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The Epidemiology of Infectious Diseases among South American Indians: A Call for Guidelines for Ethical Research

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With alarming frequency, the native peoples of South America continue to become victims of neglect and abuse. Such incidents rarely come to public attention, and in the few instances in which we learn about them remedial action is rarely taken. Who is to blame for this and what can be done to prevent the extinction of indigenous groups during the 21st century are simple questions for some social critics—notably Patrick Tierney, author of the recent and much publicized book *Darkness in El Dorado* (2000). Unfortunately, Tierney's journalistic enthusiasm for sensational allegations directed at a few individuals trivializes the complex causes of the plight of the region's native peoples (Hurtado 1990) and draws attention away from the kind of analysis that can produce lasting solutions.

One of Tierney's most serious charges is that medical scientists and anthropologists caused epidemics among the Yanomamo of Venezuela over 30 years ago. Journalists are not trained to decide such things; epidemiologists are, and they are unlikely to claim to know what caused an epidemic many years after it took place. They find it difficult enough to do so in the midst of an epidemic. The work is very time-consuming and costly and requires experts from multiple public health disciplines with a great deal of experience in collecting and analyzing valid and accurate quantitative data. We may never know the who, when, and how of the origins of the measles and malaria epidemics of the mid-1960s in Yanomamo communities, just as we may never know why a measles epidemic broke out among Angaité communities in the Paraguayan Chaco in January of this year (*Ultima Hora*, January 15, 2001). What we do know is that the vast majority of epidemics occur when medical scientists and anthropologists are absent from these communities.

Tierney's charges could have disastrous consequences. They may give policy makers the false impression that the causes of the poor health of the Yanomamo and other indigenous people are easy for journalists and others to identify. Policy makers so deceived are likely to propose and implement policies that deny South American Indians the right to epidemiological and medical research and intervention. Without adequate knowledge native peoples will not receive the medical care they so desperately need, and without medical care their health will continue to deteriorate, their economic productivity will continue to decline, and their health will deteriorate further (Psacharopoulos and Patrinos 1994).

What policy makers need to be made aware of is the many reasons for the poor health of indigenous people throughout South America. Among the most important insults to indigenous well-being are the complacent and racist attitudes of government officials who approve meager budget allocations for indigenous public health programs, fail to punish rampant embezzlement of scanty funds, and promote proposals that violate native land rights (Centeno 1997). Such complacency intensifies the negative effects on native health of biological host factors such as low genetic diversity and poor immune-responsiveness to infectious agents. Even though a great deal has been published about these and other biological insights since the 1970s (CIBA Foundation 1979), they are generally overlooked by those who plan public health programs or draft guidelines for field research. Consequently, most South American native communities today have not benefited from the scientific research that has been done among them. If indigenous groups have become increasingly hostile to scientists, it is not because medical scientists and anthropologists cause health problems but because these professionals are not helping enough to prevent new problems or to remedy existing ones.

Anthropologists and medical scientists need to be aware of the complex causes of poor health among South American natives in order to make a difference over the long term. Similar biological and social factors influence indigenous health regardless of the number of years that native peoples have lived in close interaction with outsiders, but they do so in different ways depending on the level of acculturation. We will discuss these factors and provide examples of their effects on indigenous health during contact and thereafter. We will go on to argue that this knowledge needs to become part of the process

of developing guidelines for field research. Field scientists who provide little if any medical help are now at risk of being accused of exploiting South American Indians as research subjects—advancing their careers without any concern for their subjects' well-being. This interpretation may be correct in some circumstances but not in others, and at present we lack ways to make this important distinction. This is partly because there are no internationally sanctioned guidelines that clearly specify what constitutes an ethical response to local health problems. Without such standards, anyone who wishes to can easily damage the work of others by accusing them of failing to abide by rules of behavior that they unilaterally decide to be ethical. At the same time, anyone who chooses to be apathetically negligent can do so at will. We will suggest six specific areas of field research that require immediate attention by the American Anthropological Association (AAA). The current guidelines for fieldwork developed by the AAA Committee on Ethics require only doing no harm to the study population, but this is no longer sufficient with native populations. It is time to be specific about what constitutes sufficient concern and action.

Because we are citizens of the United States and teach at a public university in the United States, we address our remarks to our national anthropological organization, the American Anthropological Association. We recognize that similar debates are taking place in other national anthropological and academic organizations in the United States, government agencies in Latin American countries (*El Nacional*, November 24, 2000), and various organizations in other continents.

EPIDEMIOLOGY OF INFECTIOUS DISEASE

The epidemiological profiles of South American indigenous groups vary in complex ways across time and space. This diversity has to be viewed against the background of the host factors that their members have in common. Ironically, James Neel, a scientist accused by Tierney of genocide among the Yanomamo, is one of the main contributors to our current understanding of disease susceptibility in these populations (Neel 1971, 1974, 1977). Among other factors, susceptibility appears to be influenced by low genetic diversity (Black 1990, 1994) and macroparasite-induced immune defense (Sousa et al. 1997).

Lack of genetic diversity is sometimes associated with higher rates of susceptibility to all sorts of illnesses (Carrington et al. 1999, McNicholl et al. 2000, Turner et al. 2000, Zlotogora 1997). On average, indigenous peoples have much less heterogeneity in the highly polymorphic loci that control the immune system, the Class I and II histocompatibility antigens (MHC) and the immunoglobulin allotype genes (Black 1994).

The negative effects of homozygosity on native health may be intensified by parasite loads on immune defense against bacteria, mycobacteria, and viruses. Most indigenous groups of South America tend to be chronically infested with macroparasites such as *Necator americanus* and *Ascaris lumbricoides* (Salzano 1988, Hurtado et al. 1997), and they also tend to produce immunoglobulin IgE at some of the highest levels ever reported for individuals who do not suffer from extremely serious and sometimes lethal anaphylaxis (Hurtado et al. 1999). Indigenous persons with abnormally high levels of IgE are healthy and active members of their groups. IgE-driven defense against parasites competes with defense against infectious diseases such as malaria and tuberculosis because some pathways of immune defense against parasites and against bacteria and viruses tend to be mutually exclusive (Beyers et al. 1998, Hurtado et al. 2001). These high levels of IgE production are only in part related to parasitic infestation, since nonindigenous populations that are equally parasitized show much lower IgE levels.

For the most part, enormous deficiencies in the public health systems of South American countries create conditions that further exacerbate the effects of susceptibility to infectious diseases. Most of these countries invest much smaller percentages of the gross national product in health than developed countries (Pan American Health Organization 1994). Very small fractions of this investment are devoted to the health of indigenous people, and even these limited funds are often embezzled by government officials (*ABC Color*, July 15, 2000).

At the same time, international efforts to control disease are hampered by local problems of distribution and surveillance. For example, Paraguay is notorious for the very high rates of tuberculosis its indigenous communities suffer. Unfortunately, the sources of this information are rural and missionary nurses as opposed to the government-mandated national surveillance officials who are responsible for tracking these epidemics (Hurtado et al. 2001). Cases are rarely treated or are treated in ways that promote drug-resistant tuberculosis (Frieden et al. 1993, Farmer et al. 2000). When Paraguay's National Commission of Tuberculosis Control receives a shipment of tuberculosis medications, it generally keeps them in the capital city or, when it makes them available to rural and indigenous communities, does so without the kind of direct observed treatment program that ensures completion of drug regimens (American Thoracic Society et al. 1992). For these and other reasons prophylactic and prompt curative treatment of tuberculosis is not an option for most Indians in Paraguay. To be treated, they have to wait until they develop active tuberculosis—that is, until they have contaminated family and friends with the airborne bacilli produced by chronic cough.

When scientists bring such disheartening observations to the attention of local officials, they often respond that their (inadequate) surveillance systems show no such pattern and claim that in fact infectious disease rates are low among indigenous communities.[1] Most officials either fail to realize or are unwilling to admit that, while many sectors of society benefit from the epidemiological

1. We base these conclusions on the fieldwork experiences of three of us (Hurtado, Hill, Kaplan) in Paraguay, Peru, and Venezuela over the past 20 years.

surveillance systems mandated to generate information that is used to justify public health expenditures, indigenous communities are almost entirely excluded from these systems because of their remote location and cultural barriers. As a consequence, the knowledge that scientists wish to share with officials about disease rates and disease prevention is infrequently if ever used to inform policy.

Thus, it appears that host factors such as homozygosity and high IgE production, among others, in combination with social factors such as lack of epidemiological surveillance and limited if any access to well-timed vaccinations, sanitation, and medical treatment, cause high rates of infectious diseases among South American indigenous groups. These factors influence the epidemiological profiles of indigenous groups with little if any admixture *regardless of the number of years that they have lived in close proximity to non-Indians.*

THE DEVASTATING EPIDEMIOLOGICAL EFFECTS OF CONTACT

Tierney is correct in stating that the past 500 years of contact between Native Americans and people of European descent have had disastrous consequences for the former. Epidemics have killed millions. Typically, first face-to-face contacts result in the death of between one-third and half of the native population within the first five years of contact (Hill and Hurtado 1996, CIBA Foundation 1979). The majority of South American Indian groups were exterminated in this way during the first two centuries after European arrival in the Americas (Hemming 1978). Unfortunately, the lessons of half a millennium have not resulted in any significant improvement. If a group of native South Americans that had been living in isolation for some time were to make contact today, the result would probably be equally catastrophic.

In Brazil alone, there are still some 30–50 groups living isolated from face-to-face contact with people of European or African descent (the National Indian Foundation [FUNAI] estimated 55 uncontacted tribes two years ago [*Veja*, June 10, 1998]). Others exist in Peru and Bolivia and perhaps in Venezuela, Ecuador, and Colombia. As global economic, social, and population forces drive people into remote areas for the purposes of colonization and resource exploitation, contact is inevitable, but there is no contingency planning for managing its medical, economic, and social consequences.

Remote peoples in South America face three major threats. First, woodcutters, miners, colonists, missionaries, and even representatives of government-sponsored organizations are entering their traditional ranges in increasing numbers. Face-to-face contacts with some members of remote groups will occur as a result of these incursions. Eventually one or more of those contacts will result in the transfer of disease organisms to individuals with little resistance to them. Epidemics will ensue, even among people who never actually come into contact with people of European descent, since the natural response to disease among mobile peoples is to flee to neighboring villages or camps. Second, the habitats of remote peoples are shrinking rapidly. As more areas are colonized, the available habitat to support subsistence is increasingly circumscribed and may eventually be insufficient to support the nutritional needs of the group. In the short run, resource pressure can lead to nutritional stress, disease, and both inter- and intragroup conflict. In the long run, it may result in loss of access to traditional territories as colonists and others establish de facto or legal ownership of them. Third, many local groups have become isolated from other members of their larger ethnic groups because of incursions into their territory. These isolated groups may be so small that they do not constitute viable mating populations (Baruzzi et al. 1979). As a result, small demographic shocks can lead to their physical extinction even without epidemics.

Many anthropologists and indigenous-rights activists believe that uncontacted Indians should be left alone. These people are well-meaning, but they are wrong because they base their position on three incorrect assumptions. First, they assume that the Indians have chosen to remain isolated. They have not. What they have chosen is to avoid those they believe would kill, enslave, and abuse them. There is little doubt that most would immediately opt for contact if they expected trade, affection, help, and support. Humans are a social species and enjoy productive interactions with neighboring groups. Most isolated tribes have difficult lives (Hill and Hurtado 1996). All the Indians that we have ever spoken to gladly accept improvements in their physical conditions and health situation if offered by true friends. None are content with the typical 30–50% child mortality rates that they experience without Western medicine. As soon as it becomes clear to isolated natives that those attempting to contact them are peaceful and friendly and can provide them with technology to ease some of the burdens of their lives, they virtually always initiate a contact.

Those who oppose contact also assume that the Indians will inevitably be decimated by virgin-soil epidemics. This is not true. Two of us, Hill and Kaplan, have been present at contact sites within days of first contact. If competent medical care is available and consistently present during the first five years following contact, few contact-related deaths need occur. The last band of Northern Aché foragers in Paraguay was contacted in April 1978, and Hill began medical care of that group in collaboration with two missionary organizations within days of contact. Only two small children out of a group of 22 died within the first five years, and both had been in poor health at contact. In 1979 another band of Aché contacted a missionary family that subsequently lived with them in their traditional home range down to the present. Only one child from a group of 37 died within the first five years after contact. The key to survival after contact for these two groups was competent medical care 24 hours a day, 365 days a year for several years.

Finally, opponents of contact assume that isolated native groups will survive if not contacted. Population ge-

netics and demographic models clearly show that this is not true. Most isolated populations of less than several hundred are destined to become extinct through accidental population fluctuations. This process is much more rapid in small groups and in situations where traditional territories have recently decreased in size. Almost certainly many isolated groups became extinct in the 20th century without ever making contact. In some cases one or two final survivors may be rescued at the end of such a decline.

Although we now have a body of scientific literature on virgin-soil epidemics among native peoples, the record of years of missionary and governmental experience, and articles providing specific advice on contact situations (e.g., Hill and Kaplan 1989), individuals and organizations making contact with isolated native groups seem as uninformed as those 100 years earlier. Even well-meaning groups and individuals continue to ignore this accumulated knowledge. For example, the planned FUNAI contact with the Korubo of Brazil in October 1996 included 26 individuals who were not screened or quarantined, including 8 journalists and their assistants, but no physicians. When outsiders suggested that the original team might have infected the Korubo, government officials returned to the contact site for a few hours but without qualified medical personnel (see http://www.nationalgeographic.com/features/96/contact/index.html).

There is now sufficient documentation of the consequences of first contacts that we can no longer plead ignorance. The remaining isolated peoples in South America should not suffer the same fate as those of the previous 500 years. The American Anthropological Association and other anthropological organizations should form a panel of experts now to develop policy on this issue and advise pertinent government and missionary organizations. The enormous number of deaths that will result from failure to act are *preventable*.

DISEASE AFTER CONTACT

Contact is only the beginning of the problems that South American Indians face. Sedentism, poverty, and poor access to health care, in addition to biological influences on disease susceptibility, lead in many cases to deterioration of health status (Psacharopoulos and Patrinos 1994). Conditions do not always improve immediately after the initial period of contact. Among the Aché of eastern Paraguay, in the first ten years after contact the infant mortality rate was higher than prior to contact, and it has returned to precontact levels only recently (Hurtado and Hill 1996). In addition, the effects of novel infectious pathogens such as *Mycobacterium* spp., *Plasmodium* spp., and numerous intestinal parasites have interacted in ways that have undermined the Aché's precontact robustness. Since contact, the Aché have experienced two malaria epidemics during which many adults were unable to provide for their dependents. Their diet has changed dramatically as well, from one based on plentiful animal protein to a nutrient-poor manioc-based diet. In fewer than five years tuberculosis became a major source of health problems, and by 1994, only a decade after contact, the lifetime prevalence of active cases of tuberculosis among Northern Aché had increased from less than 1% to 18%. In addition, 50% of individuals over 15 years of age now test positive for tuberculosis infection (Hurtado 2000). Other hunter-gatherers have fared equally poorly. Among the Hiwi of Venezuela, who made contact in 1957 and continue to depend on hunting and gathering for their subsistence, leprosy and violence (massacres and murders) have been some of the main causes of morbidity and mortality since the 1960s.

Tuberculosis outcomes are an excellent example of the importance of susceptibility to infectious diseases in combination with social factors many years after initial contact. The Native American case is well-documented (Rieder 1989). By 1900, tuberculosis was the most serious health problem among North American Indians. Even though mortality, morbidity, and risk of infection have sharply decreased, the incidence rate among natives is still 4.4 times higher than the rate of Americans of European descent (Centers for Disease Control 1987). In the South American countries with the highest prevalence of tuberculosis, such as Bolivia and Peru, indigenous populations have been the hardest hit by this disease. Data from other countries suggest that many communities will be devastated by tuberculosis over the next decade. By 1992, the prevalence rates of tuberculosis exceeded 1% among the Cuna of Panama, and most of those infected were not receiving any treatment (Caminero Luna 1995). Even higher prevalence rates have been reported for indigenous groups of the Paraguayan Chaco over the past decade (Galeano Jiménez 1995), and the rates of compliance with treatment are dismal, particularly among hunter-gatherers (Meincke-Giesbrecht, Floto, and Hettwer 1993). Lastly, prevalence rates of tuberculosis infection among the Shuar of Ecuador are comparable with those of the Aché and are lowest in the communities farthest from nonindigenous villages (Kroeger and Barbira-Freedman 1982).

The way in which indigenous populations mount immune defenses against bacterial pathogens is one of many host factors that may help explain high rates of infectious disease mortality not only at contact but many years afterward. Sousa et al. (1997) studied Yanomamo communities of Brazil that made contact in the 1960s and found that the Yanomamo develop immune defenses to tuberculosis infection different from those of other populations. First, the prevalence rate here of 6.4% active cases of tuberculosis is considerably higher than one would expect for a population exposed to the disease for fewer than 15 years, although it is still considerably lower than that observed among the Aché (Hurtado et al. 2001). Second, compared with their Brazilian neighbors the Yanomamo had higher titers of antibodies against *M. tuberculosis* glycolipid antigens (14% versus > 70%). Thus, relative to other populations with exposure to tuberculosis, the Yanomamo mount unusually high antibody responses at the expense of the more effective cell-mediated immune responses that are typi-

cally observed in nonindigenous people. Third, the rates of tuberculosis infection as measured by tuberculin tests show positive responses at much lower rates than one would expect in a group with as high a prevalence of active cases—27%, in contrast to the 90% reported for Eskimos in the 1950s and only slightly lower than the rate for the Aché (32%, all ages). In nonindigenous populations, lower than expected rates of positive tuberculin tests tend to occur only in immunosuppressed individuals such as HIV patients. Thus, if left unchecked, tuberculosis epidemics among the Yanomamo could have long-term consequences as devastating as those of the measles epidemics in the 1960s, particularly *if active cases are left untreated or drug-resistant tuberculosis is allowed to emerge* as a consequence of intermittent treatment. In at least one case in South America, tuberculosis has already exacted a huge toll. Six hundred of the 800 Surui who were alive at contact in 1980 had died by 1986 from concurrent tuberculosis and other epidemics (Fleming-Moran, Santos, and Coimbra 1991).

Data on indigenous groups that are considerably more acculturated than some of those just mentioned show that the future of South American Indian populations many years after contact is bleak indeed. Recent studies using large samples indicate that indigenous people are often less healthy than their rural peasant neighbors (Psacharopoulos and Patrinos 1994). In South America, indigenous people make up about 27% of the rural, and poorest, population (Jazairy, Alamgir, and Panuccio 1992). Moreover, indigenous infants and children have much higher mortality rates than their nonindigenous counterparts in every country where these rates have been measured (Psacharopoulos and Patrinos 1994). In Bolivia, monolingual urban indigenous peoples are two to four times as likely to have been sick or injured in the past 30 days, to have been kept from work for more than a week, to have received no medical help if sick, and to have missed yellow-fever vaccination campaigns (p. 68). Child mortality rates here are three times as high among monolingual indigenous mothers living in poverty as among nonindigenous mothers (p. 89). In Peru, indigenous people are less likely to have been vaccinated against BCG, polio, and measles and more likely to have had diarrhea in the past 15 days than the nonindigenous poor (p. 166).

These are only a few examples of the devastating consequences of pathogens many years after contact. Thus, guidelines that specify the ways in which indigenous people should be protected from the ravages of disease need to address both the contact and the postcontact period.

A CALL FOR ACTION

The intent of international and national guidelines for research among native peoples should be to use fundamental scientific understanding of infectious disease epidemiology to serve humanitarian ends (Eades and Read 1999). Science can and should help indigenous people just as it has helped the rest of the world. Recognizing that it took 100 years for antituberculosis campaigns to reduce death rates from 2 to 0.001 per thousand persons in the United States (Hopewell 1999) and that this is only one of innumerable examples of how science has managed to reverse ills for all humanity, it is difficult to fathom why mortality rates among some South American Indians can be as high today as they were 100 years ago.

In spite of the enormous potential benefit to indigenous communities, many have become increasingly unwilling to participate in scientific projects. In fact, many Indians are suspicious that scientists intend not to help but to exploit them. One of the most important reasons for this rejection and suspicion is that for decades scientists have not adhered to fieldwork ethics that natives can clearly identify as positive for their communities. This means that we need to reexamine fieldwork ethics and develop stronger guidelines in several key areas.

Current guidelines for fieldwork developed by the AAA Committee on Ethics require only that the anthropologist do no harm to the study population, leaving considerable room for interpretation as to what sorts of conduct are indeed harmless. We suggest that ethical behavior goes beyond simply not harming to more proactive behavior. Six areas of field research that require careful consideration in expanding on current guidelines are as follows:[2]

1. *Conduct and disease prevention during contact situations.* Tierney suggests that anthropologists and medical scientists should have taken preventive health measures to avoid excess contact-related mortality in Yanomamo communities. He does not specify what measures, nor is he able to cite internationally sanctioned guidelines that do so. Something needs to be done soon by the AAA and other national and international anthropological organizations to correct this problem. First, a commission must be established to evaluate the status of existing isolated peoples. There is a great deal of information already available through reports from private individuals and government officials who have visited or live in remote areas. This information needs to be analyzed and the status of each group evaluated. Which groups are under immediate threat of contact? What are the likely sources of contact (miners, woodcutters, colonists?) Which groups face probable extinction because of small population size in isolation? Such a commission should include experts in anthropology, physicians and public health administrators, and government officials who are responsible for policy development with regard

2. Several of these recommendations, reviewed in an early draft of this manuscript, were incorporated into a motion passed by the Executive Board at its meeting on November 16, 2000, during the AAA Annual Meeting. The motion charged the AAA Committee on Ethics to consider developing draft guidelines to be included in the Code of Ethics and/or to develop other materials regarding anthropologists' responsibility to provide assistance during health emergencies, the fairness of remuneration and the impact of material assistance, the potential negative impact of factual data, and the issue of informed consent. The motion was disseminated to the AAA membership through electronic mail and published in the *Anthropology Newsletter*.

to native peoples. Second, policies on contact need to be developed. Which groups can be protected from contact? Which groups should be approached and offered contact because they are likely to become extinct in the immediate future? How should contacts be managed in both the long and the short term? Third, medical protocols must be developed and financed. Rapid vaccination and outreach medicine could bring contact-related mortality to less than 2–3% in the first year (Hill and Hurtado 1996, Baruzzi et al. 1979). Since newly contacted peoples have no experience with health posts and Western medicines, a nontraditional medical program must be developed. Medical treatment must be delivered whenever and wherever it is required without relying on the people themselves to seek it. Since isolated peoples remain highly susceptible to foreign antigens for decades, such programs need to be permanently sustained.

2. *Medical relief during health emergencies.* Tierney criticizes scientists and journalists for not spending more time and resources fighting the Yanomamo measles epidemic and not getting more involved in alleviating observed health problems while doing fieldwork. The same charge could be leveled at him and all other observers (e.g., journalists, tourists, missionaries, those who become informed through secondary accounts) who encounter suffering but do not take "sufficient" action to alleviate it. Many anthropologists do provide health care for study populations and other forms of economic assistance, sometimes at great cost to themselves. Other anthropologists are uncomfortable with the notion that they are responsible for providing services that should be the job of other organizations supposedly dedicated to such things (e.g., governments, missionaries, and health and human rights organizations). Some sincerely feel that it is their job to observe and not to interfere in events, and some simply lack the training to provide health assistance to study populations. If anthropologists are expected to provide health assistance, who will provide the funds for medicines, medical training, and transportation and pay for lost work time? Should anthropologists lobby major funding agencies such as the National Science Foundation and the National Institutes of Health to provide each research project with funds that can be diverted into such assistance? The AAA and other anthropological organizations need to consider this issue. There are no clear answers, and every anthropologist who has ever done fieldwork has been forced to make difficult choices in this area.

3. *Fairness of renumeration for research cooperation.* Tierney suggests that Chagnon did little to help the Yanomamo during his 25 years of research with them and that the organization he created, the Yanomamo Survival Fund, was intended to help only by providing data that might be useful to other groups assisting the Yanomamo. The lack of direct assistance to the Yanomamo community appears to be a complaint voiced by many Yanomamo critics of Chagnon. Again, the same criticism could be aimed at nonanthropologists who make incomes from native peoples (e.g., journalists, missionaries, staff members of indigenous rights organizations). Many anthropologists base their entire careers on work done on populations that are paid only direct informant fees during a fieldwork period. Because the lifetime earnings of a professional anthropologist (including salary, book and film royalties, etc.) are more substantial than informant fees, this opens anthropologists up to a charge of exploitation of native peoples. This charge is reinforced by the commonly held anthropological belief that the value of specific research results to the target population is payment enough for the access and cooperation it provides. Most traditional populations, in contrast, see little practical value to the research results produced by anthropologists and medical scientists. The AAA and other anthropological organizations have never specifically provided guidelines on the level of remuneration (beyond informant fees) that is appropriate and how that remuneration should be linked to the earnings of researchers that result from their focus on a particular population.

4. *The impact of material assistance.* Tierney accuses Chagnon of fomenting violence by giving gifts to some Yanomamo communities. Given that it is impossible to give equal material support to all communities or all individuals at any field site, should anthropologists be held responsible for jealousies and competition over resources that they distribute or the acts committed by individuals who gain advantage through their material rewards? This is a general dilemma faced by all organizations and agencies who provide material assistance to groups, including national governments. The implication of Tierney's charge is that anthropologists should avoid conflict by giving no gifts at all. Most study populations would find that suggestion cruel and self-serving, and the refusal to pay for services rendered would be considered unethical behavior by many. But all researchers who do fieldwork need to consider the potential impacts of their gifts on study populations, and the AAA and other anthropological organizations have no clear guidelines here.

5. *The impact of factual data about a study population.* Tierney criticizes Chagnon for publishing information and viewpoints about Yanomamo warfare that damage the reputation of the Yanomamo and can be used by their enemies to justify denying them certain rights and privileges. Chagnon counters that he is simply publishing factual data and it would be deceitful and scientifically unethical to conceal or change them. The AAA and other anthropological organizations have not adequately addressed this dilemma, and as a result there are several other similar controversies in anthropology (e.g., reports of prehistoric cannibalism in the U.S. Southwest).

6. *Informed consent.* Tierney accuses a variety of researchers of collecting data without adequate informed consent. A similar charge has recently been leveled at other anthropological researchers using native DNA (*New Scientist* 2000). Some scientists believe that informed consent consists only of an explanation of the methodology, the procedures used on study subjects, and the potential dangers of those procedures. As long as this

information is provided and study subjects are not harmed or disenfranchised in any way, the consent is legitimate. Cultural anthropologists often obtain no informed consent for their studies but assume that if the community tolerates their presence informed consent is implied. At the other end of the spectrum, some people believe that informed consent includes not only an explanation of data collection methods but a detailed explanation of the research topics that will be examined with the data collected. If this view were taken literally, many studies could never be carried out (because informing subjects would change the character of the data gathered), and no post facto analysis of any field data could ever be done (since subjects would not have been informed at the time that a particular use of the data was contemplated). This version of informed consent would probably eliminate behavioral research entirely (since the behavior of study subjects would always be affected by knowing why they were being observed) and preclude a huge number of useful scientific studies done using data initially collected for a different purpose. Finally, no scientifically sophisticated study could ever be done on a relatively uneducated population because its members would not be able to give true informed consent (implying that they understood the purpose of the research). For example, no DNA studies could be done on any population that did not know what DNA was or understand the basics of modern genetics. Both extremes of the informed-consent debate seem unfair or unrealistic, but the AAA and other anthropological organizations should provide some guidelines on what exactly constitutes valid informed consent in anthropological studies. The same standards that apply to material data collection (blood, DNA, etc.) should apply to the collection of any information about a study group.

The success of the development of policies and guidelines will depend in large part on the composition of the teams that are brought together to implement them. Members of indigenous communities, governmental and nongovernmental Indian-affairs organizations from various continents, the World Health Organization, and other major health organizations should be active participants in this process along with large funding agencies, ethics committees, and anthropological associations. These efforts should be motivated by the realization that it is no longer tolerable for researchers who rely on First World know-how, technology, and resources to offer little if any help in implementing solutions to indigenous health problems (Farmer 2000).

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Risk Sensitivity and Value among Andean Pastoralists: Measures, Models, and Empirical Tests[1]

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Risk sensitivity has intrigued anthropologists because of the role it can reasonably be expected to play in decision making given the uncertainties of food supply and weather patterns and the hazards that surround us (Winterhalder, Lu, and Tucker 1999, Douglas and Wildavsky 1982, Vayda and McKay 1975). Using data from Andean herders, I will operationalize a definition of risk sensitivity and demonstrate how risk sensitivity varies with environmental and social variables. The potential benefits of incorporating risk into models of economic behavior are obvious in the Andes. Andean mountain environments are cold, unpredictable, and limiting (Molina and Little 1981:115–16; Orlove and Guillet 1985:5; Browman 1984:314; 1987; Goland 1993:318). Frequent droughts, snows, and generally dry environments constrain the subsistence choices of Andean peoples, leading ethnographers and archaeologists to assert that Andean people will be risk-averse (Custred 1977; Gade 1975:94; Browman 1984, 1987; Brush 1982; McCorkle 1987; 1990: 10; Guillet 1986:210; Goland 1993; Winterhalder 1994; Isbell 1978; Hesse 1982; Aldenderfer 1998). The patterns of risk sensitivity I present are consistent with research in economics (Friedman and Savage 1948, Kahneman and Tversky 1979, Bosch-Domènech and Silvestre 1999, Butler 2000, Morrison 2000), agricultural economics (Dillon and Scandizzo 1978, Elamin and Rogers 1992, Zuhair, Taylor, and Kramer 1992), biology (Real 1991, Stephens 1990), and human behavioral ecology (Winterhalder, Lu, and Tucker 1999).

RISK SENSITIVITY IN ANTHROPOLOGY

Anthropologists have not overlooked the importance of modeling decision making under uncertainty and risk (Cancian 1972, 1980, 1989; Quinn 1978; Ortiz 1980,

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