

The tropics weren't so 'stable' after all

Glacial advances had great influence on life in the southern tropics

by Louise Purrett

Glacial advances and retreats during the past million years or so have had drastic effects on plant and animal life. The resulting migrations, evolution and wholesale extinctions in the Northern Hemisphere have been thoroughly documented.

There has been relatively little geological and biological study of the Southern Hemisphere, however. Concepts of past conditions in the southern continents have been based on studies in low latitudes of the Northern Hemisphere. Such studies have indicated that the tropical areas of the southern continents remained relatively stable.

During the past 10 years, this idea has begun to give way in the face of new data, and now Dr. Beryl Simpson Vuilleumier delivers the crippling blow. Dr. Vuilleumier, an assistant curator at Harvard University's Gray Herbarium, has added her own field research to previous studies to demonstrate that the ebb and flow of glaciers in South America have in fact had a profound influence on present patterns of animal and vegetable life, even in the tropics.

Dr. Vuilleumier's evidence, described in the Aug. 27 *SCIENCE*, is derived from two sources—present patterns of speciation of flora and fauna, and geological and paleobotanical studies. In most sexually reproducing organisms differentiation occurs only if populations are isolated from one another. Where distinguishable forms of a group of organisms are in contact, the two forms must previously have been separated.

It has been known for some time that glacial advances influenced the evolution and distribution of species in the southern and central Andes. European geologists had noted parallels in the glacial histories of southern South America and northern Europe, and biologists later found that the forests of timber trees that inhabit cooler parts of



B. S. Vuilleumier

Dr. Vuilleumier: Tropical climatic stability was "a complete misconception."

the Southern Hemisphere had retreated toward the equator in a manner similar to that of forests in the Northern Hemisphere.

Within the forest belt along the mountain slopes of Chile, glacial tongues reaching out from the Andes into the central valley seem to have acted as genetic barriers, so that plant populations on either side became differentiated. South of latitude 44 degrees, all the land west of the Andes was covered by ice. But there are a number of closely related but slightly different kinds of plants in this area, indicating that isolated spots within the glacial zone may have preserved certain flora.

Vertebrate animals, in contrast appear to have been little affected by local events during glacial periods. Where fauna have become differentiated into separate species, it has been by gradual evolution.

It is only recently that scientists have begun to discover the effects of glaciation on plant and animal life in the northern Andes and the tropics. From Venezuela to Ecuador, says Dr. Vuilleumier, the mountain areas between the timberline and snowline are covered with isolated patches of grasslands. The final uplift of the Andes occurred about a million years ago, so this grassland, and therefore all its inhabitants, must have developed since then.

The bird populations of these island-like grasslands originated in the high central Andes. The number of species present in each grassland island differs from the number predicated by models for the dispersal of species and development of bird population of islands. This means, says Dr. Vuilleumier, that rates of bird immigration and extinction may have been altered, perhaps by glacial events.

In fact, there is evidence of a lowering of the treeline by about 2,000

meters during glacial maxima. The grass islands would have become closer together, allowing freer exchange of plants and animals between them.

"The presumed climatic and ecological stability of [the humid, tropical lowland areas of South America during the past 50 million years]" says Dr. Vuilleumier, "appears to be a complete misconception." Investigations of several bird classifications and of the lizard genus *Anolis* have revealed wide variations and divergent species living in close proximity in areas where there is no modern, observable physical or ecological barrier.

Jürgen Haffer of the Mobil Research and Development Corp. studied five unrelated groups of birds and found that the same barriers had apparently affected the evolution of all five groups. He, as well as Drs. E. E. Williams of the Museum of Comparative Zoology in Cambridge and P. E. Vanzolini of the Museum of São Paulo, Brazil, proposed that Pleistocene climatic oscillations caused alternating periods of expansion and contraction of the lowland tropical rainforest and its fauna. During dry phases, when the forest covered small, isolated areas, the fauna of each area would become specialized. In humid phases, the forest re-expanded and previously isolated populations came into contact.

Unfortunately, says Dr. Vuilleumier, there is little geological research to confirm that such fluctuations in tropical climate actually occurred. But preliminary studies of the shape of the coasts of Brazil and the Guyanas, and of the eastern part of the northern Andes, as well as aerial surveys of central Brazil, indicate that such changes did occur.

"The apparent paradox of the wealth of species in the 'stable tropics'" she concludes, "is partially explained by the fact that the tropics have probably been quite unstable." □