THE INCIDENCE OF TRYpanosoma CRUZI
IN TRIATOMA OF TUCSON, ARIZONA

by

David E. Bice

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STATEMENT BY AUTHOR

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SIGNED: David E. Rice

APPROVAL BY THESIS DIRECTOR

This thesis has been approved on the date shown below:

Albert R. Mead  
Professor of Zoology  
Head of the Department  

20 April 1964  
Date
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Species of *Triatoma rubida uhleri* and *T. protracta* were collected and dissected to determine the per cent infection rate of *Trypanosoma cruzi* from areas near Tucson, Arizona. Of 657 *T. rubida uhleri* and *T. protracta* dissected 65 (9.9 per cent) were infected. When each species is considered separately, a higher infection rate is found in *T. protracta* than in *T. rubida uhleri* (19.5 per cent compared to 7.5 per cent), even though there were a higher number of *T. rubida uhleri* observed in the field. It appears that the infection rate of the *Triatoma* is dependent on the ratio of *T. rubida uhleri* to *T. protracta*. The greater the number of *T. protracta*, the higher will be the infection rate in both species. A seasonal pattern for the occurrence of *T. rubida uhleri* instars was noted.
INTRODUCTION

Trypanosoma cruzi (Protomonadida: Trypanosomidae) was first observed in human blood by Carlos Chagas in Minas Gerais, Brazil in 1909. In the past fifty years the seriousness of the disease caused by this protozoan parasite has been recognized and it has been named Chagas' disease in honor of its discoverer.

Normally the parasite is maintained in nature in various species of blood-sucking bugs belonging to the subfamily Triatominae, and various vertebrate reservoir hosts including the opossum, armadillo, raccoon, skunk, fox, dog, various rodents, other mammals, and possibly reptiles. The insect becomes infected by ingesting trypanosomes with a blood meal from an infected vertebrate. In the alimentary tract of the bug the trypanosomes undergo transformation to leishmaniform bodies which multiply to crithidia and metacyclic trypanoforms. The infection is usually transmitted to the vertebrate host by contamination with the bug's feces containing the infective metacyclic trypanosomes. Defecation frequently occurs while the bug is sucking blood or shortly after the blood meal is finished, although this time element is dependent on the species of bug involved.
(Wood, 1951). The trypanosomes gain entrance by passing through the bite wound, by penetrating an abrasion of the skin which could be caused by the host scratching the bite site, or by penetrating mucous membranes.

*T. cruzi* is found in the vertebrate host in two forms; the trypanoform is found extracellularly in the blood and other body fluids, and the leishmaniform is intracellular. Although the trypanoforms may divide, most multiplication is by division of the leishmaniform stage (Noble et al., 1953; Noble, 1955). The leishmaniform bodies continue to divide until the host cell is filled, and then transform into trypanosomes, which rupture the cell and escape into the blood or tissue fluid. However, trypanosomes are found in the peripheral circulatory system in large numbers only in extremely severe cases. Later, these trypanosomes penetrate other cells, become leishmania and again undergo reproduction. This cycle is believed to continue for the entire life of most hosts.

The World Health Organization (1960a) has estimated that the number of Latin Americans exposed to this parasite is some 35 millions with an approximate 20 per cent infection rate. Although the areas covered by these estimates extend from northern Argentina and Chile to southern Mexico, the
infected insect vectors as well as the infected vertebrate hosts have a much wider distribution.

*T. cruzi* was first reported in the United States in 1916 by Kofoid and McCulloch. They found a flagellate in an assassin bug, *Triatoma protracta*, collected in San Diego, California. Since the authors failed to infect young white rats upon which infected bugs were fed (not realizing that the trypanosome was a posterior-station parasite), and were unable to find trypanosomes in the blood of wood rats from whose dens the triatomes were collected, the organism was named *Trypanosoma triatomae*. Later, Kofoid and Donat (1933) established that *T. triatomae* is in reality *T. cruzi* of Brazil.

The first infected bugs to be collected in the United States, other than those from California, were found near Tucson, Arizona by Kofoid and Whitaker (1936). Packchanian (1939) reported the first naturally infected bugs from Texas, and Wood (1961) reported on the Triatoma of New Mexico. Weinstein and Pratt (1948) in a review of the attempts to infect North American *Triatoma* with *T. cruzi* in the laboratory, reported no failures, indicating that all species in the United States are possible vectors of Chagas' disease.
No infected *Triatoma* have been reported from the southeastern United States. Packchanian (1940a) found no infected bugs from a group of 300 *T. sanguisuga ambigua* collected near Sarasota, Florida. All other workers in these areas have had similar experiences. However, many mammals in the southeastern United States have been found to harbor *T. cruzi*. Of 1,584 mammals examined in Georgia (Brook et al., 1957), 103 were positive. These animals included grey foxes, raccoons, opossums, and striped skunks. The same animals have been found infected in northern Florida, an area where *Triatoma* is rare (McKeever et al., 1958). Since *T. cruzi* was found in the urine of opossums, it has been suggested (op. cit.) that the trypanosomes may be passed from animal to animal through contact with urine. Raccoons have also been found naturally infected in Maryland (Walton, 1956; Walton et al., 1956). The trypanosomes taken from these raccoons as well as the other animals mentioned above were serologically and morphologically the same as *T. cruzi* from South America (Walton et al., 1958).

It was not until 1955 that the first natural case of Chagas' disease was reported in the United States by Woody and Woody (1955). They found trypanosomes in the blood of a 10 month old child from Corpus Christi, Texas. The vector in this case was *Triatoma gerstaeckeri* which inhabited brush and cactus where wood rats and opossums were in evidence. This was in a suburban section where
clearing of brush could force both bugs and small animals to seek shelter in or around houses.

A second case was also reported in 1955. The patient was a 6 month old infant from Houston, Texas, who had been hospitalized for meningitis; trypanosomes found in the cerebrospinal fluid were identified as *T. cruzi* (National Office of Vital Statistics, 1955). Fortunately, due to good homes and the high standard of living, these have been the only naturally occurring cases reported in the United States.

It has been indicated by the World Health Organization (1960b) that the initial step in determining the epidemiology of *Trypanosoma cruzi* in any area, which has not been thoroughly investigated, is to determine the infection rates of the various species of *Triatoma*, in addition to the specific localities where infected bugs seem to be concentrated. With this accomplished, the other aspects of Chagas' disease can be more efficiently undertaken.

The purpose of this study was to determine the infection rates of *T. cruzi* in *T. rubida uhleri* and *T. protracta* from areas near Tucson, Arizona.
METHODS AND TECHNIQUES.

By far the most important vertebrate hosts in Arizona are species of the pack rat, *Neotoma*. The vectors are blood sucking reduviids, *Triatoma rubida uhleri*, and *T. protracta*, which are located for the most part in rat dens as well as in other small mammal burrows, and *T. recurva*, which is found mainly in the burrows of the ground squirrel, *Citellus* (Ryckman et al., 1955).

Because of the difficulty of obtaining specimens of *T. recurva* this survey was limited to the two species found in rat dens. Areas supporting *Neotoma* were located, numbered, and marked on a topographical map. The general ecology of each area and the density of the rat dens were noted.

Dens were selected at random and carefully torn apart. Each rat den was numbered and the following observations made: type of den (materials from which it was constructed, in rock etc.) mammals and reptiles present, triatomes present (species, instar, and male or female if adult), and any additional observations of apparent significance. The triatomes from each den were placed in separate containers and transported to the laboratory.
In the laboratory the bugs were dissected by inserting a dissecting needle just anterior to the pygidium and pulling to the posterior. This pulled the last segment of the abdomen away, bringing with it the hind gut, in which the metacyclic trypanosomes were found. The hind gut was then macerated in a drop of 0.7 normal physiological saline solution and inspected microscopically for motile trypanosomes. Twenty microscopic fields at 430x were observed before the sample was considered negative. If trypanosomes were present, a count was made in three or more microscopic fields and the results averaged.

Attempts were made to infect mice to complete the life cycle. This was done to find the leishmaniform stage to determine if the trypanosomes were T. cruzi. Young mice were selected and inoculated intraperitoneally with physiological saline solution mixed with fecal material containing metacyclic trypanosomes. Blood samples were taken from the tails of the inoculated mice and examined microscopically. Laboratory raised, uninfected T. rubida uhleri were allowed to feed on the single infected mouse. These bugs were dissected on the 20th, 26th, and 42nd days after the feeding. The mouse was then necropsied and tissues removed from the liver, spleen, kidney, testis, and heart and fixed in Zenkers solution. These tissues were sectioned, stained, and inspected for leishmaniform bodies.
RESULTS

From 153 rat dens in 21 areas (Figure 1), 657 Triatoma rubida uhleri and T. protracta were collected and dissected. Of these, a total of 65 were found to be infected (9.9 per cent). Of the 657 Triatoma, 524 were T. rubida uhleri with 39 infected (7.5 per cent), and 133 were T. protracta with 26 infected (19.5 per cent). The 657 bugs from 153 rat dens is an average of 4.3 bugs or 3.4 T. rubida uhleri and 0.9 T. protracta per den (Table I).

It should be noted (Table II) that with the exceptions of ten T. rubida uhleri from area 2 and one T. rubida uhleri from area 20 that all other infected bugs were collected from area 17. Since the per cent of infection in area 17 was higher, 43 rat dens were excavated from this area to determine the limits of the infestation.

In considering the results of this study it is important to note that in the month of June few bugs remain in the rat dens. Because of this, the comparisons of infection rates were made from data calculated from the numbers of rat dens which did contain bugs (Table III).

From all areas excluding area 17 there were 329 T. rubida uhleri and 47 T. protracta collected from 55 rat
dens. Of these, 11 bugs (all *T. rubida uhleri*) were found to be infected. Considering the total bugs collected this is an infection rate of 2.9 per cent, or 3.3 per cent of the *T. rubida uhleri*, and no infected specimens of *T. protracta* were found. An average of 6.8 bugs, or 6.0 *T. rubida uhleri* and 0.9 *T. protracta*, was found per den.

In contrast, 281 bugs were collected from area 17. There were 195 *T. rubida uhleri* and 86 *T. protracta*. This is an average of 7.0 bugs or 4.9 *T. rubida uhleri* and 2.1 *T. protracta* per den. The remarkable difference between area 17 and the other areas was the overall infection rate of 19.2 per cent. There were 28 infected *T. rubida uhleri*, which is an infection rate of 14.3 per cent, and 26 infected *T. protracta*, or 30.2 per cent. A further indication of the infection rate of area 17 can be obtained by making a comparison of the number of infected dens. From all areas other than 17, a total of 55 dens containing bugs was excavated. Only two of these dens contained infected bugs, which is a percentage of 3.6. On the other hand, 11 of 40 dens in area 17 contained infected bugs (27.5 per cent). Possible reasons for this higher infection rate are discussed below.

In the spring of 1963 a few persons, who in one way or another had been alerted to the seriousness of the
Triatoma infestation of the Tucson area, discovered adult *T. rubida uhleri* in or about their residences (Table IV). Apparently, the adult bugs were attracted to the homes by lights. One bug was found on the front door beneath a porch light, while the others were found inside the homes behind curtains, in bed covers, and other areas where they could hide. To their knowledge none of the people in these homes were bitten. However, one family, contacted later in the summer when no bugs were found in their home, explained that they had problems with Triatoma each spring, and both the wife and husband had been bitten several times. Their home is located north of Ina Road approximately 2 miles east of the Tucson-Casa Grande highway.

Two young mice were inoculated with rectal material from an adult *T. rubida uhleri*, which was captured by Mrs. Betty Walker in her mobile home located at the Saguaro National Monument. Tail blood samples from these two mice were negative. A third mouse was inoculated with metacyclic trypanosomes from an adult *T. rubida uhleri* collected by F. J. Brady M.D. from his ranch house near Colossal Cave. Motile trypanosomes were observed in the tail blood of this mouse on the 29th day after inoculation. The infection of this mouse was then further tested by xenodiagnosis as described above. All four *T. rubida uhleri* became infected and metacyclic trypanosomes were observed. Slides prepared
from the tissues taken from this mouse were carefully examined at 970x and leishmaniform bodies were found in the heart muscle (Figure 2). Since *Trypanosoma cruzi* is the only known trypanosome having the leishmaniform stage in its life cycle, and since these organisms were demonstrated to infect triatomes, the trypanosomes observed from the rectal contents of *Triatoma* were assumed to be *T. cruzi*.
INFECTION RATES OF TRIATOMA IN ARIZONA

The infection rates of *Trypanosoma cruzi* in *Triatoma*, as well as other reduviids, may reach 100 per cent in some localities in South America. However, a sensible estimate of the infection rates so far published in the southwest United States would fall well below 50 per cent (Wood, 1934; Wood and Wood, 1937, 1938; Wood, 1928, 1941, 1942, 1943, 1944a, 1949, 1953, 1957; Davis, 1943; Ryckman, 1952; Packchanian, 1939, 1940; Mehringer, 1958, 1961).

S. F. and F. D. Wood from 1934 to 1951 found an average of 36.9 per cent of *T. protracta* from California to be infected, and in New Mexico (1961) they found an average infection rate of 3.4 per cent in *T. protracta* and *T. gerstaeckeri* from 1936 to 1959. Packchanian in 1939 found 92 per cent of 100 *T. gerstaeckeri* in Texas infected, and in 1940 he found in Texas 65 per cent of *T. heidemanni* to be infected.

Kofoid and Whitaker (1936) made the first report of infected bugs from Arizona. They received *T. uhleri* (=*T. rubida uhleri*) and *T. protracta* from November 1934 to June 1935 from the vicinity of Tucson, Arizona. These bugs were
shipped to them by Dr. L. P. Werhle of the University of Arizona. Of a total of 79 T. rubida uhleri and 2 T. protracta, they found 7 of the T. rubida uhleri infected (8.9 per cent). The bugs were collected from rat dens and from the home of Mrs. Orville Larsen. She reported having been bitten several times.


In 1945 B. R. Schuck received 16 T. longipes and 2 T. rubida uhleri from W. J. Cummings. These bugs were collected from the Tres de Mago Mine, 15 miles northeast of Nogales, Arizona. Eight of the T. longipes and one of the T. rubida uhleri were infected. She also reported (Schuck, 1945) that Davis found 3 of 7 T. longipes infected from this same area in 1941.

William H. Brown (unpublished report) collected 57 T. rubida uhleri and 16 T. protracta from the Tucson area. He found 11 or 15.1 per cent of these infected. Seven of
the infected triatomines were *T. rubida uhleri* (12.3 per cent), and 4 were *T. protracta* (25.0 per cent).

Including the present study, there have been 1,302 triatomines collected from Arizona which have been examined for *T. cruzi*. Of these, 120 or 9.2 per cent were infected. There were also 55 Paratriatoma dissected by Wood and all were found to be negative.

**Infection Rates of Triatoma in Tucson, Arizona**

There are several conclusions that can be made from the data obtained in this study. First, the over-all infection rate in *T. rubida uhleri* and *T. protracta* (9.9 per cent) is lower than observed in *T. protracta* from California and *T. gerstaeckeri* and *T. heidemanni* from Texas, but it is similar to the results obtained by Wood in New Mexico. Second, the infection rate in *T. protracta* from Tucson is comparable to the infection rate of this species in California. The percentage of *T. protracta* infected in area 17 of this study was 30.0 per cent, and Brown found 25.0 per cent infections in *T. protracta* as compared to the average of 36.9 per cent infections in this species in California. The over-all infection rate in Arizona, however, is lower because of the lower infection percentages in the more numerous *T. rubida uhleri*.
The discovery of area 17 was exceedingly important. Although the number of bugs per den (7.0) in area 17 was comparable to that found in all other areas (av. 6.8), the infection rate was significantly higher, with 19.2 per cent as compared to 2.9 per cent. There are several reasons why this situation could exist. The most striking difference between area 17 and the other areas is the ratio of T. protracta and T. rubida uhleri. In area 17 there was an average of 2.1 T. protracta and 4.9 T. rubida uhleri per den, while in all other areas only 0.9 T. protracta and 6.0 T. rubida uhleri were found per den. Although there were 47 T. protracta collected from areas other than 17, these were removed from several different areas with no appreciable concentration of T. protracta in any one area.

It has been indicated by Wood (1951) that because T. protracta tends to defecate sooner after a blood meal, it would be more likely to transfer the metacyclic trypanosomes to a host than would T. rubida uhleri, which tends to defecate later and if this is the case the latter would have probably moved away from the host by that time. If this is true it would be possible for an area with a sizable population of T. protracta to maintain and transmit Chagas' disease among Neotoma while T. rubida uhleri would become infected but actually not play as important a role in the transmission. Neotoma, however, will readily bite at or
or actually ingest *Triatoma* which are feeding on them; this could be an additional method of transmission. The metacyclic trypanosomes in this instance would penetrate the mucous membranes of the rat's mouth. With this type of transmission the ratio of *T. protracta* to *T. rubida uhleri* would apparently have no effect on the infection rate, unless *T. rubida uhleri*, which in the laboratory appears to be more active, could escape more often than *T. protracta*.

Furthermore, the ecology and location of area 17 may be important factors in the higher infection rate. The prominent vegetation is cholla (*Opuntia fulgida*) and greasewood (*Larrea divaricata*) in which Neotoma do well. The frequency of the dens in such an area is high in comparison to other areas. Area 17 is located in a small valley surrounded by low hills on all but the narrow north end. Since *Triatoma* are not strong flying insects and are usually carried with the wind currents, such a location would tend to restrict the dispersal of the insects in the spring; and with the rat dens in close approximation it would be possible for many of the insects to reach a new den. The higher percentages of dens, rats, and bugs would favor a higher percentage of infection.

It would seem that with a more thorough search, other areas similar to area 17 could be located, and areas such as these would be of medical importance to persons if
homes should be constructed near by.

Areas 2 and 20, the other two areas from which infected bugs were collected, were both located in foothills. Area 2 was on the south slope of the Santa Catalina Mountains. The ground winds of this area would be expected to be much stronger than would be found in area 17, and being located in foothills, the dispersal of the bugs would probably be greater. Similar conditions would be found in the Tucson Mountain foothills where area 20 was located.

The Life Cycle of Triatoma rubida uhleri

The life cycle of *T. rubida uhleri* is completed in one year in the laboratory (Usinger, 1944), and passes through 5 instars from the egg to the adult. As collections were made it was noted that certain instars were collected in greater numbers at different times during the year, indicating a seasonal pattern in the field. During the last of May and through June the adult *T. rubida uhleri* fly from the rat dens, and at this time few *T. rubida uhleri* were found in dens. It is during this interval that the invasion of the homes occurs. By the first of July, eggs, which were evidently deposited before the adults left, began to hatch. Throughout July, 1st, 2nd and 3rd instars were collected, and by the end of July a few 4th instars were found. During August most of the *T. rubida uhleri* collected were 4th instars with a few 3rd instars present,
and by the end of September most of the bugs were 5th instars. The over-wintering stage is the 5th instar, which molts to become the adult in early spring. Fifth instar *T. rubida uhleri* collected in February began to molt on March 26, and continued to do so throughout the month and into April. However, it is possible that the warmer laboratory temperatures would cause the molt to occur earlier than in the field.

A few instars were collected that did not fit this pattern. For example, one 3rd instar was found in March, and a few 5th instars were found in early summer after the adults had left the rat dens. The occurrence of these misplaced instars can be explained. Usinger (1944) found that the length of the nymphal period is dependent upon the time and size of the last blood meal. Considering this, if an instar failed to feed, it could become out of sequence with the other instars. In this study, *T. rubida uhleri* have remained alive for over 6 months without feeding, and for the most part, have not molted.

It is interesting to note that the instars and adults collected by Werhle (1939) fit the above cycle, and that he did not report adult *T. rubida uhleri* from rat dens in June.

No set pattern was observed for *T. protracta*, and adults and nymphs in various instars were collected
throughout the year. However, there seemed to be more adults in the dens during the winter months. *T. protracta* also has a 12 month life cycle with 5 instars from egg to adult (Usinger, 1944).

**A Sporozoan Parasite of Triatoma rubida uhleri**

During the examination of rectal contents for *T. cruzi*, 9 *T. rubida uhleri* were found to contain developmental stages of a sporozoan. The observed stages (sporonts, oöcysts, sporocysts and sporozoites) were located free in the lumen of the hind gut (Figures 3, 4, 5 and 6).

J. J. Osimani (1942) observed a sporozoan parasite in *T. rubovaria* from Montevideo which he named *Haemogregarina triatomae*. He found that the *Triatoma* was the intermediate host while a reptile, *Tupinambis teguixin*, was the definitive host. This is believed to be the only report of a sporozoan from *Triatoma*.

Positive identification of the sporozoan from Arizona can not be made until the entire life cycle is known; however, it could be placed tentatively in the genus *Hepat-ozoon*. It would be placed in this genus and not *Haemogregarina* because oöcysts containing sporocysts were observed. In the genus *Haemogregarina* the sporozoites are free in the oöcysts and are not contained in sporocysts (Levine, 1961).

Both sporulated and unsporulated oöcysts were observed. These were of an irregular shape, measuring
between 400 and 500 μ, and the sporulated oöcysts con­tained several hundred sporocysts. Each sporocyst con­tained 20 to 40 sporozoites; and measured 53-73 μ in length by 23-33 μ in width. The sporozoites were 17-20 μ by 3-5 μ. Photomicrographs were prepared utilizing both phase con­trast and bright field illumination. The measurements were made with a calibrated ocular micrometer.

The oöcyst and sporocyst walls were thin and collapsed when dried. Cover glass pressure also caused the cysts to rupture. This might indicate a direct life cycle since these stages apparently could not withstand the environment outside the gut of the bug.

Motile sporozoites were observed that exhibited a typical flexing movement as has been observed in sporozo­ites of other species of sporozoans.

The definitive host of this parasite could be *Neotoma albigula*, or possibly a reptile that comes in con­tact with *Triatoma*. Wood (1944b) reported collecting 16 species of reptiles from rat dens, and any one of these species might be suspected as being the definitive host. The reptile most frequently found in the rat dens of the Tucson area was the lizard, *Sceloporus magister*, and this was the only reptile found inhabiting dens in areas from which infected bugs were collected. It was observed in this study, and by Ryckman (1954) in California, that
when a rat den containing a *Sceloporus* was being torn apart, the lizard would repeatedly return to the den, indicating it obviously preferred this habitat. From the observations made in Arizona, it is believed that *S. magister* shares the den with *Neotoma* and that it is not used just as a temporary refuge from predators.

*T. rubida uhleri* was reported by Wood (1944) to feed experimentally on several species of reptiles including *Sceloporus*. On examination of the crop contents, 7 *T. rubida uhleri* were found to contain nucleated erythrocytes (Figure 7) indicating that this species of *Triatoma* does feed on reptiles in natural conditions. Ryckman (1954) also reported that 52 of 163 *T. protracta* instars fed on a single specimen of *S. magister*, 17 of which molted. The lizard could become infected with the sporozoan by ingesting infected bugs.

Several species of *Hepatozoon* have been identified from various reptiles, although the intermediate hosts so far identified with this genus have been mites, ticks, tsetse flies and mosquitoes (Lewis and Wagner, 1964). The genus *Triatoma* has not been associated with it.

Peter Mehringer in a personal communication stated that he had also observed similar cysts from *Triatoma* of the Tucson area, as well as in *T. protracta* from Griffith Park in Los Angeles, California. It would be interesting
not only to complete the life cycle of this organism, but to determine also what effect, if any, it has upon T. cruzi.

Summary

1—Species of Triatoma rubida uhleri and T. protracta were collected and dissected to determine the percentages infected with Trypanosoma cruzi from areas near Tucson, Arizona.

2—In considering the total number of bugs dissected there were a higher number of T. rubida uhleri infected than T. protracta. Even though the number of T. protracta observed in the field was considerably lower than T. rubida uhleri, there was a higher per cent infected.

3—When the data from individual areas were considered, the infection rate was found to be dependent on the ratio of T. rubida uhleri to T. protracta. In area 17 the overall infection rate was 19.2 per cent, compared to 2.9 per cent from all other areas. The main difference of this area was an average of 2.1 T. protracta per den, while in all other areas there was only 0.9 T. protracta per den.

4—A seasonal pattern for the occurrence of T. rubida uhleri instars during the year was noted. The adults were found in May and June, 1st, 2nd, 3rd and 4th instars develop through the summer months, and by the end
of September the majority of *T. rubida uhleri* collected were 5th instars. The 5th instars molted in the spring to the adult stage.

5— A sporozoan parasite was observed from the hind gut of *T. rubida uhleri*. The stages (sporonts, oocysts, sporocysts and sporozoites) observed were described. The definitive host of this organism could be *Neotoma*, or a reptile which comes in contact with *Triatoma*. Nucleated erythrocytes were observed in the crop of *T. rubida uhleri* indicating that this species does feed on reptiles in natural conditions.


--------. 1942. Reservoir hosts of Chagas' disease in the state of Texas. Natural infection of the nine-banded armadillo (Dasypus novemcinctus), house mice (Mus musculus), oppossum (Didelophis virginiana), and wood rats (Neotoma microps), with Trypanosoma cruzi in the state of Texas. Amer. Jour. Trop. Med. 22: 623-631.


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TOTALS 13 26 39
## TABLE III

Comparison of Rat Dens Containing *Triatoma*

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**TOTALS** 153 95 13
TABLE IV

Adult *Triatoma rubida uhleri*
from Residences

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FIGURE 2. Leishmaniform Bodies in Heart Muscle
FIGURE 3. Sporont of Sporozoan
FIGURE 4. Oöcyst Containing Sporocysts
FIGURE 5. Two Sporocysts Containing Sporozoites
FIGURE 6. One Sporozoite