Letters to the Editor

Letters (~300 words) discuss material published in *Science* in the previous 6 months or issues of general interest. They can be submitted by e-mail (science_letters@aaas.org), the Web (www.letter2science.org), or regular mail (1200 New York Ave., NW, Washington, DC 20005, USA). Letters are not acknowledged upon receipt, nor are authors generally consulted before publication. Whether published in full or in part, letters are subject to editing for clarity and space.

Revisiting Amazonia Circa 1492

IN THEIR REPORT "AMAZONIA 1492: PRISTINE forest or cultural parkland?" (19 Sept., p. 1710), M. J. Heckenberger *et al.* claim to "present clear evidence of large, regional social formations (circa 1250 to 1600 A.D.) and their substantial influence on the landscape" of the Upper Xingu, Brazil. They assert that Xingu society was "clearly hierarchical in nature" and created a "highly elaborate built environment, rivaling that of many contemporary complex societies." They consider the present vegetation the product of long-term indigenous management that "provides a viable alternative" to clear-cutting.

To those of us who have grappled with the problem of pre-Columbian cultural complexity in Amazonia, the "clear evidence" is anything but clear. A correlation between site area and population density cannot be assumed (*1*). Heckenberger *et al.* state that domestic remains cover about 50 to 60% of the ditched areas and would represent 10 to 24 houses with 12 to 16 occupants each (*2*), but provide no archaeological evidence for these estimates. No consideration is given to fluctuations in the number, dimensions, and spacing during 350 years of occupation as deteriorating houses were abandoned and rebuilt. The assumption that a large labor force would be required to construct the earthworks is invalidated by evidence in northwestern Bolivia, where 15 to 30 people working sporadically without supervision during two weeks constructed a causeway 1 km long, 4 m wide, and 5 m high (*3*).

Heckenberger *et al.* assert that "Xinguano cultivation and land management…provides a viable alternative" to modern clear-cutting strategies, but they do not describe them. Other observers deny the possibility of intensive agriculture in the region (*4*, *5*). The contemporary Kuikuru people plant 3.2 times the amount of manioc needed to feed the community, because a considerable part is lost before harvest to peccaries, agoutis, and deer. Stored flour is vulnerable to mold, leaf-cutter ants, and house fires (*6*). Similar excess production necessary to feed a population of several thousand would soon exhaust the land available in the vicinity. This suggests that the degraded vegetation may reflect overexploitation rather than successful management, and would explain the apparently sudden disappearance of the culture before European contact.

Although the ring villages they discuss appear suddenly circa 1250 A.D., Heckenberger *et al.* consider their in situ development "clearly documented by continuity in utilitarian ceramics." Because they are utilitarian, vessel shapes are not sensitive indicators of discontinuity. The propensity to overexploitation suggests a nonlocal origin, because indigenous Amazonians had achieved a sustainable exploitation of rainforest subsistence resources at least four millennia earlier (*7*). This alternative is also supported by the ring-village settlement pattern, which is unknown in Amazonia but characteristic in more open habitats to the south (*8*).

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Kuikuro village situated at the margin of anthropogenic low forest overlooking the broad floodplain of the Culuene River, Upper Xingu, Brazil (2002).

Even if Heckenberger *et al.*'s analysis were acceptable, it would have no bearing on the controversy over the pre-Columbian existence of dense settlements and complex social organization in Amazonia. Like other regions with ditches, causeways, and mounds (the Llanos de Moxos, Bolivia; Acre and Marajó, Brazil; and the western Llanos, Venezuela), the Upper Xingu is environmentally and geographically peripheral to the rainforest. Estimates of a city of 200,000 to 400,000 at the mouth of the Tapajós (*9*) and a population of 1 million on Marajó (*10*) must take into consideration the consensus among biologists that a population density of 0.2 persons/km^2 is the maximum compatible with sustainable hunting (*11*) and the evidence for inherent constraints on intensive agriculture (*12*). The credibility of the high figures can also be judged by comparison with estimates of 100,000 to 200,000 for the monumental Maya city of Tikal (*13*), well under 10,000 for the Copán Valley (*14*), and less than 2 million for the population of the Central Andes in 1520 (*15*). By contrast, all that supports the Amazonian estimates is pottery, occasional earthworks, and patches of black soil.

BETTY J. MEGGERS

Department of Anthropology, National Museum of Natural History, Smithsonian Institution, Post Office Box 37012, MRC-112, Washington, DC 20013, USA. E-mail: meggers.betty@nmnh.si.edu

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M. J. HECKENBERGER AND COLLEAGUES' Report "Amazonia 1492: pristine forest or cultural parkland?" (19 Sept., p. 1710) has refueled the debate on the size of Amazonian population in pre-Columbian times. The article has several important implications for Amazonian archaeology and ethnology—theoretical, methodological, institutional, and sociocultural. It

deserves attention because it raises important questions more than it effectively proves the "large population size" debate.

First, although evidence for population size is limited, the Report is compelling because it shows the spatial articulation and interconnection among settlements of different sizes, thus provoking new questions about the organization of political systems, trade and exchange, and specialization in environmental management. Furthermore, the data contribute to understanding both the formation of sociopolitical systems and their later annihilation.

Heckenberger *et al.* present new evidence on the distribution of "anthropogenic forests" in the region. Attention to anthropogenic forests (from the 1980s on) was a paradigm shift in Amazonian ecology and ethnology and has motivated research on human-environmental interactions. Still, the majority of evidence on anthropogenic forests has come from ethnographic-ecological work among contemporary populations. Heckenberger *et al.* correlate spatial and structural patterns of vegetation and archaeological records on settlement distribution, offering a new approach to research on the formation of anthropogenic vegetation. Furthermore, understanding the lasting imprints of pre-Columbian populations on the regional vegetation will have important implications for our understanding of the current impact of land-use practices in the region.

Integration of archaeological investigation, Global Positioning System, and remote sensing provided the spatial-temporal sampling that could reveal the articulation of settlements, their time depth, and the resulting vegetation. These methods could be brought to numerous research topics, ranging from the spectral identification of anthropogenic vegetation to the interaction between land-use history and plant communities.

Another implication of the article is institutional and sociocultural, including the direct participation of Kuikuros who share the work and authorship. Heckenberger and colleagues represent a new generation of scholars within the small community of Amazonian archaeology. In this sense, the Report broadens Amazonian archaeology not only geographically, but institutionally, through collaboration and local participation. While revealing new sites for research away from "established" excavation sites, the long-term contribution to a basin-wide "sampling" is invaluable, lessening the bias of Amazonian archaeology toward the main floodplain.

The article also raises questions about the continuity of indigenous groups since pre-Columbian times. By involving the contemporary indigenous population, from excavation to interpretation of findings, it may contribute to new forms of collaboration between researchers and local communities, as well as provide a new sense of their place in the region. A wealth of topics for ethnographers and those interested in the social context of archaeology are apparent. Interpreting this article with an overemphasis on the population size issue may divert a more engaging debate about the region's past and future.

EDUARDO S. BRONDIZIO
Department of Anthropology, Indiana University, Student Building 130, Bloomington, IN 47405, USA.

Response

WE APPRECIATE THE OPPORTUNITY TO respond to the Letters by Meggers and Brondizio. The latter resonates strongly with our own viewpoints, particularly in response to the former, but some further details and caveats are merited.

First, Brondizio is correct that questions of population size, although important, are not the central or most relevant point of our

paper. Our arguments focus on unexpectedly complex regional settlement patterns and pronounced transformations of the landscape. Specifically, pre-Columbian settlements are organized into clusters according to precise spatial layouts. In the study area, two primary settlement clusters, composed of a principal plaza center, secondary and tertiary plaza settlements, and nonplaza hamlets, cover territories of about 400 km^2 each (*1*). Demography is important, however, and the ability to estimate late pre-Columbian population size is as good in the Upper Xingu as virtually anywhere else in the Brazilian Amazon presently. We therefore present concrete estimates (2500 to 5000 per cluster, not per village) to frame future discussion and research, although large (>1000 person) villages are known from southern Amazonia and adjacent central Brazil even into the early 19th century (*2*).

Second, pre-Columbian cultural variability and even variation among recent cultural groups have often been ignored in favor of regional generalizations. Meggers seems to believe that Amazonia simply could not support such developments, based on her interpretations of highly selected ecological data. For instance, she cites a book on hunting limitations, when fishing, agriculture, arboriculture, and wetland management were more critical in diverse Amazonian systems. She also suggests that the Upper Xingu is not part of Amazonia at all. However, in her book *Amazonia* (*3*), Xinguanos were presented as an exemplary case of a general Amazonian "terra firme" tribe.

Third, there are important points of divergence between members of the interdisciplinary research team and between Western researchers and local viewpoints, but all authors of our Report agree on several things: (i) regional articulation of essentially permanent settlements, (ii) fairly intensive manioc agriculture and fruit tree arboriculture, and (iii) social hierarchy. It appears that Meggers and others [(e.g., (*4*)] fail to recognize that this assertion is based on contemporary and recent Xinguano cultural patterns and does not depend on archaeological evidence. Our Report emphasizes continuity in basic cultural patterns, in terms of the nature of the economy, sociopolitical system, and settlement pattern, although archaeology does demonstrate dramatic changes in scale before and after 1492. That such findings have important implications for conservation and development in the region, as well as indigenous cultural rights, including their lands, intellectual properties, and the conduct of research about them, is obvious (*5*–*7*).

To be perfectly clear, we do not propose that there were lost cities or civilizations in the Amazon, because this assumes that we know what one might look like in the region, when it is precisely this that we must find out. Although the press coverage of our paper predictably seized upon the "lost cities/civilizations" theme, it was not the theme of our paper. The Upper Xingu does compare well with a variety of so-called chiefdoms or small states in other parts of the world at 1492, in terms of number of people and sociopolitical organization at local and regional levels, within the overall region of some 20,000 to 30,000 km^2 (an area about the size of Belgium or Vermont). As in many non-Western settings, however, we find that social complexity here does not necessarily fit preconceived notions, about urbanism, for example.

MICHAEL J. HECKENBERGER,[1] CARLOS FAUSTO,[2] BRUNA FRANCHETTO[2]

[1]Department of Anthropology, University of Florida, Gainesville, FL 32611, USA. [2]Department

of Anthropology, Museu Nacional, Universidade Federal do Rio de Janeiro, Quinta da Boa Vista, Rio de Janeiro 20904-040, Brazil.

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A Gross Indignity to Humans

J. BOHANNON'S ARTICLE "ANATOMY'S FULL monty" (News Focus, 29 Aug. 2003, p. 1172) is very well written, but I am appalled at the possibility of such indignity to humans. I am also amazed that anyone would want to visit such a museum. I understand that plastination is a big step in the field of anatomy. However, such an exhibition should be solely for those who study the fields of anatomy and medicine. The fact that Gunther von Hagens is placing these bodies in various poses for the general public to view is absolutely revolting.

I hope that the people promoting and managing the "Body Worlds" exhibition have submitted consent forms to donate their own bodies to achieve the goal of distasteful display. I also hope they have picked the poses in which they would like to be exhibited. In this regard, I find the secrecy surrounding participants' consent very disconcerting. It is important to determine exactly what these people were told would be done with their bodies. I hope the U.S. government would take measures to prevent such an exhibit from coming to the United States.

APARNA KOLHEKAR

Frederick, MD, USA.

An Unseemly Display of Mortality?

JOHN BOHANNON'S NEWS FOCUS ARTICLE "Anatomy's full monty" (29 Aug., p. 1172) addresses the debate concerning the exhibition of plastinated bodies. Naturally, a minimum standard must be observed to ensure that this practice is ethically acceptable. Full informed consent from the donor and possibly from her or his relatives seems to be a necessary requirement. However, even if this requirement is met, we still experience some revulsion, the so-called "yuck" factor, which, although not a moral argument against the practice, still calls our attention to something problematic about it.

Undoubtedly, death is one of the last taboos in modern society. We fear death and do everything in our power to delay it. The heroic efforts of modern medicine expended at the end of life are proof of this tendency. Since we cannot eliminate death, we ignore it or deny its reality, many by belief in an afterlife. Martin Heidegger would call this stance inauthentic, because it does not face reality: the reality of our mortal nature. Plastination is shocking because it spectacularly confronts us with this reality. One could say that plastination is against human dignity. But couldn't this also be said for allowing bodies to decompose in the grave or to be cremated? For many, death itself is perceived as the ultimate indignity, and facing this fact causes the tension and revulsion that we experience while seeing plastinated bodies.

JÓZSEF KOVÁCS

Department of Bioethics, Institute of Behavioral Sciences, Semmelweis University of Medicine, Nagyvárad tér 4, 1089 Budapest, Hungary. E-mail: kovjozs@net.sote.hu