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The Study of the Physical Environment in Latin America

"What's new in the sciences?" Napoleon asked.
"Nothing." I said, "and if Alexander von Humboldt hadn't his South American voyages printed we would have a total standstill." J. Chaptal, *Mes Souvenirs sur Napoleon* (Paris, 1893).

Introduction

While collecting my thoughts on the state of research in physical geography¹ in Latin America, I was under the impression of three events which seemed to be relevant to the topic at hand.

First, the bicentennial anniversary of Humboldt has gone by in this country without any noteworthy celebration, let alone a memorial volume of some kind attesting the significance of the man and his contributions to geographic knowledge of the "nouveau continent." A hundred years ago Agassiz (1869) eulogized:

"It would be interesting to ascertain every place where the anniversary has been celebrated... for I believe it will be found that no part of the world has shown such universal appreciation of the indebtedness of **our age** (emphasis mine) to this great man as the U.S."

The question is whether the age Agassiz is referring to has long since passed. German Latinist geographers didn't think so, inviting their Latin counterparts to a month-long excursion through Germany last year, organizing a traveling exhibition of Humboldtiana to Latin American countries and presenting us, as they did ten years ago at the centennial of Humboldt's death (Schultze, 1959), with another splendid commemorative volume of his work (Pfeifer, 1969). Not was the literary harvest in the Latin countries insignificant (see e.g. Instituto Ecuatoriano de Ciencias Naturales, 1969) -- further evidence that the majority of our fellow geographers are of the opinion that even the age of the "new

geography" can still extract a lot from the "one-man academy" in which geography was the leading discipline.

The second event which caught my attention was the recent publication of what may be considered as a first attempt to put together a compendium on the physical geography of South America. Although entitled "Biogeography and Ecology in South America" (Fittkau et al., 1968) and containing a preponderance of articles dealing with floristic and faunistic biogeography, it also includes discussions ranging from continental drift to groundwater fauna, and from pre-Columbian Indian cultures to the distribution of national parks and the pollution of the environment. This is not the place to take issue with the facts presented in this work, but since it amounts to an attempt to cover most of the subject matter geographers have long been concerned with in their studies on the physical environment in Latin America, it seemed not only justified, but mandatory to briefly mention this strange collection of essays.

The third circumstance on which this paper is based or, rather, by which it will be limited, is personal research experience. The least one can hope to accomplish, given the task to review the entire spectrum of research on natural phenomena between the Rio Bravo and Tierra del Fuego, is to focus attention on what, according to one's personal evaluation of the field, seem to be the major problem complexes. I was fortunate enough to be aided in this task by colleagues² who have contributed to this volume by scrutinizing research in geomorphology and climatology of Latin America and thereby provided the necessary background against which some general principles for our work in the coming years may be outlined. I also refer the reader to Parsons' (1964) review of the geographer's contribution to social science research on Latin America, in which all basic research on the region's physical geography written by United States geographers is well taken care of and commented upon, and does not need to be repeated here.

Thanks to the above mentioned analyses of the pertinent literature in geomorphology and climatology I can allow myself the luxury to roam more freely along the environmental research frontier of Latin America. It is not characterized at the present time by any permanent settlements of North Americans. There are, however, some fossil monuments which can still be clearly identified as of Yankee origin.

Masters with and without disciples

If one were to study the continuity of research in physical geography of Latin America from the viewpoints of work objectives, regional preferences, and national schools involved, we score poorly in all respects. Although some themes and sustained efforts on the part of individual United States researchers can be recognized, looking back over half a century our effort has been sporadic. As long as the American Geographical Society exerted some kind of leadership by facilitating the publication of and possibly financing research itself, a certain degree of coherence was evident in United States Latin Americanists' work, both with respect to regional emphasis (Andes) and preferred topics (physiography, climate and acclimatization, settlement). The classic physiographic monographs of Bowman (1916, 1924), the pioneer efforts in illustrative geography by means of aerial reconnaissance (Johnson and Platt, 1930; Shippee, 1932; Rich, 1942), Davis' (1926) forgotten Lesser Antilles essay, Murphy's (1939) persistent work on the Pacific coast, and perhaps Marbut's (1926) early occupation with Amazonian pedology are names and works which come to one's mind without consulting bibliographies. It comes as a surprise, though, checking regional texts on Latin America, to find that in none of them are all of these studies cited and in some no mention is made of any. And it is symptomatic that no textbook author is able to refer to a single English language work by a geographer which would contain a general description and interpretation of Latin America's physical environment! Furthermore, over half of the general references in James (1959) "Latin America" are written in German. It may not be appropriate in this context to judge our research efforts by means of their precipitates in conventional texts, but we should bear in mind that the perspicacious student, with the flood of books, hardcover and paperback, available to him on practically any imaginable Latin theme, will not be overly impressed by our research efforts on the environmental essence of Latin America. Chances are that he will get a more meaningful elaboration of the region's natural factors from Madariaga or Tad Szulc.

The only general survey written by geographers on any aspect of the physical environment of Latin America, as far as I am aware, is to be found in the Koeppen/Geiger's "Handbook of Climatology" whose Latin American volumes were written, as we would expect, by Germans (Knoch, 1930; Sapper, 1932), with only the brief West Indian section authored, as if in afterthought, by North Americans (Brooks and Ward, 1934). A good twenty years out of date, as far as the genetic analysis of climatic types is concerned, and containing no station data recorded after 1927, it remains the only standard reference for the area as a whole

and the ancient statistics still find their way, figure for figure, into the obligatory climatic data tables of current textbooks.

Nor have we, in spite of a growing effort in coastal studies (Psuty, 1970) anything to show which would count as an internationally acknowledged contribution to Latin American geomorphology in general, or to any of its subfields. This becomes particularly apparent if we compare our past work with that of North American geologists. Their involvement in Latin America was not entirely utilitarian, as evidenced, beside a substantial number of local studies, by the useful "Handbook of South American Geology" (Jenks, 1956), which serves as an explanatory text for the geologic map of the continent published earlier (Stose, 1950). Without subtracting the least from the excellent achievement made by United States geologists in furthering the knowledge of Latin American geology, it should be mentioned that Quaternary geomorphology has, quite understandably, not been a topic of particular interest to them, and since especially in the Andean realm -- and this includes the foreland -- the relief is only in exceptional cases older than late Tertiary, much of the morphogenetic interpretation remains to be accomplished.

In stark contrast to our meager output stands the accomplishment of European geographers, and, I should emphasize, that of European-trained Latin American geographers. A good part of the reason for the overwhelming dominance of their work in physical geography over ours is the much stronger position this branch of geography holds both in Europe and Latin America. The tradition of straight-forward, or shall we say, academic physical geography has always been particularly strong in Germany, and its application to the Latin world has been conspicuous. There is no Latin American country whose store of knowledge has not been increased to a noticeable degree by the wide-ranging scope of geographic literature written by representatives of the various German schools. The consistency with which once defined problem areas were investigated over generations of German itinerant scholars -- several of whom took up residence in Latin countries and began to write in Spanish -- is particularly impressive.

I shall forego presenting a review of the European contribution to Latin American physical geography, which, especially if we include phytogeography, would fill a book (cf. Uhlig's (1967) discussion on the German contribution to Colombian geography alone). The few references cited subsequently are chosen as examples for the continuity and the topical consistency in the investigations of our German and French colleagues.

Four works are representative for the strong physical foundation German geographers are apt to incorporate into general regional discussions: the epoch-making work of Hettner (1892) on the Cordillera of Bogotá, Sapper's (1902, e.g.) writings on "volcanic land and man" in Central America, Kuehn's (1927) Argentine geographies, and the masterful treatment of the tropical Andes by Troll (1930). But it is the systematic occupation with certain problem complexes wherein lies the quintessence of the European contribution. Each of the topical concentrations is represented by a sequence of studies, often initiated by one of the early grandmasters, carried through and improved upon as well as regionally expanded by their faithful and inspired disciples. The Andes were always preferred as the regional probing ground for newly developed theories, among them especially prominent that of the influence of Pleistocene morphogenesis on the present landscape (Wilhelmy, 1952), or that of the importance of seasonal moisture availability in the development of vegetation (Lauer, 1952). Well known are Troll's numerous essays on the three-dimensional structure of climate and vegetation in the Andes (for best summary in English of his own work see "The Cordilleras of the Tropical Americas," 1968; on Troll's contributions as seen by his colleagues, see *Erdkunde* 4, 1959).

The still unsolved sequence of Pleistocene glaciations found early investigators in Sievers (1888) in Colombia, Troll (1935) himself in Bolivia, and Kinzl (1950, e.g.) in Peru. A parallel line of research on periglacial and pluvial conditions during the Pleistocene can be traced back to Jaeger (1925) in Mexico, and deMartonne (1935) in the subtropical Andes, the latter clearly establishing and basically correctly interpreting the still intriguing "*diagonale sèche*." The most recent additions to this sector of physical geography, called "*Klimamorphologie*" in German, "*morphologie climatique*" in French (and still unnamed, because not practiced, here) concern both the reconstruction of the late Pleistocene landscape and present landform-climate interactions. The studies of Wilhelmy (1954) on the North Coast of the continent, of Corte (1953) and Czajka (1955) in Argentina, and, as representative of a growing French involvement in morphoclimatic problems, Tricart (1959) in Brazil, and Dresch (1958) in the Central Andes, are not only of interest to the geomorphologist, but highly relevant in an anthropogeographic context.

Slowly some of the difficult relationships between late Tertiary and Pleistocene orogenic movements and the morphoclimatically conditioned cut-and-fill cycles in the Cordilleran valleys are seen more clearly through a series of tectonically oriented studies. They had their beginnings with none less than W. Penck (1915)

who used the southern margin of the Puna de Atacama as a major testing ground for his morphological analysis. Recent examples of morphogenetic studies in the fullest sense of the word are those of Dollfus (1964) in central Peru, Almeida (1948) in the Matto Grosso and Enjalbert (1967) in the limestone ranges of Mexico and Guatemala.

Very little of this rich -- and here only sketchingly reported -- collection of research objectives and results has influenced the direction of our own geomorphic studies. We seem to be satisfied with continuing in the descriptive-classificatory track, relying more on quantification than on a genetic interpretation.

TIERRA FIRME --and other generalizations

When we discuss the physiography of South America in a regional course -- and that, I presume, is the only type of course in which we can dwell at some length on such or any other topical aspect of the continent--chances are that most use the same worn-out building blocks: the (alas!) so old and stable shields, the intensely folded arid (ah!) so young Cordillera, and (last but not least!) the almost featureless plains. Except for the exclamations (which are mine, to remind the reader of the natural splendor of the objects involved) these could be quotes taken from conventional college texts and are quite indicative of the kind of geomorphic terminology we put before the students. It is about as intriguing as that of the Spaniards who, for lack of an appropriate name -- after all, they had no idea in what part of the world they were simply referred to the newly discovered land south of the Main as *tierra firme*.

I am aware that we are not concerned here with "teaching Latin America," but I suspect that this unimaginative approach to one of the most splendid assemblages of landforms on the globe may be a reflection of the equally dull cutting edge we use in our research. A good many of the references cited in the surveys of my colleagues on geomorphic research of United States geographers in Latin America fall into the category of relatively unsophisticated physiographic partitioning. It might be argued that we are still in a reconnaissance stage in many portions of the continental interior where even the old workhorse, the American Geographical Society Millionth Map, goes astray, or where, on newer World Aeronautical Chart sheets, we reach a honestly labeled "limit of reliable information." This is undoubtedly so, but we should realize that morphographic and morphometric analyses, necessary as they are, are merely prerequisites for a full-fledged

morphogenetic synthesis. I think we stop short of that goal too often. The techniques and tools of geomorphic research available today allow us to break down the erstwhile uniform and "featureless" plains into "grains" which still may be compartments of the topography, but also fractions of the sediment sample in the laboratory. I could not illustrate this point better than by mentioning the exemplary series of studies by Sioli (1957, e.g.) on one of the most difficult areas to "break down," the Amazon basin. The old floodplain concept has finally been flushed out of the Amazon system and has been replaced by a finely reticulated mesh in which various types of *várzeas* and *terra firme* (note the subtle difference in spelling -- and the large one in meaning) are the newly recognized grains. And Goosen (1964), to mention one other case, has transformed the once "featureless" Colombian Llanos into an array of most meaningful features include levees and dikes, dune fields, and fault systems revealed by the peculiar pattern of the Orinoco tributaries.

The same kind of generalization which has persisted too long in our Latin American physiography is apparent in our professional writings on climatological aspects of the study area. In spite of the decided improvement in techniques of observation and data acquisition over the southern Americas during and since the International Geophysical Year (1957-58), and notwithstanding the new insights in the atmospheric circulation which can be derived from them, most texts still adhere to a two-dimensional, earthbound climatology. With Trewartha's (1961) lucid summary of the dynamic aspects of Latin American climates it has become clear that there is no such thing as an anomalous climate in the light of modern three-dimensional analysis of the troposphere. The works of Leahy (1958), Serra (1959), Trojer (1959), Neiburger (1961), and Nimer (1964), among others, have done much to clarify the genetic factors of the "azonal" segments in the climatic mosaic of Middle and South America.

As far as the standstill in regional climatology is concerned, it is well evidenced by endless manipulations of the Koeppen system, which unfortunately, simply doesn't allow the refinement needed at the regional and local level because it was never intended to be anything else than a worldwide comparative system of climatic types. We still find in most atlas and textbook maps, a big H printed over the Andes which the legend identifies as that unusual climate called Undifferentiated Highlands. Even a llama knows that its range is limited to the Puna and that the wet Páramo to the north is quite a different habitat.

The entire concept of altitudinal zonation needs, I think, to be refined, not only

from the climato-ecological point of view, but also with respect to pedologic and geomorphic processes. After all, it has remained basically unchanged since the equinoctial voyager correctly interpreted the banded arrangement of vegetation about the cone of Chimborazo as a consequence of decreasing thermal efficiency with increasing height -- the lapse rate made visible. A major discovery at his time, we have stereotyped the *tierras* to such an extent that one imagines them as practically uninterrupted plant belts following the contours like hypsometric layers (see e.g. "Ecologic Map of Colombia," Espinal and Montenegro, 1963). One of the most profound impressions I have personally taken back from the Andes is the great internal differentiation of each altitudinal belt, a consequence of other than thermal influences. That local topographic conditions can become decisive climatic determinants has again been demonstrated by Troll (1952) who directed attention to the many interruptions of the montane forest belts in deeply entrenched Andean valleys of the transverse type. They act as "windgaps" in the daily exchange of air between lowland and highland and are characterized by truly xerophytic vegetation, in spite of their "windward" exposition.

A Neo-environmentalist geography?

Agreed on the generally poor record we have left as physical geographers in Latin America the question may be asked, in conclusion, whether we have failed because the task of studying the natural environment is no longer within our grasp -- if it ever was. There are those who think that the physical geographer is already an extinct academic species, and that out of him has evolved, either by mutation or by survival of the (academically and socially) fittest, a new breed known as *homo ambientalis* ssp. *ecologicus*. I think it would be professionally wise to accept the fact that climate and landforms are no longer our exclusive research domain, but have to be considered as part of a giant ecosystem everybody is responsible for and knowledgeable about. It is a kind of participatory neo-environmentalism we are witnessing, and for us, of course, this is Morphology of Landscape all over again, but with a quality judgment attached, or perhaps an applied physical geography in disguise.

This brief reflection on the general state of affairs might be useful in reevaluating our position with respect to our future work in Latin America. The evidence shows, I think, that the physical geographer's work in the Latin countries has been too "academic," that it was motivated more by little idiosyncrasies than by issues which would be of interest to a broader scientific community and, especially, of direct benefit to the people of the countries whose lands and skies are our

research objects. A shift from our past empirical and descriptive research orientation to a more dynamic, problem-oriented approach is indicated. The many acute problems of physical nature in Latin America have been too painfully obvious during recent years and they require as much attention as those within the social and economic sphere.

Our European colleagues are already ahead of us in this respect, too, as evidenced by the valuable contributions of French geographers to questions which concern the analysis of the Andean landscape in terms of natural handicaps and hazards which interfere with its developmental potentialities (see e.g. Dollfus, 1967; Tricart, 1966). There is no doubt that the earth scientist is just coming into his own as an indispensable assessor in resource evaluation which must always start with a sound knowledge of the physical landscape. I think we have the potential to contribute our share, and while not abandoning studies which challenge our academic curiosity, a more practical orientation in our future work on Latin soil might eventually gain us a better reputation as environmental scientists. Let us not stand by in splendid isolation, or we will continue to get into situations such as the one which occurred at an UNESCO symposium on deltas in the humid tropics, where the chairman, reacting to the question as to why, with so many geographers present, no mention was made of geography, answered by saying that "if (his) concept of geography, as one of the integrating sciences, is sound, this symposium and its conclusions are all geography" (UNESCO, 1966). Let us do some integrating ourselves in our future work in Latin America!

Notes

1. In agreement with the directives of the Executive Committee of CLAG, Biogeography and Ecology are not considered as a part of Physical Geography here and are dealt with by a special panel.
2. See the contributions of A. Craig, H. Daugherty, J. Lahey, and N. Psuty in this volume.

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