William M. Denevan
University of Wisconsin

Prehistoric Cultural Change and Ecology in Latin America

American cultural geographers working in Latin America have long been interested in the origins, evolution, diffusion, and ecology of pre-Columbian societies. On the other hand, archaeologists have been turning more and more to a careful analysis of the environment and man's use of it in order both to explain change and to recreate past cultures and communities as functioning entities. In fact, the so-called "ecological" approach is one of the most dynamic aspects of American anthropology today and has given new vigor and direction to the profession. Anthropological "cultural ecology" not only overlaps with a traditional geographic concern, man-land relationships (Mikesell, 1967), but now dominates the study of pre-Columbian geography in Latin America. As in the case of environmental study in general, which is receiving so much attention today, the geographers have missed the boat which is now surging forth under other officers and crew. The question is, what can geographers contribute to prehistoric culture history, and is there justification for a significant effort?

Previous work by geographers

A number of Latin American historical geographers have focused their research on questions of origins and dispersals, demography, and processes of resource utilization, with mostly only peripheral concerns with the relationships of these to the more anthropological themes of cultural evolution and social organization. Also, many cultural studies have reconstructed aboriginal geography at the time of initial European contact as a base line for examining the European impact on native peoples (Sauer, 1966; Aschmann, 1959; Gordon, 1957), the antecedents of colonial or present cultural landscapes and livelihood patterns (Parsons, 1968; Schmieder, 1928; Gade, 1967; West and Augelli, 1966), or in tracing the influence of man on the physical environment (Bennett, 1968; Harris, 1965).

Carl Sauer has done more work than any other geographer on pre-Columbian Latin America. His syntheses and ideas on plant and animal domestication and dispersal and on the origins of agriculture are well known (Sauer, 1950; 1969), and they have held up well through the accumulation of new evidence from archaeology and plant genetics. Sauer has also published widely on the spread and

ecology of early man in the Americas (Sauer, 1944; 1958). Others have pursued Sauer's controversial argument for great antiquity of man in the New World, utilizing climatic and physiographic evidence (Carter, 1957; Arnold, 1957).

Cultural geographers have been involved in the even more heated interdisciplinary debate over the evidence suggesting trans-Pacific voyages and hence Old World influences on New World cultural development. Sauer (1963), Carter (1963), and Jett (1968) have argued for early transfers of domesticated plants as well as other traits, while Edwards (1965, n.d.) has examined the case for early seaworthy craft capable of ocean voyages.

Geographers at Berkeley, along with Lesley B. Simpson, Woodrow Borah, and Sherburne F. Cook, have long been interested in pre-Columbian demography, and have consistently claimed high figures on the basis of settlement density, ecological potential, old field remnants, and historical documentation. Sauer's strong influence here is traceable to his Aboriginal Population of Northwest Mexico (1935), which challenged Alfred Kroeber's low estimates for the same region and indirectly Kroeber's figure of only 8,400,000 for the Western Hemisphere in 1492 (Kroeber, 1939). More recent population studies by geographers include those by Aschmann (1959) for Baja California, Edwards (1957) for Quintana Roo, Smith (1970) for the Andes, and Denevan (n.d.; 1966b; 1970b) for western Amazonia, the Llanos de Mojos of Bolivia, and tropical America in general.

Pre-Columbian land use has received considerable attention lately with the discoveries and descriptions by geographers of relic ridged fields in poorly drained savannas in Bolivia, Colombia, and Ecuador (Denevan, 1966b; Parsons and Bowen, 1966; Parsons, 1969; Parsons and Denevan, 1967) and in the Andean highlands (Smith, Denevan, and Hamilton, 1968). Other types of ancient drained fields have been described in Mexico by West and Armillas (1950) and by Wilken (1969), and in a general review by Denevan (1970a). Golomb (1965) has made a study of pre-Columbian irrigation and water use in the Valley of Mexico. Terraces have been examined by Field (1966) in the Andes, by West (1970) in Central Mexico , by Guzman (1962) in Yucatan, and *trincheras* (check dams) are discussed by Herold (1965) and by Howard and Griffiths (1966) in northern Mexico. Regional studies of subsistence include those of the Chibcha by Eidt (1959), the Inca Empire by Kelly (1965), and Hispaniola by Sauer (1966).

In contrast to anthropologists (Willey, 1956), geographers have done relatively

little with pre-Columbian settlement morphology, location, and growth, possibly because of an inadequate background in archaeology; however, Sauer and his early students were well at home with archaeology (Sauer and Brand, 1931; Sauer and Meigs, 1927). Sauer during the same period was very interested in the culture area approach to native peoples, which was being promoted by Kroeber (1939) at Berkeley, and in general had very close ties with anthropology. In particular, see Sauer's "Personality of Mexico" (1941) and his school textbook on native culture areas of North America including Mexico and Central America (1939).

Thus, there has been considerable research and publication by geographers on pre-Columbian Latin America based both on documents and field study, with probably the strongest work being on resource utilization. These contributions tend to be more favorably appreciated by anthropologists and historians than by other geographers who find less of relevance to their own interests. And, in turn, the cultural-historical geographers often feel very much at home in other camps. Most of them have published in non-geographical journals such as *The Hispanic American Historical Review*, *Current Anthropology*, *Southwestern Journal of Anthropology*, *American Antiquity*, and the *Ibero-Americana* monograph series. Many of them have been active at the meetings of the International Congress of Americanists, the American Anthropological Association, and the Society for American Archaeology.

Ecological studies by archaeologists

The ecologically oriented archaeologists have been zeroing in on the questions of how civilizations originated, how and why cultures change, and to what extent explanations can be found in man's utilization of, or relation to the environment. They are concerned with much the same topics as the historical geographers, but mainly as means to greater ends, and this may be why anthropological culture history has been receiving considerable attention.

According to Sahlins (1901), "The evolution of culture can be viewed as a movement in the direction of increasing utilization of the earth's resources, or, alternatively, of increasing transformation of available energy into cultural systems." This statement clearly reflects the increasing ecological orientation of anthropology in the 1960's. Related concepts pertinent to Latin American prehistory include multi-linear evolution, cultural ecology, environmental limitations on culture, ecological breakdown of cultures, agricultural-demographic intensification, and the exploitation of micro environments.

As in geography, in the first third of this century anthropology toyed with and rejected environmental determinism as an approach to man-land relations and to cultural diversity, convergence, and change. Sociological explanations became more popular, while in the culture-area approach of Wissler, Forde, Kroeber, and others the environment was a basic consideration but a passive one much as in possibilism. Julian Steward, a Berkeley Ph.D. in 1931, helped reestablish a more active role for the environment with his studies of primitive bands in the 1930's. The monumental Handbook of South American Indians, which he edited, was organized by culture areas, but in the fifth volume he reclassified native peoples on the basis of "levels" of sociocultural development (band, tribe, chiefdom, state) based on broad techno-environmental parameters (Steward, 1949). A major assumption of his concept of multi-linear evolution is that certain basic types of cultures may develop in similar ways under similar environmental conditions due to similar ecological adaptations; thus diffusion and historical explanation are relegated a secondary role (Steward, 1955). The related concept of cultural ecology, as defined by Steward and used by many North American anthropologists, refers to " ... the adaptive processes by which the nature of society and an unpredictable number of features of culture are affected by the basic adjustment through which man utilizes a given environment" (Steward, 1953; 1955). For a critique of these concepts are Vayda and Rappaport (1968) who question the "existence of significant correlations between the cultural traits and ecological adaptations and the whole issue of causation. Also see the critique by Harris who, however, points out that "the dominant orientation in contemporary American anthropological archaeology now conforms to Steward's understanding of cultural ecology," although his wasn't the only influence (Harris, 1968).

From Steward, some anthropologists have reverted fully to environmental determinism. Best known are Betty Meggers (1954; 1957) articles on limitations on the development of culture, which included an attempt to account for the lack of civilization in the Amazon Basin and the decline of the Classic Maya on the basis of a limited "agricultural potential" for the tropical rainforest. Although sharply criticized by both anthropologists (Ferdon, 1959) and geographers (Blaut, 1959; Denevan, 1966b), these articles are still widely read. In general, for cultural declines in the New World there has been an increasing movement away from sociological explanations and toward ecological explanations (climatic change, decline of fertility, savanna invasion). This has been especially true for the Classic

Maya, although the cause of their collapse remains unresolved and does not seem related to soil fertility (Cowgill, 1961).

Steward's concepts were based largely on ethnohistory and ethnology and Meggers' were largely theoretical. More recent work includes some excellent studies based on systematic ecological analysis of archaeological sites, particularly in Mexico. One of the most influential persons has been William Sanders, who outlined his cultural ecological approach in the report of the Teotihuacán Valley project (Sanders, 1965). A basic theme is that all cultures must adjust to the ecological system, and that the "efficiency of adjustment" can be measured by population density. In two recent syntheses, Sanders and Price (1968) and Sanders and Marino (1970) examine New World prehistory particularly from the point of view of cultural ecology. Sanders and others have emphasized changes in resource use in terms of technology and micro environments, with these changes correlating with rapid population growth, nucleation, greater social stratification, and cultural expansion (i.e. Palerm and Wolf, 1957; Coe and Flannery, 1964; 1967; Flannery, et. al., 1967; MacNeish 1964; and many more).

Finally, mention should be made of the conflicting theories of Wittfogel (1955) on the importance of the organizational role of irrigation in the rise of civilization and of Carneiro (1961; 1970) on the constriction of arable land and the competition for it as being the critical factors. Both theories have been applied to prehistoric Latin America. Because of the past importance of irrigation to the growth of civilization, archaeologists have long been interested in water control systems (i.e. Armillas, 1961).

The future role of geographers

The pre-Columbian "geographical" work by geographers and anthropologists in both cases includes excellent empirical and theoretical studies as well as others which are superficial, naive, or antiquarian. Recently, the contributions of anthropologists have been the more substantial, partly because they bring more technical resources to bear in their field and laboratory research, while the geographer still tends to function as a lone generalist. The Tehuacán Project (Byers, 1967 -), which utilized scholars in zoology, botany, pollen analysis, plant genetics, and geology as well as archaeology, is an excellent example, but other projects in Oaxaca, Teotihuacán, Guatemala, and currently in Peru under MacNeish can be cited. Potentially, the geographer may fit in as a specialist, as for example the geomorphologist Anne Kirkby who was with the Oaxaca project, or

he may take a leadership role in forming his own projects with a geographic point of view and objectives.

Important, often new, research questions are now being raised by both anthropologists and geographers about pre-Columbian culture history. A major issue is that of agricultural intensification, since it can be correlated with density of population, which in turn seems closely related to the complexity of social organization (Carneiro, 1967). What causes technological change, thus bringing about higher productivity per unit of land or per man hour of labor? What are the relative roles of innovation and diffusion in contrast to population pressure? To what extent is Boserup (1965) correct in her thesis that the key factor is population pressure? Accordingly, why did population density vary so much from place to place (a traditional geographic theme)? Some insight to these questions can be gained from the study of present day aboriginal and peasant subsistence systems (see Nietschmann's paper in this collection).

If population is a critical variable in cultural change, then we must do a better job of demonstrating magnitude and the rate and causes of growth and decline. This will require localized, regional studies based on early documents, extrapolation backward in time from known figures, determination of carrying capacity from a given resource base and technology, archaeological population studies such as the recent analysis of Tikal by Haviland (1969.), and other methods such as suggested by Borah (1970). It is the anthropologists rather than geographers who have been most concerned with carrying capacity in Latin America (Carneiro, 1960; Leeds, 1961; Drucker and Heizer, 1960). Likewise, a study of fluvial morphology to explain the scarcity of surviving riverine settlement sites in Amazonia is by an anthropologist (Lathrap, 1968a) rather than by a geographer. And studies of a relation between soil erosion and pre-Columbian populations in Mexico were made by a physiologist-historian (Cook, 1949a; 1949b). For some topics, then, others seem to be doing more and better geography than we are.

Dietary patterns, which are primarily culturally determined, may be very important in accounting for differences in population density and settlement size and stability. In particular, see the recent arguments for an ecological zonation of both population and culture in Amazonia due to a high starch diet and a reliance on aquatic resources for protein (Denevan, n.d.; 1966a; Lathrap, 1968b; 1970) and Reichel-Dolmatoff's (1965) thesis that inter-fluvial slope settlement did not begin in Colombia until after maize became a staple about 100 B.C. The population patterns for seed farmers in Latin America seem to be very different from those

of the tuber farmers, both in the past and at present. One of the most important frontiers in the Hemisphere is that between maize and manioc farmers, but to my knowledge it has never been mapped, nor do we know much about its history. And we are even more ignorant about the patterns of other major food staples. The food emphasis of a major culture, the Classic lowland Maya, is still debated. Gordon (1969) has recently suggested that it was "based less completely upon maize cultivation and agriculture per se than is commonly supposed," and more upon semi-cultivated "orchard-garden thickets" containing a wide diversity of multilayered economic plants. Bronson (1966) argues for the importance of manioc, and another possibility is that the Maya, at least in northern Yucatan, relied heavily on marine resources (Lange, 1971).

Another problem, already referred to, is that of the role of the humid tropics in the development, or lack of development, of New World civilizations. The environment of the antecedents of the Olmec-Mayan culture is still unresolved, but may well be the humid lowlands, and there is increasing evidence of Amazonian influences on the Andean cultures (Lathrap, 1965). The conclusive evidence will be archaeological, but the ecologically oriented geographer can do much to counter the "it couldn't happen here" attitude. If tropical antecedents for the New World civilizations can be demonstrated, the fact will help reverse the frequently negative attitude about the potential of the humid tropics for human settlement.

Only recently have archaeologists become interested in the functional dynamics of pre-historic cities in Latin America (Hardoy, 1968; Hardoy and Schaedel, 1969), but few geographers have been involved. Certainly historically oriented urban geographers should be able to contribute to the understanding of Aztec, Maya, Inca, and other aboriginal villages and cities by examining ruins, air photos, and early literature in order to work out zonation, spatial hierarchies, size, and relation to hinterlands. A recent contribution by a geographer is Fuson's (1969) study of Mayan ceremonial centers in Yucatan. As Fuson suggests, there is room for more such work by geographers.

Methodology

Some suggestions have been made as to new directions of research that might be undertaken by prehistoric Latin Americanist geographers. In addition, various techniques of analysis need to be considered which the geographer should master or at least understand if his contribution is to be rigorous and thereby move from

the more speculative to the more scientific. Little has been done with statistical methods for documentary materials, mainly because there isn't much quantifiable data to work with for the contact period in terms of either amount or reliability. The demographers, however, have used incomplete tribute statistics to arrive at population estimates for central Mexico (Borah and Cook, 1963), and undoubtedly more can be done with such data as well as with depopulation curves and ratios to derive earlier populations (Dobyns, 1966). And while documentary evidence is meager, units of land, cultural remnants, and environmental parameters can be studied quantitatively today as long as possible changes from earlier times are taken into account. Also, statistical methods are regularly used now in analyzing archaeological materials.

The use of air photos, including the more sophisticated new methods of remote sensing, are becoming common tools for studying former field systems and settlement patterns (Deuel, 1969). Partly through the influence of geographers, anthropologists are becoming much more aware of the value of air photos and, as a result, more spatially oriented. Much survey work is now being done with photos or low flying planes, and infrared photography is used to detect relic cultural features not otherwise apparent (i.e. Schaber and Gumerman, 1969).

The geographer with his training in interrelating nature and culture, his awareness that influences are decidedly reciprocal, and his spatial orientation should be able to make a contribution to pre-history, but he will still need specialized knowledge. One approach is through paleoecology with an emphasis on climatic change, geomorphology, and pollen analysis. There are few geographers active today (Craig and Psuty, 1968) with even a secondary interest in these themes for Latin America, certainly none with contributions comparable to those of Karl Butzer (1971) for Old World Pleistocene geography. A second approach is through biogeography with a concern with man's past use and modification of biotic resources, both wild and domesticated, and this requires competence in botany, zoology, and soils. There is another potential niche for geographers who can apply a systematic spatial point of view to prehistoric settlement, demography, and land use, but archaeological training is probably essential. Archaeologists have done very little with locational analysis, and neither have the pre-Columbianist geographers, so the subject is wide open.

Finally, as I have pointed out previously, anthropologists have become geographers under the label of cultural ecology. "At the very least. we should keep an eye on what anthropologists are up to, aid them with their probings of the

physical environment, and help keep them wary of 'hard core' environmental determinism ... " (Denevan, 1966a). Also, geographers should be constantly reminding anthropologists that most so-called "natural environments" have been significantly modified by man.

Rationale

Assuming that geographers can make a contribution to pre-Columbian studies, should they? Should young geographers be encouraged to take up the subject as a major research interest as it has been for Sauer and other geographers in the past? The justification for historical study would seem obvious. One of the major objectives of social science is to attempt to understand cultural behavioral patterns and how and why they change. Consequently, all of man's existence should be potentially relevant. An emphasis on contemporary problems, patterns, and events makes possible more systematic analysis, but does not provide the perspective of history. Furthermore, groups of people behave the way they do for historical (cultural) reasons as well as for functional reasons, and both should be considered for a full understanding of what is happening now and what may happen in the future. The focus of this panel is on Indian cultural and economic change. Do we want to understand the process of change or the process of change in a given place at the present time? Presumably both, especially if we wish to develop general concepts. Certainly historical as well as contemporary studies should relate to larger issues. Most of the work by geographers on Latin American prehistory has done so, but often more implicitly than explicitly. This may be one reason why prehistoric geography has been less vigorous than prehistoric anthropology which is constantly focusing on the problems of the rise and fall of civilization.

The study of native peoples in the New World before Columbus can also be of direct practical value. Knowledge of former settlement patterns has turned attention to areas now sparsely settled which once contained numerous people and to former land use systems that might well be reactivated. Frontier farmers frequently seek out evidence of former occupance as they select land for clearing. Also, knowledge of the cultural achievements of ancient peoples in difficult habitats can have significant psychological effects on attitudes toward the same habitats today.

Finally, the merits of a subject in justification of vigorous research activity, whether directly relevant to current "development" problems or not, can be

gauged in part by the attention it receives from funding agencies and from the scholarly community, students, and the general public. Today, Latin American pre-history is clearly receiving much more such attention than does the combined work of all the Latin American geographers. This is evidenced by the frequency of archaeological presentations in Science and Scientific American, in Time magazine and the newspapers, on television, in semi-popular books, and in overall publication. The problems are exciting and important. Much of the material is geographical, but geographers today are seldom involved.

References cited

Armillas, Pedro. "Land Use in Pre-Columbian America," in *Arid Zone Research, Vol. 17: A History of Land Use in Arid Regions*. pp. 255-276 (Paris: UNESCO, 1961).

Arnold, Brigham A. Late Pleistocene and Recent Changes in Land Forms, Climate, and Archaeology in Central Baja California. *University of California Publications in Geography*, Vol. 10, No. 4 (1957), pp. 201-318.

Aschmann, Homer. The Central Desert of Baja California: Demography and Ecology. *Ibero-Americana*, No. 42 (Berkeley: University of California Press, 1959).

Bennett, Charles F. Human Influences on the Zoogeography of Panama. *Ibero-Americana*, No. 51. (Berkeley: University of California Press, 1968).

Blaut, James M., "The Ecology of Tropical Farming Systems," in *Social Science Monographs VII: Plantation Systems of the New World*, pp. 83-103 (Washington, D.C.: Pan American Union, 1959).

Borah, Woodrow. "The Historical Demography of Latin America: Sources, Techniques, Controversies, Yields," in *Population and Economics*. P. Deprez, editor, pp. 173-205. (Winnipeg: University of Manitoba Press, 1970).

Borah, Woodrow and S. F. Cook. The Aboriginal Population of Central Mexico on the Eve of the Spanish Conquest, *Ibero-Americana*, No. 45 (Berkeley: University of California Press, 1963),

Boserup, Ester. *The Conditions of Agricultural Growth: The Economics of Agrarian Change Under Population Pressure.* (Chicago: Aldine, 1965).

Bronson, Bennet. "Roots and the Subsistence of the Ancient Maya," *Southwestern Journal of Anthropology*, Vol. 22 (1966), pp. 251-279.

Butzer, Karl W., *Environment and Archaeology: An Introduction to Pleistocene Geography*, revised second edition (Chicago: Aldine, 1971).

Byers, Douglas S. (Editor), *The Prehistory of the Tehuacán Valley*. 6 vols. (Austin: University of Texas Press, 1967-).

Carneiro, Robert L. "Slash-and-Burn Agriculture: A Closer Look at Its Implications for Settlement Patterns," in *Men and Cultures; Selected Papers of the Fifth International Congress of Anthropological and Ethnological Sciences*. A. F. C. Wallace, editor, pp.229-234 (Philadelphia: University of Pennsylvania Press, 1960).

_____."Slash-and-Burn Cultivation Among the Kuikuru and Its Implications for Cultural Development in the Amazon Basin," in *The Evolution of Horticultural Systems in Native South America, Causes and Consequences: A Symposium*, J. Wilbert, editor, pp. 47-67 (Caracas: Sociedad de Ciencias Naturales La Salle, 1961).

_____."On the Relationship Between Size of Population and Complexity of Social Organization," *Southwestern Journal of Anthropology*, Vol. 23 (1967), pp. 234-243.

Carneiro, Robert L. "A Theory of the Origin of the State," *Science*, Vol. 169 (1970), pp. 733-738.

Carter, George F. *Pleistocene Man at San Diego* (Baltimore: Johns Hopkins University Press, 1957).

_____."Movement of People and Ideas Across the Pacific," in *Plants and the Migrations of Pacific Peoples: A Symposium*, J. Barrau, editor, pp. 7-22 (Honolulu: Tenth Pacific Science Congress, 1963).

Coe, Michael D. and Kent V. Flannery, "Microenvironments and Mesoamerican Prehistory," *Science*, Vol. 143 (1964), pp. 650-654.

_____ . Early Cultures and Human Ecology in South Coastal Guatemala, *Smithsonian Contributions to Anthropology*, Vol. 3 (Washington, D.C.: Smithsonian Press, 1967).

Cook, Sherburne F. The Historical Demography and Ecology of the Teotlalpan, *Ibero-Americana*, No.33 (Berkeley: University of California Press, 1949a).

_____ . Soil Erosion and Population in Central Mexico, *Ibero-Americana*, No. 34 (Berkeley: University of California Press, 1949b).

Cowgill, Ursula M. "Soil Fertility and the Ancient Maya," *Transactions of the Connecticut Academy of Arts and Sciences*, Vol. 42 (1961), pp. 1-56.

Craig, Alan K. and Norbert P. Psuty, *Reconnaissance Report, The Paracas Papers: Studies in Marine Desert Ecology*, Vol. 1, No. 2 (Boca Raton: Department of Geography, Florida Atlantic University, 1968).

Denevan, William M. "A Cultural-Ecological View of Former Aboriginal Settlement in the Amazon Basin," *The Professional Geographer* Vol. 18 (1966a), pp. 346-351.

____ . The Aboriginal Cultural Geography of the Llanos de Mojos of Bolivia, *Ibero-Americana*, No. 48 (Berkeley: University of California Press, 1966b).

_____."Aboriginal Drained-Field Cultivation in The Americas," *Science*, Vol. 169 (1970a), pp. 647-654.

_____."The Aboriginal Population of Tropical America: Problems and Methods of Estimation," in *Population and Economics*, P. Deprez, editor, pp. 251-269 (Winnipeg: University of Manitoba Press, 1970b).

_____."The Aboriginal Population of Western Amazonia in Relation to Habitat and Subsistence," *Revista Geográfica* (n.d., in press).

Deuel, Leo. *Flights into Yesterday: The Story of Aerial Archaeology*. (New York: St. Martin's Press, 1969).

Dobyns, Henry F. "Estimating Aboriginal American Population: An Appraisal of Techniques with a New Hemispheric Estimate," *Current Anthropology*, Vol. 7 (1966), pp. 395-416.

Drucker, Philip and Robert F. Heizer, "A Study of the Milpa System of La Vents Island and its Archaeological Implications," *Southwestern Journal of Anthropology*, Vol. 16 (1960), pp. 36-45.

Edwards, Clinton R., Quintana Roo: *Mexico's Empty Quarter, Report of Field Work Carried Out Under ONR Contract 222 (11) NR 388 067.* (Berkeley: Department of Geography, University of California, 1957).

_____Aboriginal Watercraft of the Pacific Coast of South America, *Ibero-Americana*, No. 47 (Berkeley: University of California Press, 1965).

_____."New World Perspectives on Pre-European Voyaging in the Pacific," in *The Proceedings of a Symposium: Early Chinese Art and Its Possible Influence in the Pacific Basin* (New York: Intercultural Arts Press, n.d., in press).

Eidt, Robert C. "Aboriginal Chibcha Settlement in Colombia," *Annals of the Association of American Geographers*, Vol. 49 (1959), pp. 374-392.

Ferdon, Edwin N. "Agricultural Potential and the Development of Cultures," *Southwestern Journal of Anthropology*, Vol. 15 (1959), pp. 1-19.

Field, Chris. A Reconnaissance of Southern Andean Agricultural Terracing, unpublished Ph.D. dissertation (Los Angeles: Department of Geography, University of California at Los Angeles, 1966).

Flannery, K. V., A. V. T. Kirkby, M. J. Kirkby, and A. W. Williams, Jr., "Farming Systems and Political Growth in Ancient Oaxaca," *Science*, Vol. 158 (1967), pp. 445-454.

Fuson, Robert H. "The Orientation of Mayan Ceremonial Centers," *Annals of the Association of American Geographers*, Vol. 59 (1969), pp 494-511.

Gade, Daniel W. Plant Use and Folk Agriculture in the Vileanota Valley of Peru: A Cultural-Historical Geography of Plant Resources, unpublished Ph.D. dissertation (Madison: Department of Geography, University of Wisconsin, 1967).

Golomb, Berl. Paleogeography of the Basin of Mexico, unpublished Ph.D. dissertation (Los Angeles: Department of Geography, University of California at Los Angeles, 1965).

Gordon, B. LeRoy, Human Geography and Ecology in the Sinú Country of Colombia, *Ibero-Americana*, No. 39 (Berkeley: University of California Press, 1957).

_____. *Anthropogeography and Rainforest Ecology in Bocas del Toro Province, Panama,*

Report of Field Work Carried Out Under ONR Contract Nonr 3656 (03) NR 388 067. (Berkeley: Department of Geography, University of California, 1969).

Guzman, Louis E. "Las terrazas de los antiguos Mayas montaneses," *Revista Interamericana de Ciencias Sociales*, Vol. 1 (1962), pp. 398-406.

Hardoy, Jorge E. *Urban Planning in Pre-Columbian America*. (New York: Braziller, 1968).

Hardoy, Jorge E. and R. P. Schaedel (Editors), *The Urbanization Process in America From Its Origins to the Present Day*. (Buenos Aires: Editorial del Instituto, 1969).

Harris, David R. Plants, Animals, and Man in the Outer Leeward Islands, West Indies. *University of California Publications in Geography, Vol. 18* (1965), pp. 1-184.

Harris, Marvin. *The Rise of Anthropological Theory: A History of Theories of Culture*. (New York: T. Y. Crowell, 1968).

Haviland, William A. "A New Population Estimate for Tikal, Guatemala," *American Antiquity*, Vol. 34 (1969), pp. 429-433.

Herold, Laurance. *Trincheras and Physical Environment Along the Rio Gavilan, Chihuahua, Mexico*. (University of Denver, Department of Geography, Technical Paper No. 65-1, 1965).

Howard, W. A. and T. M. Griffiths, *Trinchera Distribution on the Sierra Madre Occidental, Mexico*. (University of Denver, Department of Geography, Technical Paper No. 66-1, 1966).

Jett, Stephen C. "Malaysia and Tropical America: Some Racial, Cultural, and Ethnobotanical Comparisons," in *Actas y Memorias, XXXVII Congreso Internacional de Americanistas*, Vol. 4, pp. 133-177. (Buenos Aires: Librart, 1968).

Kelly, Kenneth. "Land-Use Regions in the Central and Northern Portions of the Inca Empire," *Annals of the Association of American Geographers*, Vol. 55 (1965), pp. 327-338.

Kroeber, Alfred L. *Cultural and Natural Areas of Native North America*. (University of California Publications in American Archaeology and Ethnology, Vol. 38, 1939, pp. 1-240.)

Lange, Frederick W. "Marine Resources: A Viable Subsistence Alternative for the Prehistoric Lowland Maya," *American Anthropologist* (1971, in press).

Lathrap, Donald W. "Origins of Central Andean Civilization: New Evidence," *Science*, Vol. 148 (1965), pp. 796-798.

____. "Aboriginal Occupation and Changes in River Channel on the Central Ucayali, Peru," *American Antiquity*, Vol. 33 (1968a), pp. 62-79.

_____ . "The 'Hunting' Economies of the Tropical Forest Zone of South America: An Attempt at Historical Perspective," in *Man the Hunter*, R. B. Lee and I. DeVore, editors, pp. 23-29 (Chicago: Aldine, 1968b).

_____. *The Upper Amazon*. (New York: Praeger, 1970).

Leeds, Anthony. "Yaruro Incipient Tropical Forest Horticulture: Possibilities and Limits," in *The Evolution of Horticulture Systems in Native South America, Causes and Consequences: A Symposium*, J. Wilbert, editor, pp. 1346 (Caracas: Sociedad de Ciencias Naturales La Salle, 1961).

MacNeish, Richard S. "Ancient Mesoamerican Civilization," *Science*, Vol. 143 (1964), pp. 531-545.

Meggers, Betty J. "Environmental Limitation on the Development of Culture," *American Anthropologist*, Vol. 56 (1954), pp. 801-824.

_____."Environment and Culture in the Amazon Basin: An Appraisal of the Theory of Envrionmental Determinism," in *Social Science Monographs III: Studies in Human Ecology*, pp. 71-89 (Washington, D.C.: Pan American Union, 1957).

Mikesell, Marvin W. "Geographic Perspectives in Anthropology," *Annals of the Association of American Geographers*, Vol. 57 (1967), pp. 617-634.

Palerm, Angel and Eric R. Wolf. "Ecological Potential and Cultural Development in Meso America," in *Social Science Monographs III: Studies in Human Ecology*, pp. 1-37 (Washington, D. C.: Pan American Union, 1957).

Parsons, James J. *Antioqueño Colonization in Western Colombia*, revised second edition (Berkeley: University of California Press, 1968).

_____. "Ridged Fields in the Rio Guayas Valley, Ecuador" *American Antiquity*,

Vol. 34 (1969), pp. 76-80.

Parsons, James J. and William A. Bowen. "Ancient Ridged Fields of the San Jorge River Floodplain, Colombia," *The Geographical Review*, Vol. 56 (1966), pp. 317-343.

Parsons, James J. and William M. Danevan. "Pre-Columbian Ridged Fields," *Scientific American*, Vol. 217 (1967), pp. 92-100.

Reichel-Dolmatoff, Gerardo. *Colombia.* (New York: Praeger, 1965).

Sahlins, Marshall D. "The Segmentary Lineage: An Organization of Predatory Expansion," *American Anthropologist*, Vol. 63 (1961), pp. 322-345.

Sanders, William T. *The Cultural Ecology of the Teotihuacán Valley*. (University Park: Department of Sociology and Anthropology, Pennsylvania State University, 1965).

Sanders, William T. and Joseph Marino, *New World Prehistory: Archaeology of the American Indian*. (Englewood Cliffs: Prentice-Hall, 1970).

Sanders, William T. and Barbara J. Price. *Mesoamerica: The Evolution of a Civilization*. (New York: Random House, 1968).

Sauer, Carl 0. Aboriginal Population of Northwestern Mexico. *IberoAmericana*, No. 10. (Berkeley: University of California Press, 1935).

_____. *Man in Nature: America Before the Days of the White Man.* (New York Scribner's, 1939).

_____. "The Personality of Mexico," *The Geographical Review*, Vol. 31 (1941), pp. 353-364.

Sauer, Carl O. "A Geographic Sketch of Early Man in America," *The Geographical Review*, Vol. 34 (1944), pp. 529-573.

____."Cultivated Plants of South and Central America," in *Handbook of South American Indians*, J. H. Steward, editor, Bureau of American Ethnology, Bulletin 143, Vol. 6, pp. 487-543 (Washington, D. C.: Smithsonian Institution, 1950).

_____."Man in the Ecology of Tropical America," in *Proceedings of the Ninth Pacific Science Congress*, Vol. 20 (1958), pp. 104-110.

_____. *Plant and Animal Exchanges Between the Old and the New Worlds: from a Seminar Presented by Carl 0. Sauer*, R. M. Newcomb, editor (Los Angeles: Los Angeles State College, 1963).

_____. *The Early Spanish Main.* (Berkeley: University of California Press, 1966).

_____. *Agricultural Origins and Dispersals: The Domestication of Animals and Foodstuffs.* (Cambridge: M.I.T. Press, 1969).

Sauer, Carl O. and Donald Brand. *Prehistoric Settlements of Sonora, with Special Reference to Cerros de Trincheras.* (University of California Publications in Geography, Vol. 5, No. 3, 1931, pp. 67-148.)

Sauer, Carl O. and Peveril Meigs. *Lower California Studies, I: Site and Culture at San Fernando de Velicata.* (University of California Publications in Geography, Vol. 2, No. 9, 1927, pp. 271-302.)

Schaber, Gerald G. and George J. Gumerman. "Infrared Scanning Images: An Archeological Application," *Science*, Vol. 164, (1969), pp. 712-713.

Schmieder, Oscar. *The Historic Geography of Tucumán.* (University of California Publications in Geography, Vol. 2, No. 12, 1928, pp. 359-386).

Smith, Clifford T. "Depopulation of the Central Andes in the 16th Century," *Current Anthropology*, Vol. 11 (1970), pp. 453-464.

Smith, Clifford T., W. M. Denevan, and P. Hamilton. "Ancient Ridged Fields in the Region of Lake Titicaca," *The Geographical Journal*, Vol. 134 (1968), pp. 353-367.

Steward, Julian H. "South American Cultures: An Interpretive Summary," in *Handbook of South American Indians*, J. H. Steward, editor, Bureau of American Ethnology, Bulletin 143, Vol. 5, pp. 669-772 (Washington, D. C.: Smithsonian Institution, 1949).

_____. "Comments," in *An Appraisal of Anthropology Today*, Sol Tax, editor, p. 243 (Chicago: University of Chicago Press, 1953).

_____. *Theory of Culture Change.* (Urbana: University of Illinois Press, 1955).

Vayda, Andrew P. and Roy A. Rappaport. "Ecology, Cultural and Non-cultural," in *Introduction to Cultural Anthropology*, J. A. Clifton, editor, pp. 477-497. (Boston: Houghton Mifflin, 1968).

West, Robert C. "Population Densities and Agricultural Practices in Pre-Columbian Mexico, with Emphasis on Semi-terracing," in *Verhandlungen des XXXVIII Internationalen Amerikanistenkongresses, Vol. 2,* pp. 361-369. (Munchen: Klaus Renner, 1970).

West, Robert C. and Pedro Armillas. "Las chinampas de Mexico," *Cuadernos Americanos*, Vol. 50 (1950), pp. 165-182.

West, Robert C. and John P. Augelli. *Middle America: Its Lands and Peoples*. (Englewood Cliffs: Prentice-Hall, 1966).

Wilken, Gene C. "Drained-Field Agriculture: An Intensive Farming System in Tlaxcala, Mexico," *The Geographical Review*, Vol. 59 (1969), pp. 215-241.

Willey, Gordon R. (Editor), *Prehistoric Settlement Patterns in the New World*. Viking Fund Publications in Anthropology, No. 23 (New York: Wenner-Gren Foundation, 1956).

Wittfogel, Karl A. "Developmental Aspects of Hydraulic Societies," in *Social Science Monographs 1: Irrigation Civilizations: A Comparative Study*, pp. 43-52. (Washington, D. C.: Pan American Union, 1955).