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Ecological Problems and Approaches in Latin American Geography

We are generally agreed that geography has a fundamental concern with the earth as the home of man or, stated a bit more grandly, with man-environment systems. Certainly one of our fundamental commitments has been to study the relation between man and nature. Yet in recent years there has been a certain backing away from the idea that "relationships" can define any "science" and, seeking the security of more conventional academic designs, geographers have increasingly turned to such shiny new concepts and approaches as spatial interaction, locational analysis, landscape perception, and a host of others. Now, up from nowhere, comes a Galahad in shining armor with "ecology" emblazoned on his banner, proclaiming far and wide, and before an almost prostrate welcoming citizenry, that the relationship of man to nature is indeed the overriding issue of our times, fundamental to our very survival. Today we are in the midst of a traumatic popular awakening to the oneness of the earth, to the fragility and vulnerability of the earth environment, to the fact that man is indeed the ecological dominant (Sauer, 1952). Now it is "science" that must adapt itself to this new public concern. Environmental quality and ecologic balance have become the most urgent and respectable of academic concerns, the most popular of political and social rallying calls. For geography the opportunities would seem unlimited.

At first glance the ecological view appears to hold the potential for healing much of the crippling split between physical and human geography, while at the same time hopefully elevating our subject to a new level of relevance and respectability. Yet by and large we have been content to busy ourselves with other concerns to the point that we often seem to have been left standing in the dust by the roadside as the caravan rushes onward. What has been called "the introspective alienation of geographers from other forms of study" (Dury, 1970) appears at times to have almost desensitized us to the currents swirling at our feet. And now, while we have been rediscovering mathematical and theoretical geography, turning increasingly towards the library and away from the field, others have been even busier rediscovering the environment, the very environment that was

originally conceived to be the study matter of geography. Ecology is suddenly the banner under which those most concerned with the future of mankind are crowding, and at the very moment when a significant proportion of our colleagues appear to be looking in quite another direction.

The truth is that geographers, with a few conspicuous exceptions (and here it may be said that some of those working in Latin America have been in the forefront), have been relatively little concerned with the problems of resource utilization and environmental deterioration which an unprecedented demographic and technologic explosion have engendered. Many past attempts to study man as a functioning part of nature may have been associated, quite unfairly, with a rejected environmental determinism. As a result an unparalleled opportunity for geography has seemed on the point of being squandered. "I like to daydream," Zelinsky comments wryly, "about my fellow geographers heroically marching into a breach that seems providentially designed for them -- but I know better" (quoted in Luten, 1969). Yet there is still room for us to act, especially in such areas of the world as Latin America where the heavy heel of progress has not yet come down with its full weight. To date, it is the biologists, the specialists in organisms and communities other than man who have moved most successfully and most conspicuously to the forefront in this vital field, but as the ecological revolution proceeds disciplinary boundaries are fast disappearing.

Biological ecology in the "pure" and most respected form tends to leave out man, and that way things are enormously simplified. The human ecology of the sociologists, on the other hand, is man-centered and the environment that they have been concerned with is the social environment. But there is a third, more encompassing ecology, a geographical or landscape ecology, which regards landscapes as the historical consequence of the interaction between organisms and the environment. Here man is seen as an integral part of nature, impinging on it and being challenged and conditioned by it. This is where geographers are likely to feel most at home, and this is where the popular upwelling of concern is pointing. The idea of thinking ecologically, of seeing the wholeness of areas or systems and the interrelatedness of man and nature within which we have long been familiar. Such a view gives recognition to the delicate balance of nature that so conditions them, is one special man's occupance of the earth. And it tends to make of us humanists as well as scientists.

Morgan and Moss (1965) and Simmons (1966) have recently reviewed the relationship between geography and ecology. Accepting land use, the

manipulation of ecosystems, as the focus of geography, they see the major contribution of ecology as the identification of land use processes and programs which are ecologically sound. The approach of cultural geographers to ecologic problems, some of which must inevitably be pointed towards pragmatic planning and action, seems particularly promising of results. General systems theory and information theory have been put forward (Stoddart, 1965; Schultz, 1967) as potentially profitable approaches to the integration of the ecosystem concept, but so far it has proven an elusive goal.

The German geographers who have employed the term ecology tend to give but limited attention to man's role as occupant and modifier of the earth (Dickinson, 1969), their purpose being first and foremost to characterize its surface in functional but not necessarily in human terms. Thus Troll would explicitly restrict the use of the term 'ecology' to the study of the physical-biological complex, the natural landscape, which provides the ecological basis for human activity (Troll, 1966). While this may be a convenient and simplifying restriction, it seems increasingly an unrealistic one, the separation of man from nature less and less desirable or justifiable. Nor has it been in the tradition of an integrated geographical science to do so. We are reminded of Watters' (1970) concept of geographic action (production activities, trading and communication, urbanization, etc.) which includes all processes of social action which have ecological consequences.

It is striking and singular fact that it has been the archaeologists and anthropologists who have most seriously engaged themselves in developing hypotheses and evidence on man-land or culture environment relationships in Latin America. They have, in fact, tended to see in cultural ecology a new kind of magic. in partial reaction against cultural determinism (e.g. Palerm and Wolf, 1957; Meggers, 1954, 1957; Sanders and Price, 1968). Much of their interest, in the New World context, has rived from their specific problem-orientation, especially as concern the origin and spread of civilizations, including the knotty issues cultural origins and whether environment has a limiting effect on the development of cultures. The ecological commitment of anthropologists at times shows relative naivete in the examination of land and livelihood and relative sophistication in examinations of social structure. Geographical studies tend to display strength and weakness in the re verse direction (Brookfield, 1964; Mikesell, 1967, 1969). In both culture and environment are increasingly seen not as opposing forces separate entities, but rather as interlocking components of a

system Yet one cannot escape the observation that the anthropologists are taking more than their share of the load. Social and demographic history, too, are increasingly finding that the questions they are asking lead back to the land and man's temporal and spatial relationships with it.

The Ecologic Crisis in Latin America

Whatever the promise of technology, the overriding preoccupation of our time is the accelerating impact of increasing numbers of technologic man on nature. In the United States, environment has become an everyday word, a fighting word, and the maintenance of environmental quality and a reasonable equilibrium between man and the land is being proclaimed everywhere as the central issue for the 1970's. If a full awareness of this greatest of all problems -- how to live in some sort equilibrium with the earth -- seems first to have surfaced in the industrialized mid-latitude countries, it is no less crucial in the rest the world. In Latin America the "unforeseen ecologic boomerang" (Natural History, February 1969) is given special emphasis by the persistent and unchecked growth in population and the fragility of the soil water-vegetation system that must support it. As the technological revolution gains momentum south of the Rio Grande major and irreversible ecological changes are inevitable. A relevant geography ought to have something to say, for example, about such a proposal as the "South American Great Lakes Scheme" (Panero, 1967) and to be in a position "not supplant the specialist but to rein him in when he forgets that the mote consequence of his disturbances of the landscape may be serious to foresee the limits of the earth, and soon enough to avert disastrous collisions." (Luten, 1968). Yet, aside from a few recent alarms (e.g. Zelinsky, 1970a, 1970b), there has been little evidence of concern of geographers, or even of recognition of the nature of the crisis.

The whole complex of attitudes, preconceptions, definition of and time scales that ecological understanding and planning involves historically rooted. It is the history of past resource use predicted that we learn of the inadequacies of the present, the need for fundamental changes in attitudes regarding it. Nowhere is this problem of attitude probably more apparent than in Latin America. Environmental deterioration and population control are both becoming topics of concern for church and state throughout the area. Man has started chain reactions that may destroy the ecosystem, and the long range prospect for the natural wealth of the continent is a disquieting one. The recognition of the limits of the earth and two-edged character of the sword that is "progress" is beginning to

emerge, but our basic understanding remains woefully inadequate.

Vogt (1946a, 1946c, 1948, 1963) has probably done the most to put the problem in clear perspective, and among his prescriptions has been a series of geographical case studies of land-use history. Sauer (1958) argued that man long has been an important factor in the fact when environmental investigations are undertaken there. In an outstanding paper Sternberg has recently reviewed the range of man-induced changes in the environment in a 2-volume collection of essays on the *Biogeography and Ecology in South America* (Fittkau et al., eds., 1969) which includes several contributions on the application of ecologic concepts to that continent (e.g., Sioli, Schwabe). A representative cross-section of related environmental issues may be found in the reports of such conferences as those sponsored by the IUCN in Nairobi and in San Carlos de Bariloche (International Union for the Conservation of Nature, 1964, 1968), in the Bangkok symposium on Climate, Vegetation and Regional Land Utilization in the Humid Tropics (Pacific Science Congress, 1958), in the Paris Conference on the Rational Use and Conservation of the Resources of the biosphere (UNESCO 1969), the Belem-Lima reunion on Agricultural Problems in the Humid Tropics of Latin America (Brazil, Conselho Nacional de Pesquisas, 1967), the IGU Regional conference (Dyer, 1967) and the IGU Symposium on Geo-Ecology of the Mountainous Regions of the Tropical Americas in Mexico (Troll, 1968).

Some fifty years ago Albrecht Penck claimed that the carrying capacity of the earth under different levels of exploitation was the most urgent problem for the geography of man and such a research program figured as one of his last projects, focused on specific land units. Remote underdeveloped parts of the world, including most of Latin America, still are crying out for synthetic evaluations of their territories and their resources. The limits of the earth has since been the theme of many popular books (Vogt, 1948, Osborn, 1948, Garst, 1963, Bergstrom, 1966), but it has apparently seemed easier to generalize on a global scale than in regard to particular areas. For Latin America there has been no semblance of agreement. We have had dire and gloomy forecasts for the future (e.g., Vogt, 1963; Budowski, 1966b) and we have had the buoyant optimists (Hanson, 1944, 1949; Wilson, 1950). The contribution of geographers to this dialogue has not been impressive; Gourou's balanced view (1966) of the tropical world as a whole remains a fundamental guideline (see also Picó, 1968).

Vegetation As an Essential Geographic Factor

Almost all of us working in Latin America, especially in the tropics, have been sensitized inevitably to vegetation as an essential geographic factor. The relationship of plant cover to human activity is here much closer than in temperate areas. The traditional bias in physical geography towards land forms is thus being increasingly modified to make room for living things. In geography we speak not so much of plants and animals as of the earth crust covered with plants and animals. We emphasize relations, not objects, and these are based on aerial position of adaptation and succession in a somewhat different way from most biologists. Yet in such work biologists are our closest allies, and the ecological biologists are apt to find our point of view and methodology congenial. We have much to learn from them. Acquisition of the necessary competence in botany, zoology, soils and climatology is a first prerequisite to serious ecologic field work. Identification of species and tax imposes on our powers of observation quite as much as recognition of modification and aberrations in distributional relationships. Initially one is apt to rely heavily on vernacular names, and there is no better way to develop rapport with countrymen than by inquiring “como se llama esta mata,” whether wild or domestic. Plants are impersonal, non-political, completely objective entities with which people living close to the land are inevitably closely familiar. Recently the OTS program in Costa Rica has provided a providential opportunity for both graduate students and faculty to sharpen their biological awareness in the context of the warm wet lands to the south. Geographers should be taking full advantage of it.

Vegetation and vegetation change provide some of the most sensitive indicators of environmental potential and environmental deterioration, and it is here that some of the most important contributions to ecological understanding in Latin America have been made (e.g., Waibel, 1948; Lauer, 1956; Troll, 1959; Tosi, 1960, 1964; Koepke, 1961; Eden, 1964; Wagner, 1964; Hills, 1965; Holdridge, 1967; Gordon, 1969). In numerous explicitly regional studies, too, geographers have been given special attention to vegetation and its modification and use by man (e.g., Gordon, 1957; West, 1957; West, Psuty, and Thom, 1969).

Consideration of the nature of plant succession in disturbed situations such as abandoned agricultural plots is crucial to the understanding of the process of vegetation change (Budowski, 1963), which at the same time involves changes in soil and micro-climate. This has been termed by Troll (1966) a “landscape succession.” Weedy immigrant species, usually introduced through human agency, have contributed largely to the reconstitution of secondary formations throughout

the American tropics (e.g., Johannessen, 1957; Wagner, 1962; Budowski, 1968; Eder, 1970), as well as frequently being the cause of abandonment of agricultural plots (Kellman and Adams, 1970). Some of the best examples of the replacement of native plant communities by exotic species have come from the Caribbean islands (Harris, 1962, 1965; Watts, 1966). The rapidity with which such events occurred is nowhere better described than in Acosta's account of the pasture parklands of Hispaniola, as here translated into English for Purchas (1906, xv: 122):

"those trees that have most abundantly fructified, be Orange trees, Limons, Citrons, and other of that sort. In some parts there are at this day, as it were whole Woods and Forrests of Orange trees: the which seeming unto me, I asked who planted the fields with so many Orange trees? they made me answer, that it did come by chance, for that Oranges being fallen to the ground, and rotten, their seeds did spring, and of those which the water had carried away into divers parts, these Woods grew so thicke: which seemed to me a very good reason."

It has been shown that grazing animals replaced man in the tropical lowlands of Mexico with the decline of Indian populations in the 16th century, promoting the invasion of adventive woody species (Simpson, 1952). Overgrazing may have so reduced fuel supplies in some areas that fires were eliminated as an ecologic factor (Johannessen, 1963) with a resultant advantage to unpalatable woody species, especially those adapted to drought. Pines, widely distributed in Middle America, have attracted special attention as successional species adapted to fire may kill seedlings during early stages of growth (Parsons, 1955; Denevan, 1961). Ecological assemblages, although not climax or in equilibrium, are thus being established and maintained. In the field of Maya studies the thesis that invasive sod-farming grasses possibly played a significant role in the decline of the classic lowland cultures has attracted continuing attention (Morely, 1956).

Intentional introduction, and later naturalization, of superior African pasture grasses has played an increasing role in this "grassification" of the American tropics. Bermuda, Guinea, Para, molasses, Jaragua and Kikuyu grasses, all of tropical African origin, have aggressively established themselves in much of the humid American tropics much as Mediterranean annuals did in California after the arrival of the Spaniards. This process of "Africanization" of the New World tropical grasslands is still going on (Parsons, 1970). The African grasses are superior in protein content and in resistance to grazing and fire. They often have

proven valuable in the fight against soil erosion. But the durability of such short-rooted perennials in the face of a shortened nutrient cycle is unproven. Some have held that the new tropical grasslands, properly fertilized and managed, must one day become prominent surplus producers of meat and dairy foods (Clark, 1962). Today, beyond dispute, the tropical forest is fast receding on all fronts, and it has become a serious question as to how long the selva may endure. (Richards, 1952, 1967).

Tropical Agricultural Systems

Any concern for the productive capacity of the lands of tropical America leads to a consideration of agricultural systems. Comparative studies of subsistence, commercial and socialistically organized agriculture, of *minifundia* and *latifundia*, of swidden and permanent field farming are relatively few. We know little about their relative efficiency or their ecological implications. The significance of modern agronomic research for tropical agriculture generally has recently been underscored by Chang (1968). Technologic backwardness has been too easily confused with the presumed hostility of the tropical climate in evaluating the development potential of low latitudes countries in general (Courou, 1966) and Latin America in particular (Tosi and Voertman, 1964; Watters, 1967). Cultural and political barriers to change may well be decisive (e.g., Higbee, 1951) and studies of the diffusion of agricultural innovations clearly offer much scope (e.g., Myren, 1969; Floyd, 1970). The FAO-sponsored survey of shifting agriculture (Watters, in press) will provide us with the most comprehensive analysis of that form of land use, with emphasis on Mexico, Venezuela and Peru (see also Conklin, 1963; Haney, 1968). The most widely held view is that shifting agriculture is the most common traditional land use in the humid tropical zone because of the general poverty of the soil. When the forest is cut and burned by man the nutrients in the plant mass are rapidly mobilized and washed out by rain, destroying the ecological balance of the virgin tropical forest for an infinite time (e.g., Walter, 1964; Gourou, 1966).

If most of the important studies on "shifting cultivation" have been carried out in Southeast Asia and Africa, it is perhaps because in the New World the more characteristic system is one in which shifting cultivation occurs in an "impure" form, supplementary to permanent field farming. But the manner in which this "partial swidden" is organized, the spatial concepts and functional systems that support it, has only begun to attract our investigation (Sandner, 1962; Stewart, 1968).

The contemporary plantation economy of Latin America and its offshoots has been of concern to a growing number of anthropologists (e.g., Pan American Union, 1959; Wolf and Mintz, 1957) as well as to geographers (Waibel, 1942; Monbeig, 1952; Jones and Morrison, 1952; Blaut, 1959b; Chardon, 1961; Stouse, 1970). In addition numerous Latin American case studies which have had a close bearing on land use patterns and practice have been emanating from the Wisconsin Land Tenure Center.

Soil erosion is a theme of particularly crucial significance in much of Latin America, especially where topography is rugged and the history of human occupancy long. A comparison of the efficient and well-balanced Nahua agricultural system which existed in the valley of Mexico at the time of the Conquest with the scientifically organized modern agriculture and industry of today suggest the possibilities for the production of food and other organic raw materials are far greater than those now prevailing (Sears, 1953). Yet there seems abundant evidence that in some areas soil erosion was a well advanced process even before the arrival of Europeans and their livestock, apparently then as now closely associated with the build up of population densities in excess of the land's ability to support them (Cook, 1949a, 1949b, 1963). Geographical analyses of soil erosion in Latin America, both the physical process and the cultural and ecologic consequences, largely remain to be made (T.L. Smith, 1948; Sternberg, 1951; Blaut, 1959a; Haggett, 1961; Stevens, 1964). It should be vastly facilitated by the availability of air photography. The problem of the origin and extent of the caliche-like *tepetate* of highland Mexico (*cangawa* in Ecuador) or the lateritic surfaces (plinthite) of the Amazon basin are examples of themes crying out for geographical analysis. In Mexico intensive hillside farming in the past appears to have led to the silting of poorly drained basins which at the same time forced and made possible the downslope movement of population onto the flat land (West and Augelli, 1966). This movement may already have been under way in pre-Conquest times, but was much intensified with the introduction of grazing animals and the plow. Terraces and maguey-lined *bancals* have been extensively employed since early times to hold the slopes (e.g., Guzman, 1962; Wright, 1963; Herold, 1965; West, 1968; Donkin, 1970), *chinampas* and other drained-field agricultural techniques developed to make the poorly-drained, alkali-prone basins inhabitable (West and Armillas, 1950; Wilken, 1969; Denevan, 1970). The recent suggestion (Spores, 1969) that much of the erosion on the slopes overlooking the valleys of Oaxaca may have been intentionally induced to fill in behind the down

slope arroyo check dams with soil derives from the kind of field work that air photographs now vastly facilitate. Improved access to such photography, especially to permit the browsing that turns up the artificial and unnatural alignments and patterns that so often lead to significant new discoveries, would be an important aid to all of us.

Perhaps nowhere within the entire range of tropical studies is there so much contradictory evidence and confusion as in the matter of soils and soil fertility. The relative pessimism expressed by Pendleton (1955) and Gourou (1966) in this regard seems to be more or less confirmed by controlled quantitative studies (Nye and Greenland, 1960) in the eastern hemisphere, but except for Popenoe (1960), who has experiments in progress in Guatemala, nothing comparable appears to have been done in the New World. Reviews of Latin American soil resources (Stevens, 1964; Wright and Bennema, 1965; Beek and Bramaio, 1968) are generalized and based on reconnaissance. Guatemala has one of the best soil surveys on any Latin American country. Large scale corporate farming enterprises in the Amazonian selva both in Peru and Brazil would seem to offer exceptional opportunities for controlled, long-term experiments of the consequences of forest clearing and cropping.

The Opening of New Lands

Geographers have recently been giving priority to studies of the opening of new lands, to the impact of the *vías de penetración* that have been reaching down from the Central American and Andean highlands into the *tierra caliente* (Crist and Guhl, 1957; Eidt, 1962, 1967; Monheim, 1965; Stewart, 1965, 1969; Gonzalez, 1966; Hegen, 1966; Siemens, 1966; Fifer, 1967; Parsons, 1967; Nuhn, 1969), and the contrasts between spontaneous and planned settlement of such areas. The recent literature on agricultural colonization has been reviewed by T. Lynn Smith (1969).

This process of the replacement of forest by cropland or pasture is visibly conspicuous and peculiarly adaptable to geographical field techniques. The classic studies by Sandner (1961, 1964) in Costa Rica and Central America are models of their kind in this regard. The ecologic consequences of this massive alteration of the face of the tropical lowlands by man is but dimly perceived. There are those who view the destruction of the rain forest with equanimity and even enthusiasm, much as early North American pioneers saw the replacement of woodland by cropland as inevitable and desirable. The consequences of such attitudes, deeply

rooted in culture and history, deserve careful and immediate examination by geographers and other scholars with a humanistic and ecologic bent.

The rationale of government investment in land settlement schemes on marginal and distant lands, as opposed to intensification of productive efforts on areas closer to major consuming centers, has been frequently questioned (e.g., Sternberg, 1955; Zelinsky, 1966; James, 1969). Yet it seems seldom to have been subjected to serious cultural or economic analysis. The major studies on agricultural location theory and the organization of economic space, at least, scarcely allude to the Latin American situation.

Historical Demography and Cultural Ecology

Such downslope movement of settlement into the *tierras calientes* takes on added interest and significance where archaeological remains are exposed as the forest is cleared. The case for dense former native populations has been substantiated by careful case studies using early tribute and missionary counts, observations of soil erosion and man induced vegetation change, and the food resource diet and consumption patterns of contemporary inhabitants (Borah, 1970). The stimulus for much of this detailed local study on which such estimates have been based came originally from geographers, notably Carl Sauer (1935) and before him Karl Sapper (1924, 1948). Estimates of the total pre-Conquest population of the Americas have gone steadily higher, with the most recent suggestions that we might well find in the end that the population was upwards to 100 million, mostly inhabiting the tropical and sub-tropical zones. The controversy has naturally expanded to the demographic history of the colonial period and to the present (e.g., Borah, 1970). The introduction of malaria, smallpox and other European diseases clearly had much to do with the early and rapid depopulation of the *tierra caliente* (Crosby, 1967), while the control of the first of these by DDT in our day is facilitating a current reestablishment of major population clusters in this once insalubrious lowland zone.

The tropical forest agricultural pattern is essentially one of carbohydrate production, with fat and protein components of the diet having been supplied by prodigious fish, aquatic mammal, reptile and avian resources of the flood plain or sea coast (Sauer, 1952). A sophisticated set of fishing practices, including fish poisoning, and effective water craft are also involved. Anthropologists have increasingly accepted the proposal (Lathrap, 1965; Reichel-Dolmatoff, 1965) that the development of agriculture and ceramics is older in some areas of the tropical

lowland than in the central Andes and that the rise root-crop agriculture in lowland South America was an important contributing factor to the rise of civilization in the highlands. Our discovery of ancient ridged field agricultural surfaces in the lowlands Bolivia, Colombia, Ecuador and elsewhere (Parsons and Bowen, 1966; Parsons and Denevan, 1967; Denevan, 1966a, 1970) have added support to this argument, as has the archaeological evidence, supported by studies of alluvial flood plain morphology and dynamics (Denevan, 1966b; Lathrap, 1968). Lathrap convincingly argues for a series of waves of migration from the heartland of Amazonia into the Andes, with intense and continuous population pressures on the flood plain of the central Amazon. The extreme and continuing competition for territory is understood if one realizes the limited amount of flood plain -- the only ecological niche really suitable to the tropical forest culture -- available in the Amazon Basin (Marbut, 1926; Sternberg, 1964). In this thesis the primitive groups of the interfluvial surfaces are seen as essentially the wrecks of agricultural societies forced into an environment unsuitable to the basic economic pattern (Lathrap, 1965, 1966). This construction flies in the face of the rigorously environmentalist interpretation that the rain forest could support only a sparse subsistence population based shifting field agriculture (Meggers, 1957), a thesis that has given to a veritable storm of ecological commentary from anthropologists since it was first propounded.

More than anything else the pressures of an unrelenting and massive population increase may in the end press tropical America against the ecological wall (e.g. Budowski, 1966b). The rapidly accelerating population growth here is a relatively new phenomena, attributable to a crease in mortality rates and not an increase in birth rates. In so areas it is already pressing directly on a limited resource base; almost everywhere it is interfering with economic and social development (Sandner, 1970; Zelinsky, 1970b). It is the accumulation of human quality resulting from education, not the number of people, which quite clearly determines the potential for improved economic well-being. The distribution of population and mappable, geographical differentials rates of growth, standard of consumption, migration, productivity, and a host of other spatial variables awaits the attention of geographers. The problems of population geography have been attacked at a few points (e.g., Nunley, 1960), but a dent has scarcely been made on this funds tally ecological problem. For years Preston James has called for a program of land use and population mapping in Latin America, but we lack anything but the most generalized idea of where people live and what conditions. Here is room for several platoons of geographers a cartographers, combining census data and direct

field observation with available air photography and other remotely sensed evidence.

Opportunities Ahead

While our limited knowledge and understanding of man's place in tropical ecosystem leaves much to be done, problems of environmental pollution, pesticides, preservation of open space and biological reservoir siltation, ground water depletion and replacement, the imp of modern technology on the fragile environment call out for our attention. We need case studies of socioeconomic structures and of particular cases. Natural resource inventories by themselves are not enough. Where supplies of money and trained people are sharply limited to pile up as many data as possible can even do more harm than good to the cause of economic progress and well-being, at least to the extent that scarce resources are thus made less available to other essential tasks (Herfindahl, 1969). But where resources are viewed in the cultural-historical ecological context insights may appear that the engineers' survey will entirely miss. Herein may lie a role for the North American geographer looking in on Latin America, so to speak, as a sympathetic and objective outside observer.

Planning has become the ordering force of our society, and good planning involves massive doses of applied ecology and applied geography, with sufficient historical perspective to illuminate the processes at work. Air photography and other remote sensing devices have given us new tools with which to tackle the enormous problem of documenting the present -- where things are and in what abundance. But to know why usually requires personal involvement and direct field observation. There is no substitute for immersing one's self in the language, culture and history of a piece of country. Our first job is to record, to describe the land as we see it, to note how things pile up at certain places and the consequences of this. Such documentation may be carried out hand in hand with the study of process, of change, involving the evidence from past and observed dynamics of contemporary interaction of man and the land. Theory may provide us the framework on which to hang our observations, but theory for its own sake is no substitute for information and experience, in environmental studies as in the stock market. Field work permits us to originate hypotheses, to discover distinctive or unusual relationships. What we learn in doing it may quite likely one day turn out to have historical or documentary significance. Population growth and modernization is smothering what was. The evidences of older ways of living and systems of land use are fast disappearing (e.g., Wagner, 1958). Case studies of

local areas or situations are often the best approaches to the understanding of change and the ecologic consequences of development schemes. The earth is composed of distinctive parts, and where man lives close to nature, as in much of tropical America, the particular as opposed to the general is likely to have primary significance.

What may be required is a shift away from the city-oriented geographers committed to symbol manipulation, cost-benefit analyses, and the fascination of spatial geometry. We need more students who are at home in the field, ready to saturate themselves in the language, culture and daily life of Latin American society, attuned to the biological world and its processes, alert to indications of ecologic disbalance and disaster. For geography this means going back to our original concern for the environment, especially the biosphere, and to man as the operative factor in using it, in modifying it, in keeping it in good health or in disarrangement. Biologists have begun to recognize the urgency of bringing man into the picture; social scientists are becoming acutely aware that environmental problems may be at the root of human survival. It may lie in the hands of the area specialists among the geographers to bring the subject back into the mainstream of human concern -- the manner of man's occupance and use of the habitable earth. Ecologic research in the Latin American tropics provides an unexcelled opportunity to demonstrate this potential.

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