infective to humans; the slow alanine aminotransferase (ALAT) pattern, previously found only in *T. b. gambiense* from man, occurred in one dog and seven pig stocks; two pig stocks were both plasma resistant and had the ALAT marker (GIBSON *et al.*, 1978). This constituted evidence that the pig is a reservoir of human trypanosomiasis.

In 1977, a further five localities were visited in Liberia and blood was taken from 293 pigs and 50 dogs in 20 villages. About a third of the pigs and a tenth of the dogs were found to be infected in the field by the haematocrit centrifuge technique; rodent inoculation increased the infection rate to two thirds of the pigs and one sixth of the dogs. Approximately 60% of these infections were classified in the subgenus *Nannomonas*, 20% in the subgenus *Trypanozoon* and 20% were mixed infections. Examination of the trypanosomes by BIIT and isoenzyme electrophoresis is still in progress. To date, of 22 *Trypanozoon* stocks from pigs, six had the slow ALAT pattern of *T. b. gambiense*; all of the stocks with this marker came from the Ganta-Sanniquelle region of North-central Liberia near the Guinea and Ivory Coast borders. Of 21 stocks examined with the BIIT, two were highly resistant and eight sub-resistant. Two of these stocks also had the ALAT marker.

In two localities Dr. P. Van Wettere (WHO entomologist) investigated the tsetse population, although weather conditions were unfavourable. *Glossina fusca*, a forest fly, was found in villages, as well as *G. palpalis*. There was a high infection rate with *Nannomonas* trypanosomes. Of four tsetse blood meals analysed at Imperial College, two were from pigs, one from man and one from an unidentified mammal (BOREHAM, personal communication).

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Epidemiological studies of Chagas's disease in Brazil

M. A. MILES[1,2], T. V. BARRETT[1,3], R. H. HOFF[3] AND K. E. MOTT[3]

[1] *London School of Hygiene and Tropical Medicine, Keppel St., London WC1E 7HT*

[2] *Instituto Evandro Chagas, C.P. 3, 66 000 Belém, Pará, Brazil (present address)*

and

[3] *Organização Pan Americana da Saúde, C.P. 0133, 40 000 Salvador, Brazil*

Populations of *Trypanosoma cruzi* and related organisms from bats are morphologically indistinguishable. Biochemical methods were therefore used for characterizing stocks of the parasite, and enzyme electrophoresis clearly revealed stable intrinsic differences between separate populations (BAKER *et al.*, 1978; MILES *et al.*, 1977, 1978). To establish whether the natural distribution of *T. cruzi* zymodemes (groups of populations with like forms of specified enzymes) is meaningful epidemiologically, *T. cruzi* stocks from various localities in Brazil were examined.

The rural communities of São Felipe and Castro Alves are located in an area of endemic Chagas's disease around the coastal city of Salvador in the state of Bahia. The vector *Panstrongylus megistus*, which is prevalent in the typical unplastered mud-and-wattle houses, appears to be strictly domestic in this region. The sylvatic vectors, *Triatoma tibiamaculata* and *Rhodnius domesticus*, are found in *Aechmea multiflora* and other epiphytic bromeliads in which the opossum, *Didelphis albiventris*, which is the principal sylvatic reservoir of *T. cruzi*, commonly nests. Three zymodemes of *Trypanosoma cruzi* were identified from this region: Z1, from mammals and triatomines associated with bromeliads; Z2, from man, domestic animals and *P. megistus*; and Z3, from the armadillo *Dasypus novemcinctus* and the associated vector *P. geniculatus*.

Riacho de Santana is situated in a more arid region of the interior of Bahia. The domestic vector *Triatoma infestans* had recently become established in this region, provoking an unusual outbreak of acute Chagas's disease. *Trypanosoma cruzi* was isolated from man, dogs, cats, *Rattus rattus*, *Didelphis albiventris*, *Triatoma infestans* and the main peridomestic vector *T. sordida*. *T. sordida* was also found in woodland habitats along with *T. pseudomaculata*. The mobility of *R. rattus* between houses and the adjacent woodland, and other features of the distribution of hosts and vectors, suggested that sylvatic and peridomestic sources of *Trypanosoma cruzi* might have contributed to the outbreak of human disease. In contrast to the situation in the littoral region of Bahia, both *T. cruzi* Z1 and Z2 were found in man, domestic animals and *R. rattus* from Riacho de Santana.

In the Amazon basin of Brazil houses are not colonized by any of the seven local species of triatomine captured in sylvatic habitats. *T. cruzi* Z1 and Z3 are prevalent in forest mammals and vectors in the State of Pará and were responsible for the six recorded cases of autochthonous Chagas's disease in the city of Belém.

Three zymodemes of *T. cruzi* capable of causing

acute disease in man are thus widespread in northern and eastern Brazil, but their medical importance varies according to local epidemiological factors. The three areas studied can be roughly classified as having either separate domestic and sylvatic transmission cycles of *T. cruzi*, overlapping domestic and sylvatic cycles, or enzootic transmission rarely involving man. At least zymodeme 2 causes chronic heart disease and mega syndromes in Bahia. As yet, no strictly sylvatic reservoir of *T. cruzi* Z2 has been identified, and it remains to be seen whether the three zymodemes produce different disease syndromes in man.

This abstract summarizes the results of collaborative projects in Brazil and England involving many individuals and organizations, fully acknowledged in the papers cited and in preparation.

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Epidemiological studies on *Trypanosoma evansi* in Sudan

A. R. GRAY, M. M. MAHMOUD, R. BOID, A. G. LUCKINS, K. H. MALIK AND P. RAE

Centre for Tropical Veterinary Medicine, University of Edinburgh, Roslin, Midlothian, Scotland, EH25 9RG

and

Faculty of Veterinary Science, University of Khartoum, Sudan

Trypanosoma evansi is widely distributed in Central and South America, in Asia and in Africa to the north and east of areas affected by the tsetse-borne trypanosomiases (HOARE, 1972). Although this parasite has been studied previously in considerable detail, it still adversely affects domesticated livestock in many countries and there is a continuing need for more information about its epidemiology. In 1976, a collaborative research project was established to examine aspects of the epidemiology of *T. evansi* in the Sudan where infections with this parasite in camels have been a problem for many years (EL KARIB, 1961). The aims are: (a) to develop improved serodiagnostic techniques for the detection of chronic infections, (b) to identify methods for recognizing particular isolates of *T. evansi* based on their enzymic or antigenic components and (c) to utilize any improved techniques in a study of the distribution and transmission of *T. evansi* among domesticated animals in a selected area.

Preliminary studies using sera from rabbits with experimental *T. evansi* infections led to the selection of the indirect fluorescent antibody test (IFAT) and enzyme immuno-assays (ELISA) for more detailed work in domesticated animals (LUCKINS *et al.*, 1978). These tests were then applied to sera from experimentally infected camels and the results compared with those obtained by established diagnostic aids. Antibody levels determined by IFAT and ELISA correlated well with active infections in the camels, but difficulties were encountered when attempts were made to study the decline of antibody levels after drug treatment because of suramin resistance in the infecting trypanosomes.

Camels in various field localities were also examined for parasites and for serum antibody content and good correlation was found again between IFAT and ELISA and the presence of infection. These techniques were more sensitive than the mercuric chloride test, the formol gel test and IgM assays in detecting infected animals.

Work on the characterization of isolates of *T. evansi* from different localities has also been started (BOID, 1976). Trypanosomes have been collected from camels near Khartoum, Kassala and Kosti and stored in liquid nitrogen pending comparison of their isoenzyme content by methods outlined by other workers (BAGSTER & PARR, 1973; KILGOUR & GODFREY, 1973). Recent work on *T. evansi* has indicated considerable similarity between the enzymes of isolates from South America and one from West Africa and it might be necessary to include examinations of trypanosomal protein and amino-acid content in the work to find useful criteria for strain differentiation (GIBSON *et al.*, 1978).

An area of eastern Sudan has been selected for epidemiological studies on *T. evansi* in different hosts. The collection of trypanosomes and sera for examination by techniques used in the work completed to date will continue during the next two years to identify any reservoir hosts or trypanosome transmission patterns of potential importance in relation to future control measures.

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