SOME ASPECTS OF GEOGRAPHIC PATHOLOGY IN PERU

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Peru is located in the Western Hemisphere between 0°02′-18°21′ of latitude South and 68°39′-81°19′ longitude West. Because of its geographic location, the whole Peruvian territory is situated in the tropical region of the New World and one therefore would expect to find a warm or tropical climate prevailing all over the country. However, this does not happen in a considerable proportion of the area, mainly due to the presence of the Andes Mountains, which change and diversify the climate to such an extent that a variety of climatic conditions can be found in different regions of the country.

Peruvians divide their country into three main but different geographic-climatic regions, which can be described as follows: (1) Coast — A narrow and mostly arid region on the western side of the Andes, with very little rain and a temperate climate; (2) Sierra — The region of high mountains with cold weather prevailing all the year round; and (3) Jungle — The region of tropical forest in the Amazon. As the climate changes gradually from one region of the country to the other, particular attention has been focused on the plants and wild animals that are present at different altitudes. In this way some climatic classifications have been attempted.

This report attempts to describe the natural conditions and the effect of altitudinal differences relating to the endemicity of some insect-borne diseases. For this purpose the Peruvian territory will be divided as follows: a) Western side of the Andes, i.e., Pacific watershed, and b) Eastern side of the Andes, i.e., Amazon watershed.

In Peru the general pathological pattern is somewhat altered according to the climatic conditions of each geographic region or subregion. It is interesting to note in this connection the significance of altitude on the presence and incidence of most of the human diseases transmitted by insects that are endemic in certain regions. This phenomenon was clear some decades ago when the highly effective and long-lasting insecticides were not available. Today, because of the intensive use of such insecticides, some of these diseases have tended to disappear while others have been reduced considerably. However, since the natural conditions

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still remain the same and none of these
diseases have yet been eradicated, it would
be proper to mention how altitude affects
the presence and incidence of some arthro-
pod-born diseases around 12° of latitude
South. For this purpose, previously gathered
information is used as a basis for the prepa-
ration of the schema presented in figure 1.

1. WESTERN SIDE OF THE ANDES, i.e.,
PACIFIC WATERSHED

Rivers originating in the upper parts of
the mountains descend directly to the Pa-
cific Ocean along narrow and deep valleys,
where native population have lived for cen-
turies. One of these valleys, the Rimac, lies
around 12° latitude and extends from the
ocean to the highlands. Lima, the capital of
Peru, is found in this valley at approximately
150 meters above sea level. For many
years several endemic insect-born diseases
have been investigated in this area and
important information concerning their epide-
miology has been gathered. The presence
and incidence of such diseases follow:

1. Malaria: From sea level to 1,800 m.
This disease, which presently is almost erad-
icated from the Rimac valley due to the
effectiveness of the Malaria Eradication
Program, was of considerable economic
importance before the use of modern insecti-
cides. Only one species of *Anopheles*
mosquito is important in the transmission of
malaria in this valley. This insect is more
abundant shortly after the rainy season in
the highlands. During that time of the year
small ponds which are found along the river
constitute the principal breeding places for
the mosquito. The low temperature found
above 1,800 meters seems to be the main
factor that limits the altitudinal distribution
of the insect vector.

2. Carrion's disease: 1,000 to 2,800 m.
This disease, also called verruga Peruviana
and human bartonellosis, is almost restricted
to certain mountainous regions of Peru.
For long time it was the most dangerous
disease that affected particularly the for-
ereigns. Written information on the disease
has been available since 1630, less than a
century after the first arrival of the Span-
iards in Peru.

In modern times human bartonellosis
constituted an important public health
problem when non-immune persons re-
ained, even for a few days, in endemic
localities. But at present, due to the long-
lasting effect of modern insecticides, this
disease has been almost completely con-
trolled. Carrion's disease is transmitted in
nature through the bite of a few species of
Phlebotomus sandflies, which are very sen-
sitive to DDT and other similar insecticides.
The epidemiology of this disease suggests
the existence of non-human reservoirs, but
these are unknown at present.

There is a close relationship between
the presence of *Phlebotomus* sandflies, particu-
larly *P. verrucarum*, and the prevalence of
Carrion's disease, at least in the Rimac
valley and other valleys on the western side
of the Andes. Its incidence in relation to
altitude was demonstrated in a valley 200
kilometers north of the Rimac valley.

3. Cutaneous leishmaniasis: 1,200 to
3,000 m. A benign form of cutaneous leish-
maniasis called uta prevails endemically in many mountainous localities on the western side of the Andes, together with Carrion’s disease. Uta seems to be a very old disease and some investigators believe that it has been present in Peru since the time of the Incas. It is epidemiologically related to Carrion’s disease, since both are usually present in the same localities, are transmitted by Phlebotomus sandflies, and seem to have non-human reservoirs.

The direct effect of altitude on the incidence of uta was clearly demonstrated about 20 years ago in the province of Huarochiri, in which the Rimac valley is located. At that time both uta and Carrion’s disease were highly prevalent in Peru. A survey on uta infection among school children, grouped according to altitude, revealed the following:

<table>
<thead>
<tr>
<th>Altitude in meters</th>
<th>Incidence of the disease (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>900 - 1,199</td>
<td>0.0</td>
</tr>
<tr>
<td>1,200 - 1,499</td>
<td>19.8</td>
</tr>
<tr>
<td>1,500 - 1,799</td>
<td>48.0</td>
</tr>
<tr>
<td>1,800 - 2,099</td>
<td>90.3</td>
</tr>
<tr>
<td>2,100 - 2,399</td>
<td>71.6</td>
</tr>
<tr>
<td>2,400 - 2,699</td>
<td>37.8</td>
</tr>
<tr>
<td>2,700 - 2,999</td>
<td>14.3</td>
</tr>
<tr>
<td>3,000 - 3,299</td>
<td>0.7</td>
</tr>
</tbody>
</table>

Some years later a similar epidemiological investigation on uta and Carrion’s disease was carried out in another valley of the Pacific watershed. The results concerning the effect of altitude on the incidence of uta were comparable to those obtained in the previous Rimac valley study.

4. Epidemic typhus fever: About 3,000 m. and above. The actual effect of altitude on the incidence of this disease at 12° latitude South or in other areas in Peru is not well known due to the lack of adequate studies. However, at higher altitudes the ecological conditions frequently determine the occurrence of this disease. Cold climate, low economical status, and lack of adequate education of most of the native people are factors that frequently create conditions favorable to infection by the insect vector and to the presence of the disease itself.

II. EASTERN SIDE OF THE ANDES OR AMAZON WATERSHED

The eastern side of the Peruvian Andes is very different from the western one, at least in relation to the climate, course and importance of rivers, fauna, flora, and other aspects which effect the ecology of disease. Unfortunately, in relation to the epidemiology of the diseases considered in this paper (except malaria), the knowledge available at present is almost nil.

1. Cutaneous leishmaniasis: 300 to about 1,800 m. In this region, as in the rest of the Peruvian jungle and in other South American countries, a clinical form of cutaneous leishmaniasis, called espundia, is present. This form is much more pathogenic than uta since, in addition to the skin lesions, the mucosa of the nose and mouth are frequently involved; in these cases the infection tends to be chronic. Aside from its greater pathogenicity, espundia is also considered different from uta geographically and epidemiologically. The incidence of espundia in relation to altitude, potential reservoirs, and the insect vector (supposedly Phlebotomus sandflies), are completely unknown at present.

2. Malaria: 300 to about 1,800 m. Malaria was highly endemic in this area before the Malaria Eradication Program was initiated. The main vector is the same species of Anopheles found in the Rimac valley. Few secondary vectors exist but only at lower altitudes.

3. Carrion’s disease: About 2,800 to 3,000 m. Human bartonellosis is rare in the eastern side of the Andes and most of the information available concerning this disease still needs to be checked. Nevertheless, during the first months of 1959 an epidemic occurred around 12° of latitude. In that outbreak the disease was demonstrated only in a narrow zone of 2,800-3,000 meters above sea level. Phlebotomus verrucarum, the well known insect vector of Carrion’s
disease, was not found; instead, two other species of Phlebotomus sandflies were abundant. From epidemiological correlations one of these species was incriminated as the possible vector. In addition, some other peculiarities of the epidemiology of the disease, such as high mortality and the absence of cutaneous eruptions, were observed.

4. Epidemic typhus fever: About 3,000 meters and above. Also in the eastern side or Amazon watershed, there is lack of information concerning the role of altitude on the incidence of this disease. However, in this zone the natural factors which determine either directly or indirectly the infestation by the insect vector and certain customs of the native population are certainly important.

SUMMARY

Information concerning the role of altitude on the presence and incidence of some insect-born diseases in Peru are presented. The important effects of altitude have been clearly demonstrated in the Rimac valley, which is found on the western side of the Andes or Pacific watershed at 12° of latitude South. The principal diseases involved are: malaria, Carrión’s disease, cutaneous leishmaniasis, and epidemic typhus fever.

REFERENCES