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Cultural Survival is thus concerned with human rights issues related to economic development. The organization searches for alternative solutions and works to put those solutions into effect. This involves documenting the destructive aspects of certain types of development and describing alternative, culturally sensitive development projects. Publications, such as the Newsletter and the Special Reports, as well as this Occasional Paper series, are designed to satisfy this need. All papers are intended for a general public as well as for specialized readers, in the hope that the reports will provide basic information as well as research documents for professional work.

Cultural Survival's quarterly Newsletter, first published in 1976, documents urgent problems facing ethnic minorities and indigenous peoples throughout the world, and publicizes violent infringements of human rights as well as more subtle but equally disruptive processes. Newsletter articles, however, are necessarily brief.

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Jonathan Hill

THE IMPACT OF CONTACT: TWO YANOMAMO CASE STUDIES

The Forest and the Highway

by

John Saffirio and Raymond Hames

Epidemics in a Tribal Population

by

Napoleon A. Chagnon and Thomas F. Melancon

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TABLE OF CONTENTS

THE FOREST AND THE HIGHWAY

	Page
PREFACE	1
INTRODUCTION	3
THE YANOMAMA OF THE CATRIMANI RIVER BASIN	6
Location	6
Population and History	6
Forest Villages	12
Highway Villages	12
THE INTRODUCTION OF TRADE GOODS	14
The Effects of Trade Goods	16
The Costs and Benefits of Trade Goods	17
Forest and Highway Contrasts	19
Economic Values	22
SOCIAL CHANGE	25
The Traditional Status System	25
Changes in the Status System	25
THE ECONOMIC CONSEQUENCES OF ENVIRONMENTAL DEGRADATION	28
Introduction	28
The Wild Resource Quest	28
Hunting	31
Fishing	33
Gathering	34
Protein Consumption	35
Village Location and Mobilitiy	36
ECONOMIC INTEGRATION	38
Exchange	39
CONCLUSION	42
Some Policy Recommendations	45
BIBLIOGRAPHY	47

TABLE OF CONTENTS

	Page
 MAPS	
1. The Yanomama Area of Northern Brazil	4
2. Villages Under Study	7
 TABLES	
1. Yanomama Villages in the Catrimani Basin	8
2. Age-sex composition of Yanomamo villages in area of study .	9
3. Age-sex composition of each village	10
4. Brazilian goods introduced by rubber-workers, hunters, expeditioners, missionaries and FUNAI agents prior to 1980	15
5. Western goods owned by forest village members	20
6. Western goods owned by highway village members	21
7. A comparison of the performance of forest and highway hunters	32
8. Total game	32/33
9. A comparison of the performance of forest and highway villagers in fishing	34
10. Gathering	35
11. Animal protein consumption	36
12. Exchanges of game, fish and vegetable foods in forest and highway villages	40
 PHOTOS	
1. Yanomama traveling by truck on the Northern Perimeter Highway	13
2. Yanomama squeezing cane to make sugar	18
3. Funeral ceremony at Wakathauteri village, 1968	24
4. Woman spinning cotton in her hammock, Uxiutheri, 1979	24
 FIGURES	
1. Relationship between settlement duration and foraging efficiency	38
2. Relationship between sharing and foraging efficiency	42

TABLE OF CONTENTS

EPIDEMICS IN A TRIBAL POPULATION

	Page
INTRODUCTION	53
ETHNOGRAPHIC BACKGROUND	54
THE 1973 EPIDEMIC	59
ANALYSIS OF THE EPIDEMIC	59
Loss to the Population	59
Loss to the Individuals	64
DISCUSSION	69
Behavioral Reactions to Epidemics Among the Yanomamo	69
Social Organization and Epidemics	70
Social and Territorial Consequences of Epidemics	72
ACKNOWLEDGEMENTS	74
BIBLIOGRAPHY	74
 FIGURES	
1. The Yanomamo in Venezuela	55
2. Macro movements: General direction	57
3. Origin of existing villages	58
4. Percent total males and male victims of 1973 Epidemic by Age Category	60
5. Percent total females and female victims of 1978 Epidemic by age category	60
6. Quartiles of relatedness among individuals in villages struck by epidemics	65
7. The loss of expected offspring equivalents for survivors as a result of female epidemic mortality	68
 TABLES	
1. Calculation of the total expected future fertility for an average female within each age interval	62
2. Loss to population of expected future births due to female epidemic mortality	63
3. Loss of immediate individual local genetic representation due to total epidemic mortality for 281 survivors	66
4. Loss to individuals of future births due to the death of female relatives in epidemic for 281 survivors	67

FOREWORD

The impact of contacts between the indigenous societies of Amazonia and representatives of Western cultures more often than not has been devastating physically, culturally, and socially to native peoples. This volume constitutes another chapter in that long, painful history.

The Yanomama, in contrast to many societies in South America who exist only in the reports of the early chroniclers of the European conquest of the New World, appear to have escaped the ravages of earlier centuries. Until recently they were able to live successfully in relative isolation, their traditional culture intact. That isolation has been shattered. Missionaries want to save their souls; anthropologists want to study their bodies, minds and behavior; settlers, national and multinational corporations want their land. The outcome of the onslaught is far from certain.

The papers published herein document the results of contact in two separate areas of Yanomamaland. Saffirio and Hames examine the effects of the construction in the Catrimani River Basin of Brazil of a segment of the highway network being constructed by the Brazilian government in the Amazon basin. Their study is of particular interest because it provides data on villagers who chose to take advantage of the opportunities for direct contact with Brazilians living along the highway and villagers who did not. Chagnon and Malencon report on the results of a 1973 epidemic in three remote villages of the Upper Mavaca River in Venezuela and examine the cultural, social, and demographic implications of such epidemics.

Are the Yanomama and other societies living in the Amazon basin faced with extinction or assimilation into the lowest levels of national societies? History does not provide us with a clearcut answer. Many tribal societies have disappeared while others, like the Venezuelan Panare, have survived several centuries of contact with their cultures relatively intact. (See Paul Henley's excellent study of Panaré contacts with Criollos, The Panaré: Tradition and Change on the Amazonian Frontier, Yale University Press, 1982.) What is clear is that knowing what we do about the potentially devastating impact of contact on indigenous peoples, we are also in the position of being able to minimize, if not prevent, further disasters through the enactment and meticulous enforcement of enlightened public policies.

The Impact of Contact: Two Yanomama Case Studies is a joint publication of Cultural Survival, Inc. and Bennington College. As editor of the Working Papers on South American Indians, I am grateful to David and Pia Maybury-Lewis and Jason Clay of Cultural Survival for providing the encouragement and funds necessary to see this project to completion and to the authors for their patience and responsiveness throughout the editorial process.

Kenneth M. Kensinger

Editor, WPSAI

The Forest and the Highway

by

John Saffirio and Raymond Hames

PREFACE

The Yanomama of northern Brazil and southern Venezuela are at once an unusual and typical native society of the New World. They are unusual because they are the largest, relatively unacculturated South American native population and, until recently, their population was growing at a rapid rate. Their commonality with other native peoples of the New World stems from their history of contact with the Western world. This has led to massive deaths due to foreign epidemics (see Chagnon and Melancon this volume; Neel et al. 1970) and rapid, unplanned social change. Such processes have been repeated innumerable times in all historic periods throughout the New World whenever white has met native. The Yanomama of the Catrimani River Basin of Roraima, Brazil, the subject of this report, are no longer isolated from the rest of the world. A mission has been established and a highway has been constructed near their traditional lands. White settlers have entered the area and have begun to exploit land on the periphery of their tribal distribution. The aim of this report is to describe as objectively as possible the effects of inter-ethnic contact on the Yanomama as it emanates from the activities of the greater Brazilian society. Hopefully we will be able to offer explanations for the effects of contact on the Yanomama and, importantly, describe what is likely to occur in the future, as contact and development in the area is maintained.

Little was known about Yanomama culture prior to the 1950s when initial fieldwork began with missionary James Barker's research on linguistics, settlement pattern, and warfare (Barker 1953) and the work of

anthropologists Otto Zerries (1964) and M. Schuster (1960). It was not until the 1960s that intensive ethnographic work was initiated by Napoleon Chagnon resulting in a widely-read ethnography (Chagnon 1968), numerous journal articles, films (in conjunction with Timothy Asch), and a volume on field methods (Chagnon 1974). During the late sixties and early seventies a team headed by James Neel of the Department of Human Genetics of the University of Michigan worked with Chagnon to produce a number of important studies on genetic and biomedical topics (see Neel and Weiss {1978} for a summary of this research). Jacques Lizot began intensive ethnographic research on the Yanomama in the late sixties producing studies on economics (1971), mythology (1975), and ecology (1977). While Chagnon, Neel, and Lizot had focused most of their attention on the Yanomama of Venezuela along the Orinoco River and its major tributaries, the following researchers initiated a variety of research projects in other portions of the Yanomama tribal distribution, particularly in Brazil and along the Brazilian-Venezuelan border: Migliazza (1972) on linguistic diversity among the Yanomama; Judith Shapiro (1971) in the Surucucu region and in the Catrimani River Basin of Brazil on sex roles; Alcida Ramos (1972, 1974) and Kenneth Taylor (1976) on social organization, and social classification and food taboos, respectively, in the Auaris region of northern Brazil; and William Smole (1976), Raymond Hames (1979, 1980) and Alex and Nelly Lhermillier (1974) on Venezuelan Yanomama ecology and economic organization. These sources will be used to provide a broader perspective for the new data analyzed here.

While most of the scholarly work on the Yanomama mentioned above has focused on a variety of aspects of aboriginal life, a growing body of literature now is concerned with Yanomama culture change and inter-ethnic contact. In his account of changes in material culture (1974) and the role of missionaries and mission schools (1976) Lizot was the first to intensively document the forces and consequences of change among the Yanomama of Venezuela. Next, Peters (1973) devoted a doctoral thesis to the description of changes in family life in Brazil, and Chagnon et al. (1970) and Ramos (1979) described the role Ye'kwana Indians have played in Yanomama and Sanumá culture change. Recently, Chagnon revised his ethnography on the Yanomama to include a chapter on culture change (Chagnon 1977). Some biomedical research (Neel et al. 1970) dealt with the terrible impact of white-introduced epidemics on the demographic integrity and health of the Yanomama in Venezuela.

With the publication of The Yanoama in Brazil 1979 (ARC/IWGIA/SI) public attention is increasingly focused on the relationship between Brazilians and the Yanomama. This report has been followed up by constant monitoring of new developments by the ARC (ARC 1980, 1981a, 1981b, 1981c) and other groups such as the American Anthropological Association (1981), Survival International (1981) and Cultural Survival (1981). The work we present here differs from the above studies in that it focuses intensively on the role that the Perimetral Highway (BR-210) has played in Yanomama culture change.

John Saffirio, the senior author of this report, first met the Yanomama of the Catrimani in October 1968 in his capacity as a member of the Consolata Society, a Catholic missionary order. After about nine years of studying their language, ministering to them medically, collecting myths,

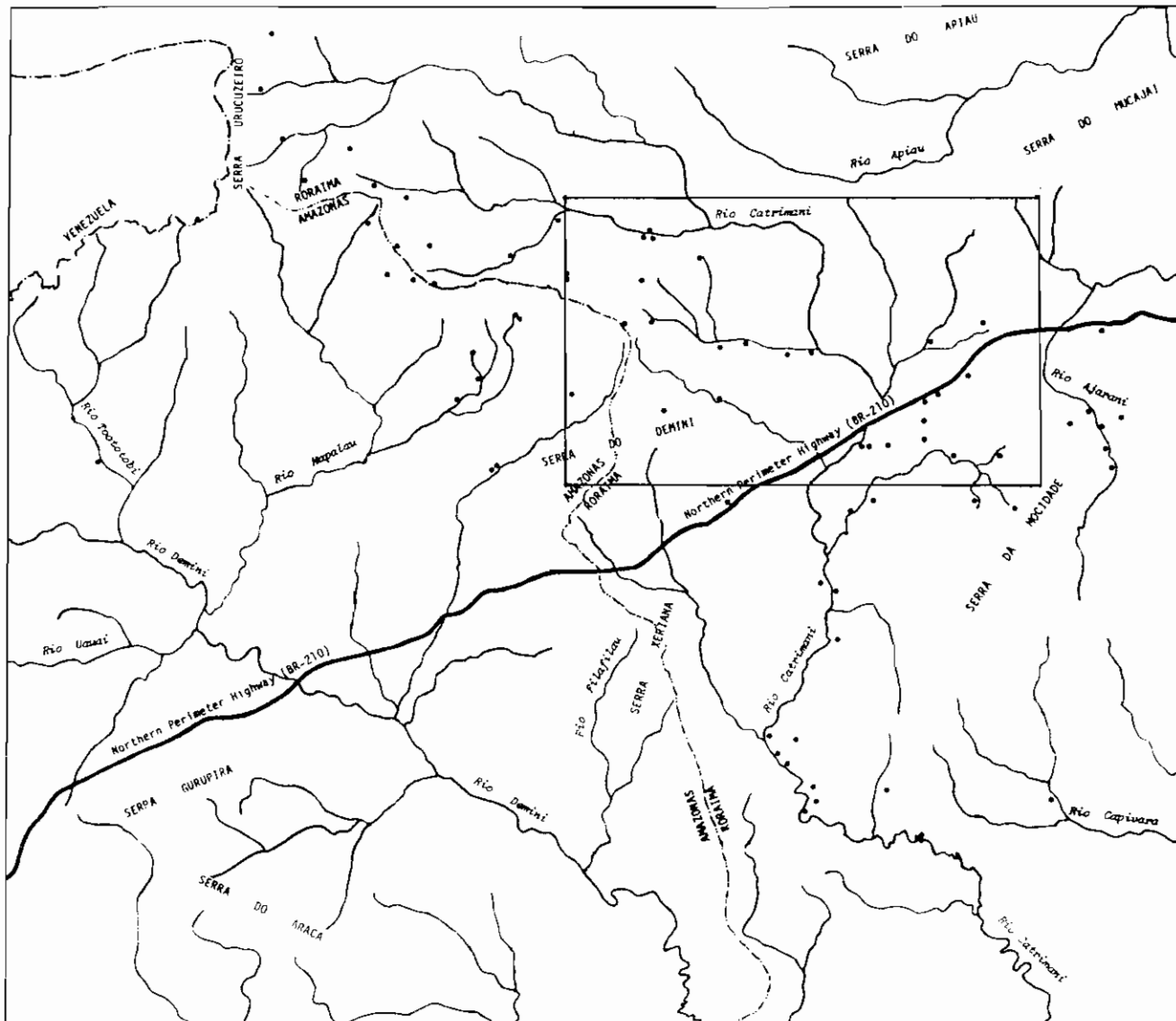
and genealogical and demographic data, he came to the United States to enter the anthropology doctoral program at the University of Pittsburgh. While in Pittsburgh he traveled to nearby State College where Napoleon Chagnon taught anthropology at Penn State University. Since Chagnon had done the main ethnographic work on the Yanomama, he and Saffirio had developed a warm friendship. During one of his visits to Penn State he met Raymond Hames who had recently returned from field research among the Ye'kwana and Yanomama of Venezuela and it was agreed that Chagnon and Hames would supervise his future research. After one year of anthropology courses at the University of Pittsburgh he returned to the Yanomama to collect data for his masters paper. He spent 155 days (October 15, 1979 to March 18, 1980) in seven different Yanomama villages on the Catrimani Basin (Roraima, Brazil) collecting data on social and economic change. When he returned home he began to analyze his data with Raymond Hames (then on a Guggenheim Fellowship at Penn State) and then wrote it as a masters paper. The primary data contained in this paper almost entirely derives from his paper. Saffirio would like to thank the following people for their assistance, financial support, training, and encouragement: Dom Aldo Mongiano, Bishop of the Diocese of Roraima, Brother Carlo Zacchini, Director of the Catrimani Mission, Dinarte Nobre de Madeiro delegate of the 10th FUNAI Delegation of Roraima for facilitating fieldwork; Fathers Cecil Nally and Matthew Tosello of the Diocese of Pittsburgh for financial support; Napoleon Chagnon of Northwestern University for assistance in the development of field methods and hospitality; Hugo Nutini of the University of Pittsburgh and Alice Schlegel of the University of Arizona in their capacity as thesis advisors; and Keith Brown and James Richardson, III of the University of Pittsburgh for reading the original manuscript and offering useful criticism.

Raymond Hames would like to thank Jason Clay of Cultural Survival and Ken Kensinger of Bennington College for editorial assistance beyond the call of duty; and Dorothy McEwen for her masterful job of word processing.

INTRODUCTION

The Yanomama Indians comprise one of the largest populations of Indians living in the Amazon rainforest. Like other native populations of the Amazon rainforest, the Yanomama are now being irreversibly affected by Brazilian development efforts. The search for new sources of energy and wealth has brought the Brazilians into increasing contact with the Yanomama (Davis 1977). In September 1973 the Brazilian government began to build a highway called the Perimetral Norte BR-210 that crossed the southern part of Yanomama land (see Map 1), and reached the Catrimani River in November 1974. Since then, Yanomama contact with Brazilian highway workers, settlers, farmers, miners, and government agents has increased greatly.

The aim of this study is to describe the process of inter-ethnic contact resulting from the construction of a highway and the introduction of modern manufactures on Yanomama environmental adaptation and socioeconomic



MAP 1

THE YANOMAMA AREA OF NORTHERN BRAZIL

organization. In order to effectively analyze the consequences of inter-ethnic contact, villages which have had the greatest amount of contact are compared along a number of dimensions to villages which have had little contact and more strongly retain aboriginal patterns of belief and behavior.

Previous studies, mentioned above, have focused on isolated elements of change in Yanomama culture which have stemmed from a variety of contact situations. In contrast, our report covers a wide variety of changes in Yanomama culture which has emanated largely from a single source, the Perimetral Norte Highway. The vast Trans-Amazon Highway system is the main infrastructural mode of Brazilian penetration and development into the homeland of Amazonian Indians. Almost monthly, kilometers of roads push into the vast interior of the Amazon forest to link it and its native peoples with the rest of the world. We feel that the changes we document herein on Yanomama settlement pattern, social organization, economy, technology, and environmental adaptation are typical of what is likely to occur as roads push further into Yanomama territory and the territories of other Amazonian native peoples. By presenting the clearest picture possible of the rapid and unplanned changes occurring in Yanomama life we hope that the Brazilian government will realize the consequences of its actions and take measures to redirect its development efforts to lessen the considerable damage already done to the Yanomama, and, for the first time, to allow the Yanomama to knowledgeably select the course of their own destiny.

Studies of this kind tend to be controversial because of the easy blurring of the line which separates scientific analysis from moral and political advocacy. Some have argued that the Brazilian government, in historical continuity with all other state-level political organizations in the New World, has mounted a deliberate campaign of genocide and ethnocide against the Yanomama. Others have argued that although governmental actions have not been aimed at deliberately destroying the Yanomama as a culture or people this has been the inevitable effect of development policies. Curiously absent in the analysis of ethnocide and genocide is the role the Yanomama play as the passively affected or the actively behaving. Many studies imply that the Yanomama are simple automatons unable to distinguish, for a variety of reasons, what is and is not in their best interests as individuals. For example, all Yanomama recognize disease as the worst dimension of contact with whites, yet some actively seek contact and the mortal risk associated with it, while others actively avoid contact believing the material benefits (e.g., steel tools) are not worth the potentially deadly results. Some Yanomama eagerly drop old customs and imitate those of Brazilians. Frequently this is the result of relentless persuasion and ridicule by whites of Yanomama customs, but at other times it is the result of a belief that they can do better by changing.

It is our position that the Yanomama ought to be able to make decisions which are in their own self-interests as they believe those interests to be. The major stumbling block they have in making such decisions is their gross ignorance of the long-term consequences of whatever decision they do make. Crucial to making decisions is having a set of alternatives from which to choose. As long as the Yanomama do not have full control over their aboriginal territory, from which their life derives, then they will not have the choice of staying as they are or becoming Brazilians.

THE YANOMAMA OF THE CATRIMANI RIVER BASIN

Location, Population and History

There are nine Yanomama villages on the Catrimani River Basin between 1 40' to 2 10' North latitude and 62 20' to 62 50' West longitude. Five of them are located on the borders of three important tributaries of the Catrimani River, three are on the highway border and one is located south near the first rapid of the Catrimani River (see Map 2 and Table 1). Villages 6, 7, and 8 (in Tables 1 and 3) along the Lobo de Almada River (Map 2) are forest villages while villages 2 and 3 are highway villages located on the border of BR-210. Most of the comparative information collected in the field comes from these five villages. Some demographic characteristics of the Catrimani River Basin Yanomama are given in Table 2 and 3. Yanomama local groups identify themselves as dwellers of, or inhabitants of, a specific place, suffixing the morpheme theri to the names of rivers, mountains, or the kind of vegetation or animals found in the area. In general these auto-denominations are valid until the village moves to another location (Migliazza 1972:32).

The Yanomama of the Catrimani River Basin originated in the northwest Parima Mountain Range (Serra Parima). For at least two hundred years they had occupied the high Catrimani River Basin. In 1787, the Portuguese Boundary Commission (headed by Gama Lobo de Almada) met with Oayaccas (Waika) Indians on the headwaters of the Parima River. In 1929-1930 G. Salathé found Karimé Indians in the region of the middle Catrimani River. In 1939, D. Holdridge found Waika in the region of the Catrimani and Demeni River. In 1944, A.C. Ferreira Regis flew over the area of the Catrimani River and noted the presence of Waika houses (ARC/IWGIA/SI Document 37, 1979:101-102). According to detailed analysis of village histories given by informants, the Yanomama of the Lobo de Almada, Pacu, and Catrimani have moved from the northwest to the southeast during the last eighty years. The impetus for this migration was the pressure of continuous raids from Yanomama living in the Orinoco drainage in Venezuela (Chagnon 1977:40-43).

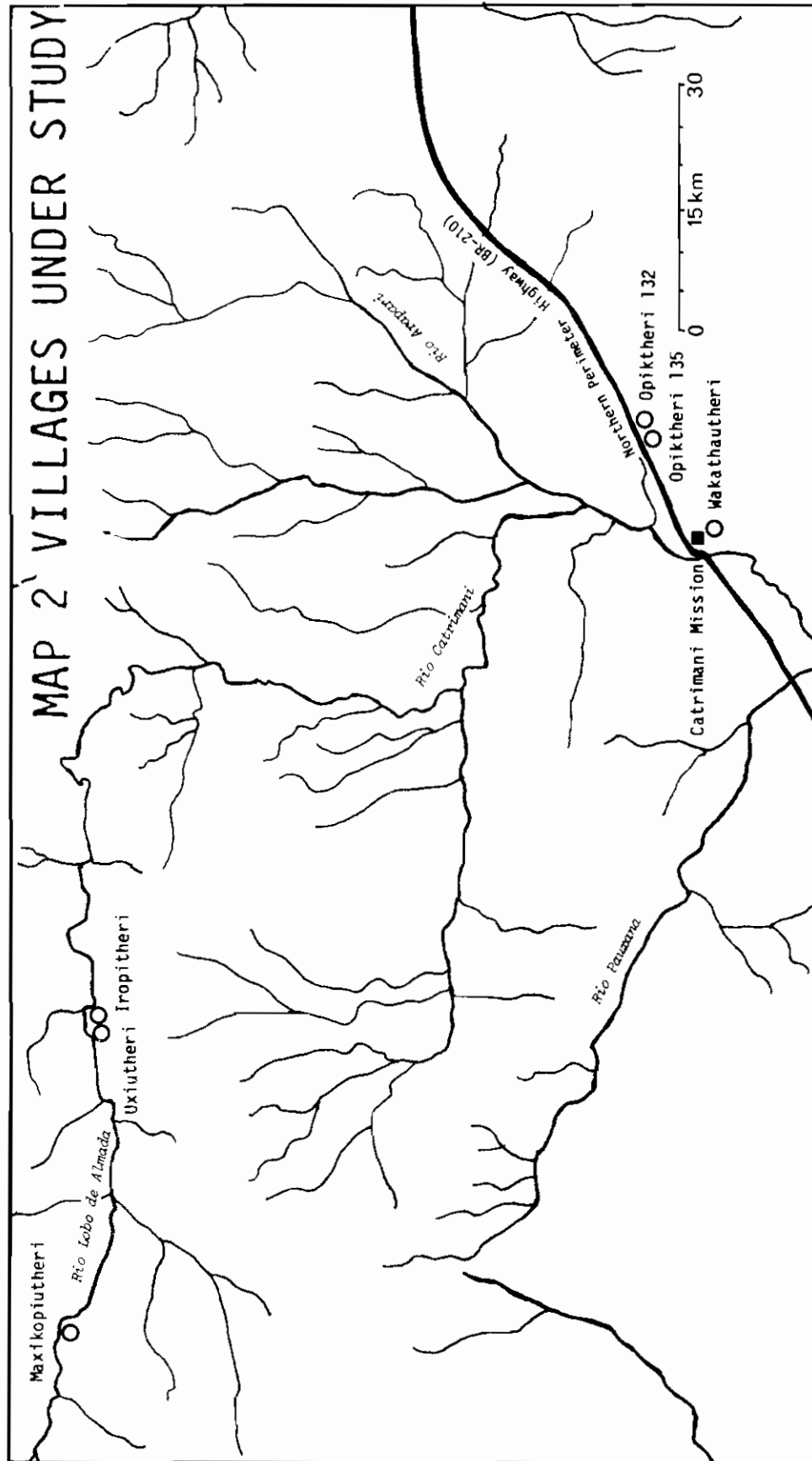


Table 1. Yanomama villages in the Catrimani Basin (March 1980)

Villages	Pop.	Location	Walking distance (hours) From Highway BR-210
1. Wakathautheri	61	Catrimani River	1/2 hour
2. Opiktheri-135	46	Km. 135 of BR 210	on the highway BR-210
3. Opiktheri-132	28	Km. 132 of BR 210	on the highway BR-210
4. Hewenahipitheri	46	Jundiá River	8 hours
5. Wapokohipiutheri	17	Pacu River	4 1/2 hours
6. Uxiutheri	12	Lobo de Almada	22 hours
7. Iropitheri	31	Lobo de Almada River	22 hours
8. Maxikopiutheri	24	Lobo de Almada River	32 hours
9. Awarihipitheri	25	Igarapé Castanho	48 hours
TOTAL	290		
Average village size: 32			

Table 2. Age-sex composition of Yanomama villages in area of study.

Age Categories	Males	Females	Total
Over 51	13	7	20
41-50	10	9	19
31-40	17	8	25
21-30	32	18	50
11-20	54	29	83
0-10	48	45	93
<u>TOTAL</u>	<u>174</u>	<u>116</u>	<u>290</u>

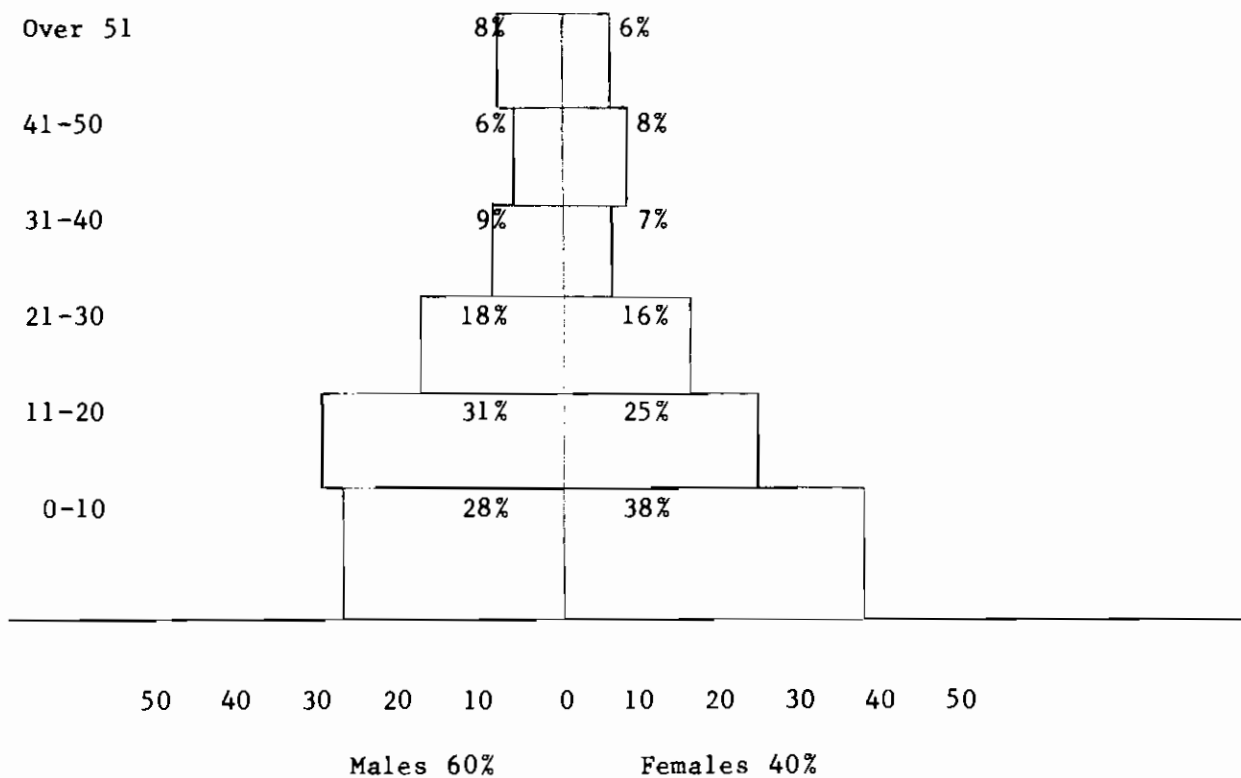


Table 3. Age-sex composition of each village (March 1980).

	a.	b.	c.	d.	e.	f.	g.	h.	i.
1. Wakathautheri	33	28	16	17	2	10	14	2	61
2. Opiktheri 135	25	21	8	11	4	9	13	1	46
3. Opiktheri 132	17	11	4	6	6	5	6	0	28
4. Hewenahipitheri	30	16	9	9	7	4	13	4	46
5. Wapokohipiutheri	10	7	5	5	1	2	4	0	17
6. Uxiutheri	9	3	2	2	3	1	2	2	12
7. Iropitheri	22	9	6	6	7	3	8	1	31
8. Maxikopiutheri	13	11	6	7	2	4	5	0	24
9. Awarihipitheri	15	10	5	6	5	4	5	0	25
TOTAL	174	116	62	69	37	42	70	10	290
a. males	d. married women		g. young boys*						
b. females	e. bachelors		h. widowers						
c. married men	f. young girls*		i. total						

* under 10 years

Since the late 1920s the Yanomama of the Catrimani River Basin have had occasional contacts with scientific expeditions, boundary commission teams, hunters, rubber gatherers, and Brazil nut gatherers. In October 1965, two Catholic missionaries settled permanently among the Indians of a village in the middle Catrimani River. During the following year, many Yanomama of the upper and lower Catrimani River visited the missionaries and bartered with them. The missionaries built some houses and a medical dispensary for them and expanded their contacts with all the Yanomama of the Catrimani River Basin. In January 1974, the Perimetral Norte highway reached the middle Catrimani River (Map 1). Hundreds of lumber workers, contracted without regard for their health by construction firms, entered the Yanomama area and caused epidemics of flu and measles. The Committee for the Creation of the Yanomama Park (ARC/IWGIA/SI Document 37, 1979:105-106) reports that between 1971 and 1974, during the 38 months which preceded the arrival of the first road workers, the missionaries in the region had dispensed medicines to Indians 4,596 times; during the 38 months which followed, this number jumped to 18,488. During February and March 1977, 68 Indians died in a measles epidemic. One Yanomama village lost 51% of its population, another lost 46% and a third 30%. At present, the health of the Yanomama is improved. Nearly all the Yanomama living near the highway are vaccinated against measles, smallpox, tuberculosis, and poliomyelitis. Most Yanomama living far from the highway are also vaccinated against the same diseases. Occasionally a medical team visits Yanomama living along the highway. Seriously ill Yanomama are taken to the nearest hospital.

Since December 1968, anthropologists, missionaries and committees for Indian rights have been trying to persuade the Brazilian government to create a Yanomama Park in order to save Yanomama land and culture. The National Indian Foundation (FUNAI) has rejected thirteen such proposals. In April 1980, the proposed area for the Yanomama Park was approximately ten million hectares with a perimeter of 2,950 kilometers for an estimated indigenous population of 7,000. At that time the FUNAI seemed willing to create a park of three million hectares. The principal opposition to a larger park came from Brazilian mineral companies, subsidiaries of multinational mining companies such as Bethlehem Steel and Alcan (Davis 1977:87). Federal and regional Brazilian authorities allied with local economic interest groups also opposed the Park. Meanwhile, since 1974, Brazilian settlements, farms, and sawmills have been established on Yanomama lands along the first 45 km of the highway. On March 9, 1982, the Brazilian Minister of the Interior interdicted an area of 7.7 million hectares (29,700 square miles) inhabited by the Yanomama Indians. The Perimetral Norte limits the southern boundaries of this area. Nobody can cultivate this land, or even enter it. The area cannot be used or designated for any other purpose. It was a compromise between the CCPY project (Brazilian Commission for the Creation of the Yanomama Park) that had proposed an area of ten million hectares for the Park (April 1980) and political pressure on FUNAI from governors, representatives, and the wealthy people of northern Brazil to allow settlers and farmers to exploit the Yanomama land bordering the highway. In the near future the FUNAI resolution will make available for occupation by Brazilians the land on the southern border of the highway where approximately 200 Yanomama Indians (2/3 of the total Catrimani Yanomama) have their villages. These Indians have been asked by FUNAI agents to move north of the highway where land has been reserved for them.

Forest Villages: Uxiutheri, Iropitheri and Maxikopiutheri

The history of these villages and their movements are intermingled. For the purpose of this paper we will consider these three villages of one type, calling them forest villages. During the past twenty years the inhabitants of Uxiutheri, of Iropitheri and of Maxikopiutheri moved east following the Lobo da Almada River and its tributaries (Map 2), a migration route followed by other Yanomama groups who left the Parima mountain range. They were searching for better garden land and for better game and gathering resources. Since the end of 1979 the villagers of Uxiutheri and Iropitheri have lived in close proximity to one another at the mouth of the Lobo da Almada River--three days' walk from the highway (Map 2). They form a tight kin network. Until 1976 the Iropitheri lived in two villages near the two different streams but during a measles epidemic in the beginning of 1977, 35 of 69 persons (51%) died. The Uxiutheri population was also reduced by the same measles epidemic: 15 of 32 persons (46%) died. The Maxikopiutheri who live one day's walk from the mouth of the Lobo da Almada River experienced a measles epidemic in which 10 of 33 persons (30%) died.

Since 1974, when the Perimetral Norte Highway reached the middle course of the Catrimani River, forest villagers have been moving toward the highway. Infrequently, they make a difficult walk five to six days through the forest and on the highway to beg and barter from Brazilians, but rarely do they stay in contact with them for long. Walking on the highway is painful and after about two days sores form between the toes and on the heel. Younger individuals most commonly make these treks, but occasionally elders accompany them. Since the measles epidemic of 1977 contact with Brazilian highway settlers has diminished.

Highway Villages: Opiktheri 132 and 135

The history of the Opiktheri who are living at Km 132 and those who are living at Km 135 of the highway is the history of one man, Waytharo 2 (Tuxawa Chico). In a biological sense, Waytharo 2 literally created Opiktheri 132 and 135. During his lifetime he married six women and sired about 30 children (15 sons and four daughters are still alive). Among the 12 families of the Opiktheri 132 and 135, six are headed by his sons and five by his sons-in-law. Among the 14 bachelors, nine are his sons and five are sons of his brothers-in-law.

In 1974 when the Perimetral Norte (Map 2) reached the Opiktheri forest, the families were living in one village about three hours' walk from the highway. Enticed by the highway, 20 bachelors and some married men spread out among the highway workers begging for shorts, shirts, food,...anything. They succeeded in receiving many Brazilian goods and became excited with the new way of life. They thought it would be easy from then on. It was only necessary to live along the highway and to beg tenaciously for goods. Thus, in September 1976 they built a new village along the highway. However, at the same time, the company that was building the highway ran out of money and construction stopped at Km 225. The National Indian Foundation (FUNAI) forbade squatters and farmers to occupy lands on the highway borders from Km 45 to Km 225. Without Brazilians living on the highway near them, the



Yanomama traveling by truck on the Northern Perimeter Highway

Opiktheri travelled to the beginning of the highway where farms and sawmills had been working since early 1974 and to the end of the highway (Km 211) where the FUNAI manages an Indian post. For 20 or 30 days' work at the farms or at the FUNAI Post, they receive a little money--not more than two or three dollars--cigarettes, thongs, and used shorts and shirts. Since 1975 their travels to visit settlers and farmers have increased.

THE INTRODUCTION OF TRADE GOODS

Since the beginning of contact with Brazilians, the Yanomama of the Catrimani River Basin found foreign goods useful, and they desired them. For example, they found that aluminum pots are not only unbreakable, but easier to carry than clay pots. (Adoption of foreign items is not unusual; during their migrations from the Parima Mountains, they contacted other Indians and borrowed new technology from them. For example, from the Ye'kwana Indians they learned how to make canoes, women's aprons, deerbone flutes, roofing for a house, etc....see Hames and Hames (1976) on Ye'kwana influence on Yanomama material culture. Also, from the same source, they incorporated some myths into their belief system). The introduction of trade goods by whites began as early as 1929, when the Yanomama met two scientific expeditions (Zerries 1964:10). During the 1930s they received axes, machetes, and knives from rubber gatherers. On one expedition, however, when the Yanomama of Jundia' River (see Map 1) were helping the Brazilians to carry the rubber forms from the Brazilian compound to the Catrimani River borders, some of them were killed by three rubber gatherers. Later, in 1941 and 1953, the Yanomama had contacts with the Brazilian Boundary Commission, and again, in 1961 and 1962, with Brazilian rubber gatherers. In October 1965, they came in contact with two Catholic missionaries from the Catrimani Mission. Since then, change was stimulated by the missionaries and, since 1974, by the National Indian Foundation (FUNAI), highway workers, settlers, and farmers.

The goods introduced to the Yanomama between the 1930s, the time of contact, and 1974 were limited in quantity and in diversity to ten kinds--knives, axes and machetes, fishing line and hooks, combs, mirrors, beads, matches and salt. Initially, the effect of these goods on their traditional economic patterns was not extensive or deep. However, in 1974 when the highway reached their forest and increased the potential supply of goods, the Yanomama were lured to settle along the highway. Two villages (Opiktheri 132 and Opiktheri 135, Map 2) chose to live on the highway borders, taking full advantage of contact with the Brazilians. As a result, the acquisition of large and varied quantities of trade goods began to have profound effects on traditional attitudes toward material objects, conceptions of ownership, technological and economic autonomy and the social relations of production. Below, we historically and comparatively analyze these changes for highway and forest villages.

The acquisition of Western goods by native peoples has numerous effects

on socio-economic organization. For example, in some cases the acquisition of steel axes induces little change except to increase leisure time (Salisbury 1962), but in other cases it may reorder traditional status hierarchies (Sharp 1969). Overall, increased reliance almost invariably leads to loss of technological autonomy, an increase in outside economic control, and fundamental change in traditional social organization. Table 4 divides goods by time periods in which they were introduced to the Yanomama. Goods gained prior to extensive contact (before 1970) are primarily basic, multi-purpose productive tools (axes, machetes, and knives) which replaced their traditional equivalents (e.g., polished stone axes and hardwood and bamboo cutting tools). Such tools are used in traditional subsistence activities (e.g., steel axes in garden clearance) and/or are used in the manufacture of other traditional tools and materials (e.g., using a machete to make a bow or to construct a house). Although most of the goods gained prior to 1970, shown in Table 4, are basic productive tools, the Yanomama

Table 4. Brazilian goods introduced by rubber-workers, hunters, expeditioners, missionaries and FUNAI agents since the time of the first contact until 1980.

Before 1970

1. steel axes
2. machetes
3. knives
4. scissors
5. fishing lines and hooks
6. combs
7. mirrors
8. beads
9. matches
10. salt

1970-1974

11. shotguns and cartridges
12. tobacco (Brazilian made)
13. steel grater boards
14. aluminum pots
15. soap
16. toothbrushes and paste
17. whetstones

Since 1974

18. hammocks (Brazilian made)
19. aluminum basins
20. aluminum pans
21. harpoons
22. adzes (for dugout canoes)
23. hoes and digging tools
24. rakes
25. thread and needles
26. clothing
27. hats
28. thongs and shoes
29. blankets
30. towels

Since 1974 (cont.)

31. candles
32. cigarettes
33. flashlights and batteries
34. cooking oil
35. dishes
36. cups
38. spoons
39. plastic containers
40. sacks and bags
41. suitcases
42. medicines
43. files

also acquired a few consumer goods (i.e., combs, mirrors, and beads). With increased contact between 1970 and 1974 these Yanomama began to acquire more finished and single-purpose tools such as shotguns, steel grater boards, and aluminum basins which replaced a traditional item with one which was nearly functionally equivalent but structurally different (e.g., a shotgun for a bow). The chief difference between the productive goods received in these two periods is that those gained between 1970 and 1974 were highly specialized. For example, a bow can be used for fishing or hunting, but a shotgun can be used only in hunting. Finally, as the Yanomama acquired all the basic productive and multi-purpose goods they needed, they increased their demand for consumer goods and specialized tools designed to exploit the environment in non-traditional ways. Many consumer goods such as hats, towels, shirts, thongs, etc. have no traditional equivalents, but are attractive to the Yanomama because they are adaptations to either a modified physical environment (e.g., one needs thongs and a hat to walk on the highway in comfort) or a new social environment (e.g., one must wear clothing when interacting with Brazilians so as to avoid ridicule or to be considered more civilized). Such consumer goods are identified as Brazilian rather than as Yanomama, and their possession and use can be employed as a means of identifying with Brazilians. Highly specialized tools such as harpoons and adzes for canoe construction allowed the Yanomama to exploit a new ecological niche, the river, that they never fully exploited before.

The Effects of Trade Goods

Dependency on non-locally produced tools by Yanomama has a number of powerful effects on autonomy and self-sufficiency. To take one example of many, most Yanomama men are no longer able to manufacture the traditional clay pot used in cooking since relatively cheap and better made aluminum pots have replaced them (Lizot 1974). Although this may seem a positive gain for the Yanomama it leads to increased dependence on Brazilian suppliers of these goods and subsequent loss of technological autonomy. In some cases where contact is sporadic or limited and the supply of Western goods is unsure, individuals still maintain their skills in the production of traditional goods while relying on Western goods when possible (e.g., in forest villages). For example, Ye'kwana and Yanomama Indians of Venezuela use shotguns when they have an adequate supply of ammunition and bows when they lack ammunition (Hames 1979). However, among the Yanomama living along BR-210, who have a more dependable supply of trade goods, a different process is occurring. Loss of traditional skill creates greater dependence on Brazilians, which in turn forces the Yanomama to engage in more labor for Brazilians, all of which leads to ever greater dependence on them for basic goods.

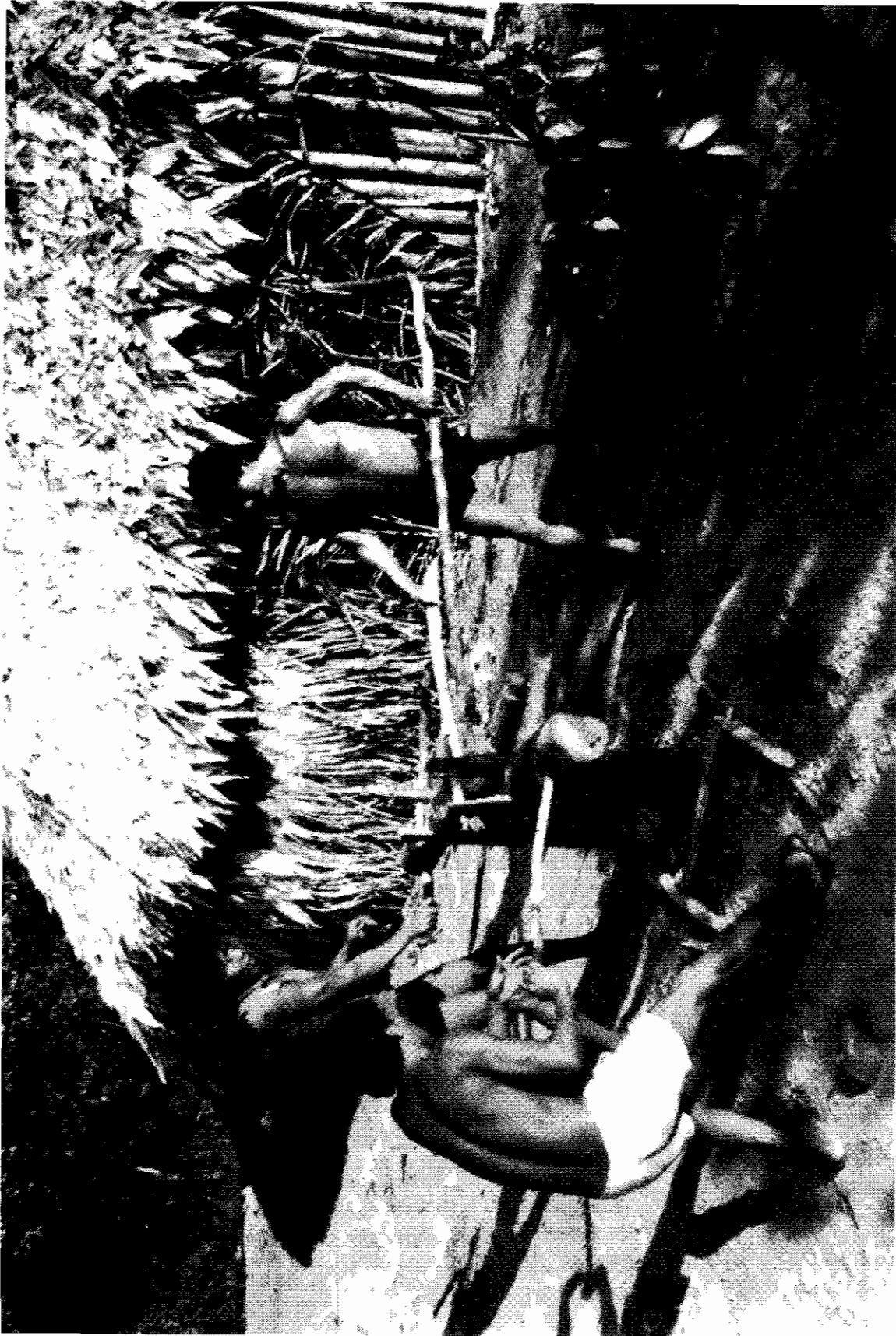
Not only do the Yanomama borrow individual elements of Brazilian technology and integrate them into their traditional subsistence patterns, they also borrow alien technological complexes. Borrowing whole complexes is an indication of even more fundamental change. Manioc squeezers, sieves, griddles, and storage baskets are the basic components of a technological complex for the manufacture of bitter manioc (*Manihot utilissima*) products. This complex is rare in traditional Yanomama culture. Traditional Yanomama rely on plantains, bananas, sweet manioc, and a variety of lesser garden

crops for the bulk of their dietary intake (Lizot 1977). Highway Yanomama are now beginning to depend on bitter manioc and the alien technological complex which makes its production possible to the increasing exclusion of traditional crops. Bitter manioc has not been selected because it fulfills traditional subsistence needs better than plantains and bananas (in fact it is less efficient to grow and nutritionally it is no better for them), but because it can be sold to Brazilians for cash which is then used to purchase trade goods. Traditional crops cannot be used in this way. The use of manioc for sale has multiple effects on Yanomama life. First, the production of food gains its value in trade and not in local consumption. As a result, production considerations are not aimed at meeting family needs but the requirements of an external market system. Second, the Yanomama are becoming increasingly tied to regional, national, and international networks which determine the utility of what they produce. So not only have they lost technological autonomy, but the autonomy to make decisions about what they will produce, which is instead governed by an alien pricing system. Lastly, the production of manioc through the use of its associated technology is a concrete means for the Yanomama to deny their own cultural distinctiveness and take on those traits which characterize pioneer Brazilians. They use the same tools, eat the same food, wear the same clothes, and are tied to a national market system.

The Costs and Benefits of Trade Goods

It is useful to discuss acquisition of trade goods from a cost-benefit perspective because it most faithfully mirrors the Yanomama decision-making process; that is, the Yanomama are the active agents in change and they decide what to reject and accept from the West according to perceived self-interests. The major costs to the Yanomama for accepting trade goods have been the loss of technological and productive autonomy. But, as we will point out in the conclusion, they have not as yet, apparently, realized the consequences of these costs. The fundamental benefit realized by accepting basic productive goods such as axes, machetes, knives, fish hooks and line, and shotguns has been the reduction of labor necessary to carry on traditional subsistence activities such as horticulture, fishing, and hunting. In addition, some technology, such as the newly introduced canoe, has opened a new niche and habitat for the Yanomama, permitting them to consume riverine resources and move about their territory more efficiently. Numerous studies have demonstrated that trade goods are accepted by tribal peoples because they are more labor efficient than traditional goods (Salisbury 1962; Sharp 1969; Hames 1979). A problem ignored by all these studies, and which awaits further research among the Yanomama, is whether the price paid in terms of economic autonomy and the need to devote labor to produce goods for trade goods enhances an individual's ability to survive and reproduce.

The integration of Brazilian consumer goods and practices into Yanomama culture occurred after the integration of productive goods. Consumer goods, with some exceptions such as medicine and some items of food and clothing, have very little utilitarian value for the Yanomama in that they do not enhance subsistence effort, diet, or provide protection against the environment. For example, Yanomama carrying baskets, houses, tobacco, and



Yanomama squeezing cane to make sugar

hammocks are just as good as Brazilian equivalents. In addition, the labor to produce some traditional artifacts are less than the labor one must perform for Brazilians to gain the money to buy Brazilian goods. In addition, the Yanomama have acquired a number of Brazilian customs such as consuming deer meat (it is taboo for traditional villagers), Brazilian hair styles, use of cigarettes (they traditionally chew tobacco), and the heavy use of salt in food preparation. For the Yanomama the goal of acquiring these goods and customs is to present an image to Brazilians that they are just like Brazilians or civilizados and unlike indios brabos (wild Indians). In no sense is this goal irrational because the Yanomama realize that if they appear like Brazilians they will be able to interact with them more successfully and thus get what they want more efficiently. Conforming to Brazilian consumer patterns and customs is a form of social adaptation.

Forest and Highway Contrasts

Tables 5 and 6 list the quantities, kinds, and proportions of trade goods owned by forest and highway villagers. The most obvious differences between the two types of villagers is that highway people own some 42 different kinds of goods while forest people have only 24, although the mean number of trade goods owned differs little, at 18 and 23 per person for forest and highway people, respectively. The crucial difference is that highway villagers own proportionately more consumer goods than productive goods, depend on Brazilians to a far greater extent, and the depth of their dependence is increasing at a faster rate than among forest villagers.

Axes, machetes, matches, fishing tackle, knives, etc., as noted earlier (see Table 4), are basic productive goods that the Yanomama have had since contact began. Although highway villagers have proportionately more goods overall, they generally have two to three times fewer of these basic goods than forest villagers. To some extent this is because forest villagers do most of their trade with missionaries who dispense only 18 different types of goods and these are primarily basic productive goods. Highway residents, on the other hand, trade with both missionaries and settlers and thus have a greater variety of goods from which to choose. The greatest area of difference between highway and forest villages in the ownership of consumer goods: nearly all items 25-42 (Table 6) are consumer goods and they comprise 21% (370 items) of all goods owned by highway villagers and 0% for forest villagers.

A difference not noted in Tables 5 and 6 is that highway villagers buy some of their foodstuffs (largely canned meat, fish, and candy). From a strictly utilitarian point of view this is rather curious behavior because the traditional Yanomama diet appears to be superior to that of the Brazilian peasant in all respects and the labor costs to gain it are less (see Lizot 1977; Chagnon and Hames 1979; and below, for data regarding work effort and diet). Thus, highway Yanomama are no longer self-sufficient food producers. It appears they perceive their need to identify with and be like local Brazilians greater than their need for dietary self-sufficiency. However, this poses no immediate problem of permanent dependence because they still have the option of gaining their total diet from the forest if they so desire.

Table 5. Western goods owned by forest village members

<u>Good</u>	<u>Uxiutheri</u>	<u>Iropitheri</u>	<u>Maxikopiutheri</u>	<u>Items per person</u>	<u>Total</u>
1. Axes	4	16	8	.32	22
2. Machetes	27	29	17	1.08	73
3. Knives	26	47	45	1.76	118
4. Hoes	3	4	2	.13	9
5. Pots	16	34	24	1.10	74
6. Basins	2	4	1	.10	7
7. Grater board	2	6	5	.19	13
8. Mirrors	0	7	6	.19	13
9. Combs	1	8	3	.18	12
10. Salt (kg)	4	5	3	.17	11
11. Braz. hammock	4	4	0	.12	8
12. Shotguns	1	1	0	.08	2
13. Flashlights	0	2	0	.03	2
14. Scissors	3	4	2	.13	9
15. Fishline	7	16	20	.64	43
16. Fishhooks	78	174	242	7.37	494
17. Toothbrushes	2	4	1	.10	7
18. Trousers	0	1	0	.01	1
19. Shorts	10	9	10	.43	29
20. Shirts	6	5	2	.19	13
21. Skirts	0	1	0	.01	1
22. Soaps	6	17	9	.48	32
23. Adzes	0	1	1	.03	2
24. Matches (boxes)	51	100	73	3.49	234
TOTAL				18.35	1229
Village Population	12	31	24		67

Table 6. Western Goods owned by highway village members

Good	Opiktheri 132	Opiktheri 135	Items per person	Total
1. Axes	9	11	.25	19
2. Machetes	11	21	.43	32
3. Knives	25	35	.80	60
4. Hoes	7	5	.16	12
5. Pots	20	30	.67	50
6. Basins	0	1	.01	1
7. Grater boards	0	3	.04	3
8. Mirrors	6	5	.14	11
9. Combs	8	4	.12	12
10. Salt (kg)	7.5	6.5	.19	14
11. Hammocks	11	14	.33	25
12. Shotguns	0	0	.00	0
13. Flashlights	1	2	.04	3
14. Scissors	10	7	.22	17
15. Fishline	13	14	.36	27
16. Fishhooks	133	371	6.80	504
17. Toothbrushes	5	5	.14	10
18. Trousers	5	2	.09	7
19. Shorts	1.9	88	2.80	207
20. Shirts	41	31	.97	72
21. Skirts	12	26	.51	38
22. Soap	28	53	1.09	81
23. Adzes	0	0	.00	0
24. Matches (boxes)	65	85	2.02	150
25. Blouses	25	15	.54	40
26. Underwear	9	9	.24	18
27. Bras	3	2	.06	5
28. Thread (spools)	12	2	.19	14
29. Needles	9	5	.19	14
30. Powdered soap (kg)	2	4	.08	6
31. Thongs & shoes	24	19	.58	43
32. Pans	2	2	.05	4
33. Spoons	5	9	.19	14
34. Cooking oil (cans)	3	3	.18	6
35. Dishes	5	4	.12	9
36. Cups	3	9	.16	12
37. Hats	5	7	.16	12
38. Blankets	2	1	.04	3
39. Towels	3	3	.08	6
40. Sacks & Bags	28	20	.64	48
41. Suitcases	0	2	.03	2
42. Medicine	49*	65**	1.50	114***
TOTAL			22.94	1698
Village population	28	46		74
* 44 pills	**45 pills	*** 89 pills		

Economic Values

Yanomama values clash with Brazilian values. Yanomama values are oriented towards kinship bonds, marriage alliances, defense against enemies, the exchange system, mutual help among brothers-in-law, etc. Brazilian society values economic productivity, individualism, and authoritarian relationships while downplaying kinship and marriage, the integrating factors in Yanomama society. These differences in value orientations make interaction between Brazilian and Yanomama difficult.

Yanomama see Brazilian society as superior because of its material goods, its technical power, and its organizational skill. Western goods, Western technology, and organization have had a strong influence on Yanomama society. Given a choice between equally well-made Brazilian and Yanomama products, a Yanomama will generally choose Western products.

Since the acquisition of goods requires exchange it is useful to analyze and contrast the different functions and entailments of exchange among Yanomama and Brazilian. The Yanomama engage in what is known as reciprocal exchange as opposed to the Brazilian mode known as market exchange (Polanyi 1957). Reciprocal exchanges are governed by social factors, particularly kinship and co-residence, which are deeply embedded in the fabric of society. For example, if a hunter returns with a large bag of game he is expected to share it widely with other members of the village. By doing so he reaffirms social relationships and gains prestige; if he does not, he literally isolates himself from the rest of the community and loses respect. Exchange as a means of achieving social solidarity is seen in an extreme form, for example, when men exchange identical bows or arrows with each other. The material consequence is irrelevant in this case and the crucial element is that the exchangers have established a friendship (an example of this is nicely portrayed in the film The Feast by N. Chagnon and T. Asch). For the Brazilian the situation is quite different; exchange has but a narrow function with no entailment of friendship or solidarity expressed. Market exchange is governed by the raw forces of supply and demand built around differences of wealth and power.

A Brazilian living among the Yanomama has difficulty dealing with their perseverance in asking to barter goods, every kind of good, including those they do not know how to use--recorders, cameras, books, etc. Although much of Yanomama motivation for exchange may be utilitarian, like that of the Brazilian, the traditional Yanomama desire to create a social bond is not understood or desired by the Brazilian and this results in misunderstandings, conflicts, and hard feelings. In order to successfully adapt to the Brazilian system, a Yanomama must change his trading behavior which, if carried over to Yanomama-to-Yanomama exchanges, changes the basis of Yanomama reciprocity.

The nature of the Yanomama exchange system and its conflict with the Brazilian system also results from the nature of the goods themselves. The goods that Yanomama exchange among themselves differ dramatically from goods made by Brazilians. Every Yanomama adult has the necessary skills and training to make all traditional Yanomama goods appropriate to their sex, and the resources used in their production are freely available to all.

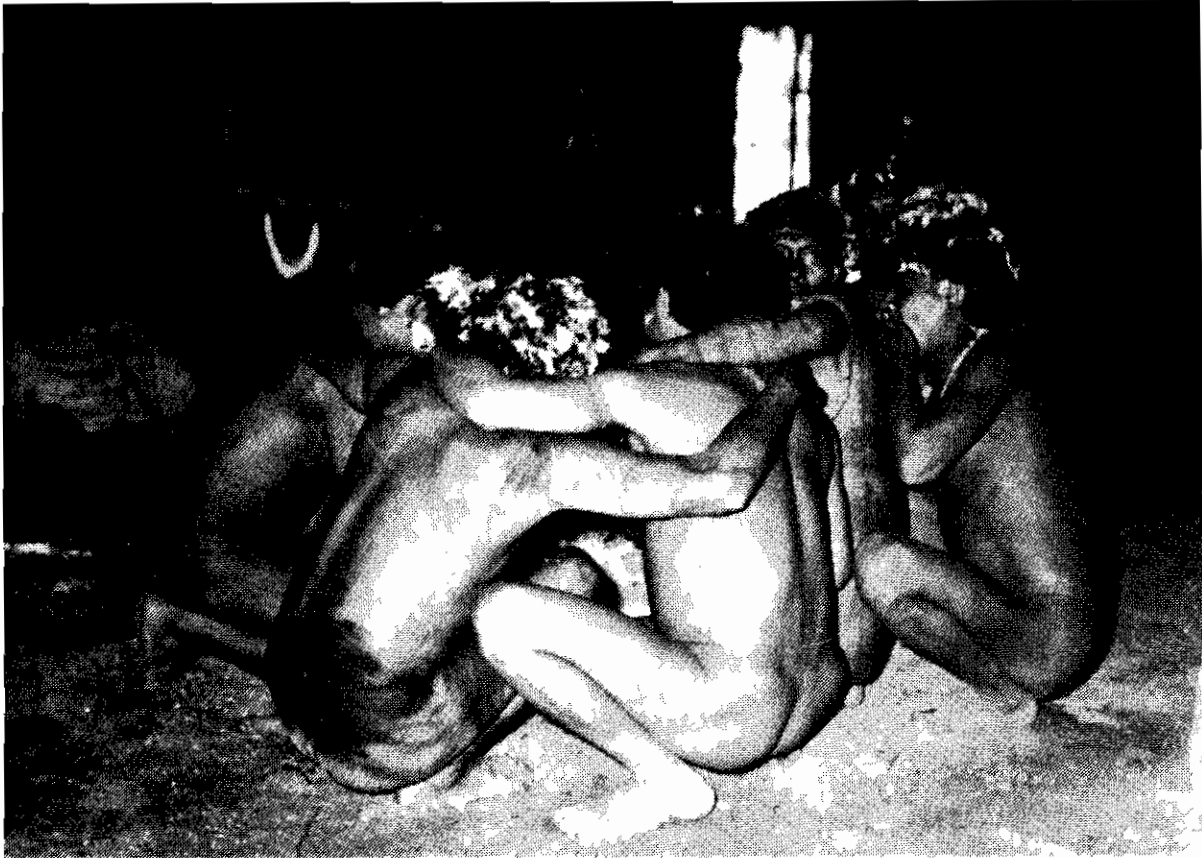
Goods are "personalized" in that individuals in the village can identify the maker of a specific good. "Personalization" is further increased because there is little specialization in the production process itself in that the same individual locates and prepares the resource needed for manufacture, and makes and exchanges the good for another. Finally, everybody owns an identical set of essential goods--there are no distinctions based on differences in material wealth. The value of a good derives from the person who made it or gives it and not from the good itself. For the Yanomama it is easy and convenient to barter their goods. A Yanomama is not eager to make or possess more goods than he needs. He doesn't desire a surplus. If a guest asks for something which he has in excess, he ought to give it to him. If he does not, he will be called xi imi (selfish), and he can be the target of some kind of retaliation by the guest. To possess goods is not a value in the Yanomama way of life. The making and using of goods, and giving and taking of goods, are the real values.

In contrast, Western goods for which the Yanomama trade are devoid of many of the traits which characterize Yanomama goods. Western goods are depersonalized, due to modern methods of resource procurement, production, and distribution, such that the maker of the good is not normally the same individual who exchanges it. Nobody possesses the knowledge to make all the goods he needs nor are the resources needed for production freely available to all. And the value of a good is not attached to the person who made or gives it, but it is attached to the good itself. Western goods are mass produced, impersonal objects whose singular utility in exchange is the acquisition of some sort of profit for the exchanger who is rarely the maker of the good. Since Western goods are impersonal, transactions involving them are impersonal. The highway Yanomama slowly are beginning to understand the nature of Western goods and exchange and are learning how to respond appropriately in their economic dealings with Brazilians.

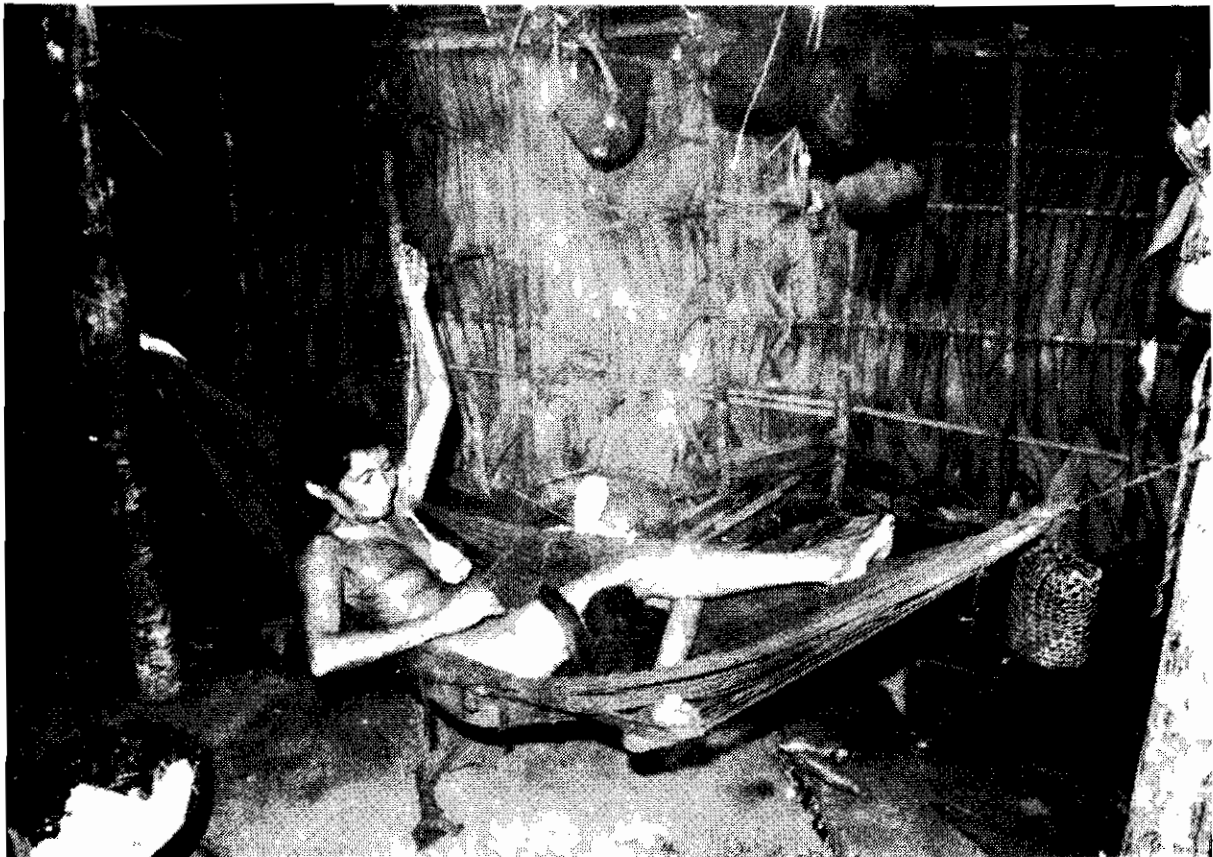
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The introduction of non-locally produced goods into Yanomama society has disrupted village life. Traditional items were in general widely shared since they were plentiful and could easily be replaced or repaired. However, whether or not a Western good is shared depends on whether or not it is scarce, easily lost, ruined, or expended. For example: (1) axes, machetes, grater boards, hoes, and digging tools are frequently shared; (2) scissors, knives, thongs, and files are rarely shared; and (3) hammocks, shotguns, ammunition, and fishing line and hooks are never shared. The differential ownership of goods not easily shared creates resentment on the part of those without them and is a new source of tension in both forest and highway villages.

In traditional Yanomama society goods are privately owned, but since all adults could make any item appropriate to their sex, invidious distinctions based on property did not exist. In forest villages privately owned trade goods are widely shared, but in highway villages they are rarely shared. Moreover, greater differences in levels of material wealth are developing among individuals in highway villages compared to forest villages, and contrary to traditional patterns women in highway villages own more material goods than men. As a result of these changes individuals are now differentiated not merely along age, sex, and kinship variables, but also according to property.



Funeral ceremony at the Wakathauteri village--December, 1968 (above) and woman spinning cotton in her hammock at Uxiutheri village--November, 1979.



SOCIAL CHANGE

The Traditional Status System

The Yanomama are an egalitarian people, and, as a result, their status system is based on age, sex, and charismatic leadership. In general, males have higher status than females and increased age, which cross-cuts sexual differences, leads to higher status for both sexes. The higher status of men is a result of their dominant role in politics, warfare, and religion. This is not to say that women have no influence in these domains (see, for example Ramos 1979 on the Sanuma Yanomama; and the film and Ax Fight by Asch and Chagnon), but that their influence is largely behind the scenes and informal. Women may never rise to the position of headman or shaman. Sexual inequality is made manifest in a fundamental way by the fact that female infants have a higher probability of suffering infanticide than male infants. It is not uncommon for men to beat their wives over accusations of adultery or other perceived outrages. The reverse is rarely the case.

The greatest respect and authority is given to older men who have the authority to make such decisions as choosing mates for their daughters, selecting the location of the next village, giving advice in regards to raiding other villages, or the scheduling of a feast and related activities. An older age means years of experience, which makes a person's knowledge more reliable. Part of the increase in status also is due to reproductive abilities in that older individuals are likely to have greater numbers of offspring, kin, and affines on whom they draw for support. This applies equally to men and women.

This size of one's kinship group is another factor which can enhance individual status for men and women. The largest patrilineage in a village is politically dominant and the headman comes from that group (Chagnon 1974, 1979). Not only is one's status enhanced by being a member of a large patrilineage but also one's social security as a member of a secure network in which goods and services are easily and harmoniously exchanged.

The two specialized positions of leadership, shaman and headman, are reserved for men. The shaman cures the sick, protects the village by sending hekura (demons) against enemy villages, seeks the location of game through divination, and tells and retells myths which are the ideological foundations of Yanomama society. The headman, and there may be several in large villages, is a primus inter pares who leads through his superior organizational and rhetorical skills primarily in matters having to do with maintaining internal harmony, forging alliances, and making war on enemy villages. A headman usually is a shaman. A headman's ability to lead depends on a practical day-to-day demonstration of effective leadership; he has no institutionalized powers of coercion and is easily deposed when people simply cease to acknowledge his leadership. Finally, higher status accrues to individuals, regardless of sex, who are generous, industrious, provide well for their families, and are skilled in economic tasks.

Changes in the Status System

Since contact, the basis for attaining and for defining status in

these structures are more or less rectangular with pitched roofs. On the other hand, the Yanomama of the forest villages still live in traditional Yanomama houses.

The acquisition of Western goods has caused changes in the traditional form of bride service among the Catrimani River Yanomama. Peters (1973) has found similar changes among the Mucajaí River Yanomama. A Yanomama man to whom a woman is promised has to perform "considerable work for his wife's parents as part of his bride service" (Shapiro 1971:94; see also Chagnon 1977, Lhermillier and Lhermillier 1974). He must hunt for them, work in their garden, help them in the construction of a new house, and provide them with the traditional goods they need. A man starts to work and to hunt for his father-in-law from the day he asks him for the daughter, often when she is only three to five years of age. Immediately before and after the marriage, bride service is extremely intense, but usually after two or three years of marriage the in-laws' relationship decreases. However, it never ends. As long as the bride's parents are alive they may ask for and receive help and goods from their son-in-law.

Prior to 1974, the Yanomama of the Catrimani River Basin followed the traditional pattern of bride service; after that they began to expect the bridegroom to provide a few Brazilian goods such as axes, machetes, knives, as well as Yanomama hammocks and bow and arrows. The number of items given depends upon the bride's parents and brothers as well as on the amount of goods possessed by the bridegroom (Peters 1973:122). As Brazilian goods became more available, in-laws in Opiktheri 132 and 135 included more of them as a part of bride service, making it more of a bride payment. The traditional bride service is no longer fashionable among the highway villages because the in-laws prefer goods rather than services. For example, during 1978 and 1980 two men of Opiktheri 135 and another from Opiktheri 132 obtained wives from Yanomama villages at Km 37 and 49 by substituting Brazilian goods. They did less than six months of bride service. This trend weakens the relationship between in-laws. A father-in-law from a highway village can no longer count on his son-in-law to provide game or to help in his garden. This new pattern could change profoundly the traditional marital alliance system of the highway villages. In contrast, the scant supply of Brazilian goods among the forest villagers has not converted bride service to bride payment.

The introduction of Western goods and the practice of wage labor is altering the very basis of Yanomama social organization. Age, sex, and individual achievement in traditional skills no longer dominate the integration of Yanomama society, especially in highway villages. Traditional skills are devalued because they fail to facilitate interactions with Brazilians. The young view the traditional knowledge and values held by the elders as impediments to successful relations with Brazilians. Thus, as the Yanomama become more dependent on Brazilians for economic resources, the bonds of kinship and marriage among them deteriorate. Modern medicine has eroded the position of the shaman. Finally, many of the younger Yanomama from the highway villages no longer wish to be considered Yanomama.

Yanomama society has altered, especially among the Yanomama of the highway villages. New methods of achieving higher status are: (1) skillfulness in making handicrafts for Brazilians; (2) industrious use of new skills in hunting and fishing; (3) ability to develop good relationships with missionaries, FUNAI agents, and settlers; (4) ability to speak and understand Portuguese; and (5) adaptability to do wage labor for Brazilians.

Yanomama of the highway villages are encouraged to be industrious by missionaries, FUNAI agents, and settlers; hardworking is praised and laziness is ridiculed. Not complaining and being industrious brings Brazilian goods and a cordial relationship with Brazilians. From their first contact with Brazilians, young Yanomama have gained increasing amounts of authority in the village because of their ability to acquire Brazilian goods, their skillfulness in conforming to Brazilian expectations, and their ability to speak Portuguese. As a result, their independence from elders and from village life has increased enormously. They go often to the FUNAI posts and to the settlers, staying away from their villages for weeks and sometimes months. The wives of these men want more goods and demand greater freedom in their marriages. A comparison of highway and forest villages pinpoints some of these fundamental changes.

The people of Opiktheri 132 and 135 think of themselves as Brazilian-like people because they wear clothes and thongs, own Brazilian hammocks, smoke cigarettes, speak some Portuguese words, and work at the FUNAI posts, and for settlers. The Yanomama who live far from the highway also think of the Opiktheri as Brazilian-like people. However, the Brazilians still consider them Indians.

Feasts are important events in Yanomama life, but now the Opiktheri 132 and 135 arrange few feasts during the year, and they do not invite many villages to attend. They only invite those who also live along the highway. During the feasts Brazilian items such as clothing, metal tools, etc. are exchanged. The Yanomama of the forest villages still have many feasts during the year to which they invite as many villages as they can.

Ten bachelors--six from Opiktheri 132, four from Opiktheri 135--live nearby, independent of their home villages. They spend more time among the settlers and farmers than among their own kinsmen. During the 45 days Saffirio spent in the two villages, the bachelors spent twenty days on the Brazilian farms and twenty-five days in their village. They worked with Brazilians in order to acquire the new needs (cigarettes, clothes, soap, thongs, etc.). None of the bachelors from the forest villages spent time among the settlers and farmers.

Most of the Yanomama of the highway villages do not use kinship terms; rather they use Brazilian personal names when addressing their kinsmen. They are no longer proud to be Yanomama. When asked about their myths or some of their customs, they answer they do not know them. In contrast, all the Yanomama of the forest villages call each other by kinship terms, and proudly recount their myths.

The Opiktheri 132 and 135 do not build big communal houses (yano) as they once did. They now build small Brazilian-like houses where only a few closely-related families can live together. Copied from Brazilian peasants,

THE ECONOMIC CONSEQUENCES OF ENVIRONMENTAL DEGRADATION

Introduction

Thus far we have discussed the effect of Brazilian goods on the Yanomama from an historical perspective focusing on changes in Yanomama technological and economic autonomy, identity, attitudes toward ownership and exchange, and in the status system. We now turn to an examination of the effects of environmental change on traditional hunting, gathering and fishing. Horticulture, which forms the basis of Yanomama subsistence (Chagnon 1968; Lizot 1977), has been little affected by environmental change thus far; the change which has occurred has been in a small shift towards growing crops which can be traded or sold to Brazilians (e.g., manioc products). While the efficiency and productivity of horticultural activities is probably unaltered, the same is not true for hunting, gathering, and fishing--vital components of Yanomama subsistence.

The Yanomama of the highway villages occupy a degraded and overexploited environment. Degradation of the environment is largely a result of highway construction activities which scared away a great deal of game and overhunting by Brazilians with rifles and shotguns. Road construction blocked a number of streams which previously crossed the highway. This lowered fishing productivity by creating swamps. Traditionally, Yanomama choose village sites according to their ability to furnish their needs for adequate horticultural land and drinking water. Now the chief consideration for village location is the highway. Traditionally, villages were moved and reconstructed every four to six years as nearby garden land was abandoned after three to four years of continuous cultivation. Even though such "micro-moves" (see Chagnon 1973) are seldom more than a kilometer, they slightly enhance hunting, gathering, and fishing by moving the Yanomama closer to relatively unexploited portions of their environment. Also, problems of disease and pollution resulting from the build-up of domestic pathogens and pests are lessened by village abandonment. Increasingly, villages along the highway are becoming more sedentary as residents wish to remain in contact with Brazilians. Increased sedentariness is fueling village environmental pollution and leading to some possible serious health problems and altering the efficiency of the wild food quest. Diseases caused by intestinal parasites (exyuriasis, ascariasis and amebiasis being the most widespread) are becoming a serious health problem. The highway Yanomama rebuild their houses four to five times on the same spot. As a result the ground around their villages becomes highly contaminated because of their custom of defecating unrestrictedly inside the forest, around the village, and in their gardens. In this section we compare highway and forest villages to demonstrate how living in an altered environment changes the efficiency, time allocation, productivity, and consumption of wild resources, and how these changes, in turn, have altered traditional patterns of reciprocity.

The Wild Resource Quest

Hunting, fishing, and gathering among the Yanomama conforms to the general pattern found throughout Amazonia. Hunting is the male economic

activity, although women will occasionally make fortuitous kills while doing other activities. The main weapon of the hunt is the bow and arrow (see Hames {1979} for a description of Yanomama hunting technology). Bows are 1.8 to 2.0 m long, 3 centimeters in diameter, and made of one of several species of palm. The arrows which are about two meters long vary slightly in diameter and length depending on the type of point attached. Four different types of point are used: (1) a lanceolate bamboo blade about 20 cm long used for the largest game animals (tapir, deer, and peccary); (2) a thin palm splinter point coated with poison (curare) about 15 to 20 cm long for monkeys and sloths; (3) a harpoon point with a wood shaft and monkey bone barb for birds and small terrestrial game weighing less than eight kilograms and (4) a stunning point for small birds usually made on the spot from a short stem which has three to four branches diverging from a node. Arrows have a maximum effective horizontal range of 21 to 25 meters, and a vertical range of more than 30 meters.

The Yanomama feel that hunting is the most important male economic activity and excellence in hunting enhances male status. A man hunts once every three to four days with day hunts (*rama*) lasting about six hours in forest villages and nearly eight hours in highway villages (Table 9). Most hunting is a solitary pursuit although men also hunt in teams of two or more. In preparation for feasts men engage in long distance, multiple-day hunts (*heni*) to ensure that a large supply of game will be garnered for guests.

In the late 1960s the Yanomama first received shotguns from Brazilian hunters and missionaries and by the early 1970s 20% of all Yanomama men in the Catrimani Basin owned them. Since 1975, however, the FUNAI began to patrol the Catrimani area and prohibit the sale of guns and ammunition to Yanomama. As a result, no more than 9 men in the entire region own guns. In our sample population of highway and forest villages only 2 of 51 hunters owned shotguns. Due to a scarcity of ammunition the Yanomama hunt very infrequently with shotguns, and when they do they invariably seek only big game (e.g., tapir, deer, peccary). The shotgun seems to diminish the frequency of cooperative hunting because it is more than 200% more efficient (measured in kilograms of game per hour of hunting) than the bow and has greater shocking power against big game (see Hames {1979} for a controlled comparison of shotgun and bow hunting).

Available evidence indicates that the Yanomama homeland originally was in the Parima Highlands, an area of small and turbulent streams and rivers where fishing generally is difficult and unproductive (Chagnon 1968; Lizot 1976; Smole 1976). As a result Yanomama fishing technology is poorly developed consisting of fishing arrows, fish poison (*timbo*), and crudely made fish hooks and line. Traditional Yanomama canoes are made of bark and seldom last longer than their maiden voyage; they are made for a single crossing of a river. The Yanomama learned to make dugout canoes from neighboring Indian peoples (especially members of the Carib linguistic family) only within the last 50 to 60 years and this in some areas has aided fishing greatly. As segments of the Yanomama population expanded southward and westward from the Parima Highlands they encountered larger rivers which made fishing more productive. During the last twenty years since they acquired nylon fishing line and steel hooks from Brazilians and

missionaries, hooks and lines are the most common items used in fishing, although poison and bow and arrow fishing still persist. Everyone fishes: males and females, young and old participate nearly equally. Fishing, like gathering, is seasonal, being practiced most in the dry season when stream levels are lower and the water clearer.

Gathering provides less than five percent of the calories consumed by the Yanomama (Lizot 1977) making it calorically the least important food-getting activity. Nevertheless, gathered food may supply a number of important vitamins and minerals which cannot be gained easily through horticulture, fishing, and hunting. (Furthermore, gathering is extremely important because it supplies the Yanomama with most of the basic materials for artifact construction. Gathering is done by both sexes with females spending more time at it than males {Lhermillier and Lhermillier 1975}). Palm fruits are by far the most important food gathered: of 673 kilograms of fruit gathered by forest and highway villages during the sampling period 95% or 665 kilograms came from five different species of palms (see Table 12). Honey, crustaceans, insects, and arachnids are also gathered by the Yanomama. The introduction of axes and machetes has undoubtedly had a powerful impact on Yanomama gathering, especially fruit and honey gathering. Before the advent of steel tools the Yanomama relied on fruit fall, climbed trees, or used hooked poles to collect fruit and honey. With the introduction of steel tools they have begun to fell all but the largest fruit trees (e.g., the Brazil nut tree Bertholetia excelsa and the cashew tree Anacardium occidentale) or trees which are fairly easy to climb, such as palms. Felling trees was difficult in the past because a polished stone ax is about 400% less efficient than the steel ax (Salisbury 1962). The Yanomama realize that a felled tree can never be harvested again, but this does not deter them since, as they argue, there are so many trees in the forest. It is possible that the introduction of steel tools has increased the importance of gathering among the Yanomama. But this is problematic because Western technology has increased the efficiency of all other traditional economic pursuits and one would have to know much before this inference could be reliably made.

The introduction of Western technology for the exploitation of wild resources has affected some activities more than others. Hunting remains little affected for the moment, because the shotgun is used infrequently. Gathering has been made easier with the advent of axes and machetes which permits harvesting through felling instead of the sometimes more laborious method of climbing or using hooked poles to bring down fruit. With the introduction of the nylon line and steel hook, the efficiency and productivity of fishing has probably increased dramatically over aboriginal methods. Nevertheless, it is clear that traditional fishing methods with poison and arrows are still viable. In certain situations traditional methods are more productive and efficient than hook and line fishing since they have not been abandoned in villages where steel hooks and nylon line are readily available. Today there are few Yanomama villages which do not have a fairly adequate supply of the above-mentioned Western goods (with the exception of shotguns) to aid them in their quest for food in the forest. Although there are differences in the proportion of these goods owned by

forest and highway villages the differences are not sufficiently great to influence the differences in productivity, efficiency, consumption, and time allocated to gaining wild resources between highway and forest villages which we shall examine below.

Hunting

Table 7 summarizes data on the hunting activities of 29 forest village hunters and 22 highway village hunters. Although women occasionally make fortuitous kills of games while engaged in other activities and males under the age of 18 make some contributions to the household game supply, it was decided to sample only mature hunters who regularly hunted so comparisons between highway and forest hunters would be on an even basis. There are a number of striking differences between forest and highway hunters in terms of time allocated to hunting and efficiency in hunting (measured in kilograms of game taken per hour of hunting). Columns 'e' and 'f' in Table 7 show that forest hunters hunt an average of 57 minutes per day while each trip averaged 362 minutes in duration compared to 142 minutes and 443, respectively, for highway hunters. Thus highway hunters average 153% more minutes per day hunting and each hunting trip is 22% longer compared to forest hunters. These differences are largely due to differences in hunting efficiency (column 'h'): forest hunters kill game at a rate of 0.979 kilograms of game per hour compared to 0.688 for highway hunters which makes forest hunters 42% more efficient than highway hunters. Essentially, highway hunters must hunt more frequently and intensely to gain an adequate amount of game as their forest counterparts.

Highway hunters must hunt in a game-depleted environment. As mentioned previously, road construction has drastically altered the game habitat, and hunting by large numbers of workers with rifles and shotguns during highway construction depleted game species. Since the road was completed, noise from vehicular traffic of FUNAI agents, settlers, and missionaries continually frightens game, keeping it away from the highway's edge and driving it deep into the forest. Table 8 is a list of the proportions and frequencies of game species taken by all members of forest and highway villages. A summarizing figure entitled "average weight of kill" (kilograms of game taken divided by number of individuals) provides ample evidence of big game depletion along the highway: the average weight of a kill by forest villagers is 156% greater (8.8 kilograms) than highway villagers (5.8 kilograms). This simply means that forest hunters are encountering large game more frequently than highway hunters. If we define big game as any game animal heavier than 16 kilograms (e.g., tapir, mazama deer, giant anteater, white-lipped peccary, and collared peccary) we find that these animals compose 71% by weight of all game taken by forest hunters, but only 54% for highway hunters. In fact the white-lipped peccary is the only large game species taken by highway hunters and this animal is highly migratory (Kiltie 1980). As a result of depletion and dispersion of big game, highway villagers resign themselves to hunting small game and collecting tortoises. The tortoise apparently is not frightened by road noise and its habitat has been surprisingly enhanced by the production of swamp land through highway construction.

Table 7: A comparison of the performance of forest and highway hunters.

	a.	b.	c.	d.	e.	f.	g.	h.
Villages	People Hunting	Total Days in Vill.	Total Days Hunt	Total Hours Hunt	Average Minutes Per Day	Average Minutes Hunting Trip	Total Kg Game*	Kg Per Hour
F O 1. UXIU	5	118	16	95.10	48.29	306	188.49	1.980
R E 2. IROPI	12	169	25	166.70	59.10	344	121.76	0.730
S T 3. MAXIKOPIU	12	267	32	270.87	69.86	437	211.8	0.780
	TOTAL	29	554	73	533.05	57.73	522.0	0.979
H 4. OPIK 132	13	410	94	936.08	137.27	463	548.06	0.580
I G 5. OPIK 135	5	186	56	504.59	162.65	417	440.88	0.870
H W TOTAL	22	596	150	1440.67	145.96	443	989.25	0.688
A Y								

* field dressed weight

Table 8. Total game

Game	Weight*	FOREST VILLAGE		HIGHWAY VILLAGE	
		No. of Animals	Total Kg	No. of Animals	Total Kg
1. Black Curassow	2.5	8	20.0	16	40.0
2. Green-Backed Guan	0.7	2	1.4	30	21.0
3. Rusty-margined Guan	0.9	-	-	19	17.1
4. Common Guan	1.0	6	6.0	11	11.0
5. Macaw	1.0	17	17.0	3	3.0
6. Mealy Parrot	0.4	3	1.2	-	-
7. Red-legged Tinamou	0.7	3	2.1	7	4.9
8. Buff-necked Ibis	0.4	-	-	6	2.4
9. Marbled Wood Quail	0.6	3	1.8	1	0.6
10. Toucan	0.5	4	2.0	6	3.0
11. Spider Monkey	7.5	-	-	17	127.5
12. Red Howler Monkey	7.5	3	22.5	2	15.0
13. White Monkey	4.1	3	12.3	3	12.3
14. Capuchin Monkey	3.8	4	15.2	1	3.8

Table 8. (continued)

Game	Weight*	FOREST VILLAGE		HIGHWAY VILLAGE	
		No. of Animals	Total Kg	No. of Animals	Total Kg
15. White-lipped Peccary	24.5	6	147.0	25	612.5
16. Collared Peccary	19.0	3	57.0	-	-
17. Tapir**	215.0	1	215.0	-	-
18. Mazama Deer	22.8	3	68.4	-	-
19. Nine-Banded Armadillo	9.5	3	28.5	-	-
20. Two-Toed Sloth	11.4	1	11.4	-	-
21. Three-Toed Sloth	5.5	1	5.5	-	-
22. Giant Anteater	32.0	2	64.0	-	-
23. Silky Anteater	3.9	2	7.8	-	-
24. Agouti	3.5	1	3.5	1	3.5
25. Grey-winged Trumpeter	0.8	1	0.8	-	-
26. Rail	0.5	-	-	1	0.5
27. Squirrel	0.7	-	-	1	0.7
28. Crab	0.1	5	0.5	-	-
29. Tortoise	4.0	8	32.0	58	232.0
30. Small Caiman	4.5	3	13.5	3	13.5
TOTAL		96	766.9	210	1124.3
AVERAGE WEIGHT OF KILL			7.98		5.35

* Whole weight of game

** Only 1/3 of this tapir was brought home
1.0 = less than 1 Kg.

Fishing

When we examine fishing the same kinds of patterns emerge but the differences between forest and highway villages are not as dramatic (see Table 9). There is essentially no difference in the length of an average fishing trip between forest and highway villagers at 364 and 362 minutes per trip, respectively. However, forest villagers average 13 minutes per day less (or highway villagers fish 35% more minutes per day) than highway villagers. The most striking difference, however, is to be found in fishing efficiency (kilograms of fish per hour of fishing); at 0.37 kilograms per hour forest villagers gain fish at twice the rate of highway villagers who fish at 0.18 kilograms per hour. As in hunting the lower rate of efficiency

in highway villages are a reflection of living in a degraded environment. Road construction of the Perimetral Norte crossed the courses of a number of small streams and dammed them. As with hunting, the greater amount of time spent fishing by highway villagers is a result of their lower efficiency.

Table 9. A comparison of the performance of ~~Forest~~ and Highway Villagers in fishing.

	a.	b.	c.	d.	e.	f.	g.	h.
Villages	People Fishing	Total Days in Vill.	Total Days Fish	Total Hours Fish	Average Minutes Per Day	Average Minutes Fishing Trip	Total Kg Fish	Kg Per Hour
F 1. UXIU	4	118	11	47.18	23.90	257	46.20	1.00
O 2. IROPI	12	168	7	29.26	10.30	250	10.49	0.35
E 3. MAXIKOPIU	12	267	36	251.71	56.50	419	67.36	0.26
T TOTAL	29	554	54	328.15	35.50	364	124.05	0.37
H 4. OPIK 132	13	410	51	276.40	40.44	318	59.25	0.20
I 5. OPIK 135	9	186	28	207.31	66.30	444	28.50	0.13
G TOTAL	22	596	78	483.71	48.60	362	87.75	0.18
H W A Y GRAND TOTAL	51	1150	132	811.86	-	~	211.80	-

Gathering

Calorically, gathered food resources (fruits, honey, nuts, crustaceans, arachnids, insects, etc.) are of minor importance in the Yanomama diet, composing less than 5% of the total energetic intake (however, it is possible that the minerals and vitamins gained from these resources may be important nutritionally). Correspondingly, as shown in Table 10 only 15 to 20 minutes per day are allocated to this subsistence category. Although the differences are slight, forest villagers spend more minutes per day in gathering and the length of an average gathering trip is longer. However, forest villagers gather about twice as efficiently as the highway villagers. The difference in gathering efficiency between forest and highway villagers is probably not because the latter must gather in a degraded environment, but simply because research in forest villages was done in November and December when many species of palm fruits and nuts were ripe (and over 80%

of all plants gathered for food by the Yanomama come from palms) while research in highway villages was done in January and February when just one species of palm (*Maximiliana regia*) had ripe fruit. We expect that if sampling were done in the same months for both types of villages there would be little difference in terms of labor input or efficiency of labor in gathering beyond that which relates to the natural distribution of palms in the two areas. Furthermore, it is probable that gathering might be more efficient for highway villagers because of the opportunity to use the highway to travel quickly to gathering sites.

Table 10. Gathering*

	a.	b.	c.	d.	e.	f.	g.	h.
	People	Total	Total	Total	Average	Average	Total	Kg
Villages	Gather- ing	Days in the Vill.	Days Gather- ing	Hours Gather- ing	Minutes Gather- ing	Minutes Gather- ing Trip	Kg Fruit	Per Hour
F 1. UXIU	4	118	10	39.83	20.2	238	173.00	4.34
O								
R 2. IROPI	12	169	17	105.48	37.4	372	246.00	2.33
E								
S 3. MAXIKOPIU	12	267	7	39.66	08.9	339	61.50	1.55
T								
TOTAL	28	554	34	184.97	20.0	326	480.50	2.60
H 4. OPIK 132	13	410	29	132.65	19.4	306	168.00	1.33
I								
G 5. OPIK 135	2	186	5	24.70	07.9	296	24.50	0.99
H								
W TOTAL	15	596	34	157.35	15.8	314	192.50	1.27
A								
Y GRAND TOTAL	43	1150	68	342.32	-	-	673.00	-

* food resources only

Protein Consumption

Environmental degradation appears to have a nutritional impact as well. Table 11 presents an estimate of animal protein consumption of highway and forest villages and indicates that highway villagers consume 96.75 grams of protein per capita/day and forest villagers 69.63. Both of these rates are within the middle to upper ranges of consumption for Venezuelan Yanomama villages and other native Amazonians who live traditionally (Lizot 1977; Chagnon and Hames 1979). Nevertheless, the higher rate of consumption for highway villagers may be more apparent than real. Nearly 90% of all the white-lipped peccaries taken by highway villagers were the result of a single henimu hunt which netted them about one-third of the total game they

took during 45 days of observation. It has been noted, on the basis of detailed research (Kiltie 1979), that white-lipped peccaries are highly mobile and unpredictable in their movements. Without this spectacularly successful hunt, highway village consumption is equal to that of forest villagers.

Table 11. Animal Protein Consumption *

	FOREST VILLAGES		HIGHWAY VILLAGES	
	Hunting	Fishing	Hunting	Fishing
Number of days sampled	51	51	45	45
Average village population	32	32	34	34
Total consumer-days	1632	1632	1530	1530
Kilograms game** and fish***	793.70	124.05	1124.30	87.75
Kilograms edible portion	476.22	93.03	674.58	65.81
Bulk grams per capita per day	291.80	57.00	440.52	43.01
Grams protein per capita per day	58.36	11.40	88.10	8.60
<u>Total grams protein per capita per day</u>	67.76		96.75	

* Calculations based on the method devised by Gross (1975) and followed by Chagnon and Hames (1979).

** See Table 8.

*** See Table 9.

The main impact of living in a degraded environment on traditional Yanomama economic organization has been to lower the efficiency of hunting and fishing and to increase the amount of time allocated to these tasks. Hunting and fishing are from two to three times more efficient for forest villagers compared to highway villagers. As a result highway villagers must spend 88 more minutes per day in these activities.

Village Location and Mobility

The location of a village and the length of time its occupants choose to live there are major factors in environmental adaptation. Traditionally, village location and duration are determined by the demands of shifting

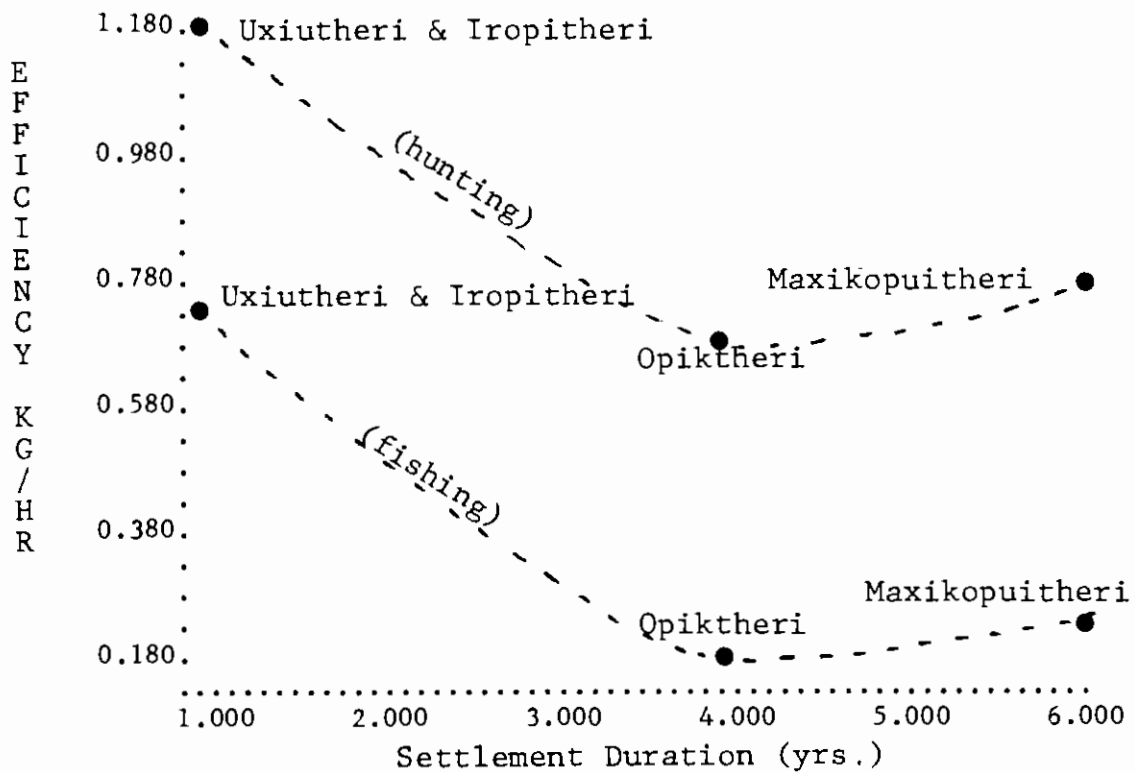
cultivation. Villages are moved short distances (1-2 kilometers) every four or five years as cultivable land becomes more distant from the village. New sites are chosen for their horticultural potential, that is an area of abundant crop-land which permits villagers to make 'micro-moves' (Chagnon 1973) of short distances resulting in minimal disruption to village economic continuity. In this way the Yanomama are able to maintain an efficient horticultural system with a slight additional benefit of relieving pressure on depleted wild resources gained through hunting, fishing, and gathering. As mentioned above, the decision of where to locate a highway village is no longer determined solely by a site's potential for traditional economic activities but whether or not the site offers easy access to Brazilians. Although having easy access to Brazilians allows highway villagers to more easily maintain economic relations with them, it also means that they must face competition for resources from Brazilian settlers who also hunt and fish (Smith 1976).

The decision of highway villagers to locate near Brazilians has caused them to occupy a degraded environment and to become more sedentary by reducing the frequency of village relocation. The economic effects of this new settlement pattern as they affect hunting and fishing can be graphically seen by comparing highway villages to the more traditional forest villages in Figure 1. As can be seen on Map II the forest villages Uxiutheri and Iropitheri are located adjacent to one another. They moved to this area in 1979 and it has not been exploited within the living memory of any Yanomama. Therefore, their figures on average minutes per day and labor efficiency in hunting and fishing have been combined to occupy two points on the scattergram in Figure 1 instead of four. Another forest village, Maxikopiutheri, occupied its current site in 1974 and according to informants the site was last exploited by the inhabitants of another village approximately 20 years prior to their arrival. The highway villages of Opiktheri 132 and Opiktheri 135, being only 1.7 kilometers apart have their totals combined, as with Uxiutheri and Iropitheri, and have occupied their present location since 1976. Although we cannot claim anything in the way of statistical significance to the scattergram, the obvious implication is that efficiency in hunting and fishing declines and work effort increases the longer the time a village population has been exploiting an area, and living in an already degraded environment hastens the process. That the people of Opiktheri 132 and Opiktheri 135 have been living in their current location for six years (as of 1982) indicates that they are willing to suffer the costs of increased sedentism which lead to lower resource procurement efficiency and higher labor time costs in hunting and fishing, in order to achieve the benefits of economic relations with Brazilians.

One could question our interpretation of the scattergram by arguing that differences in labor efficiency between forest and highway villagers, and hence increased labor costs, is a result of natural environmental differences as they relate to fish and game densities. Control of environmental variables in comparative human ecological research is notoriously difficult to achieve, but we have no reason to believe the differences between forest and highway environments stem importantly from factors other than environmental degradation and increased sedentization. Furthermore, the forest village of Maxikopiutheri has occupied its site two years longer than the highway villages of Opiktheri 132 and Opiktheri 135

but as Tables 9 and 11 indicate they hunt and fish much more efficiently. To some extent the decline in labor efficiency in highway villages is a function of their greater population size which increases the rate of environmental exploitation. Even so, this is still the result of Brazilian economic influences which result in localizing two villages of moderate size in nearly the same place instead of two villages of small size as in the case of the forest villages of Uxiutheri and Iropitheri. Our results are supported by the research of Vickers (1980) on the Siona-Secoya of the Ecuadorian Amazon and Hames (1980) on the Ye'kwana and Yanomama of the Venezuelan Amazon on settlement duration and game depletion. It is evident that hunting and fishing will become more difficult for the highway Yanomama the longer they desire to remain in contact with Brazilians.

FIGURE I



ECONOMIC INTEGRATION

In Yanomama society the exchange of goods and services between individuals and groups is a daily event which powerfully serves to integrate a village economically and socially. Men, after returning from a successful hunt, give portions of game to kin and affines who in turn may make secondary distributions of these gifts to their relatives and affines. Women help weed and harvest one another's gardens or share foods gathered in the forest in much the same way men share meat from the hunt. At times the

village acts as a single economic entity when all cooperate to prepare a feast (reahamu) for a visiting village, at other times cooperation does not extend beyond the nuclear family, but most of the time it is somewhere in between. Individuals who are generous with their produce or who readily help others in economic projects gain a great deal of respect. This reciprocity is 'embedded' (Polyani 1957) in kinship and other social institutions. In contrast the Brazilian system is based on market forces (e.g., supply and demand) which are disembedded to a large degree from considerations of kinship and other social forces. Nuclear families tend to be independent economic units with each attempting to maximize its own economic position. In market-based exchange systems individual families are no longer linked to one another through the exchange of goods and services, rather families are linked to markets and firms from which they gain their goods and to which they give their labor. Prestige accrues to those individuals who gain material wealth and display it conspicuously.

In conjunction with the collection of data on hunting, fishing and gathering productivity, data were collected on the exchange of these products within the village, specifically: the quantity of each kind of food given by each individual producer to other members of the village; the social relation between givers and receivers of foods; and secondary exchange of foods. This is a rather complex data set that requires extensive analysis. Here, we propose to analyze only the amount of food produced in hunting, fishing, and gathering by nuclear family units, comparing the amount they retain for their own consumption to the amount given to other families in the village. From these basic data we propose to measure and compare the degree of reciprocity in forest and highway villages. The more family units give of what they produce to other and the less they keep for themselves, the greater the degree that reciprocity integrates a village economically. Conversely, the less a family unit gives to others in the village and the more they retain for themselves, the lower the degree of economic integration through reciprocity. When low degrees of reciprocity exist in a village population, individual family units exist as a series of rather independent units with little social solidarity.

Exchange

Table 12:a-c lists the amount of goods (game, fish, and vegetables) produced, retained, and exchanged in forest and highway villages. Overall, forest village families never retained more than 45% (fish) of what they produced while highway villages never retained less than 51% (fruit) of what they produced for their own consumption. These differences are even more startling when compared by subsistence category. Game is the most prized of all food commodities. The Yanomama even have a word which expresses a hunger or desire for meat (naiki) and use another word to express hunger in general (ohi). On the average forest villagers who follow traditional patterns of sharing meat gave 76% of what they hunted to other families in the village while highway villagers only gave 18% of what they hunted to other families, keeping 82% for themselves. Fish, which is second only to game as an esteemed food, was shared less than half as much as game in forest villages, but twice as frequently as game in highway villages. While there is little difference in the sharing of fruit between forest and highway villagers, forest villagers share more frequently. The data on the sharing of game,

fish, and fruit indicate that forest villages have a higher degree of economic integration through reciprocity than highway villages.

Table 12. Exchanges of game, fish, and vegetable foods in forest and highway villages.

Village	12a: Game		% Kept	% Exchanged
	Kg Game	Kg Kept		
Uxiutheri	217.5	25.0	11	89
Iropitheri	118.5	37.5	31	69
Maxikopiutheri	251.5	80.75	32	68
Forest village totals	587.5	143.25	24	76
Opiktheri 132	331.5	278	84	16
Opiktheri 135	210.5	165.5	79	21
Highway village totals	542.0	443.5	82	18
Village	12b: Fish		% Kept	% Exchanged
	Kg Fish	Kg Kept		
Uxiutheri	46.2	15.33	33	67
Iropitheri	10.49	7.87	75	25
Maxiopiutheri	37.36	32.37	48	52
Forest village totals	124.05	55.57	45	55
Opiktheri 132	59.25	53.50	90	10
Opiktheri 135	28.50	27.50	96	4
Highway village totals	87.75	81.00	92	18
Village	12c: Edible plants		% Kept	% Exchanged
	Kg Fruit	Kg Kept		
Uxiutheri	173.0	46.0	26	74
Iropitheri	246.0	89.5	36	64
Maxikopitheri	61.5	27.75	45	55
Forest village totals	480.5	163.25	34	66
Opiktheri 132	168	77.5	46	54
Opiktheri 135	24.5	21.5	88	12
Highway village totals	192	99.0	51	49

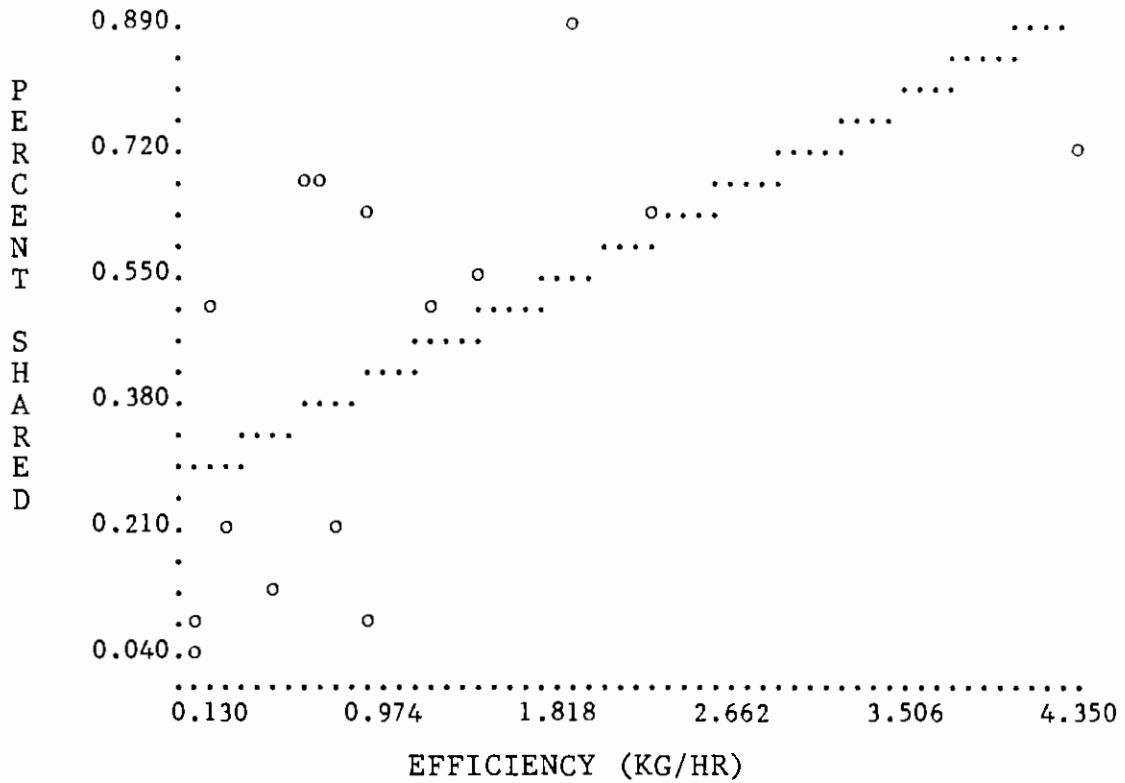
Note: data on exchange was collected at the same time data on hunting, fishing, and gathering was collected.

Lack of reciprocity among highway villagers, as seen in their low levels of sharing, is real, but cannot be simply attributed to diffusion of Brazilian ideals of nuclear family self-sufficiency and autonomy. Among the Yanomama closeness in the degree of relatedness or kinship and marital ties dispose individuals to behave altruistically toward one another. (Furthermore, closeness in the degree of kinship is the chief determinant of cooperation and reciprocity among tribal peoples {Sahlins 1968; Alexander 1974}). Conceivably, differences in sharing patterns found in forest and highway villages could be accounted for by differences in degrees of relatedness. If this were true then we would predict that highway villagers have weaker kin ties than forest villagers since low degrees of relatedness would be consistent with infrequent sharing and high degrees of relatedness would be consistent with frequent sharing. An inspection of genealogies and of preliminary computer analysis of relatedness in all villages reveals that differences are small with highway villagers being slightly more related among themselves than forest villagers, just the opposite of what would be predicted on the basis of the sharing data.

As Figure 2 demonstrates, the propensity to share seems to be determined by the efficiency of hunting, gathering, or fishing. Forest villagers gain wild resources more efficiently than highway villagers and they also give a much larger proportion of what they gain to others outside of their nuclear family compared to highway villagers. In modern economic terms the cost of gaining resources (measured in kilograms of produce per hour of labor) is lower for forest villagers but higher for highway villagers and, as a result, the wild goods produced are more costly or valuable for highway villagers than for forest villagers. It is tempting to suggest resource accrual efficiency and sharing are causally related since the correlation coefficient (Pearson's product-moment) is $r = 0.588$ ($p < 0.05$) which means that more than one-third of the variance in sharing is due to the variance in resource accrual efficiency. If this were the case then variation in sharing may be a normal Yanomama response to resource accrual efficiency and is, therefore, only indirectly related to Brazilian-caused environmental disruption.

Regardless of the cause of low degrees of reciprocity in highway villages, the important point in this analysis of sharing is that one of the most important modes of achieving social solidarity, sharing, is disappearing in highway villages. Individuals and families no longer depend upon one another for some of the most basic necessities of life. They now look outward toward farm owners and merchants for many of their needs, establish narrow economic alliances with them, and are on their way to becoming fully integrated into a market economy which has values foreign to Yanomama culture. If this process is related to living in a degraded environment and the presence of Brazilian settlers, we predict it will grow to even greater levels. Soon highway villages will begin to disintegrate with individual nuclear families establishing independent and autonomous homesteads and some will move more or less permanently to Brazilian areas. With the control of inter-village raiding and the disappearance of reciprocity, highway Yanomama no longer have a need to live in their own villages.

FIGURE II



CONCLUSION

An old man from the Wakathautheri village (see Map 2) recounted this myth about the creation of the Yanomama and the Nap (foreigners) with the foam from a rapid on the heights of Parima Mountain. Then the flood dispersed the Yanomama and the foreigners. The Yanomama settled near the streams around the Parima Mountain, but the foreigners went far away, down river. Now they are coming back, carrying a lot of goods. The foreigners have built a large path (the highway) in order to barter more goods with the Yanomama.

This myth suggests that the Yanomama are eager to contact the Brazilians, but fail to foresee the consequences of this contact, nor are they concerned about it. They want to meet Brazilians, barter with them, and take full advantage of these new neighbors.

The Yanomama of highway villages have been inhabiting the edge of the Perimetral Norte for only four years. Yet in this short span of time they have come to differ immensely from the forest villagers who have not yet

decided to maintain intensive contact with Brazilians. Highway villagers interact with Brazilians by working in their fields for low wages and cast-off manufactures. They do this by choice, not by force. Forest villagers are eager to acquire Western manufactures also, but for the moment, they feel the price of sustained contact not worth the benefit of material goods.

It is easy to understand why both highway and forest villagers choose to maintain some contact between themselves and Brazilians. Western goods such as steel tools, shotguns, and aluminum pots make subsistence tasks more efficient, secure, less arduous, and increase time available for non-subsistence activities. However, it is difficult to understand why highway villagers apparently desire to have more contact with Brazilians than forest villagers. Forest villagers are able to gain the same basic productive goods as highway villagers and at the same time avoid intensive and extensive contact with Brazilians. Highway villagers now have needs for clothing, cooking oil, shoes, etc. which they did not need just six years earlier. In order to fulfill these new needs they choose to live in a degraded environment where traditional economic tasks have become more time consuming. In pursuit of these new needs they have allowed their labor to be purchased by Brazilians, thereby entering into a new economic relationship. Many of these new material needs have been stimulated by a desire to adapt Brazilian standards of dress, decorum, and symbols of affluence. As a result, they deny their ethnic identity by not reciting myths, using kinship terms, or participating in inter-village feasting. Being a Yanomama is seen as an impediment to assimilation. The Yanomama view Brazilians as powerful individuals who have an inexhaustible supply of wonderful material objects. They wish to acquire these same things in the belief that by having them they too will become powerful. They are dazzled by what they see and know about Brazilians.

It is possible that the Yanomama would resist Brazilian invasion of their land if they knew what their eventual status in Brazilian society would be, what the realities of Brazilian peasant life are, and that assimilation could mean the loss of economic and political autonomy. Brazilian economic expansion into Yanomama territory is facilitated by Yanomama desire for goods and their ignorance of a capitalist economic system. Darcy Ribeiro (1977:340-341) concludes on the basis of his extensive and long-term studies of the consequences of Brazilian and Indian contact that:

What is fundamental, therefore, is not the backwardness of the Indian in the face of the progress of the white, that is, the objective disparity in the equipment of civilization, but the opportunities which the national economic system presents for him to participate in the benefits of civilization. To understand the destiny of the groups affected by the expansion of Brazilian society, what is important is not the difference of technological level but the system of stratification into which they will be drawn. The transition from a tribal to the national economy takes cooperative life of the village, entirely directed towards ensuring the survival of the group, to a market economy aimed at making profits in function of other people's needs and using the labor force that it is possible to attract. This

amounts not only to the lessening of tribal unity, the enrollment of its members in the mass of dependents on a business firm, but also to its consumption as human fuel, as it were, in the business machine.

The attitudes that Brazilian settlers and the Brazilian government have towards the Yanomama are largely negative. Government apologist Danton Jobim tries to whitewash such attitudes by assuring us that:

No one hates the Indian because he is an Indian. The antagonism arises at the moment when the two cultural frontiers meet, between mentalities which clash with one another, because they cherish entirely different scales of values, seeing the world from different angles, which means that the white pioneer sees in the Indian a stranger, an inferior being, at most a big unruly child with bad habits who can become aggressive and dangerous. (Jobim 1970:8)

On the other hand, Roque Barros Laraia and Roberto da Matta in their intensive study of the relationship between Brazilian-run cattle and nut industries and Indians paint a truer picture of the general sentiments Brazilians have for Indians:

For the members of the great society the Indians must be "exterminated because they are savages". Frequently this is masked in another form: "The Indian must be civilized;" that is, they will lose the control of their land, they will be collected into a feudal estate where their existence as a people will become impossible. For the regional society, the pacification must be carried out in a way that turns the aborigines into marginal elements because they presuppose their transformation into cheap labour is impossible. (Laraia and da Matta 1967:67)

The Yanomama of the highway will become caboclos. In the Brazilian Amazon caboclo is a term dating from colonial times and was once used to designate the offspring of a European man with an Indian woman. Presently it identifies a person of the lowest social status and of apparent Indian physical characteristics who speaks a strange language at home and a broken Portuguese with Brazilians. In the past the term índio acquired a negative connotation among the Brazilians. Most of the time índio meant índio brabo, a savage, therefore from the Indian point of view being called caboclo by the Brazilians was a good way to raise their social status. But Wagley points out:

People of American Indian descent, unlike those of Negroid descent, do not like to be reminded of their Indian ancestry. ...In the Amazon the Indian, even more often than the Negro, was the slave in colonial society. In the opinion of the European, the Indian was a nude barbarian and of less prestige than the more expensive African slave. Today, Indian physical characteristics are therefore a symbol not only of slave ancestry but also of a social origin in colonial times lower than the Negro's. At the present, most of the stereotypes associated with the caboclo....are derogatory. The caboclo is

considered lazy....The caboclo is thought to be timid because he lives isolated in the forest....The caboclo is thought to be tricky and exceedingly suspicious (1978:141).

Brazilians believe that caboclo feasts often turn into farras (orgies) with drunkenness and numerous fights. The caboclo--like the Indian in general--is an obstacle to progress. Therefore, he must become civilizado (civilized) and acculturado (acculturated). It means he must behave like a Brazilian. Government officials, FUNAI agents, and missionaries no longer use the term caboclo, but the settlers who live in the Amazon still use it and the negative connotations will last for many years.

The relationship the Yanomama have to their environment is being reordered as a result of increasing contact with Brazilians. White introduced diseases have decimated several villages and are likely to recur. The quality of the diet has measurably declined and labor time for traditional subsistence tasks has increased. Both of these changes result from living in an environment partially degraded by road building activities and increased sedentism on the part of the Yanomama who wish to maintain proximity to Brazilians. These consequences are not unique; they have been repeated numerous times throughout the Amazon where native peoples have been met by the advancing frontier. For example, a team of researchers led by D. Gross who studied four different central Amazonian native peoples (Kayapo, Mekranoti, Xavante, and Bororo) concluded that:

...in Amazonia, native groups undergo circumscription and become sedentary as national frontiers encroach on their lands. This causes intensified use of local resources. A degraded habitat results in lower yield per unit area and per unit labor. Under these conditions, people turn to new techniques, tools, and activities to meet subsistence needs....with low yields people must work more to meet their food needs. (Gross et al. 1979:1043).

The introduction of trade goods, wage labor, and increasing environmental degradation has had numerous social effects on the Yanomama. Traditional patterns of sharing natural resources gained through hunting, fishing, and gathering is diminishing and economic integration at the level of the village and extended family is being replaced by integration at the level of the nuclear family with strong ties to a market economy. The status system which is traditionally based on age and sex differences and expertise in Yanomama culture is becoming based on differential material wealth and the ability to conform to Brazilian cultural standards.

Some Policy Recommendations

Most of the dramatic changes in Yanomama life have been a result of attempting to acquire Western goods. Many of the results, such as decimation by infectious disease and increased labor time, have not been desired. They are part of the costs of gaining the benefits of trade goods. The entrance of Brazilians into the peripheries of the Yanomama tribal distribution is the initial cause of these changes. Nevertheless, with the exception of the missionaries in the area, government officials, FUNAI agents, and settlers have done little to mitigate the harmful effects of contact. FUNAI agents

who are responsible for assuring the welfare of native peoples in Brazil by protecting them from land invasion and the devastation of disease, with few exceptions, have never done this job adequately (Davis 1977) and their current performance among the Yanomama is consistent with their poor record elsewhere.

Prior to contact with the Western world the Yanomama, throughout their tribal distribution in Venezuela and Brazil, were a healthy and robust people as a result of their superb adaptation to the tropical forest ecosystem. Their numbers were increasing at a rate of about 1% per annum (Chagnon 1974). Where they have had sustained contact with whites their rate of growth not only declined but in some instances depopulation is occurring (Lizot 1976). Increased contact in the coming years will lead to further depopulation unless steps are taken by the government. Although the Brazilian government does not have an official policy of genocide, government inaction in not restricting the spread of epidemics or not providing medical aid will have genocidal results. The fine line between governmental intent and governmental inaction means nothing to a dying people.

Whether the Yanomama wish to maintain their traditional way of life or become caboclos and enter the mainstream of Brazilian peasant life should be left up to them. The only way in which both options will remain available is for them to be able to maintain rights to their ancestral land. And traditional Yanomama life derives from the exploitation of large tracts of land.

Although the long-awaited decree of a Yanomama park has been postponed many times, on March 9, 1982 the Brazilian Minister of the Interior signed a decree of interdiction of an area of 29,700 square miles (7.7 million hectares) for the protection of the Yanomama. In its Spring 1982 bulletin SIUSA (Survival International USA)

welcomed the news and hoped it indicates the government's intention to complete the process by following through with a declaration of the still so necessary park....Since the outbreak of a serious double epidemic of measles and whooping cough among the Yanomama in mid-1981,...events have confirmed the urgent need for the protection and health care which only the creation of a Yanomama Park would make possible...The area recently interdicted is an uninterrupted, continuous area between the Venezuelan border and the BR-210 (Perimetral Norte) highway. The area is larger than that proposed by the Committee for the Creation of the Yanomama Park (CCPY) in 1979 but smaller than FUNAI's own 1980 revision of this proposal. Some 17 villages will be outside the area, to the east and south.

Five of these villages are Opiktheri 132 and 135, Wakathautheri, Wapakohipiutheri, and Awarihipitheri which are located in the southern area of the Perimetral Norte highway. They number about 200 Indians (2/3 of the total Catrimani Yanomama). FUNAI agents are asking these Indians to move north of the highway where land has been reserved for them. However, it seems unlikely that Opiktheri 132 and 135 and Wakathautheri will move away from the highway anytime in the future, because it will prevent easy access

to Brazilians.

To solve this problem the Brazilian government and FUNAI could simply increase the size of the interdicted area to encompass those villages unwilling to relocate. However, SIUSA (1982) points out that the recent history of land interdiction in Brazil shows that

an interdicted area can never be as secure from invasion and take-over as a legally and permanently decreed, physically demarcated and appropriately protected Indian Park. The land interdicted, therefore, will unfortunately remain under threat of invasion and partial expropriation. This almost certainly will be a problem along most of the eastern boundary of the area, where two large agricultural development and colonization projects are already underway...While interdiction is thus an important step in the right direction, by itself it is not enough...The Brazilian Government must still establish the Yanomama Park to guarantee the land base of the Yanomama people and to protect their health and future prosperity.

If the planned Yanomama Park is to succeed then the government must foster increased research on Yanomama ecology, economics, and social organization and insure that adequately trained and equipped professional staff maintains the integrity of the Park. Thus far the government has apparently ignored the numerous studies of Yanomama ecology (e.g., Chagnon 1973; Weiss and Neel 1978; Smole 1976; Lizot 1977, 1979; Hames 1980) in policy formulation. Anthropologists who understand Yanomama culture could be crucially valuable in the training of FUNAI staff, yet they have not been employed in this capacity (e.g., ARC/IWGIA/SI 1979). If the Yanomama are to survive then the government must work with anthropologists, other professionals, and the Yanomama to design a reservation which is viable.

BIBLIOGRAPHY

Alexander, R.

1974 The evolution of social behavior. Annual Review of Ecology and Systematics, 5:325-338.

American Anthropological Association

1981 AAA endorses communication to Inter-American Commission. Anthropology Newsletter, 22(2):1, 10.

Anthropology Resource Center

1980 Status of the Yanomami Park Proposal. ARC Bulletin 2:5.

1981a The Yanomami Park: the next Carajás?. ARC Bulletin 6:5-8.

Anthropology Resource Center (cont.)

1981b Massive gold rush in Yanomami territory. ARC Bulletin 4:3-4.

1981c The Yanomami Indian Park: A Call for Action. Special Publication of ARC.

ARC/IWGI/SI

1979 The Yanomamo in Brazil 1979. ARC/IWGIA/SI Document 37: Copenhagen.

Barker, J.

1953 Memoria sobre la cultura de los Guaika. Boletin Indigenista Venezolana 1(3-4):433-489.

Chagnon, N.

1968 Yanomamo: The Fierce People. Holt, Rinehart, and Winston. New York.

1973 The culture-ecology of shifting (pioneering) cultivation among the Yanomamo Indians. In Gross, D. (ed.) Peoples and Cultures of Native South America, Doubleday/The Natural History Press, Garden City, pp. 126-143.

1974 Studying the Yanomamo, Holt, Rinehart, and Winston, New York.

1977 Yanomamo: The Fierce People. 2nd ed., rev. New York: Holt, Rinehart and Winston.

1979 Is reproductive success equal in egalitarian societies? In Chagnon, N. and W. Irons (eds.) Evolutionary Biology and Human Social Behavior: An Anthropological Perspective. Duxbury Press: North Scituate, MA.

Chagnon, N. and R. Hames

1979 Protein deficiency and tribal warfare in Amazonia: new data. Science, 203:910-913.

Chagnon, N., J. Neel, L. Weitkamp, H. Gershowitz, and M. Ayres.

1970 The influence of cultural factors on the demography and pattern of gene flow from the Makiritare to Yanomamo Indians. American Journal of Physical Anthropology 32:339-349.

Cultural Survival

1981 Vaccination project for the Yanomami. Cultural Survival Newsletter 5(1):4.

Davis, S.

- 1977 Victims of the Miracle. New York: Cambridge University Press.

Gross, D.

- 1975 Protein capture and cultural development in the Amazon. American Anthropologist, 77(3):526-549.

Gross, D., G. Eiten, N. Flowers, F. Leoi, M. Ritter, and D. Werner

- 1979 Ecology and acculturation among native peoples of Central Brazil. Science, 206:1043-1050.

Hames, R.

- 1979 A comparison of the efficiencies of the shotgun and the bow in neotropical forest hunting. Human Ecology, 7(3):219-252.

- 1980 Game depletion and hunting zone rotation among the Ye'kwana and Yanomamo of Amazonas, Venezuela. Working Papers on South American Indians, 2:31-66. R. Hames, ed. Bennington College: Bennington, VT.

Hames, R. and I. Hames

- 1976 Ye'kwana basketry: Its cultural context. Antropologica, 44:3-58

Jobim, D.

- 1970 O problema do Índio e a acusação de genocídio. Ministerio da Justiça, Conselho de Defesa dos Direitos da Pessoa Humana. Boletim No. 2. Brasília.

Kiltie, R.

- 1979 More on Amazonian cultural ecology. Current Anthropology 21(4):541-544.

Laraia, R. and R. da Matta

- 1967 Índios e Castanheiros, a Empresa Extrativa e os Índios no Médio Tocantins. São Paulo: Difusora Européia do Livro.

Lhermillier, A. and N. Lhermillier.

- 1974 La Vie Economique et Sociale d'une Unité Familiale Yanomami. Thesis: L'Ecole Pratique des Hautes Etudes, Paris.

Lizot, J.

- 1971 "Aspects économique et sociaux du changement culturel chez les Yanomami". L'Homme, 11:(1)32-51.

Lizot, J. (cont.)

- 1971 Société ou économie? Quelques thèmes à propos d'une communauté de
Amerindiens. Journal de Société des Americanistes, 60:136-175.
- 1974 Contribution à l'étude de la technologie Yanomami. Antropologica
38:15-33.
- 1975 El hombre de la Pantorilla Prenada y Otros Mitos Yanomami.
Caracas, Fundación La Salle de Ciencias Naturales.
- 1976 The Yanomami in the face of ethnocide. IWGIA Document No. 22
Copenhagen: International Work Group for Indigenous Affairs.
- 1977 Population, resources, et guerre chez les Yanomami. Libre,
1977(2):111-145.

Migliazza, E.

- 1972 Yanomama Grammar and Intelligibility. Ph.D. Dissertation. Indiana
University, Bloomington.

Neel, J., W. Centerwall, N. Chagnon, and H. Casey

- 1978 Notes on the effect of measles and measles vaccine on a
virgin-soil population of South American Indians. American
Journal of Epidemiology 91:418-429.

Neel, J. and K. Weiss

- 1978 The genetic structure of a tribal population, the Yanomama
Indians, XII Biodemographic Studies. American Journal of Physical
Anthropology 42:25-52.

Peters, J.

- 1973 The effects of Western material goods on the social structure of
the family among the Shiriana. Ph.D. Thesis, Michigan University.

Polanyi, K.

- 1957 The economy as an instituted process. In K. Polanyi, C.
Arensberg, and N. Pearson, eds., Trade and Market in Early
Empires. Glencoe, IL: The Free Press.

Ramos, A.

- 1972 The social system of the Sanumá of northern Brazil. Ph.D.
Dissertation. Wisconsin.
- 1974 How the Sanumá acquire their names. Ethnology 8(2):171-185.
- 1978 El Indio y los otros: la visión multiétnica de un indio maiongong.
América Indígena 37(1):89-112.

Ramos, A. (cont.)

- 1979 On women's status in Yanomama societies. Current Anthropology 20(1):187-188.

Ramos, A. and K. Taylor

- 1979 The Yanoama in Brazil 1979. IWGIA Document No. 37. ARC/IWGIA/SI: Copenhagen.

Ribeiro, D.

- 1977 Os Indios e a Civilização. A Intergração das Populações Indígenas no Brasil Moderno. Petropolis: Editora Vozes Ltda.

Sahlins, M.

- 1968 On the sociology of primitive exchange. In The Relevance of Models for Social Anthropology. M. Blanton, ed. London: Tavistock pp. 139-236.

Salisbury, R.

- 1962 From Stone to Steel. Cambridge University Press: Cambridge.

Schuster, M. and O. Zerries

- 1969 Mahekodotedi. Monographie eines Dorfes der Waika-Indianer (Yanomama) am oberen Orinoco, Venezuela. Ergebnisse der Frobenius-Expedition 1954/55 nach Sudost-Venezuela, Bd. II. Muenchen.

Shapiro, Judith

- 1971 Sex roles and social structure among the Yanomamo Indians in north Brazil. Ph.D. Dissertation, Columbia, University.

Sharp, L.

- 1969 Steel axes for stone age aborigines. In T. Harding, ed., Peoples and Cultures of the Pacific. Glencoe, IL: The Free Press.

Smith, N.

- 1976 Utilization of game along Brazil's Transamazon Highway. Acta Amazônica 6(4):455-466.

Smole, W.

- 1976 The Yanomama Indians: A cultural geography. University of Texas Press: Austin.

Survival International USA

1981 Yanomami rights still violated. SIUSA News 1(3):4, 6.

1982 Brazil takes first step to create Yanomami Park. SIUSA News 2(1):1-2.

Taylor, K.

1976 Sanumá Fauna: Prohibitions and Classifications. Fundación La Salle de Ciencias Naturales, Instituto Caribe de Antropología y Sociología, Monografía No. 18.

Vickers, W.T.

1980 An analysis of Amazonian hunting yields as a function of settlement age. Working Papers on South American Indians 2:8-29. R. Hames, ed. Bennington College: Bennington, VT.

Wagley, C.

1978 Amazon Town: A Study of Man in the Tropics. New York: Oxford University Press.

Zerries, O.

1964 Waika: Die Kulturgeschichtliche Stellung der Waika-Indianer des Oberen Orinoco in Rahmen der Volkerkunde Sudamerikas. Munich: Klaus Renner Verlag.

EPIDEMICS IN A TRIBAL POPULATION

by

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INTRODUCTION

Historically, depopulation and impaired reproduction are known to have been an all too predictable consequence of initial contacts between native and colonial populations the world over. For example, smallpox decimated the native populations of the Northwest Coast of North America (Codere 1951); syphilis, gonorrhea, measles throughout the Pacific Islands (Oliver 1961); syphilis and gonorrhea among the Bushmen of southern Africa (Howell 1979); measles and smallpox in many Amazon Basin tribes (Cardoso de Oliveira, 1964; Ribeiro 1970; Laraia, and da Matta 1967; Nimuendajú 1939; 1946). All of these diseases, and others, have probably reduced most of the North American native populations to between one-tenth and one twenty-fifth of their former numbers (Dobyns 1966, Driver 1969).

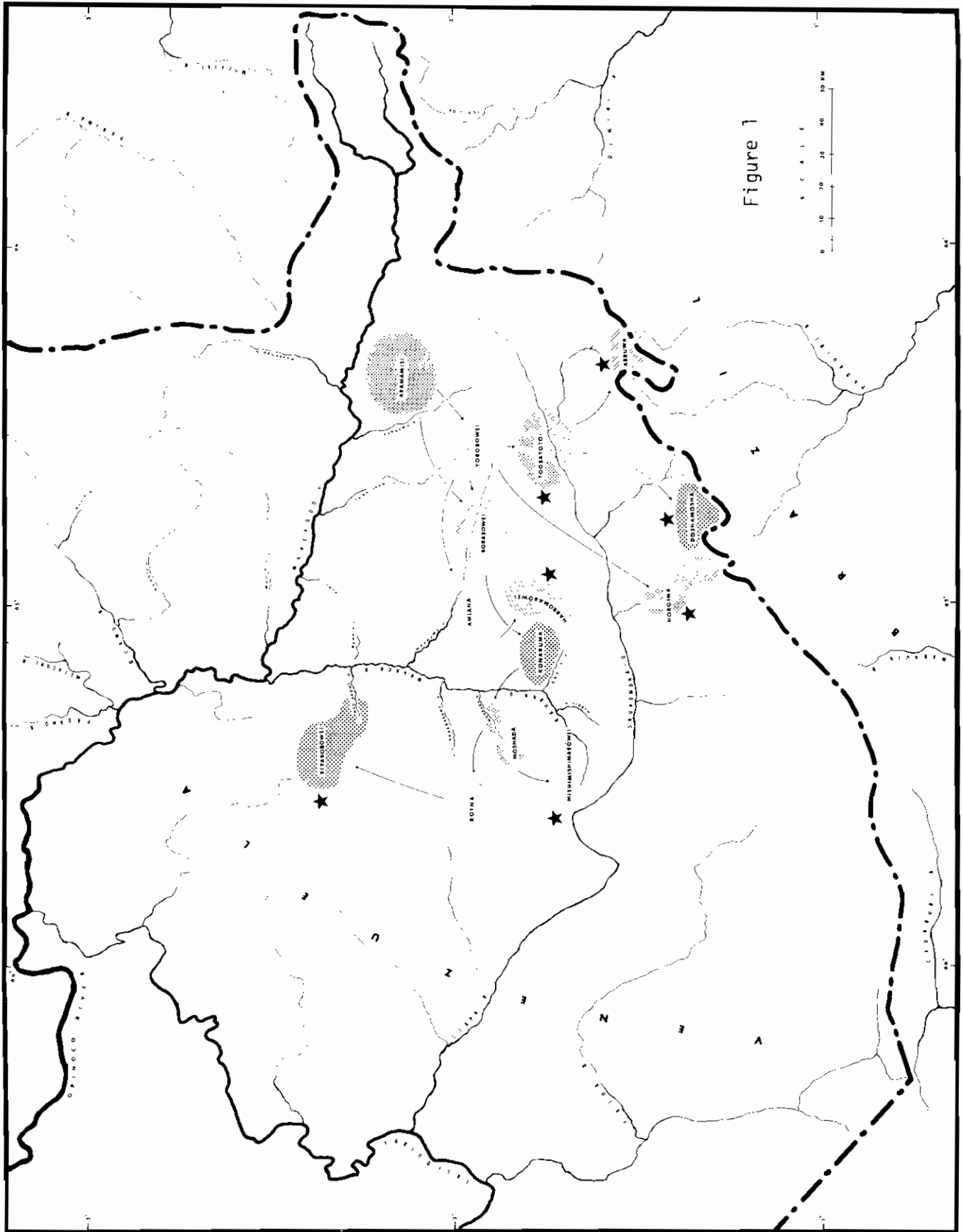
It appears that the Yanomamo Indians of southern Venezuela and northern Brazil, one of the largest remaining relatively-unacculturated tribal populations in the world, will be no exception to this historical process. Not much is directly known about the early health history of the Yanomamo, but since the late 1950s and early 1960s, different regions of the tribe have suffered from a variety of exogenously introduced diseases, some of which have reached epidemic proportions. *Falciparum* malaria began taking a heavy toll in some parts of the tribe in late 1950 and early 1960, measles struck the population in the Upper Orinoco Basin and adjacent portions of Brazil in the late 1960s (Neel et al. 1970) and more recently, upper respiratory infections and influenza-like infections have sporadically afflicted a number of different villages throughout the tribal distribution. In this paper we will examine the immediate loss and potential long-term reproductive consequences of an influenza-like disease that struck three villages of Yanomamo in epidemic proportions in 1973.

The depopulation associated with epidemics among native peoples can have far-reaching consequences. It affects the genetic composition of the small residential communities (bands, villages), the internal social organization of the communities, political relationships between communities, marriage alliance patterns, ceremonial activities and native patterns of land use. In many respects, the very structure and integration of tribal society is tied closely to the numbers of individuals in local groups and the distribution of those groups across the surface of the landscape. The effects of an epidemic on such groups is, therefore, dramatically different from the effects of an epidemic on a population such as our own: the structure and integration of our society is not usually eradicated by epidemics. Among most tribesmen, regional settlement distributions are dramatically altered when whole villages are destroyed or become too small to remain viable; independent units. The shattered villages are then forced to disband, disperse and join with other splinter groups to form new, composite villages. These effects are often ignored or glossed over in ethnographic accounts, although at least one authority has attempted to re-examine the entirety of human social evolution, taking depopulation and contact with colonial societies into consideration (Service 1971). As this process begins among the Yanomamo, we are fortunate to have a reasonably complete picture of the pre-epidemic social and demographic characteristics of the tribe (Chagnon 1968a, 1974; MacCluer, Neel and Chagnon 1971; Neel and Weiss 1975; Melancon 1981) and are in a position to attempt to assess the impact of epidemics on this society and, hopefully, contribute to the development of policies that will prevent catastrophes of the sort that have been inflicted on native populations elsewhere in the world.

ETHNOGRAPHIC BACKGROUND

The Yanomamo Indians currently number approximately 12,000 people. Their villages are scattered thinly in the low-lying tropical forest of Amazonian Venezuela and the adjacent portions of northern Brazil (Figure 1). Villages range in size from a minimum of approximately 40 people to a maximum of 300 individuals. There is no over-arching political organization linking the approximately 150 extant Yanomamo villages: each is politically sovereign and acts as an independent entity. In parts of the tribe, inter-village warfare is chronic and as much as 30 percent of adult male mortality can be attributed to interpersonal violence (Chagnon 1975). In other regions of the tribe, warfare occurs sporadically and the political life of members of these villages is relatively tranquil. Distances between villages in the region of more chronic warfare ranges from about a day's walk between non-belligerent villages to as many as three or four days' walk between villages that are actively hostile to each other. In the more tranquil areas, villages may be located a few hours' walk from each other or, during the process of fissioning, sometimes just a few hundred feet. Data presented in this paper is drawn from the area of the tribe where warfare is relatively intense and chronic--the southwestern region of the tribal distribution.

Over the last 125 to 150 years the Yanomamo population has been growing at a moderate rate and expanding in all directions (Figure 2) away from the



Sierra Parima, a chain of low-lying mountains forming the central backbone of the tribal distribution (Chagnon 1968c). Around the tribal periphery, the Yanomamo are expanding into an uninhabited area of the tropical forest through a process of village growth, fission, and migration (Chagnon, 1968b, 1968c, 1974; *infra.*). This process can only be documented through the statements of informants concerning their political history, warfare and fissioning, as well as genealogical information that reveals the common origins of congeries of villages forming population blocs that are historically descended from the same parent group and whose members are genealogically related to many of the residents in neighboring groups (Chagnon 1974). As villages grow, they ordinarily subdivide or fission once they attain a size of 100 to 150 individuals, their ability or freedom to do so being a function of the immediate military conditions. Active hostilities with neighbors inhibits fissioning, since two smaller villages are more vulnerable to the raids of enemies (Chagnon 1968a). When this occurs, villages may grow to a size of 300 individuals, and in rare cases, to as many as 400. Once a fission occurs, the newly formed groups set off on a politically independent course and gradually move further and further apart, continuing to grow in size and, ultimately, fissioning again and again. Figure 3 schematically summarizes the fissions and historical interrelationships for two population blocs that were the focus of the senior author's field research between 1964 and 1975, during which he spent approximately 40 months in residence with the Yanomamo in this area. Figure 4 shows the spatial or geographical aspect of the political history of Population 1 in Figure 3 through 1972, indicating the process of fissioning and westerly expansion of villages in this area of the tribe (see Chagnon 1968c, 1974).

In 1964, when the senior author began field research in the tribe, many Yanomamo villages had not yet been contacted by the outside world. Foreexample, most of the villages in Population 1 of Figure 3 had never seen an outsider until the senior author located their villages and made friendly first contact with them (Chagnon 1974). Similarly, many Yanomamo villages elsewhere in the tribe had not as yet been located or contacted by outsiders, a situation that is changing rapidly at the present time. Still, even the most remote villages have felt the influence of the outside world to some extent. Through complex native trading patterns, for example, such items as battered or broken machetes, worn axes and a smattering of trinkets such as tiny glass beads have filtered into the most remote villages. When members of Village 16 (shown in Figure 3) were first contacted (Chagnon 1974), one of the young men in the village was even wearing a tattered pair of jockey underpants or, rather, the tattered remains of a pair of jockeys that had managed to find their way into the village via a trade network involving three intermediate Yanomamo villages. The point is that despite the fact that some villages are isolated and have never experienced direct contact, indirect links to the outside world have existed for some time.

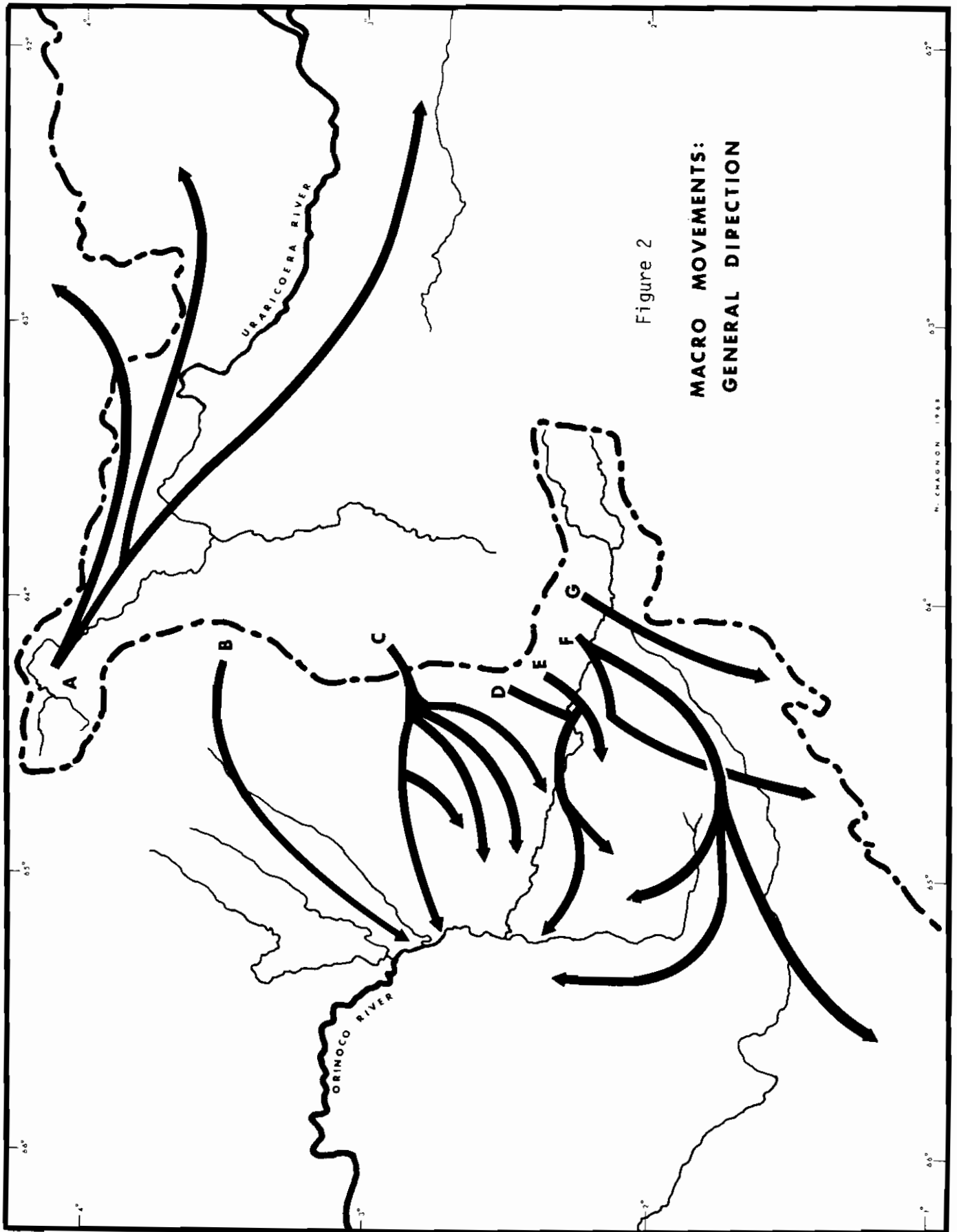
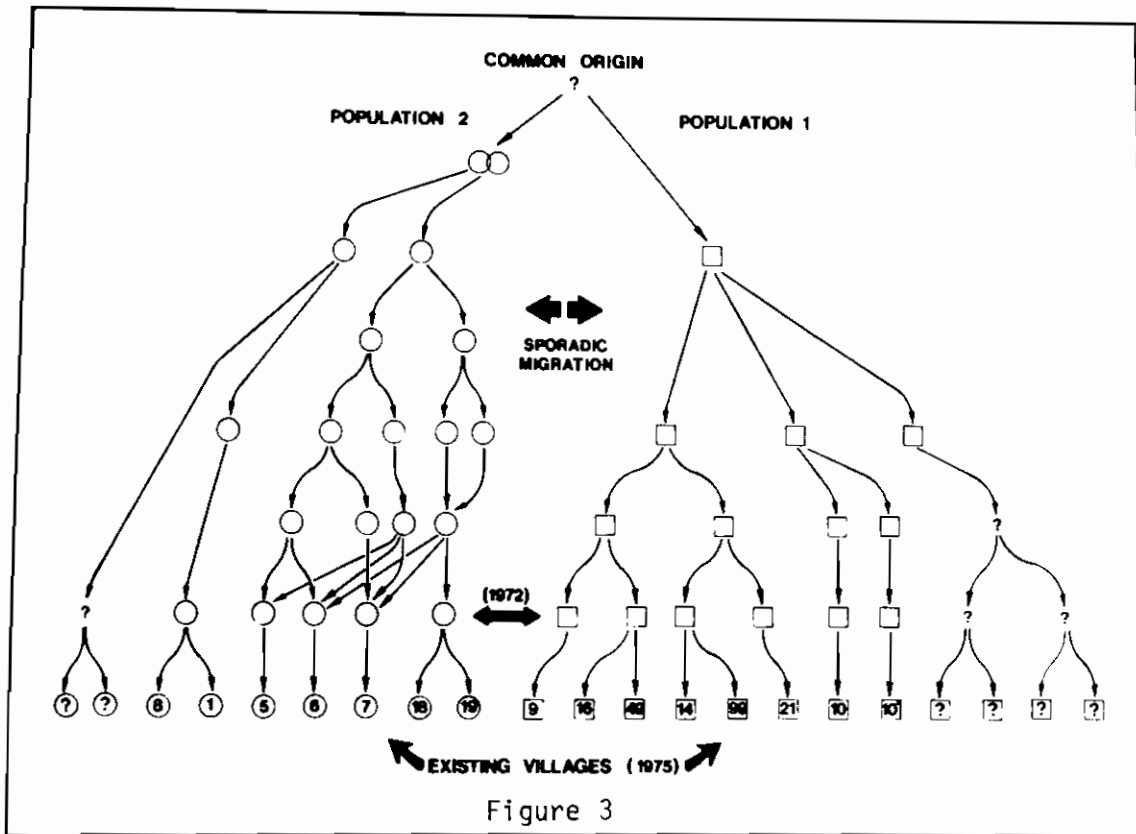


Figure 2
MACRO MOVEMENTS:
GENERAL DIPECTION



THE 1973 EPIDEMIC

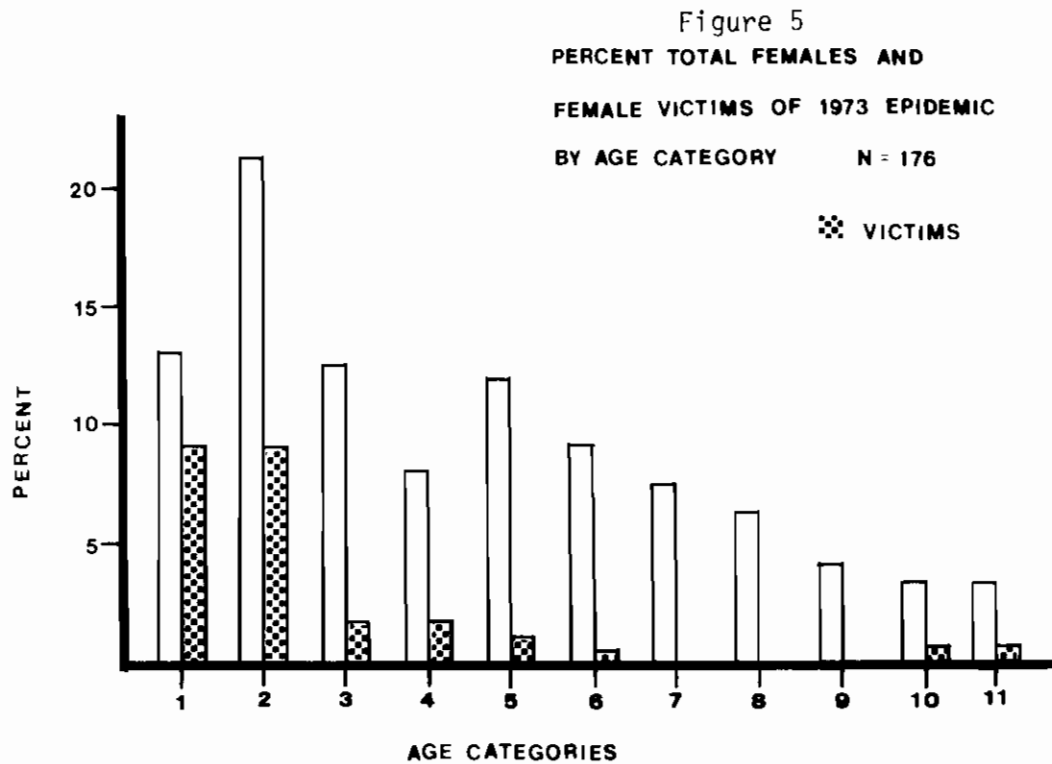
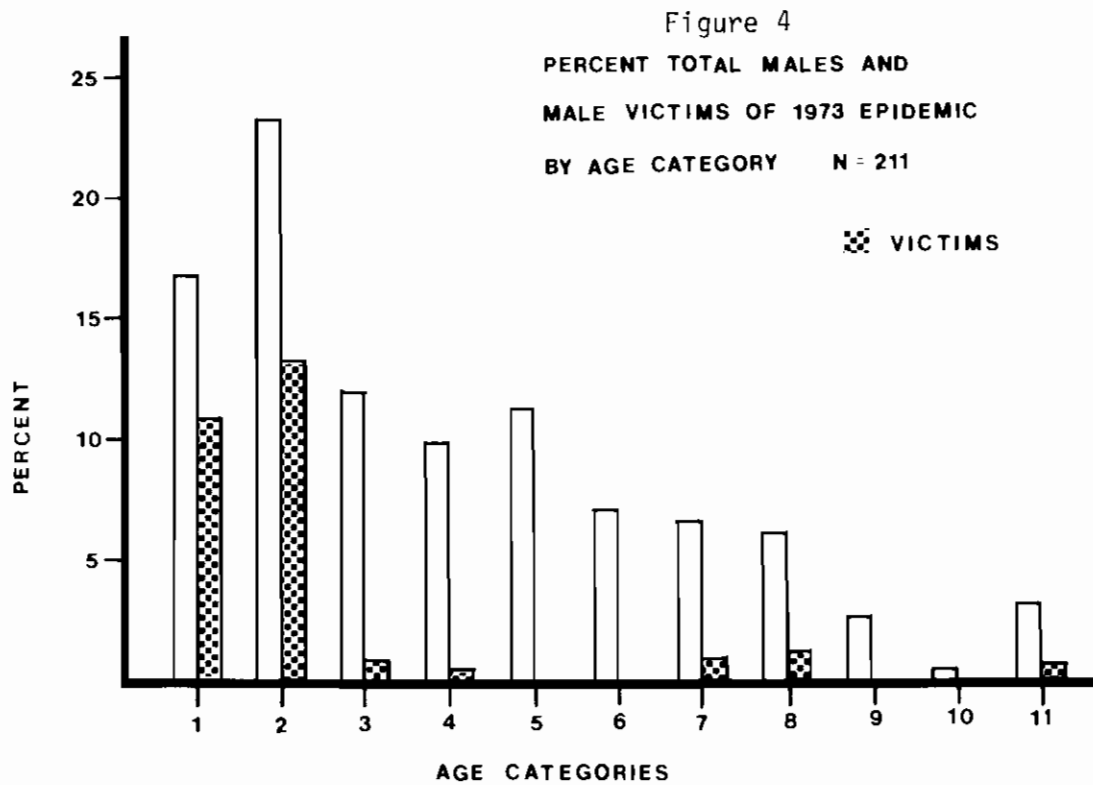
The 1973 epidemic on which we now report was the result of an upper respiratory infection which we believe was produced by some form of influenza that afflicted three remote villages in the region of the Upper Mavaca River. No Europeans were present in the villages when the epidemic struck. The description given by informants in their language was that the sickness was shawara, a term they use to describe what happens when many people die at the same time. They were, however, able to describe the symptoms which included fever, diarrhea, and chronic coughing. A Salesian Mission downstream some 10 days' walk from the villages had a resident Sister who was a trained nurse. She confirmed the fact that a serious gripe (flu) problem had developed during the year and that many of the local Indians around the mission had contracted it. Presumably, visiting Yanomamo from that area communicated the sickness to the Upper Mavaca River villages (see below for more discussion of contact).

The villages located in the Upper Mavaca River had been the focus of the senior author's field research between 1968 and 1972. Villages in this area had never before been contacted by Europeans until the senior author's contact with them in 1968 (Chagnon 1974). Part of the aversion to this area by both the Yanomamo and Europeans was due to the remoteness of the villages and to the reputation that these particular Yanomamo had for hostility and treachery (Chagnon 1968a, 1974). Between 1968 and 1972 the political history of the villages in the area, as well as genealogies and individual reproductive histories, were collected by the senior author (Chagnon 1974). He did not return to the field in 1973, but did so in late 1974, at which point he learned that the largest village in the region (shown on Figure 3 as "Village 16") had fissioned into three distinct villages (shown on Figure 3 as "Villages 16, 09 and 49") and had suffered a recent epidemic. The extent of the mortality during the intervening period could be precisely determined, since individual identification photographs of all village residents had been taken in 1972. When previous residents were found to be absent in 1974, informants were questioned about what had happened to them, and, if they had died, a native diagnosis of the cause of death was obtained in each case.

ANALYSIS OF THE EPIDEMIC

Loss to the Population

The epidemic took a heavy toll in the three villages it afflicted. A total of 106 people died, 63 males and 43 females, which comprised 27.4 percent of the total pre-epidemic population in the three villages. Not only was the level of mortality high, it also had a distinct "U"-shaped age pattern with the young and aged suffering the heaviest losses. The effect of the epidemic on the age distribution of males is shown in Figure 4 and on that of females in Figure 5. The solid bars in the figures show the percent of each sex in each age class just prior to the epidemic while the hachured bars show the percent of each age class that was eliminated by the epidemic.



In all, 83 children died who were less than 10 years of age, which represented 57 percent of all children in this age interval at the time, and 78 percent of all deaths attributed to the disease. The number of deaths that occurred at older ages was much smaller, as was the number of individuals at risk of death prior to the epidemic. As a result, although only 6 individuals died who were 45 years of age or older, they comprised a relatively large fraction, 28 percent, of the population in this oldest age interval. The extent to which the behavioral response of the Yanomamo to the disease may have effected both the level and age pattern of epidemic mortality will be considered later in the paper.

A population suffers not only an immediate loss in an epidemic from the death of individuals, but also sustains a long-term loss measurable in terms of the reproductive potential of those members. In order to assess the loss of future reproduction in the villages afflicted by the epidemic, we have calculated the number of births that the female epidemic victims could have expected to achieve over the remainder of their lives had they survived, given the normal regimes of mortality and fertility characteristic of the Yanomamo.

In a finite population partitioned into 5-year age intervals with unchanging age schedules of mortality and fertility, the number of same-sex births that an average female at the exact age x can expect to produce over the remainder of her life can be found from the expression:

$$V'_x = \sum_{y=x}^{\alpha} L_y / l_x f_y \quad (1)$$

where l_x is the probability that a female will survive from birth to the exact age x , L_y is the number of years that a female at birth can expect to live in the age interval y to $y+5$, and f_y is the annual number of same-sex offspring that a female can expect to have within a given age interval. The sum of the fertility schedule in (1) from any age forward shows the number of same-sex offspring that a female could expect to have in the remaining years of life in the absence of mortality. The mortality component, L_y / l_x , in turn, diminishes the quantity of expected future offspring by the probability that the female will survive to each future age given that she has already survived to age x . The prime is used to indicate that the formula differs from the traditional measure of reproductive value (Fisher 1965; Keyfitz 1977) by expressing the expected future reproduction of females in terms of the absolute number of expected births rather than the relative reproductive contribution that they could expect to make to the succeeding generation.

The formula for V'_x in (1) gives the expected fertility for females at the beginning of each age interval. An approximation of the expected fertility for an average female within a given age interval can be found from recurrence formula (see Keyfitz 1977:147):

$$V'_x = 2.5 f_x + L_{x+5} / L_x (2.5 f_{x+5} + V'_{x+5}) \quad (2)$$

It is assumed that males are born in a constant ratio to females at each age given by the sex ratio at birth (SRB), then the total number of expected future births for females can be found by multiplying the number of expected female offspring by 1.0 plus the sex ratio at birth:

$$VV'_x = (1.0 + \text{SRB}) V'_x \quad (3)$$

The method by which the expected future fertility of Yanomamo females at each age was estimated as shown in Table 1. The female age schedules for mortality and fertility were estimated from the data available from ten other villages not affected by the epidemic (Melancon, 1981).

TABLE 1. Calculation of the total expected future fertility for an average female within each age interval: SRB=1.1311.

Age	f_x	L_x	L_{x+5}/L_x	V'_x	VV'_x
0	0.0	2.9992	0.8256	2.5033	5.3348
5	0.0	2.4762	0.9515	3.0320	6.4615
10	0.0124	2.3561	0.9527	3.1556	6.7249
15	0.1434	2.2445	0.9343	2.9214	6.2258
20	0.1620	2.0971	0.9181	2.3379	4.9823
25	0.1720	1.9255	0.9069	1.6797	3.5796
30	0.1333	1.7463	0.8921	9.0499	2.4506
35	0.1068	1.5578	0.8726	0.5365	1.1433
40	0.0565	1.3594	0.8512	0.1677	0.3574
45	0.0062	1.1571	0.8230	0.0156	0.0333
50	0.0	0.9412	0.7855	0.0	0.0

$$V'_x = 2.5 f_x + L_{x+5}/L_x (2.5 f_{x+5} + V'_{x+5})$$

$$VV'_x = (1.0 + \text{SRB}) V'_x$$

Source: Mortality and Fertility Schedules from Melancon (1981).

The change with age in the expectation of future fertility for Yanomamo females follows a trajectory that is characteristic of that found for reproductive value (e.g. Fisher 1958; Keyfitz 1977). Females between the ages of 0 and 4 years can expect to have an average of approximately 5.3 children during the remainder of their lives, which then increases gradually with age until reaching a peak of 6.7 children for females in the 10- to 14-year age interval who have managed to survive early childhood and still

have most of their fertile years ahead of them. The number of expected offspring then declines with age at an ever-increasing pace as successively older women have fewer and fewer years remaining in which to have children.

The loss to the population in potential future births due to female deaths in the epidemic is shown in Table 2. The first column, (A), shows the age distribution of females in the three villages prior to the epidemic and the total number of future births that could be expected by those females. The number of expected future births was estimated by multiplying the number of females in each age interval by the average expected fertility, $VV'x$, for females within each age interval. Columns (B) and (C) show the age distribution and the number of births that could have been expected for surviving females and victims respectively. The loss of future fertility due to the epidemic is equal to the difference between columns (A) and (B) of Table 2.

Prior to the epidemic, there were 176 females in the three villages. They had an average expected fertility of 4.6 offspring each and a total expected fertility of 806.2 offspring. The 43 females who died in the epidemic had a relatively high average expected fertility of 5.6 births each, reflecting their comparatively young age and, therefore, their high reproductive potential. The total loss in expected fertility was 241.4 future offspring, or roughly 30 percent of the total expected fertility in the population prior to the epidemic.

TABLE 2: Loss to population of expected future births due to female epidemic mortality.

AGE CLASS	VV'x	FEMALE POPULATION (A)		FEMALE SURVIVORS (B)		FEMALE VICTIMS (C)	
		N	BIRTHS	N	BIRTHS	N	BIRTHS
0	5.3348	23	122.7	7	37.3	16	85.4
5	6.4615	37	239.1	21	135.7	16	103.4
10	6.7294	22	148.0	19	127.8	3	20.2
15	6.2258	14	87.2	11	68.5	3	18.7
20	4.9823	21	104.7	19	94.7	2	10.0
25	3.5796	16	57.3	15	53.7	1	3.6
30	2.4506	13	31.9	13	31.9	0	.0
35	1.1433	11	12.6	11	12.6	0	.0
40	.3574	7	2.5	7	2.5	0	.0
45	.0333	6	.2	5	.1	1	.1
50	.0	6	.0	5	.0	1	.0
TOTAL		176	806.2	133	564.8	43	241.4
MEAN			4.6		4.3		5.6
PERCENT OF (A)				76	70.1	24	29.9

Loss to Individuals

The extent to which any individual will be genetically represented in the succeeding generation depends partially on that individual's own reproduction and partially on the reproduction of his/her biological relatives (Hamilton 1964). The reproductive interests of individuals thus overlap to a greater or lesser extent, depending on the degree to which they are genetically related. Thus, the loss of life in an epidemic affects not only the reproductive success of the victims but radiates out through the "web of kinship" to affect the genetic representation of many others as well. The extent to which individual survivors in the three villages suffered reproductively from the death of relatives in the epidemic can be assessed, since the degree to which individuals in the three villages were related can be determined from the genealogies.

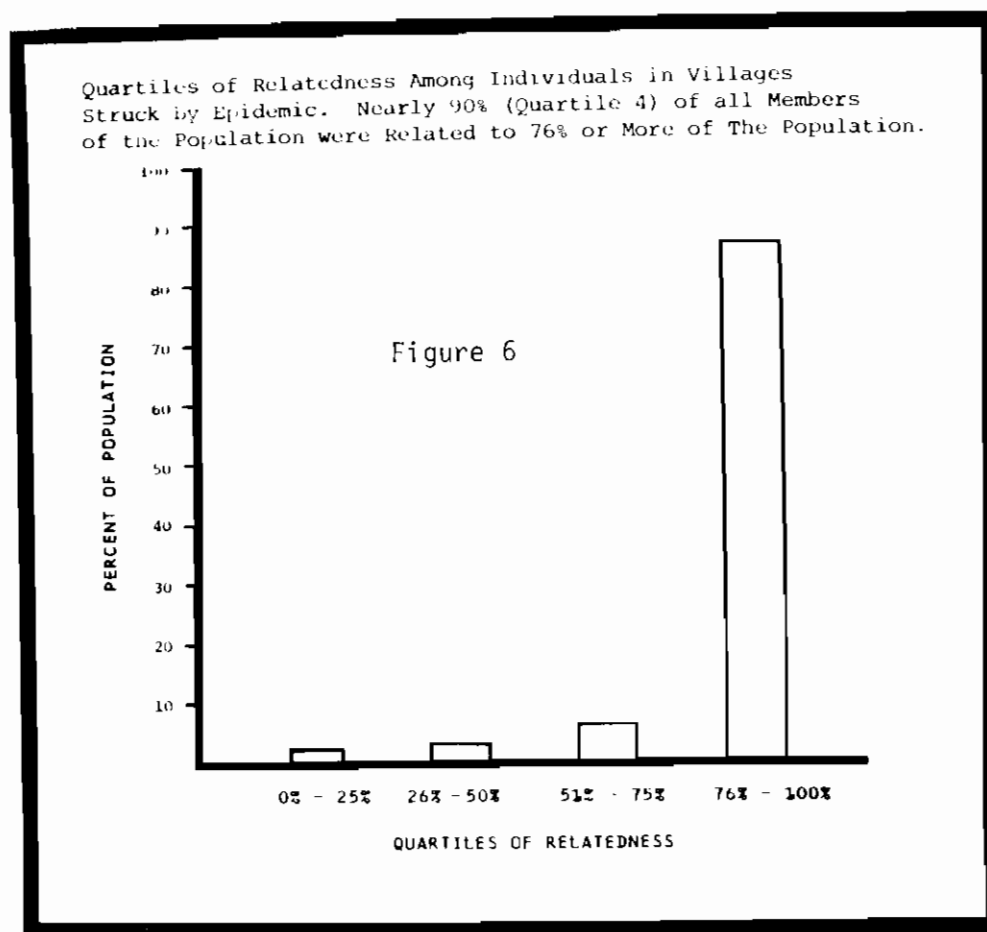
The members of the three Yanomamo villages struck by the epidemic were known to have a common biological and social history. To determine the extent to which they were interrelated, each of the 387 members of the pre-epidemic population was compared to all of the other members. In each comparison field-obtained pedigrees were constructed by computer for four generations and then examined for common ancestors. The inbreeding coefficient for a hypothetical offspring of the pair was then calculated and the appropriate coefficients of relatedness between the two individuals determined.

Yanomamo villages in general tend to be highly inbred (Chagnon 1974, 1975, 1979a). The three epidemic villages were no exception to this rule. Anthropologists who study kinship are well aware of the fact that kinship closeness is a major factor in determining the quality of interaction between individuals (Fortes 1969, Sahlin 1964). They are also aware that kinship can cover fictive (socially determined) as well as actual (biologically determined) relatedness. For at least actual relatedness, one can measure closeness and remoteness as population biologists and geneticists do: i.e., by calculating the coefficient of relatedness between individuals who are actual kin. The inbreeding coefficient is a simple function of the coefficient of relatedness: the parents of an inbred child have a coefficient of relatedness approximately 1/2 of the value of the inbreeding coefficient of their (inbred) child. The discussion of kinship and relatedness in this paper refers to genealogically demonstrated relatedness and does not include fictive kinship. The calculations of relatedness used here are derived from formulas found in Hamilton 1971, 1972).

The average relatedness between all individuals who were demonstrably related to one another was 0.0979 ± 0.0475 which is a level of relatedness that falls in a range between that associated with first and second cousins (0.1250 to 0.0313). The high degree of relatedness between individuals stems from the fact that villages tend to be small and highly endogamic. Marriages ordinarily take place between co-resident cross cousins. Moreover, families (technically, these families are patrilineal descent groups) related by marriage tend to continue to intermarry over several generations (Chagnon

1968, 1974). The Yanomamo in fact have one of the most widely distributed kinds of marriage systems in the tribal world (bilateral cross cousin marriage) and although there is a paucity of data against which their interrelatedness can be compared, it is likely that the high degree of inbreeding implied by this type of marriage system characterized many ancient human populations in the history of our species, as well as many tribal populations that were ravaged by epidemics prior to demographic and genealogical research among them (Fox 1967; Service 1971).

Individuals in the three epidemic villages were not only closely related to those individuals who were their relatives, most of them were also demonstrably related to almost all other individuals in the three villages. This is illustrated in Figure 6 which show the proportions of individuals that were related in some way to between 0-25%, 26-50%, 51-75%, and 75% or more of the other residents in the three villages. Over 90% of all individuals were related to 75% or more of the pre-epidemic population.



The extent to which the genetic representation of those individuals who survived the epidemic was diminished in the local population as a result of the disease is a function of the number of relatives which they lost and the degree to which they were related to those victims. The loss of genetic representation due to the epidemic for the 281 individuals who survived is summarized in Table 3. The survivors had an average of 326.8 relatives in the pre-epidemic population and their average relatedness to those relatives was $b = 0.0983$. The average sum of the coefficient of relatedness over all relatives for the survivors in the pre-epidemic population was 30.2. Thus, in a sense, each survivor had more than "one life to give for his village," since an "equivalent" of the genome of each survivor was represented an average of approximately 30 times in the pre-epidemic population.

Table 3: Loss of immediate individual local genetic representation due to total epidemic mortality for 281 survivors.

	INITIAL POPULATION (A)		SURVIVORS (B)		VICTIMS (C)	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Relatives	326.8	76.9	234.0	55.3	92.9	21.9
Relatedness	.0983	.0483	.0984	.0464	.0970	.0524
Individuals(g)	30.2	9.78	21.6	6.59	8.6	3.45

The survivors lost an average of 92.9 relatives in the epidemic to whom they were related, on average, by $b = 0.0970$. The average sum of their relatedness to the victims was 8.6, so each individual lost an average of approximately 8 equivalents of their own genome, or approximately one-third of their total genetic representation in the local population.

Just as a population suffers a loss of both present and future members in an epidemic, individuals also suffer a loss of both present and future genetic representation as a consequence of the death of relatives. The extent to which individual survivors lost potential genetic representation in the future depends on the number of relatives lost, how closely they were related, and the reproductive potential of those relatives at the time of their deaths. An index of the cost of the epidemic in terms of future genetic kin representation of the survivors can be obtained from the product of the coefficient of relatedness and the expected fertility of victims who were their genealogically demonstrable kinsmen summed over all kinsmen lost.

$$O_g = \sum_{j=1}^N b_{ij} V'_j \quad (4)$$

The measure, in effect, devalues the expected fertility of relatives by the coefficient of relatedness, and can be readily interpreted as the

number of expected 'offspring equivalents' lost by survivors as a result of the epidemic.

The extent to which the epidemic is likely to have effected the future genetic reproduction of individual survivors through female mortality is summarized in Table 4. Prior to the epidemic, the survivors had an average of 146.1 female relatives in the three villages whose total expected fertility at the time was 696.0 births, and who were related, on average, to the survivors by $b = .0995$. The genetic equivalents of the survivors were represented an average of 13.7 times in the female portion of the pre-epidemic population and the survivors could expect an average of 64.0 offspring equivalents through all of their local female relatives.

Table 4: Loss to individuals of future births due to the death of female relatives in epidemic for 281 survivors.

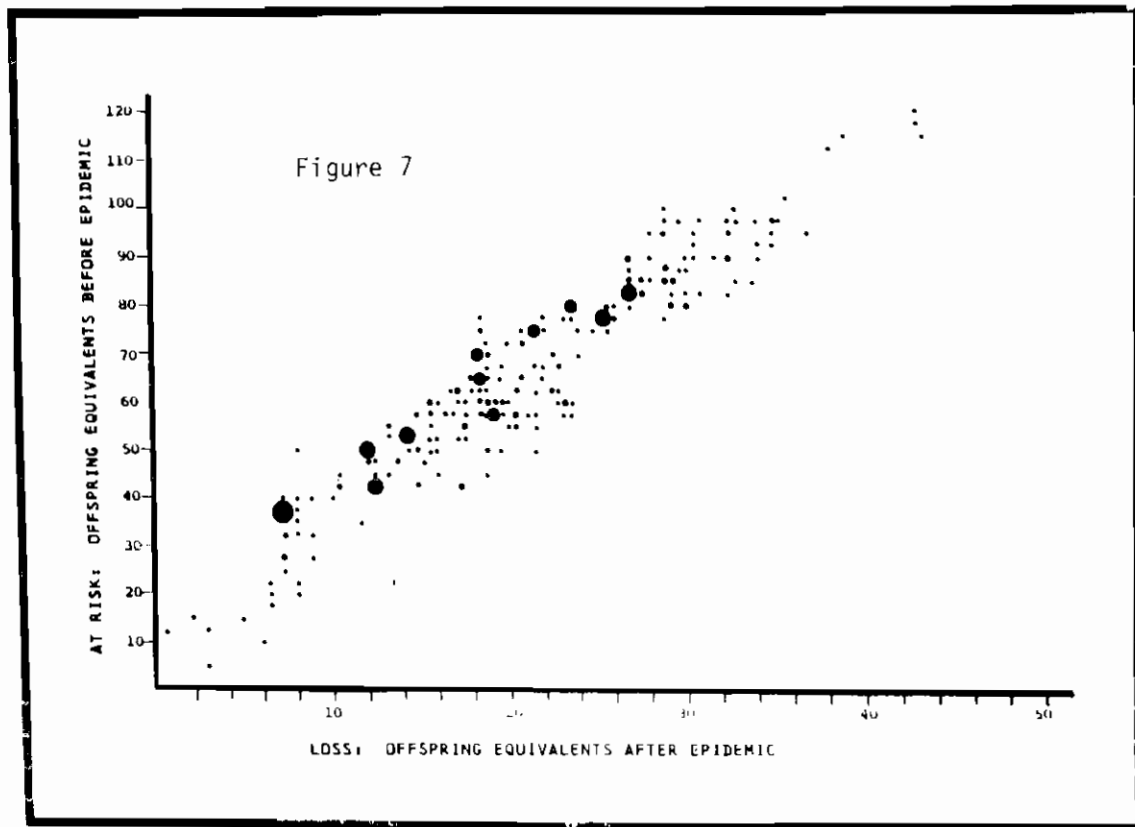
	POPULATION (A)		INITIAL SURVIVORS (B)		VICTIMS (C)	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Relatives	146.1	33.8	108.2	25.4	38.2	8.1
Offspring	696.0	156.6	478.6	109.2	219.0	45.7
Relatedness	.0995	.0489	.0992	.0467	.0985	.0529
Individuals(g)	13.7	4.41	10.1	3.13	3.6	1.41
Offspring(g)	64.0	21.9	43.7	14.2	20.4	8.2

The survivors lost an average of 38.2 female relatives who had an average total expected fertility of 219.0 offspring, and who were related to the survivors by an average of $b = .0985$. As a result, survivors lost an average of 3.6 equivalents of their own genome, and an average of 20.4 offspring equivalents through the loss of reproductive potential embodied in their female relatives who perished.

The extent to which the reproductive potential of individual survivors was diminished by the death of female relatives was closely correlated with the extent to which they were "at risk" of loss prior to the epidemic.

The scattergram in Figure 7 shows the relationship between the loss of expected offspring equivalents for survivors as a result of female epidemic mortality, and the number of expected offspring equivalents that survivors had through female relatives prior to the epidemic. As might be expected from the pattern in the scattergram, a Pearson's product moment correlation showed the relationship to be very close ($r = .949$, $p < .0001$), so that from the perspective of the local population, the epidemic did not have a major impact on the expected proportional genetic representation of individuals in the succeeding generation.

The epidemic took its greatest toll on the very young and aged, those in the population most dependent on the care of others for their survival.



If those individuals in the high risk age intervals were better able to survive who could garner the most care and attention from their relatives, it might be expected that those individuals with the most relatives, the appropriate kinds of relatives, or whose relatives had the greatest ability to provide care, might have a better chance of surviving the disaster than those who lacked the necessary kinsmen. In order to determine the influence of kinsmen on survivorship we compared victims and survivors who were less than 10 years of age with respect to the following kin attributes:

- 1) Father survived epidemic
- 2) Mother survived epidemic
- 3) Father co-resident
- 4) Mother co-resident
- 5) Parents currently married
- 6) Parents currently married monogamously
- 7) Number of co-resident relatives
- 8) Number of co-resident full siblings less than 10 years of age.
- 9) Number of co-resident half siblings less than 10 years of age.

No statistically significant differences were found between survivors and victims with respect to these attributes. Thus, distribution of relatives does not appear to have influenced an individual's chances of surviving the epidemic. In other words, the individual's chances of surviving the epidemic was not convincingly associated with the extent of his or her kinship network. This is a somewhat unexpected finding in terms of both the general theory of anthropology and the more recent arguments from evolutionary biology. Both suggest that the individual's well being and success is a function of having the support of kin, especially close kin.

DISCUSSION

Behavioral Reactions to Epidemics Among the Yanomamo

This epidemic, and others similar to it, can be placed into a larger context of general kinds of hazards and catastrophes that are known to have affected tribally-organized populations all over the world in the past several hundred years. These range from typhoons, droughts and floods at the environmental and climatological end of the spectrum, to smallpox, measles and influenza at the epidemiological end. The suddenness and novelty in the spectrum of hazards that afflict tribal populations vary. The particular hazard to one cluster of villages of one native population analyzed here, while having unique properties, can be taken to represent a larger class of similar events that have either already transpired in many other populations elsewhere in time and space, or a portend of more to come in the population under discussion. Several kinds of questions can be raised at this point, some purely academic and others simply humane. They have to do, in essence, with the capacity of native populations like the Yanomamo to react adaptively to hazards inflicted on them from the outside, hazards with which they have never had to deal. And, they have also to do with measures that can be taken to prevent them from happening.

Academically speaking, the impact of the epidemic on the infant and child end of the age structure raises a number of important questions. Is this mortality pattern the consequence of a novel stress, or is it the product of an acquired immunity due to a previous experience with this particular disease? We believe that this particular epidemic is a novel experience in this population, a conclusion suggested by information given by informants about the recent health history of their population and the descriptions they provided to the senior author about the epidemic and the sickness at the time that it struck. Their descriptions of the sickness in 1973 are reminiscent of: 1) the reactions the senior author witnessed in 1968 during a measles epidemic in other Yanomamo villages to the north and northeast; and 2) reactions of members of this population to a common cold that struck one of the villages in 1971 just as the senior author took up residence in that village for his annual field research.

I (Chagnon) found the village--some 280 people--on the verge of coming down with an upper respiratory infection when I visited them in 1971. It had presumably been communicated to the group by Yanomamo visitors who were in chronic contact with foreigners and who began visiting the village in 1971 just prior to my return that year. They reached the village, a ten days' walk by trail, by paddling upstream three days in canoes obtained from mission personnel. The shamans had concluded, when the first two or three individuals began coughing and running a fever, that the whole group had been victimized by hekura (spirits) from enemy villages. Everyone in the village ceased activities and stoically retired to their hammocks, refusing to work in their gardens, go hunting and gathering, collect firewood, water or food from the gardens. They literally had decided that they were all going to die, and resigned themselves fatalistically to that inevitable doom. At first just a few people retreated gloomily to their hammocks, quietly staring at the roof of the shabona, waiting to die. After a day or

two, everyone had retired to their hammocks and the village assumed a dismal aura: nearly three hundred people swinging quietly in their hammocks waiting to die, the babies and children crying for food or water. I began haranguing them publicly, insisting that they were not dying and that "my people" knew of such sickness and that it would pass in a few days if they continued to eat and drink. I began making rounds, persuading people to drink water and eat the few plantains or other food lying about their houses. A few complied. Some of the young men began feeling better and began to help others by fetching food and water for them. Those who began eating and drinking began feeling better, and, in turn, began tending for themselves and members of their own families, until everyone in the village had resumed eating and drinking and adopting the attitude that they weren't going to die after all! In fact, not a single person of the 280 died, and, after a few days, they actually began laughing and joking about the catastrophe that never was. I am convinced that had I not gotten to the village when I did, large numbers of them would have died, simply because they were convinced that they had been charmed or assaulted by hekura and that death was inevitable.

Although there is no direct evidence concerning the inherent virulence of the strain of what is presumed to be influenza that struck the population that we have considered here, it is fairly certain that the chances of death among the young and aged, those members of a population who are inherently most susceptible to death and who are most dependent on the aid of others for survival, were considerably enhanced by the characteristic reaction of the Yanomamo to cease or greatly curtail eating and drinking in this kind of circumstance. (See Neel et al. 1971, for a discussion of complications of this sort during a measles epidemic in the same tribe.) In short, the age pattern, and to some extent the level, of epidemic mortality can probably be attributed to an interaction between the inherent susceptibility of the young and aged, and the characteristic behavioral response of the Yanomamo to an epidemic sickness.

Social Organization and Epidemics

The population on which we have reported above, the Yanomamo Indians of southern Venezuela and northern Brazil, are only now entering that phase of their history when increased contacts with the outside world bring new sicknesses and a new epidemiological picture. The Yanomamo are now receiving international attention in the press (Holden 1979) in part because of the ill-advised attempts of the Brazilian officials to guarantee them land insufficient to their needs, (ARC/SI/IWGIA 1979) and in part because they are a widely known tribal case study in the anthropological literature and can be, for that reason, offered as exemplars of the problems faced by many other Native American populations in the Amazon Basin. We believe that it is both legitimate and necessary to draw attention to the possibility that much of the predictable destruction to be caused by probable future epidemics can be avoided if steps are taken now by the authorities in Brazil and Venezuela who have both the authority and the responsibility to do so (Chagnon, 1977:145-151).

One of the unexpected features of this epidemic was the lack of

relationship between survivorship and the number of kinds of kinsmen available to tender aid and support to the sick. Previous analyses of other aspects of Yanomamo social organization and behavior have indicated that individuals "favor" or "prefer" closer kin over more distant kin and kin over non-kin (Chagnon 1974, 1975, 1979, 1981; Chagnon and Bugos 1979). We expected to find some kinship attributes of survivors and victims in the 1973 epidemic such that those who survived perhaps did so because they were in a position to receive more aid and support by virtue of having more kin or more kin of the right categories, i.e., they may have received qualitatively different care during the epidemic as a function of their individual webs of kinship.

The lack of correlation between survivorship and the individual's kinship attributes is reason for alarm, for it indicates that the Yanomamo as a population are ill-equipped to overcome or resist traumas of the sort that struck one group of them in 1973. Our concern is that kin-directed altruism, one of the few features in their native social organization that might have dampened the effects of the epidemic, was not a detectable response made by the Yanomamo to this epidemic. It is possible that their failure to respond in this way was, in part, due to the initial fury of the sickness, and that the response, as in the case of the cold described above, was simply fatalistic resignation on the assumption that since everyone in the village contracted the sickness, all were going to inevitably die. Traumas of this sort, however, are likely to become an integral part of their epidemiological landscape as contact between them and the outside world increases. It is clear that national governments, Venezuela and Brazil in this case, are both in a position to and have an obligation to assure that the most likely agents of contact (missionaries, researchers, government officials and employees working in the area, and tourists) are informed of the health threat their presence creates and are aware of the possibility of contact-generated epidemics of the sort just described. This applies not only in the communities in which these non-indigenous agents work or live, but equally importantly, in the remote Indian communities with which they have little or no direct contact.

Lack of awareness and understanding of the health hazards that a non-indigenous presence constitutes for the Yanomamo can be appreciated in one simple example. The nun who assured the senior author in 1974 that gripe (flu) had struck at the mission and caused much sickness among the Yanomamo living there, also insisted that the origin of this gripe had to be laid at the steps of the remote, uncontacted Yanomamo who lived inland and away from the mission and who, in her opinion, were a constant crucible of sicknesses that afflicted the mission Indians... who otherwise enjoyed excellent health! Other missionaries with whom the senior author has discussed native sicknesses also had a similar attitude. While we do not wish to suggest that these dedicated individuals are engaged in deliberate slander or malevolence regarding the uncontacted villages of Yanomamo, we do believe that their knowledge about and understanding of sickness and epidemics among the Yanomamo must be improved. It is a characteristic of many of them to proudly cite the fact that few Yanomamo in their villages have died in recent years, and yet be totally uninformed about the impact of the presence of their mission (largely due to the constant stream of outsiders who visit it regularly) on the health of the more remote Yanomamo who are exposed to

exotic sicknesses through sporadic visits to their villages by "healthy" Yanomamo who are in direct contact with missions. These "healthy" Yanomamo have learned to live with the new health hazards and/or can receive immediate medical attention at the missions should they become ill. Their more remotely located "unhealthy" neighbors cannot.

Social and Territorial Consequences of Epidemics

Epidemiological studies of large national populations rarely consider the social structure of such populations except, perhaps, to comment on the health delivery systems characteristic of the societies. Epidemics in modern nations usually do not drastically modify or alter the social order when they strike. In tribal populations, this is not the case. There, epidemics are likely to eliminate significant portions of the population and by so doing, lead to the breakdown and dissolution of social organization and a radical transformation of native social life.

One of the consequences of the 1973 epidemic, and others like it that are likely to occur (or perhaps already have), is that the age structure of the village is radically altered and the village is reduced in size. A common response to this in most tribal societies is for the survivors of several ravaged groups to merge to form a new village, creating a group made up of disparate elements. The members of such villages are often unrelated or related in remote ways, and social relationships among them are confused and disrupted from the outset. Tapirape Indians of Brazil, described by Charles Wagley over 40 years ago, are instructive:

In the memory of one Tapirapé informant, there were five villages (about 1890), each of which must have contained well over two hundred people. The introduction of small pox about 1895 caused one village to disband, since most of the inhabitants had died. About 1900, another European disease, probably influenza, caused a second village to break up through loss of people. Yellow fever must have taken its toll among the Tapirape at various times, as it did among the neighboring Caraja Indians, and, in 1920, the world-wide influenza epidemic came belatedly to the Araguaya and on to the Tapirapé. In 1932, the survivors of a third village, depopulated by disease, joined the most southern village, Tampitawa, and, during my residence there in 1939, the survivors of a fourth village joined us. As a result of this wholesale depopulation from disease, there remained only one village and only 147 inhabitants... Tampitawa (Village of the Tapir) is composed, therefore, of a residue from all of the five original villages. All of the customs and ceremony attached to inter-village relations have of course disappeared.

Note that the mortality discussed by Wagley is close to 85% if the original villages contained only 200 inhabitants each. Anthropologists who have attempted to estimate the pre-Colonial population of North America have made assumptions regarding the degree of depopulation there that are consistent with Wagley's estimates of the Tapirapé loss. Wagley's estimates, guided in this case by ethnohistorical accounts of village sizes among the Tapirapé, are more informed than estimates we are usually able to give on pre-contact native populations (see Driver 1969:63-64; Dobyns 1966).

The impact of epidemics on native social organization depends, of course, on the specific features of that organization. The social organization of all tribes, by definition, is based on kinship ties and marriage alliances between kinship groups. These arrangements vary in type from tribe to tribe, but all are alike insofar as being intimately related to the populations they organize. Among the Yanomamo, political authority of local leaders is also a function of kin support and the numbers of future brides and grooms, i.e., the number of children present in the population, whose future marriages are controlled and arranged by the older men. To a very large extent, the degree of authority that leaders exercise in such communities is a function of the number of marriages they will arrange, and their influence over others is therefore a function of the number of young people in the village.

Disruption of village life and the resulting coalescence or fusion shatters the social organization and creates chaos, conflict and disorder in the newly-constituted village(s). This is so because whatever integration and order existed in the independent local villages before the epidemic, was enmeshed in the kinship, marriage and leadership patterns. The development of these kinship ties and marriage alliances takes years of inter- and intra-group social promises and actual exchanges, and is a complex, difficult process in even the most demographically advantageous circumstances. Forging a new order out of the chaos generated by epidemics and depopulation is all the more difficult in composite villages, and what emerges is usually quite a different system entirely (see Service 1972, for an assessment of this cross-culturally). We have one additional tragic example among the Yanomamo of the Catrimani River Basin where the development of the Perimetral Norte road in the southeasternmost region of the Yanomamo tribe led to approximately a 60% depopulation in villages there, bringing about the emergence of the same kind of process described above by Wagley for the Tapirapé (Saffirio 1980). This did not happen in the villages on which we report here, but it remains a distinct possibility should other diseases strike and further reduce the population in this area of the tribe.

It should also be pointed out here that the political relationships among Yanomamo villages in this area are often antagonistic. Smaller, or less well-organized, villages are at a tremendous disadvantage in dealing with their neighbors (Chagnon 1968). Losing 25% of the younger spectrum of the population places any Yanomamo village at a serious disadvantage for many years in their political relationships with other villages. Those neighbors who were unaffected by the 1973 epidemic in the area under discussion will continue to grow, fission and expand into adjacent regions,

and if past political strategies among the Yanomamo are a guide to the future, they will pressure the smaller groups to coalesce again with other neighbors. This, of course, will force the members of the smaller groups to make disadvantageous marriage alliances with their benefactors, who will demand many more marriageable females from the weaker groups than they will cede in return. That is, the weaker groups will lose a fraction of the now-small number of younger girls whose future reproduction is required to restore their villages to their former positions in the political arena within which they must compete.

We have emphasized, in our analysis above, the long-term future effects of the epidemic because it is not simply 'soma' or 'immediate individuals' that is lost in an epidemic among tribesmen, but the entire sociopolitical future of the survivors of the epidemic. Reproduction and the organization of reproduction is one of the most fundamental bases of tribal social order and the process out of which kinship, descent, marriage alliance and the ephemeral authority of local leaders grows. In short, tribesmen may survive epidemics in a biological sense, albeit in a much reduced state, but they can rarely remain tribesmen thereafter.

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BIBLIOGRAPHY

Cardoso de Oliveira, Roberto

- 1964 O Índio e o Mundo dos Brancos: A Situação dos Tukuna do Alto Solimões. Corpo e Alma do Brasil, XII. Difusão Européia do Livro. São Paulo.

Chagnon, Napoleon A.

- 1968a Yanomamo: The Fierce People. Case Studies in Cultural Anthropology. Holt, Rinehart and Winston, New York.
- 1968b Yanomamo Social Organization and Warfare In: War: The Anthropology of Armed Conflict and Aggression, Morton Fried, Marvin Harris and Robert Murphy, Eds. Natural History Press. Garden City, New York. pp. 109-59.
- 1968c The Culture-Ecology of Shifting (Pioneering) Cultivation among the Yanomamo Indians, Proceedings of the VIII International Congress of Anthropological and Ethnological Sciences. Volume 3:249-255. Tokyo and Kyoto.

Chagnon, Napoleon A., cont.

- 1974 Studying the Yanomamo. Holt, Rinehart and Winston. New York.
- 1975 Genealogy, Solidarity and Relatedness: Limits to Local Group Size and Patterns of Fissioning in an Expanding Population, Yearbook of Physical Anthropology, Vol. 19:95-110. American Anthropological Association . Washington.
- 1977 (1968) Yanomamo: The Fierce People. Second Edition. Holt, Rinehart & Winston. New York.
- 1979a Mate Competition, Favoring Close Kin and Village Fissioning Among the Yanomamo Indians, In: Evolutionary Biology and Human Social Behavior: An Anthropological Perspective. Napoleon A. Chagnon and William Irons, Eds. Duxbury Press. North Scituate, MA. pp. 86-131.
- 1979b Is Reproductive Success Equal in Egalitarian Societies? In: Evolutionary Biology and Human Social Behavior: An Anthropological Perspective. Napoleon A. Chagnon and William Irons, Eds. Duxbury Press. North Scituate, MA. pp. 374-401.
- 1981 Terminological Kinship, Genealogical Relatedness and Village Fissioning Among the Yanomamo Indians In: Natural Selection and Social Behavior: Recent Research and New Theory. Richard D. Alexander and Donald W. Tinkle, Eds., pp. 490-508. Chiron Press. New York.

Chagnon, Napoleon A. and Paul E. Bugos, Jr.

- 1979 Kin Selection and Conflict: An Analysis of a Yanomamo Ax Fight, In: Evolutionary Biology and Human Social Behavior: An Anthropological Perspective. Napoleon A. Chagnon and William Irons, Eds. Duxbury Press. North Scituate, MA. pp. 213-238.

Codere, Helen

- 1951 Fighting with Property. Monographs of the American Ethnological Society, Monograph No 18. University of Washington Press: Seattle.

Dobyns, Henry F.

- 1966 Estimating Aboriginal American Population, Current Anthropology, Vol. VII, pp. 395-449.

Driver, Harold E.

- 1969 Indians of North America. Second Edition, Revised. University of Chicago Press: Chicago.

Fisher, Ronald A.

- 1958 The Genetical Theory of Natural Selection. Dover Publications: New York.

Fox, Robin

- 1967 Kinship and Marriage. Penguin Books: Baltimore.

Hamilton, William D.

- 1964 The Genetical Evolution of Social Behavior I and II. Journal of Theoretical Biology 7:1-51.
- 1971 Selection of Selfish and Altruistic Behavior in Some Extreme Models, In: Man and Beast: Comparative Social Behavior J.F. Eisenberg and W.S. Dillon, eds. Smithsonian, Washington, D.C.
- 1972 Altruism and Related Phenomena, Mainly in Social Insects, Annual Review of Ecology and Systematics, 3:193-232.

Holden, C.

- 1979 Park is Sought to Save Indian Tribe in Brazil. Science 206:1160- 1162.

Howell, Nancy

- 1979 Demography of the Dobe !Kung. Academic Press: New York.

Keyfitz, Nathan

- 1977 Applied Mathematical Demography. Wiley-Interscience, John Wiley and Sons: New York.

Laraia, Rocque de Barros and Roberto da Matta

- 1967 Indios e Castanheiros. Difusão Européia do Livro: Rio de Janeiro.

MacCluer, Jean W., James V. Neel and Napoleon A. Chagnon,

- 1971 Demographic Structure of a Primitive Population: A Simulation, American Journal of Physical Anthropology, Vol. 35, Pp. 193-207.

Melancon, Thomas F.

- 1981 Marriage and Reproduction Among the Yanomamo Indians of Venezuela. Ph.D. Dissertation, The Pennsylvania State University, University Park, PA.

Nimuendajú, Curt

- 1939 The Apinayé. Catholic University of America, Anthropological Series, No. 8: Washington.
- 1946 The Eastern Timbira. University of California Publications in American Archaeology and Ethnology, Vol. 41: Berkeley and Los Angeles.

Neel, James V., Willard Centerwall, Napoleon A. Chagnon and Helen Casey

- 1970 Notes on the Effect of Measles and Measles Vaccine on a Virgin-Soil Population of South American Indians, American Journal of Epidemiology, Vol. 91, pp. 418-429.

Neel, James V. and Kenneth M. Weiss

- 1975 The Genetic Structure of a Tribal population, The Yanomama Indians. XII. Biodemographic Studies, American Journal of Physical Anthropology, Vol. 42, No. 1, pp. 25-51.

Oliver, Douglas

- 1961 The Pacific Islands. Revised Edition. Anchor Books: Garden City.

Ribeiro, Darcy

- 1970 Os Índios e a Civilização. Editora Civilização Brasileira: Rio de Janeiro.

Saffirio, Giovanni

- 1980 Some Social and Economic Changes among the Yanomama of Northern Brazil (Roraima): A Comparison of "Forest" and "Highway" Villages. M.A. Thesis in Anthropology, University of Pittsburgh.

Service, Elman R.

- 1971 Primitive Social Organization: An Evolutionary Perspective. Second Edition. Random House: New York.

Wagley, Charles

- 1940 The Effects of Depopulation upon Social Organization as Illustrated by the Tapirape Indians Transactions of the New York Academy of Sciences, series II, vol. 3, no. 1, pp. 12-16.
- 1977 Welcome of Tears. The Tapirapé Indians of Central Brazil. Oxford University Press: New York.

Wrangham, Richard, Thomas F. Melancon and Napoleon A. Chagnon (Ms)

- 1982 Inclusive Fitness Value and Its Measurement in a Population
 of Yanomamo Indians. Unpublished MS.

Wright, Sewall

- 1922 Coefficients of Inbreeding and Relationship, American
 Naturalist, Vol. 56, pp. 330-38.