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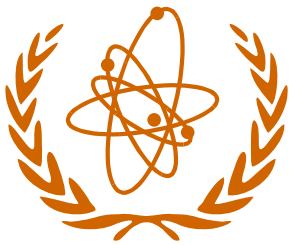

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SECTION B — ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

[See also **15**: no. 7502.]

7488 **Kaona, F.A.D., Masaninga, F., Rickman, L.R. and Mukunyandela, M., 1991**. Sleeping sickness and tsetse awareness: a sociological study among the Tambo and Lambya of the northern Luangwa Valley, Zambia. *Central African Journal of Medicine*, **37** (9): 298-301.

Kaona: TDRC, P.O. Box 71769, Ndola, Zambia.

Data on awareness of tsetse flies and knowledge of trypanosomiasis were collected in May 1988 in the Luangwa Valley of Isoka District in the Northern Province of Zambia. One thousand and nine hundred adult males and females were interviewed. There was a high level of fly awareness among all the respondents, regardless of duration of residence and age groups. Malaria was considered as the most serious illness in the community, and hence overshadowed the impact of trypanosomiasis. Disease awareness gravity cannot be attributed to individuals' socio-economic levels.

7489 **Kaufmann, R.R. von and Peters, K.J., 1990**. Achievements and difficulties in ruminant livestock development in the humid and subhumid zones of West and Central Africa. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 21-28.

ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

It is estimated that the countries of West and Central Africa have only 26.4 million cattle, of which 7.6 million are trypanotolerant. In the more humid regions, where trypanosomiasis is a major problem, the most prominent breeds of cattle, sheep and goats are indigenous trypanotolerant dwarf types. Trypanotolerant cattle are not very productive per individual but in terms of units of feed they are as productive as non-tolerant Zebu. Increasing human populations have reduced tsetse habitat by tree clearance and increased hunting has reduced the number of alternative hosts for trypanosomes. Those that survive in a single host species tend to be less virulent than those with multiple hosts, with fewer vectors carrying less pathogenic strains of trypanosomes. Government action has extended tsetse-free areas by spraying insecticides, SIT, trapping and use of insecticide-impregnated screens. Nigeria has had the largest tsetse control programme and by 1977-78 204,802 km^2 had been cleared, mostly in areas north of the subhumid zone. Tsetse control measures have been successful but are now proving hard to sustain

financially: there is a good possibility of reinvasion in cleared areas.

7490 **Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990**. *Livestock production and diseases in the tropics* (Proceedings of the 6th International Conference of Institutes for Tropical Veterinary Medicine, Wageningen, Netherlands, 28 August – 1 September 1989). Utrecht, Netherlands; University of Utrecht. 411 pp.

Office for International Cooperation, Faculty of Veterinary Medicine, University of Utrecht, P.O. Box 80.163, NL-3508 TD Utrecht, Netherlands.

This conference was organised by the Association of Institutes for Tropical Veterinary Medicine (AITVM) to provide an international forum for scientists to discuss achievements, difficulties and future prospects in the fields of tropical animal health and production. In addition to invited papers, the proceedings include summaries, conclusions and recommendations of four workshops on pastoral systems, dairy production systems, livestock production systems of the humid and subhumid zones and helminthiasis in tropical areas. There are numerous references to trypanosomiasis (see **15**: nos. 7489, 7491, 7493, 7507, 7525, 7527, 7528, 7531, 7532, 7536, 7541-7544, 7547, 7550).

7491 **Masiga, W.N., 1990**. Achievements and difficulties of animal health services and the application of preventive animal health measures in Africa. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 63-67.

OAU/IBAR, P.O. Box 30786, Nairobi, Kenya.

Trypanosomiasis is currently the most widespread disease of livestock on the continent. The tsetse fly vector is unique to Africa and infests over 10 million km^2 of the best arable land. The tsetse belts are expanding in all areas except those where vigorous anti-tsetse measures are being undertaken. If these areas can be made tsetse free, food production in Africa could be increased several fold. The available control measures against tsetse are expensive, as is the maintenance of livestock on drug regimes.

7492 **Overseas Development Administration and University of Bristol, 1992**. *Tsetse Research Laboratory annual report 1991*. Bristol; ODA and University of Bristol. 80 pp.

TRL, Langford House, Langford, Bristol BS18 7DU, UK.

TRL's objectives of tsetse research and control, the maintenance of tsetse colonies and the provision of research and advisory facilities have remained the same as in previous years, although major changes are

envisaged by 1993 as the result of changes in funding policy by ODA. The nutritional state of feeding *Glossina pallidipes*, the estimation of fly age, life history strategies, the use of pyriproxyfen to control tsetse in Zimbabwe and the efficacy of pyrethroids for control were studied, including the effect of sublethal doses of pyrethroids on the establishment of trypanosome infections in treated insects. Trap and target related behaviour was investigated with regard to target design and colour and the response of tsetse to skin secretions and sebum and host odours. The relative attractiveness of infected and uninfected cattle to tsetse was studied in Kenya. Supernumerary chromosomes were analysed in wild and laboratory strains of *G. morsitans morsitans*. The role of *Glossina* as vector has been studied with reference to fly age and susceptibility to infection, lectin inhibition, the stage of trypanosome killing in flies and the role of *G. longipennis* in the epidemiology of bovine trypanosomiasis. Trypanosome studies included the collection of isolates (with individual reports from Uganda, Kenya, Tanzania and Côte d'Ivoire), genetic identification and computer analysis. Isolates of *Trypanosoma grayi* from crocodiles and *T. varani* from monitor lizards are shown to be separate species with, probably, separate vectors.

7493 **Peters, K.J., 1990**. Prospects for game utilization in Africa. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 75-83. ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

Game utilisation in Africa is an important element in economic development and an earner of foreign currency. Administrative, biological and ecological issues are discussed. Trypanosomes are carried by game animals and previous policy decisions to control trypanosomiasis often included the elimination of its wild hosts. In general this is no longer considered feasible. However, in Zimbabwe there are now arguments about the sustainability of expensive tsetse eradication programmes, necessary for the introduction of domestic livestock, at the expense of adapted wildlife production.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

[See also **15**: no. 7492.]

7494 **Gooding, R.H. and Rolseth, B.M., 1992**. Genetics of *Glossina morsitans morsitans* (Diptera: Glossinidae). XIV. Map

locations of the loci for phosphoglucomutase and glucose-6-phosphate isomerase. *Genome*, **35** (4): 699-701.
Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3, Canada.
The locus for phosphoglucomutase (*Pgm*) was mapped at less than 1.2 recombination units from the locus for arginine phosphokinase (*Apk*) in linkage group I, the X chromosome. Linkage group III loci were mapped in the order *sabr* (long scutellar apical bristles in females), *Mdh* (malate dehydrogenase) and *Pgi* (glucose-6-phosphate isomerase). The loci *sabr* and *Mdh* were separated by 39.3 □ 4.6 recombination units and *Mdh* and *Pgi* were separated by 45.5 □ 4.7 recombination units. Intrachromosomal recombination was rare or did not occur in males. Previously published recombination distances are summarised as a linkage map for the 16 loci that have been mapped in *G. m. morsitans*.

7495 **Nguu, E.K., Osir, E.O., Ochanda, J.O. and Olembo, N.K., 1992**. Isolation and properties of a 23-kD haemolymph protein from the tsetse, *Glossina morsitans morsitans*. *Insect Science and its Application*, **13** (2): 189-197.
Nguu, Ochanda, Olembo: Department of Biochemistry, University of Nairobi, P.O. Box 30197, Nairobi, Kenya; Osir: ICIPE, P.O. Box 30772, Nairobi, Kenya. (Correspondence to Osir.)
The haemolymph of the tsetse *G. m. morsitans* contains a low molecular weight protein of very high density (1.29 g/ml). The protein was detected in the haemolymph during all developmental stages of the insect. Purification of the protein was achieved by a combination of density gradient ultracentrifugation and repeated gel permeation chromatography. Electrophoresis under non-denaturing and denaturing conditions showed the protein to be a single polypeptide chain ($M_r \simeq$ 23,000). Amino acid analysis revealed a relatively high content of the acidic amino acids as well as serine and glycine. The protein contained lipids as shown by Sudan Black staining but was non-glycosylated. Using rabbit antiserum against the isolated protein in immunodiffusion and immunoblotting experiments, no cross-reactivity was detected with haemolymph samples from insects representing six orders. Although the function of the protein remains unknown, its uniqueness to *Glossina* suggests that it may have a role in the physiology of this insect.

7496 **Njagi, E.N.M., Olembo, N.K. and Pearson, D.J., 1992**. Proline

transport by tsetse fly *Glossina morsitans* flight muscle mitochondria. *Comparative Biochemistry and Physiology (B)*, **102** (3): 579-584.
Department of Biochemistry, College of Health Sciences, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.
Proline accumulation by *G. morsitans* flight muscle mitochondria was studied *in vitro* by the swelling technique and direct measurement of (U-^{14}C) proline. Proline transport was inhibited by the uncharged liposoluble -SH reagent, *N*-ethylmaleimide, but not by ionic reagent, mersalyl, suggesting that the -SH groups involved in the transport of proline are located in a hydrophobic part of the membrane or on the matrix side of the membrane. The kinetic study of proline accumulation revealed saturation kinetics and a high temperature dependence. It gave a K_m of 85 μM and a V_{max} of 962 pmol/min/mg protein and an activation energy (E_a) of 11 kcal/mol. Certain other amino acids (L-valine, L-alanine, L-methionine, L-phenylalanine, L-tryptophan and L-hydroxyproline) significantly stimulated proline uptake. These observations indicate that *G. morsitans* flight muscle mitochondria contain a proline transport mechanism.

7497 **Saini, R.K. and Hassanali, A., 1992**. Olfactory sensitivity of tsetse to phenolic kairomones. *Insect Science and its Application*, **13** (1): 95-104.
ICIPE, P.O. Box 30772, Nairobi, Kenya.
Behavioural and electrophysiological (EAG) studies were undertaken to determine the olfactory selectivity of the antennae of *Glossina morsitans morsitans* and *G. pallidipes* to phenolic kairomones. Responses of both species to 3-alkylphenols increased as the alkyl chain increased from one carbon atom to three, while the opposite trend was observed with 4-alkylphenols. These results indicated that 4-cresol and 3-*n*-propylphenol are the most stimulatory of the two respective groups of phenols. However, comparison of the responses indicated differences in the sensitivities of the chemoreceptor systems of the two species. Hence different compositions of the phenols may be required to best attract these species. Probable interactions of the phenols with the binding sites on the receptor surface are discussed.

7498 **Zdárek, J., Denlinger, D.L. and Otieno, L.H., 1992**. Does the tsetse parturition rhythm have a circadian basis? *Physiological Entomology*, **17** (3): 305-307.
ICIPE, P.O. Box 30772, Nairobi, Kenya; Zdárek: also Institute of Organic Chemistry and Biochemistry,

Czechoslovak Academy of Sciences, Prague, Czechoslovakia; Denlinger: also Department of Entomology, Ohio State University, 1735 Neil Avenue, Columbus, OH 43210, USA. (Correspondence to Denlinger at Ohio State University.)
Under an LD 12:12 h photoregime at constant temperature, parturition in *Glossina morsitans centralis* is a gated event occurring late in the afternoon. When flies are switched to continuous light the rhythm quickly dampens, but its persistence for at least two 24 h cycles beyond the final scotophase suggests the rhythm has a circadian basis. A weak rhythm appears after 7 days of continuous light, perhaps in response to the daily disturbance caused by feeding. Return of the flies to LD 12:12 h restores the rhythm after exposure to a single scotophase.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **15**: no. 7492.]

7499 **Brightwell, R., Dransfield, R.D. and Williams, B.G., 1992.** Factors affecting seasonal dispersal of the tsetse flies *Glossina pallidipes* and *G. longipennis* (Diptera: Glossinidae) at Nguruman, south-west Kenya. *Bulletin of Entomological Research*, **82** (2): 167-182.
C/o Ms S. MacMillan, ILRAD, P.O. Box 30709, Nairobi, Kenya; ICIPE, P.O. Box 30772, Nairobi, Kenya; ibid.
Seasonal changes in the distribution of the tsetse flies *G. pallidipes* and *G. longipennis* along a transect from riverine thickets out into open plains were monitored along with tsetse density, climatic factors, vegetation and host abundance. Dispersal of tsetse into open country was quantified using the mean spread. During and after the rains both species extended their distribution out into open country up to at least 3.5 km from riverine thicket areas. The mean spread of *G. longipennis* was greater than that of *G. pallidipes*. The spread of males and females was very similar, as was the spread of different age categories of parous females, but nulliparous flies and females carrying second-instar larvae were under-represented in samples from open areas. This seasonal dispersal can be accounted for by random diffusion with an average root mean square displacement of about 175 m per day. Observed degrees of spread were best correlated with humidity conditions prior to sampling, but multiple

regression models suggested that host abundance, vegetation as measured by normalised difference vegetation indices (NDVI) and, in the case of *G. longipennis*, tsetse density, were also factors in determining the degree of spread. The significance of these findings in relation to tsetse control is discussed.

7500 **D'Amico, F., Moussa, A., Sarda, J. and Gouteux, J.P., 1992**. Distribution et importance des gîtes à *Glossina fuscipes fuscipes* Newstead, 1910 dans l'agglomération de Bangui (République Centrafricaine). [Distribution and importance of breeding sites of *G. f. fuscipes* in the suburbs of Bangui (Central African Republic).] *Bulletin de la Société de Pathologie exotique et de ses Filiales*, **85** (1): 64-68.

D'Amico, Gouteux: Centre ORSTOM, Bangui, Central African Republic; Moussa: CIESPAC, B.P. 14513, Brazzaville, Congo; Sarda: Région Sanitaire no. 1, B.P. 300, Bangui, Central African Republic.

The authors review urban sites of *G. f. fuscipes* in the suburbs of Bangui and propose a classification of these sites. Among them, two isolated breeding sites (Sakaï, Zila) are characterised by a high density of tsetse and close man/fly contact. To prevent a possible reactivation of the historical sleeping sickness focus of Bangui-Bimbo, a tsetse control programme in these two sites is necessary.

7501 **Gouteux, J.-P., 1992**. Un cas d'exclusion géographique chez les glossines: l'avancée de *Glossina palpalis palpalis* vers Brazzaville (Congo) au détriment de *G. fuscipes quanzensis*. [A case of geographical exclusion in tsetse flies: the advance of *G. p. palpalis* towards Brazzaville (Congo) to the detriment of *G. fuscipes quanzensis*.] *Insect Science and its Application*, **13** (1): 59-67.

Centre ORSTOM, B.P. 893, Bangui, Central African Republic.

The line of contact between *G. p. palpalis* and *G. f. quanzensis* passes near Brazzaville, to the south and south-west of the Congolese capital. Observations made between 1948 and 1961 show an advance of *G. p. palpalis* towards Brazzaville, along the Djoué and Congo river valleys. Recent captures confirm this spectacular advance of *G. p. palpalis* to the detriment of *G. f. quanzensis*. Indeed, *G. f. quanzensis* is no longer found within a distance of 20 km where it used to co-exist with *G. p. palpalis*. Ecological competition for food or habitat thus occurs between these two closely related species. It is suggested that both heterospecific copulations and demographic pressure play a crucial part in the exclusion.

7502 **Rogers, D.J., 1991**. Satellite imagery, tsetse and trypanosomiasis in Africa. *Preventive Veterinary Medicine*, **11** (3-4): 201-220.
Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK.
This paper describes the application of remote sensing to studies on the African trypanosomiases causing sleeping sickness in man and `nagana' in domestic animals. After giving some biological background to the problem, an important relationship between the risk of infection of domestic animals, tsetse fly numbers and fly infection rates is presented. An understanding of the latter leads to a prediction of risk in cattle. The problems of analysing and interpreting the distribution and abundance patterns of flies are explored, and a mortality climogram approach is described in which the important meteorological variables appear to be temperature and saturation deficit. This approach, which can be applied to data collected at only very few sites, leads to extensive predictions of the distributional limits of the tsetse *Glossina morsitans*. These predictions are supported by the known distribution of this species throughout Africa. A similarity noted between published whole-Africa normalised difference vegetation indices (NDVI) and tsetse distribution leads to an exploration of the usefulness of NDVI for such vector studies. The likely information content of the images is identified through principal component analysis, and correlations are shown between NDVI values and annual temperature, saturation deficit and rainfall figures for more than 300 sites throughout the sub-Saharan region of the continent. NDVI values are highly correlated with both saturation deficit and rainfall figures. Significant correlations are shown between vector mortality rates and mean monthly NDVI values, and between the physical size of the vectors (known to reflect the mortality rates affecting the parental population) and NDVI along an approximately 700 km transect across a whole range of eco-climate conditions in West Africa. Reasons are suggested for the localisation of human sleeping sickness to just one of several regions sampled by the transect. Finally, seasonal changes in case numbers of human sleeping sickness in both Uganda and Kenya are correlated with mean monthly NDVI from the areas concerned. The first of these correlations is negative, the second positive. Explanations for this difference are given in terms of the different vector

species and epidemiological situations in these long-standing foci in East Africa. It is concluded that the rather limited amount of information available in NDVI has already proved enormously useful, and a plea is made for a more complete exploration of National Oceanic and Atmospheric Administration (NOAA) data, especially at the highest available resolution, whilst not neglecting the vitally important ground-based studies that made possible the results presented in this paper.

7503 **Thakersi, H., 1991**. Records of the tsetse fly *Glossina pallidipes* in the north-eastern region of Zimbabwe. *Transactions of the Zimbabwe Scientific Association*, **65**: 20-23.

Tsetse and Trypanosomiasis Control Branch, Department of Veterinary Services, P.O. Box 8283, Causeway, Zimbabwe.

Trap, bait ox and odour-baited screen surveys for tsetse flies were conducted in the Mutoko District in the north-eastern border region of Zimbabwe. The results confirmed that *G. pallidipes* occurs in this area, which had been considered previously to be inhabited by *G. morsitans* only. The invading *G. pallidipes* appear to have come from Mozambique, and the present distribution of this fly in the Mutoko District is mapped. The relationship of *G. pallidipes* from Mutoko to *G. longipalpis* and *G. borgesi* is discussed.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

[See also **15**: nos. 7489, 7492.]

7504 **Bauer, B., Kabore, I., Liebisch, A., Meyer, F. and Petrich-Bauer, J., 1992**. Simultaneous control of ticks and tsetse flies in Satiri, Burkina Faso, by the use of flumethrin pour on for cattle. *Tropical Medicine and Parasitology*, **43** (1): 41-46.

Bauer, Kabore, Petrich-Bauer: CRTA, 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso; Liebisch, Meyer: Institut für Parasitologie, Tierärztliche Hochschule, Hannover, Germany.

Treatments of 2000 cattle at monthly intervals with flumethrin pour on (1 mg active ingredient/kg body weight) resulted in a rapid decrease of African animal trypanosomosis. After an initial curative treatment of the sentinel herd with diminazene aceturate (7 mg/kg) only positive cases were treated. Three applications of flumethrin were sufficient to reduce the prevalence of trypanosomosis to below 5%. Apart from a slight

increase at the end of the first year the infection rate varied between 0 and 5%. A tsetse population disappeared from a heavily infested habitat after six treatments. The average tick infestation was 3-10 times lower than in a control site in spite of the repeated use of another acaricide. Between 3282 and 8624 animals were treated five times in the second year at intervals of about 2 months. One hundred and thirty monoconical insecticide-impregnated traps were deployed in habitats which were inaccessible for the cattle. The highest infection rate of the sentinel herd was 1.4%. Among another 150 eartagged cattle scattered over a district of about 1000 m^2 the prevalence of trypanosomosis dropped to 4.8% at the end of the second year. The importance of active and financial participation of the rural communities is emphasised to ensure a viable campaign and good prospects of local organisations taking over responsibility once the external interventions have stopped.

7505 **Bauer, B., Kabore, I. and Petrich-Bauer, J., 1992**. The residual effect of deltamethrin Spot On when tested against *Glossina palpalis gambiensis* under fly chamber conditions. *Tropical Medicine and Parasitology*, **43** (1): 38-40.

CRTA, 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso.

Groups of single zebu cattle were exposed to infestations of the tsetse fly *G. p. gambiensis* in fly chambers following treatment with a pour on formulation of deltamethrin, Coopers Spot On. During the experiment one animal was maintained in a stall and the other exposed at intervals to sunlight. Both mortality and knockdown of exposed flies was demonstrated. Mortality rates of greater than 90% were recorded during the period 0-20 days after treatment and values in excess of 50% during the period 41-59 days after treatment. Knockdown was more marked, with rates in excess of 90% and 65% being recorded for, respectively, 45 and 75 days after treatment. Exposure to sunlight did not significantly affect the performance of Spot On. Flies were observed to land repeatedly on the deltamethrin-treated cattle, so contributing to the overall pick-up of effective concentrations of the chemical. It was considered that this effect of the chemical could considerably reduce the risk of transmission of trypanosomosis from the start of a tsetse campaign.

7506 **Ikeshoji, T., Langley, P. and Gomulski, L., 1991**. Genetic control by trapping. *In*: Curtis, C.F. (ed.), *Control of disease vectors in the community* (London, UK; Wolfe Publishing),

pp. 159-172. (This book appears to be an unrevised paperback edition of Curtis, C.F. (ed.), 1990, *Appropriate technology in vector control*, although no reference is made in it to the original edition; see *TTIQ*, **14** (2): nos. 6711 and 6716.)
Department of Agricultural Biology, University of Tokyo, Bunkyo-Ku, Tokyo 113, Japan; TRL, University of Bristol, Langford, Bristol BS18 7DU, UK; Department of Biology, Queen Mary College, Mile End Road, London E1 4NS, UK.
Chemosterilant traps or targets for tsetse flies are reviewed. The use of decoys mounted on dark cloth screens has been successful in sterilising *Glossina morsitans morsitans*. Males attracted visually to the screens are stimulated to attempt copulation with the nylon cloth decoys, which are treated with both sex pheromone and the chemosterilant bisazir. Both sexes could be sterilised by using bisazir vapour in traps but this compound is volatile and unstable and traps would require frequent servicing. Conventional chemosterilants are not cost-effective for tsetse control and attention has turned to the possible use of juvenile hormones as tsetse sterilants. Treatment of adult females with the synthetic analogue S-31183 effectively sterilises the flies by ensuring that their offspring fail to develop beyond day 20 of their intrapuparial life. Tarsal contact on treated cloth provides an effective dose of S-31183 and it is believed that this compound used on black cloth screens or traps could provide the means of a worthwhile self-help campaign to control tsetse in Africa.
7507 **Jordan, A.M., 1990**. Aspects of the control of African trypanosomiasis in the future. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 91-94.
TRL, University of Bristol, Langford, Bristol BS18 7DU, UK.
Animal trypanosomiasis has been a major factor restricting the development of mixed farming in Africa and preventing the widespread use of draught animals. Control methods include the use of curative and prophylactic drugs, trypanotolerant breeds and tsetse control. Tree clearance and killing wild reservoir hosts are now rarely practised, except that expanding human populations continue to remove much of the natural flora and fauna. Today tsetse control is effected almost exclusively by insecticides, by aerial and ground spraying or by impregnating traps and

targets. For the foreseeable future trypanosomiasis control is going to have to depend on existing techniques. The major constraint is cost. More sedentary livestock as traditional pastoralists become settled in the face of land shortage will improve the prospects for control and local communities can play an active role in maintaining traps. Large-scale tsetse control campaigns in the past, as in Nigeria, have succeeded only when the cleared land is rapidly settled and developed, or when the area is isolated from other infested areas. The most dramatic proposal for the future is an attempt to eradicate tsetse from some 320,000 km^2 in Malawi, Mozambique, Zambia and Zimbabwe; preliminary studies are in progress. Trypanosomiasis control measures must be integrated with other aspects of development to ensure that the carrying capacity of the cleared land is not exceeded.

7508 **Lancien, J., 1991**. Lutte contre la maladie du sommeil dans le sud-est Ouganda par píegeage des glossines. [Controlling sleeping sickness in south-eastern Uganda with tsetse fly traps.] *Annales de la Société belge de Médecine tropicale*, **71** (Suppl. 1): 35-47.
ORSTOM, 213 rue La Fayette, 75010 Paris, France.
An outbreak of human trypanosomiasis due to *Trypanosoma brucei rhodesiense* has been affecting the Busoga District of Uganda since 1976. More than 40,000 cases had been recorded up to 1990. Since 1988 the epidemic area has been extending into the neighbouring Tororo District, where the vegetation is savanna intersected by gallery forest. In both regions the vector is *Glossina fuscipes*. In order to stop disease transmission a vector control project was launched in 1988 in the Busoga area based on tsetse fly trapping, using pyramidal traps impregnated with deltamethrin (10 traps per km^2). The results were excellent. Everywhere fly populations were reduced by more than 95%. In some parishes total elimination was achieved. The number of new human cases of trypanosomiasis was reduced in the same proportions. A complete cessation of transmission in the Busoga area can be reasonably expected in the near future. Since 1990 trapping has been extended to the epidemic areas of the Tororo District. The results after only a few months have also been excellent. To reinforce the effect, monthly treatment of cattle with `pour-on' deltamethrin has been tried in a small area with promising first results. The cost of protection is US $0.9 per person per year.

7509 **Laveissière, C., Vale, G.A. and Gouteux, J.-P., 1991**. Bait methods for tsetse control. *In*: Curtis, C.F. (ed.), *Control of disease vectors in the community* (London, UK; Wolfe Publishing), pp. 47-74. (See note at **15**: no. 7506.)
ORSTOM, B.P. 1434, Bouaké, Côte d'Ivoire; Tsetse and Trypanosomiasis Control, P.O. Box 8283, Causeway, Harare, Zimbabwe; ORSTOM, 213 rue La Fayette, 75010 Paris, France.
This article reviews tsetse control by baiting. Tsetse biology makes the flies promising candidates for baiting; however, their highly mobile life-style results in continual invasion pressure and bait techniques alone are unlikely to eliminate tsetse completely. Recent developments, using electrocuting devices, artificial baits and cattle as bait, and the implementation of bait methods are described, with reference to odour attractants, trap design and population studies. A strategy for the use of baits against savanna tsetse is proposed. Riverine tsetse are important vectors of *gambiense* sleeping sickness in West Africa and their control using the biconical trap in Côte d'Ivoire is described. Tsetse control in the forest zone is discussed with reference to insecticide spraying, use of impregnated screens, community participation, timing of treatment, surveillance for sleeping sickness, cost, planning, choice of insecticide and interspecific variation in susceptibility to trapping. Colour and colour contrast in trap design, the Vavoua trap and the use of pyramidal traps without insecticide in the Congo are described. The advantages and disadvantages of bait methods are summarised.

7510 **MacCormack, C.P., 1991**. Appropriate vector control in primary health care. *In*: Curtis, C.F. (ed.), *Control of disease vectors in the community* (London, UK; Wolfe Publishing), pp. 221-227. (See note at **15**: no. 7506.)
Bryn Mawr College, Bryn Mawr, PA 19010, USA.
Vector control may be sustained at relatively low cost over a long period of time through community action, organised through the national primary health care structure. The role of community health workers and community participation in vector control are reviewed. Education, detection and trapping for tsetse control are possible with community participation; residual and space spraying are also possible but require professional involvement.

7511 **Mestres, R. and Mestres, G., 1992**. Deltamethrin: uses and environmental safety. *Reviews of Environmental Contamination and*

Toxicology, **124**: 1-18.
Laboratoire de Chimie Appliquée à l'Expertise, Université de Montpellier I, 34060 Montpellier, France.
The physicochemical and toxicological properties of deltamethrin are reviewed and its potential uses discussed. Use risks are evaluated. Aerial treatments alongside rivers at the rate of 12.5 g a.i./ha for tsetse control in Côte d'Ivoire, Burkina Faso and Nigeria did not affect fish or birds and aquatic invertebrates were disturbed only for a very short time.

4. EPIDEMIOLOGY: VECTOR-HOST AND VECTOR-PARASITE INTERACTIONS
[See also **15**: nos. 7492, 7502.]
7512 **Gibson, W. and Ferris, V., 1992**. Sequential infection of tsetse flies with *Trypanosoma congolense* and *Trypanosoma brucei*. *Acta Tropica*, **50** (4): 345-352.
Department of Pathology and Microbiology (Gibson) and TRL (Ferris), University of Bristol Veterinary School, Langford, Bristol BS18 7DU, UK.
The question whether tsetse flies can be experimentally infected with more than one trypanosome species or strain by sequential feeding was investigated using DNA probe technology to identify directly the small numbers of trypanosomes in the fly gut. Bloodstream form trypanosomes of *T. congolense* or *T. brucei* ssp. were used for initial infection, followed by sequential feeds using either *T. congolense* or *T. brucei* ssp. Midgut trypanosome populations were subsequently analysed by hybridising dot blots with species-specific DNA probes. Two different *T. brucei* stocks were also fed in succession and the midgut trypanosome populations analysed by molecular karyotype. Contrary to expectations from previous reports, it was comparatively easy to superinfect flies with a second trypanosome species or stock, although the presence of trypanosomes already in the gut did not aid establishment of those incoming. Thus, to develop a mixed infection, a prerequisite for trypanosome mating, flies do not necessarily have to pick up both parental trypanosomes on their first feed.
7513 **Imbuga, M.O., Osir, E.O. and Labongo, V.L., 1992**. Inhibitory effect of *Trypanosoma brucei brucei* on *Glossina morsitans* midgut trypsin *in vitro*. *Parasitology Research*, **78** (4): 273-276.
ICIPE, P.O. Box 30772, Nairobi, Kenya. (Offprint requests to Osir.)
The ability of *T. b. brucei* to inhibit trypsin or trypsin-like enzymes in crude midgut homogenates of *G. m.*

morsitans was studied *in vitro*. The isolated parasites caused a concentration-dependent decrease in midgut trypsin activity. Furthermore, trypanosomes lysed by repeated freeze-thawing had a similar effect on trypsin activity. In both cases, the inhibition by either intact or lysed parasites was partial as revealed by Dixon plots. Similarly, trypanosome membrane proteins stoichiometrically inhibited trypsin activity, suggesting that the enzyme interacts specifically with a moiety on the parasite surface. The K_m and K_i values obtained in this case were 35 μM and 0.18 mg/ml, respectively. These results suggest that one of the ways in which trypanosomes overcome the hostile tsetse fly midgut barrier involves the inhibition of enzyme activity.

7514 **Mihok, S., Munyoki, E., Brett, R.A., Jonyo, J.F., Röttcher, D., Majiwa, P.A.O., Kang'Ethe, E.K., Kaburia, H.F.A. and Zweygarth, E., 1992**. Trypanosomiasis and the conservation of black rhinoceros (*Diceros bicornis*) at the Ngulia Rhino Sanctuary, Tsavo West National Park, Kenya. *African Journal of Ecology*, **30** (2): 103-115.

ICIPE, P.O. Box 30772, Nairobi, Kenya; ibid.; Kenya Wildlife Service, Nairobi, Kenya; ibid.; P.O. Box 24525, Nairobi, Kenya; ILRAD, P.O. Box 30709, Nairobi, Kenya; Department of Public Health, Pharmacology and Toxicology, University of Nairobi, Kenya; ibid.; KETRI, P.O. Box 362, Kikuyu, Kenya.

Tsetse populations and trypanosome infections were monitored at the Ngulia Rhino Sanctuary to assess the impact of trypanosomiasis on rhinoceros. High densities of *Glossina pallidipes* were found near a permanent spring by the Ngulia escarpment; *G. longipennis* and *G. brevipalpis* were also present in lower numbers. Infection rates in *G. pallidipes* averaged 3.6%, with three times as many *T. vivax* as *T. congolense* infections. *T. simiae* and *T. brucei* were present at low frequency. DNA probes revealed that all mature *T. congolense* infections belonged to the Savanna subgroup. *G. pallidipes* fed on many hosts, with most meals taken from bovids and elephants. Rhino accounted for one of the blood meals in a small sample taken from *G. longipennis*. During a time of low tsetse densities (dry season), we estimated that the wild host population was acquiring seven infections per km^2 per day. At lower levels of challenge, an experimental rhino became infected with *T. congolense*. These results are discussed in terms of future plans for the repopulation of rhino in tsetse-infested areas in Kenya.

7515 **Molyneux, D.H. and Stiles, J.K., 1991**. Trypanosomatid-vector interactions. *Annales de la Société belge de Médecine tropicale*, **71** (Suppl. 1): 151-166.
Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK; ICIPE, P.O. Box 30772, Nairobi, Kenya.
This paper reviews recent studies on *Glossina* lectins in relation to trypanosome behaviour in flies, including recent studies on different *G. palpalis* subspecies, and reviews evidence that trypanosomatids have an effect on their insect hosts, for example on feeding behaviour, susceptibility to insecticides and longevity of infected vectors. The basic mechanisms of attachment observed in all trypanosomatid interactions are described and the presence of molecules associated with attachment identified. The genetic basis of susceptibility is also becoming better understood and it is to be expected that modern molecular techniques when applied to well defined systems can give results which could permit an attempt at intervention; even if this is not achieved, the basic understanding of a widespread phenomenon of the insect/parasite association will have been furthered to permit better epidemiological knowledge.

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

[See also **15**: nos. 7508, 7521.]

7516 **Ngaira, J.M., Olaho-Mukani, W., Omuse, J.K., Tengekyon, K.M., Mbwabi, D., Olado, D. and Njenga, J.N., 1992.** Evaluation of procyclic agglutination trypanosomiasis test (PATT) for the immunodiagnosis of *Trypanosoma brucei rhodesiense* sleeping sickness in Kenya. *Tropical Medicine and Parasitology*, **43** (1): 29-32.
KETRI, Muguga, P.O. Box 362, Kikuyu, Kenya.
Documented sera from 156 patients admitted to Alupe Sleeping Sickness Hospital in western Kenya were tested to determine the potential usefulness of the procyclic agglutination trypanosomiasis test (PATT) for the diagnosis of *T. b. rhodesiense* sleeping sickness. A total of 490 serum samples were tested, including 42 controls. Anti-trypanosome antibodies were detected in 99% of the sera taken prior to trypanocidal drug therapy. Antibody levels remained high during courses of treatment. In cured cases antibodies declined to negative or low levels 4 months to one year after treatment. High antibody levels persisted in patients who relapsed. Although the results showed a high sensitivity and specificity, confirming the potential

usefulness of the test for serodiagnosis of African sleeping sickness, PATT in its present form is unsuitable for routine diagnosis. This is due to difficulties inherent in the use of live trypanosomes as detector antigen.

7517 **Ormerod, W.E., 1991**. Hypothesis: the significance of Winterbottom's sign. *Journal of Tropical Medicine and Hygiene*, **94** (5): 338-340.

Old Rectory, Padworth, Reading RG7 4JD, UK.

Swollen glands in the neck in African sleeping sickness are usually considered to be a sign of peripheral trypanosomiasis without cerebral involvement. Experimental evidence of connection between these glands and the ventricles of the brain is reviewed. The evidence suggests that Winterbottom's sign may also indicate a cerebral infection. It also suggests that trypanosomes may enter the brain via the lymphatic system.

(b) PATHOLOGY AND IMMUNOLOGY

7518 **Dumas, M. and Boa, F.Y., 1988**. Human African trypanosomiasis. *In*: Vinken, P.J., Bruyn, G.W., Klawans, H.L. and Harris, A.A. (eds), *Handbook of clinical neurology, vol. 52, revised series 8, Microbial disease* (Amsterdam, Netherlands; Elsevier Science Publishers B.V.), pp. 339-344.

Institut de Neurologie Tropicale, Faculté de Médecine, Université de Limoges, 2 rue du Dr Marcland, 87025 Limoges Cédex, France.

A general account of *rhodesiense* and *gambiense* trypanosomiasis is given, including pathogenesis and neuropathology, clinical signs, laboratory findings, diagnosis and treatment.

7519 **Tabaraud, F., Hugon, J., Tapie, P., Buguet, A., Lonsdorfer, A., Gati, R., Doua, F. and Dumas, M., 1992**. Study of evoked potentials in human African trypanosomiasis. *Journal of Tropical Medicine and Hygiene*, **95** (4): 246-252.

Tabaraud, Hugon, Tapie, Dumas: Institut d'Epidémiologie Neurologique et de Neurologie Tropicale, Faculté de Médecine, Université de Limoges, 2 rue du Dr Marcland, 87025 Limoges Cédex, France; Buguet, Gati: Centre de Recherche du Service de Santé des Armées, Unité de Physiologie de la Vigilance, B.P. 87, 38702 La Tronche Cédex, France; Lonsdorfer: Service de Physiologie, Faculté de Médecine, 67085 Strasbourg, France; Doua: PRCT, B.P. 1425, Daloa, Côte d'Ivoire.

Human African trypanosomiasis or sleeping sickness has a stage of neurological involvement characterised by

the onset of diffuse meningoencephalitis with sleep disturbances and decreased wakefulness. The pathogenesis of this disease is not well understood. We studied auditory, visual, sensory and motor evoked potentials in 16 patients with trypanosomiasis in the early stage of meningoencephalitis. In all patients, the brain-stem auditory evoked response (BAER) and the pattern-reversal visual evoked response (PVER) were normal. On the other hand, abnormalities of the somatosensory evoked response (SSER) or the motor evoked response (MER) were found in only five cases; however, their relationship to the illness could not be definitely confirmed. The study results indicate that the evaluated pathways were essentially intact, in particular at the level of the brain-stem in the early stage of the disease. Sleep disturbances and decreased wakefulness noted at this stage were thus linked more closely to functional involvement at the level of the sleep centres than to any detectable specific anatomic lesion.

(c) TREATMENT

[See also **15**: no. 7571.]

7520 **Hamon, J.F. and Camara, P., 1991**. Etude électroencéphalographique de la méningoencéphalite à *Tripanosoma gambiense* avant et après traitement au mélarsoprol. [Electroencephalographic study of meningoencephalitis during *gambiense* trypanosomiasis before and after melarsoprol treatment.] *Neurophysiologie clinique*, **21** (3): 173-181.

Laboratoire de Psychologie Expérimentale, Faculté des Lettres et des Sciences Humaines, 93 boulevard Edouard-Herriot, B.P. 369, 06007 Nice Cédex, France; Laboratoire de Physiologie Animale et Psychophysiologie, Faculté des Sciences et des Techniques d'Abidjan, B.P. 582, Abidjan 22, Côte d'Ivoire.

The purpose of the study was to assess the long-term effects of melarsoprol on awakening electroencephalogram (EEG) in 18 patients at the meningo-encephalic stage of human African *gambiense* trypanosomiasis. Electroencephalographic data were taken prior to and then 1 and 3 months after therapy. Before treatment EEG tracings showed important abnormalities (delta bursts organised in a more or less periodic fashion); 1 and 3 months after treatment a clear improvement was observed in 10 patients; however, it was unusual for the EEG to return completely to the

normal pattern and a case of relapse was noted 3 months after the end of therapy. As indicated by persistence of the EEG abnormalities, several patients were unresponsive and one of them reacted negatively to melarsoprol. The use of regular EEG investigations as a means of long-term supervision of patients with trypanosomiasis is discussed.

7521 **Pépin, J., Ethier, L., Kazadi, C., Milord, F. and Ryder, R., 1992**. The impact of human immunodeficiency virus infection on the epidemiology and treatment of *Trypanosoma brucei gambiense* sleeping sickness in Nioki, Zaire. *American Journal of Tropical Medicine and Hygiene*, **47** (2): 133-140.

Pépin, Ethier, Milord: Infectious Diseases Section, Centre Hospitalier Universitaire, 3001 12ème Avenue Nord, Sherbrooke, Quebec J1H 5N4, Canada; Kazadi: Projet SIDA, c/o U.S. Embassy, B.P. 8502, Kinshasa, Zaire; Ryder: Department of Community Medicine, Mount Sinai Medical Center, New York, NY 10029-6574, USA.

To determine if there is an association between human immunodeficiency virus type 1 (HIV-1) infection and *T. b. gambiense* sleeping sickness, all incident cases of trypanosomiasis and a control group of blood donors presenting to the same rural hospital in Zaire were tested for anti-human immunodeficiency virus type 1 (anti-HIV-1) antibodies. There was no significant difference in the prevalence of HIV-1 infection between the two groups (7 of 220 or 3.2% for the incident cases and 8 of 388 or 2.1% for the blood donors; $P = 0.56$). Among the three HIV-1 seropositive incident cases of trypanosomiasis treated with difluoromethylornithine, two (67%) relapsed after treatment compared with four of 39 (10%) HIV-1 seronegative incident cases treated with the same drug ($P = 0.05$). These findings suggest that, at the present time, HIV-1 infection is not having a significant impact on the incidence of *T. b. gambiense* sleeping sickness in rural Zaire, but the possibility that incident cases of trypanosomiasis concurrently infected with HIV-1 may be at a higher risk of treatment failure warrants further investigation.

7522 **Pépin, J., Milord, F., Meurice, F., Ethier, L., Loko, L. and Mpia, B., 1992**. High-dose nifurtimox for arseno-resistant *Trypanosoma brucei gambiense* sleeping sickness: an open trial in central Zaire. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **86** (3): 254-256.

Pépin, Milord, Ethier: Infectious Diseases Section, Centre Hospitalier Universitaire, 3001 12ème Avenue Nord, Sherbrooke, Quebec J1H 5N4 Canada; Milord,

Ethier, Loko, Mpia: Zone de Santé Rurale de Nioki, Nioki, Zaire; Meurice: Hôpital de Mushie, Mushie, Zaire.
Thirty patients with arseno-resistant *T. b. gambiense* sleeping sickness were treated with high-dose nifurtimox (30 mg/kg/day for 30 days). During treatment, the CSF white blood cell (WBC) count decreased in all patients except one (mean CSF WBC count before nifurtimox: 117/mm^3; after nifurtimox: 25/mm^3), and trypanosomes disappeared from the CSF of all nine patients in whom parasites had been demonstrated before nifurtimox. Among 25 patients seen at least once after treatment, nine (36%) have relapsed so far. High-dose nifurtimox was significantly toxic: one patient died during treatment and eight others developed adverse neurological effects. High-dose nifurtimox seems more effective than the previously used regimen (15 mg/kg/day for 60 days), but at the expense of significant toxicity.

7523 **Wery, M., 1991**. Therapy for African trypanosomiasis. *Current Opinion in Infectious Diseases*, **4** (6): 838-834.
Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp 1, Belgium.
The main problem in the treatment of human African trypanosomiasis remains the toxicity of the universal and effective drug melarsoprol (4-8% lethality during treatment). Other drugs do not penetrate the CNS, where the trypanosomes migrate very early in the infection before any inflammatory signs appear in the CSF. DL-α-difluoromethylornithine provides an efficient and safe alternative for *Trypanosoma brucei gambiense* infection, while *T. b. rhodesiense* is more resistant. Moreover, the administration scheme is spread over 5 weeks including 14 days of i.v. injections. Nifurtimox taken orally for 1 or 2 months has a marked effect on *T. b. gambiense* infection. Too frequent relapses are observed in some trials. Imidazoles, new arsenicals and antimitotics were successfully tested in experimental models. Combinations of drugs with additive or potentiating effects mainly based on decarboxylase enzymes or methylating molecules seem promising.

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

[See also **15**: nos. 7536, 7550.]

7524 **Akinpelu, R.O. and Oyejide, A., 1990**. Comparison of the buffy coat parasitological method and the enzyme-linked

immunosorbent assay (ELISA) for the diagnosis of trypanosomiasis in N'Dama cattle. *Tropical Veterinarian*, **8** (1-2): 113-119.
Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria.
The prevalence of species-specific trypanosome infection in 40 ranch-reared N'Dama cattle was determined using the buffy coat, dark ground (DG) parasitological technique and the enzyme-linked immunosorbent assay (ELISA) for antibodies. By the DG technique, there were five positive cases (12.5%) made up of two of *Trypanosoma congolense* alone and three of *T. congolense* mixed with *T. brucei*. *T. vivax* was not detected. By the ELISA technique, there were 33 positive cases (82.5%) made up of 13 single infections (11 of *T. congolense*, two of *T. vivax* and one of *T. brucei*). Also included among the 33 cases were 19 mixed infections including 11 of *T. congolense* and *T. brucei*, two of *T. congolense* and *T. vivax*, one of *T. brucei* and *T. vivax* and five of all three organisms. ELISA detected all the five cases which were positive by DG, for a relative sensitivity of 100%.

7525 **Nantulya, V.M., Lindqvist, K.J. and Stevenson, P., 1990**. Towards improved diagnosis of African trypanosomiasis. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), 310-312.
ILRAD, P.O. Box 30709, Nairobi, Kenya; ibid.; KETRI, P.O. Box 382, Kikuyu, Kenya.
Simple antigen-trapping enzyme immunoassays for the detection of circulating trypanosome antigens in the blood of infected animals have been developed as a means of diagnosis. The assays are based on monoclonal antibodies against trypanosome internal antigens which are specific for *Trypanosoma vivax*, *T. congolense* and *T. brucei/T. evansi*. Preliminary results show the sensitivity of the antigen-trapping ELISA for diagnosis of *T. evansi* infections in camels to be around 92%; in addition the assay detected a significant proportion (55%) of infections which could not be detected by parasitological methods. For bovine trypanosomiasis, the method had a sensitivity of 96% and a significant number (52.6%) of parasitologically-negative animals were found to be infected.

7526 **Nantulya, V.M., Lindqvist, K.J., Stevenson, P. and Mwangi, E.K., 1992**. Application of a monoclonal antibody-based antgen detection enzyme-linked immunosorbent assay (antigen ELISA) for field diagnosis of bovine

trypanosomiasis at Nguruman, Kenya. *Annals of Tropical Medicine and Parasitology*, **86** (3): 225-230.
ILRAD, P.O. Box 30709, Nairobi, Kenya; ibid.; KETRI, P.O. Box 362, Kikuyu, Kenya; ibid.
A monoclonal antibody-based, enzyme immunoassay (antigen ELISA) for the detection of species-specific invariant antigens of *Trypanosoma congolense*, *T. vivax* or *T. brucei* in the serum of infected animals was evaluated as a means of diagnosis using bovine field sera from a trypanosomiasis endemic area, Nguruman, Kenya. Circulating trypanosome antigens were detected in 126 (96.2%) of 131 serum samples from animals with parasitologically confirmed diagnosis: 74.8% were positive for antigens of two or three trypanosome species, while 21.4% tested positive for one trypanosome species. When 70 sera from animals (at Nguruman), which had tested negative for trypanosomes by the buffy coat technique, were tested, 35 (50.0%) of them were shown to be antigen-ELISA positive: 24 (34.3%) showed infection with a single species and 11 (15.7%) with mixed infections. The predominant trypanosome species diagnosed in the two herds by antigen ELISA was *T. vivax*, which was detected in 133 (82.6%) of the 161 sera that tested positive for antigens, followed by *T. congolense* in 122 (75.8%) sera, with 109 (67.7%) showing evidence of mixed infections with two or three trypanosome species. In single infections, *T. vivax* exceeded *T. congolense* by a ratio of 2:1, with *T. brucei* accounting for less than 1.0%. Evidence for the specificity of the test was provided by analysis of field sera from 100 cattle, from a trypanosomiasis-free area, infected with other haemoparasites (anaplasmosis, babesiosis and theileriosis), which all tested negative in the assay.
7527 **Rooij, R.C. de and Wood, A.P., 1990**. `Who foots the bill?': towards sustainable cattle development in western Zambia. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 386-391.
RDP Livestock Services, P.O. Box 523, 3700 AM Zeist, Netherlands; Department of Geographical Sciences, The Polytechnic, Queensgate, Huddersfield HD1 3DH, UK.
Initiatives for sustainable livestock services in the Western Province of Zambia include efforts to improve the efficiency of use of veterinary medicine. This has involved assessing the prevalence of diseases and drafting control policies. An initial detailed trypanosomiasis prevalence survey with annual follow-up surveys have outlined areas requiring different

intensities of trypanocidal drug administration. The economic practicability of tsetse control using odour bait technology is also being assessed.

7528 **Smith, O.B., Bosman, H.G., Ademosun, A.A. and Chiboka, O., 1990**. Impact of disease on productivity of the West African dwarf goat. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 180-187.
Department of Animal Science, Obafemi Awulowo University, Ile-Ife, Nigeria.
Trypanosoma vivax and *T. congolense* are listed among the parasitic infections recorded from the West African dwarf goat. There is no evidence of associated disease conditions and it is concluded that trypanosomiasis does not constitute a major health problem for West African dwarf goats.

(b) PATHOLOGY AND IMMUNOLOGY

7529 **Abebe, G. and Eley, R.M., 1992**. Trypanosome-induced hypothyroidism in cattle. *British Veterinary Journal*, **148** (1): 63-70.
Faculty of Veterinary Medicine, Addis Ababa University, P.O. Box 34, Debre Zeit, Ethiopia; Institute of Primate Research, National Museums of Kenya, P.O. Box 24481, Nairobi, Kenya.
Three Boran (*Bos indicus*) cattle infected with *Trypanosoma congolense* IL 1180, and two uninfected control Boran cattle, were used to study the effect of trypanosomiasis on the function of the thyroid gland. On a weekly basis, plasma thyroxine (T4) was measured by ^{125}I-radioimmunoassay. Results indicated that *T. congolense* caused a significant decline in plasma T4 concentration in infected animals.

7530 **Abebe, G. and Eley, R.M., 1992**. Hypothalamic-pituitary-adrenal axis responsiveness to insulin-induced hypoglycaemia is modified by trypanosome infection in Boran (*Bos indicus*) cattle. *Research in Veterinary Science*, **53** (1): 68-73.
Faculty of Veterinary Medicine, Addis Ababa University, P.O. Box 34, Debre Zeit, Ethiopia; Institute of Primate Research, National Museums of Kenya, P.O. Box 24481, Nairobi, Kenya.
Ten Boran (*Bos indicus*) cattle were used to study the stress responsiveness of the hypothalamic-pituitary-adrenal (HPA) axis during trypanosome infection. Five cattle were infected with *Trypanosoma congolense* IL 1180 by tsetse challenge and five cattle served as controls. All infected animals developed acute trypanosomiasis. Insulin-induced hypoglycaemia (50% of pre-insulin

glucose concentration) was used as a stress factor. Acute hypoglycaemia was observed in three infected and three control animals after insulin challenge. Two animals from each group either did not respond or responded slowly. Hypoglycaemia in infected animals completely failed to induce an HPA axis response, while in control animals an HPA axis response was indicated by a significant increase in plasma adrenocorticotrophic hormone (ACTH) and cortisol concentrations ($P < 0.01$). The results show that trypanosomiasis in Boran cattle can cause a decrease in the stress responsiveness of the HPA axis as indicated by a blunted ACTH/cortisol response to insulin-induced hypoglycaemia.

7531 **Ademosun, A.A., 1990**. Achievements, difficulties and future prospects in small ruminant development in the tropics. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 39-46.
Department of Animal Science, Obafemi Awulowo University, Ile-Ife, Nigeria.
Trypanosomiasis, not previously considered to be a serious disease of small ruminants (sheep and goats), has been found to limit their productivity in some parts of West, Central and East Africa. The disease usually occurs in animals under stress.

7532 **Clausen, P.-H., Sidibé, I., Bassinga, A., Richard, X., Bauer, B. and Pohlit, H., 1990**. Susceptibility to African trypanosomiasis of West African shorthorn (Baoulé) and Zebu cattle in Burkina Faso: a comparative study. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 318-320.
CRTA, B.P. 753, Bobo-Dioulasso, Burkina Faso.
In 1987 a comparative study on the responses of Baoulé and Zebu cattle to trypanosomiasis challenge was carried out in an area 50 km north-east of Bobo-Dioulasso. Tsetse challenge was assessed monthly using biconical traps: most flies were *Glossina palpalis gambiensis* with a few *G. morsitans submorsitans* and *G. tachinoides*, and trypanosome infection rates varied from 0-40%. Nineteen of 20 Zebu and 15 of 17 Baoulé which had been reared in a fly-proof stable required treatment. Most of the Baoulé reared in a trypanosomiasis-infested area showed only mild clinical symptoms and only five (15%) required treatment. Parasitological findings, changes in PCV and immune responses showed that Baoulé cattle are superior to Zebus in their ability to control parasitaemia and anaemia. Previous exposure to tsetse challenge had a significant positive effect on this

potential. The drop in PCV levels during the first 7 weeks of parasitaemia under high natural fly challenge in Baoulé cattle with field pre-exposure could be used as a marker for trypanotolerance.

7533 **Esievo, K.A.N. and Saror, D.I., 1991**. Immunochemistry and immuno-pathology of animal trypanosomiasis. *Protozoological Abstracts*, **15** (7): 337-349. (Also *Veterinary Bulletin*, **61** (8): 765-777.)

Department of Veterinary Pathology and Microbiology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria.

The immunochemical causes and the immunopathological effects of the anaemia and immunosuppression during animal trypanosomiasis are reviewed in relation to the antigenic variation that characterises the pathogenic African trypanosomes. Emphasis is given to erythrophagocytosis and the reduction of erythrocyte life-span due to the effects of surface sialic (neuraminic) acid on the red cells and the trypanosomes, and the production of sialidase (neuraminidase) by trypanosomes. It is suggested that an anti-neuraminidase agent or serum may be beneficial in the control of the disease.

7534 **Flynn, J.N., Sileghem, M. and Williams, D.J.L., 1992**. Parasite-specific T-cell responses of trypanotolerant and trypanosusceptible cattle during infection with *Trypanosoma congolense*. *Immunology*, **75** (4): 639-645.

ILRAD, P.O. Box 30709, Nairobi, Kenya.

During primary tsetse-transmitted challenge of Boran (*Bos indicus*) cattle with *T. congolense* ILNat 3.1, a transient parasite antigen-specific T-cell proliferative response was observed in peripheral blood mononuclear cells and splenic mononuclear cells stimulated *in vitro*. A response was also observed with cells of N'Dama (*Bos taurus*) cattle, but in this case higher stimulation indices were observed and the response was maintained until the termination of the experiment at 40 days p.i. The highest parasite antigen-specific proliferative responses were observed at 20 days p.i. At this time N'Dama cattle not only responded to the antigens derived from the infecting clone (ILNat 3.1), but also to antigens from a clone of a different serodeme (ILNaR 2), whereas Boran cattle only recognised antigens from the infecting clone of parasites. To determine the molecular mass of the antigenic trypanosome proteins, whole trypanosome lysates made from *T. congolense* ILNat 3.1 were fractionated by SDS-PAGE and transferred onto

nitrocellulose membranes. The major protein bands were isolated and used directly in T-cell proliferation assays. In this instance, no differences in the antigen recognition profiles of Boran and N'Dama cattle were observed. The variable surface glycoprotein did not induce T-cell proliferation in infected cattle despite the presence of serum antibodies to this variable antigenic type.

7535 **Katunguka-Rwakishaya, E., Murray, M. and Holmes, P.H., 1992**. Pathophysiology of ovine trypanosomiasis: ferrokinetics and erythro-cyte survival studies. *Research in Veterinary Science*, **53** (1): 80-86.

University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.

The haematological changes, erythrokinetics and ferrokinetics of sheep were investigated after infection with *Trypanosoma congolense*. Following the detection of parasites in blood, the infected sheep developed macrocytic hypochromic anaemia. Studies with ^{51}Cr-red cells, ^{125}I-albumin and ^{59}Fe as ferric citrate 11 weeks after infection revealed that infected sheep had significantly lower mean circulating red cell volumes but higher plasma and blood volumes than control sheep. The infected sheep also had enhanced erythropoietic activity as judged by significantly higher plasma iron turnover rates, faster disappearance of radio-labelled iron and higher iron incorporation rates than control sheep. The rate of disappearance of ^{51}Cr-labelled red cells was greater in infected than in control sheep. It was concluded that the anaemia observed at this stage of infection was due to an increased rate of removal of red cells from the circulation coupled with haemodilution, with no evidence of dyshaemopoiesis.

7536 **Leeuw, P.N. de, 1990**. Interactive effects of environment, management and mortality on cattle productivity in livestock systems in sub-Saharan Africa. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 29-38.

ILCA, P.O. Box 46847, Nairobi, Kenya.

Examples of agro-pastoralists are drawn from Mali, Nigeria and The Gambia in West Africa and Ethiopia and Kenya in East Africa. In five locations Zebu cattle are kept; the N'Dama breed predominates in The Gambia. There is no trypanosomiasis risk in the Mali and Ethiopia locations and at the Kenyan site the risk is low to medium enabling the Zebus to survive without treatment. The locations in The Gambia and Nigeria were considered risky in the past but due to increased

human population pressure the tsetse challenge has been much reduced. Productivity data are compared with ranching systems in Zaire (N'Dama), Botswana (Sanga), Ethiopia, Tanzania and Kenya (all Boran Zebu). The level of trypanosomiasis has no effect on N'Dama productivity, lower calving rates being offset by lower mortality of cows and calves.

7537 **Ndung'u, J.M., McEwan, N.A., Jennings, F.W. and Murray, M., 1991**. Cardiac damage in dogs infected with *Trypanosoma brucei*: clinical and electrocardiographic features. *Journal of Small Animal Practice*, **32** (11): 579-584.

KETRI, Muguga, P.O. Box 362, Kikuyu, Kenya; Departments of Veterinary Medicine (McEwan, Murray) and Parasitology (Jennings), University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.

Intravenous infection of dogs with *T. brucei* resulted in an acute disease syndrome, characterised by fever, intense parasitaemia, severe anaemia and rapid weight loss. During the course of infection, evidence of severe cardiac abnormalities developed. Tachycardia and tachypnoea occurred soon after detection of parasitaemia, around day 6, progressing to severe bradycardia and dyspnoea in terminal stages of the disease in week 4. Murmurs of mitral and tricuspid incompetence were heard from day 12 by auscultation of the thoracic cavity. Electrocardiography revealed abnormalities in generation and conduction of electrical impulses, including sinus arrest and atrioventricular blocks, and accumulation of pericardial effusion in terminal stages. Effective treatment with the trypanocidal drug suramin resulted in rapid improvement of one of the dogs. When treatment was unsuccessful, however, chronic myocardial damage developed, with intramyocardial conduction defects, including S-T segment and T wave changes, and ventricular escape beats. These abnormalities were similar to those reported for human African trypanosomiasis.

7538 **Ogwu, D. and Njoku, C.O., 1991**. Genital lesions in experimental *Trypanosoma congolense* infection in heifers. *Animal Reproduction Science*, **26** (1-2): 1-11.

Department of Veterinary Surgery and Medicine (Ogwu) and Veterinary Pathology and Microbiology (Njoku), Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria.

A group of normocyclic heifers experimentally infected with *T. congolense* (strain 2295) became anoestrous within 50 days of infection. This followed a dramatic loss of

body condition which characterised the onset of parasitaemia, pyrexia and anaemia. Grossly, the ovaries of the infected heifers were atrophic and weighed significantly less than those of the controls ($P < 0.05$). Histopathological sections revealed multiple follicular cystic degeneration and a complete absence of corpora lutea. In the uterus, there was massive endometrial mononuclear cell infiltration, glandular atrophy, periglandular cell infiltration, myometrial atrophy and fibroplasia. There was cellular infiltration into the cervix which had non-secretory desquamated mucosa. The vaginal lesions were characterised by mononuclear cell infiltration and necrosis. The severity of the lesions was directly related to the duration of infection.

7539 **Ogwu, D., Njoku, C.O. and Ogbogu, V.C., 1992**. Adrenal and thyroid dysfunctions in experimental *Trypanosoma congolense* infection in cattle. *Veterinary Parasitology*, **42** (1-2): 15-26.

Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria.

Severe pathological changes were observed in the adrenal and thyroid glands of Zebu (*Bos indicus*) heifers infected with *T. congolense*. In the adrenal glands, severe inflammatory changes characterised by mononuclear cellular infiltration in the subcapsular areas, zona glomerulosa, zona fasciculata and zona reticularis were observed. In addition, there were hyperaemia, haemorrhage and hyperplasia resulting in increased adrenal weight in the two heifers slaughtered on days 50 and 70 p.i. In the medullary areas of these two heifers, there was only mononuclear cellular infiltration. In the two heifers slaughtered on day 113, localised mononuclear cellular infiltration was observed in addition to cortical cell depletion and fibrosis, resulting in reduced adrenal weight when compared with the controls. In the thyroid glands of the infected heifers, gross enlargement of the follicles filled with pale staining colloids was observed in association with squamous metaplasia of the follicular epithelium and fibroplasia. Serum cortisol concentrations showed an appreciable but non-significant increase between weeks 2 and 6 p.i. in the infected heifers (5.6 □ 0.86 ng ml^{-1} *v.* 4.4 □ 0.34 ng ml^{-1})when compared with the uninfected controls or the pre-infection level. Thereafter, cortisol levels declined though non-significantly throughout the rest of the study. However, there was a steady increase

towards normal levels from week 12 p.i. until the end of the experiment. Changes in the basal serum concentrations of thyroxine (T4) were also measured weekly. There was a progressive decrease in the levels of T4 from the third until the 11th week p.i., when the decrease became significant ($P < 0.05$) and remained so until the 16th week when the experiment ended.

7540 **Omeke, B.C.O. and Onuora, G.I., 1992**. Comparative effects of *Trypanosoma brucei brucei* and *Trypanosoma congolense* on the reproductive capacity of boars in tsetse-endemic zone. *Animal Reproduction Science*, **27** (2-3): 225-237.

Department of Veterinary Physiology and Pharmacology, University of Nigeria, Nsukka, Nigeria.

A comparative study of degrees of parasitaemia, localisation, lesions and effect on sperm quality of pigs experimentally infected with pathogenic *T. b. brucei* and *T. congolense* was made. Fifteen crossbred (Landrace ∃ Large White) boars aged between 12 and 15 months were used. They were divided into three groups of five animals each and slaughtered on two occasions according to the spermatogenic cycle of the boar. Clinically, the disease course could be divided into prepatent phase, lasting 4 and 7 days for boars infected with *T. b. brucei* and *T. congolense*, respectively, acute phase from 9 to 15 days, and chronic phase. Similar clinical symptoms included fluctuating pyrexia (37.6-41.6□C) and parasitaemia (log 5.4-7.8) and severe genital lesions. Trypanosomes were found in the genital tract, soft organs and the brain of infected boars. *T. b. brucei* was present more in organs, particularly in the genital tract, than *T. congolense*, and caused more severe lesions resulting in the degeneration of testes which involved the Leydig cells, basement membrane, Sertoli and germ cells, with loss of libido. Significant differences existed between *T. b. brucei*- and *T. congolense*-infected boars on one hand, and between infected and control boars on the other hand, with regard to gonadal and body weights ($P < 0.05$), and sperm reserves ($P < 0.01$) of different sections of the genital tract. The consequences of trypano-somiasis due to trypanosomes other than *T. simiae* on boar reproductive capacity are discussed.

7541 **Zwart, D., Verstegen, M.W.A., Hel, W. van der, Brouwer, B.O. and Wensing, T., 1990**. Effect of *T. vivax* infection on the energy and nitrogen metabolism of West African dwarf goats. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no 7490), pp. 324-328.

Zwart, Brouwer: Department of Tropical Husbandry, P.O. Box 338, 6700 AK Wageningen, Netherlands; Verstegen,

Hel: Department of Animal Husbandry, P.O. Box 338, 6700 AK Wageningen, Netherlands; Wensing: Department of Large Animal Medicine, Faculty of Veterinary Medicine, P.O. Box 80.163, 3508 TD Utrecht, Netherlands.
Trypanotolerant West African dwarf goats were used to measure the effects of *Trypanosoma vivax* strain Y 486 on energy and nitrogen metabolism and performance. Sixteen goats were i.v. infected and placed, individually caged, in one large indirect calorimeter chamber, with 16 controls in another. The animals were weighed weekly and feed residues, faeces and urine were collected daily for analysis. Rectal temperature and PCV were recorded twice weekly. The results were used to calculate the digestibility and metabolisability of feed intake and the nitrogen and energy balances. An increased serum urea concentration in infected goats indicated an increased breakdown of body proteins, which is supported by differences in creatinine content in the urine of infected and unifected animals. Protein gain was less in infected animals since less nitrogen was ingested and more was excreted. Maintenance requirements increased by approximately 25% after infection and this is associated with a very high energy demand.

(c) TRYPANOTOLERANCE

[See also **15**: no. 7532.]

7542 **Dwinger, R.H., Agyemang, K., Little, D.A., Leperre, P., Jeannin, P., Bah, M.L. and Grieve, A.S., 1990**. Health and production aspects of village based N'Dama cattle in The Gambia. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 169-172.
ITC, P.M.B. 14, Banjul, Gambia.
Monthly measurements of milk production by trypanotolerant N'Dama cattle showed that the average lactation length under village conditions was 375 days with a lactation offtake for human consumption of 437 kg. This production level was achieved by animals weighing an average of only 220 kg and exposed to constant tsetse challenge and a dry season of 7 months. Small amounts of supplementary feed increased productivity. In five of six study areas in The Gambia trypanosomiasis prevalence was low; in the Missira area relatively large numbers of cattle (35% of 220 in 1987 and 15% in 1988) were found to be infected during the last quarter of the year, when it was possible to catch many infected *Glossina morsitans* and *G. palpalis*.

7543 **d'Ieteren, G.D.M., Feron, A., Kakiese, O., Kemp, S., Maille, J.C., Teale, A., Trail, J.C.M. and Yangari, G., 1990**. Aspects of trypanotolerance and their association with performance in N'Dama cattle. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 232-236.
d'Ieteren, Yangari: ILCA, P.O. Box 46847, Nairobi, Kenya; Feron, Kakiese: Compagnie J. van Lancker, B.P. 199, Kinshasa, Zaire; Maille, Trail: OGAPROV, B.P. 25, Moanda, Gabon; Teale: ILRAD, P.O. Box 30709, Nairobi, Kenya.
Trypanotolerance is associated with at least three independent characteristics: the ability to control parasitaemia, to control anaemia and to develop an effective immune response. Every other week a group of 120 N'Dama cattle in Gabon was weighed and their blood analysed for PCV and the presence of trypanosomes using the darkground/phase contrast buffy coat technique. The ranch was in an area of high tsetse challenge and the average trypanosome prevalence in the cattle was 32%. There were no detectable parasitaemias in 16% of the cattle, which grew the fastest. The rest had parasitaemias from 10-80% of the time and showed a linear negative relationship between the length of time they were parasitaemic and growth. There was a very significant relationship between the ability to maintain above-average PCV levels and growth rate and animals that were detected as parasitaemic for up to 35% of the 20 week study period grew at the same rate as non-parasitaemic animals if they were able to maintain their PCV. This ability under high natural challenge could form the basis for practical selection for anaemia control. The ability to acquire resistance also appears to be under genetic control. Two polymorphic systems of bovine lymphocyte antigen, the major histocompatibility complex (MHC) and common leukocyte antigens (CLA), are being studied in the search for genetic markers of trypanotolerance. A study of N'Dama cattle in Zaire revealed a number of significant relationships between MHC and CLA phenotypes and health and performance parameters.

7544 **Teale, A.J., 1990**. Potential approaches in the study of the genetic control of trypanotolerance in cattle. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 321-323.
ILRAD, P.O. Box 30709, Nairobi, Kenya.
Recent studies in the search for markers of bovine trypanotolerance are briefly reviewed. Associations between antigen phenotype and parasitaemia and

productivity are not absolute: trypanotolerance is probably a multigene trait and the associations are not valid for all populations. Technical and theoretical advances have now made the objective of determining the approximate position in the genome of genes controlling aspects of trypanotolerance a realistic target. It is probable that a pan-genome set of DNA probes will shortly become available. A model was used to estimate the size and structure of a study population of animals produced by crossing trypanotolerant N'Dama with trypanosensitive Boran cattle. On this basis F2 progeny will be used for challenge and marker analysis. Their degree of trypanotolerance will be assessed using various parameters and inheritance of markers will be scored and computer searches made for evidence of linkages.

7545 **Trail, J.C.M., d'Ieteren, G.D.M., Viviani, P., Yangari, G. and Nantulya, V.M., 1992.** Relationships between trypanosome infection measured by antigen detection enzyme immunoassays, anaemia and growth in trypanotolerant N'Dama cattle. *Veterinary Parasitology*, **42** (3-4): 213-223. ILCA, P.O. Box 46847, Nairobi, Kenya; ibid.; OGAPROV, Moanda, Gabon; ibid.; ILRAD, P.O. Box 30709, Nairobi, Kenya. (Correspondence to d'Ieteren.)

Relationships were evaluated between trypanosome infection as measured by antigen detection enzyme immunoassays (antigen ELISA), anaemia as determined by average packed red cell volume (PCV), and animal performance as assessed by daily weight gain in 99 N'Dama cattle in Gabon exposed to natural tsetse challenge at 11.5 months of age and recorded 14 times over a 13 week period. Approximately half the animals were found to be infected for an average of five of the 14 times that they were examined: 38% with *Trypanosoma congolense*, 13% with *T. vivax* and 49% with a mixed infection. *T. congolense* infections had significant deleterious effects on animal growth, while *T. vivax* infections did not. Animals found on several occasions to be infected with *T. congolense* had significantly lower PCV values than those demonstrated to be infected on fewer occasions. No relationship was found between mean optical density (OD) values in antigen ELISA and PCV values. Animals capable of maintaining PCV values, even when antigen ELISA positive on a high number of occasions, grew at the same rate as uninfected animals. Animals that could not maintain PCV values when infected had poorer growth. Antigen ELISA has the potential to increase the efficiency of selection of

trypanotolerant N'Dama cattle under tsetse challenge in the field in three main ways: (i) accurate identification of trypanosome species, especially in mixed species infections, clarifies relations between infection, anaemia and animal performance; (ii) detection of animals antigenaemic without patent parasitaemia could allow individuals with superior ability to control trypanosome infection to be identified; (iii) more accurate measurement of the proportion of time an animal is infected allows more accurate evaluation of its anaemia control capability.

(d) TREATMENT

[See also **15**: no. 7527.]

7546 **Ainanshe, O.A., Jennings, F.W. and Holmes, P.H., 1992**. Isolation of drug-resistant strains of *Trypanosoma congolense* from the Lower Shabelle Region of southern Somalia. *Tropical Animal Health and Production*, **24** (2): 65-73. NTTCP, P.O. Box 6956, Mogadishu, Somalia; University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK; ibid. (Reprint requests to Holmes.)

Drug resistance by pathogenic trypanosomes in Somali livestock has been suspected for some time but there have been few attempts to examine this problem in detail. Field isolations from two areas in the Lower Shabelle Region were obtained by injecting blood from trypanosome infected cattle into a recipient calf. Once the calf became parasitaemic it was treated with a standard dose of isometamidium chloride at 0.5 mg/kg. When a subsequent relapse infection developed, indicative of drug resistance, blood was taken and injected into groups of cattle and mice and these were treated with a range of doses of isometamidium chloride and diminazene aceturate to determine the degree of drug resistance. Both isolates showed remarkably high levels of drug resistance to both isometamidium chloride and diminazene aceturate, with minimum curative doses in cattle of > 2.0 mg/kg and 7.5 mg/kg for the two drugs respectively. Minimum curative doses in mice were approximately ten-fold those in cattle. Fortunately there have been very few reports from Africa of such high levels of resistance of *T. congolense* to this normal `sanative pair' of drugs. The results indicate that drug resistance could be an important constraint on the use of trypanocidal drugs to control trypanosomosis in Somalia.

7547 **Gool, F. van, Kassa, B., Ababe, S. and Zelleke, D., 1990**. Efficacy of a novel trypanocide in the treatment of

Trypanosoma evansi infections in camels. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 329-333.
Rhône Mérieux, 4 Chemin du Calquet, 31057 Toulouse, France; Veterinary Services Department, Ministry of Agriculture, Addis Ababa, Ethiopia; ibid.; ibid.
Camels, infected with a field stock of *Trypanosoma evansi* isolated near Gewane, Ethiopia, were cured by treatment with Cymelarsan at 0.3 or 0.6 mg/kg body weight, administered by subcutaneous injection. No trypanosomes were detected, by any of the methods employed, during the 95 day post-treatment observation period. Local reactions were mild and transitory. Further studies and field trials are currently being carried out to determine the minimum curative doses for this and other *T. evansi* field stocks or strains in camels.

7548 **Jibike, G.I. and Anika, S.M., 1991**. Treatment of experimental trypanosomiasis in pigs. *British Veterinary Journal*, **147** (6): 556-564.
Department of Veterinary Physiology and Pharmacology, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria; Department of Veterinary Physiology, Pharmacology and Biochemistry, University of Nigeria, Nsukka, Nigeria.
The therapeutic activity of difluoromethylornithine (DFMO), diminazene aceturate (Berenil) and their combination against chronic trypanosomiasis was investigated in experimental *Trypanosoma brucei brucei* infections of growing pigs. DFMO (300 mg/kg/day orally for 10 days), diminazene aceturate (7 mg/kg in single i.m. injection) and a combination of the two agents at the above dosages produced varied periods of aparasitaemia in the treated pigs. Relapse parasitaemia occurred in all treatment groups, with diminazene aceturate providing the longest relief period of 17 days, combination treatment 11 days and DFMO 6 days. The PCV, blood haemoglobin concentration and red cell count values decreased after the pigs were infected with the parasites. The values improved following treatment with the agents and their combination.

7549 **Joint FAO/WHO Expert Committee on Food Additives, 1990**. *Toxicological evaluation of certain veterinary drug residues in food*.
Prepared by the 34th Meeting of the Joint FAO/WHO Expert Committee on Food Additives (JECFA), held in Geneva, Switzerland, 30 January – 8 February 1989.

Geneva; WHO. (WHO Food Additives Series, no. 25.) 168 pp.
WHO, 1211 Geneva 27, Switzerland.
Safety data on certain veterinary drug residues are summarised, including the trypanocides diminazene aceturate and isometamidium chloride and its contaminant homidium. Biochemical aspects, including the distribution and excretion of the drugs in laboratory animals, and toxicological studies are reviewed. Trypanosome kinetoplast studies suggest an interaction of diminazene with DNA but the relevance to genotoxicity is unknown. Acute diminazene toxicity studies in mice, dogs, cattle and donkeys showed some effects on the CNS. Cerebellar haemorrhage, oedema and hepatotoxic effects were also recorded. There are no acceptable data from humans. Isometamidium is mutagenic in *Salmonella typhimurium* and yeast and causes weak teratogenic and foetotoxic effects in rats. High doses cause excessive salivation and numerous toxic effects involving the CNS, heart, liver and kidneys in rabbits and other test animals. The maximum tolerated i.v. doses in cattle, goats, dogs and camels were 1.5, 0.5, 2.0 and 1.0 mg/kg respectively. There are no adequate studies of effects on humans. It was not possible to establish an ADI (acceptable daily intake) for either of these drugs because of lack of data.

7550 **Klink, E.G.M. van, Rooij, R.C. de and Wiersma, S.H., 1990**. Trypanosomiasis surveillance and control in south-west Zambia. *In*: Kuil, H., Paling, R.W. and Huhn, J.E. (eds), 1990 (see **15**: no. 7490), pp. 313-317.
Department of Veterinary and Tsetse Control Services, P.O. Box 910034, Mongu, Zambia.
Since 1985 trypanosomiasis control in the Western Province of Zambia has been based on regular dosing of cattle with isometamidium chloride every 3 months. Costs and the need for increased efficiency necessitated careful monitoring. The level of trypanosomiasis challenge was determined by blood sampling every tenth animal receiving treatment. The samples were examined by Giemsa staining, any trypanosome species being identified as far as possible and the infection rate expressed as the percentage of animals sampled. It was found that the challenge varied considerably, according to season, grazing management and characteristics of the grazing range. As a result a more strategic approach to control has been adopted. In areas of high challenge four treatments a year, once every 3 months, are carried

out; in areas of moderate to low challenge two or three treatments are carried out between October and May. One treatment per year is with diminazene aceturate, to reduce the possibility of drug resistance.

7551 **Münstermann, S., Mbura, R.J., Maloo, S.H. and Löhr, K.-F., 1992.** Trypanosomiasis control in Boran cattle in Kenya: a comparison between chemoprophylaxis and a parasite detection and intravenous treatment method using isometamidium chloride. *Tropical Animal Health and Production*, **24** (1): 17-27.

Witu Veterinary Laboratory, P.O. Witu/Lamu, Kenya; ibid.; Veterinary Investigation Laboratory, P.O. Box 204, Mariakani, Kenya; ibid.

Two methods of trypanosome control in Boran cattle kept under very high trypanosomiasis risk were compared: the traditional i.m. isometamidium chloride prophylaxis with a parasite detection and i.v. isometamidium chloride treatment method. The results were related to a control group under diminazene aceturate treatment. Isometamidium chloride at 0.25 mg/kg as routinely used by the ranch was of little benefit by either method, with breakthrough infections occurring as early as 1 week after treatment. When isometamidium chloride at 1 mg/kg was used, the curative i.v. method appeared to be superior to the i.m. prophylaxis with regard to cost of drugs and to a 31% higher weight gain over a 30 week period. Weekly infection rates in the i.v. group decreased over time, despite an increasing trypanosomiasis challenge, with a mean interval of 6.4 weeks between treatments as compared with 4.3 weeks in a diminazene aceturate control group. It was concluded that isometamidium chloride given i.v. had not only a very good therapeutic but also a considerable prophylactic effect of not less than 4 weeks.

7552 **Silayo, R.S., Mamman, M., Moloo, S.K., Aliu, Y.O., Gray, M.A. and Peregrine, A.S., 1992.** Response of *Trypanosoma congolense* in goats to single and double treatment with diminazene aceturate. *Research in Veterinary Science*, **53** (1): 98-105.

Silayo: Department of Veterinary Microbiology and Parasitology, Sokoine University of Agriculture, P.O. Box 3019, Morogoro, Tanzania; Mamman, Moloo, Peregrine: ILRAD, P.O. Box 30709, Nairobi, Kenya; Aliu: Department of Physiology and Pharmacology, Faculty of Veterinary Medicine, Ahmadu Bello University, Zaria, Nigeria; Gray: KETRI, P.O. Box 362, Kikuyu, Kenya. (Reprint requests to Peregrine.)

Diminazene aceturate is one of a limited number of compounds currently marketed for treatment of

trypanosomiasis in cattle, sheep and goats. The pharmacokinetics of the compound in goats suggest that double treatment with diminazene aceturate might enhance the compound's therapeutic activity. A study was therefore conducted in goats using two clones of *T. congolense*, IL 3274 and IL 1180, which were previously shown to be resistant and sensitive, respectively, to single treatment with diminazene aceturate. The results indicated that, as compared to single treatment, double treatment with diminazene aceturate at a dose of 7.2 mg kg^{-1} bodyweight, at either 8 or 24 h intervals, did not greatly enhance the therapeutic activity of the drug. Furthermore, treatment with the same drug dose eliminated infections with *T. congolense* IL 3274 when treatment was administered 24 h after infected *Glossina morsitans centralis* had fed, but failed to do so if treatment was delayed until after goats were detected to be parasitaemic. This suggests that failure of *T. congolense* IL 3274 to respond to treatment with diminazene may not be due to drug resistance *per se*.

7. EXPERIMENTAL TRYPANOSOMIASIS

(a) DIAGNOSTICS

7553 **Büscher, P., Draelants, E., Magnus, E., Vervoort, T. and Meirvenne, N. van, 1991**. An experimental latex agglutination test for antibody detection in human African trypanosomiasis. *Annales de la Société belge de Médecine tropicale*, **71** (4): 267-273.

Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp 1, Belgium.

A latex card agglutination test for detection of antibodies in human African trypanosomiasis is presented. The latex was covalently coated with semipurified surface glycoprotein of variable antigen type LiTat 1.6 of *Trypanosoma brucei gambiense*. Sera from 100 patients infected with *T. b. gambiense*, 26 patients infected with *T. b. rhodesiense* and 707 individuals without trypanosomiasis, including 132 malaria seropositives, have been tested. At serum dilution 1:16, sensitivity of the test was 91% for the *T. b. gambiense* and 42.3% for the *T. b. rhodesiense* group. Specificity was over 99%. The reagent remained stable at □ 6□C for at least 3 months. Reagent kept at 37□C for 3 months retained its sensitivity and showed a slight decrease in specificity.

7554 **Olaho-Mukani, W., Munyua, W.K. and Njogu, A.R., 1992**. An enzyme-linked immunosorbent assay (ELISA) for the detection of trypanosomal antigens in goat serum using

a monoclonal antibody. *Journal of Immunoassay*, **13** (2): 217-229.
Olaho-Mukani, Njogu: KETRI, P.O. Box 362, Kikuyu, Kenya; Munyua: Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Kabete, Kenya.
An IgM murine monoclonal antibody (MAb) TEA 1/23.3.4.6 raised against circulating trypanosome antigens was used in a sandwich ELISA to assay trypanosomal antigens in a trypanosome lysate preparation and in sera from goats infected with *Trypanosoma brucei evansi*. As little as 1.25 μg/ml of trypanosomal antigen could be detected by this assay. Following infection, trypanosomal antigens were first detected in goat serum 24 h after the i.v. or 6 days after the i.m. inoculation of trypanosome parasites. Antigen levels remained detectable during the course of infection. After treatment with diminazene aceturate, antigens dropped to undetectable levels between days 12 and 41, suggesting that this assay offers a promising approach to the diagnosis of African trypanosomiasis.

(b) PATHOLOGY AND IMMUNOLOGY

7555 **Ahmad, N., Bansal, S.R., Gupta, S.L., Sharma, R.D. and Sharma, R., 1991**. Suppressed immune response to foot and mouth disease vaccination in guinea pigs experimentally infected with *Trypanosoma evansi*. *Indian Veterinary Journal*, **68** (7): 622-626.
Department of Veterinary Medicine, College of Veterinary Science, Haryana Agricultural University, Hisar 125004, Haryana, India.

7556 **Gillett, M.P.T. and Owen, J.S., 1992**. Comparison of the cytolytic effects *in vitro* on *Trypanosoma brucei brucei* of plasma, high density lipoproteins, and apolipoprotein A-I from hosts both susceptible (cattle and sheep) and resistant (human and baboon) to infection. *Journal of Lipid Research*, **33** (4): 513-523.

Owen: University Department of Medicine, Royal Free Hospital School of Medicine, Rowland Hill Street, London NW3 2PF, UK.

7557 **Horváth, G., Albert, M. and Kemenes, F., 1990**. The pathogenicity of *Trypanosoma equiperdum* to different rodents. III. Susceptibility of the guinea pig (*Cavia porcellus*). *Parasitologia Hungarica*, **23**: 19-26.
Horváth: Department of Parasitology and Zoology, University of Veterinary Science, Landler Jenö utca 2, H-1078 Budapest, Hungary.

7558 **January, B.E., Toth, L.A. and Parker, R.F., 1992**. Pathophysiologic correlates of experimental trypanosomiasis in rabbits. [*T. b. brucei*.] *Laboratory Animal Science*, **41** (6): 585-589.
Department of Comparative Medicine, University of Tennessee, Memphis, TN 38163, USA.

7559 **Kaushik, R.S. and Gupta, S.L., 1991**. Non-specific immunization studies in pups challenged with *Trypanosoma evansi*. *Indian Veterinary Journal*, **68** (9): 889-891.
Department of Veterinary Medicine, College of Veterinary Science, Haryana Agricultural University, Hisar 125004, Haryana, India.

7560 **Olubayo, R.O. and Brun, R., 1992**. The influence of buffalo and bovine serum on transformation of *Trypanosoma congolense* from metacyclic forms to bloodstream forms *in vitro*. *Tropical Medicine and Parasitology*, **43** (2): 102-105.
KARI, Veterinary Research Centre, P.O. Box 274, Uthiru, Nairobi, Kenya; Swiss Tropical Institute, Basel, Switzerland.

7561 **Soudan, B., Tetaert, D., Racadot, A., Degand, P. and Boersma, A., 1992**. Decrease of testosterone level during an experimental African trypanosomiasis: involvement of a testicular LH receptor desensitization. [*T. b. brucei*; rats.] *Acta Endocrinologica*, **127** (1): 86-92.
Boersma: Unité INSERM no. 16, Place de Verdun, F-59045 Lille Cédex, France.

7562 **Takayanagi, T., Kawaguchi, H., Yabu, Y., Itoh, M. and Yano, K., 1992**. Diversity of complement-mediated immune reaction to *Trypanosoma gambiense*. [Rabbits.] *Southeast Asian Journal of Tropical Medicine and Public Health*, **23** (1): 87-91.
Department of Medical Zoology, Medical School, Nagoya City University, Mizuho-ku, Nagoya City 467, Japan, and Institute of Microbial Diseases, Osaka University, Yamadaoka, Suita City, Osaka 565, Japan.

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