

## INFECTIOUS DISEASES ALONG BRAZIL'S TRANS-AMAZON HIGHWAY: SURVEILLANCE AND RESEARCH<sup>1, 2</sup>

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*Brazil's Trans-Amazon highway has unavoidably brought workers and settlers into contact with disease agents in the vicinity of the road. This article reports the results of preliminary research designed to identify such agents—and to identify specific disease agents from outside that are being introduced by migration into the region.*

### Introduction

The Trans-Amazon highway, construction of which began in September 1970, branches off east and west from the existing Belém-Brasília highway, the western portion more or less paralleling the Amazon River for about 3,000 km until it reaches a point close to the Peruvian border. The road crosses vast areas of forest, most of them untouched by man, and passes through a wide variety of environments.

Colonization of the highway area by immigrants from other parts of the country began in mid-1971. By March 1973 about 22,000 immigrants had settled along three different sections of the road which had already been completed.

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. The situation thus afforded a unique opportunity for long-term study of certain infectious diseases among the new settlers, and for ecological investigation of zoonotic foci and their possible threat to man.

Epidemiologic studies of leptopirosis, leishmaniasis, schistosomiasis, and arbovirus infections (including yellow fever) have been underway in this area since 1971. The occurrence of a hemorrhagic disease associated with several fatalities in 1972 and 1973 was also investigated. Future studies will be extended to cover Labrea black fever, Chagas' disease, and malaria.

A multidisciplinary field team made five trips to different sections of the Trans-Amazon highway and one to the Santarém-Cuiabá highway, each trip lasting between 40 and 70 days (see Figure 1); several shorter trips were also made. The team collected blood and other clinical specimens from both normal and sick persons.

In addition, specific serologic surveys were made or have been planned. A leishmanin skin-test survey of 157 persons, including both adults and children, obtained positive reactions from 47 per cent of the subjects tested. Very few active cases of leishmaniasis have been encountered along the Trans-Amazon highway as of this writing, however, the positive reac-

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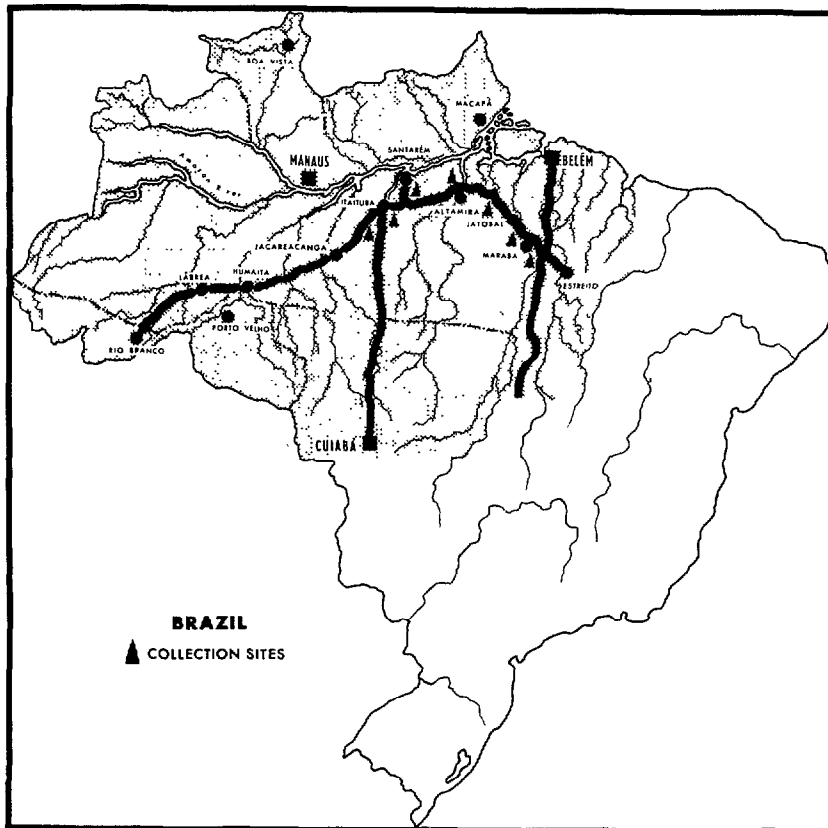
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PLATE 1—An aerial view of the Trans-Amazon highway. (Courtesy of *Manchete*.)

FIGURE 1—Location of the collection sites for the field studies described by the authors along the Trans-Amazon and Santarém-Cuiabá highways.



tions being obtained from immune persons with past infections contracted elsewhere. Leishmaniasis along the highway will doubtless become more important in future generations.

Also, reservoir hosts among wild animals and the role of certain arthropod vectors were investigated, and foci of planorbid snails were sought in ponds and streams located along nearly 300 kilometers of the road.

In November 1972 a permanent surveillance program was started in the Altamira area in order to detect and study cases of arboviral infections, viral hepatitis, the hemorrhagic syndrome of Altamira (HSA), and certain parasitic and bacterial diseases.

## Arbovirus Studies

### *Arboviruses in Human Febrile Cases*

Blood samples collected from 207 febrile persons in an effort to isolate viruses yielded negative results. The majority of the patients, however, were bled after the fifth day of illness, when viremia is usually difficult to detect. An examination of blood films from 107 of these 207 patients revealed malaria parasites in 18, most of the organisms being *Plasmodium falciparum*.

*Necropsy Material.* We were able to examine necropsy material from five patients who died

along the highway. In two cases there was malarial pigment in the liver; in two others histopathologic findings indicated viral hepatitis; and in one case the cause of death remained unknown.

*Serum survey.* Almost 4,000 blood samples were taken from different groups of people. These included immigrants, both before and after they entered the Trans-Amazon area, as well as residents and road workers living at various sites along the highway. These sera were tested against 18 arbovirus antigens, most of them of medical interest, by hemagglutination-inhibition (HI). In some instances neutralization tests (NT), usually in mice, were also performed.

The results of these tests, carried out on 2,823 serum specimens, are shown in Table 1. They demonstrate clearly that the prevalence of arbovirus antibodies was lower among settlers than among residents in all four of the areas surveyed. For instance, the incidence of antibodies to group A arboviruses was 6 to 24 times lower among the settlers than among the residents.

Among the group A arboviruses, Mayaro virus prompted by far the greatest number of positive reactions. However, a few positive reactions to the Mucambo virus, a member of

the Venezuelan Equine Encephalitis (VEE) complex, were also obtained; and in rare instances positive reactions to the Western Equine Encephalitis (WEE) and Eastern Equine Encephalitis (EEE) viruses were detected. The difference between settler and resident sera with respect to the incidence of group B arbovirus antibodies was less marked than the difference with respect to group A arbovirus antibodies. Two points, however, should be emphasized concerning antibodies against the group B arboviruses: (1) most of them were probably due to vaccination against yellow fever (YF) virus; and (2) specific antibodies to St. Louis Encephalitis (SLE) virus were found in a small number of persons by HI, with confirmation by NT.

The incidence of antibodies to the other arbovirus groups varied according to the area and the virus group, but in most cases the incidence found was below 10 per cent and in a few cases it was zero. Low levels of antibodies to the Oropouche virus, an agent previously implicated in four major epidemics occurring within the Amazon region, were found in all the areas studied.

Infections caused by the Piry virus (a Rhabdovirus), or by an agent antigenically related to it, seem common among both settlers

TABLE 1—Incidence of arbovirus antibodies\* found among immigrants and people with six months' residence or more at various sites along the Trans-Amazon highway.

Arbovirus group	Residents of:					Immigrants at:	
	Marabá	Altamira	Itaituba <sup>1</sup>	Itaituba <sup>2</sup>	Santarém	Tacajós <sup>3</sup>	Altamira <sup>4</sup>
A	13.9	10.3	26.4	21.2	14.9	2.2	1.2
B	50.9	22.4	35.0	41.8	30.8	9.9	25.0
C	4.3	0.8	2.8	4.2	0	1.0	0
Guama	2.8	1.7	3.4	1.3	0	1.1	0
Bunyamwera	8.1	0	12.6	8.1	0.9	1.0	0
Simbu	1.4	4.3	0	1.9	2.2	0.2	0.3
Phlebotomus	4.8	2.5	6.8	6.5	2.9	0.3	0
Anopheles A	1.9	0.8	0.5	0.3	0.2	0.15	0
Piry (NT) <sup>5</sup>	17.4	4.3	6.3	15.5	Not done	20.3	Not done

\*Reactions at 1:20 against four units of antigen were considered positive.

<sup>1</sup>Blood samples collected in 1971.

<sup>2</sup>Blood samples collected in 1972.

<sup>3</sup>Immigrants bled before entering the Trans-Amazon area.

<sup>4</sup>Immigrants with less than a months in the Trans-Amazon area.

<sup>5</sup>This agent is now considered to be a Rhabdovirus; antibody levels were determined by neutralization test.

TABLE 2—Neutralizing antibodies against Piry virus found among immigrants from the State of Rio Grande do Sul.

Município of origin	Sex	Age groups (years)*					
		0-9	10-19	20-29	30-39	40-49	50+
Tenente Portella	F	2/25	11/33	7/24	3/7	10/15	2/3
	M	3/32	11/37	12/24	9/13	12/16	5/5
Irai	F	1/1	3/5	1/2	3/3		1/1
	M	2/3	2/5	1/3	3/3		1/1
Total	Both sexes	8/61	27/80	21/53	18/26	22/31	9/10
Percentage positive	Both sexes	13.1	33.7	39.6	69.2	70.9	90.0

\*No. positive over No. tested.

and residents—judging from the incidences of neutralizing antibodies found. These incidences were found to be especially high among immigrants from Rio Grande do Sul, Brazil's southernmost state. As shown in Table 2, the incidence of antibodies to Piry virus among immigrants from Rio Grande do Sul increases with age, reaching 90 per cent in the group of subjects over 50 years old. No marked sex differences were noted.

Tests were also conducted with paired sera obtained from 308 immigrants before and after they entered the Altamira area. These tests revealed 33 serologic conversions specific for arboviruses (Table 3), 27 of them specific for group B. The latter could possibly have resulted from YF vaccination, although two of the 27

were specific for Ilhéus and one for SLE. Of the remaining six sera, two showed conversions for Mayaro, two for Catu, one for Guaroa, and one for Itaporanga.

#### *Arboviruses in Reservoir Hosts and Vectors*

In conjunction with the human studies mentioned above, studies were undertaken to determine the presence of known or new arbovirus types, especially those of medical interest, and to gather information about their natural patterns of activity. Wild birds and animals were captured by various methods such as trapping, shooting, or mist netting. At the time of this writing 4,465 specimens of the following types had been captured:

Birds .....	3,218
Marsupials .....	220
Rodents .....	683
Primates .....	131
Edentates .....	21
Chiroptera .....	145
Miscellaneous .....	47

TABLE 3—Serologic conversions in paired serum samples from 308 settlers, as shown by HI test.

Group	Viruses	Number of conversions
A	Mayaro	2
B	Yellow fever	6
B	Ilhéus	2
B	SLE	1
B	Other group B	18*
Bunyamwera	Guaroa	1
Guama	Catu	2
Phlebotomus	Itaporanga	1
Total		33

\*Five sera cross-reacted with SLE and Ilhéus viruses, but not with YF virus.

The blood or viscera of these animals yielded 11 arbovirus strains. As indicated in Table 4, the SLE virus, an agent recognized as being pathogenic in man, was isolated on four occasions.

In addition, during November 1971 a strain of the *Wyeomyia* complex was isolated from a pool of mosquitoes (genus *Wyeomyia*) captured

TABLE 4—Arboviruses isolated from wild animals.

Arbovirus group	Virus	Source	No. of isolations	Area and date of capture
B	SLE	Bird	4	Marabá, March 1971 (1) Altamira, August 1971 (1) Itaituba, November 1971 (2)
C	Murutucu	Bird	1	Altamira, August 1971
Turlock	Turlock	Bird	3	Altamira, September 1971 (1) Itaituba, November 1971 (1) Itaituba, July 1972 (1)
Phlebotomus	Candiru complex	Marsupial	1	Itaituba, December 1971
Phlebotomus	Icoaracy	Rodent	1	Itaituba, July 1972
Ungrouped	An 141106	Bird	1	Marabá, March 1971

25 km from the town of Itaituba in western Pará State.

The distribution of arbovirus antibodies found among the birds and animals by HI test is shown in Table 5. Of all the creatures tested, birds showed by far the highest rates of immunity, and they had antibodies to all the arbovirus groups for which they were tested. It should be noted that most group A reactions were caused by WEE virus and most group B reactions by SLE virus. Birds of the family Formicariidae showed a higher incidence of antibodies than other bird families.

A few rodents showed HI antibodies to Pixuna virus, a group A virus belonging to the VEE complex, and this finding was confirmed by NT. The tests also showed a high incidence of rodent antibodies against viruses of the

"Phlebotomus" group, but only low antibody incidence to other arbovirus groups in comparison with rodents captured near Belém.

Primates in all the areas surveyed usually had a high level of immunity to Mayaro (group A) and YF (group B) viruses, and lower levels of antibodies against the Simbu, Phlebotomus, and Anopheles A groups. The occurrence of YF antibodies in monkeys, indicating circulation of yellow fever virus in the jungle, constitutes a strong reason for continued vaccination of settlers against this agent.

Sera from the marsupials, bats, edentates, and other animals sampled either failed to react or showed only low antibody titers against most of the viruses tested. But each class of subjects tested had antibodies against the Phlebotomus group of viruses—even though the

TABLE 5—Minimum and maximum percentages of wild animals at different sites along the Trans-Amazon highway with HI arbovirus antibodies.

Arbovirus group	Percentage positive						
	Birds	Marsupials	Rodents	Primates	Edentates	Bats	Others
Group A	0.7-9.9	0	0-2.08	20.67	0	0	0
Group B	6.9-18.6	0	0-0.6	0-45.4	0	0-12.5	5.4
Group C	0-3.3	0	0-4.7	0	0	0	0
Guama	0-2.3	0-5.2	0-2.8	0	0	0	0
Capim	Not tested	0	0.9	Not tested	Not tested	Not tested	Not tested
Bunyamwera	0-0.7	0	0	0	0	0	0
Simbu	1.0-2.8	0	0	0-8.0	0	0	0
Phlebotomus	0-2.8	0-10.5	0-33.3	0-16.0	37.6	0-2.0	2.7
Turlock	0.3-9.6	0	0	0	0	0	Not tested
Anopheles A	1.0-5.2	0	0	0-6.0	0	0-6.7	0

percentage of positive reactions was generally not as high as in the case of the rodents.

Arthropods were captured using human bait, mechanical suction, light traps, and the Trinidad No. 17 trap. A total of 17,583 hematophagous (blood-feeding) arthropods, 13,555 of them mosquitoes, were captured and used to inoculate mice for attempted virus isolations. As previously mentioned, only one virus was isolated, this being a strain belonging to the *Wyeomyia* complex.

The *Culex* genus predominated among the mosquitoes, comprising 46.9 per cent of all the mosquitoes caught. However, the composition of the catches varied markedly, depending on the methods used (see Table 6). *Culex* was the only genus present in reasonable numbers in all types of collections. Variations were also observed in different areas, but the data are not strictly comparable because the captures were made during different seasons.

#### Investigation of the Hemorrhagic Syndrome of Altamira (HSA)

In 1972, 22 settlers of the Altamira region,

mostly young persons, experienced a hemorrhagic disease that was diagnosed as thrombocytopenic purpura (2). Clinical and laboratory data have shown that the disease was responsible for two deaths. Three other fatal cases were reported, but were not available for investigation. From January to March 1973, 30 additional patients experienced the disease; two died, but no autopsies were performed. It was noted, however, that one patient who died had a very low platelet count. Family grouping of cases was observed, as shown in Table 7.

In spite of an increase in bone marrow megakaryocytes, the platelet count was exceedingly low in some patients, occasionally dropping to about 10,000 per cubic millimeter. The retraction of blood clot was poor or absent and the bleeding-time markedly prolonged. The patients had ecchymoses and petechiae throughout their bodies (see Plate 1). In addition, some had melena and bled from the gums and nose. Petechiae also covered the mucosa of the mouth of surviving patients and the pericardial membrane, lungs, brain, and intestines of one who died. Most patients were anemic, but this condition may have been caused by

TABLE 6—Types of mosquitoes captured at different sites along the Trans-Amazon and Santarém-Cuiabá highways.

Area/date	Collection method							
	Human bait		Trinidad No. 17 trap, baited with mice		CDC light trap		Mechanical suction	
	Genus	%	Genus	%	Genus	%	Genus	%
Itaituba-Altamira (Km 25) March-April 1972	<i>Psorophora</i>	57.4	<i>Culex</i>	56.9	+ <sup>1</sup>		No collection	
	<i>Culex</i>	15.5	<i>Psorophora</i>	40.7				
	<i>Aedes</i>	13.5	<i>Aedes</i>	1.0				
	<i>Anopheles</i>	8.7						
Itaituba-Jacareacanga July-August 1972	<i>Culex</i>	87.4	<i>Culex</i>	97.3	<i>Uranotaenia</i>	75.8	<i>Culex</i>	94.7
	<i>Anopheles</i>	8.4			<i>Culex</i>	22.5	<i>Anopheles</i>	2.3
Santarém-Cuiabá (Km 84) November-December 1972	<i>Trichoprosopon</i>	83.2	++ <sup>2</sup>		<i>Uranotaenia</i>	79.3	<i>Culex</i>	81.2
	<i>Wyeomyia</i>	7.1					<i>Anopheles</i>	9.7
	<i>Anopheles</i>	4.4						
							<i>Uranotaenia</i>	8.5

<sup>1</sup>+ = 16 mosquitoes captured but not included in breakdown.

<sup>2</sup>++ = 39 mosquitoes captured but not included in breakdown.



TABLE 7—Grouping of cases of hemorrhagic syndrome of Altamira.

Year	No. of cases	Families with two or more cases	No. of cases in these families	Families with single cases
1972	22	4	18	4
1973 (Jan-Mar)	30	4	10	20

hookworm infections, iron deficiency, or other conditions. The coagulation time and levels of prothrombin and fibrinogen in the blood were normal, as were the levels of SGOT,<sup>5</sup> SGPT,<sup>6</sup> and urea. No fever or only low-grade fever was experienced by the patients.

Long-time residents connect the illness with the bites of Simuliidae (black flies) that are particularly abundant in the rainy season. They also say that the illness has been observed for many years, but in immigrants only. Sporadic cases occur, but not every year. Whether these opinions are correct is unknown; but the fact remains that no cases of HSA were reported

from April to December 1972. At this time of year the *Simulium* population apparently declines. New cases occurred in early 1973, following the start of the rainy season and the reappearance of Simuliidae. Figure 2 shows the distribution of cases on a monthly basis.

Sera from patients, contacts, and other sources were examined by the Ouchterlony double-diffusion-in-gel technique for precipitating antibodies to an extract of black flies captured in the HSA focus. Whereas 94 per cent of the patients and 55 per cent of their contacts (other immigrants living in the area) possessed precipitating antibodies against the flies, only 4.8 per cent of the natives of the Altamira region were positive. No positive sera were found among samples taken from residents of

<sup>5</sup>Serum glutamic-oxaloacetic transaminase.

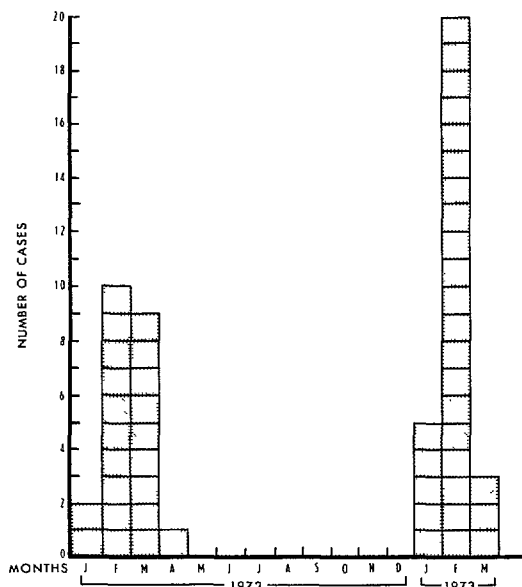
<sup>6</sup>Serum glutamic-pyruvic transaminase.



PLATE 2—A case of HSA in the first week of disease, showing generalized petechiae and mucosal bleeding.



FIGURE 2—Cases of hemorrhagic syndrome of Altamira occurring in 1972 and January-March 1973, by month.



Belém, where there are no black flies. Sera from eight colonists who had resided in the region less than a month were also negative.

With regard to treatment of this disease, blood transfusions, vitamin therapy, and bed rest produce mild improvement and complete remission of symptoms after a long period of time. Administration of moderate doses of steroids has brought about fast recovery and is the treatment of choice.

Attempts to isolate a virus from blood samples and other specimens taken from the patients, using mice, hamsters, and VERO and

H. Ep-2 cell cultures, have not been successful. However, one guinea pig inoculated with blood collected from a patient in the acute phase of the disease died 18 days after receiving the inoculation. And in three subsequent passages, inoculation of organ tissues or blood from this animal killed other guinea pigs at intervals varying from 23 to 69 days. Histopathologic examination of these animals revealed lung congestion sometimes associated with pulmonary hemorrhages, but no lesions characteristic of thrombocytopenic purpura.

No pathogenic bacteria or parasites could be identified in association with the syndrome. Serology performed on paired sera from representative patients was negative for 17 arbovirus strains (by HI test), except for one seroconversion for Catu virus after onset of purpura; the results were also negative for 18 leptospiral subgroups (by microagglutination technique); and for spotted fever, typhus, scrub typhus, and Q fever rickettsial groups (by indirect fluorescent antibody test).

## Bacteriology

### *Enterobacteria*

Attempts were made to isolate pathogenic enterobacteria from humans and *Salmonella* from wild animals. From March 1971 to November 1972, 418 coprocultures were made using specimens obtained from road workers, settlers, and long-term residents living along various sectors of the Trans-Amazon and Cuiabá-Santarém highways. At the same time efforts were made to isolate *Salmonella* from the large

TABLE 8—Incidence of antibodies against material in macerated black flies.

	No. of positive subjects over No. tested	% positive
Natives of Altamira	6/123	4.8
Persons who had resided for about 1 month at the farming center of Km 46	0/8	0
Natives of Belém	0/38	0
Patients with HSA	17/18	94
Contacts of HSA cases	5/9	55

TABLE 9—Enterobacteria isolated from humans and animals.

Source	Age of subject	Location of subject	Date of sample	Bacteria isolated
Human	3 years	Marabá Km 68	March 1971	<i>Salmonella</i> serogroup C2
"	8 months	Mirituba (Itaituba)	November 1971	<i>Salmonella</i> serogroup B
"	unknown	Km 10, Itaituba-Jacareacanga road	July 1972	<i>Shigella dysenteriae</i>
"	unknown	Km 10, Itaituba-Jacareacanga road	July 1972	<i>Shigella dysenteriae</i>
"	20 years	Km 73, Santarém-Cuiabá road		<i>Salmonella</i> serogroup B
<i>D. marsupialis</i>		Km 12, Marabá-Altamira road	March 1971	<i>Salmonella</i> serogroup C2
<i>Metachirus</i>		Km 19, Itaituba-Jacareacanga road	July-Sept 1972	<i>Salmonella</i> serogroup D
<i>Proechimys</i>		Km 19, Itaituba-Jacareacanga road	July-Sept 1972	<i>Salmonella</i> serogroup D
<i>Oryzomys</i>		Km 84, Santarém-Cuiabá road	Nov-Dec 1972	<i>Salmonella</i> sub-genus IV (K-W scheme)
<i>Ameiva</i>		Km 84, Santarém-Cuiabá road	Nov-Dec 1972	Arizona group

and small intestines of 1,432 wild animals caught in forested areas along the two roads.

Three strains of *Salmonella* and two of *Shigella dysenteriae* were isolated from humans. The *Salmonella* strains belonged to serogroups B and C2. In addition, four *Salmonella* isolations—two of serogroup D, one of serogroup C2, and one of subgenus IV (Kauffmann-White scheme)—were obtained from wild animals. One strain of the *Arizona* genus was cultured from a lizard of the genus *Ameiva*. Data concerning these isolations are provided in Table 9.

### *Leptospira*

Serologic studies of humans and wild animals, and attempted isolation of *Leptospira* from wild animals, revealed a number of infections caused by several serotypes of this microorganism.

For instance, 15 of 222 sera from rodents and marsupials captured along various parts of the road had antibodies against *L. grippityphosa*, *L. wolffi*, *L. bataviae*, and *L. butenbo*, with titers ranging from 1:200 to 1:400. Provisionally it may be noted that the serotype *L. wolffi* appears to be the one most often found in

marsupials, and that *L. grippityphosa* appears to be the serotype most commonly found in rodents. In addition, five isolations were obtained from 157 pieces of renal cortex derived from rodents and marsupials. The cultures of these strains, which have not yet been typed, were made in Fletcher's medium. Efforts to isolate leptospire from 90 urine specimens produced only negative results.

Human sera tested for *Leptospira* antibodies thus far include 131 obtained from settlers passing through Belém. These people came from the southern states of Rio Grande do Sul and Santa Catarina, and were bound for one of the Trans-Amazon farming towns. Two of the 131 sera were found to be positive for *Leptospira*, one for *L. bataviae* and one for *L. panama*—both showing titers of 1:200. Current plans call for reexamining this group of settlers intermittently at their new place of residence along the highway.

Of 190 sera collected from other persons already living along the road, 35 yielded significant titers for various *Leptospira* serotypes. These were: *L. panama* (16), *L. tarassovi* (6), *L. grippityphosa* (4), *L. australis* (4), *L. bataviae* (3), *L. pyrogenes* (1), and *L. wolffi* (1).

## Parasitology

Details of the epidemiology of leishmaniasis have been covered in a previous article (1). It is worth repeating here, however, that *Leishmania* has been isolated from 35 wild animals collected in the Trans-Amazon highway region.

In addition, a variety of other parasites have been found in these same wild animals, either by direct examination of blood films, by cultures grown in NNN medium, or through inoculation of laboratory animals with various tissue samples.

Parasites of medical interest include *Histoplasma*, isolated from the viscera of three rodents (*Proechimys guyannensis*) from the Itaituba-Jacareacanga sector of the highway (see Figure 1) and *Toxoplasma*, isolated from the viscera of a single opossum (*Didelphis marsupialis*) from the Santarém-Cuiabá sector.

The blood parasites *Babesia* and *Grahamella* have been found in marsupials and rodents, respectively, and *Trypanosoma cruzi*-like parasites have been found repeatedly, most of the time in *Didelphis*, but also occasionally in rodents. In mice these trypanosomes are morphologically and pathologically indistinguishable from *T. cruzi* found in man.

### Schistosomiasis

A search for human cases of schistosomiasis

was carried out in March 1971 by stool examination, using the method of Hoffman, Pons, and Janer. Eggs of *S. mansoni* were found in three of 73 fecal samples examined, but all three test subjects belonged to an imported labor force. The task of looking for human schistosomiasis has been taken over by another agency of the Brazilian Ministry of Health, and it is known now that the number of human cases is much higher. Many of these patients have been treated at the hospital of the town of Altamira.

In the future, we aim to find if antibodies against *Schistosoma* are present in the sera already collected from settlers and residents along various sections of the highway, as well as in the serum samples to be collected in the future.

Foci of planorbid snails identified as *Biomphalaria straminea* (an important intermediate host in the epidemiology of schistosomiasis) were encountered in two streams. One of these streams was located approximately 9 km from the town of Altamira, while the second was in a suburban area of the same town. No planorbid species were found at 169 other sites investigated along almost 300 km of several road sections (Altamira-Itaituba, Altamira-Vitoria and Altamira-Marabá) during 1971.

## SUMMARY

Brazil's new Trans-Amazon highway has brought many road workers and settlers into contact with extensive and essentially uninhabited tropical regions of the country for the first time. This event has considerable medical significance. For one thing, relatively large numbers of people are being exposed to disease agents whose identity until now has been uncertain. For another, some of these people may be bringing with them human disease agents that are new to this area.

Efforts to investigate both of these phenomena have been underway since 1971. They include an extensive search for arboviruses in human sera and in captured animals and birds; study of the hemorrhagic syndrome of Altamira; attempted isolation of enterobacteria and leptospira from humans and animals; a search for evidence of schistosomiasis; and attempted isolation of various protozoan parasites from captured animals. This article reports the initial results of this research.

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