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BIOLOGICAL SUBDIVISIONS OF THE INDIAN ON THE BASIS OF GENETIC TRAITS

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Table of Contents

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The improvement of new techniques for the identification of new traits in the erythrocytes and in various chemical components of the plasma has disclosed in the last 20 years a new era in the field of population genetics. Some of these traits have shown a distribution limited to a large sub-division of mankind reaching the rank of gene markers, others, are common to practically all populations but with variable frequencies according to the population; and some others, less important, are fixed or with a very low frequency. It is now possible to set up a more comprehensive "mosaic" of gene frequencies according to the population, which could help and complement the classical division of mankind formulated in the past on the basis of external features of bodily and skeletal structures.

Several attempts have been made to design a classification of mankind (Winner, 1948; Boyd, 1956, 1963) on the basis of blood traits. At the begining only blood groups were used as the only tool for the purpose of classification; later, new blood traits different from blood groups were incorporated. Boyd (1963) using the available information distinguishes in human populations 13 races included into 7 major groups. Among the major groups was placed the "American group" with a single race "American Indian" and Boyd suggests that "... it may

eventually be possible to distinguish between North American and South American indians serologically ...".

All American indians, considered as one population, are characterized in general, by high frequency of blood groups O, M, R_2, Fy^a, Di^a, and ABH secretor, and low frequency or absence of A_2, B, Ro, r, Lu^a, K, Le^a and abnormal hemoglobins (Mourant, 1954; Boyd, 1963; Neel and Salzano, 1964). These characteristics permit to distinguish the American indians so far studied from other sub-divisions of mankind. However, there are differences between tribes which suggest that Indian populations are not forming an homogeneous gene pool, as has been stressed by some anthropologists in the past.

Before we try to formulate or discuss any possible sub-division of Amerindians derived from the frequency of blood group traits, it would be worth while to make a general review on their geographical and socio-linguistic division. The aboriginal population of America from Alaska to Tierra del Fuego is distributed in tribes* which occupy one or several territories. Most tribes specially in South America, live in a state of semi-isolation separated from their neighbours not only by geographical barriers but also by cultural differences in language, social organization, value systems, etc., which impede interbreeding with other tribes. Some large tribes are subdivided into sub-tribes which in turn are formed by independent villages. It is interesting to mention that villages are politically independent one from another and in some cases the independence

* As the term of "tribe" is rather confusing and it is used by anthropologists to express different meanings, this term will be used in this paper to designate group of independent villages of indians which are linguistically and cultural similar.

is so strong that intermarriage between members of neighbouring villages is very sporadic. In three villages recently studied among the Warao living in the Orinoco Delta (Wilbert and Layrisse, 1968) strong endogamy was observed even though the communications between villages is rather easy. From 42 marriages recorded in Sacupana village, in 39 both parents belong to the same village, and in only 3 marriages one parent is from outside. In 33 marriages from Jobure villages, both parents are from the same village; in 4 marriages, only one parent is from outside, and in 2 marriages both parents are from neighbouring villages. Assuming that the total population of a tribe come from the same gene pool it is not impossible to predict that the relatively scarce gene flow between the villages of this tribe will create the ground for a genetic differentiation between the villages.

The sub-division of indian populations already mentioned shows a peculiar situation that one should analyze to see how these socio-political divisions would induce changes in the frequency of blood traits. Accordingly, we will analyze : 1) Distribution of blood traits between tribes 2) Distribution of blood traits within tribes.

1. - Distribution of blood traits between tribes.

One of the most demonstrative example of divergencies in the frequency of blood traits is provided by two tribes living in the Amazona Territory of Venezuela : The Makiritare and the Yanomama. The Yanomama occupy an extense area (0°30' - 5°N and 62-65°W) in the South part of the Venezuelan Amazon Territory and the North part of Brazil. The Makiritare, a carib sub-tribe, has disseminated villages distributed in the Southern and Northern limits of the Yanomama Territory. Their cultures are different : The Yanomama are

hunting and gathering individuals with an incipient agriculture and very low culture (Layrisse, Layrisse and Wilbert, 1962; Zerries, 1964; Layrisse and Wilbert, 1966; Arends et al. 1967; Chagnon, 1966) and the Makiritare is a more developed population relying his subsistence, mainly in agriculture (Layrisse and Wilbert, 1966). Although there are evidences of interbreeding with Makiritare in the north and south of the Yanomama villages, the gene flow between them can be considered in general, at a very low level. The comparisons of blood group frequencies between the Makiritare and two Yanomama sub-tribes (Sanema and Waica) showed significant differences in practically all the blood group systems. S, of the MNS system is high in Makiritare (63%) while it reaches only 19% in Waica and 9% in Sanema. R_1 of the Rh system in both Yanomama tribes is about twice higher than in Makiritare, while the former tribes showed the lowest frequency of R_2 ever found in indians, 6% in Waica and 3% in Sanema. Frequencies of Fy^a is 83% in Makiritare and 58% in the other tribes, and finally Di^a is 16% in Makiritare and 0% in Waica and 3% in Sanema. As the Sanema live very close to the Makiritare villages of the North, it might be possible that this Diego frequency can be accounted for by admixture between these tribes.

The above observation is not unusual in the literature on indians; among others, Matson and Swanson have reported differences in blood groups between Maya and non-Maya groups living in Central America (1959, 1961), Salzano in Brazilian tribes (1964); Córdoba, Lisker and Loria (1967 in various Mexican tribes and Matson, Sutton, Etcheverry, Swanson and Robinson (1967) in Chilean tribes.

2. - Blood group distribution within the tribes.

The indian tribes in some instances occupy one geographical area; in some other cases, the villages of a tribe are separated by a belt of territory occupied by other indian tribes or by a creole population. It is pertinent, therefore, to consider these two possibilities.

An example of the first situation is the so called Cariban tribe. At the time of the Spanish conquest, this tribe occupied the central and southeastern part of Venezuela and some territories in Colombia, Brazil and British Guiana; to the north they had conquest most of the lesser islands. Today, many Carib sub-tribes have been extinguished and the surviving groups have retreated to less penetrable areas of Venezuela and the other countries. With the exception of the Guaiquery of Margarita, who are heavily acculturated and integrated, and the Cariña of Anzoategui State of Venezuela, who have began to mix with the creole population, the rest of the tribes live in semi-isolation with sporadic contacts with other tribes or the creole population. The 14 Cariban sub-tribes studied for blood groups and other blood traits speak languages of Cariban affillation, their social organization and some cultural material is uniform and have developed a neo-indian type of culture based on slash-burn agriculture (Layrisse, Layrisse and Wilbert, 1963 a).

A comparison of blood group frequencies between these tribes showed a marked dispersion in all systems. The MS ranged from 5 to 43%, R_1 from 36 to 79%, R_2 from 8 to 48%, Fy^a from 43 to 81%, Kidd from 32 to 75% and Di^a from 9 to 23%. This dispersion was also found in sub-tribes living in a more narrow habitat as occurred within the various Yupa and Pemon sub-tribes.

This internal divergence in gene frequency has also been observed in

Chibchan tribes (Layrisse, Layrisse and Wilbert, 1963 b) in Caingang (Salzano, 1964) in Maya (Matson and Swanson, 1961) and others.

The study of 10 villages of the Yanomama tribe, carried out in 1966, provided excellent information on how gene frequencies may change between tribal villages living in the same area and separated by a relatively short distance (Arends, Brewer, Chagnon, Gallango, Gershowitz, Layrisse, Neel, Shreffler, Tashian, and Weitkamp, 1967). Five hundred and sixty eight individuals representing 72% of the total population of these 10 villages, were examined for 7 blood group systems, 7 serum protein traits and 7 erithrocyte enzyme groups. The variation in gene frequencies was greater than in any other tribe yet examined in the same circumstance. Genes with low frequency such as MS, NS, R_2, Lp^a and Ag^a were lost in several villages; genes with high frequencies such as PGM and Se were fixed in some villages, and finally, genes with intermediate frequencies such as R_1, Ms, Ns, Fy^a and Jk^a showed a very wide range of frequency.

The Warao villages at the Orinoco Delta also provide excellent information on the variation in gene frequency within the tribes. Three villages studied were : Jobure, Sacupana and Winikina, with populations of 200, 180 and 330 respectively (190, 160 and 300) (Wilbert and Layrisse, 1968). Three previous studies of these tribes had shown a very low M (less than 15%) with a relatively high S (40%) traveling mostly with N, which is uncommon in indians; very high R_1 , and negative or very low frequency of Di^a. The village of Jobure was the excentric tribe. The frequencies in the MNS and Diego systems in Jobure were completely different from the frequencies found in the other 2 villages and from those previously reported. The frequency of gene M was 90% and of gene S only 13% and this gene was mostly traveling with gene N. It was also found that these tribes had 4% of Di^a. Perusal of the genealogy of the Sacupana village

gave a clue for such genes dispersion. Twenty one members out of the 48 living individuals forming the second generation come from a polyginous family in which the father happens to be MSs and three wives are sisters of the type Ms. All Diego positive cases found among the Warao living in the Sacupana villages came from one family which we were able to follow in three generations. It is interesting to observe that the members of this family also carried the transferrin D_{chi} which is absent in all Warao individuals examined but present in various frequencies in Carib tribes. As the western and north-eastern Warao territory is surrounded by Carib, it is not unlikely that both Di^a and D_{chi} genes were introduced into the Warao population by Carib in early times.

The three Xavante villages studied by Gershowitz, Junqueira, Salzano and Neel (1967) showed a variation of the gene SN, from 1-50% and of the gene R_2 from 24-39%; the other gene frequencies had comparable results.

FINAL COMMENTS

The analysis of the frequency of blood groups and other blood traits has shown that the population unit used in cultural anthropology does not always correspond to the biological unit; thus, the population of each village rather than the whole tribe represents, in some cases, an independent gene pool. It will not be a surprise, therefore, that independent studies carried out in a tribe may show great divergence in gene frequencies because they are performed in different villages. Such possible variations should be kept in mind when one wants to collect information from the literature and needs to decide whether the sampling is inadequate or really represents the population under study. According to my experience in the study of two large tribes, the gene frequency obtained by sampling the less closely related individuals from several villages of a tribe fits very well with the frequency obtained by summing up the genes counted separatedly in villages in which more than 70% of the population was examined.

Blood tests in indians would be more fruitful if they are accompanied by other anthropological and medical studies. Demography including a history of the tribe and formation of the villages, as well as a careful genealogy, provide valuable information that could serve to understand, at least partially, the variation of the gene pool between villages. The gene pool of a village among the Warao, for instance, is the result of the fusion of two, three or four extended families which have split up from neighbouring villages. This pattern is very similar in many respects to the "Fission, fusion" model observed by Salzano and Neel (1967) among the Xavantes and also observed by Chagnon (1966) among the Yanomama. It is not unlikely , therefore, that variants of these patterns are also operating in many tribes.

It is evident that in the formation of the new village as previously described, there are circumstances which may induce variation of the gene frequency in the following generations such as the number of individuals from each family who contribute to the breeding population, the polygonous habit as a man married to several sisters, and others. Consequently, genetic drift would suit with more probability to explain the variation of gene frequencies in indian populations in the place of other genetic forces such as selection and gene flow. It is also probable that these mechanisms may operate similarly in the formation of hybrid populations, explaining, in some cases, gene frequencies which are equal or even higher than those observed in the original populations (Lisker, Loria and Cordova, 1965).

Having in mind the variation of gene frequency in indians, we would like to discuss finally the possibility of a sub-division of the American Indian populations, which could reconcile somewhat the frequency of blood traits with other anthropological characteristics. Dr. Juan Comas has previously described

some of the attempts of classification of indians risen by prominent Americanists. However, none of these classifications fits the distribution of blood traits. Garn in 1965, for instance, included all South American indians, excepting Circum-Caribbean and Fueguian, in one homogeneous population. It is known that in such a large area there are populations with marked morphological cultural and serological differences.

Even though it is very difficult to attempt a comprehensive sub-division of the aborigines of America on the basis of genetic traits; some taxonomic considerations can be formulated from the information available; they are as follows :

1. - It is very likely that the Eskimo can be individualized genetically from the rest of North American indians. They are characterized by the presence of the gene B and absence of the gene Di^a. The frequency of the other blood traits do not differ from American indians.

2. - Due to heavy non-indian admixture it is very difficult to analyze the gene frequency in North American indians. Provisionally they could be classified in one group.

3. - It might be possible to make a first sub-division of the Middle American indians : the northern group including To tocanas and Mayan families and, the southern group who speak Chibchan or hokan philum languages and have culture material ascribed to the Chibchan or Circumcaribbean culture (Wilbert, 1968). However, the only difference found is the frequency of the Di^a which tend in general, to be higher from 4 to 18% with a mean of 10% in the north group and low from 0 to 10% with a mean of 3% in the south group.

4. - The large number of tribes distributed in the accidented territory of South America, favours the formation of micro-differenciated populations. Thus, in spite of the variation of gene frequency between sub-tribes and villages of the same tribe, it might be possible to find differences which permit to individualize a tribe, or a group of tribes, which also show other anthropological differences. For example, it would be interesting to investigate the relatively high frequency of A_1 among the Andean indians, first noticed by Newman (1958), which is not accompanied by the presence of other non-indian genes; the possible connection on the basis of genetic traits, between the Chilean indians and the Polynesians as has been stressed by Matson, Sutton, Etcheverry, Swanson and Robinson (1967) in a recent study; the possibility that the populated tribes : Yanomama and Warao, distinguished by the absence of the gene Di^a and other anthropological aspects could be classified separatedly or together but different from the neighbouring tribes.

It is highly probable that the hesitation we exhibit at present to subdivide the American Indians on the basis of genetic traits will be overcome in the near future with the increase of gene markers and the utilization of mathematical models in which all the variables found in a tribe can be computed.

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