Public Health Hazards Among Workers Along The Trans-Amazon Highway


The colonization of the forested areas intersected by the Trans-Amazon highway was started in mid-1971. The immigrants originated from different areas of the country, but most of them came from the northeast. The colonization has been more intense in the areas of Altamira, Marabá and Itaituba, all in Pará State. Up to the end of 1974 about 28,000 colonists and their families are living in these areas.

It was logical to assume that these people would come into contact with certain zoonotic agents such as arboviruses and leishmanias, and that agents and vectors of infectious diseases previously unknown in the Trans-Amazon area, such as schistosomiasis and Chagas' disease, might be introduced. Investigations commenced in 1972, therefore, with the aim of identifying certain health problems, in different areas of the highway. In November 1972 a permanent surveillance program was initiated in the area of Altamira.

Serological studies demonstrated that arbovirus infections have occurred among colonists. Thus, 2.6% of the persons studied, mainly in hospitals and health posts, were infected in the first semester of 1973; 6.5% in the second semester of 1973; and 18.0% in the first semester of 1974. Mayaro, Guaroa, Itaporanga and Oropouche were the commonest arboviruses responsible for the infections. Group B arboviruses were excluded from the analysis.

A thrombocytopenic purpura, named Hemorrhagic Syndrome of Altamira (HSA), was noticed in the Altamira area from the beginning of 1972. The great majority of cases is restricted to the colonists and about 160 cases have been observed up to October, 1974. On the basis of clinical and laboratory data, the disease was responsible for three deaths. Epidemiological and serological evidence suggests that the syndrome is associated with the black-fly, Simulium and its bite.

Studies on leishmaniasis revealed a high incidence of infections among wild animals trapped at various sites along the Trans-Amazon highway. Thus, of 166 specimens of the rodent Proechimys studied, 26 were infected with Leishmania mexicana amazonensis (15.7%), and parasites of the Leishmania braziliensis complex have been isolated from Proechimys, and the opossum Didelphys.

Skin tests on colonists along the highway have shown a high incidence of positive reactions to leishmanin (up to 60%), but up to now active cases of cutaneous leishmaniasis have been uncommon. It is anticipated that the incidence of the disease will rise sharply in the succeeding, nonimmune generation: cutaneous leishmaniasis may then form a serious problem. We have already established the inevitable presence of dense populations of highly anthropophilic sandfly species at all points studied along the new roads. Some of these species will undoubtedly act as vectors.

Between 1971 and 1974, 310 imported cases of schistosomiasis were diagnosed in the Altamira and Marabá areas and all were treated with etrenol. Although three foci of planorbid snails have been discovered, there is no evidence yet of local transmission of the disease.

Malaria is a most important problem along the Trans-Amazon highway and thousands of cases have been diagnosed. Most infections are caused by P. falciparum but infections with P. vivax are also common. Leptospira antibodies have been detected among persons already living along the road and also in wild animals.

Finally, cases of South American Blastomycose have been detected in the area between Marabá and Altamira; and Histoplasma has been isolated from a number of wild animals.

The construction of a network of highways in the Amazon region of Brazil was initiated in 1970. The Trans-Amazon, Santarém-Cuiabá and the North Perimetral highways, which intersect vast areas of previously uninhabited, virgin forest, are among those of particular relevance. The Trans-Amazon highway extends from the northeast of the country westwards, following a line more or less parallel to the Amazon river, with an extension of about 3,000 km (Fig 1).

A government program for the colonization of the areas located along these roads was started in 1971. The areas intersected by
the Trans-Amazon highway, such as the Altamira, Marabá and Itaituba areas, at the present time constitute the main centers of colonization. By the end of 1974, approximately 28,000 colonists and their families were settled in these areas: it is estimated that 10 to 20% of this total have since left the area.

The immigrants originate from different regions of Brazil, though most are from the northeast. Along the highway they live variously in isolated houses, communities of 48 to 64 houses called agrovilas with 300 to 500 persons, or in larger settlements termed agropolis. Cultivation of cocoa, black pepper and other plants is just starting, and cattle farming is planned for the near future.

It was obvious that medical problems of major public importance would arise during the colonization. Firstly it was necessary to consider the possibility that the immigrants would introduce diseases which either had not previously occurred, or which were previously limited to small foci in the Amazon region, for example Chagas' disease and schistosomiasis. Secondly, problems would undoubtedly arise as a result of the contact by colonists with certain zoonotic agents such as arboviruses and leishmanias. In addition, malaria and leptospiroses are examples of public health hazards of major concern. Finally the possible existence of unknown agents pathogenic to man was borne in mind.

The Evandro Chagas Institute, Belém, which has been studying infectious diseases in the Amazon region for over 30 years, therefore decided to carry out epidemiological and ecological investigations aimed at identifying and describing present and potential problems. Field trips were undertaken to ten different areas along the Trans-Amazon and Santarém-Cuiabá highways in order to capture and examine wild animals and vectors, for the detection of foci of zoonotic disease. Specific serologic surveys were also planned, and a leishmanin skin-test survey including the detection of foci of zoonotic disease. Specific serologic surveys were also undertaken. In addition, investigations regarding the prevalence of malaria and detection of schistosomiasis cases were undertaken by the Superintendencia das Campanhas (SUCAM).

In November 1972 a permanent surveillance program of diseases was started in the Altamira area. Where colonization has been most extensive.

Arboviruses

Attempts were made to isolate viral agents from man, wild animals and haematophagous insects in mice and in VERO cells (Table 1). Parallel to these serological studies were performed on the sera of the people and wild animals, using the haemagglutination inhibition (HI) test and occasionally the neutralization test.

Table 1 - Number of Humans, Wild Animals and Hematophagous Insects Examined from Different Sections of the Trans-Amazon and Santarém-Cuiabá Highways 1971-1974.

<table>
<thead>
<tr>
<th>Human Group</th>
<th>1971-1974</th>
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<tbody>
<tr>
<td>Man</td>
<td>6,227</td>
</tr>
<tr>
<td>Birds</td>
<td>5,031</td>
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<tr>
<td>Marsupials</td>
<td>403</td>
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<td>Rodents</td>
<td>1,181</td>
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<td>Primates</td>
<td>230</td>
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<td>Edentates</td>
<td>23</td>
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<tr>
<td>Bats</td>
<td>164</td>
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<tr>
<td>Miscellaneous</td>
<td>101</td>
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<tr>
<td>Hematophagou</td>
<td>47,572</td>
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Yellow fever is the most important arboviral disease in the Amazon region. Evidence based on serology indicates that yellow fever (YF) virus is present in the wild monkey population of practically all of the ten areas surveyed along the highways. In certain areas up to 45% of the primates examined have antibodies to YF virus. Also mosquitoes of the genus Haemagogus, the most important vector of YF virus in the forests of the Amazon region, are commonly found in the study areas. No cases of the disease have, however, been observed among the colonists yet, probably because they usually receive the yellow fever vaccination before entering the areas of colonization.

Other arboviruses known to be pathogenic to man have been also detected enzootically, the birds acting as main vertebrate hosts. Among these are two agents responsible for serious central nervous system disease in man, i.e., St. Louis encephalitis (SLE) and western equine encephalitis (WEE) viruses, the latter of which is also capable of producing encephalitis in horses.

Several arboviruses which induce human febrile illness have been also encountered such as Mayaro, Oropouche, Guaroa and other viruses.

Arbovirus antibody surveys have shown that the immunity rate to these agents is higher among the residents of localities along the highway, than among the immigrants before entering the area. This is not the case, however, for the group B and Piry viruses. Thus, no marked differences in the antibody rates for the group B viruses were encountered between the two human populations. The assumption is that colonists acquire these kinds of antibodies as result of YF vaccination; the same explanation holds true for the group B antibodies found among the residents though, in addition, natural infection caused by members of this group of viruses probably occurs. Surprisingly, colonists originating from the southern part of the country have a higher antibody level to Piry virus than residents.

Studies were also carried out on patients, most of whom were colonists, who attended the health posts and the hospital at Altamira. They were bled for attempted virus isolation and for serological studies. During the period between January 1973 and June 1974, 549 blood samples were inoculated into baby mice. Only one arbovirus strain of Mayaro was isolated, from a febrile case, bled in March of 1974. Such low rate of virus isolation is due to the fact that the majority of the patients were bled after the third day of illness, when viremia is usually absent. But 160 (19.2%) out of 832 persons had serological conversion to arboviruses by the HI test during the same period of observation. One hundred of the 160 serological conversions were detected for group B viruses, and they probably reflect yellow fever vaccinations, although six specific serological conversions were found to Iheus virus and two against SLE virus, both members of the group B of arboviruses. Of the 60 seroconversions to arboviruses of other antigenic groups, 12 were for Mayaro virus, ten for Guaroa virus, and a smaller number to the other agents tested.

Table 2 - Seroconversions to Arboviruses* Among Colonists Attending Health Posts of the Altamira Area

<table>
<thead>
<tr>
<th>Year</th>
<th>Semester</th>
<th>No. Seroconversions/No. Paired Sera Tested</th>
<th>% of Seroconversions</th>
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<td>1973</td>
<td>First</td>
<td>10/377</td>
<td>2.6</td>
</tr>
<tr>
<td>1973</td>
<td>Second</td>
<td>18/277</td>
<td>6.5</td>
</tr>
<tr>
<td>1974</td>
<td>First</td>
<td>32/178</td>
<td>18.0</td>
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</table>

*Excluding seroconversions to group B arboviruses.
The analysis of the number of serological conversions per semester, excluding those to the group B viruses, indicated an increase in the percentage of conversions as times passed. As seen in Table 2, only 2.6% of patients showed conversion in the first semester of 1973. In the second semester of the same year the rate increased to 6.5%, and it was even higher (18%) in the first semester of 1974. The reason for this increase is not clear at the moment: it could be related to the time of residency of colonists in the area, or may reflect a high incidence of arboviruses in the first semester of 1974. In support of this view there is the fact that in 1973 no arbovirus strains were isolated from sentinel chickens or from mosquitoes, and in the birds there was no serological evidence of infection. Conversely four arbovirus strains were isolated from the sentinel birds or from mosquitoes during the first semester of 1974.

It is conceivable to expect that outbreaks caused by arboviruses may occur among colonists when the population increases in the area. As a result of this a great number of susceptible individuals will appear and due to their close contact with the forest, they will be exposed to infected vectors. Environmental changes may create favorable conditions for the appearance of efficient vectors in the settlements, which could transmit the viral infection to susceptible individuals.

**Hemorrhagic Syndrome of Altamira (HSA)**

This syndrome constitutes the first example of an illness which, although probably not new to the area, soon became a matter of concern — principally because of its hemorrhagic manifestations of the skin and sometimes the mucosal membranes. Epidemiological and serological evidence suggests that HSA is associated with the bites of black-flies (*Simulium* species).²

It has been observed since January of 1972, in the Altamira region of the Trans-Amazon highway, about six months after the beginning of colonization in that area. On the basis of clinical and laboratory data, it was diagnosed as a thrombocytopenic purpura, with the patients presenting localized or disseminated cutaneous hemorrhages: mucosal bleeding was observed in 77% (17/22) of the cases in 1972, whereas only 15% (11/79) and 18% (11/62) of them showed this sign in 1973 and in 1974, respectively. Although several patients complained of asthenia and were severely ill, there were no signs of altered cerebral functions. On occasion was diarrhea, vomiting, jaundice, myalgia, tremor, paresis or convulsions recorded. Recurrence of the syndrome was observed in six out of 45 patients. The platelet counts were low in all cases but prolonged bleeding time and poor clot-retraction occurred in about only half of the cases. The coagulation time, and levels of fibrinogen, prothrombin, serum glutamic-oxaloacetic transaminase, serum glutamic-pyruvic transaminase and blood-urea were within normal values or only moderately elevated.

No specific etiological agent could be identified as responsible for the syndrome and drugs or toxic substances were excluded in this respect. We have been unable to demonstrate bacteria, protozoal parasites, rickettsia or viruses as causative agents of the illness. Interestingly, however, the patients all reported intense biting by black-flies (*Simulium*).

During a three-year study period, 163 cases were detected in the Altamira area. As seen in Table 3, 22 cases were diagnosed in 1972, whereas this number increased to 79 and to 62, in 1973 and in 1974 respectively. The higher incidence observed in these two years may be explained on the basis of the population increase in the area and, of course, the surveillance which was started in the area in November, 1972. One death occurred in 1972, and two others in the beginning of 1973, all three being settlers. No more fatal cases were observed after this period of time, possibly due to the better medical care of the patients and especially because of the initiation of steroid therapy, which is very effective.

Old residents say that sporadic cases of the illness have been seen for many years, but only among newly arrived settlers. This largely agrees with our observations in 1972 and in 1973. In 1974, however, 11 of the 62 cases diagnosed were natives to the affected region. Several cases were observed among members of the same family. Thus, the first series of cases were among nine out of the 11 children of one family. Nevertheless, in 1973 and especially in 1974, evidence of familial clustering was less conspicuous. The number of cases was slightly greater in children under 12 years of age (87/163) than above this age, and the cases were more frequent among females than in males (95/163).

The syndrome shows a seasonal pattern, most cases appearing during the rainy season, which begins in December-January and ends in June-July. During this rainy season the population of black-flies is greatly increased, whereas they virtually disappear during the dry season. The coincidental, higher frequency of cases with high level of the *Simulium* population was consistent in the two years of surveillance (Fig 2) and till now is the only epidemiological event that can be linked with the disease. It is highly significant that patients develop precipitating antibodies to an extract of black-flies captured in the HSA focus.³

Large *Simulium* populations along extensive sections of the Trans-Amazon highway constitute a veritable scourge for the colonists, who are frequently forced to take the most extravagant protective measures (Fig 3) including the use of cloth hoods over the face (Fig 4), long-sleeved shirts and gloves, even during the hottest hours of the day.

At the present moment preventative measures for the control of HSA cannot be recommended, because its etiology is unknown. If *Simulium* is in the future proven to be the cause of HSA, then control of the fly will be crucial. Before this, however, we recommend that studies on the ecology of *Simulium* should be undertaken. Such studies may provide information to enable limited control which would reduce the prevalence and thereby relieve the colonists from the vicious attack of these insects.

**Cutaneous and Mucocutaneous Leishmaniasis: Prevalence and Importance in the Amazon Region**

This is a zoonotic disease, with the principal reservoir-hosts so far found in wild rodents and marsupials, and vectors in the various species of phlebotomine sandflies (Diptera: Psychodidae).² It can be regarded, therefore, as an occupational disease of forest-workers engaged in clearing the forest for road-building, timber, agricultural or mining purposes, etc.
Fig 1. Map of the Amazon region showing the Trans-Amazon highway, Santarém-Cuiabá and north perimetral highways.

Fig 2. Comparison of cases of HSA with Simulium capture rate.
Regarding its medical importance, we need go no further than to look at the following illustration of the disease in its worse form (Figs 5 and 6). The highly mutilating mucocutaneous form of the infection is by no means the inevitable outcome, but it is sufficiently common to arouse considerable concern in all who develop the initial skin lesion.

Records of the incidence of the disease in Brazil, and especially the Amazon region, are hard to come by; and in any case they can represent but a fraction of the true figures when considering the size of the country, lack of communication with much of the population living in the "interior", and the sparsity of medical assistance in such regions. Thus the WHO Statistics Report (1968) records only 71 cases in the whole of the Amazon region during 1940-1968, and only two cases were reported from Pará State, where the Wellcome Parasitology Unit is currently studying cutaneous leishmaniasis, in the Evandro Chagas Institute. On the other hand workers in this Unit located records of 633 cases of cutaneous leishmaniasis in just two hospitals (Belém and Manaus), in the period 1954-1970, and their own records include 138 during 1968-1973 [all proven parasitologically]. Finally, the Unit's skin-test surveys suggest that at least 50% of the adult, rural population eventually acquires the infection in the Amazon region. Cutaneous leishmaniasis, then, is of particular economic importance in the Amazon region of Brazil, when rapid developmental strides involve the exploration and clearing of huge areas of virgin forest for agriculture, mineralogy and the construction of the new network of roads, including the Trans-Amazon highway. Among the protozoal diseases it must rank as second in importance only to malaria.

While skin-test surveys along the various sectors of the new highways show a generally high exposure to infection, they may give little or no reliable information on the locality of the disease. The settlers are of variable origin and most have experienced previous infection elsewhere. Long term, follow-up study of those with negative reactions are needed, over a number of years, to indicate the exposure-risk in the newly opened regions. The problem must be borne in mind, however, that we are not dealing with a very static population and such investigations will be hampered by the frequent population drift.

Similar studies on more fixed or concentrated populations in the Amazon region have largely been confined to Indian tribes. The Indians, although generally suffering little from the disease, do act as very useful indicators of exposure-risk. Some tribes have shown up to almost 100% positive skin-test reactions among the men, and only slightly less among the women. As might be expected, the incidence of positivity rises with age, i.e., with longer exposure. Finally another guide was found in the records of one particular mining company in Pará, who experienced one case of cutaneous leishmaniasis for every kilometer of road they constructed. All these observations, even on comparatively static populations, however, must be interpreted with care and cannot be used alone in attempts to define the prevalence of cutaneous leishmaniasis throughout the whole of the Amazon region. The following factors must be considered.

1. The Specific Nature of the Study Area

We know that "hot-spots" of infection exist in certain areas of the forest. The presence or absence of these areas of effective transmission is controlled by a variety of factors, some of which we are still in ignorance.

We can, however, mention the following: (a) The density of the sandfly population, and in particular the anthropophilic species. (b) The biting habits of these anthropophilic species. Most sandfly species prefer to feed at night, and transmission to man is thus restricted to men who need to frequent the forest in the dark hours. Hunters and others needing to sleep in the forest are particularly affected. On the other hand a few species bite avidly by night and day. Areas with such species are the real danger spots, for most of man's activities in the forest are carried out in daylight. Luckily it would appear that day-biting species of sandflies are relatively uncommon: their existence in a given area, however, may give an exaggerated impression of the prevalence of cutaneous leishmaniasis if the incidence of human infection in that area is taken as an index for the Amazon region as a whole. (c) The prevalence of cutaneous leishmaniasis in a given area will also depend on the presence of sufficient infected wild animals.

2. The Period of Study

Transmission of leishmanial parasites is geared to a complexity of environmental features which vary throughout the year, and from year to year. Rainfall, temperature fluctuations, and the resulting rise and fall in the sandfly or animal-reservoir populations are some of the more conspicuous examples. Studies on the exposure-risk for man, and the prevalence of human leishmaniasis, must be of sufficient duration to allow for these natural fluctuations: preferably over several years, within the selected areas.

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Fig 3. — A family of colonists on the top of a wood tower trying to escape without success, from Simulium bites during hours of their greatest activity.

Fig 4. — Workers at the Trans-American highway using protective clothes against Simulium bites.
Prevention and Control
Cutaneous leishmaniasis in Brazil, as in most of the Americas, is essentially a disease acquired in tropical rain forests, and there can be little hope, therefore, of any effective control by insecticide spraying or destruction of the wild animal hosts. If individuals could be persuaded to regularly use insect repellents (particularly at night) this would undoubtedly cut the infection rate considerably.

Unfortunately the rugged forest-worker considers this “effeminate” practice with scorn, and in any case would resent spending his hard-earned money on repellents. Again, the effective action of repellents on the skin tends to be of short duration, due to the excessive sweating of men working in the high humidity and temperature of the forest. The most effective control of the problem, at present, is in the hands of the contractors of large labor forces where forest clearing has to be done. If the men are alerted to the probability of acquiring infection and acquainted with the appearance of the early skin lesion, then at least this will enable quick treatment and easier cure before the disease becomes mutilating and more resistant to antimonial treatment. All labor camps should have at least one doctor capable of diagnosing the infection and, failing this, should send suspected cases to the nearest center which carries such facilities. Refrigerated stocks of pentavalent antimonial drugs should be available, for these are still the safest and most effective method of treatment. If companies employing men for long periods of forest work could skin-test future employees, this would help considerably. Those with positive reactions, indicating prior exposure to Leishmania are immune to further infection by the same parasite: these are the men best selected for the forest clearance, whilst those with negative reactions would best be employed in inter-camp activities. Clearly, the employment of large work forces imported from non-endemic regions is asking for problems.

As with most protozoal parasites, there is as yet no effective vaccination against Leishmania using the dead organism or extracts. In parts of Russia and Israel, mass vaccination is practiced, however, using the living parasite. The inoculation is made into the skin at some inconspicuous place, such as the buttock, where the spontaneous healing of the resulting lesion will leave the scar well hidden. Vaccinated persons will not, therefore, contract a future, natural infection which might have left them with unsightly scarring of the exposed parts, such as the face.

The parasite used in this case, however, is L. tropica which produces a relatively small, single sore which is of short duration and heals spontaneously. Unfortunately we do not as yet know of a similarly innocuous Leishmania in the New World which could be used in the same way to protect against L. braziliensis. Work in this direction would seem a profitable line of approach.

Malaria
Malaria is a very important problem along the Trans-Amazon highway and in spite of the use of control measures, such as spraying houses with DDT every six months and searching for positive cases with subsequent treatment, the prevalence of malaria continues to be high. From Table 4 it can be seen that there has been an increase of the index of positive slides from 1971 to 1974 in natives and colonists of the Marabá, Altamira, Itaituba, Itupiranga and Jacaracanga areas. This table also indicates that infection rates are higher during the second semester (dry season) than in the first semester (wet season). Although infections caused by P. falciparum were predominant from 1971 to 1973, there was a slow decrease of this species in these years, which has resulted in P. vivax being the commoner during the first semester of 1974.

Control measures presently used should be intensified and, in addition to this, the possible mosquito breeding sites, such as the...
In addition to this, epidemiological investigations are needed to determine the main vectors, and to investigate the potential extra-domiciliary transmission. A constant lookout should be maintained for possible drug resistance of *P. falciparum* and *P. vivax*.

**Schistosomiasis**

Schistosomiasis in the Amazon region is limited to two foci, both of which are in Pará State — one in Belém and the other in the eastern part of Pará State.

Between 1971 and 1974, 310 imported cases of schistosomiasis were diagnosed in the Altamira and Marabá areas, and all were treated with hycanthone. Three breeding sites of *Biomphalaria straminea* have been found along the highways, two in the municipality of Altamira and one close to the river Curuá-Una, in the municipality of Santarém. All three sites are in Pará State but to date there is no evidence of bilharzia transmission occurring in these areas.

**Blastomycoses**

Lutz mycose has been diagnosed only sporadically in Pará State. Of the 49 cases identified in the past years, 26.5% were in individuals who were natives of the Marabá-Conceição do Araguaia area, which is a region under the influence of the Trans-Amazon highway. The second greatest incidence of cases is among residents of the Santarém-Fordlandia region, which is under the influence of the Santarém-Cuiabá highway. It is possible that in the future the disease may appear in new settlers.

**Histoplasmosis**

The inoculation of viscera from wild rodents and marsupials captured along areas of the highway has yielded several strains of *Histoplasma capsulatum*. At km 19 of the Itaituba-Jacareacanga section of the Trans-Amazon highway, four rats of the genus *Proechimys* were positive from a total of 162 rodents and marsupials captured and examined. At km 212 of the same section road 76 rodents and marsupials were examined and *H. capsulatum* was isolated from one *Proechimys* and one *Didelphis*.

**Leptospirosis**

With regard to leptospirosis, a study of 309 inhabitants along the Trans-Amazon highway revealed significant antibodies, by microagglutination tests, in 16.5%. In order of importance, the positive sera were for *panama*, *grippotyphosa*, *tarassovi*, *australis* A, *bataviae*, *castellonis*, *autumnalis*, *pyrogenes*, *braziliensis* and *wolffi*.

Among 222 wild forest animals examined, of various species, 12.1% showed evidence of *Leptospira* infection by serology or direct isolation of the organism. Serotypes encountered in these wild animals included *castellonis*, *ballum*, *wolffi*, *grippotyphosa*, *bataviae*, *butembo*, *panama*, *celledoni*, *canicola* and *icterohaemorragiae*.

**Summary and Conclusions**

Since 1971 the IEC and SUCAM have been monitoring malaria, leishmaniasis, schistosomiasis and leptospirosis amongst the workers settled along the Trans-Amazon highway. The possible appearance of new diseases was also taken into consideration.

In addition to this, short term ecological studies have been performed in ten different sites along the highways, aiming to identify zoonotic foci of some of the diseases. An investigation of the breeding sites of snails known to serve as intermediary hosts of schistosomiasis was also carried out.

To date, malaria seems to be the most important infectious disease of public health importance along the Trans-Amazon highway. Infections caused by arboviruses and less frequently by leishmania have been diagnosed in the area. No cases of yellow fever, however, were observed among the colonists. The hemorrhagic syndrome of Altamira to date constitutes the only new illness diagnosed in the area. This syndrome is limited to the Altamira area, as to date no cases have been found in other locations where colonists are also exposed to the bites of black flies.

A significant (16.5%) number of a group of 309 inhabitants possessed antibodies to different types of *Leptospira*, however, no specific diagnosis of clinical cases has yet been made. Also no cases of histoplasmosis or autochthonous cases of schistosomiasis have so far been diagnosed.

Zoonotic foci of known human pathogens were identified, such as: arboviruses, leishmanias, leptospiiras, *Histoplasma*. Three foci of *Biomphalaria straminea* have also been found, two in the Altamira area and one near to Santarém. The assessment of the importance of these findings is rather difficult at the moment. Certainly infection of man with some of these agents is already occurring, although its exact rate has not yet been determined. The potentiality of these foci is certain a matter of concern, despite the fact that the nature of their hazard to the colonists is unpredictable. It will probably depend upon the ecological changes brought about by man.

Some of the preventative measures already adopted by the public health authorities are certainly benefiting the population. Thus, yellow fever vaccination given to the colonists before entering into the areas protects them against sylvan yellow fever. Also the diagnosis and treatment of cases of schistosomiasis is a most important step to stop the disease from becoming established in the area.

Malaria is still a great threat to the colonists, in spite of the preventative measures used. Apart from the intensification of these measures it is clear that others need to be taken into consideration. Firstly, one should consider that all colonists and their families, as well as workers, should have their blood examined for the presence of malaria parasites, and treatment given to the positive cases. Secondly, elimination by drainage or by chemical treatment of the breeding foci of *Anopheles* should have special emphasis. In this respect road constructors should be prevented from leaving unfilled excavations along the highways, which will accumulate water and thus serve as breeding sites for the vectors. Advice should also be given to the colonists to avoid storing water in uncovered containers. Thirdly, special emphasis should be given

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<th>Year</th>
<th>Semester</th>
<th>No. of Slides Examined</th>
<th>Positive Slides</th>
<th>Index of Positive Slides</th>
<th>% of P. Falciparum</th>
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<td>975</td>
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</table>

* Population of localities between Marabá and Jacareacanga.
to the epidemiology of the infection as it is possible that extradomiciliar transmission is accounting for a considerable number of cases. If this is so then new approaches have to be adopted: in addition to the screening of infected colonists, the possibility of drug prophylaxis should also be considered.

In view of the danger of introduction of species of domestic reduvide bugs from endemic Chagas’ areas, insecticide treatment of materials originating from such areas is advisable.

Although the present data do not reflect the true incidence of the infectious diseases among the colonists, they do however give useful information regarding some of the present and potential health hazards. A well organized and long term surveillance program for the diseases described here and for others of public health importance should be implemented in this area and also in other areas of colonization.

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References


Pictured at the speaker’s table at the combined luncheon at the American Occupational Health Conference in Boston are (left to right) Marvin Moser, M.D., Graham Ward, Anne Murphy, R.N., and Bruce E. Douglass, M.D., incoming President of AOMA.