

# HOUSING AND THE CONTROL OF VECTORS OF HUMAN CHAGAS' DISEASE IN THE STATE OF MINAS GERAIS, BRAZIL<sup>1,2</sup>

João Carlos Pinto Dias<sup>3</sup> and Rosinha Borges Dias<sup>4</sup>

*Certain changes in rural housing can make a major contribution to control of Chagas' disease, but such changes can be hard to implement. The following account, based on rural housing information derived from past Brazilian experience and recent studies, raises a number of points of interest to those concerned with control efforts.*

## Introduction

Today Chagas' disease still constitutes one of Brazil's main public health problems. That is, even though the principal vector species (*Triatoma infestans*) appears to have been controlled or eliminated in areas totaling approximately two million square kilometers (1), official data show that domiciliary triatomines are still present in 1,200 Brazilian municipalities.

According to a national survey on the extent of the problem, between six and seven million people are infected with the disease agent, *Trypanosoma cruzi* (2). More specifically, morbidity data from the affected state of Minas Gerais suggest that Chagas' disease cardiopathy occurs in approximately 40 per cent of all infected adults in the state's endemic areas—although it should be noted that similar indexes obtained in Rio Grande do Sul show a significantly lower percentage thus affected (3). In addition, Prata (4) has confirmed that this cardiopathy was responsible for 57 per cent of the deaths of people with

Chagas' disease in Bahia, and Paula (5) has shown that over 30 per cent of the pensioners in endemic areas of Minas Gerais have chagasic cardiopathology. A discussion of other epidemiologic parameters (including the social cost as measured by unemployment, loss of working time, and other forms of social incapacity) is provided in another work by the authors (6).

Despite "urbanization" of Chagas' disease in Brazil and the growing importance of transmission through blood transfusions (7), a great majority of the nation's human *T. cruzi* infections result from human-vector contacts within dwellings of the endemic regions (1, 8, 9). Furthermore, rapid changes in the rural environment (such as reforestation, changes in dwelling styles, and the vector's ecological adaptations) all affect the prevalence of Chagas' disease (8, 10, 11). In this vein, it is noteworthy that the first two interdependent factors mentioned are linked to prevailing economic, political, and social situations arising from the history of man's conquest of the environment and creation of extensive human settlements in Brazil (6).

The strategy of the Brazilian Government's program for combating Chagas' disease is directed primarily at controlling the vector in private dwellings (8, 9). This program is under the jurisdiction of the Ministry of Health, which is assisted by regional health organizations.

Theoretically, the desired vector control should be accomplished by applying residual insecticides and improving human dwellings,

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<sup>3</sup>Senior Researcher, Oswaldo Cruz Foundation; Assistant Professor, School of Medicine, Federal University of Minas Gerais (Belo Horizonte, Brazil).

<sup>4</sup>Social Worker, Social Work Department, Catholic University of Minas Gerais (Belo Horizonte, Brazil).

the latter step providing ultimate consolidation of the work (1,11,12). Because of technical and financial limitations, however, the Ministry of Health has restricted itself mainly to systematic insecticide spraying, evaluation of triatomine and trypanosome levels, and national serologic surveys (1). Even so, insecticide applications have succeeded in interrupting transmission of *T. cruzi* to man in several regions of the states of São Paulo and Minas Gerais, especially in regions where *T. infestans* was the dominant vector (6,13,14).

There has long been interest in research on rural housing improvement and in actual construction of adequate rural dwellings. Indeed, as early as 1919 Carlos Chagas and colleagues called attention to the disease's relationship with rural housing and helped introduce appropriate legislation in Paraná State (15). However, because of lending priorities and the risks involved, banks and other lending agencies have generally shown little interest in becoming involved with rural housing projects; and for this and other reasons little nationwide progress has occurred.

For the purpose of putting the problem into focus, this article describes relevant housing issues in two areas with endemic Chagas' disease. These are the municipalities of Luz and Bambuí in Minas Gerais, for which data from clinical and epidemiologic studies are available (16) and where epidemiologic surveillance based on community participation was conducted from 1974 to 1979 (17). Because the health education and community participation aspects of this work have been described elsewhere (6,9,17), this article deals principally with physical aspects of local housing that have a significant bearing on triatomine control and with conclusions derived from our work in these local areas that could prove generally applicable to other endemic regions.

### General Considerations about Housing

The concept of housing, broadly defined, involves things that extend well beyond an ordinary home's four walls. That is because the environment around as well as within a home

can affect people and can contribute (very notably in the case at hand) to health levels. So the concept of housing must take account of this environment and of the various contacts between people and other living things that may relate in one way or another to the home.

Our study area, situated in the western part of Minas Gerais State at about 20°S, 46°W, includes two small and predominantly rural municipalities with populations ranging from 15,000 to 25,000 inhabitants. In one of these areas, the municipality of Bambuí, the Oswaldo Cruz Institute (then under the direction of Emmanuel Dias) established a Chagas' disease center in 1943. From then until 1955 the area remained heavily infested with triatomines, half or more of the dwellings (especially in the most rural parts) being positive for the vector, and 40 to 50 per cent of the people over 20 years of age being infected with *T. cruzi* (15). Thereafter, insecticide spraying changed this situation, producing nearly complete eradication of *T. infestans* from local residences after 1956. In addition, beginning in 1974 a system of epidemiologic surveillance was started in Bambuí. This system operated through detection of triatomine foci by the occupants of infested residences, who would report the infestations to a central agency responsible for insecticide application.

At least 40 per cent of the rural dwellings in Bambuí are made of adobe. By and large the inhabitants are extremely poor, with no land or other major possessions, and they lack the financial means or motivation to improve their homes; so the dilapidated condition of these homes reflects the precarious social circumstances of their inhabitants. Things such as lack of storage facilities, lack of transportation, lack of cash income, lack of steady employment, and so forth make it necessary for residents to store grain inside their homes—thereby attracting rodents and marsupials that serve as reservoirs for *T. cruzi*. The situation is worsened by the presence of domestic animals, which provide a source of blood for triatomines in and around the houses, and which in time become new reservoir hosts for *T. cruzi*.

In addition, the physical structures and environments provided by some homes encourage colonization by triatomines. Bamboo, *cana brava*, and other light materials are often used for homebuilding because they are plentiful, flexible, and durable. Walls are commonly completed with applied mud, because such walls provide reasonable temperature control and protection against excess humidity. However, cracks soon appear in these walls, sometimes only a few months after construction. This creates hiding-places for triatomines; and the inhabitants' practice of filling the cracks with newspapers, rags, or tiles merely creates new hiding-places—as do such objects as religious figurines or pictures of popular actors hanging from the walls. In addition, because wood and other window materials are expensive, few windows are installed in such huts, and this creates a permanent semidarkness favoring the triatomines.

Within our study regions, these huts are generally found standing in isolation on poor farmland, grouped into small clusters, or scattered around small towns. By and large they stand alone or grouped about small streets or public ways in areas where the population density is low—on the order of 10 to 20 inhabitants per square kilometer. This isolation tends to encourage triatomines to concentrate inside the dwellings (18).

The family income of these dwellings' residents is at the subsistence level for many reasons. Among other things, the prices paid for the agricultural products of rural workers tend to be low (below normal market values) because of both government control and speculation. Inadequate credit, lack of know-how, and poor transportation further reduce earnings. Under the resulting subsistence conditions, little priority tends to be given things like formal education, hygiene, and prevention of triatomine infestations (6).

## Early Observations

### *Infestation Patterns*

Beginning in 1943, Emmanuel Dias insti-

tuted a residential census in Bambuí to determine the degree of house infestation by triatomines. The predominant reduviid bug species throughout the entire region was found to be *T. infestans*, and its preference for huts was demonstrated (15). About 25 per cent of the *T. infestans* studied were found to be infested with *T. cruzi*. A second man-biting reduviid bug, *Panstrongylus megistus*, was found in smaller numbers.

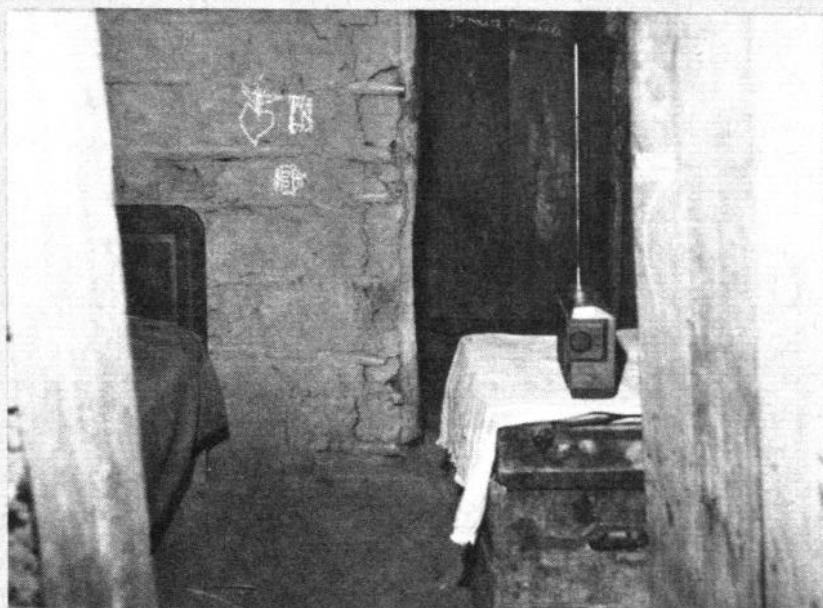
Infestation of houses by these triatomines appeared to be in a state of delicate balance, since even slight manipulation of a number of factors related to home construction was believed to affect the prevalence of Chagas' disease. Dias verified that hut infestations could be reduced by simply applying mud to the splits and cracks in the walls, thus killing or confining the triatomines and making recolonization difficult (19,20).

Dias (15) subsequently built experimental huts in Bambuí and Rio de Janeiro to confirm observed relationships between construction features, climate, and triatomine infestation. Among other things, he noted that although whitewashing house walls with lime helped improve appearances and encouraged better hygiene, this measure did not prevent splits and cracks. (It is interesting to note that Dias viewed combinations of mud and cattle dung as inadequate and unhygienic wall materials.)

In general, Dias showed that the best course of action, as indicated by economic and social realities, would be to improve existing houses rather than build new ones. (More recently, this idea has been adapted by Raadt—21.) The microhabitats preferred by the house-dwelling bugs were determined in these early studies, it being confirmed that the house walls (especially bedroom walls) afforded the best habitats. These facts were of great importance in further work against the bugs, including study and collection efforts—as was demonstrated graphically in one extreme case where Dias and Zeledon (22) collected over 8,000 triatomines from a single dwelling. This is believed to be the first instance in which the technique of house dismantlement was applied to study the population density of the vectors.







**Pictures from Bambuí and Luz municipalities showing (A) a typical hut in Bambuí, (B) a typical tile-roofed hut in Luz, (C) a rural brick and tile home in Bambuí, (D) present (1979) appearance of two Bambuí houses built by Emmanuel Dias in 1948, (E) cracked interior adobe wall, (F) the windowless bedroom of a typical hut (note radio), and (G) one of the Bambuí houses improved by E. Dias in 1944.**

### *New Housing Construction*

After long observation of the relationship between vectors and housing, Dias instituted an initial housing construction project in 1943 (15,20). This project was to become a pioneering effort to employ new housing design features as a tool for the control of Chagas' disease. The effort was successful in that Dias developed health and education activities which awakened authorities to the need for changing housing conditions in order to fight Chagas' disease (23). Isolated trials were made to test methods for constructing mud houses of better quality and, later, for using "soil-cement" mixtures. Nevertheless, the residents involved always showed a certain resistance to replacement of their traditional adobe. Poverty, social instability, and underemployment limited their receptivity to the new methods; and of course the disease itself, anemia, lack of proper nourishment, other parasitosis, alcoholism, and social apathy only aggravated matters.

It is also true, however, that this pattern of general resistance was found to be pervasive among occupants of triatomine-prone houses irrespective of their health and living standards, as was demonstrated by subsequent experiences. Specifically, after great effort Dias obtained permission from the state railroad (*Rede Mineira de Viação—RMV*) to replace some huts occupied by a few of the railroad workers with masonry-tiled homes. This was the beginning of an experimental program where masonry-tiled homes were provided for a number of families occupying substandard huts in Bambuí. Then, in 1949, Dias obtained financial support from a government housing cooperative (the *Fundação da Casa Popular*) and received an allotment of land within the town limits from the municipal government of Bambuí for a larger pilot project (20). This latter project built 10 houses, each equipped with running water and electricity and each containing a dining room, two bedrooms, a kitchen, and a bathroom. These houses were built quickly and economically by local people experienced in this type of work, with the intent that they be occupied by families then liv-

ing in substandard huts who could rent them at token cost or buy them outright with low payments spread over a long period. The contract to be signed by new residents called for periodic cleaning and physical repair of the home. The potential occupants were not consulted in advance about these various conditions.

The results were as follows:

- It was impossible for people to accept their new houses. After 11 months of unfruitful effort, it was concluded that people (a) found even token rent a burden on family income and did not wish to pay it; (b) were afraid of losing their former residence while running the risk of later being evicted from their new one; (c) found it difficult to use the toilet and shower and to keep the new house clean; (d) wanted to keep their domesticated animals (fowl, pigs, and so forth) in or near the new house, which was not permitted; (e) did not wish to destroy their old house when they moved into the new one; and (f) claimed in many cases that they had no fixed residence and needed to move constantly to seek employment.
- The houses were finally occupied by a few of the Chagas' disease center's personnel and were used for community programs (e.g., milk distribution). These houses are still standing and remain free of triatomines.
- The principal physical problem of these houses has involved the structure of the roof. The original roof frames of all the houses were made of "white wood"<sup>5</sup> and had to be replaced some years later.
- The people first invited to occupy the new houses remained in their original huts; some of them are still there today.
- An attempt to broaden this work failed. However, buildings similar to the new houses appeared spontaneously in the area; it is unclear whether or not this was due to the influence of the experiment.

<sup>5</sup>A Brazilian term meaning light, inexpensive wood generally obtained from a kind of local pine named *Araucaria brasiliensis*.

### Recent Observations in Luz and Bambuí

As part of the aforementioned epidemiologic surveillance activities, in 1976-1977 rural lifestyles and housing conditions were studied in the municipalities of Bambuí and Luz. In Bambuí this involved coordinated activity performed with the assistance of 36 rural teachers and their pupils—a group belonging to 464 families in 73 separate locales. In Luz, a group of 420 randomly selected rural workers were interviewed directly and given clinical examinations (16, 17).

In general, the social and economic conditions of both municipalities were found to be similar. More than 75 per cent of the family heads had always lived in each municipality. About 55 per cent of the family heads earned something on the order of US\$785 per year, while only about 12 per cent earned the equivalent of US\$2,355 per year. The principal sources of family income were agriculture and cattle-raising. Statistical analysis indicated that the people studied provided a reasonably representative mix of subjects in these various categories (24).

Other specific data obtained from these studies were as follows:

1) The number of rural dwellings in these areas had dwindled progressively over the last 30 years, and the rural population of Bambuí had declined by at least 35 per cent since Dias made his initial census there (15). Rural populations had migrated, and several rural villages had virtually disappeared. The number of vacant houses in Bambuí increased by 120 per cent between 1956 and 1965 (25), the increase in vacant substandard huts being especially marked. In contrast, the population of Bambuí areas classed as urban had risen from 10,000 to 15,000 since 1950, primarily due to migration from the rural areas.

2) The families studied were found to occupy their dwellings anywhere from one to 40 years, the mean being seven years, the median being 4.2 years, and the mode being one year. It was found that the percentages of families living in their houses for less than five and 10 years, respectively, were 41 and 71 per

cent. This frequent moving by the inhabitants made major home improvements problematic.

3) Most of the dwellings occupied by study subjects were small, having an average area of about 45 square meters. The houses had an average of 5.7 rooms (the mode being four), and an average of 2.9 bedrooms (the mode being 2). The number of people per house varied from one to 16, the average being between five and seven and the mode being four. The small size of the rooms, especially the bedrooms, and the large size of the study families influenced the distribution and density of triatomines in the houses, contributing to the transmission of *T. cruzi*.

4) The walls of roughly half the houses were made of brick; many others (between roughly a quarter and two-fifths) were made of adobe; and the remainder were made of wood or mixed materials. A progressive decline over time in the percentage of mud (adobe) walls, especially among the newer houses, was observed. It was also noted that houses in at least one Luz locale were made with a mixture of kaolin (a type of clay) and fresh cattle dung that formed durable crack-free walls. In contrast, kaolin is scarce in Bambuí, such wall construction was uncommon there, and the mud walls found provided ideal environments for *T. infestans* and other intradomiciliary bugs.

5) The roofs of most houses studied (86-87 per cent) were made of tile, most of the rest (12-13 per cent) being made of *sapé* grass thatch. Invariably, the *sapé*-roofed houses were the poorest and shortest-lasting. However, one rarely finds triatomines in *sapé* roofs; so in contrast to palm-frond roofs in other endemic regions, *sapé* roofs are not an important factor affecting triatomine infestations. Among other things, the *sapé* construction provides little space to the triatomines, maintains a low humidity believed detrimental to the vector, and becomes impregnated with smoke rising from wood-burning stoves. All these conditions are thought to limit triatomine colonization of *sapé* roofs.

6) The floors of many houses (35-37 per

cent) were of earth, while many others (33-45 per cent) had cement floors. A relatively small share of the homes (19-28 per cent) were covered with wood boards—which provide a most favorable habitat for triatomines, especially when there is space below affording shelter for mice, fowl, and other vertebrates. Of the three types of floors, however, the earthen floors reflected by far the lowest socioeconomic standards.

7) Regarding vacant houses, extensive migration from rural Bambuí and Luz has made such houses common. For example, a survey of 27 locales in Bambuí municipality turned up over 60 vacant dwellings (mainly huts), and survey data from Luz indicated a total of nine vacant houses (6.5 per cent of all the dwellings) in the village of Esteios. Such houses, which may either be reoccupied or rot away, can harbor rodents, marsupials, snakes, and other vertebrates capable of feeding numerous triatomines and maintaining the *T. cruzi* cycle.

#### *Bambuí Data*

Outbuildings, storage areas, and equipment all provide important shelters for various insects and reflect the sociocultural conditions of life in rural areas. A survey of rural houses in Bambuí (Table 1) has provided some indication of the relative abundances of these associated structures.

The presence of animals is another important epidemiologic factor. In addition to animals that may harbor *T. cruzi*, some other

creatures can provide significant indications of hygienic and socioeconomic conditions. Cattle, for example, demonstrate a source of income, while roaches and fleas suggest a low level of cleanliness in the home. Table 2 summarizes the data obtained on animals associated with the 464 Bambuí residences studied.

Regarding home improvement, 46.5 per cent of the Bambuí families surveyed said they would like to improve their houses or had recently done so. However, the information obtained showed that the families tended to define home improvement as repair of the house rather than betterment. All of the reported repairs had been made fairly recently, 51 per cent being made one or two years before the 1974 survey, 21 per cent being made 6-11 months before the survey, and 28 per cent being made less than six months before the survey. In this vein, it should be noted that in connection with the triatomine surveillance program in Bambuí, rural teachers there had been developing local interest and activities related to dwelling improvement since 1974. In some communities the number of water filters and sanitary facilities also increased significantly during the period in question.

**Table 2. The percentages of 464 rural Bambuí residences associated with various types of vertebrates and insects.**

	% of residences possessing the indicated creature
<i>Sources of income:</i>	
Poultry	96.7
Pigs	81.4
Bovine animals	63.5
Equine animals	60.8
<i>T. cruzi reservoirs.*</i>	
Dogs	86.6
Mice	84.7
Cats	82.3
Opossums	28.9
<i>Indicators of poor hygiene.*</i>	
Roaches	94.1
Mice	84.7
Fleas	75.3
Bedbugs	11.6

\*See reference 26

**Table 1. The percentages of 464 rural Bambuí homes having certain types of storage spaces, outbuildings, and equipment.**

Types of structures	% of homes with each structure
Basements	21.1
Attics	8.7
Storerooms	84.3
Poultry houses	50.7
Water filters	60.5
Sanitary facilities	17.7
Radio equipment (in the house)	78.0



With respect to domiciliary insecticide applications, mud and various other wall surfaces may inactivate or reduce the residual activity of certain insecticides (e.g., HCH<sup>6</sup>). Indeed, different wall substrata can cause insecticides to have different residual capacities and effects (12,14). In Bambuí it was shown that primitive masonry houses in poor structural condition tended to reduce the efficiency of insecticides more than did mud huts. However, this was probably due to the relatively greater size and complexity of these houses, which therefore provided more potential shelter areas for the bugs and posed greater technical obstacles to effective placement of insecticide on all building surfaces. In this regard, it is important to be aware of the possibility that *T. infestans* foci destroyed by disinsection may be replaced by foci of *P. megistus*, the secondary species. From the ecological standpoint this could lead to a dangerous situation in the future, since *P. megistus* thrives in both wild and peridomestic habitats and therefore has a better chance of surviving domiciliary insecticide applications. For this reason, it becomes essential to pay added attention to outbuildings and other neighborhood structures near treated houses, because *P. megistus* can easily reinfest the dwellings a few months after insecticide is applied. In our areas of activity, this behavior of *P. megistus* has made it necessary to provide insecticide treatment for each reinfested house (17,25).

#### Luz Data

In the municipality of Luz, a past survey of dwelling features showed a high degree of association between certain of those features and trypanosomiasis (16). Specifically, significant associations were found between trypanosomiasis and homes (a) with triatomines present, (b) with mud walls, (c) with earthen floors, (d) without water filters, and (e) without sanitary facilities.

With regard to our more recent studies, the area of investigation in Luz was the small community of Esteios containing 135 houses. During the 1950s over half the Esteios dwellings were infested with triatomines, and the prevalence of human infection of *T. cruzi* was around 45 per cent. But ever since 1975 it had been noted that the bugs were no longer present in the homes, even though the village had witnessed no official insecticide program since 1969.

Because of this, the village was studied closely. It was found that of 124 houses in the study sample, 91 were made with brick and tiles and the remaining 33 were made of what appeared to be mud and *sapé* thatch. The general situation with regard to house size, number of inhabitants, and so forth, was similar to that found in Bambuí. Nevertheless, the huts were better built and cleaner, and the walls were without splits or cracks.

It turned out that these "mud" walls were actually made with a mixture of mud, kaolin clay, and fresh cattle dung that yielded smooth, strong, and impermeable walls. Moreover, in over two-thirds of the homes the walls were repaired at intervals ranging from one to six months. This work was performed by women using the same mud, kaolin, and dung mixture used for the original construction, who usually considered these repairs part of regular housecleaning activities such as doing laundry and removing filth. Of the villagers surveyed, 58 per cent said they did the retouching to avoid "plagues," while 42 per cent said they did it to provide cleanliness and proper maintenance.

The year before the survey a water supply system had been installed, and this had come to serve 82 per cent of the homes. According to schoolteachers and local leaders, this had considerably encouraged improvement of the poorer houses—including the replacement of *sapé* with roofing tiles. (It should be noted that most Esteios families own their homes.)

At the beginning of 1979, entomologic surveys were made of 123 Esteios dwellings; vestiges of triatomines were found in only two houses. In addition, a random sample of 128

<sup>6</sup>Hexachlorocyclohexane.

villagers were tested on their knowledge of triatomines. We found that of those over 20 years old, 72 per cent could identify *P. megistus* and 30 per cent could identify *T. infestans*. However, among inhabitants less than 20 years old these percentages were significantly smaller (32.2 and 9.7 per cent, respectively). In addition, the villagers were found to use insecticides (HCH and Baygon) in their houses, and serologic surveys of schoolchildren showed nearly complete interruption of *T. cruzi* transmission. Overall, it appears that Esteios provides a good example of a place where Chagas' disease has been controlled through measures adopted by the population using their own resources, without official intervention or assistance.

### A General Overview

Ultimately, control of Chagas' disease may depend upon gradual evolution and modification of rural society. Rural dwellings reflect rural man. Temporary home improvements and insecticide applications have certainly proved useful; but for more permanent control, such measures should ideally be followed by more permanent lifestyle changes and improved living conditions. However, such long-term changes demand solution of social problems relating to working conditions, production, and property ownership—complex problems that defy easy or quick resolution. Furthermore, in areas with endemic Chagas' disease the rural health facilities are generally inadequate—usually lacking, among other things, proper financing and effective coordination with other public and private organizations that share their goals. For these various reasons, isolated short-term measures against parasitic diseases in these areas remain valid and necessary until such time as long-term solutions can be developed.

In this vein, certain kinds of housing improvements must eventually serve to reduce our dependence on anti-triatomine insecticides; and at present such improvements offer the only potential long-term answer to this problem. Therefore, institutional housing

programs should consider aiding the rural sector and providing support through agricultural financing agencies. Agricultural development authorities should become better acquainted with the problems of rural residents vis-a-vis property ownership and the quality of life, and should seek actively to improve present conditions. In addition, incentives designed to provide the basis for a better rural life should become a vital part of efforts to improve housing. And, at the community level, housing improvement should go hand in hand with development of other social activities—provision of education and health services, encouragement of cooperation among people, and establishment of community organizations that can lend political strength to the expression of public desires and needs.

Another related problem is that basic ecological imbalances have been very much neglected in Brazil. Extensive forest destruction, land-burning, and indiscriminate replacement of the prevailing flora still occur in extensive parts of the country, including the Amazon region. In this regard, present agricultural and forestry policies are still far removed from the social and sanitary problems faced by the rural populations (6,27).

Even more important are the general dimensions of the triatomine problem and the costs of dealing with it. For example, 1979 data from the 15 most heavily endemic Brazilian states showed that over two million rural dwellings were infested. Estimating a population density of roughly six people per house, this implies that at least 12 million people in those states are at high risk of infection with *T. cruzi*. Also, figures obtained from three municipalities in the state of Minas Gerais suggest that 25 per cent of the dwellings in question are unsalvageable and need to be replaced. If one accepts roughly US\$1,200 as the cost of building a plain, hygienic rural house, the cost of constructing the roughly 500,000 houses needed would be on the order of US\$600,000,000 (6,14,19,28,29). This is a key consideration, because at-risk rural people in many endemic areas seem to have some awareness of the relationship between house

quality and triatomine infestations. Nevertheless, economic and social barriers generally prevent them from building homes that would be hygienic and triatomine-free (19,27,28).

In sum, such housing improvement projects serve both to reduce triatomine infestation levels and to promote detection of triatomines by local residents. In addition, these projects—as well as the actual work of eliminating triatomines—can create an excellent public dialogue, and this in turn can pave the way for understanding social problems better and seeking out solutions. Indeed, even without specific programs, personnel can still take advantage of their contacts in rural areas to ex-

change ideas about the benefits of improved housing at the family level.

It is true that rural people often need help in order to understand the bureaucracy, credit mechanisms, and aid-related problems, as well as to discuss the broader implications of improved housing; furthermore, employment and some financial stability are generally required in order for residents to take effective action. On the other hand, there is no reason why action should not be encouraged—especially since the actual monetary costs involved, which seem bound only to rise in the future, are relatively small in terms of the number of people to be served.

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### SUMMARY

Chagas' disease constitutes a major public health problem in Brazil. Recent estimates suggest that between six and seven million people are infected with the disease agent, *Trypanosoma cruzi*, and that substantial percentages of such people ultimately experience Chagas'-related cardiopathology and death.

The Brazilian Government's strategy for combating Chagas' disease is directed primarily at controlling house infestations of triatomine bugs that transmit the agent. In theory, this can be done temporarily through insecticide applications and more permanently through improvement of the dwellings harboring the bugs. In practice, for a variety of reasons, the Ministry of Health has restricted itself mainly to insecticide spraying, which has nevertheless succeeded in interrupting *T. cruzi* transmission in several portions of the states of São Paulo and Minas Gerais.

Previous findings show that cracks in the adobe walls of rural houses tend to provide excellent refuges for triatomines. For this reason, nearly all in-

festations in many areas could be eliminated by diligent sealing of the cracks or by introduction of new building practices that abolish crack-prone walls. Past work has demonstrated that rural residents tend to resist replacement of their traditional adobe, and that poverty and other factors tend to limit the affected villagers' receptivity to both new housing and new methods. However, community participation and other long-term efforts against Chagas' disease in the Minas Gerais municipality of Bambuí seems likely to have heightened local awareness of the problem and raised homeowners' interest in health-related home improvements.

In a similar fashion, increased awareness among residents of at least one Minas Gerais village appears to have prompted effective local control of Chagas' disease without official government intervention or support. One reason was that most mud walls of homes in this village actually consisted of a mixture of mud, kaolin (clay), and cow dung that tended to resist cracking. Another was that the walls were repaired with the same mixture at inter-

vals of anywhere from six months to a year—because the residents felt health, sanitary, or other considerations justified the action.

These and other experiences suggest that control of Chagas' disease may ultimately depend upon gradual evolution and modification of rural society. And while the cost of massive new rural housing programs would certainly be justified in monetary

terms, the long-term changes needed to solve the problem must also rely on resolution of an array of complex and difficult social problems. Therefore, isolated short-term measures against Chagas' disease will remain both valid and necessary until such time as effective long-term solutions can be developed.

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### PSITTACOSIS IN THE UNITED STATES

An outbreak of psittacosis occurred among employees of an Ohio turkey processing plant in July 1981. The last previously reported outbreaks at turkey processing plants occurred in 1976 (one) and 1974 (five).

At the Ohio plant, approximately 27 of 80 employees became ill. Turkeys being slaughtered at the plant were the probable source of infection. The attack rate was significantly higher for workers in the kill-pick and evisceration areas than in other parts of the plant. An epidemiologic survey indicated either that infections were the result of aerosol transmission or that multiple routes of exposure may have been involved.

Public health officials and physicians should be aware of the possibility of psittacosis among turkey processing plant employees so that a diagnosis can be made and appropriate therapy instituted promptly.

Source: U.S. Centers for Disease Control, *Morbidity and Mortality* 30(52), 1982.