Further Studies on the Xavante Indians

VII. The Oral Status of the Xavantes of Simões Lopes

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As ONE aspect of the effort to characterize the Xavante Indians described in the present series of papers, dental examinations were performed on 166 individuals more than approximately three years of age living near the Post Simões Lopes. No attempt was made to do a systematic oral examination on children younger than this, but they were inspected for obvious signs of gross pathology. Oral examinations were also performed on 38 young adult Xavante males living near the Catholic mission at São Marcos. The state of acculturation of these Xavantes has been described (Neel *et al.*, 1964; Maybury-Lewis, 1965, 1967; Salzano *et al.*, 1967).

In addition, 42 Bakairi Indians, living at the Post Simões Lopes, were examined between the examinations of the two Xavante groups. Linguistically, the Bakairi belong to the Carib-speaking family and apparently are closely related culturally to the other Carib-speaking tribes of the Upper Xingu. Oberg (1953) has described their present status; he estimates that in 1947 the number of Bakairi in the northern Mato Grosso was 200–250. There have been contacts between the Bakairi and neo-Brazilians since 1820 so that considerable acculturation has taken place. Although it would seem likely that significant miscegenation had occurred in the intervening 100–150 years, in 1950 Lima reported that 108 of 109 Bakairi typed for the ABO groups were type O. However, one of the examining team with a considerable experience in this respect (F. M. Salzano) felt the proportion of Caucasian admixture to be significantly higher than the blood types would suggest.

The major objectives of the oral examination were:

1. To evaluate by standard criteria the major categories of dental disease, namely, dental caries and periodontal disease.
2. To assess occlusion and dental maturation.
3. To enumerate other significant oral pathological entities encountered.
4. To obtain comparative data for certain variable morphological characteristics of the dentition and minor dental anomalies.

RESULTS

Dental caries. Dental caries rates in the two Xavante villages were rela-

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TABLE 1. MEAN DENTAL CARIES SCORES (DMF) FOR INDIVIDUALS FROM SEVERAL POPULATION GROUPS

	Approximate age (years)		Mean number DMF teeth	
	Range	Mean	♂	♀
Xavante, Simões Lopes	18–56	26	1.6	3.2
Xavante, São Marcos	10–45	20	.8	—
Jivaro Indians	—	26	.6	2.2
Attawapiskat Indian band	26–45	—	5.2	6.8
Bakairi Indians	18–65	32	15.2	19.5
U. S. white	25–34	29	16.8	18.4
U. S. Negro	25–34	29	8.4	12.3

TABLE 2. PERIODONTAL AND ORAL HYGIENE SCORES FOR XAVANTES, U. S. WHITE AND U. S. NEGRO

	Simões Lopes Xavante		U. S. white		U. S. Negro	
	♂	♀	♂	♀	♂	♀
Periodontal index	.4	.4	.9	.5	1.3	.9
Oral hygiene score	2.6	1.5	1.6	1.1	2.0	1.9
Age	26	26	29	29	29	29

tively low. Comparisons of the mean number of DMF (decayed, missing, and filled) teeth for adult Xavantes with the Bakairi, the Jivaro Indians of Ecuador (Interdepartmental Committee on Nutrition for National Defense, 1960), the Attawapiskat Indian band of Ontario, Canada (McIntosh, 1949), and U. S. whites and Negroes (National Center for Health Statistics, 1965) are given in Table 1. Mean DMF scores for Xavantes are strikingly lower than the Bakairi or either U. S. sample and also are lower than for the Attawapiskats but are slightly higher than for Jivaro Indians. Approximately 33% of the Xavantes at Simões Lopes were caries free. Neel *et al.* (1964) noted almost complete absence of dental caries in the Xavante village at São Domingos. The difference in the two villages may at least in part be accounted for by the fact that, for some five years, the Simões Lopes Xavante have had access to sugar cane, whereas none was grown at São Domingos. It would appear that, although these Xavantes still enjoy relative freedom from dental caries, this advantage is disappearing after only six years of permanent contact with a post of the Indian Protective Service.

Periodontal disease. The importance of oral hygiene and age in the etiology of periodontal disease is well established. While a variety of intrinsic factors have been suggested, little definitive information exists on their importance in the usual types of periodontal problems (Scherp, 1964). Likewise, nutritional deficiencies, particularly vitamin deficiencies, have received a great deal of attention, but they have not proven to be of as great an importance as once thought (Russell, 1965 and unpublished).

The periodontal status of the first 56 Xavante adults ($\geq$ 17 years) examined at Simões Lopes was assessed using the periodontal index developed by

TABLE 3. DISTRIBUTION OF MALOCCLUSION BY ANGEL'S CLASSIFICATION—SEXES COMBINED

Type	Xavante	Bakairi	Japanese children	Utah school children
"Ideal" occlusion	148 (95%)	23 (55%)	2241 (41%)	503 (36%)
Malocclusion:				
Class I	7	13	2408	420
Class II	0	3	643	342
Class III	0	3	241	124
TOTAL	155	42	5533	1397

Russell (1956). Oral hygiene was scored using the index of Greene and Vermillion (1964). The periodontal index was not included in later oral examinations because of limitations of time available for the total series of tests and examinations. Results are shown in Table 2. Also shown are values for U. S. whites and Negroes (National Center for Health Statistics, 1965). The Xavantes show considerably higher oral hygiene scores (the higher the score the more debris, plaque material, and calculus found on the teeth) than either comparison group. Periodontal index scores tend to be lower for Xavante, indicating less gingival and periodontal disease. Thus, we have a seemingly paradoxical situation of relatively healthy periodontal tissues existing in mouths with poor hygiene, suggesting that further study of periodontal disease in primitive groups might prove fruitful.

Dental occlusion. Malocclusion was assessed using Angel's classification of anterior-posterior jaw relationship with a variety of subtypes (Anderson, 1960). In addition, a category of "ideal" occlusion was recognized. In this category, the jaw relationship was normal (Class I) and the individual teeth were in near perfect alignment. The only relaxations of this requirement were that slight rotation of upper or lower incisors was allowed (winged incisor) and very slight crowding of lower incisors was permitted. When overjet was greater than 4–5 mm and/or the overbite was more than two-thirds of the lower incisors, the dentition was considered to be malocclused.

Frequencies of ideal and Angel Class I, II, and III malocclusion for Xavantes (Simões Lopes and São Marcos combined), Bakairi Indians living at the Post Simões Lopes, Japanese children (Schull and Neel, 1965), and Utah school children (J. D. Niswander, unpublished observations) are given in Table 3. Fifty-one Xavantes were unclassifiable because of missing teeth or undeveloped permanent dentition; therefore, data are presented for only 155 individuals. All groups were examined by the author using the same criteria.

Forty-five per cent of the Bakairi showed some malocclusion, whereas only 5% of the Xavante were affected. The Japanese and U. S. school children in turn showed a significantly greater frequency than either Indian group—approximately 59% and 64%, respectively, having malocclusion.

Characteristically, the Xavante adults exhibited broad dental arches, almost perfectly aligned teeth, end-to-end bite, and extensive dental attrition. At 18–20 years of age, the teeth were so worn as to almost totally obliterate the cusp patterns, leaving flat chewing surfaces.

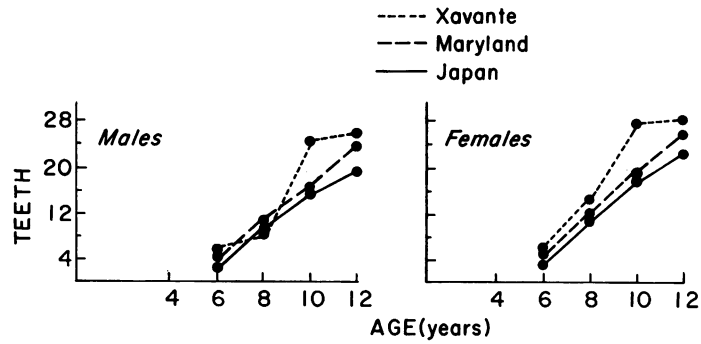

FIG. 1. A comparison of the eruption of permanent teeth in Xavante, Japanese, and U. S. Caucasian children.

Dental eruption. Dental maturation was assessed by a count of the number of permanent teeth exclusive of third molars which were erupted at a given age. A tooth was considered erupted if any portion of the crown had pierced the gingiva. Figure 1 depicts the mean eruption curves for Xavante children compared to Caucasians from Prince Georges and Montgomery Counties, Maryland (A. L. Russell, unpublished observations), and Japanese residing in Nagasaki City (Schull and Neel, 1965). The Xavante children show an accelerated dental eruption compared to the other two groups, confirming an Indian characteristic apparently first reported by Steggerda and Hill (1942). However, the factor of tropical residence may also play a role (cf. Eveleth, 1966).

Gross oral pathology. One female with an apparent submucous cleft of the hard palate and a short soft palate was seen, but no frank clefts of the lip or palate were observed.

Three adult males with moderate to marked (up to 2×) enlargement of the parotid glands were encountered. The glands were soft, spongy, and nontender. One individual showed definite bilateral enlargement, whereas the other two cases were unilateral with questionable to slight involvement of the opposite side. Enlargement of the parotid glands has been reported among a variety of populations with widespread but usually tropical geographic distributions. Polunin (1953) and Borsanyi and Blanchard (1960) have reviewed the literature and found mention of association between parotid enlargement and a wide variety of diseases. On the other hand, the condition also occurs in the absence of apparent disease. Thus, Polunin (1953) and Farago (1964) have described parotid enlargement as a frequent feature of "routine" physical examinations performed on Malaysian aborigines and New Guinea natives. Various authors (cf. Polunin, 1953; Farago, 1964) have suggested the enlargement is due to a compensatory hyperplasia of the gland to meet the increased need for ptyalin necessitated by the low calorie, high bulk, predominantly carbohydrate diets of the natives, a suggestion supported by the interesting case report of Silverman and Perkins (1966).

One or more discrete papillomatous lesions up to .5 mm in diameter were

seen in the oral mucosa of six young males and one female. The age of the individuals ranged from 6 to 18 years. Invariably, the focus of the lesions was the lower right labial mucosa near the commissure, suggesting that certain habits or behavioral patterns might play a role in the etiology. However, none was observed which might account for the condition. Similar lesions were seen among the individuals examined at São Marcos and a biopsy specimen was obtained. The pathology report described "acanthotic epithelial thickening with broadening and loss of normal rete peg formation." The epithelial surface was parakeratotic and the basal cell layer was quite proliferative. Diagnosis was epithelial hyperplasia.

Archard *et al.* (1965) have described histological studies of 19 similar cases (including the one specimen reported here from São Marcos). They term the condition *focal epithelial hyperplasia.* Seventeen of their cases were obtained from Indians residing in the southwestern United States. One case was reported in an Eskimo from Point Barrow, Alaska. With the exception of the one Eskimo, all cases reported to date have been American Indians. The occurrence of this lesion in North, Central, and South American Indians living under rather different cultural and environmental circumstances is intriguing. Although it seems unlikely, this apparent racial association could be spurious, since in all cases Indians form a large segment of the population in the areas where the lesion has been found.

Morphological variation and dental anomalies. At the outset, there was some question as to the extent of co-operation which could be obtained from this group; therefore, the decision was made to avoid a number of procedures which might cause apprehension or otherwise jeopardize the study. For this reason, as well as limitation of time, dental impressions were not obtained. Thus, detailed information on molar cusp patterns and similar minor variations in dental morphology is not available. It should be emphasized that the frequencies for several of the conditions reported here must be treated as approximations. Because of the language difficulties, our historical information concerning loss of teeth through trauma or caries is necessarily limited. Furthermore, X-ray studies to distinguish impacted from missing teeth or to detect unerupted supernumerary teeth were not feasible.

The findings regarding a number of dental characteristics are summarized in Table 4. Some of these may be considered as normal variants and others as definite anomalies. Almost all occur with appreciable frequency in certain population groups. The references to previous studies given in Table 4 are not intended to be exhaustive but only representative. In general, the Xavantes are typically "Indian" in regard to the occurrence of various oral and dental characteristics. Previous data are neither uniform nor extensive enough at this time to attempt any meaningful subclassification of Indians on the basis of these traits.

DISCUSSION

Oral examination of the Xavante revealed a relative freedom from the common dental diseases. The jaws were broad and well formed with the

TABLE 4. SUMMARY OF MORPHOLOGICAL VARIANTS AND DENTAL ANOMALIES ENCOUNTERED AMONG 93 MALE AND 71 FEMALE XAVANTE INDIANS

Condition	Number observed (%)	Previous reports of Mongoloid groups			Remarks
		Author	Population	Frequency	
Congenitally missing teeth (other than third molars)	9 (5.4%)	Niswander and Sujaku (1963)	Japanese children	5.8% boys 9.2% girls	Usually appears to follow autosomal dominant mode of transmission—probably a number of independent loci involved
		Dunkel (1965)	Navajo children	5.7%	
One or more third molars missing	18 (30.5%)	Brothwell *et al.* (1963)	Chinese	32.2%	Mongoloid populations generally have high frequencies
			Japanese	18.4%	
			Burmese	11.0%	
			American Indian	12.6%	
			E. Greenland Eskimo	36.6%	
			S. W. Greenland Eskimo	29.5%	
			Alaska Eskimo	26.6%	
Supernumerary teeth	5♂ (5.3%) 1♀ (1.4%)	Niswander and Sujaku (1963)	Japanese children	5.3% males 2.2% females	Apparently occur more frequently in Mongoloids than in Caucasians—no clear-cut simple mode of inheritance
		Dunkel (1965)	Navajo	3.2%	
Peg-shaped lateral incisor	8 (4.8%)	Niswander and Sujaku (1963)	Japanese children	~1.5%	Apparently dominantly transmitted and a variation in expression of the trait "missing lateral incisors"
		Dunkel (1965)	Navajo children	.4%	
Dens in dente	2 (1.2%) (with periapical abscesses)	Dunkel (1965)	Navajo children	10.1%	Increased frequency has been shown in sibs and parents of affected individuals
Barrel-shaped incisor	17 (10.2%)	Dunkel (1965)	Navajo children	10.0%	Apparently an Indian trait; may be a variation of dens in dente

Transposition of canine and first premolar	1 bilateral * 2 unilateral (.18%)	—	—	—	No known report of previous cases
Shovel-shaped central incisor	166 (100%)	Dahlberg (1963)	American Indians	100%	A Mongoloid racial trait
		Carbonell (1963)	N. Chinese	71.8%	
			Eight other studies on mongoloids	93.2–100%	
Mesially rotated (winged) central incisors	41 (25%)	Dahlberg (1963)	American Indians	22–38%	A Mongoloid racial trait
			Japanese	10%	
			Caucasians	3%	
Torus mandibularis and palatinus	None observed	Moorrees (1957)	Aleuts	35% T. mand. 0% T. pal.	Highest frequencies reported in Mongoloid populations—frequency increases with age

*This individual is further described in the paper giving the results of the physical examinations (Weinstein *et al.*, 1967).

teeth in good alignment. Caries rates were low and periodontal disease was insignificant.

The relative freedom from dental caries of ancient as well as modern, unacculturated primitive man is well documented. Likewise, the loss of this "immunity" on contact with civilization has been recognized. Toverud (1952) and Finn (1952) have reviewed the evidence concerning the speed with which the "immunity" is lost with acculturation, a point possibly about to be illustrated by the Xavantes near Simões Lopes.

Little data exist concerning the relative importance of periodontal disease among primitives. Although ancient skulls are said to show significant affliction (Rabkin, 1937; Sedwick, 1936; Angel, 1944; Dummett, 1957), it is unclear whether the frequency of severe periodontitis was less than is seen today. Barrett (1953) and Cran (1955) report an increased incidence of gingivitis among Australian aborigines on a civilized diet in contrast to those eating native food. They suggest that this effect may be due to lesser mechanical stimulation of the gingival tissue and poorer cleansing of the teeth resulting from the softer diet. Russell (1965) has shown considerable variation among present day populations living under widely differing conditions. There is, however, no clear-cut evidence for racial differences independent of oral hygiene and age. Periodontitis is a disease of the older ages and seldom a great problem before 35–40 years of age. Therefore, by virtue of the shorter life span of populations at this cultural level, periodontal disease should not represent as great a problem as for longer lived peoples.

In this regard, it should be mentioned that, for the most part, simple gingivitis was the only finding among the Xavante and significant periodontitis was observed in but two individuals. Both were among the five villagers over 40 years of age who were examined. However, as mentioned earlier, even though this is a youthful group, there is less reaction of the periodontal tissues to poor oral hygiene than might be expected from other studies. Thus, the lower periodontal index, if real, appears to reflect a greater resistance to local irritants associated with poor oral hygiene and suggests that other less apparent factors are important. Perhaps the oral flora or, as suggested by Cran, the beneficial effects of gingival stimulation produced by a coarse diet play a significant part.

Although the case is not nearly as well established as for dental caries, it has long been claimed, and there is evidence to suggest, that malocclusion is considerably more prevalent in modern industrialized populations than in present day primitive groups or in ancient man (Rihan, 1932; Leigh, 1928; Krogman, 1938; Sedwick, 1936; Rabkin, 1937; Angel, 1944; Begg, 1954; Brash *et al.*, 1956; Campbell, 1925; Keith, 1924; Hunt, 1961; Mills, 1963). The reason for this apparent relationship is not clear. However, variations and combinations of one or more of three explanations are frequently encountered. The first assumes a genetic basis for the condition and further assumes a recent relaxation of the rigors of natural selection, so that individuals with malocclusion are at less selective disadvantage in a modern society and, hence, the frequency of the condition has been allowed to increase. Second, it has been suggested that the present high frequency of malocclusion is due to disharmonies resulting

from recent outbreeding with the resultant genetic admixture of diverse physical types. The third explanation frequently advanced is that these changes are the result of environmental factors.

Severe abrasion was not apparent among the Bakairi, and the dental arches did not appear as broad and massive as in the Xavantes. Dental caries and malocclusion were strikingly more prevalent; and, although not recorded systematically, the Bakairi also showed considerably more periodontal disease. If it can be assumed that the Bakairi once enjoyed a freedom from dental disease and malocclusion equal to that now exhibited by the Xavantes, the available data suggest that the changes in occlusal patterns as well as caries and periodontal disease have been too rapid to be accounted for by an hypothesis involving relaxed selection. Furthermore, the very limited data on blood types suggest that as recently as 15 years ago there had been relatively little admixture of the Bakairi with non-Indians, although, as noted earlier, these data were felt to be at variance with the present-day appearance of these Indians.

SUMMARY

Oral examinations were performed on 166 Xavante Indians over three years of age living near the Post Simões Lopes. An additional 38 young adult males were examined at São Marcos. Findings in the two groups were essentially similar. These Xavante groups exhibited relatively low dental caries rates, almost total absence of malocclusion, and some indication that periodontal disease was less prevalent than expected. A more acculturated group, the Bakairi, showed a much higher frequency of malocclusion. The frequency of minor dental abnormalities and other pathological conditions in the mouth was at least as great as and perhaps greater than expected in a similar age group living in a more civilized environment. In regard to morphological characteristics of the dentition and the frequencies of many dental variants, the findings were in keeping with previously published data for American Indians.

REFERENCES

ANDERSON, G. M. 1960. *Practical Orthodontics,* 9th Ed. St. Louis: C. V. Mosby Co., 738 pp.

ANGEL, J. L. 1944. Greek teeth: Ancient and modern. *Hum. Biol.* 16: 283–297.

ARCHARD, H. O., HECHT, J. W., AND STANLEY, H. R. 1965. Focal epithelial hyperplasia: An unusual oral mucosal lesion found in Indian children. *Oral Surg., Oral Med., Oral Pathol.* 20: 201–212.

BARRETT, J. J. 1953. Dental observations on Australian aborigines: Yuendumu, Central Australia, 1951-52. *Australian J. Dent.* 57: 127–138.

BEGG, P. R. 1954. Stone age man's dentition. *Amer. J. Orthodont.* 40: 298–312, 373–383, 462–475, 517–531.

BORSANYI, S. J., AND BLANCHARD, C. L. 1960. Asymptomatic enlargement of the parotid glands. *J. Amer. Med. Assoc.* 174: 20–23.

BRASH, I. C., MCKEAG, H. T. A., AND SCOTT, J. H. 1956. *The Aetiology of Irregularity and Malocclusion of the Teeth,* 2nd Ed. London: Dental Board of the United Kingdom.

BROTHWELL, D. R., CARBONELL, V. M., AND GOOSE, D. H. 1963. Congenital absence of teeth in human populations. In *Dental Anthropology,* D. R. Brothwell (ed.). New York: The MacMillan Co.

CAMPBELL, T. D. 1925. *Dentition and Palate of the Australian Aborigine.* Adelaide: Hassell Press.

CARBONELL, V. M. 1963. Variations in the frequency of shovel-shaped incisors in different populations. In *Dental Anthropology,* D. R. Brothwell (ed.). New York: The MacMillan Co.

CRAN, J. A. 1955. Notes on the teeth and gingivae of Central Australian aborigines. *Australian J. Dent.* 59: 356–361.

DAHLBERG, A. A. 1963. Analysis of the American Indian dentition. In *Dental Anthropology,* D. R. Brothwell (ed.). New York: The MacMillan Co.

DUMMETT, C. O. 1957. The relation of periodontal disease to public health. *J. Amer. Dent. Assoc.* 54: 49–56.

DUNKEL, I. C. 1965. The prevalence and significance of dental anomalies in the Navajo Indian. Unpublished manuscript presented before Public Health Service Clinical Society, Gallup, New Mexico.

EVELETH, P. B. 1966. Eruption of permanent dentition and menarche of American children living in the tropics. *Hum. Biol.* 38: 60–70.

FARAGO, C. 1964. Bilateral parotid gland enlargement in a tropical country. The territory of Papua and New Guinea. *Med. J. Australia* 2: 218–221.

FINN, S. B. 1952. Prevalence of dental caries. In *A Survey of the Literature of Dental Caries.* Washington, D. C.: National Academy of Sciences–National Research Council Publication 225.

GREENE, J. C., AND VERMILLION, J. R. 1964. The simplified oral hygiene index. *J. Amer. Dent. Assoc.* 68: 7–13.

HUNT, E. E. 1961. Malocclusion and civilization. *Amer. J. Orthodont.* 17: 406–422.

INTERDEPARTMENTAL COMMITTEE ON NUTRITION FOR NATIONAL DEFENSE. 1960. *Ecuador Nutrition Survey.* Washington: U. S. Government Printing Office.

KEITH, A. 1924. Concerning certain structural changes which are taking place in our jaws and teeth. In *The Growth of the Jaws Normal and Abnormal in Health and Disease.* London: Dental Board of the United Kingdom.

KROGMAN, W. M. 1938. The role of urbanization in the dentition of various population groups. *Z. f. Rassenkunde* 7: 41–72.

LEIGH, R. W. 1928. Dental pathology of aboriginal California. *American Archaeology and Ethnology* (University of California Publications) 23: 399–440.

LIMA, P. E. 1950. Grupos sanguíneous dos Indios do Xingu. *Bol. Mus. Nacional* (n.s.) 11: 1–4.

MAYBURY-LEWIS, D. 1965. *The Savage and the Innocent.* London: Evans Bros. Ltd., 270 pp.

MAYBURY-LEWIS, D. 1967. *Akwẽ-Shavante Society.* Oxford: Clarendon Press. (In press.)

MCINTOSH, W. G. 1949. Dental studies and nutritional findings in the James Bay Indian. *J. Can. Dent. Assoc.* 15: 69–85.

MILLS, J. R. E. 1963. Occlusion and malocclusion of the teeth of primates. In *Dental Anthropology,* D. R. Brothwell (ed.). New York: The MacMillan Co.

MOORREES, C. F. A. 1957. *The Aleut Dentition.* Cambridge: The Harvard Press.

NATIONAL CENTER FOR HEALTH STATISTICS, U. S. PUBLIC HEALTH SERVICE, 1965. *Selected Dental Findings in Adults by Age, Race and Sex. United States, 1960–1962.* U. S. Public Health Service Publication 1000, Series 11, No. 7.

NEEL, J. V., SALZANO, F. M., JUNQUEIRA, P. C., KEITER, F., AND MAYBURY-LEWIS, D. 1964. Studies on the Xavante Indians of the Brazilian Mato Grosso. *Amer. J. Hum. Genet.* 16: 52–140.

NISWANDER, J. D., AND SUJAKU, C. 1963. Congenital anomalies of teeth in Japanese children. *Amer. J. Phys. Anthropol.* 21: 569–574.

OBERG, K. 1953. *Indian Tribes of the Northern Mato Grosso, Brazil.* Smithsonian Institution, Institute of Social Anthropology, Publication 15. Washington, D. C.: U. S. Government Printing Office.

POLUNIN, I. 1953. The medical natural history of Malayan aborigines. *Med. J. Malaya* 8: 55–174.

RABKIN, S. 1937. Cranial structural variations and their association with dental conditions. *J. Dent. Res.* 16: 203–224.

RIHAN, H. Y. 1932. Dental and orthodontic observations in 289 adult and 53 immature skulls from Pecos, New Mexico. *Internat. J. Orthodont. Oral Surg.* 18: 708–712.

RUSSELL, A. L. 1956. A system of classification and scoring for prevalence surveys of periodontal disease. *J. Dent. Res.* 35: 350–359.

RUSSELL, A. L. 1965. World epidemiology and oral health. In *Environmental Variables in Oral Health.* Washington, D. C.: AAAS Publication.

SALZANO, F. M., NEEL, J. V., AND MAYBURY-LEWIS, D. 1967. Further studies on the Xavante Indians. I. Demographic data on two additional villages: Genetic structure of the tribe. *Amer. J. Hum. Genet.* 19: 463–489.

SCHERP, H. W. 1964. Current concepts in periodontal disease research: epidemiological contributions. *J. Amer. Dent. Assoc.* 68: 667–675.

SCHULL, W. J., AND NEEL, J. V. 1965. *The Effects of Inbreeding on Japanese Children.* New York: Harper and Row.

SEDWICK, H. J. 1936. Observations on pre-Columbian Indian skulls unearthed in New York State. *J. Amer. Dent. Assoc.* 23: 764–773.

SILVERMAN, M., AND PERKINS, R. L. 1966. Bilateral parotid enlargement and starch ingestion. *Ann. Int. Med.* 64: 842–846.

STEGGERDA, M., AND HILL, T. J. 1942. Eruption time of teeth among whites, Negroes, and Indians. *Amer. J. Orthodont.* 28: 361–370.

TOVERUD, G. 1952. Introductory review. In *A Survey of the Literature of Dental Caries.* Washington, D. C.: National Academy of Sciences–National Research Council Publication 225.

WEINSTEIN, E. D., NEEL, J. V., AND SALZANO, F. M. 1967. Further studies on the Xavante Indians. VI. The physical status of the Xavantes of Simões Lopes. *Amer. J. Hum. Genet.* 19: 532–542.