somewhat disadvantaged in both tribes from a matrimonial point of view, for the respective notions regarding marriage are such that half-Yanomama sons are not readily incorporated into either marriage

system. Daughters of mixed marriages, on the other hand, are always marriageable although they do not enjoy the status of full tribal members in every case, particularly among the Makiritare. There are subtle sociological issues involved here, but these do not speak directly to the immediate problem and will be handled in other publications.

During the period of time when the members of Borabuk resided in close proximity to Huduaduña, men of the Makiritare group persistently had affairs with Yanomama women, much to the chagrin of the Yanomama men. In addition to this cause of friction, the Yanomama suspected the Makiritare of practicing harmful magic against them, and their general interrelationships were potentially strained, if not hostile. According to Borabuk informant matters came to a climax when a Yanomama man was accused of stealing tobacco from the garden of a Makiritare, which eventually led to arguments and then to an intervillage fight in which a Yanomama man was badly injured with a knife. The Yanomama decided to separate from the Makiritare and moved down the Auaris River to its junction with the Uraricoer (Parima), probably just prior to 1900. (A dissident faction of the Yanomama group also separated and moved eastward, to Venezuela.)

The headman of the Yanomama group at this point in time was half-Makiritare, having been sired by a prominent shaman of the latter group but raised by his mother among her people. The dissident Yanomama group remained in this general area until about 1910 when a feud within the village over the possession of a woman caused a fission, and part of the group migrated to the east, entering into active hostilities with those who remained behind. The latter group moved further to the southeast and settled on a branch of the Mucajai River known as Koroknai-u (not shown on fig. 2).

Shortly after the split in the Yanomama village a serious epidemic of unknown etiology struck and killed a large number of men. We do not know why only men died in this particular epidemic, but similar situations are known to occur among the Yanomama elsewhere. Yanomama m-

frequently take long trips to visit or trade with distant groups and occasionally are exposed to disease long before it reaches their natal village. We have informants' accounts of such groups becoming seriously ill and their members dying in large numbers before they return home. Presumably this is what happened in this epidemic. It should be pointed out that the Yanomama have just one word to describe a situation in which many people become sick and die and our (Chagnon's) translation of the word is not meant to coincide precisely with our medical notions of epidemic. The Makiritare and the Makú (a tribe now extinct save for three or four survivors who reside among the Yanomama on the Mucajai and Uraricaa Rivers) were blamed for the epidemic. One important consequence of the epidemic was that the half-Makiritare Yanomama headman acquired as his wives several of the widows of men who perished, a prerogative he exercised largely because of his status.

Some time after the epidemic the Yanomama raided the Makú and abducted a woman from them during the skirmish; she still lives in Borabuk (Weitkamp and Chagnon, '68). A few years later the Makiritare of Huduaduña sent a party of workers down the Uraricoera to cut logs and make canoes to trade with the Brazilians in the town of Boa Vista, several days journey further downstream. The members of Borabuk took this opportunity to get their revenge on the Makiritare and visited the temporary camp on the Uraricoera. They were invited into the hut, and, discovering that they greatly outnumbered the Makiritare, at a signal from Iro, the instigator of the attack, set upon the men and killed many of them with staves. Our informant for the raid details was a Makiritare woman who was captured at this time and who now lives among the Borabuk (individual III-4 of fig. 3). Two other women were captured with her, and likewise live with the Borabuk, incorporated as wives.

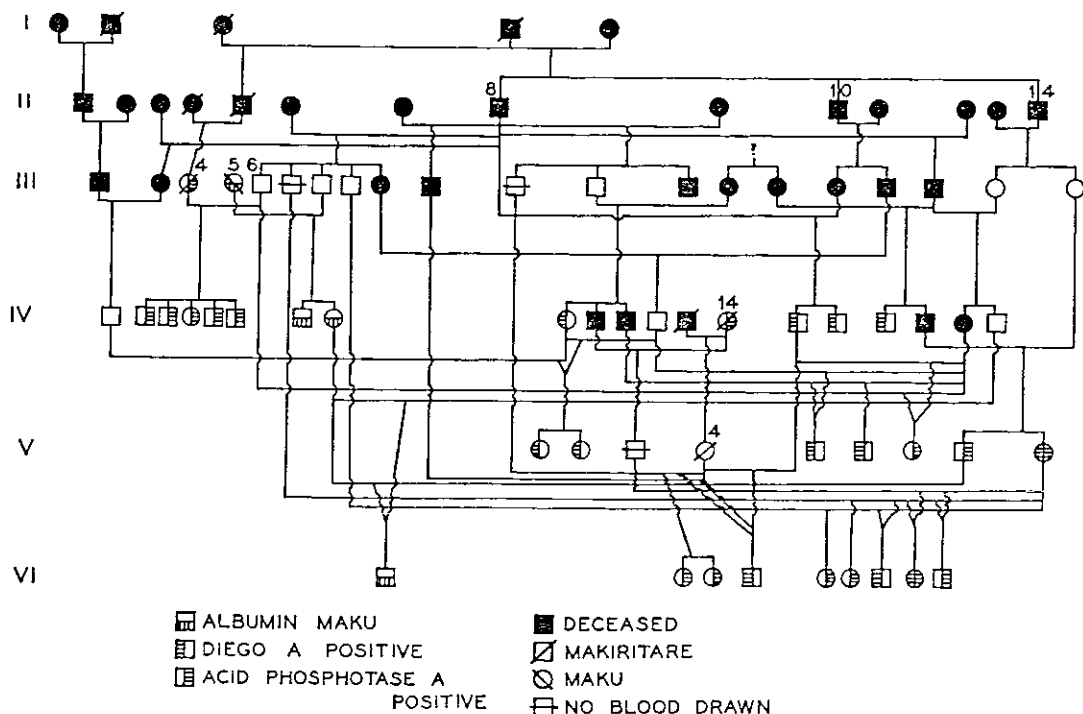


Fig. 3 Partial genealogy of individuals carrying the Di^a, Ap^a and Albumin Makú genes. The genealogy shows only the putative family ties among affected individuals as given by informants. This particular Yanomama genealogy is somewhat distinct in the more-than-usual level of polyandry, polygyny and paternity uncertainty compared to genealogies collected in other villages. Note that some individuals have more than one possible father.

This raid took place sometime around 1930.

Mating structure and status of headmen

We have noted (Salzano, Neel and Maybury-Lewis, '67) that among the Xavante, a tribe of approximately the same cultural level, there is a significant difference in the reproductive performance of males and females. Whereas women are uniformly exposed to the risk of pregnancy and rarely fail to reproduce, men, on the other hand, are characterized by an appreciably higher variance in their reproductive performance. The basis for this difference is sociological in origin, since males in this type of society are "rewarded" for political and military astuteness and prowess by being in a much better position to acquire multiple wives. Consequently, some men will reproduce very little and others will make significantly large, often dramatic, contributions to the gene pool. Thus, in one Xavante village the headman's contribution to the present generation amounted to 23 surviving children. The same phenomenon is also observed in many Yanomama villages (Chagnon, unpublished). In one Yanomama village south of the Orinoco River the two headmen sired 28 children (25 of whom were alive at the time of the study), amounting to approximately one-fourth of the total village population.³

Mating structure and status of abducted women

Borabuk includes four non-Yanomama women, three abducted Makiritare and one Makú (see fig. 3, individuals III-4, III-5, IV-14 and V-4). With the exception of one of the Makiritare women (individual IV-14), abducted while she was well along in her reproductive lifespan, these women have substantially larger families than is characteristic for Yanomama women (they average 7.3 living children, as compared to 3.8 for Yanomama women of comparable age (Neel and Chagnon, '68)).

One cultural difference between the Yanomama and Makiritare is the practice of preferential female infanticide by the former, partially accounting for the remarkably low "achieved" fertility in this population (Neel and Chagnon, '68). We

have no information on the Makú in this regard, since they were effectively extinct before their culture was recorded. The Makiritare, however, are not known to practice either male or female infanticide.

If after delivery the woman picks the newborn child up and carries it to the village, it is allowed to live. Given that the decision rests with females, abducted women from tribes *not* practicing infanticide are therefore predisposed to have larger families and, in this case, have in fact achieved this. More importantly, the attitude of abducted females toward killing their offspring, particularly female babies, can affect the probability of retaining an introduced gene: since women rarely fail to reproduce despite their tribal status, in this particular circumstance chances are greater that the gene will be maintained when introduced by a female carrier from the outside because such women are less prone to kill their offspring. The effect is compounded when female offspring are considered, since females, as we have noted several times above, almost invariably reproduce.

The Yanomama also practice coitus taboos during lactation (Chagnon, '66, '68b), a phenomenon that has some bearing on the size of completed family (Neel and Chagnon, '68). The length of time that the taboo is maintained depends on the receptivity of the female to sexual advances made by men. In the case of the abducted Makiritare and Makú females, neither tribe known to have this taboo (or if they did it would largely be inoperative because of the disadvantage of captive status), exposure to the risk of pregnancy is somewhat higher when compared to their Yanomama counterparts.

The Yanomama practice regarding abducted women is as follows: men who participated in the raiding party rape the captive before reaching home, and the men in the village are later given the same opportunity. For some considerable time these women are "seduced" by men in the

³ When the offspring of these men are counted, two-thirds of the village are lineal descendants of just two men. Although not germane to the reproductive performance of headmen, in the case mentioned here, the two men were married to each other's sisters or half-sisters, giving a rough notion of how consanguineous some villages are as a result of traditional marriage practices.

village until one of them can claim her as a wife and thereby limit the access of his covillagers to her sexual favors. In the village of Borabuk, where there is an acute shortage of women as a result of female infanticide (male/female sex ratio: 1.45), the lower status of the abducted women and their consequent higher than usual opportunities to reproduce is reflected not only in their reproductive performance but in the fact that two of them had multiple, simultaneous husbands (polyandry), one of them having six "legal" husbands at the same time.⁴

In addition to the role of attitudes regarding coitus taboos, infanticide and polyandrous marriages, it can be shown that when a gene is introduced through a captive, the sex of the initial carrier also affects the probable retention of an introduced gene in another way. Genes introduced by male captives are less likely to be retained in the recipient population for two reasons. First, the status of the captive males (usually the immature sons of abducted women, since adult males are never taken captive) is uniformly lower than that of captured females, so low that the Yanomama are even known to kill young male captives once they have them back in their village (Chagnon, '68b). If the male is allowed to live and reaches adulthood, he must have exceptional personal attributes to compete effectively in a demographic situation where there are fewer marriageable women than competing men, especially in a social system where marriage is arranged by one's male kinfolk. These kinsmen, of course, are non-existent for a captive male unless the husband of his mother adopts him without undue qualification as his legitimate offspring. Given that he has only average capabilities, he will marry later than his peers and have difficulty maintaining possession of and exclusive sexual access to his wife. In many cases the young man, if he retains his natal language, returns to his mother's village even though he knows nobody there, largely because he hopes his kinsmen will provide him with a wife within the context of the tribal marriage practices. Without male kin to support him a young man is at a severe disadvantage in seeking a spouse. Both the Yanomama and the Makiritare

have a prescriptive bilateral cross-cousin marriage system, the essence of which is that a male must marry a female who belongs to a single (social) category of women, two genealogical specifications of which are mother's brother's daughter and father's sister's daughter. (See Chagnon, '68b, for more complete details). Since marriage in both societies is arranged by kinsmen of the ascending generation, a young man with only half of his kinsmen (and adopted ones at that) in his village will be severely restricted as to possible mates in a way that a female captive would not be. Secondly, he is at a different kind of disadvantage because males marry, in general, later than females. Of the two kinds of cross cousin he could legitimately marry, those on his mother's side live in enemy villages, leaving only his (adopted) patrilineal cross cousins as possible choices. Because females marry, on the average, some seven years earlier than men in this particular case, the man in question would have only his (adopted) father's sister's daughters (and their categorical equivalents) to choose from, most of whom would be married by the time he comes of age. This demographic situation, lower probability of marrying a father's sister's daughter, has been demonstrated for other populations (Hajnal, '63; Rose, '60) and characterizes the Yanomama as well (Chagnon, unpublished data). In brief, the probability of a gene introduced by a captive surviving in a population with these socio-cultural parameters appears to be in large measure a function of the sex of the initial carrier. Indeed, it would appear that an introduced gene by an abducted female carrier would stand a better chance of retention than a newly arisen mutant within the non-mixed population because of the social and cultural factors influencing the reproductive performance of captured women.

With respect to the population of Borabuk and the frequencies of Di^a and Ap^a , the headman of the group (i.e., the half-

⁴ One Makiritare woman was quite old at the time she was abducted and therefore somewhat undesirable (individual IV-14) and another (individual III-4) was a lineal descendant of the Makiritare man who sired the Borabuk headman. She was accorded somewhat special treatment in that her new husband (individual III-6), her known kinsman, managed to limit his peers sexual advances toward her.

Makiritare founder, individual II-8) appears to have carried the Di^a gene and possibly Ap^a so their frequency in the population might be in some measure a result of his fecundity. This, in turn, was the result of his acquiring three additional wives during the epidemic, by whom he had a total of 13 children (of whom 12 are presently living). Although we do not have precise information regarding the politics of acquiring the widows of the epidemic, we do know that the same phenomenon occurs in Yanomama villages at the present time. Whenever there is a controversy regarding the disposition of a widow or a separated woman, the headman often takes her into his household as a wife in order to maintain village order. He may, if he wishes, give her to a bachelor in the village, preferably his younger brother, but often he simply keeps her as an additional wife.)

Of the 12 living offspring, only two men (1 of them a headman) had the Di^a allele (only 10 were sampled). However, depending on how the genealogy is interpreted, and several interpretations are possible because of unsampled or dead individuals, as many as three-fourths of the village's present Di^a positive individuals may have gotten the allele from this man or his offspring. On the other hand, the headman's brother (individual II-10) may have carried the allele and passed it on to some of his descendants. Some individuals are presumed to have derived their Di^a positive alleles from Makiritare admixture prior to the separation of the two groups at a time beyond the genealogical recall of our oldest informants.

Regarding the Ap^a allele, it can be seen from the genealogy that over half of the individuals carrying the positive factor are either the abducted Makiritare women or their offspring. Finally, all of the individuals with abnormal albumin are descendants of the abducted Makú woman (individual III-5).

DISCUSSION AND CONCLUSIONS

The manner in which previously absent genes are introduced into populations and then increase in frequency is, of course, a basic phenomenon in population genetics. The present communication has been devoted to a small case history. As a result

first of what appears to be a concatenation of unlikely sampling events ("drawing" individuals with the Di^a , Ap^a , and albumin Makú genes) and secondly of cultural practices which result in abducted women having larger than usual families, a Yanomama village now finds itself with two genes (Di^a and Ap^a) in higher frequency than in the Makiritare village which was the presumed source of the gene flow. In addition, raids on another tribe have introduced a third "new" gene to the group. Ethnographic studies provide a partial explanation for otherwise puzzling findings. The picture would be clearer if we could document all the introductions of these three "foreign" genes, but this would be too much to expect in such a population. It should be emphasized that the events we are discussing occurred prior to the intrusion into this region of outsiders, aside from a few expeditions that moved through, so that these events would seem to mirror the traditional pattern of gene flow. Although we cannot rigorously preclude the possibility that the Di^a and Ap^a genes were introduced into the Mucajai population of Borabuk prior to 1875, we believe that events since then could account for the entire situation. On that basis, these two genes have "moved" over 200 miles in three generations.

A question which can in part be answered by future studies, but to which there may never be a completely satisfactory answer, is the extent to which "micro-events" such as here described may dominate "macro phenomena." If, were it not for the European intrusion, events such as those just described were destined to occur at multiple points along the Makiritare-Yanomama frontier, then indeed the gene frequencies in the mixed population might have reflected the degree of admixture more accurately. If, by contrast, the Borabuk population, now on the periphery of the tribal distribution, were to separate still further, multiplying disproportionately in the process, while the remainder of the tribe did not fare so well in its exchanges with the Makiritare, then this small event could play an important role in establishing certain allele frequencies in an emergent tribe. Elsewhere we (Neel and Salzano, '67) have pointed out how stochastic

events might be of importance in enabling a polymorphism which is frequency dependent under schemes of normalizing selection (cf. Fraser et al., '67) to reach a point of stable equilibrium; these findings provide an actual illustration of the possibilities inherent in this breeding structure.

Matson et al. ('68) have recently reported on the allele frequencies of the "Uaica," "Xirixano," "Cacarapai" and "Paramiteri" Indians of northern Brazil. These are simply local names for parts of villages, distinct villages or groups of villages of the Yanomama. The "Xirixano" (Xirixana?), "Cacarapai" (Kasrapai?) and "Paramiteri" (Parimiteri?) specimens were in fact collected in 1963 at Mucajai station of the Unevangelized Fields Mission (Borabuk), then the most accessible of the Brazilian Yanomama villages. Failure to investigate carefully the genealogical and historical relationships among the several groups in the sample has led to an unfortunate lumping and separating of the samples. Thus, the "Paramiteri" (Parima-teri) individuals sampled at Mucajai were visitors to that village from the location of Matson's second sampling point (Waika Station of the Unevangelized Fields Mission), and should have been included among them. However, the sample collected at Waika station (Matson's "Uaica"), according to local missionaries, included individuals from five distinct villages; three groups of people happened to be visiting there at the time, and the local population at Waika station is, from genealogical and informants' historical accounts, a composite of two distinct groups. Again the "Cacarapai" (Kasrapai?) individuals are, from our genealogical and ethnohistorical evidence, merely a small fraction of the Borabuk population living a few miles upstream from the latter. Finally, a few members of the Waika station population have recently (one generation ago) migrated there from Borabuk.

Matson et al. ('68) report, without comment, a D_i^+ positive allele frequency of 0.10 for the "Xirixano" and a 0.01 frequency for the same allele among the "Uaica." From the foregoing it is apparent how very unrepresentative these frequencies are of the Yanomama tribe as a whole, or of any

tribe. That our own findings and theirs are puzzling and/or unrepresentative could only be determined by comparing them to allele frequencies found in other, related villages and viewing the results in the light of the specific mating structure, the village history, the genealogical relationships and actual village composition at the time of the study.

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