

ARTIGOS

Indigenous populations of the São Paulo-Rio de Janeiro coast:
trade, aldeamento, slavery and extinction

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This essay * will provide an estimate of the Amerindian population on the southern littoral of the state of Rio de Janeiro, at the time of first contact with Europeans in 1500. It will also attempt to trace the decline of that population up to 1600, taking into consideration forms of labor exploitation and disease. Environmental impact of this population will then be assessed as an essential aspect of human occupation. It will be possible to extend these observations to the littoral of São Paulo, with whose inhabitants those of Rio de Janeiro had considerable interaction.

The density of the native Brazilian population has been subject to upward revision over the last century. Varnhagen estimated 0.1/km² for all of Brazil, but thought the coast more densely populated. Steward and Faron estimated 0.7/km² along the coast, John Hemming estimated an average 2.2/km² for all the state of Rio de Janeiro, and Pierre Clastres estimated 4.0/km². These, and other estimates, were not, however, the result of a careful review of the available historical evidence for each locality. The loss of initial population in this region, due to epidemics, social disruption, and forced labor, has not been studied, although a

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sizeable amount of historical evidence has accumulated. Since there is a clear relationship between these subjects and the forms of environmental exploitation for subsistence and trade, and since environment and techniques as factors limiting population density have been debated by anthropologists in relation to other areas of Brazil, this question will form part of the analysis. (1)

The area under study is lowland, isolated from the continent by the barrier of an escarpment up to 900 meters high. This coastal range in some places almost reaches the shore line, but it retreats in the west to a maximum distance of more than 60 kilometers. The coast is deeply indented by several bays, inlets and estuaries. In places shielding dunes had cut these inlets off from the sea and formed brackish, shallow lakes. The climate of the region is tropical, hot and super-humid to sub-humid. Rainfall is extremely heavy on the coastal escarpment itself, but it is less on land distant from it, so that on the flatter coastal islands and on Cape Frio a drought-resistant vegetation is present, including cacti (2).

The shore line was covered with dune and mangrove formations and a scrub formation called *restinga*. Behind this vegetation stretched, all the way to the base of the escarpment, a dense forest, denominated by Hueck the Evergreen Tropical Rainforest of the Atlantic Coastal Plains. This was a formation extending as far north as Natal and as far south as Rio Grande do Sul, with some regional variation. It was related floristically to the upland forest and, less closely, to the Amazon rain forest. It contained many distinct species, however, and this sector centering on Rio de Janeiro was apparently an important center of endemism (3).

The first human settlements in this region were founded by the *sambaqui* makers, beginning about 8,000 BP. Sambaquis are mounds of shellfish shells, which were middens of a people who were contemporaneous with the cave dwellers of Lagoa Santa in Minas Gerais. There are hundreds of these mounds along the coast from Vitória to Rio Grande do Sul. Other hundreds have been exploited industrially for lime or have been obliterated by rising waters and currents. In a later phase, the

(1) — Varnhagen, *Historia geral do Brasil antes da sua separação...* (8th ed.; Rio de Janeiro, 1975), 1:23; Steward, Julian, and L. C. Faron, *Native Peoples of South America*, New York, 1969, pp. 45, 52, 57; Hemming, John *Red Gold*, Cambridge, MA, 1978; Clastres, Pierre *La société contre l'état*, Paris, 1974, p. 81. William M. Denevan's introduction to the collection edited by him, *The Native Population of the Americas in 1492* Madison, WI, 1976, has been employed for methodological procedures; his article in the same collection mentions other estimates, p. 219.

(2) — Brazil, FIBGE, *Geografia do Brasil*, vol. 3, *Região Sudeste*, Rio de Janeiro, 1977, pp. 51-87.

(3) — *Ibid.*, pp. 91-116; Hueck, Karl and Paul Seibert, *Vegetationskarte von Südamerika*, Stuttgart, n.d.; Mori, A. Scott *et al.*, "Distribution Patterns and Conservation of Eastern Brazilian Coastal Forest Tree Species," *Brittonia*, 33, 1981, No. 2, 233-245; Golfari, Lamberto "Comunidades vegetais do Brasil," in III Curso de Zoneamento Florestal, Recife, 18 a 27 de julho de 1973 (Mimeo).

sambaqui dwellers began to engage in agriculture. Meanwhile further incursions were made into the region by Gê-speaking and other peoples. These settlers were increasingly dependent on agriculture for subsistence. Occupation during this period may not have been continuous. The next-to-last wave of Amerindian peoples was that of the Waitaká. They appear to have reached the coast from the north, following the Paraíba do Sul valley down to the sea. The Waitaká may not have expanded along the entire coast but reached at least as far as Grand Island (Ilha Grande), where an isolated remnant remained at the time of European contact (4).

The Tupinambá succeeded the Waitaká in this region, entering it and probably conquering it sometime between 1 AD and 700 AD. The name "Tupinambá" is confusing, since it was a name by which several Tupi-speaking groups designated themselves. These Tupi had formed a league, extending along the coast, from Cape Frio, where they confronted the Waitaká, to Ubatuba, in present-day São Paulo state. The league was called the "Tamoio," which might be a better designation because it is a more exclusive term, but it is a term not much used any more to refer to this group. The Tupinambá in any event were closely related culturally and linguistically to other Tupi-speaking groups to the west — the Tupiniquim, who occupied the coast southward to Cananéia and inland for some distance, and the Goianá, who occupied part of highland São Paulo and a part of Minas Gerais (5).

By 1000 AD the Tupinambá had achieved a fairly dense settlement. They also occupied some undefined part of the highlands, but those villages will not be taken into account in this essay, since the historical record for that area is extremely slight and archaeological study has barely begun. When the Europeans arrived in 1500 or shortly afterward, then, they confronted this people, which was more dependent on agriculture than any of the earlier occupants of the region, and most likely therefore formed a denser population.

(4) — Beltrão, Maria da Conceição de M. C. — *Os tupinambá no Rio de Janeiro* (1.200 anos de ocupação), Brasília, 1972; Guidon, Niède et al., *Documents pour la préhistoire du Brésil méridional: I, l'état de São Paulo*, Paris, 1973; Dias Jr., Ondemar "Pesquisas arqueológicas no sudeste brasileiro," *Boletim do Instituto de Arqueologia Brasileira*, serie especial (1975), No. 1; Dias Jr., Ondemar "Dados para o povoamento não tupiguarani do estado do Rio de Janeiro," *Boletim do Instituto de Arqueologia Brasileira*, June, 1979, No. 8; Kneip, Lina Maria et al., "The radiocarbon Dating of the 'Sambaqui de Cambinhos,' Itaipu, Niterói, RJ, Brazil," *Anais da Associação Brasileira das Ciências*, 53 (1981), No. 2.

(5) — Susnik, Branislava *Dispersión tupi-guaraní prehistórico: ensayo analítico*, Asunción, 1975, pp. 58-70. The two fundamental surveys of the literature on the Tupinambá are Métraux, Alfred "The Tupinamba," in Steward, Julian ed., *Handbook of South American Indians*, 2d ed., New York, 1963, 3, pp. 95-133, along with the same author's *La civilisation matérielle des tribus Tupi-Guarani*, Paris, 1928; and Fernandes, Florestan *Organização social dos tupinambás*, 2d. ed. rev. and amp., São Paulo, 1963. See also Fernandes' *Aspectos do povoamento de São Paulo no século XVI*, São Paulo, 1948.

Tupinambá Population, ca. 1555

How many Tupinambá were there on the littoral when the Europeans arrived? To answer this question, the procedure will be followed of estimating the population circa 1555 and then providing calculations concerning the possible rate of population decline before that point. It is necessary to follow this procedure because the earliest observation we possess of Tupinambá population date from the decade of the 1550's.

These observations refer only indirectly to total population. They include measures of the sizes of the long houses that were the dwellings of the Tupinambá, the number of stalls or households within the long houses, and the number of long houses per village. The long houses, or *malocas*, variously estimated to contain 25 to 80 households, were grouped 4 to 8 to a village, or *taba*. Forty is here posited as the average number of Tupinambá households per *maloca*. This is higher than Staden's report of 25, but it is considerably below the median estimate of contemporary observers. The number of adults per family must have been somewhat below two, since observers report an excess of women over men in each *maloca*, either married to the chief of the *maloca* or *taba*, or unattached, apparently at the disposition of the chiefs. This excess was undoubtedly the result of warfare, which was most deadly to the males. It also seems reasonable to calculate that a *maloca* did not necessarily contain a full complement of women, but that there was usually some room to spare. The number of women per *maloca* will therefore be estimated at 38, and the number of males at 30. The Tupinambá population, it will be suggested below, was growing and was subject to a moderately low death rate from natural causes. Therefore it will be posited that the dependency ratio would have been that of a population with life expectancy of 30, and the excess of male deaths will be ignored. This would result in a population of children under age 16 of about 67 per *maloca*. Finally, the most common number of *malocas* per village appears to have been four, though a somewhat higher average number may be assigned, 4.5, to the average-sized *taba*. The average *maloca* under the conditions described, thus contained 135 persons, and the average *taba* contained 607 persons (6).

(6) — House sizes and households are reviewed in Fernandes, *Organização*, 68-59, to which add Soares, Francisco *Coisas notáveis do Brasil*, Rio de Janeiro, 1966, 1:101; Gandavo, Pero de Magalhães *Tratado da Terra do Brasil*, São Paulo, 1980, pp. 52-53. On the ratio of children to adults, see United Nations, UNESCO, *Methods for Population Projection by Sex and Age*, New York, 1956. Clastres would consider the above estimate for *taba* size too low. Serafim Leite would probably consider it too high, see his remark at the report of Ir. Diogo Jacome in 1551, that he customarily entered villages numbering '400 souls or more.' (*Monumenta Brasiliae*, Rome, 1956, 1, p. 242n).

No complete list was made by any of the European observers of all the Tupinambá villages on the coast. Hans Staden names 5 in the vicinity of Parati, and Léry names 22 on Guanabara Bay. Five of Léry's villages were on Governador Island. Thevet's map shows these villages, which contain a total of 35 malocas, thus 4725 persons. Governador was about 44 km² in size, thus population density on that island was very high, 107/km². The population density of islands on the coast seems to have been higher than on the mainland, because of the attractiveness of a favorable defensive situation, and because of the high productivity of the shellfish and fishing resources. It may be that the inhabitants of Governador also did some collecting or fishing on the other islands of the bay or on the mainland. The nearby smaller island of Paquetá, or perhaps it is Fundão, is also shown on the Thevet map. There is one taba on it, suggesting an elevated population there as well, perhaps 37/km², if it is indeed Paquetá (7).

The five villages around Parati occupied what are now the counties of Ubatuba, Parati, and Angra dos Reis. These counties contain 2,333 km². The average density of this area would therefore appear to be much lower, a little more than 1/km². The terrain in that part of the coast is least favorable to human settlement, however. The Bocaina mountain range, part of the coastal escarpment, approaches the shore itself, and most of the massif presents declivities of more than 45 degrees. Only Ubatuba possesses any sizeable proportion of level land. The Tupinambá may have been attracted there for the area's defensibility and must have depended to an unusual extent on the resources of the bay for subsistence. The effective zone for farming and the more productive zone for hunting may be estimated at no more than 500 km². Thus a density of 4.8/km² might be taken as a figure more nearly applicable to the rest of the Tupinambá coast.

Léry's list of villages includes 14 in the area which is now Rio de Janeiro city. There too, the definition of the habitable land is sharp because of the massif rising to the west, but the area of level land is much larger. The villages named by Léry occupied, it may be presumed, no more than 1600 km², including most of the present suburbs of Duque de Caxias and Nova Iguaçu. If the villages on the bay islands are excluded from this calculation, then the average density would be a little over 5.3/km². Léry noted only three tabas on the east side of the bay, but he was probably counting only the villages which were friendly to the French.

(7) — Staden, Hans *Viagem ao Brasil*, Salvador, 1955, pp. 96, 97; Teixeira Filho, Alvaro *Roteiro cartográfico da baía de Guanabara e cidade do Rio de Janeiro, século XVI e XVII*, Rio de Janeiro. See also Lussagnet, Suzanne *Les Français en Amérique*, Paris, 1953).

An account of 1567 mentions two other villages, probably on the east side, but this is not a complete listing, either (8).

There are no other enumerations of villages for the area between the bay of Ilha Grande and Rio de Janeiro, nor for the coast to the east of Rio de Janeiro as far as Cape Frio. It will be assumed here that the remaining unenumerated portion of the littoral was similar in its array of resources to the level lands of the Parati and Rio de Janeiro zones and therefore contained a population within the range of 4.8 to 5.3/km².

It will be necessary, however, to exclude the area occupied by the massifs. Besides the Bocaina range, there are a few isolated massifs east of Guanabara Bay, including Tijuca, now within the city limits of Rio de Janeiro, occupying all together about 300 km². To the east of the Bay are a few more mountainous outcroppings, about 100 km² of which is as inclined as the massifs to the east. All these ranges, including Bocaina, which extends over about 250 km² of coastal lands east of Angra dos Reis, subtracted about 2500 km² from the effective agricultural and hunting lands of the Tupinambá. The remaining territory, 10,960 km², does not include Ilha Grande, still in the hands of the Waitaká, and it excludes all the Paulista littoral beyond Ubatuba, which was by then a no man's land as far as the Portuguese fort at Bertioga. Within these bounds the population of the coastal Tupinambá is therefore estimated to have numbered in 1555 between 57,000 and 63,000, taking into consideration as well the denser population of Governador and Paquetá Islands.

The accounts of Tupinambá war parties suggest that the native population may have been more dense than this. Some of these mention armies up to 10,000 strong. Knivet tells of leading 30,000 Tupinambá into battle, sometime around 1596. The counting of warriors in battle array, however, was probably the least objective of the European's eye witness reports. Even when the Tupinambá were their allies, and when the observer did not intend to take part in the battle, the excitement and tension of the moment may have provoked an exaggeration in the count. Ulrich Schmidel's tale of having been attacked by 6,000 warriors somewhere in nearby Paraná is incredible. The event occurred near a single village and in a forest that could not have afforded a clear view from the trail. Knivet's account was not corroborated by Portuguese sources, which should have taken note of what would have been an immense conflict, perhaps the largest battle ever to have taken place on Brazilian soil (9).

(8) — *Monumenta*, 4, p. 383n.

(9) — Schmidel, Ulrich *Crónica del viaje a las regiones del Plata, Paraguay y Brasil...*, Buenos Aires, 1948, p. 435; Knivet, Anthony "The Admirable Adventures and Strange Fortunes of Master Anthonie Knivet," in *Hakluytus Posthumus or Purchas His Pilgrims*, Glasgow, 1906, p. 4, p. 12; Léry, Jean de *Histoire d'un voyage fait en la terre du Brésil*, Paris, 1972, pp. 176, 177, 178.

Staden, on the other hand, described a war party more in scale with the size of the village he lived in. That village, and another nearby, put together a force of a few over 300, and defeated another smaller party of Tupiniquim at sea. Armies up to 1,000 or 2,000 are conceivable, as are sea-going expeditions of 50 to 100 canoes, supposing that in those instances a half-dozen or even a dozen villages had formed a league, but numbers greater than that may be considered fanciful (10).

Population Decline Before 1555

The observations made of Tupinambá society in the 1550's and 160's are of a situation already altered through the constant presence of the Europeans for more than fifty years. The population of 1555 was not the "contact" population. It is possible that the decline in numbers of the Ameridians which took place elsewhere in the New World had already begun along the Tupinambá coast by that date. To demonstrate that possibility, the extent of European invasion before 1555 must be calculated.

The first recorded voyage to this region was that of Gonçalo Coelho, probably in 1501. Vespucci took part in this expedition, which traded in brazilwood at Cape Frio and possibly ventured as far as Guanabara Bay. Another expedition may have taken place in 1501, since later expeditions reaching São Vicente found there a Portuguese who claimed he had landed there by that date. The Nicolau de Caveiro map of 1502-1503 already shows the bays of Guanabara and Ilha Grande, possibly obtained from some source other than the Coelho fleet. Paulmier de Gonneville, who arrived somewhere on the Tupinambá coast in 1504, said that there had been sailings to Brazil out of his home port of Honfleur "for several years" before his. Thus it may be supposed that European vessels were sailing with some frequency to this region shortly after the official discovery of Brazil in 1500, or even before (11).

Spanish and Portuguese navigators sent to discover a southwest passage during these early years turned Rio de Janeiro, São Vicente, Cananéia and Santa Catarina into convenient supply and repair stations. São Vicente was considered by the Portuguese the furthest point south on the coast within their side of the treaty line of Tordesillas, and so they

(10) — Staden, *op. cit.*

(11) — Abreu, João Capistrano de *O descobrimento do Brasil*, 2d. ed., Rio de Janeiro, 1976, pp. 42-49; Teixeira Filho, *Roteiro*, p. 22; Vespucci, *Americo El nuevo mundo, cartas...*, Buenos Aires, p. 152; Garcia Diego, "Relación v derrotero... 1526," in J. T. Medina, ed., *Los viajes de Diego Garcia de Moguer al Rio de la Plata Santiago de Chile*, 1908, p. 237; de Gonneville, Binot Paulmier, *Relation authentique du voyage...* Paris, 1869, pp. 104-106; Cortesão, Jaime *A fundação de São Paulo, capital geográfica do Brasil*, Rio de Janeiro, 1955, p. 114, 137.

expended some effort to hold it. A stone tower was built there sometime before 1530, and the site was known by a Tupi word probably meaning "provisioning place." Brazilwood concessionaires arrived regularly at Cape Frio, one of the three principal harbors in that trade. The log of only one of these ships, the "Bretoa", exists for its voyage to that place in 1511. It suggests a regular trade, with stores awaiting them on shore. The French replaced the Portuguese in the trade at Cape Frio after 1519. Apparently the Portuguese had antagonized the Tupinambá by taking slaves, and the French appeared by comparison to be more benign trading partners and convenient allies (12).

Without setting down here all the voyages of which a record exists or may be easily inferred, it can be stated that, by 1555, 10 Spanish expeditions had touched the Tupi coast, that at least 2 Portuguese trading vessels a year before 1519 and 6 French trading vessels a year thereafter anchored at Cape Frio, and that 8 other Portuguese expeditions were made to this coast. These voyages must have included more than 330 ships. Counting the vessels rigged for war at a complement of 100 men each, and trading vessels at 35, then about 10,000 Europeans had certainly made contact with the Tupinambá between 1501 and 1555. In addition there may have been other clandestine or simply unrecorded voyages by these nationalities and perhaps a few others by the English, of whom there is some slight evidence, and who had left at least one factor ashore by the 1580's (13).

These European contacts varied in intensity. Sailors on ships loading brazilwood were supposedly forbidden to leave the factory, yet they dealt in trade goods on their own account. Some sailors were shipwrecked. Factors were left behind to purchase and stack the brazilwood and to teach the parrots to speak Portuguese or French. The Portuguese set ashore Franciscan missionaries, of whose activities and fate almost nothing is known. Others of the sailors were abandoned on shore as punishment or they deserted because of the vile living conditions on shipboard or their fear of participating in a battle, or merely because they wanted to enjoy the apparently guiltfree sexuality of the naked Tupinambá women. These sailors fathered a mestizo population. On Magellan's expedition of 1519, one of his Portuguese pilots persuaded him to put in at Rio de Janeiro,

(12) — Almeida Prado, J. F. de *Primeiros povoadores do Brasil*, 5th ed. rev. and. aug., São Paulo, 1976, pp. 62-70, 104-108; Serrão, Joaquim Veríssimo *O Rio de Janeiro no século XVI*, Lisbon, 1965, 1, pp. 38-40; Neme, Mário *Notas de revisão da história de São Paulo, século XVI*, São Paulo, 1959, pp. 23-33; Marchant, Alexander, *From Barter to Slavery*, Baltimore, 1942, p. 29; Mollat, Michel "Premières relations entre la France et le Brésil: des Verrazani a Villegagnon," *Cahiers de l'Institut des Hautes Etudes de l'Amérique Latine*, 6, 1964; Cortesão, *A fundação*, p. 43.

(13) — Hakluyt Richard, *The Principall Navigations, Voiages, and Discoveries of the English Nation*, 2 vols., Cambridge, Eng., 1965, 2, pp. 638-641.

in order to pick up the pilot's son, borne him by a Tupinambá woman on an earlier voyage (14).

These contacts were sufficient to elevate the mortality of the Tupinambá. The Portuguese exported slaves whom they purchased from the Tupiniquim at São Vicente. Some of these were Tupinambá captives. After 1531 the slaves began to be used to work sugar plantations at São Vicente, and again Tupinambá captives were employed, provoking continuous warfare between the two tribal groups (15).

It seems quite possible that European infectious diseases were introduced before 1555. There is a notice of "many" deaths of a fever in the fleet of Sebastián Caboto while it was anchored at Lagoa dos Patos, in 1527. This is the only notice of such an occurrence, though it may be sufficient to make the point, since there is so little record of any of the events that may have transpired on these voyages. Abandonment on shore may have been commonly the fate of sailors suffering an illness. This was done to Anthony Knivet and several companions on the Cavendish expedition in 1591, and Pero Lopes de Sousa's log of the 1531 expedition provides dramatic evidence of the terror induced by epidemics on shipboard. The practice of abandonment on the beach would certainly have increased the danger to the indigenous coastal population (16).

It might be suggested that the curious under-population of the entire coast of São Paulo observable in the 1550's was attributable to disturbances wrought by the presence of the Portuguese during the previous half-century. The south coast of São Paulo was populated by the Tupiniquim as far as Cananéia, and perhaps beyond, according to early reports. The shipwrecked Portuguese mentioned above contracted with Diego Garcia to deliver 800 slaves, suggesting that he disposed of a formidable force of warriors. But by the 1550's the only Amerindian village on that coast was at Peruibe, and Itanhaem and Iguape had to be re-founded with Portuguese settlers later on.

The coast between the Portuguese towns of São Vicente and Santos and the most southerly Tupinambá village of Ubatuba was a no man's land according to Staden in the 1550's. So wide a distance between antagonistic tribes, 125 km of shore line, seems unusual. There was perhaps 30 km of space between the Tupinambá at Cape Frio and the Waitaká beyond them. It seems possible that the Portuguese, with their Tupiniquim allies, had widened the distance separating them the Tupinambá by more persistent

(14) — Willeke, Venâncio *Missões franciscanas no Brasil (1500-1975)* Petrópolis, RJ, 1974, pp. 20-29.

(15) — Abreu, Capistrano de *O descobrimento*, p. 52; Almeida Prado, *Primeiros*, chapter 3.

(16) — Almeida Prado *Primeiros*, p. 108.

and effective slave raiding, and by passing European infectious diseases across the battle lines. If these conjectures are correct, the Tupinambá of the littoral would have been more numerous at the beginning of the sixteenth century, occupying a wider swath of the coast as well as occupying it more densely.

Tupinambá protein supply

It may be possible to approach the question of contact population by assessing the food resources of the region in the subsistence of the Tupinambá. The accounts of the Europeans, from the Vespucci letter of 1502 onward, display amazement at their physical vigor, with allowed them to run through the forest or to row war canoes from dawn to dusk. The Tupinambá were obviously not on starvation rations, so that a calculation of their resource base must assume that it provided them a fully adequate diet. It will be shown below that higher density of population could have been achieved within the agricultural techniques of the Tupinambá, if caloric needs are all that is considered. Their plant cultivates included protein sources—maize, several species of beans, and peanuts, as well as wild nuts. But they appear to have depended little on these sources. Instead they obtained most of their protein from fishing and shellfish gathering and from hunting.

It may be supposed that at the time of the European invasion the entire coast from Cananéia inlet to Cape Frio possessed highly productive fishing grounds. The sambaqui-dwellers had attained a moderate density by feeding almost entirely on shellfish. It was easy to garner oysters, shrimps, crayfish, clams and mussels from the mangrove forests that ringed the bays, including Guanabara. Iguape is still one of the world's most important spawning grounds of mullet of several species, and their arrival there in May and June was probably the principal reason why the Guarani villages in Paraná maintained their access trail to that inlet. Probably all the estuaries and inlet were once as rich as Iguape, and Iguape, it may be supposed, is considerably degraded from its former state. Guanabara Bay was visited by great schools of whales from June through September, where they may have spawned and fed on we know not what fish and krill stocks (17).

Of all the early chroniclers, only Francisco Soares seems to have been a fisherman. He listed 24 species of fish in Guanabara Bay, most of them edible, and remarked on the abundance of all of them. He listed squid and octopus (but said there were few), crabs (8 kinds), oysters ("many"),

(17) — Caldeira, Pedro Soares *O corte do mangue; breves considerações sobre o antigo e actual estado da Bahia do Rio de Janeiro...*, Rio de Janeiro, 1884, pp. 5, 7; Soares, *Coisas notáveis*, 1:183, 185.

mussels (4 kinds), cockles, and conchs ("many and of many kinds"). He also counted 8 species of freshwater fishes and 3 of freshwater shrimps (18).

The Tupinambá were probably limited in their ability to catch fish, especially deepwater fish. They did have hooks and lines, but also used barbed arrows, poisons, nets and weirs, and drove them into shallows with sticks. The Europeanized inhabitants of Rio de Janeiro were practicing the same techniques at the beginning of the seventeenth century. Its municipal council licensed the kill of mullet in the Magé River. This was carried out by 2,000 persons, at the time nearly all the city's inhabitants (19).

The Tupinambá preserved fish by barbequeing and grinding to a kind of meal. They favored the winter months of fish runs for warfare, since it was then easier to mount expeditions along the coast.

The mammalian biomass of a number of South American habitats has been estimated. These estimates suggest that floodplain or estuarine habitats are more productive than those of the highlands, a conclusion that did not escape early observers. Gandavo reported in 1576 that Vitória, in Espírito Santo, situated on a river island a few kilometers from the sea, had "infinite fish" and "in consequence infinite game of which the inhabitants are well provided" (20).

An estimate made by an animal rescue team on a Surinam river in the 1960's included 17 species of more than 3 kg body weight, with a biomass of 2,257 kg/km². This was an undercount because many animals which are swimmers, like capibaras, avoided rescue, while many of the smaller animals were entirely unnoticed. The river may also have been already subjected to extractive hunting practices and to deforestation. The true mammalian biomass may have been 50 percent greater, say 5000 kg/km². On the Tupinamba coast mamalian prey would have included several species each of marmosets, monkeys, deer, sloths and peccaries, agoutis, armadillos, anteaters, and felines, plus capibaras, tapirs, pacas, and otters. The Surinam rescue operation, although incomplete, is the closest approximation available at present of the region under study, although it might be supposed that the Tupinambá littoral was somewhat more productive because of its large estuarine habitats, bringing together fresh and salt water species. Of this larger mammalian biomass, a harvest ratio of 10 percent would seem to be

(18) — Soares, *Coisas notaveis*, 1, pp. 49, 193, 195, 199, 201, 203, 205; André Thevet, *Singularidades da França Antartica a que outros chamam de América*, São Paulo, 1944, pp. 169, 172, 188.

(19) — Nóbrega, Manuel da *Cartas do Brasil e mais escritos*, Coimbra, 1955, p. 22n.

(20) — Gandavo, Pero de Magalhães *Historia da Provincia Santa Cruz*, Lisbon, 1858, p. 12.

sustainable, considering all the species together. Assuming that usable protein represents one-tenth of body weight, then 50 kg/km² was available in similar South American habitats (21).

It can be calculated that adult Tupi required 52 g and children 38 g of protein a day, or an average 16.2 kg per person per year. Assuming 15 kg of this amount would have been derived from animal sources, then the Tupi might have attained a density of 3.3 km², considering only larger mammalian prey. That was only a part of the hunting stock of the Tupi, however. They were observed to eat rats, low in yield per unit of effort, but prolific, and therefore high yielding. Hunting for rats, along with activities like nest raiding and the stalking of small birds and lizards, was carried out by small children, for whom it was a more productive activity, and provided most of their protein supply. Hunting for larger birds, both native and migratory, must have been a highly rewarding form of hunting. The Tupinambá also consumed amphibians and reptiles, including turtles, crocodiles, and snakes. The swarming in October of leaf-cutting ants, of the genus *Atta*, a very common insect, provided several weeks of feasts. There may have been other insects the Tupinambá also consumed. It does not seem unreasonable to suggest that the yield calculated for the larger mammals might be doubled to take into account these other sources of animal protein, for a potential human density of 6.6 km² (22).

Fish and shellfish resources must have been at least as abundant as game and gamebird stocks, since the former were lower on the food chain and largely explain the presence of the animal and bird population in the

(21) — For contemporary lists of animals hunted see Soares, *Coisas notáveis*, 1, pp. 103, 115, 119, 135; Gandavo, *Historia*, pp. 25-26; for modern accounts, Métraux, "The Tupinamba," p. 100; Valverde, Orlando *Geografia agrária do Brasil*, Rio de Janeiro, 1964, p. 261. Walsh J. and R. Gannon, *Time is Short and the Water Rises* Camden, NJ, 1967, cited in John F. Eisenberg, *et. al.*, "Density, Productivity and Distribution of Mammals in Two Venezuelan habitats," in Eisenberg, John ed., *Vertebrate Ecology in the Northern Neotropics*, Washington, 1974. See also Eisenberg John F. and Richard W. Thorton, Jr., "A Preliminary Analysis of a Neotropical Mammal Fauna," *Biotropica*, 5, 1973, No. 3, pp. 150-161; Fittkau, E. J. and H. Klinge, "On biomass and the Structure of the Central Amazonian Rain Forest Ecosystem," *Biotropica*, 5 1973, No. 1, pp. 2-14. Usable protein ratio combines United States, Department of Agriculture, *Agricultural Statistics, 1981* Washington, 1981, pp. 320, 321, live and dressed weights for hogs and sheep, and Hansen, R. Gaurth *et. al.*, *Nutritional Quality of Foods*, Westport, CT, 1979, pp. 257-273, protein yields, various meats.

(22) — Thevet, p. 187; Protein requirement based on body weight for males of 65 kg, and 52 kg for women, an average 25 kg for children. Cf. Cook, Sherburne F. and Woodrow Borah, *Essays in Population History*, Berkeley, CA, 1979, 3, p. 149, for Mexican populations. Protein allowances from *Recommended Dietary Allowances*, 9th ed., Washington, DC, 1980, pp. 46-48. On game birds see also Silva, José Carneiro *Memoria topographica e historica sobre os Campos dos Goitacases*, 2d ed., Rio de Janeiro, 1970.

region. Vespucci was under the impression that the Tupinambá hardly hunted at all, which suggests the relative importance of fish and shellfish in their diet, in spite of the availability of game. A combined protein supply adequate to support a population of 13.2/km², then, seems a not unreasonable estimate for the Tupinambá coast (23).

Population Control and Ritual Cannibalism

Since the Europeans admitted that the Tupinambá were more vigorous than they, it would appear that a density of 13.2/km² was not reached, if that was the limit, although there are signs that it was occasionally approached. Staden on one occasion mentions that his captors had nothing to eat in the village. He was probably referring to an absence of fish or game. Since the Tupinambás' technique for preserving fish and game was inadequate, and since the return to effort in hunting and fishing fluctuated unpredictably, a given village might well experience intermittent shortages, although their supply might be generally adequate (24).

The ritual practice of murdering captives and eating them might be considered a response to protein shortage, implying that the approach to limit of food reserves was narrow and constant on the Tupinambá littoral. The ritual of murder and cannibalism was the central drama of the Tupinambá social order. A male could not marry until he had killed a captive, thus the formation of families and procreation was dependent upon the ritual. Males, especially chiefs, encouraged each other to kill more captives in order to acquire more honor.

This practice helps largely to explain the rapid expansion of Tupi-speaking tribes which engaged in it, since it encouraged skill and bravery in warfare. Success in raiding other villages might have a very favorable effect on food supply, even though not directly through the consuming of the enemy. But the Tupinambá also carried on this form of warfare against other Tupi-speakers, suggesting a form of population control. The practice would have required that all Tupi villages would have to lose a quarter of the population so that a given generation of Tupi might wed. Evidently this requirement would delay marriage, and by provoking a decline in males, would reduce conceptions. The ritual sacrifice did not have to be a male. Observers saw captive women and children also killed for the ceremony. Nevertheless it may be supposed that there was a preference for male victims, since the village that did not capture its neighbors' males would soon be at a serious disadvantage in warfare.

Calculating the number of captives needed by each village at 171 (one per woman, ie one for each marriage ceremony), over the reproductive

(23) — Vespucci, *El nuevo mundo*, pp. 146-148; Thevet, p. 188.

(24) — Staden, *Viagem*, p. 170.

life span of each generation of 18 years, and quantity of usable protein per victim at 6 kg, then each villager would receive only 95 g per year, or a mere 0.6 percent of his requirements. Furthermore it is recorded that the victim was often held for months before his sacrifice, and that neighboring villages were invited to join in celebrations for a week or two before. Obviously there was no net gain in protein (25).

Since males were the preferred victims, a shortage of males was constant. This is to be seen in the practice of polygamy among the chiefs and principal warriors, and in the practice of bestowing excess unmarried women on the European visitors. The hope of the villagers was that the visitor would remain to help defend the village, but even when he didn't, such women continued to be identified as their wives, in the expectation that the village would gain at least their occasional collaboration.

The shortage of males does not seem to have been as great as it might have. Possibly this is because the ritual was not or could not be actuated as thoroughly as desired. The honor accruing from the death of a victim might be shared. The killing of a jaguar was as honorable as killing a man, though given the density of human population postulated above, it is not likely that many jaguars could be found to kill. Certainly the killing of female captives would help to balance the sex ratio.

The killing of female captives was a sign that the coastal Tupinambá were approaching some lower limit of the carrying capacity of their environment. It suggests that the villages which engaged in this practice had no need of additional female labor because it would not add proportionately to output, or, stating the relationship another way, that the males of the village would not be able to provide securely the additional supply of animal protein that would be necessary (26).

Tupinambá Gathering and Agricultural Resources

The gathering of wild plants and plant cultivation supplied the Tupinambá with an adequate supply of necessary nutrients, excepting protein. A small amount of protein was available from gathered species, notably cashew nuts and *pinhões*, the "pine nuts" of *Araucaria angustifolia*. The latter is a highland tree, but the Tupinambá made seasonal visits to arau-

(25) — *Monumenta Brasiliae*, 1:227; On protein content, see Stanley Garn and Walter Block, "The Limited Nutritional Value of Cannibalism," *American Anthropologist*, 72, February, 1970, 106. I am indebted to Charlotte Revilla for this reference.

(26) — Gandavo also noted that some Tupi women did not marry at all but cut their hair like males, became warriors and took wives. Tupi women, he claimed, did not wean their children for 7 to 8 years. The consequences for population control are evident in these practices. *Historia*, 47, 48.

caria stands on the coastal escarpment. A list of food-bearing trees on the littoral would include at least 41 species. Some, perhaps most, of these trees were re-planted near the villages, a sort of incipient cultivation. The forest also yielded honey, obtained easily with the use of fire from several species of stingless bees (27).

The staple cultivate was cassava, the bitter variety. Other root crops—cará (*Dioscorea spp.*), mangara and taioba (*Xanthosoma spp.*), jacatupé (*Pachyrhysus bulbosus*), and sweet potatoes (*Ipomoea batatas*), were cultivated. Sweet cassava and maize were grown for the brewing of beer, and pumpkins, several species of pepper (*Capsicum spp.*), and pineapple were cultivated, as well as beans and peanuts. Cassava could be left growing underground for two years or more, or left above ground in storage, or it could be preserved for a considerable time in the form of smoked, toasted cakes. The different varieties cultivated by the Tupinambá were intended for use in different soils, and for differing periods of growth to maturity (28).

Cultivation was carried out in patches which had been cut and burned in forested land, either primary or secondary. The fertility of this land was sufficient to permit a subsistence supply from a plot of 0.1 to 0.3 ha per person, taking into account losses from insects and animal pests. These plots were abandoned quickly, after 2 to 4 years, because the Tupinambá had no adequate means of combatting weed species that would invade the patches. They therefore allowed succession to climax to resume, meanwhile continuing to exploit the patch in the gathering mode. When the forest had regrown sufficiently to have eliminated grasses and other weeds, within 30 years more or less, the patch could be cut, burned and planted once again (29).

(27) — See lists of fruits in Métraux, "The Tupinamba"; Liberalli, Carlos Henrique "Nossa flora, nossa história," *Estudos Históricos* 1971, n. 10, pp. 43-63; and Valverde, *Geografia*, 256-259.

(28) — To the sources listed in the preceding footnote, add F. C. Hoehne, "Jacatupé," *Boletim de Agricultura*, 39, 1938, pp. 753-754. The most extensive contemporary description of Tupi cultivates is found in Souza, Gabriel Soares de *Tratado descritivo do Brasil em 1587*, 4th ed.; Sao Paulo, 1971, pp. 172-184.

(29) — Description of techniques in Cardim, Fernão *Tratados da terra e gente do Brasil*, 3rd ed., São Paulo, 1978, p. 112. For modern calculations, see Hermann von Ihering, "Os machados de pedra dos índios do Brasil e o seu emprego nas derrubadas de mato," *Revista do Instituto Histórico e Geográfico de São Paulo*, 12, 1907, pp. 426-436; Clastres, *La société* p. 82; Carneiro, Robert L. "Slash-and-Burn Cultivation Among the Kuikuru and its Implications for Cultural Development in the Amazon Basin," in Gross, Daniel ed., *Peoples and Cultures of Native South America*, Garden City, NY, 1973; Wedelt, "Der Brandhackbau in Brasilien und seine Auswirkungen auf die Waldvegetation" (PhD. Dissertation in Forestry, Georg-August University of Göttingen, Munden, 1968).

Taking the higher estimate of cultivated land per capita — 0.3 ha, surpluses would be available for storage, trade among the village and yearly festivals. When Martim de Souza anchored in Guanabara Bay in 1531, no difficulty was reported in securing a year's supply of food for his 400-man expedition. Later on the provisioning of ships returning to Europe was customarily done by the Tupinambá. The average village, then, maintained about 182 ha under cultivation, of which 61 ha was put into production each year and another 61 was removed, on average. About 1820 ha more, then, had to be held in reserve. A village therefore required some 20 km² to carry on agriculture, suggesting a higher density of population, 30/km², was possible through agriculture, than under the hunting and fishing regime if 13.2/km² is an accurate representation of that resource (30).

Protein capture would appear to be the more limiting factor, however farming and hunting and gathering were inter-related, since most of the hunting probably took place in successional forest. The two estimates of density ceilings are not separated by a large interval, which suggests both interrelatedness and a balance in the effort expended in maintaining yield from these two regimes.

It seems reasonable to hypothesize that the population of the coastal Tupinambá may have and could have been higher than the estimate for 1555, but that its size would have been lower than 13.2/km² representing the limit of animal and fish productivity. A density will be posited here of 9/km², which would not quite double the lower estimate for 1555. The 101 total population would then have been about 103,000 and the rate of decline a little less than 0.85 percent per year (31).

Labor Exploitation

The decline of Tupinambá population is easy to observe from the mid-1550's. The direct causes were warfare, epidemic disease, and social disruption. But the reason underlying these phenomena was the European demand for Tupinambá labor, and underlying that demand was the expansion of mercantile capitalism.

The presence of the Portuguese on the Tupinambá coast was at first motivated by the desire to hold a position that might secure a passage to China, or to the fabled gold mines of the interior. In the meantime they dabbled in the slave trade, a commodity whose utility seems to have been at first as purely ornamental as the parrots and monkeys they also acquired.

(30) — Souza, Pero Lopes de *Diario de Navegação... pela costa do Brasil...*, Rio de Janeiro, 1867, p. 33.

(31) — Denevan's estimate was 9.5/km² for coastal habitats. Denevan, *The Native Population*, p. 219.

Meanwhile at Cape Frio they loaded as well a few tons of brazilwood each year. The French who quickly followed them there apparently took no slaves, but they expanded considerably the search for brazilwood, and traded in cotton and skins as well (32).

The Tupinambá were pleased to receive iron weapons and tools in return. Iron axes shortened labor time in forest clearing and iron hooks greatly increased the efficiency of fishing. The French did not hesitate to add firearms to their stock in trade. The nature of this barter, as far as the Tupinambá were concerned, was not that of a simple exchange of goods without money, but implying money equivalents. Barter exchange in which one side accumulates capital and the other side lacks even the concept must end impoverishing the non-accumulators. Furthermore, the Tupinambá thought of these exchanges as ceremonial. The axes were token of friendship, in return for which they were willing to respond by feeding a whole ship's company or filling it with brazilwood. The friendship was further cemented by bestowing daughters of the tribe in marriage, or by turning over prisoners they had won in battle. The Europeans were unable or unwilling to recognize the commitments they made by accepting these gifts, although they took full advantage of them. (33).

The Europeans could not survive on this coast through their own efforts alone. They depended on the Tupinambá to supply them with food, otherwise they starved. "The *Indian* is a fish in the Sea, and a Fox in the Woods, and without them a *Christian* is neither for pleasure or profit fit for life or living." So declared Thomas Turner, described by Samuel Purchase as one who had "lived the best part of two yeeres in Brasill, &." Nearly all the Europeans were able to acquire Tupi women, whom they regarded as their mistresses, and who were their all-round servants, planting, harvesting, processing and cooking their food (34).

The building of the first sugar mill in São Vicente in 1532 brought to an end the first precarious phase of labor exploitation. Sugar milling required steady labor from the Indians on land removed definitively from Indian reserves. More labor was needed to raise food for the sugar workers and to transport that food to the plantations and the sugar to the docks.

(32) — Neme, *Notas*, p. 65.

(33) — See Nóbrega's appalling discussion of the morality of Tupi selling themselves and relatives into slavery, for a case of the usual misconstruction by Portuguese. *Monumenta Brasiliae*, 4, pp. 401-414. Use was made of Tupiniquim as intermediaries in procuring slaves from remote tribes. They were called *pombeiros*, after the pigeons that lured other pigeons to the roost. Cortesão, *A fundação*, p. 135.

(34) — "Relation of Master Thomas Turner who lived the best part of two yeeres in Brasill, &." in *Hakluytus Posthumus*, 4 p. 1243. Nóbrega found hunger in Bahia in 1558, for lack of "some one to make the food," and because of an over-supply of "idlers to eat it." *Cartas*, p. 283.

The Tupiniquim were set to making war on their neighbors to obtain these slaves. Or they engaged them as agents to barter for them. The word *resgate*, or “rescue” came to be employed, since the convention was that the slaves thus acquired had been rescued from cannibalism (35).

It is difficult to image how the Portuguese managed to impose a regime of steady field labor on people who had never had to experience it. One technique was an adaptation of the Tupi practice of intensive cooperative labor, rewarded by the serving of an alcoholic refreshment (36).

Introducing slave capture for the purpose of labor exploitation heightened the level of warfare among the tribal peoples. Villages which took captives in battle had always had to prepare for retaliation from the victimized tribe. The Tupiniquim therefore drew closer to the Portuguese settlements and the Portuguese had to prepare for their defense. The Tupiniquim, furthermore, would have to assist them to repress their field slaves, who might rebel. Waves of attacks and counter-attacks engendered a protected satellite population, the Indians of the *aldeias*, or “villages”, a word that acquired the exclusive meaning of a Portuguese-administered Indian settlement, turned over, usually, to missionary control (37).

Settlement in *aldeias* implied the obliteration of Tupi culture, however. The Jesuits, who arrived at São Vicente in 1550, demanded the abolition of ritual murder, cannibalism, polygamy, shamanism, and nakedness. They considered permanent occupation in one place essential to efficient and effective Christian indoctrination, and they insisted that the Tupi abandon their long houses and build houses for single families, and, in each *aldeia*, an imposing church and house for the missionary. Permanency of occupation, however, made shifting cultivation impossible and town building and indoctrination, along with personal service to the missionary, were intolerable demands upon their labor (38).

The Tupi continually backslided; the Jesuit Anchieta, frustrated after six years of fruitless evangelization, called for the military conquest of the entire coast, to force the Tupi to accept Christianity by “subjection and

(35) — Magalhães, Basilio de *O açúcar nos primórdios do Brasil colonial*, Rio de Janeiro, 1953. Evidence that there was already an inter-provincial trade in slaves before 1555 is the fact that P.^o Leonardo Nunes' first voyage to São Vicente in November of that year was with a group of Tupis whom he had liberated from their owners in Bahia and was returning to their homes.

(36) — Cardim, *Tratados*, p. 109.

(37) — On aldeamentos see Pasquale Petrone, “Os aldeamentos paulistas e a sua função na valorização da região paulistana,” (Livre-Docência Dissertation in Geography, University of São Paulo, 1964). On the work regime, Leite, Serafim *História da Companhia de Jesus*, Lisbon, 1938-1950, 2 pp. 42, 92-94.

(38) — Nóbrega, *Cartas*, pp. 282-283; Willeke, *Missões*, pp. 126-127.

terror," since they would receive it no other way. The crown had meanwhile come to the same conclusion. São Paulo and São Vicente were precariously held as long as the Tupinambá were supplied by the French. In 1560 a Portuguese expedition conquered the French colony at Rio de Janeiro, and three sugar mills were immediately built there (39).

In the meantime the Tupiniquim had risen against the Portuguese at São Paulo. The aldeias were so temptingly handy a source of labor that the colonists at São Paulo and São Vicente had gradually turned the villagers in them into slaves as well. The rebellion was put down, but the inhabitants of São Paulo had lost their principal ally. Most of the villagers fled and reverted to tribal living. The plantations of Rio de Janeiro and São Vicente were stocked with a fresh gang of slaves, now both Tupiniquim and Tupinambá.

The war against the Tupinambá was not ended. A second campaign destroyed their tabas at Cape Frio in 1574, and by 1582 the Tupinambá had entirely withdrawn from the coast, retreating to the highlands of the interior. Meanwhile, in 1581 and again in 1585, expeditions were sent from São Paulo to attack the highland Tupinambá villages in the Paraíba do Sul valley. The captives were taken to aldeias near Rio de Janeiro and São Paulo, to form a reserve labor pool, or were forced to work on the sugar plantations.

Epidemics

Epidemic outbreaks before 1554 remain conjectural. The pattern of epidemic from that year forward are clear and suggest that others might have already occurred. The first epidemic mentioned by European observers in this region was that of July to September 1554. No specific disease was noted. In 1555 Staden mentioned the sudden death of all the members of a chief's family and Léry described a disease he thought similar to smallpox, but more virulent, and attacking only the Indians. In February 1559 Espírito Santo was struck by an epidemic of hemorrhagic dysentery and lung infection, which had proceeded up the coast from Rio de Janeiro. Indians fleeing their villages had carried the epidemic with them. There it was reported that 600 died, of a population that may be estimated at no more than 3,000, including the aldeias, a loss of 20 percent (40).

(39) — *Monumenta Brasiliae*, 2 pp. 196, 3:255; see also Nóbrega, *Cartas*, 278-279.

(40) — João Barbosa Rodrigues mentioned an epidemic of 1550, without citing the source, in "A diminuição das águas no Brasil...", III Reunião do Congresso Científico Latino-Americano, *Relatorios, Livro A*, Rio de Janeiro, 1905, p. 175; *Monumenta Brasiliae*, 2 p. 70 (18 July 1554); 3 pp. 17-45, 4 pp. 460-461; Leite, Serafim *Páginas de Historia do Brasil*, São Paulo, 1937, pp. 200-202; Leite, *História*, 1 p. 569, 571-575; Hemming, *Red Gold*, pp. 140-141.

The military campaigns of 1560 and 1562 greatly disrupted Tupinambá social and economic organization. Captives were transferred from Guanabara to São Paulo and to Espírito Santo. This disruption, and the probable decline in food supplies, may be considered the proximate cause of the next great epidemic outbreak, which began in São Vicente in 1561 and continued along the coast through 1564. The terror provoked by the epidemic may have been a motive for the Tupiniquim uprising of 1562. The epidemics of 1561 to 1564 included hemorrhagic dysentery, lung infections, and smallpox (41).

The epidemics raged uncontrolled. Not only were the Tupi without any resistance to European diseases, the countermeasures of the Jesuits, mainly bleeding, were entirely counter-productive. The tendency of the Indians to flee, when this did not result in the spread of the epidemic, at the least exposed the Indians to a precarious survival in the forest, without fire, shelter or food. Although the Tupinambá hesitated to eat captives who showed signs of illness, they did not, as Staden observed, necessarily restrain their customary vengefulness. The epidemic was usually followed by a period of famine. Obviously hunting must be carried on almost every day, since little is stored, but the supply of plant food was just as critical. Cassava was normally left in the ground to be dug up as needed. When the women of the village all fell ill, that laborious task, along with scraping, drying and roasting, were all left undone. It appears that there was a tendency for the epidemic to break out, or rage most strongly, in fall, from March to June. Perhaps this reflects seasonality of protein supply as well as lowering temperatures, or perhaps seasonality in the arrival of ships from Europe. In the sub-tropical to tropical climate, however, there was no reason why the epidemics could not go on unchecked from one year to the next (42).

The eye witness estimates of deaths in the great epidemic from 1561 to 1564 were fragmentary and vague. The Jesuits who made these estimates did not consider physical death a significant matter, except in relation to the drama of salvation. The unregenerate and the backsliders "suffered the vengeance of God," while the catechumens were "called to Him," with heavenly dispatch, to forestall backsliding by them as well. Their counts were of the number of deaths in each aldeia, and they mentioned only that there were 3 or 4 a day, or 3 or 4 or more, or 5 a day, or that no house was without a stricken member, sometimes 3 or 4 were stricken in each house. It was noted that "a great part" of the slaves at São Vicente died (43).

(41) — *Monumenta Brasiliae*, 3 pp. 379, 451, 454-455, 4 pp. 178, 267-269; São Paulo (City), Arquivo Municipal, *Atas da Câmara Municipal*, São Paulo, 1914, 1 p. 40.

(42) — Staden, *Viagem*, pp. 127-129.

(43) — *Monumenta Brasiliae*, 2:107, 108.

The epidemics left the sugar plantations at São Vicente and São Paulo once again short of labor. The response of the Portuguese was to accelerate their slave raiding activities. Their raids provoked further mortality among the Tupi who were still their allies, both in battle and from disease. In a later account, of 1607, a raider complained petulantly that he had lost 240 "servants" on a fruitless search for slaves in the interior of São Paulo. Raids in the early 1570's in São Paulo produced a levy of Tupi or Goianá slaves who were transferred to Rio de Janeiro, and the final assault on Cape Frio yielded a large gang of Tupinambá slaves to send to São Paulo (44).

The cycle of epidemic accelerated as a result of nearly constant raiding. In the late 1570's epidemics again provoked severe labor shortages on the coastal plantations. The settlers at São Paulo petitioned the governor to lead an expedition into the interior, complaining of wrongs done against them a generation before. This the governor did, and again the Tupiniquim of the interior rose up in rebellion. Although the Jesuits tried to prevent that aggressive expedition, and the governors for a time gave no further encouragement, a series of private raids was then staged, in the 1590's, to restock the aldeias and to provide labor for the coastal estates. Again, in 1597, an epidemic outbreak occurred.

Before the end of the sixteenth century the Tupinambá were nearly extinct on the littoral of Rio de Janeiro, and the Tupiniquim were nearly extinct on the São Paulo littoral. The aldeias around Guanabara Bay contained perhaps 1,000 Tupinambá. The aldeias around São Paulo and the sugar plantations of São Vicente may have held another 1,000. It is not possible to estimate how many Tupinambá retreated inland, if in fact any appreciable number did so. Knivet's encounter with a Tupinambá village somewhere in the interior sometime in the 1590's may have been fanciful, but in any case his count of their numbers was surely greatly exaggerated. If it is guessed that by 1600 there were 7,000 survivors among the Tupinambá resident on the coast 45 years before, it must be admitted that they had lost their cultural identity or were much reduced in their material circumstances. For the second half of the century, then, a decline twice as fast as that of the first half had taken place, 1.8 percent per year (45).

Environmental Transformation

If the Tupinambá maintained a population density of 9/km² on the littoral of Rio de Janeiro for five centuries, they must have provoked

(44) — Machado, Alcântara *Vida e morte do bandeirante*, São Paulo, 1965, p. 179.

(45) — Later population estimates in Serrão, *O Rio de Janeiro*, 1 pp. 180-181; Soares, *Coisas notáveis*, 1 p. 11; and Cardim, *Tratados*, pp. 209, 210. See also Fernandes, *Organização*, pp. 31-32.

changes in a considerable part of the coastal forest. At that density of human population, the forest might have been cleared once every 110 years. That would have been a period of time more than adequate to provide for the restoration of the conditions needed to maintain the Tupinambá agricultural regime. But it may not have permitted return of forest to its climax state, since that process takes longer. The restoration of a tropical forest to climax has never been observed, even indirectly, but very likely it requires more than 100 years—perhaps 150 or 200 years. It may be that the concept of a return to climax is not realistic and that tropical forests never return to a state identical to the original state (46).

The Tupinambá, however, may have spared part of the original forest, because primary forest was very difficult to fell with stone axes. Instead they may have preferred to cut secondary forest more frequently. Such a practice would have permitted the maintenance of a broader resource base, since the species of the primary and secondary forests differ, and more frequent burning in recently farmed patches would encourage invasion by game animals and some of the more highly productive plant species. Each village's forest reserve, then, may have included both primary and secondary forest in various stages of regrowth.

The Tupinambá may have altered the forest even more by burning it during the hunt. It is not possible to estimate the extent of this practice, but it is likely that it was carried on. Again, secondary growth was more desirable for this purpose, and was more vulnerable to burning.

It may be, as the result of fire used for either or both of these purposes, that along parts of the coast, for example on sandier soils, that the forest had been permanently transformed into a scrub or grassy formation, a fire climax. The removal of the forest cover in such places would have the effect of degrading further the mechanical and chemical properties of the soil, so that the forest was not able to initiate its successional stages, or to go very far with them. Some geographers consider all such formations anthropogenic, and many more consider them fire-induced. The Europeans did find open fields in the highland around São Paulo, and on the coast from Cape Frio northward to the Paraíba do Sul River (47).

Brazilwood (*Caesalpinia echinata*), is a species about which astonishingly little is known, considering its former economic value and the historical curiosity concerning it. It appears to be mesophilic (preferring a soil neither very wet nor dry), and it was quite common in the forests between

(46) — *Tropical Forest Ecosystems*, Paris, 1978, pp. 229, 230.

(47) — von Ihering, Hermann "A distribuição de campos e matos no Brasil," *Revista do Museu Paulista*, 7, 1907, pp. 129-132; Rawitscher, Felix "Problemas de fitoecologia com considerações especiais sobre o Brasil meridional," *Boletim da FFCL-USP*, No. 41 (Botânica, No. 4), 1944.

Rio de Janeiro and Cape Frio. It grew on islands in Guanabara Bay. Dansereau suspected that it may be a tree of the cubclimax, since it could be found in relatively pure stands. Such a conclusion would be strong evidence for the widespread transformation of the coastal forest by the Tupinambá, and an indirect proof of high population densities before 1501 (48).

It is not suggested that the Tupinambá had altered their environment so as to have reduced its capacity to maintain their numbers, but they may have induced the spread of a forest and sub-arboreal vegetation quite different from that which would have occupied the littoral in their absence.

The arrival of the Europeans provoked further alteration in the forest. The cutting of brazilwood, in itself, probably had little effect. The amount that was cut around Cape Frio was not very great. Under the Portuguese contracts, sixty tons a year was cut, the cores of perhaps 120 trees. But brazilwood was cut at several ports to the north as well, so that the harvest at Cape Frio was much less. The French may have tripled the Cape Frio output, but even so all this activity up to 1555 would have come to no more than 5,000 trees. If brazilwood was indeed to be founded in relatively dense stands, then no more than a few hundred, or a few dozen hectares were disturbed.

The axes that were traded to the Tupinambá did not inspire them to increase their felling of trees. According to European observers they simply reduced the time they devoted to forest cutting and increased the time devoted to feasting and making war. The Tupinambá accepted few of the European domesticates that were proffered them. They planted bananas and sugar cane, and were delighted with chickens, for feather ornamentation, not for their meat. This curious adaptation, which may very well have been a reversion to the original motive for domesticating the chicken, suggests that by the 1530's when it occurred, the Tupinambá were not concerned to acquire an additional handy supply of protein (49).

The establishment of sugar plantations had severe local effects in São Vicente and Santos. The cutting of mangrove in the channels of the estuaries, to burn lime and to boil down the cane syrup, caused the silling of

(48) — Souza, Bernardino José de *O pau-brasil na história nacional* (Intro. by Artur Neiva), 2d ed.; São Paulo, 1978; Alemão, Francisco Freire "Apontamentos sobre a conservação e corte das madeiras de construção civil," and "Carta a von Martius, Rio 30 Novembro 1849," both in *Anais da Biblioteca Nacional*, 81, 1961, pp. 135, 185; Dansereau, Pierre "The Distribution and Structure of Brazilian Forests," *Bulletin du Service de Biogeographie*, (Mar. 1948), No. 3, p. 13.

(49) — *Monumenta Brasiliae*, 1:445. Pe. Correia in this letter, dated 1553, advocated withholding iron tools, which would provoke famine among the Tupi, until they converted!

the channels. This was noticed in 1585 by Anchieta, who also complained of the increasing sterility of the land in the region. A much greater impact was produced by the introduction of cattle. They were brought to São Vicente only a year after the first sugar mill began to operate. They had little pasture on the littoral and so were led to the open fields around São Paulo, and later to the great plain on the coast north of Cape Frio. On these grasslands they multiplied marvelously, providing a steady supply of meat, tallow and hides. They also nibbled at the forest margin, preventing its regeneration as farm patches were abandoned. Year by year the open fields expanded and soil erosion proceeded (50).

The terrible death toll among the Indian population turned all the coastal plain and much of the interior into a no man's land. Over the next two centuries many areas not visited by cows, or even by humans, must have seen the regeneration of forest. Only very gradually was this space replenished by a mestizo population, hardier and under European control, but curiously exhibiting more traces of Tupi than European culture. This population practiced a form of agriculture that included European domesticates — pigs, citrus, figs, and even wheat in highland São Paulo — but was basically Indian, since it depended on shifting patches of farmed land, cut and burned from the forest. The mestizo, however, was able to intensify his attack on the primary forest, since his iron axes were so much more effective than stone axes. His iron-bladed hoe, furthermore, made it possible to continue to farm the same patch for several years, until its fertility had declined much further than under Tupi cultivation. Under these conditions, forest succession did not resume and erosion and ineradicable weeds took over that were of slight nutritional value even to the relentless semi-wild cattle (51).

The density of this mestizo population was perhaps not much higher than that of their Tupi predecessors. The São Paulo council prohibited, in 1583, the building of homesteads closer together than 660 m (52). This implies 43.56 ha per household, or (calculating a household size of 5), 11.4 persons/km². Since Tupiniquim settlement in the highland had probably not been as dense as that of the coast, this suggests a somewhat more efficient agriculture. Nevertheless, it was not possible to sustain towns in the highland or on the littoral much larger than the former *tabas* of the Tupi. Throughout the colonial period only Rio de Janeiro and São Paulo, supplied in part by imports, were able to escape that limitation.

(50) — *Atas da Camara Municipal*, 1 pp. 99, 119, 122-123, 141, 181, 185. Leite *Historia*, 1 p. 262.

(51) — Machado, Alcantara, *Vida e morte*, p. 60 (on wheat); Sousa, Soares de *Tratado*, pp. 166-168, and Cardim, *Tratado*, pp. 67-68, 209.

(52) — *Atas da Camara Municipal*, 1:201.