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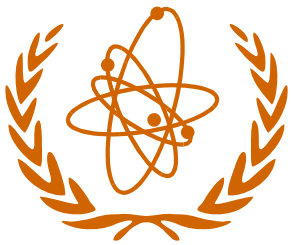

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section b — abstracts
1. general (including land use)

8450 **African Trypanotolerant Livestock Network, 1994.** *Research on livestock production under trypanosomiasis risk: a year of progress and transition. Annual scientific report 1993.* Nairobi; ILCA. 38 pp. ILCA, P.O. Box 46847, Nairobi, Kenya.

The African Trypanotolerant Livestock Network coordinates extensive collaboration between ILCA, ILRAD, national and regional centres in several sub-Saharan African countries, and institutions elsewhere. Research has been carried out on the epidemiology of trypanosome resistance to trypanocidal drugs and on factors affecting estimates of tsetse challenge and trypanosomiasis risk and susceptibility to trypanosomiasis in N'Dama cattle and sheep. The effects of trypanosomiasis on animal health and performance, and criteria of trypanotolerance and their link with performance have also been investigated. Special studies have been made of the effect of trypanosomiasis on the resumption of post-partum ovarian function in East African Zebu cattle, and of the differential susceptibility to trypanosomiasis of Orma and improved Kenya Boran cattle. The genetics of trypanotolerance have been studied in N'Dama and Zebu cattle and Djallonke sheep and a practical genetic improvement programme has been developed for N'Dama cattle. Other studies include the socio-economic evaluation and environmental impact assessment of alternative trypanosomiasis control measures, including opportunities for local participation in tsetse control. This report provides an overview of the work carried out in 1993 and a list of publications is appended.

8451 **Barrett, J.C., 1994.** *Economic issues in trypanosomiasis control: case studies from southern Africa.* Ph.D. thesis, University of Reading, UK. (Unpublished thesis.) xiii + 486 pp. NRI, Central Avenue, Chatham Maritime, Chatham, Kent ME4 4TB, UK.

Case studies, mainly in Zimbabwe but also in Zambia, investigated economic aspects of controlling savanna species of the tsetse fly, which is the vector of bovine trypanosomiasis in southern Africa. Costs for the four major techniques for tsetse control, each of which has been used on a large scale in the recent past, were analysed on a comparative basis. The costs of using odour-baited insecticide-treated targets compared well with traditional ground spraying using DDT, which is increasingly disfavoured on environmental

grounds. The cheapest method of tsetse control is to treat cattle with appropriate insecticides. There are many situations where this is not feasible, for lack of cattle, but the approach is generally very promising and needs urgent technical development. Although aerial spraying is likely to be the preferred method for tsetse control in some specific situations, it is the most expensive of the four techniques which were evaluated. A case study showed that the policy of the Government of Zimbabwe was justified in relying upon tsetse control rather than the use of trypanocides. However, the comparative advantage is variable according to specific circumstances. A methodology for cost comparison has been developed and demonstrated, based upon simple economic models usable by planners without formal economics training. The second area of investigation concerned the alleged inappropriateness of tsetse control in the Zambezi Valley. A multidisciplinary case study sought and examined evidence of environmental degradation associated with sustained smallholder mixed farming in areas cleared of tsetse. A rapid appraisal methodology was developed for the study, which led to the conclusion that, in the area of the case study, it is inappropriate to argue against tsetse control on the grounds that the ecology of the area is inherently unsuited to agriculture. However, evidence is presented to argue that land use issues must be addressed in close coordination with tsetse control programmes, in order to promote sustainable land use. There is a key role for the economics profession in assisting to ensure that coordination is effective and appropriate.

8452 **Food and Agriculture Organization of the United Nations, 1994.** *The development of a systematic approach to tsetse and trypanosomiasis control*. (Report of the Meeting of the FAO Panels of Experts on Ecological, Technical and Development Aspects of the Programme for the Control of African Animal Trypanosomiasis and Related Development, Rome, 1-3 December 1993.) Rome; FAO. 19 pp.

FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

Tsetse and trypanosomiasis control is now considered to be technically feasible following the introduction of relatively simple and environmentally acceptable attractant techniques for vector control. The collection and analysis of data, the significance of tsetse to area development, the influence of tsetse control on resource utilisation, and technical issues such as programme coordination, sustainability of

control and training are considered. It is stressed that trypanosomiasis control is a single element within the overall objective of sustainable agricultural production: expertise should be exploited at multidisciplinary level and a comprehensive database should be established. The role of expanding human populations in fragmenting tsetse infestations must be taken into account when planning control interventions. It is recommended that livestock owners should be made aware of the availability of modern vector control techniques and governments should be made aware of the problems associated with chemotherapy. FAO should assume global responsibility for the overall coordination of control programmes, with the creation of specialist working groups to update progress. Viable, cost-effective, socially acceptable and sustainable control systems must be developed, with long-term environmental monitoring.

8453 **Itty, P., 1992.** *Economics of village cattle production in tsetse affected areas of Africa: a study of trypanosomiasis control using trypanotolerant cattle and chemotherapy in Ethiopia, Kenya, Côte d'Ivoire, The Gambia, Zaire and Togo.* Konstanz, Germany; Hartung-Gorre Verlag. (Thesis, Swiss Federal Institute of Technology, Zürich.) 316 pp. + appendices.

Department of Agricultural Economics, Swiss Federal Institute of Technology, ETH Zentrum, CH-8092 Zürich, Switzerland.

Cost-benefit analyses were carried out and projected for a 10 year period using a herd model. In Ethiopia and Kenya, trypanosusceptible East African Zebu are produced using trypanocidal drugs but profitability is not sustainable due to high risks of drug resistance. At Ghibe in Ethiopia, vector control was considered to be more profitable than drug use. Traditional use of trypanotolerant cattle was studied at Keneba and Gunjur in The Gambia and Boundiali in Côte d'Ivoire, where socio-economic considerations were found to be important constraints on profitability. Imported trypanotolerant cattle were studied in Togo and Zaire: profits were much higher in Zaire due to differences in the métayage (lease) system, local production alternatives and labour availability. Control methods were divided into those requiring heavy initial capital investment (aerial and ground spraying, SIT, importation of trypanotolerant livestock) and those with recurrent expenditure (traps and screens, deltamethrin treatment of cattle, drugs and locally available trypanotolerant stock), which are less risky

and more flexible. Because of trypanosome resistance, drugs should be used more for strategic purposes and in integrated control. Trypanotolerant cattle are suited to situations with low to medium trypanosomiasis prevalence but their introduction may not be economical. Tsetse control is appropriate in situations with higher disease risk but requires long-term commitment; traps and screens are considered to be the most profitable method.

8454 **Kilonzo, B.S. and Komba, E.K., 1993.** The current epidemiology and control of trypanosomiasis and other zoonoses in Tanzania. *Central African Journal of Medicine*, **39** (1): 10-19.

Kilonzo: Rodent Research Project, Sokoine University of Agriculture, P.O. Box 3110, Morogoro, Tanzania.

The epidemiology and control strategies of African trypanosomiasis and other zoonotic diseases in Tanzania have been described. Initial outbreaks of trypanosomiasis in Tanzania were caused by *Trypanosoma brucei gambiense* which originated from West Africa and reached Tanzania via Zaire around 1902. *T. b. rhodesiense*, which is currently responsible for human trypanosomiasis in Tanzania, was introduced from Mozambique around 1910 and quickly spread to many parts of the country. The disease is currently prevalent in the western, northern and north-western parts, the southern highlands and southern regions. Over 6000 cases have been reported since 1979. Control strategies against sleeping sickness in Tanzania include chemical control of vectors, treatment of patients with trypanocides and avoidance of human-tsetse contact.

8455 **Leeflang, P., 1993.** Some observations on ethnoveterinary medicine in northern Nigeria. *Veterinary Quarterly,* **15** (2): 72-73. (Also published in *Indigenous Knowledge and Development Monitor*, **1**: 17-19 (1993).)

Groenoord 66, 2401 AG Alphen a/d Rijn, Netherlands.

Management procedures adopted by Fulani herders in northern Nigeria to protect their cattle from disease are briefly described. Trypanosomiasis is associated with tsetse fly bites and common control measures include the application of home-made fly repellents, lighting fires to drive off insects and avoiding fly-infested grazing areas and shade trees. Annual migration routes are carefully chosen to avoid tsetse-infested areas. In the rainy season the cattle are brought to the Fulani's ancestral homeland in the Sudan zone, where tsetse only occur among riverine

vegetation. With the advent of the dry season the cattle are moved southwards through the savanna tsetse belt, where possible following disease-free tracks scouted in advance, to the subhumid Guinea zone. Some exposure to tsetse is unavoidable, but the Fulani allow their animals to spend only a very short time at watering places with bush or forest vegetation.

8456 **Mutugi, J.J., Young, A.S., Kariuki, D.P., Maritim, A.C. and Orinda, J., [1991?].** Challenges posed by haemoparasitic diseases in livestock development. *In*: Kenya Agricultural Research Institute, *Agricultural research in Kenya: achievements, challenges and prospects* (Proceedings of the 1st KARI Annual Scientific Conference, Nairobi, Kenya, 14-16 August 1990), pp. 141-148.

KETRI, P.O. Box 382, Kikuyu, Kenya; ibid.; ibid.; ibid.; National Veterinary Research Centre, KARI, Kabete, Kenya.

Trypanosomiasis forms a major constraint to livestock development in the rangelands of Kenya, causing production losses and restricting the introduction of more productive but susceptible stock into certain areas. The most economically important species are tsetse-transmitted *Trypanosoma vivax, T. congolense* and *T. brucei* in cattle and *T. simiae* in pigs, and mechanically-transmitted *T. evansi* in camels. The tsetse belt is more or less clearly defined and includes western districts (South Nyanza, Kisumu, Siaya, Busia and Bungoma) and the coastal region. Control measures include chemotherapy, with the extensive use of homidium compounds as prophylactic drugs; vector control, with increasing use of insecticide-impregnated or odour-baited traps and targets; and the use of trypanotolerant livestock, including the Orma Boran. The introduction of trypanoresistant genes into trypanosusceptible but highly productive Friesian cattle is a goal for the future. Integrated control is seen as the most cost-effective approach.

2. tsetse biology

(a) REARING OF TSETSE FLIES

8457 **Elsen, P., Hees, J. van and Lil, E. de, 1993.** L'historique et les conditions d'élevage des lignées de glossines (Diptera, Glossinidae) maintenues à l'Institut de Médecine tropicale Prince Léopold d'Anvers. [The history and breeding conditions of tsetse lines maintained at the Prince Leopold Institute of Tropical Medicine in Antwerp.] *Journal of African Zoology*, **107** (5): 439-449.

Service d'Entomologie, Institut de Médecine Tropicale

Prince Léopold, Nationalestraat 155, B-2000 Antwerpen 1, Belgium.
Three species of tsetse flies, *Glossina morsitans morsitans, G. palpalis palpalis* and *G. p. gambiensis*, representing altogether seven lines, are maintained as breeding colonies in Antwerp, Belgium, at the Prince Leopold Institute of Tropical Medicine. The history and pedigree of these lines are detailed. Insectary conditions and procedures used for keeping these *Glossina* spp. in Antwerp are described in detail. This information should be useful in comparing results obtained with other lines of these species, which may differ genetically or due to the conditions in other laboratories.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY
[See also **17**: nos. 8487, 8493.]

8458 **Carlson, D.A., Milstrey, S.K. and Narang, S.K., 1993.** Classification of tsetse flies *Glossina* spp. (Diptera: Glossinidae) by gas chromato-graphic analysis of cuticular components. *Bulletin of Entomological Research*, **83** (4): 507-515.
USDA, ARS, Medical and Veterinary Entomology Research Laboratory, P.O. Box 14565, Gainesville, FL 32604, USA; ibid.; USDA, ARS, Biosciences Research Laboratory, Fargo, ND, USA.
Gas liquid chromatography (GC) was used to analyse the cuticular alkanes of 26 species and subspecies of tsetse flies. Unique interspecific and intraspecific (males *v*. females) chromatographic patterns were observed. Solvent extraction of dried museum specimens and fresh specimens were equally successful and left specimens undamaged. GC peaks were used as characters with one of five character states per peak, to show phenetic relationships among species by sex using a UPGMA algorithm, using 23 peaks for males and 40 peaks for females. Comparisons among species of the *morsitans* group often agreed with recognised *morsitans* group classification using morphological techniques, with *G. austeni* being somewhat aberrant. *G. tachinoides* was less closely related to others in the *palpalis* group than previously described using morphology. Eleven members of the rarely studied *fusca* group were also classified by this methodology.

8459 **Gooding, R.H. and Moloo, S.K., 1994.** Genetics of two colonies of *Glossina pallidipes* originating from allopatric populations in Kenya. *Medical and Veterinary Entomology*, **8** (2): 133-136.

Gooding: Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3, Canada.
Two large colonies, originating from allopatric populations of *G. pallidipes* in the Shimba Hills and Nguruman, Kenya, which differ biologically and with respect to vectorial competence, were compared at 14 enzyme loci using polyacrylamide gel electrophoresis. The colonies had similar levels of genetic diversity with approximately half of the loci being polymorphic, an average of 1.6-1.7 alleles per locus, and a mean heterozygosity per locus of approximately 18.4%. However, the colonies differed significantly in allele frequencies at the loci for phosphoglucomutase, glucose-6-phosphate dehydrogenase, xanthine oxidase, octanol dehydrogenase and phosphoglucose isomerase. The results were compared with earlier studies on this species and no evidence was found for selection of specific alleles during establishment or maintenance of colonies of *G. pallidipes*, nor were specific chromosomes, or marker genes, associated with the biological differences between the two colonies.

8460 **Isaacson, L.C. and Nicolson, S.W., 1994.** Concealed transepithelial potentials and current rectification in tsetse fly Malpighian tubules. *Journal of Experimental Biology*, **186**: 199-213.

Department of Physiology, University of Cape Town Medical School, Observatory 7925, South Africa; Department of Zoology, University of Cape Town, Rondebosch 7700, South Africa.
Electrophysiological techniques have been applied to tsetse fly Malpighian tubules for the first time. In either Cl^- or SO_4^{2-} Ringer, both non-perfused and perfused tubules displayed transtubular potentials (V_t) at or close to 0 mV. Exposure to cyclic AMP elicited a marked secretory response and, in SO_4^{2-} Ringer, a sharp (lumen-positive) increase in V_t. In Cl^- Ringer, despite more than double the secretory response, there was little or no change in V_t. Replacing Cl^- with SO_4^{2-} Ringer, in the presence of cyclic AMP, promptly increased V_t. In perfused tubules, this occurred irrespective of the Cl^- or SO_4^{2-} composition of the perfusate. In Cl^- Ringer, the transepithelial resistance (R_{trans}) was less than half that previously reported in Malpighian tubules of other species. Cyclic AMP reduced R_{trans} still further, whether tubules were bathed in Cl^- or SO_4^{2-} Ringer. Current-voltage (I/V) plots often displayed current rectification, both before and more frequently after exposure to cyclic

AMP, thus permitting estimation of both the electromotive force of the Na^+ transport mechanism (E_{Na}) and of the shunt resistance (R_{shunt}). Both E_{Na} and R_{shunt} were markedly lower in tubules bathed in Cl^- than in SO_4^{2-} Ringer. Cyclic AMP was without effect on E_{Na} and R_{shunt}, in either Cl^- or SO_4^{2-} Ringer. In terms of the equivalent electrical circuit, the secretory response to cylic AMP was due solely to a fall in resistance of the active transport pathway (R_{series}). The absence of an appreciable V, in Cl^- Ringer, is consistent with an apical Cl^- shunt.

8461 **Jura, W.G.Z.O., Zdarek, J. and Otieno, L.H., 1993.** A simple method for artificial infection of tsetse, *Glossina morsitans morsitans* larvae with the DNA virus of *G. pallidipes*. *Insect Science and its Application*, **14** (3): 383-387.

Jura, Otieno: ICIPE, P.O. Box 30772, Nairobi, Kenya; Zdarek: Institute of Organic Chemistry and Biochemistry, Czech Academy of Sciences, Prague, Czech Republic.

Newly deposited *G. m. morsitans* larvae were chilled over ice and inoculated with 1 µl of either virus suspension derived from *G. pallidipes* salivary gland homogenate or sterile tsetse physiological saline. They were allowed to pupariate and then maintained at 25□C and 70% r.h. until soon after emergence when their salivary glands were examined for enlargement and presence of virus particles. Teneral *G. m. morsitans* which received the virus inoculum (n = 135) as larvae all became infected as revealed by gross hypertrophy of their salivary glands and ultrastructural manifestation of virus particles within the glandular epithelial cells and lumina. In the control group, which received the tsetse physiological saline (n = 91), only 1.1% of the flies showed the salivary gland enlargement, a level equivalent to the prevalence of virus infection normally detectable in the *G. m. morsitans* colony. This technique opens the way for testing the biocontrol potential of this virus. The DNA virus from *G. pallidipes* is clearly infective to *G. m. morsitans*, suggesting that the hypertrophied, chalky-white salivary glands, reported in various *Glossina* spp., are a manifestation of infection by one and the same virus.

8462 **Miyan, J.A. and Tyrer, N.M., 1993.** Innervation of dipteran eclosion muscles: ultrastructure, immunohistochemistry, physiology and death. *Philosophical Transactions of the Royal Society of London (B)*, **341** (1298): 361-374.

Department of Biochemistry and Applied Molecular Biology, UMIST, P.O. Box 88, Manchester M60 1QD, UK.

The thoracic eclosion muscles of flies die by cytotoxic attack under neural control. We have investigated the innervation, ultrastructure and immunohisto-chemistry of the ventral eclosion muscle of *Glossina morsitans*. Two neurons located in the thoracic ganglion innervate this muscle. One of these is immuno-reactive for serotonin and does not provide motor innervation. It appears to terminate near the attachment of an immunocyte involved in the dismantling of the muscle. The neuromuscular junction has features that distinguish it from any other chemical junction. A narrow, 3 nm gap separates pre- and post-synaptic membranes and this apparently acts to limit diffusion into and out of the junction. The immunocyte may use neuromuscular innervation as a path-finder to all muscle fibres and may even receive direct input from this source. Neuromuscular transmission is probably chemical as decreasing temperature results in decreasing amplitude of the (graded) muscle potential.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

8463 **Green, C.H., 1993.** The effects of odours and target colour on landing responses of *Glossina morsitans morsitans* and *G. pallidipes* (Diptera: Glossinidae). *Bulletin of Entomological Research*, **83** (4): 553-562.

Tsetse Research Group, Department of Veterinary Medicine, Bristol University, Langford, Bristol BS18 7DU, UK.

A laboratory bioassay was developed to allow blind testing of panels of odours for their effect on target-orientated behaviour of tsetse (*Glossina* spp.) in the laboratory. Landing responses of *G. m. morsitans* on black and blue targets were increased up to four-fold in the presence of carbon dioxide but no significant effect of any other odours could be demonstrated. 2-Methoxy phenol gave an apparent increase in landing behaviour in the laboratory but this substance diminished rather than increased landing of *G. pallidipes* and *G. m. morsitans* on targets in the field, as well as repelling tsetse from the target vicinity. Black, blue and red targets elicited strong landing behaviour in male *G. m. morsitans* in the laboratory and white and yellow targets elicited little or none, whether carbon dioxide was present or not. In the field, high ultraviolet reflectivity increased landing behaviour of *G. pallidipes* but only when there was a proportion of trans-mitted light through the target. Ultraviolet reflectivity always reduced

overall attraction of tsetse to a single-coloured target. Two-coloured targets incorp-orating ultraviolet-reflecting white cloth obtained strong landing on the white panels but caught fewer flies overall than all-black or blue-and-black targets.

8464 **Groenendijk, C.A., Dekker, M.J., Otieno, L.H. and Takken, W., 1993.** A survey of the distribution of *Glossina pallidipes* Austen around the Lambwe Valley, South Nyanza District, Kenya. *Insect Science and its Application*, **14** (2): 225-228.

Groenendijk, Dekker, Takken: Department of Entomology, Agricultural University, P.O. Box 8031, 6700 EH Wageningen, Netherlands; Otieno: Tsetse Programme, ICIPE, P.O. Box 30772, Nairobi, Kenya. (Correspondence to Otieno.)

Populations of *G. pallidipes* have recently been found in neighbouring areas and the Lambwe Valley population can no longer be regarded as isolated. Odour-baited biconical traps were used in an area extending from Kavirondo Gulf in the north to the Nyandhiwa road in the south, and from Lake Victoria in the west to the Kodera Forest in the east, to determine the presence of tsetse; trapped flies were dissected to assess trypanosome infection and ovarian age. The results indicate that *G. pallidipes* is breeding in areas to the east and north-east of Lambwe Valley, especially in the Ruri Hills, the coniferous plantation on the Kanyamwa escarpment and the Kanyabala Forest. These populations probably feed on domestic livestock and were infected with *Trypanosoma vivax*, *T. congo-lense* and *T. brucei*. *G. fuscipes* was also trapped in areas to the west and north-east of Lambwe Valley and is a potential vector. The incidence of animal and human trypanosomiasis is rising and the situation resembles that before the 1966 epidemic. Fly density should be reduced using baited targets or Nguruman traps.

8465 **Nevill, E.M., Kappmeier, K. and Venter, G.J., 1993.** Tsetse fly research in Zululand. (Abstract only.) *In*: *Proceedings of the Ninth Entomological Congress organized by the Entomological Society of Southern Africa, Johannesburg, 28 June – 1 July 1993* (Pretoria, South Africa; Entomological Society of Southern Africa), p. 81.

Onderstepoort Veterinary Institute, Pretoria, South Africa.

Trypanosomiasis carried by *Glossina brevipalpis* and *G. austeni* killed about 10,000 cattle in Zululand in 1990 and research into trapping these vectors has been carried out. The synthetic ox odour combination developed in Zimbabwe for attracting *G. morsitans* and *G. pallidipes* was

found to be very effective in attracting *G. brevipalpis* to black cloth targets. Attraction increased with target size, 1.5 ∃ 1 m being optimal. Phthalogen blue targets were significantly more attractive than black targets but, as in Zimbabwe, few flies alighted on them. Individual odour components showed some attraction for *G. brevipalpis* but were not as attractive as the four-component Zimbabwe combination. Phthalogen blue was the most attractive colour to *G. austeni*, followed by white, baby-blue and black. There was no significant difference between the attractiveness of individual odours and the Zimbabwe combination, and the synthetic odour did not appear to increase the number of *G. austeni* attracted to targets or traps.

8466 **Rawlings, P., Ceesay, M.L., Wacher, T.J. and Snow, W.F., 1993.** The distribution of the tsetse flies *Glossina morsitans submorsitans* and *G. palpalis gambiensis* (Diptera: Glossinidae) in The Gambia and the application of survey results to tsetse and trypanosomiasis control. *Bulletin of Entomological Research*, **83** (4): 625-632.

Institute for Animal Health, Pirbright Laboratory, Ash Road, Pirbright, Woking GU24 0NF, UK; ITC, P.M.B. 14, Banjul, Gambia; ibid.; ibid.

A country-wide survey of the distribution of *G. m. submorsitans* and *G. p. gambiensis* was carried out in The Gambia during 1989-90 using box traps at 1654 sites over an area of 10,000 km^2. The general distribution of tsetse had changed little during the last 45 years. *G. m. submorsitans* was present in dry, canopied woodland throughout most of the country, but was absent from an area south of the River Gambia stretching from the coast to some 100 km inland. *G. p. gambiensis* occurred in evergreen forest and woodland near the coast, and in riparian habitats along the length of the River Gambia and its major tributaries. Nowhere in the country was more than 20 km from tsetse-infested areas. Five major foci of *G. m. submorsitans* infestation were identified. Demographic, climatic and environmental factors affect tsetse populations in The Gambia, but it is expected that these foci of infestation will persist for at least the next 5-10 years. The numbers of tsetse trapped, expressed as relative densities, were used to assess the extent and severity of losses from trypanosomiasis to different categories of livestock. Survey results such as these could be used to assess whether control measures to reduce tsetse challenge are likely to be economically viable by using techniques such as insecticide-impregnated targets, pour-ons or

chemotherapy.

8467 **Rawlings, P., Wacher, T.J. and Snow, W.F., 1994.** Cattle-tsetse contact in relation to the daily activity patterns of *Glossina morsitans submorsitans* in The Gambia. *Medical and Veterinary Entomology*, **8** (1): 57-62.
Institute for Animal Health, Pirbright Laboratory, Ash Road, Pirbright, Woking GU24 0NF, UK; ITC, P.M.B. 14, Banjul, Gambia; ibid.
The daily flight activity patterns of one of the main vectors of animal trypanosomiasis in West Africa, *G. m. submorsitans*, were assessed using four different methods. Results from all the methods showed that there was some flight activity nearly every hour in all seasons but they differed in the level of contact between grazing cattle herds and *G. m. submorsitans*. In the late dry season, trap data indicated that there was negligible activity from midday to late afternoon, whereas observations of tsetse contact with cattle herds or hand-net collections on herd followings showed no fall in attack rates on the cattle by *G. m. submorsitans*. Differences between trap and animal-baited collection data may be attributable to the type of *G. m. submorsitans* sampled by each method. Male *G. m. submorsitans* captured by traps were more fat-depleted than those caught on ox-baited flyrounds or by hand-net collections on herd followings. All methods showed that male *G. m. submorsitans* were most fat-depleted in the late dry season and least in the early dry season. It was concluded that the traps were mainly sampling the spontaneous flights of *G. m. submorsitans*. Hunger and endogenous rhythms increase the likelihood of spontaneous flights towards dusk, particularly in conditions such as those at midday in the very hot, late dry season. However, the presence of cattle herds in infested habitats probably activated nearby *G. m. submorsitans* and the continual movement through the grazing areas ensured contact with tsetse throughout grazing. The data indicated that strategic management of herd grazing times cannot eliminate the risk of trypanosomiasis transmission occurring, irrespective of the harshness of the dry season climate. An assessment of the level of this risk could only be measured suitably by collecting tsetse using animal-baited methods, not from trap data.

8468 **Saini, R.K., Hassanali, A., Ahuya, P., Andoke, J. and Nyandat, E., 1993.** Close range responses of tsetse flies *Glossina morsitans morsitans* Westwood (Diptera: Glossinidae) to host body kairomones. *Discovery and Innovation*, **5** (2): 149-153.
ICIPE, P.O. Box 30772, Nairobi, Kenya.

Methanolic extracts of body wash from the neck and back of cattle were separated into ethyl acetate-insoluble, phenolic, acidic, neutral and basic fractions and used in behavioural studies with teneral male *G. m. morsitans* in a wind tunnel. An olfactory response to kairomones present in the extracts activated the flies and initiated upwind flight and increased activity such as landing and probing. Significantly fewer flies ($P < 0.05$) became activated at 40 cm from the odour source than from 10 or 20 cm. Active components occurred in all the cattle wash fractions, with the phenolic fraction eliciting most activity and the basic fraction the least. This suggests the presence of a series of different compounds which may act synergistically to affect tsetse behaviour at close range. Examination of the phenolic fraction showed that all the phenols present in buffalo and cattle urine were present in the skin with the addition of several other components, suggesting that body phenols may play an important role in host identification and that these may be more important than those derived from urine. Close range kairomones may also be responsible for the selection of particular feeding sites on a host animal.

8469 **Stiles, J.K., Otieno, L.H., Chaudhury, M.F.B. and Moloo, S.K., 1994.** Upsurge of the tsetse fly *Glossina swynnertoni* at Nguruman, Kenya. *Medical and Veterinary Entomology*, **8** (2): 199-200. Tsetse Programme, ICIPE, P.O. Box 30772, Nairobi, Kenya; ibid.; ibid.; ILRAD, P.O. Box 30709, Nairobi, Kenya.

G. swynnertoni has a limited distribution in northern Tanzania and southern Kenya. Routine sampling of *G. pallidipes* in March-May 1992, using NG2G traps on the Nguruman escarpment, showed that up to 4% of the tsetse caught were *G. swynnertoni*. The coexistence of *G. swynnertoni* with *G. pallidipes* and also *G. longipennis* in this area was previously unsuspected and could be a recent phenomenon. The suppression of the *G. pallidipes* population to approximately 1% of its previous level may have allowed for an influx of *G. swynnertoni* from either Tanzania or the Maasai Mara population about 50 km to the west. *G. swynnertoni* has been implicated as a vector of animal trypanosomiasis and the vector competence of this species at Nguruman should be studied in parallel with that of the associated *G. pallidipes* and *G. longipennis*. The differentiation of female *G. pallidipes* and *G. swynnertoni* is illustrated.

8470 **Thakersi, H., 1992.** New records of tsetse flies in eastern Zimbabwe. *Transactions of the Zimbabwe Scientific*

Association, **66**: 30-34.
Tsetse Control Senanga West, Veterinary and Tsetse Control Service, P.O. Box 920034, Senanga, Zambia.
Trap and bait-ox surveys were conducted in the Holdenby Communal Land in the eastern region of Zimbabwe following the appearance of trypanosomiasis in the area. Three species of tsetse fly were found: *Glossina pallidipes*, *G. morsitans morsitans* and *G. austeni*. The infestation appears to have originated from Mozambique and its distribution in the Holdenby Communal Land is mapped.
8471 **Vale, G.A., 1993.** Development of baits for tsetse flies (Diptera: Glossinidae) in Zimbabwe. *Journal of Medical Entomology*, **30** (5): 831-842.
RTTCP, P.O. Box A560, Avondale, Harare, Zimbabwe.
The analysis of host-orientated behaviour of *Glossina morsitans morsitans* and *G. pallidipes* has led to a ten- to 1000-fold improvement in the cost-effectiveness of baits for surveys and control. The principles of behavioural analysis are discussed and include the interpretation of catches and activity indices. Three criteria are necessary for data analyses: overall activity must be split into its component responses; overall stimulus from baits must be divided into its constituents; and individual responses must be measured. Aspects of response measurement are discussed. Two common factors are that the number of responding insects must be counted at the instant of transition between two behavioural phases and that it is analytically meaningless to count the number of flies doing one thing without counting the numbers that do other things. Objective sampling devices of measured efficiency are essential and these include the use of electric nets and video recording. The history of research into bait-orientated behaviour is reviewed, with reference to the development of practical baits, trap and target design, and changes in cost-effectiveness and practical use. Areas for further research include the identification of additional attractants, use of sterilising hormones, improving the placement of baits, investigating long distance stimulus-response relationships, and developing new techniques such as radar tracking to monitor continuously the behaviour of individual flies.
8472 **Williams, B., 1993.** Predicting the distribution of tsetse flies using climatic, vegetation and remotely sensed data. (Abstract only.) *In*: *Proceedings of the Ninth Entomological Congress organized by the Entomological Society of Southern Africa, Johannesburg, 28 June – 1 July 1993* (Pretoria, South

Africa; Entomological Society of Southern Africa), p. 120.
LSHTM, Keppel Street, London WC1E 7HT, UK.
The use of computers and remote sensing techniques has made it possible to determine accurately the temperature, rainfall and vegetation of inaccessible regions and to estimate the suitability of these regions for tsetse flies. Climatic and vegetational data from Zimbabwe have been correlated with the historical distribution of tsetse flies, and used to develop an efficient methodology for the analysis of such data and a model to predict the distribution of tsetse in other parts of Africa. The potential and limitations of these methods were discussed.

3. tsetse control (including environmental side-effects)
[See also **17**: nos. 8451, 8461, 8463.]

8473 **Cuisance, D., Gouteux, J.P., Blanc, F. and Le Gall, F., 1994.** Centrafrique: des pièges à tsé-tsé pour les éleveurs Mbororo. [Central Africa: tsetse traps for Mbororo herders.] *ORSTOM Actualités*, no. 42: 2-8.
CIRAD-EMVT, Centre ORSTOM de Montpellier, 911 avenue Agropolis, 34032 Montpellier Cedex 1, France; Département de Santé et des Maladies Infectieuses et Parasitaires, Université de Pau et des Pays de l'Adour, Pau, France; Mission Française de Coopération et d'Action Culturelle, Bangui, Central African Republic; ibid. and ANDE, B.P. 1509, Bangui, Central African Republic.
Trypanosomiasis transmitted by *Glossina fuscipes fuscipes* is a major problem among the 2.6 million Zebu cattle in the Central African Republic, where cattle numbers have increased as a result of the migration of Mbororo herders from the Sahel. Control is by costly chemotherapy with risk of the development of resistant strains. Tsetse eradication is considered impractical but trapping has successfully reduced vector pressure. A low-cost blue and black bipyramidal trap has been developed using everyday materials, such as recycled bottles, wooden struts and polyethylene sheeting. Field trials at Ouro-Djarfoun showed that the apparent density of *G. f. fuscipes* was significantly reduced after 2 months in the rainy season and after 1 month in the dry season, with a concomitant reduction in *Trypanosoma congolense* and *T. brucei brucei* infections in cattle. From 1988 to 1990 traps were distributed free to herders, who demonstrated their ability to use them efficiently

under supervision. It is hoped that the herders will eventually take full responsibility for the cost and maintenance of the traps. Long-term success will depend on the herders becoming completely sedentary: at present their cattle are protected for only 6-7 months of the year.

8474 **Gouteux, J.P. 1992.** Surnaturel, santé et action communautaire en Afrique noire. [Supernatural beliefs, health and community action in Black Africa.] *Bulletin de la Société de Pathologie exotique*, **85** (3): 256-260.

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

Using the example of a community-based tsetse control project carried out in the Congo from 1984-87, the influence of supernatural beliefs on the attitude of local people to disease and to their participation in public health programmes is discussed. Belief in the spirit world and in the role of the ndoki or witch doctor is of great social importance in African communities and has a considerable effect on their response to disease. Projects involving the community, such as tsetse control, must therefore take into account the possible influence of these beliefs, including symbolic cannibalism, the interaction of different cults (such as Christianity, Islam and local religions), lack of scientific understanding of primary health care, the ambivalence and richness of African thought, and ethical problems which may arise. The African way of thinking is very different from Western thought and must not be ignored.

8475 **Hussain, M., Han, L.-F. and Rathor, M.N., 1994.** Evaluation of oil formulations of deltamethrin for use on cotton targets for tsetse fly control. *Pesticide Science*, **40** (4): 299-306.

Hussain: Agrochemicals Unit, Joint FAO/IAEA Programme, IAEA Laboratories, A-2444 Seibersdorf, Austria.

A range of formulations of deltamethrin was prepared, some containing an ultraviolet (UV) absorber compound or a combination of the UV absorber and an oil, and applied to blue cotton tsetse fly target samples which were then exposed to the effect of simulated sunlight and water in the laboratory. The residue of insecticide remaining on the targets and the activity of the latter against tsetse flies were determined. Formulations containing the UV absorber and coconut oil or silicone oil remained the most effective against tsetse flies. A coconut oil formulation of the insecticide was selected for field evaluation in comparison with a commercial deltamethrin formulation,

`Glossinex 200' S.C., which contains 10% UV absorber. Target samples treated with these formulations were exposed to natural tsetse fly habitat in Ghana for a period of 5 months and evaluated for deltamethrin residues and activity against four species of tsetse fly. After 5 months, 4-13 times more deltamethrin remained on the targets treated with the coconut oil formulation than on those treated with `Glossinex', and consequently the former were more active against tsetse flies than the latter. Target samples sequentially dipped in the coconut oil formulation resulted in uniform insecticide concentration on the targets, whereas those dipped in `Glossinex' contained gradually decreasing deltamethrin concentrations.

8476 **Lancien, J., 1993.** La maladie du sommeil contrôlée au sud de l'Ouganda. [Control of sleeping sickness in southern Uganda.] *ORSTOM Actualités*, no. 41: 7-10. Département de Santé et des Maladies Infectieuses et Parasitaires, Université de Pau et des Pays de l'Adour, Pau, France.

Sleeping sickness is undergoing a resurgence in Uganda following the political disturbances since 1970. Sudanese refugees have reintroduced *Trypanosoma brucei gambiense* sleeping sickness into the northern focus: this is being controlled by diagnosis and treatment. Insecticide campaigns had almost eliminated *Glossina fuscipes*, vector of *T. b. rhodesiense* sleeping sickness, in the south-eastern focus by 1970 but the disease reached epidemic levels again in 1987 when 8000 new cases were diagnosed in Busoga Province alone. ORSTOM then introduced the use of deltamethrin-impregnated traps through the cooperation of locally recruited fieldworkers and village committees. The modified Challier-Laveissière trap is cheap and easy to use, consisting of a blue and black tent-like structure with a conical top of white gauze suspended from a tree. Tsetse attracted by the colour combination fly up into the cone where they are poisoned and collected for counting. In 1987 15,000 traps were set at a rate of 10/km^2. Within 10 months the fly population had been dramatically reduced and the disease had declined by 90%. Trap density was halved and over 5 years the project has been extended to cover an area of 3000 km^2, protecting 600,000 people at a cost of 0.5 US$/person/year. The programme is now maintained by the Ugandan government and local communities.

8477 **Luguru, S.M., Bennett, S.R. and Chizyuka, H.G.B., 1993.** Observations on the incidence of bovine trypanosomiasis

in cattle dipped in deltamethrin in a tsetse infested area of Zambia. *Tropical Animal Health and Production*, **25** (3): 129-130.
Central Veterinary Research Institute, Balmoral, P.O. Box 33980, Lusaka, Zambia; Hoechst Zambia Ltd, P.O. Box 32055, Lusaka, Zambia; Department of Veterinary and Tsetse Control Services, Mulungushi House, P.O. Box 50060, Lusaka 10101, Zambia.
The prevalence of trypanosomiasis was determined by thick blood smears in three herds of cattle in Petauke District, Eastern Province, Zambia. All cattle were treated with diminazene aceturate at 3.5 mg/kg body weight and 1 week later were dipped in deltamethrin (Butox 5% w/v) at an estimated concentration of 0.00375%. Two herds (Chimtowe, North Nyamphande) were dipped at 14-day intervals and one (Kachusi) was dipped at 7-day intervals. Thick blood smears were examined monthly during the dipping period (January-July 1986), when no clinical infections requiring treatment were diagnosed. A substantial reduction in the incidence of trypanosomiasis and an increase in productivity were indicated in all three herds.
8478 **Merron, G.S., 1992**. Tsetse fly control and the environmental implic-ations for fish in the Okavango Delta, Botswana. *Botswana Notes and Records*, **24**: 49-56.
J.L.B. Smith Institute of Ichthyology, Grahamstown, South Africa.
Aerial spraying of an endosulfan/deltamethrin formulation was successfully used during the 1980s to control tsetse in the Okavango Delta, although mortality to fish and other aquatic organisms occurred under certain conditions. The toxicity of various insecticide formulations to fish has now been tested and recommendations made for minimising environmental side effects. The research programme showed that it is safer to spray during the cooler winter months when fish are physiologically less active and the tsetse population is lowest. It was recommended that endosulfan should be replaced, and use of u.l.v. deltamethrin in 1991 gave adequate tsetse control and no apparent fish kills or gross damage to the aquatic environment. Two surface-feeding fish, *Aplocheilichthys johnstoni* and *Barbus haasianus*, showed signs of temporary disorientation. The use of deltamethrin also resulted in a 50-fold reduction in the total amount of a.i. applied. Aerial spraying using smaller aircraft flying just above the tree canopy was recommended to reduce drift and the ProNav satellite navigational system was

first used in 1991 with greatly improved accuracy. Traps and targets may be appropriate in more accessible areas.

8479 **Okello-Onen, J., Heinonen, R., Ssekitto, C.M.B., Mwayi, W.T., Kakaire, D. and Kabarema, M., 1994.** Control of tsetse flies in Uganda by dipping cattle in deltamethrin. *Tropical Animal Health and Production*, **26** (1): 21-27.

Okello-Onen: Animal Health Research Centre, P.O. Box 24, Entebbe, Uganda.

The effect of treating cattle with deltamethrin to control tsetse flies and ticks was investigated on two ranches 8 km apart in central Uganda where there was a high risk of trypanosomiasis. This area had a moderate challenge of *Glossina pallidipes*, and a very low challenge of ticks due to regular treatment of the cattle with dioxathion. On one ranch a dip was charged with deltamethrin to treat cattle regularly for 3 months. The other ranch was used as a control for the tsetse population, but the animals continued to be treated regularly with dioxathion using hand sprays. On the ranch using deltamethrin treatment a reduction of 96.9% in the tsetse population was recorded after two treatments at 2 week intervals. Total (100%) control of tsetse was achieved from the fourth treatment up to the end of the trial period. The ranch with dioxathion treatment experienced an overall tsetse reduction of 19.15% during the thirteenth to fifteenth weeks and the factors contributing to this are discussed. However, the mean apparent tsetse density of 4.83 flies/trap/day recorded at the control ranch was significantly different from the mean of 0.81 flies/trap/day ($P < 0.001$) at the ranch using deltamethrin treatment. It was difficult to assess the effect of this product on ticks because of lack of controls. However, there are indications that deltamethrin can also reduce tick populations and the incidence of tick-borne diseases. The possible limitations and practical implications associated with large-scale use of this product in the country are discussed.

8480 **Okiria, R. and Kalunda, M., 1994.** Knock down and survival of tsetse flies fed on cattle and pigs dipped in deltamethrin. *Annals of Tropical Medicine and Parasitology*, **88** (1): 77-81.

UTRO, P.O. Box 96, Tororo, Uganda.

Glossina morsitans, G. pallidipes and *G. fuscipes fuscipes* were fed on cattle or pigs that had been dipped in 0.00375% deltamethrin in water 0-31 days previously. The knock down and survival of the tsetse were then followed in

the laboratory. Although mortality was generally less the longer after the dip the flies were fed, all those that fed on the animals within 7 days of the dipping were killed and all those that fed within 21 days were at least knocked down. *G. morsitans* was slightly more susceptible than the other two species tested.

8481 **Regional Tsetse and Trypanosomiasis Control Programme and Scientific Environmental Monitoring Group, 1993.** *Environmental monitoring of tsetse control operations in Zambia and Zimbabwe. Impact of aerial spraying and odour-baited targets on ecosystems: report 1987-1990.* Saarbrücken, Germany; Institut für Biogeographie, Universität des Saarlandes. 125 pp.

SEMG, Institut für Biogeographie, Universität des Saarlandes, Saarbrücken, Germany.

Environmental monitoring of endosulfan application in Zimbabwe and Zambia is described with reference to the study area and spraying operations, effects on terrestrial and aquatic vertebrates and invertebrates, and residue analyses. The environmental impact of deltamethrin application by fixed-wing aircraft and helicopters, and of odour-baited insecticide-impregnated targets, in Zimbabwe is also described with reference to effects on non-target organisms. Control operations in Zimbabwe were considered to be successful with regard to the eradication of *Glossina morsitans* (but not *G. pallidipes*) using 14-24 g a.i./ha endosulfan, 0.25 g a.i./ha deltamethrin or odour-baited targets. These dosages had little effect on the non-target fauna. However, it is recommended that delta-methrin should be used in preference to endosulfan in areas with fisheries and that care should be taken with deltamethrin where aquatic crustaceans are of economic importance. Insecticide residues in the food chain were either not detectable or were considered to be low risk. Adverse effects on humans were not detected. Odour-baited targets were found to attract Stomoxyinae, Muscinae and Tabanidae in addition to tsetse flies and future studies are necessary to determine any effects on their populations. Similar control operations could be extended to other areas with comparable climate, land use and vegetation patterns, although it might be necessary to increase the insecticide dosage to control *G. pallidipes* effectively.

8482 **Vale, G.A., Wilcox, J. and Abson, J., 1994.** Prospects for using odour-baited trees to control tsetse flies (Diptera: Glossinidae). *Bulletin of Entomological Research*, **84** (1): 123-130.

RTTCP, P.O. Box A560, Avondale, Harare, Zimbabwe;

Biology Department, University of Southampton, UK; Zoology Department, Rhodes University, Republic of South Africa.
Field studies in Zimbabwe elucidated the responses of *Glossina morsitans morsitans* and *G. pallidipes* to natural and artificial trunks of trees baited with odours of acetone, 1-octen-3-ol and phenols. The numbers of tsetse electrocuted in flight near the base of the trunk increased 2-12 times when the trunk was shortened from 7.2 m to 0.9 m and its diameter was increased from 25 cm to 5 m, when the base was coloured blue or black to contrast with the upper trunk, or when the upper trunk was separated from the base by a gap of 2.7 m. A swarm flying near short trunks was more compact than near tall trunks. Electrocuting grids to catch alighting tsetse indicated that only about 20% of the attracted tsetse alighted on the base of the trunk, whether this was blue or blue/black. Since there is presently no apparent means of cost-effectively avoiding the inhibitory effects of tall trunks, the use of odour-baited trees as baits for tsetse control seems uneconomical.

8483 **Williams, B., 1993.** Community run control of vector borne diseases in Africa: trypanosomiasis and malaria. (Abstract only.) *In*: *Proceedings of the Ninth Entomological Congress organized by the Entomological Society of Southern Africa, Johannesburg, 28 June – 1 July 1993* (Pretoria, South Africa; Entomological Society of Southern Africa), p. 121.
LSHTM, Keppel Street, London WC1E 7HT, UK.
A successful community-based tsetse control programme has been set up on a Maasai ranch at Nguruman in south-west Kenya, using odour-baited traps. The development of this programme involved several years of research into trap design, tsetse ecology and disease epidemiology, and the local community was involved from the start. The Nguruman tsetse control project was used as a case study to examine the feasibility of extending this approach to other parts of Africa.

4. epidemiology: vector-host and vector-parasite interactions

[See also **17**: nos. 8464, 8467, 8468, 8503, 8537.]

8484 **Aldhous, P., 1993.** Bacteria may provide access to the tsetse fly. (Editorial.) *Science*, **261** (5121): 548.
Researchers are investigating the possibility of isolating genes which might confer resistance to trypanosomes and inserting them into symbiotic bacteria in the tsetse gut to produce vectors that are `immune'

to trypanosomes. Cells in the tsetse midgut secrete a lectin that kills trypanosomes but which is inhibited by *N*-acetyl-*D*-glucosamine, produced when a chitinase secreted by the symbionts breaks down the lining of the tsetse gut. Flies carrying more symbionts are therefore more susceptible to trypanosomes: this could be counteracted if the symbionts are genetically altered to produce tsetse lectin or to mop up the glucosamine. Another group is working to isolate the gene that produces an antibody fragment that attacks a trypanosome antigen called procyclin: splicing this into the symbiont should produce a bacterium capable of killing trypanosomes. Difficulties in introducing and spreading the altered symbionts through the tsetse population might be overcome by using *Wolbachia pipientis*, a maternally inherited bacterium which infects tsetse ovaries, to drive engineered symbionts throughout a population.

8485 **Gouteux, J.P., Kounda Gboumbi, J.C., D'Amico, F., Wagner, C., Noutoua, L. and Bailly, C., 1993.** Enquête épidémiologique pour la recherche des lieux de contamination probables dans un foyer centrafricain de maladie du sommeil. [An epidemiological survey to discover the probable places of infection within a sleeping sickness focus in the Central African Republic.] *Bulletin of the World Health Organization*, **71** (5): 605-614.

ORSTOM, B.P. 893, Bangui, Central African Republic; CIESPAC, Brazzaville, Congo; Université des Sciences et Techniques du Languedoc, Montpellier, France; UPPA, Pau, France; DMPGE, Bangui, Central African Republic; ibid.

A sample of 142 sleeping sickness patients from the Nola-Bilolo focus was studied to ascertain their probable places of infection. The localities where infection was highest within the focus are M'Poyo (18% of cases), Bilolo (9%), Mékara (8%), Modigui-Kouna, Ziendi and Domissili (all 7%). The main places and times of human-tsetse contact were determined by agricultural activities: coffee-growing for men and steeping cassava in the river for women. The patients were either detected passively (average age 30 □ 3 years) from medical records or actively (average age 22 □ 3 years) during a survey carried out in January-February 1991. During the survey, patients supplied information about their points of contact with flies, not just their homes but during their daily movements and at places of work. There was considerable movement between villages. The results showed that poorly

targeted vector control is unlikely to succeed and priority areas should first be defined by trapping.

8486 **Grootenhuis, J.G. and Olubayo, R.O., 1993.** Disease research in the wildlife-livestock interface in Kenya. (Review.) *Veterinary Quarterly*, **15** (2): 55-59.
P.O. Box 25021, Nairobi, Kenya; ICIPE, P.O. Box 30772, Nairobi, Kenya.
Wildlife disease research in Kenya is reviewed with reference to animal health management. The wildlife-livestock interface is here defined as an area where wildlife and livestock coexist and conflict for food, disease control and predation. The attractiveness of domestic and wild Bovidae to tsetse was compared by penning one Boran cow together with one buffalo, eland, oryx or waterbuck and observing the number of flies landing and engorging on the animals. Buffalo and cattle were equally attractive to tsetse and 20-25% of the flies engorged; eland attracted only half the number of flies as cattle and only 10% engorged; oryx attracted one sixth the number of flies and only 3% engorged; and waterbuck attracted very few flies, none of which engorged. Studies of the responses of African buffalo to tsetse infection are reviewed. The isolation from buffalo of serum proteins with trypanocidal activity against all common species of trypanosomes could be important for the development of genetic control methods for trypanosomiasis in domestic bovines. The relatively close genetic relationship between buffalo and cattle makes buffalo an excellent model for the study of trypanotolerance relevant to the development of disease control strategies in cattle.

8487 **Mihok, S., Stiles, J.K., Mpanga, E. and Olubayo, R.O., 1994.** Relationships between protease activity, host blood and infection rates in *Glossina morsitans* sspp. infected with *Trypanosoma congolense, T. brucei* and *T. simiae*. *Medical and Veterinary Entomology*, **8** (1): 47-50.
ICIPE, P.O. Box 30772, Nairobi, Kenya.
Midgut protease activity in *G. m. centralis* and *G. m. morsitans* at 48 h post bloodmeal averaged 1.8 IU of trypsin-like activity. These two tsetse subspecies differ in their susceptibility to trypanosome infection. Except for low levels in flies fed on waterbuck blood (0.7 IU), activity did not differ in flies fed a variety of host bloods (goat, pig, cow, buffalo, eland) and trypanosome species (*T. congolense, T. brucei, T. simiae*). Protease activity was also not correlated with infection rates, despite large differences in infection rates among experiments. Nevertheless, addition of 0.06 M D(+)-glucosamine to

parasitaemic blood resulted in a three-fold reduction in protease activity, coincident with a large increase in infection rate. This effect did not occur when parasites or D(+)-glucosamine were added alone to the bloodmeal, suggesting that the effect was due to metabolism of D(+)-glucosamine by parasites.

8488 **Olubayo, R.O., Mihok, S., Munyoki, E. and Otieno, L.H., 1994.** Dynamics of host blood effects in *Glossina morsitans* sspp. infected with *Trypanosoma congolense* and *T. brucei*. *Parasitology Research*, **80** (3): 177-181.
Olubayo: ICIPE, P.O. Box 30772, Nairobi, Kenya.
The pattern of infection in *G. m. morsitans* and *G. m. centralis* membrane-fed on eland, buffalo or goat blood mixed with *T. congolense* or *T. brucei* was studied from day 1 to day 10. Tsetse were initially permissive vectors with most flies harbouring infections of 10^4-10^5 parasites on day 3. However, after a second blood meal on day 3, flies cleared many infections, with *G. m. morsitans* clearing more infections than *G. m. centralis*. Infective feeds of goat blood consistently increased final infection rates by limiting the number of infections lost between days 3 and 6. In further experiments with *G. m. morsitans* only, this effect was replicated by feeding flies on erythrocytes but not on serum. These results suggest that compounds from some mammalian erythrocytes match the target specificity of *G. m. morsitans* midgut lectins and, therefore, have a protective effect on trypanosome establishment in the fly.

8489 **Osir, E.O., Imbuga, M.O. and Labongo, L.V., 1993.** Lectins and trypsin in tsetse fly-trypanosome interactions. (Abstract only.) *In*: *Proceedings of the Ninth Entomological Congress organized by the Entomological Society of Southern Africa, Johannesburg, 28 June – 1 July 1993* (Pretoria, South Africa; Entomological Society of Southern Africa), p. 88.
ICIPE, P.O. Box 30772, Nairobi, Kenya.
Biochemical interactions between trypanosomes and their tsetse vectors are being investigated in the search for novel control methods. Factors that influence the differentiation of trypanosomes in the tsetse midgut have been identified as trypsin, lectins, agglutinins and lysins. These factors appear to be related as they are inducible by bloodmeals, they are specifically inhibited by glucosamine or soya bean trypsin inhibitor, and their activities peak at the same time and co-elute on HPLC ion-exchange columns. It is suggested that these factors may reside on the same protein.

8490 **Rossignol, P.A. and Shieh, J.-N., 1993.** Feeding success of

vectors on infected hosts. (Comment.) *Parasitology Today*, **9** (12): 442-443. (Reply by M. Baylis, *Parasitology Today*, **9** (12): 464.)
Department of Entomology, Cordley Hall, Oregon State University, Corvallis, OR 97331-2907, USA.
The importance of a recent study of tsetse bias towards *Trypanosoma congolense*-infected cattle in the field (see *TTIQ*, **16** (4): no. 8069) is acknowledged. However, the mechanism of the bias was not determined and this is attributed partly to experimental design: for example, that it was not possible to separate infection from anaemia as possible causes of tsetse feeding success. It is recommended that future field studies should develop a strict reductionist approach. Attraction should be evaluated independently of probing, probing should be separated from ingestion and so on, so that each step is evaluated and not just the overall process. Elucidating the mechanism of tsetse bias towards infected hosts may be of great consequence in the development of new control techniques. In a reply, one of the authors of the original article reasserts that there was no indication of a role for anaemia in determining tsetse bias.

8491 **Schaub, G.A., 1992.** The effects of trypanosomatids on insects. (Review.) *Advances in Parasitology*, **31**: 255-319.
Department of Special Zoology and Parasitology, Ruhr University, D-4630 Bochum, Germany.
The author divides his review into: behavioural alterations, disturbances of organ systems, effects on pre-adult development times and mortality rates, effects on adult life span and reproduction rate, and synergistic effects of trypanosomatids and other stressors. The article includes a section on the modification of feeding behaviour in tsetse flies infected with *Trypanosoma*; there are other references to African trypanosomes throughout the text but the author concentrates mainly on Stercoraria.

8492 **Wacher, T.J., Rawlings, P. and Snow, W.F., 1993.** Cattle migration and stocking densities in relation to tsetse-trypanosomiasis challenge in The Gambia. *Annals of Tropical Medicine and Parasitology*, **87** (5): 517-524.
ITC, P.M.B. 14, Banjul, Gambia. (Correspondence to Snow.)
The local migration of village N'Dama cattle between two study sites, Niamina East and Bansang, 40 km apart in the inland region of The Gambia, is described. The consequences of seasonal variations in local stocking densities on the epidemiology of African animal

trypanosomiasis are reported. Tsetse abundance at each study site was monitored throughout the study period from trap catches, and cattle censuses at each site were carried out on a monthly basis. Detailed ecological, productivity and health data, including dietary intake and trypanosomiasis prevalence, were collected from selected study herds resident at the two sites and from a third group of (four) herds that migrated annually between the two areas to spend the late dry season period in Niamina East. It was shown that the migration strategy allowed migrants to maintain a high level of green grazing in the diet throughout the year. Cattle were moved to the area of highest tsetse density in the region to obtain this grazing, but it appeared that individual risk of trypanosome infection was diminished by a dilution effect created by locally high livestock densities. Trypanosomiasis prevalences in resident cattle at Niamina East were best correlated with the tsetse catch/trap/day 2 months previously, once this index of tsetse abundance had been corrected to allow for changes in relative stocking density. *Glossina morsitans submorsitans* was the only tsetse species present in significant numbers in the study areas.

8493 **Welburn, S.C., Maudlin, I. and Molyneux, D.H., 1994.** Midgut lectin activity and sugar specificity in teneral and fed tsetse. *Medical and Veterinary Entomology*, **8** (1): 81-87. Tsetse Research Group, Department of Veterinary Medicine, University of Bristol, Langford House, Langford, Bristol BS18 7DU, UK; ibid.; Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK.

Midgut infection rates of *Trypanosoma congolense* in *Glossina palpalis palpalis* and of *T. brucei rhodesiense* in *G. pallidipes* are potentiated by the addition of D+ glucosamine to the infective feed, but not to the levels of superinfection reported for *G. m. morsitans*. *G. p. palpalis* and *G. pallidipes* are shown to possess two trypanocidal molecules: a glucosyl lectin which can be inhibited by D+ glucosamine and a galactosyl molecule inhibited by D+ galactose. Addition of both D+ glucosamine and D+ galactose to the teneral infective feed promotes superinfection of the midgut of *G. p. palpalis*. The glucosyl lectin is specific for rabbit erythrocytes and is present in guts of fed *G. m. morsitans* and *G. p. palpalis*. Titres of lectin activity do not increase substantially after the second bloodmeal. The galactosyl-specific molecule does not show any erythrocyte specificity, although haemolytic

activity is observed only in *G. p. palpalis* and not in *G. m. morsitans*. The presence of two trypanocidal molecules in some species of tsetse may account for the innate refractoriness of these flies to trypanosome infection. As D+ glucosamine also inhibits the killing of procyclic trypanosomes taken as an infective feed, it is suggested that the midgut lectin is normally responsible for the agglutination of trypanosomes in the fly midgut by binding to the procyclic surface coat, prior to establishment in the ectoperitrophic space.

5. human trypanosomiasis
(a) SURVEILLANCE
[See also **17**: nos. 8454, 8476, 8538.]

8494 **Groof, D. de, Bruneel, H., Mungoma, K. and Ruppol, J.F., 1993.** Une stratégie de lutte contre la trypanosomose à *Trypanosoma brucei gambiense* dans un foyer du Zaire. Association d'un test sérologique et d'un traitement précoce des cas suspects. Résultats préliminaires. [Preliminary results of a strategy to control trypanosomiasis due to *T. b. gambiense* in an endemic region of Zaire: the relationship between a serological examination and the early treatment of suspected cases.] *Bulletin de la Société de Pathologie exotique*, **86** (4): 260-263.

Coopération Médicale Belge, B.P. 457, Niamey, Niger; Bureau Central de la Trypanosomose, Kinshasa, Zaire; ibid.; Secteur Médical, Ambassade de Belgique, Kigali, Rwanda.

The authors report results obtained after combination of a serological diagnostic test and the early treatment of suspected cases (a person with a positive serological test without parasitological confirmation) in an area in Zaire where sleeping sickness caused by *T. b. gambiense* is endemic. The serological test used was Testryp CATT, which has a very high sensitivity and quite a high specificity, is easy to handle in the field and permits results to be obtained on the spot. The treatment employed was diminazene aceturate which is active in the first stage of the disease (haematolymphatic stage), has few side effects and is easy to administer. This strategy was applied for 1 year in the Fankana-Kalakitini focus in the Bandundu region of Zaire. The entire population was examined with the classical methods and with Testryp CATT every 6 months. Individuals positive for the serological test (but negative for the parasite) received one

injection of diminazene aceturate while those in whom parasites were found received classical treatment, i.e. suramin and pentamidine in the haematolymphatic stage and melarsoprol in the nervous stage. After this period, there was a clear decline in the incidence rate of new cases (parasite positive) and also in seropositivity rates in the general population. The authors believe that in a circumscribed area where the disease is endemic, the combination of a serological test and early treatment of suspected cases can rapidly diminish the incidence of the disease to an acceptable level.

8495 **Laveissière, C. and Meda, H., 1993.** Equipes mobiles ou agents de santé: quelle stratégie contre la maladie du sommeil? [Mobile teams or community health workers: which strategy against sleeping sickness?] (Editorial.) *Annales de la Société belge de Médecine tropicale*, **73** (1): 1-6.
IPR/OCCGE, B.P. 1500, Bouaké, Côte d'Ivoire.
The future of sleeping sickness control in Africa is questioned: at the present time the disease is in resurgence, mobile surveillance and control teams are not fully operational and field work is limited by economic constraints. It is proposed that instead of mobile teams surveillance networks should be established, using community health workers who are motivated and trained to undertake serological surveys and to assess the level and extent of the disease. The intervention of specialised services would be more effective if it could be aimed at areas at particular risk. If necessary, the services of community health workers could also be used for vector control. A trial network was set up in the rural health zone of Issia in the forest zone of Côte d'Ivoire in October 1992. A screening laboratory was established and 24 community health workers were trained to undertake a population census, trypanosomiasis surveillance (using Testryp CATT) and confirmation and treatment of suspected cases. A rapid evaluation of the prevalence and distribution of trypanosomiasis in the Issia area was achieved.

8496 **Olaho-Mukani, W., Nyang'ao, J.M.N., Ngaira, J.M., Omuse, J.K., Mbwabi, D., Tengekyon, K.M., Njenga, J.N. and Igweh, A.C., 1994.** Immunoassay of circulating trypanosomal antigens in sleeping sickness patients undergoing treatment. *Journal of Immunoassay*, **15** (1): 69-77.
Olaho-Mukani: KETRI, P.O. Box 362, Kikuyu, Kenya.
Sera from 99 patients infected with *Trypanosoma brucei*

rhodesiense and undergoing treatment were analysed for circulating trypanosomal antigens using a sandwich antigen-trapping ELISA. Trypanosomal antigens were detected in 83 (84%) of the patients. Post-treatment antigen profiles in 67 patients showed five distinct patterns: in 48% of the patients, antigen levels remained elevated throughout the time of hospitalisation and follow-up; in 31%, antigens had dropped to the negative value by the second month; in 7.5%, antigens dropped to the negative level and became elevated afterwards; in 7.5%, antigen levels were negative initially but later became elevated and remained so throughout the observation period; in 6%, antigen levels remained below the negative value throughout. All patients who relapsed on follow-up had earlier shown evidence of elevated antigen profiles. There were no cases of relapses among 21 patients whose antigen levels dropped subsequent to treatment. This ELISA trypanosome antigen detection test could be useful in evaluating treatment success, when used together with parasitological diagnostic techniques.

(b) PATHOLOGY AND IMMUNOLOGY

8497 **Reincke, M., Allolio, B., Petzke, F., Heppner, C., Mbulamberi, D., Vollmer, D., Winkelmann, W. and Chrousos, G.P., 1993.** Thyroid dysfunction in African trypanosomiasis: a possible role for inflammatory cytokines. *Clinical Endocrinology,* **39** (4): 455-461.

Reincke, Allolio: Department of Medicine, University of Würzburg, Josef-Schneider-Strasse 2, D-97080 Würzburg, Germany; Petzke, Heppner, Vollmer, Winkelmann: Department of Medicine II, University of Köln, Köln, Germany; Mbulamberi: Uganda National Sleeping Sickness Control Programme, P.O. Box 1241, Jinja, Uganda; Chrousos: Developmental Endocrinology Branch, National Institute of Child Health and Human Development, Bethesda, Maryland, USA.

The function of the hypothalamic-pituitary-thyroid axis was evaluated before, during and after therapy in haemolymphatic sleeping sickness patients receiving suramin i.v., in cerebral cases receiving melarsoprol and in controls in Uganda. All subjects were injected with 400 μg thyroid releasing hormone (TRH) i.v. and blood samples were examined for fT3, fT4, serum thyroid hormone level (TSH), reverse T3, tumour necrosis factor (TNF-α), interleukin-1 (IL-1) and IL-6 at 0 min, and for TSH at 60 min. Baseline TSH was elevated in unmedicated patients whereas fT3 and fT4 concentrations

were low. Stimulated TSH concentrations did not differ significantly from controls. Reverse T3 concentrations were normal. During treatment, baseline TSH, fT3 and fT4 concentrations slowly returned to normal. Plasma concentrations of TNF-α and IL-6, but not IL-1β, were elevated when thyroid impairment and disease activity were maximal but gradually decreased with therapy. Unmedicated sleeping sickness appears to be associated with a significant impairment of thyroid function which is reversed with therapy. Increased TSH concentrations and low fT3 and fT4 concentrations suggest primary hypothyroidism but an additional pituitary and/or hypothalamic component may be involved. This impairment may be due to elevated plasma cytokine concentrations or it may be the result of parasitic thyroiditis.

8498 **Reincke, M., Heppner, C., Petzke, F., Allolio, B., Arlt, W., Mbulamberi, D., Siekmann, L., Vollmer, D., Winkelmann, W. and Chrousos, G.P., 1994.** Impairment of adrenocortical function associated with increased plasma tumor necrosis factor-alpha and interleukin-6 concentrations in African trypanosomiasis. *Neuro-immunomodulation*, **1** (1): 14-22.

Reincke, Allolio: Department of Medicine, University of Würzburg, Josef-Schneider-Strasse 2, D-97080 Würzburg, Germany; Heppner, Petzke, Arlt, Vollmer, Winkelmann: Department of Medicine II, University of Köln, Köln, Germany; Siekmann: Department of Clinical Biochemistry, University of Bonn, Bonn, Germany; Mbulamberi: Uganda National Sleeping Sickness Control Programme, P.O. Box 1241, Jinja, Uganda; Chrousos: Developmental Endocrinology Branch, National Institute of Child Health and Human Development, Bethesda, Maryland, USA.

The function of the hypothalamic-pituitary-adrenal axis in Ugandan sleeping sickness patients before, during and after therapy was investigated. The standard adrenocorticotropic hormone (ACTH) stimulation test was used to assess the maximal adrenocortical responsiveness of patients: this demonstrated paradoxically subnormal cortisol responses before suramin therapy which improved with suramin and/or melarsoprol therapy. A human corticotropin releasing hormone (hCRH) test was performed on a different group of patients: ACTH and cortisol responses to hCRH were blunted, suggesting the presence of secondary adrenal insufficiency. First cortisol and then ACTH responsiveness improved with therapy, indicating an additional primary component of adrenal dysfunction.

Plasma concentrations of tumour necrosis factor (TNF)-α and inter-leukin (IL)-6, but not IL-1β, were elevated in patients but decreased with therapy. Unmedicated sleeping sickness appears to be associated with impairment of the adrenocortical function, which may be due to elevated plasma cytokine concentrations and may represent a natural adaptation to inflammatory states.

(c) TREATMENT

[See also **17**: nos. 8494, 8496.]

8499 **Groof, D. de, Bruneel, H., Musumari, T.S. and Ruppol, J.F., 1992.** Traitement de la maladie du sommeil à *Trypanosoma brucei gambiense* avec le DL-alpha-difluorométhylornithine (DFMO) dans un hôpital rural au Zaïre. [Treatment of *T. b. gambiense* sleeping sickness with DL-alpha-difluoromethylornithine (DFMO) in a rural hospital in Zaire.] *Médecine tropicale*, **52** (4): 369-375.

Coopération Médicale Belge au Zaire (Groof) and Lutte contre la Maladie du Sommeil (Bruneel, Musumari), Bagata, Bandundu, Zaire; Bureau Central de la Trypanosomiase, Kinshasa, Zaire.

The results of treating 32 *gambiense* sleeping sickness patients (five new cases, one reinfection and 26 cases of primary or secondary resistance or relapse) are reported. Twenty-six patients were given only oral DFMO (300 mg/kg/day for 4 weeks) while the other six received i.v. DFMO (400 mg/kg/day for 2 weeks) followed by oral DFMO (300 mg/kg/day for 3 weeks). Side effects were never serious enough to necessitate discontinuation of treatment. Twelve cases were followed for a period of 24 months, 16 for a period between 1 and 18 months, and four patients died during the study (three during treatment and one 8 months afterwards), but DFMO was not thought to be the cause of death. Out of the 12 cases followed for 2 years, 11 were in perfect health at the end of this period (one case may have been a secondary resistance to DFMO, but could have been a reinfection). All the 16 cases followed for a period of less than 2 years showed a very fast disappearance of trypanosomes from ganglia, blood and CSF immediately after the beginning of treatment, and a rapid and often impressive improvement in clinical signs. DFMO given orally appeared to provide as good results as DFMO given in a combined therapy, and seems much easier to administer in rural areas.

8500 **Hamon, J.-F. and Camara, P., 1992.** Etude électroencéphalographique chez des trypanosomés en

phase méningoencéphalitique de la trypanosomiase humaine africaine à *Trypanosoma brucei gambiense* avant et après un traitement à la DL-alphadifluorométhylornithine hydrochloride monohydratée (DFMO). [Electroencephalographic study of patients in the meningoencephalitic phase of *T. b. gambiense* human African trypanosomiasis before and after DL-alphadifluoro-methylornithine (DFMO) therapy.] *Bulletin de la Societé de Pathologie exotique*, **85** (5): 378-384.
Laboratoire de Psychologie Expérimentale et Comparée, Faculté des Lettres et des Sciences Humaines, Université de Nice Sophia-Antipolis, 98 boulevard Édouard-Herriot, B.P. 369, 06007 Nice Cedex, France; Laboratoire de Physiologie Animale et de Psychophysiologie, Faculté des Sciences et des Techniques d'Abidjan, B.P. 582, Abidjan 22, Côte d'Ivoire.
The aim of the study was to assess the effects of DFMO on the waking electroencephalogram (EEG) of 25 patients at the meningoencephalitic stage of human African *gambiense* trypanosomiasis, six of whom had been previously treated with and were considered refractory to melarsoprol. DFMO was administered i.v. at a dose of 400 mg/kg/day for 14 days, followed by oral treatment at a dose of 300 mg/kg/day for 21 days. EEG data were performed before, then 15 days after the end of the therapy. Initially tracings presented diversified abnormalities which have been classified into four groups: intermittent delta waves, generalised delta waves, low voltage background, and paroxistic activities. After treatment, recordings showed an improvement but, as with melarsoprol, tracings did not return completely to normal patterns. In most of the patients, therapy was associated with clinical improvement and in all but one with disappearance of trypanosomes. Marked improvement in the recordings of the patient who presented trypanosomes in his CSF samples suggest he was responsive to the treatment and would perhaps have benefited from continuation of therapy. The use of EEG investigation as a means of monitoring treatment of patients with trypanosomiasis is discussed.

6. animal trypanosomiasis
(a) SURVEY AND DISTRIBUTION

8501 **Dargie, J.D., Ooijen, C.J.P.G. and Plaizier, J.C.B., 1993.** The FAO/IAEA DGIS coordinated research programmes on trypanosomiasis diagnosis and animal production in

Africa. (Review.) *Veterinary Quarterly*, **15** (2): 75-78.
Animal Production and Health Section, Joint FAO/IAEA Division, Vienna International Centre, P.O. Box 100, Vienna, Austria; ibid.; Department of Animal Science, University of Guelph, Guelph, Ontario N1G 2WJ, Canada.
In 1987 the Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture was funded by the Netherlands Directorate General of Development Cooperation (DGIS) to implement two coordinated research programmes, one of which (entitled `Improving the diagnosis and control of trypanosomiasis and other vector-borne diseases of African livestock using immunoassay methods') brought together staff from ten African national research centres, ILRAD and CTVM. The aims of this programme were to validate antigen-detection ELISAs (Ag-ELISAs) against other techniques for the diagnosis of bovine and camel trypanosomiases and then to use the tests to monitor the effectiveness of national control programmes. The main achievements of the programme are reviewed. The provision of standardised equipment and reagents in kit form, training and other inputs greatly improved the efficiency of national control systems, particularly in situations where the presence of trypanosomes could not be detected by conventional parasitological techniques. On Zanzibar island, for example, Ag-ELISA indicated a 12% prevalence of infection in an area reported as trypanosomiasis-free for 3 years as a result of control activities.

8502 **Diall, O., Bocoum, Z., Diarra, B., Sanogo, Y., Coulibaly, Z. and Waïgalo, Y., 1993.** Épidémiologie de la trypanosomose à *T. evansi* chez le dromadaire au Mali: résultats d'enquêtes parasitologiques et cliniques. [Epidemiology of trypanosomiasis due to *T. evansi* in the dromedary camel in Mali: results of parasitological and clinical surveys.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **46** (3): 455-461.
Laboratoire Central Vétérinaire de Bamako, B.P. 2295, Bamako, Mali; ibid.; ibid.; ibid.; ibid.; Direction Regionale de l'Elevage de Gao, Gao, Mali.
An epidemiological study of trypanosomiasis was conducted in the rearing areas of dromedary camels in Mali. According to the parasitological and clinical surveys performed, the overall infection rates were 9.5% (29/305) in Western Sahel (region I) and 4.5% (28/627) in the areas of Tombouctou and Gao (region II). The proportion of contaminated herds was 55% in region I and 68% in region II and in some herds the

infection rate exceeded 50%. The surveys showed a trend for increasing parasitological prevalence with age. While it was almost nonexistent in young camels less than 1 year old, it increased with age and reached a maximum in 2 to 5 year old camels. The infection was shown to have a significantly negative effect on PCV and on the overall status of the animals, confirming the pathogenicity of *Trypanosoma evansi* in dromedary camels. This trypanosome is almost the only species detected in the dromedary camel in Mali and it does not seem to cause infections in other animals reared in the same environment.

8503 **Majiwa, P.A.O., Thatthi, R., Moloo, S.K., Nyeko, J.H.P., Otieno, L.H. and Maloo, S., 1994.** Detection of trypanosome infections in the saliva of tsetse flies and buffy-coat samples from antigenaemic but aparasitaemic cattle. *Parasitology*, **108** (3): 313-322.

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

Relatively simple protocols employing non-radioactive DNA probes have been used for the detection of African trypanosomes in the blood of mammalian hosts and the saliva of live tsetse flies. In combination with the polymerase chain reaction (PCR), the protocols revealed trypanosomes in buffy-coat samples from antigenaemic but aparasitaemic cattle and in the saliva of live, infected tsetse flies. Furthermore, the protocols were used to demonstrate concurrent natural infections of single tsetse flies with different species of African trypanosomes.

8504 **Nantulya, V.M., 1994**. Suratex$^{\varepsilon}$: a simple latex agglutination antigen test for diagnosis of *Trypanosoma evansi* infections (surra). *Tropical Medicine and Parasitology*, **45** (1): 9-12.

Brentec Diagnostics, P.O. Box 42477, Nairobi, Kenya.

Suratex, a simple field-orientated latex agglutination test, detected *T. evansi* antigens in 53 of 60 (88.3%) serial blood samples collected from experimentally infected rabbits. By comparison, the buffy coat technique and wet blood film examination diagnosed the infection in only 22 (36.7%) and two (3.3%) of the samples respectively. The analysis of field sera from camel herds experiencing a *T. evansi* outbreak demonstrated the superior sensitivity of Suratex: 30 of a herd of 32 (94.0%) tested positive for antigens, compared with only five (15.6%) which were diagnosed by the buffy coat technique. In a second herd of 60 camels, Suratex showed all 60 to be infected whereas mouse inoculation diagnosed infection in only 28

(46.7%). There was a high degree of correlation between parasitological results and those obtained with Suratex.

(b) PATHOLOGY AND IMMUNOLOGY

8505 **Egbe-Mwiyi, T.N.C., Antia, R.E. and Onyeyili, P.A., 1993.** Assessing hepatic dysfunction in splenectomised dogs experimentally infected with *T. b. brucei*. *Bulletin of Animal Health and Production in Africa*, **41** (2): 105-109.
Departments of Veterinary Pathology (Egbe-Mwiyi) and Veterinary Physiology and Pharmacology (Onyeyili), University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria; Antia: Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria.
Twenty adult mongrel dogs of both sexes were used to assess hepatic dysfunction. Ten of the dogs were splenectomised while the rest were not. Five dogs each from the splenectomised and intact groups were inoculated i.v. with *Trypanosoma brucei brucei* strain 8/18 while uninoculated dogs served as controls. All the infected animals developed trypanosomiasis from day 4 to day 7 p.i. Splenectomy was observed to shorten the pre-patent period and enhanced parasitaemia. The plasma fibrinogen and cholesterol levels were increased in the infected groups. Treatment of the infected dogs with diminazene aceturate at a dose rate of 7.0 mg/kg body weight on day 21 p.i., although effective in eliminating the infection within 24 h, did not immediately reduce the elevated fibrinogen and cholesterol levels which were attributed to hepatic dysfunction.

8506 **El-Sergany, M.A., Soufy, H., Lotfi, M.M., Hassanain, M.A., Nassar, A.M., Mohamed, L.A. and Shash, S., 1991.** Lymphadenitis in Egyptian camels with special reference to bacteriological and parasitological affections. *Egyptian Journal of Comparative Pathology and Clinical Pathology*, **4** (1): 25-45.
Faculty of Veterinary Medicine, Cairo University, Cairo, Egypt.
Lymphadenitis was diagnosed in 64 of 107 (59.8%) Egyptian camels. Haematological examination of the affected animals revealed leukocytosis and neutrophilia in acute, suppurative and chronic lymphadenitis, leukocytosis and lymphocytosis in chronic lymphadenitis, a decrease in erythrogram in addition to leukocytosis, neutrophilia, and monocytosis in parasitic lymphadenitis. *Trypanosoma evansi* was recorded in 2.8% of the investigated camels. *Theileria* species

and a variety of bacteria were also isolated from camels showing different types of lymphadenitis.

8507 **Flynn, J.N., McKeever, D.J., Sileghem, M. and Naessens, J., 1994.** Modulation of the phenotype and function of bovine afferent lymph cells during infection with *Trypanosoma congolense*. *Veterinary Immunology and Immunopathology*, **40** (1): 17-29.

Flynn: Department of Veterinary Pathology, University of Glasgow, Bearsden Road, Glasgow G61 1QH, UK.

Alterations in the phenotype and function of cells isolated from bovine afferent lymph were studied following tsetse-transmitted *T. congolense* infection. Little alteration was observed in the output of the CD2+ T cells in the lymph, and within this population the CD4:CD8 ratio remained relatively constant. By contrast, a marked decrease was observed in the output of $\gamma\delta$ T cells over the first 7 days following infection. The number of B cells increased between 2 and 6 days p.i. and thereafter returned to pre-infection values. Little change was observed within the afferent lymph veiled cell population. Examination of activation markers on the lymphocyte fraction of afferent lymph revealed a decrease in the number of cells expressing the interleukin-2 receptor α-chain from day 5 p.i. At this time the expression of ACT 1, another early activation marker, was seen to increase. Afferent lymph cells collected pre-infection and on the first 4 days p.i. proliferated in response to stimulation with concanavalin A *in vitro*. This response to mitogenic stimulation was completely abrogated from day 5 p.i. However, these cells were not capable of suppressing the capacity of normal peripheral blood mononuclear cells to respond to mitogenic stimulus in co-culture assays. These studies suggest that although a degree of lymphocyte activation occurs in the afferent lymph following tsetse-transmitted infection with *T. congolense*, this may be sub-optimal owing to the immunosuppression which appears to operate at the level of the skin and the lymph nodes.

8508 **Payne, R.C., Sukanto, I.P., Bazeley, K. and Jones, T.W., 1993.** The effect of *Trypanosoma evansi* infection on the oestrous cycle of Friesian Holstein heifers. *Veterinary Parasitology*, **51** (1-2): 1-11.

Payne, Jones: CTVM, Easter Bush, Roslin, Midlothian EH25 9RG, UK; Sukanto, Bazeley: Research Institute for Veterinary Science, Bogor, West Java, Indonesia. (Correspondence to Jones.)

The effect of *T. evansi* infection on oestrous cycling was

studied in 12 Friesian Holstein heifers. In phase 1 of the investigation, six heifers were infected with *T. evansi*; the remaining six acted as uninfected controls. Daily body temperature, PCV and parasitaemia measurements were obtained from each animal for 90 days. The animals were examined for external signs of oestrous activity twice daily, blood samples were taken three times a week and subjected to an enzyme-linked immunosorbent assay to detect plasma progesterone. Body weights were measured weekly. Parasites were eliminated by trypanocidal drug treatment 90 days after infection. In phase 2 of the trials, the uninfected heifers were injected with a different stock of parasites and monitoring was continued as before. Infection with *T. evansi* resulted in a marked reduction in the rate of weight gain, an increase in body temperature and a fall in PCV value. Eleven of the heifers continued to cycle normally for the duration of the study, irrespective of their infective status. One animal which stopped cycling lost 16.2% of its pre-infection body weight as a result of the infection and cessation of oestrous activity was considered to have been due to weight loss.

8509 **Sileghem, M., Flynn, J.N., Logan-Henfrey, L. and Ellis, J., 1994.** Tumour necrosis factor production by monocytes from cattle infected with *Trypanosoma (Duttonella) vivax* and *Trypanosoma (Nannomonas) congolense*: possible association with severity of anaemia associated with the disease. *Parasite Immunology*, **16** (1): 51-54.

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

Plasma of cattle infected with *T. vivax* IL 2337 was analysed for the presence of bovine tumour necrosis factor (TNF) by EIA in which TNF was captured by a monoclonal antibody (MoAb BC9) and detected by a rabbit polyclonal antiserum. At week 2-3 p.i. only a low activity was detected. Therefore, an alternative approach was used in which TNF production was measured *ex vivo*. Monocytes from *T. vivax* IL 2337-infected cattle manifested a strong TNF production which peaked around week 2.5 p.i. Monocytes from pre-infection controls did not produce significant concentrations of TNF. In contrast to the strong production of TNF by monocytes from cattle infected with *T. vivax* IL 2337, TNF production was not detected from monocytes of cattle infected with *T. congolense* ILNat 3.1. Trypanosomiasis due to these parasites differs in the degree of anaemia as indicated by PCV. *T. vivax* IL 2337 causes a severe, acute PCV fall whereas *T. congolense* ILNat 3.1 causes a

more gradual fall in PCV.

(c) TRYPANOTOLERANCE

[See also **17**: nos. 8450, 8486.]

8510 **Bradley, D.G., MacHugh, D.E., Loftus, R.T., Sow, R.S., Hoste, C.H. and Cunningham, E.P., 1994.** Zebu-taurine variation in Y chromo-somal DNA: a sensitive assay for genetic introgression in West African trypanotolerant cattle populations. *Animal Genetics*, **25** (1): 7-12.

Bradley: Department of Genetics, Trinity College, Dublin 2, Eire.

Owing to increasing scientific and agricultural interest in the disease-resistant (trypanotolerant) indigenous cattle breeds of West and Central Africa, there is a need for a rational genetically based description of populations in the region. The greatest threat to the invaluable genetic resource represented by these animals is that of extensive genetic introgression of distantly related zebu cattle from northern populations which do not share their inherited tolerances. Southern blotting with a chromosome Y-specific probe, btDYZ-1 (locus DYZ1), is shown to be a sensitive assay to detect such introgression. Evidence of historical crossbreeding is reported in two important N'Dama populations previously classed as purely taurine.

8511 **Hoste, C.H., Chalon, E., d'Ieteren, G. and Trail, J.C.M., 1992.** *Trypanotolerant livestock in West and Central Africa. Volume 3 – A decade's results*. Addis Ababa; ILCA. xvii + 206 pp. (ILCA Monograph no. 2, vol. 3.) (French version, *Le bétail trypanotolérant en Afrique occidentale et centrale. Volume 3 – Bilan d'une décennie*, published as FAO Animal Production and Health Paper no. 20/3 (1988).)

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

This volume is a continuation of volumes 1 and 2 of the study which were published both as ILCA Monograph no. 2, volumes 1 and 2 (1979), and as FAO Animal Production and Health Paper nos. 20/1 and 20/2 (1980) (see *TTIQ*, **4**: nos. 1548 and 1549). Volume 1 presented the study area and its livestock and a description of trypanotolerant cattle and their productivity. Recommendations and possible locations for further evaluating the production potential and the management and conservation of these livestock breeds were also presented. Volume 2 presented detailed information on trypanotolerant livestock found in each of the 18 countries of the study area. Volume 3 is based on data collected in 1985 and thus presents major results

obtained since the publication of the earlier volumes and updates national data on trypanotolerant livestock. Part 1 analyses populations and their trends between the two surveys, reviews research and development activities, and gives recent information available on the potential and utilisation of trypanotolerant livestock. Part 2 presents recent data for the 18 study countries, as well as for Equatorial Guinea, and highlights major developments since 1977. In 1985 there were an estimated 9.8 million head of trypanotolerant cattle in the 19 West and Central African countries of the study area (4.9 million N'Dama, 2 million Savannah Shorthorn, 0.1 million Dwarf Shorthorn and 2.8 million Zebu ∃ Shorthorn crossbreds). The trypanotolerant sheep and goat populations were estimated at 12 and 20 million respectively. The trypanotolerant cattle population increased at an annual rate of 3.2% over the last 8 years (due mainly to N'Dama) while the small ruminant population remained apparently static. Unexpectedly, a relatively slow rate of crossbreeding increase between Zebu and Shorthorn cattle was seen, despite fears of possible dilution of pure breeds. During the study period, national governments have become increasingly aware of the value of their trypanotolerant livestock populations, and national research policies have focused on the development of pure breeds and traditional livestock production systems.

8512 **Paling, R.W. and Dwinger, R.H., 1993.** Potential of trypanotolerance as a contribution to sustainable livestock production in tsetse affected Africa. (Review.) *Veterinary Quarterly*, **15** (2): 60-67.

Bureau Internationale Contacten, Faculty of Veterinary Medicine, Utrecht University, P.O. Box 80.165, 3508 TD Utrecht, Netherlands; Escuela de Medicina Veterinaria, Universidad Nacional, Apdo 149, 3000 Heredia, Costa Rica.

Vector control and the use of trypanocidal drugs are effective but non-sustainable control methods for trypanosomiasis. The trypanotolerance of N'Dama cattle is reviewed and the use of trypanotolerant livestock is envisaged as an additional and sustainable method of control. N'Dama cattle currently comprise about 6% of the African cattle population and have been shown to have a higher productivity potential at village level than was previously assumed. N'Dama trypanotolerance is an innate characteristic which can be enhanced by improving rearing conditions. The analysis of a large

data base has shown PCV values to be a useful selection criterion for trypanotolerance. Economically sound breeding programmes for increased productivity and trypanotolerance are now feasible. It should soon be possible to accelerate selection by the use of genetic markers and by the introgression of trypanotolerance genes to improve the resistance of other breeds.

8513 **Reduth, D., Grootenhuis, J.G., Olubayo, R.O., Muranjan, M., Otieno-Omondi, F.P., Morgan, G.A., Brun, R., Williams, D.J.L. and Black, S.J., 1994.** African buffalo serum contains novel trypanocidal protein. *Journal of Eukaryotic Microbiology*, **41** (2): 95-103.
Black: Department of Microbiology, Ohio State University, 484 W. 12th Avenue, Columbus, OH 43210, USA.

The high ability of African buffalo, as compared to domestic cattle, to control infections with *Trypanosoma brucei brucei* ILTat 1.4 organisms did not correlate with the timing or magnitude of parasite surface coat-specific antibody responses and may have resulted from the constitutive presence in buffalo blood of a novel trypanocidal factor. Buffalo plasma and serum contained material that killed bloodstream stage *T. b. brucei, T. b. rhodesiense, T. b. gambiense, T. evansi, T. congolense* and *T. vivax* organisms during 4 h of incubation at 37□C *in vitro*. Serum from eland was also trypanocidal whereas serum from oryx, waterbuck, yellow-back duiker, cattle, horse, sheep, goat, mouse, rat and rabbit was not trypanocidal. The buffalo serum trypanocidal material was not lipoprotein or IgG and had the following properties: (i) a density of > 1.24 g/ml determined by flotation ultracentrifugation; (ii) insolubility in 50% saturated ammonium sulphate; (iii) non-reactivity with anti-bovine IgM and anti-bovine IgG; (iv) non-reactivity with protein G and protein A; (v) a relative molecular mass of 152 kDa determined by chromatography on Sephacryl S 300 and of 133 kDa determined by chromatography of the 50% SAS cut of IgG-depleted buffalo serum on Superose 12; (vi) no associated cholesterol; and (vii) inactivation by digestion with proteinase K that was immobilised on agarose.

8514 **Shugaba, A., Umar, I., Omage, J., Ibrahim, N.D.G., Andrews, J., Ukoha, A.I., Saror, D.I. and Esievo, K.A.N., 1994.** Biochemical differences (*O*-acetyl and glycolyl groups) in erythrocyte surface sialic acids of trypanotolerant N'Dama and trypanosusceptible Zebu cattle. *Journal of Comparative Pathology*, **110** (1): 91-95.
Shugaba: Department of Veterinary Pathology and Microbiology, Ahmadu Bello University, Zaria, Nigeria.

Differences in the distribution and concentration of *O*-acetyl and glycolyl groups in erythrocyte sialic acids of trypanotolerant N'Dama and trypano-susceptible Zebu cattle were investigated. Erythrocyte surface sialic acid concentrations were 25.4 □ 5.5 mg/dl and 5.9 □ 0.97 mg/dl in N'Dama and Zebu animals, respectively. In N'Damas, *O*-acetyl and glycolyl groups were present in concentrations of 16.4 □ 4.3 mg/dl and 12.8 □ 2.9 mg/dl, respectively, whereas the corresponding values in Zebus were 2.8 □ 5.0 mg/dl and 7.6 □ 1.7 mg/dl, respectively. The differences between N'Dama and Zebu cattle in surface sialic acids and in *O*-acetyl and glycolyl groups were significant ($P < 0.01$ to < 0.001). N'Dama erythrocyte sialic acids had more *O*-acetyl than glycolyl groups while those of Zebus had less *O*-acetyl than glycolyl groups. These findings may be relevant to the trypanotolerance of N'Dama cattle.

8515 **Stevens, J., 1993.** Mapping the genes of African cattle. Tanzania Ministry of Agriculture and Livestock Development *Research and Training Newsletter*, **8** (1-2): 22-24. ILRAD, P.O. Box 30709, Nairobi, Kenya.

This popular article describes the research carried out by ILRAD and other members of the African Trypanotolerant Livestock Network to produce trypanotolerant cattle. Breeding trypanotolerant strains such as N'Dama cattle by conventional means will not produce sufficient numbers of resistant stock. Geneticists working on bovine genome projects aim to identify 200 genetic markers for trypanotolerance and other traits that will increase productivity. To produce the cattle needed for gene mapping, trypanotolerant N'Dama bulls were crossed with susceptible Boran cows using embryo transfer technology. The F2 generation will be exposed to trypanosomes and its DNA analysed. The identification of genetic markers will involve `bulked segregant analysis' using random amplified polymorphic DNA markers (RAPDs). The possible trans-ference of trypanotolerant traits from an N'Dama foetus to a Boran foetus simultaneously implanted in a Boran cow is being investigated.

(d) TREATMENT

[See also **17**: no. 8477.]

8516 **Eisler, M.C., Arowolo, R.O.A., Gault, E.A., Moloo, S.K., Holmes, P.H. and Peregrine, A.S., 1994.** Isometamidium concentrations in the sera of Boran cattle: correlation with prophylaxis

against tsetse-transmitted *Trypanosoma congolense*. *Acta Tropica*, **56** (1): 39-50.
Eisler: University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.
Fifteen Boran cattle from a trypanosomiasis-free area were injected i.m. with isometamidium chloride at a dose of 1 mg/kg body weight. Thereafter, the cattle were challenged at monthly intervals with *Glossina morsitans centralis* infected with one of three populations of *Trypanosoma congolense* (IL 3893, IL 3889 or IL 1180) until all animals became infected. Isometamidium concentrations in the sera of these cattle were measured using a competitive enzyme-linked immunosorbent assay over the first 105 days following treatment. All cattle challenged with IL 3893 or IL 3889 developed infection following the first challenge, at which time the mean serum drug concentration in all treated cattle was 6 ng/ml. Cattle challenged with IL 1180 became infected following six to eight monthly challenges. The mean serum drug concentration in these cattle at the time of their third monthly challenge with IL 1180 was 0.75 ng/ml. Trypanosome populations IL 3893 and IL 3889 were considered to be highly resistant to isometamidium, while IL 1180 was relatively sensitive. It was therefore concluded that *T. congolense* persisting at serum isometamidium concentrations greater than 0.75 ng/ml can be considered moderately resistant, while those persisting at concentrations greater than 6 ng/ml can be considered markedly resistant. These results will be most valuable in the investigation of isometamidium resistance of *T. congolense* in the field.

8517 **Mamman, M., Moloo, S.K. and Peregrine, A.S., 1994.** Relapse of *Trypanosoma congolense* infection in goats after diminazene aceturate is not a result of invasion of the central nervous system. *Annals of Tropical Medicine and Parasitology*, **88** (1): 87-88.
ILRAD, P.O. Box 30709, Nairobi, Kenya. (Correspondence to Peregrine.)
Goats infected with *T. congolense* (IL 3274) were cured when given a single 7.0 mg/kg dose of diminazene aceturate i.m. on day 1 of infection but not on day 19, approximately 3 days after the appearance of trypanosomes in the peripheral blood. The parasitaemic profiles of this latter group were similar to those observed when relapse occurs after the survival of parasites in drug inaccessible foci. Lumbar CSF was collected daily by cannulation from 3 days before infection until 3 days after trypanosomes had

reappeared following treatment on day 19 (days 25-27 p.i.). None of the samples contained trypano-somes or trypanosomal antigen, suggesting that the reappearance of *T. congolense* in these goats after treatment was not due to reinvasion from the CNS. The findings do not exclude the possibility that trypanosomes may have survived in sites such as the microcirculation, lymph nodes, spleen, heart or bone marrow.

7. experimental trypanosomiasis

(a) DIAGNOSTICS

8518 **Singh, V. and Chhabra, M.B., 1993.** Counter immuno-electrophoresis for rapid detection of circulating antigens of *Trypanosoma evansi*. [Rabbits.] *Indian Journal of Animal Sciences*, **63** (6): 625-627.

Singh: Department of Veterinary Parasitology, College of Veterinary and Animal Sciences, Gujarat Agricultural University, S.K. Nagar (Dantiwada), Gujarat 385 506, India.

8519 **Waghela, S.D., Kogi, J.K., Kihara, S.M. and Rurangirwa, F.R., [1991?].** Applications of biotechnology in livestock research. *In*: Kenya Agricultural Research Institute, *Agricultural research in Kenya: achievements, challenges and prospects* (Proceedings of the 1st KARI Annual Scientific Conference, Nairobi, Kenya, 14-16 August 1990), pp. 178-185.

National Veterinary Research Centre, KARI, Kabete, Kenya.

Modern biotechnology has provided new techniques for veterinary medicine which are applicable to trypanosomiasis control. These include the use of monoclonal antibodies in diagnostic assays, and DNA probes for the detection of *Trypanosoma* species. The use of these techniques is briefly described. The development of a new generation of subunit vaccines, including anti-idiotypic vaccines, may provide effective vaccines for many parasitic diseases. Immunisation with an anti-idiotypic vaccine has protected mice against infection with *T. brucei rhodesiense*, but these vaccines are limited by their specificity and low immunogenicity.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **17**: nos. 8519, 8533, 8544.]

8520 **Alafiatayo, R.A., Cookson, M.R. and Pentreath, V.W., 1994.** Production of prostaglandins D_2 and E_2 by mouse fibroblasts and astrocytes in culture caused by *Trypanosoma brucei brucei* products and endotoxin. *Parasitology Research*, **80** (3): 223-229.

Alafiatayo: Department of Biological Sciences, University of Salford, Salford M5 4WT, UK.

8521 **Bentivoglio, M., Grassi-Zucconi, G., Peng, Z.-C., Bassetti, A., Edlund, C. and Kristensson, K., 1994.** Trypanosomes cause dysregulation of c-fos expression in the rat suprachiasmatic nucleus. [*T. b. brucei.*] *Neuroreport*, **5** (6): 712-714.
Kristensson: Division of Neurodegenerative Disease Research, Department of Neuroscience, Karolinska Institute, S-10401 Stockholm 60, Sweden.

8522 **Fakae, B.B., Harrison, L.J.S., Ross, C.A. and Sewell, M.M.H., 1994.** *Heligmosomoides polygyrus* and *Trypanosoma congolense* infections in mice: a laboratory model for concurrent gastrointestinal nematode and trypanosome infections. *Parasitology*, **108** (1): 61-68.
Harrison: CTVM, Easter Bush, Roslin, Midlothian EH25 9RG, UK.

8523 **Gould, S.S. and Castro, G.A., 1994.** Suppression by *Trypanosoma brucei* of anaphylaxis-mediated ion transport in the small intestine of rats. *Immunology*, **81** (3): 468-474.
Castro: Department of Physiology and Cell Biology, University of Texas Medical School, P.O. Box 20708, Houston, TX 77225, USA.

8524 **John, M.C., Neduhchelliyan, S. and Venkataraman, K.S., 1993.** Studies on the effect of temperature on the course of *Trypanosoma evansi* infection. [Mice.] *Indian Veterinary Journal*, **70** (8): 776-778.
John: Department of Laboratory Animal Medicine, Madras Veterinary College, Madras - 600007, India.

8525 **Montmayeur, A. and Buguet, A., 1994.** Time-related changes in the sleep-wake cycle of rats infected with *Trypanosoma brucei brucei*. *Neuroscience Letters*, **168** (1-2): 172-174.
Montmayeur: Centre de Recherches du Service de Santé des Armées Emile Parde, B.P. 87, F-38702 La Tronche Cedex, France.

8526 **Pentreath, V.W., 1994.** Endotoxins and their significance for murine trypanosomiasis. [Incl. *T. brucei*.] *Parasitology Today*, **10** (6): 226-229.
Department of Biological Sciences, University of Salford, Salford M5 4WT, UK.

8527 **Shapiro, S.Z., 1994.** Failure of immunization with trypanosome endo-cytotic vesicle membrane proteins to provide nonvariant immuno-protection against *Trypanosoma brucei*. [Rabbits.] *Parasitology Research*, **80** (3): 240-244.

Laboratory for Retrovirus Research, Building 29A, Room 3D2, CBER/FDA, Bethesda, MD 20892, USA.

8528 **Shapiro, S.Z., Thulin, J.D. and Morton, D.G., 1994.** Periocular and urogenital lesions in mice (*Mus musculus*) chronically infected with *Trypanosoma brucei*. *Laboratory Animal Science*, **44** (1): 76-78.
Shapiro: Department of Veterinary Pathobiology, College of Veterinary Medicine, University of Illinois, Urbana, IL 61801, USA.

8529 **Soudan, B., Tetaert, D., Hublart, M., Racadot, A., Croix, D. and Boersma, A., 1993.** Experimental `chronic' African trypanosomiasis: endocrine dysfunctions generated by parasitic components released during the trypanolytic phase in rats. [*T. brucei*.] *Experimental and Clinical Endocrinology*, **101** (3): 166-172.
Boersma: Unité INSERM no. 16, Place de Verdun, F-59045 Lille Cedex, France.

8530 **Sternberg, J., Mabbott, N., Sutherland, I. and Liew, F.Y., 1994.** Inhibition of nitric oxide synthesis leads to reduced parasitemia in murine *Trypanosoma brucei* infection. *Infection and Immunity*, **62** (5): 2135-2137.
Sternberg: Department of Zoology, University of Aberdeen, Aberdeen AB9 2TN, UK.

8531 **Uche, U.E. and Jones, T.W., 1994.** Protection conferred by *Trypano-soma evansi* infection against homologous and heterologous trypano-some challenge in rabbits. *Veterinary Parasitology*, **52** (1-2): 21-35.
Uche: Royal Veterinary College, University of London, Royal College Street, London NW1 0TU, UK.

(c) CHEMOTHERAPEUTICS

[See also **17**: nos. 8546, 8550, 8554.]

8532 **Bacchi, C.J., Nathan, H.C., Yarlett, N., Goldberg, B., McCann, P.P., Sjoerdsma, A., Saric, M. and Clarkson, A.B., 1994.** Combination chemotherapy of drug-resistant *Trypanosoma brucei rhodesiense* infections in mice using DL-α-difluoromethylornithine and standard trypanocides. *Antimicrobial Agents and Chemotherapy*, **38** (3): 563-569.
Bacchi: Haskins Laboratories, Pace University, 41 Park Row, New York, NY 10038-1502, USA.

8533 **Berger, B.J. and Fairlamb, A.H., 1992.** Interactions between immunity and chemotherapy in the treatment of the trypanosomiases and leishmaniases. *Parasitology*, **105** (Suppl.): S71-S78.
Department of Medical Parasitology, LSHTM, Keppel Street, London WC1E 7HT, UK.
The relationship between the host immune system and

chemotherapy in the treatment of trypanosomiases is reviewed. In animal models suramin and quinapyramine appear to require an intact immune system for the rapid removal of trypanosomes from the bloodstream, but the precise mechanism remains unclear. The immune system has also been shown to play a significant role in the effectiveness of DFMO chemotherapy in African trypanosomiasis: the drug was unable to clear *Trypanosoma brucei* sspp. infections in immunosuppressed mice. It was concluded that antibody was necessary to remove DFMO-treated trypanosomes from the bloodstream and the successful treatment of athymic mice showed the antibody response to be T cell-independent. The inhibition of macromolecular synthesis, including VSG, by DFMO could be an important component of the relationship between DFMO and an effective antibody response. An antibody response may also be important in treatment with melarsoprol (Mel B) or oxophenarsine. Repeated subcurative treatment with Cymelarsan, Berenil or isometamidium led to the development of drug resistant trypanosomes only in immunosuppressed animals, suggesting that the state of the host immune system is important in the development of drug resistance.

8534 **Jernigan, J.A. and Pearson, R.D., 1993.** Chemotherapy of leish-maniasis, Chagas' disease and African trypanosomiasis. (Review.) *Current Opinion in Infectious Diseases*, **6** (6): 794-802.

Pearson: Box 485, Department of Medicine, University of Virginia Health Sciences Center, Charlottesville, VA 22908, USA.

8535 **Omholt, P.E., Cox, B.A., Prine, L.C., Byrd, S., Yielding, L.W. and Yielding, K.L., 1993.** Use of drug-specific antibodies to identify ethidium adducts produced in *Trypanosoma brucei* by photoaffinity labelling. *Acta Tropica*, **55** (4): 191-204.

Department of Human Biological Chemistry and Genetics, Pharmacology and Toxicology, and Internal Medicine, 5.108 Administration Building A 32, University of Texas Medical Branch, Galveston, TX 77550, USA. (Correspondence to K.L. Yielding.)

8. trypanosome research

(a) CULTIVATION OF TRYPANOSOMES

[See also **17**: no. 8578.]

8536 **Hirumi, H. and Hirumi, K., 1994.** Axenic culture of African trypano-some bloodstream forms. [*T. brucei, T. congolense, T. vivax.*] (Review.) *Parasitology Today*, **10** (2): 80-84.

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

8537 **Mihok, S., Munyoki, E.N., Masaninga, F., Ndegwa, P.N. and Olubayo, R.O., 1994.** Isolation of *Trypanosoma* spp. from wild tsetse flies through procyclic expansion in *Glossina morsitans centralis*. *Acta Tropica*, **56** (1): 25-37.
Mihok: ICIPE, P.O. Box 30772, Nairobi, Kenya.
Procyclic trypanosomes from wild tsetse flies were membrane-fed to *Glossina morsitans centralis* in order to develop an optimal technique for propagating field isolates. A 70% success rate was achieved in isolating *Trypanosoma simiae* and a variety of genotypes of *T. congolense* originating from *G. pallidipes, G. brevipalpis* and *G. swynnertoni*. Parasites matured into forms infective for mammals, and could be maintained by passage of gut forms to new groups of flies. In experiments with laboratory stocks, we also passaged immature gut infections of *T. congolense* and *T. brucei* from various tsetse species to *G. m. centralis*. The optimal technique was investigated for procyclic *T. congolense* through addition of various compounds to goat blood using *G. m. centralis* and *G. m. morsitans* as recipients. From these experiments, many approaches to procyclic expansion appeared possible. However, a simple and practical method based on the use of fresh goat blood for rapid feeding of *G. m. centralis* is recommended. Application of this technique should aid in the resolution of questions relating to the cryptic diversity of *Nannomonas* trypanosomes in diverse host and vector communities.

(b) TAXONOMY, CHARACTERISATION OF ISOLATES
[See also **17**: no. 8570.]

8538 **Mathieu-Daude, F., Bicart-See, A., Bosseno, M.-F., Brenière, S.-F. and Tibayrenc, M., 1994.** Identification of *Trypanosoma brucei gambiense* group 1 by a specific kinetoplast DNA probe. *American Journal of Tropical Medicine and Hygiene*, **50** (1): 13-19.
Mathieu-Daude: UMR ORSTOM/CNRA 9926, Genetique Moléculaire des Parasites et des Vecteurs, ORSTOM, 911 Agropolis, B.P. 5045, 34032 Montpellier Cedex 01, France.

8539 **Mathieu-Daude, F. and Tibayrenc, M., 1994.** Isozyme variability of *Trypanosoma brucei s.l.*: genetic, taxonomic, and epidemiological significance. *Experimental Parasitology*, **78** (1): 1-19.
Mathieu-Daude: California Institute of Biological Research, 11099 North Torrey Pines Road, La Jolla, CA 92037, USA.

8540 **Waitumbi, J.N. and Young, J.R., 1994.** Electrophoretic karyotyping is a sensitive epidemiological tool for studying *Trypanosoma evansi* infections. *Veterinary Parasitology*,

52 (1-2): 47-56.
Waitumbi: Laboratoire d'Immunologie et de Parasitologie Moléculaire, Université de Bordeaux II, URA CNRS 1637, 146 rue Léo Saignat, F-33076 Bordeaux Cedex, France.
Thirty-six isolates of *Trypanozoon* trypanosomes collected from camels in northern Kenya during the dry season sporadic infections of 1986 and during the wet season epidemic infections of 1987 were identified as *T. evansi* by the homogeneity of their kinetoplast DNA minicircles. Although the minicircles of all the isolates were indistinguishable, polymorphism in chromosome-sized DNA molecules detected by electrophoresis was extensive. The isolates could be grouped into eight distinct electrophoretic karyotypes which could be distinguished from three additional karyotypes identified among earlier *T. evansi* isolates. In one camel herd with a long history of trypanocide application, which was continued during the present study, all isolates bar one belonged to one karyotype group. From a second herd, in which trypanosomiasis management was by individual treatment of proven parasitaemic cases, isolates with diverse karyotypes were obtained. Some of the karyotypes identified during the dry season sporadic infections were re-isolated in the subsequent wet season epidemic. These observations indicate that distinguishing *T. evansi* isolates by molecular electrophoretic karyotypes is more discriminating than kDNA analysis. Observations of karyotype patterns recurring in isolates from herds kept under chemoprophlaxis could help in the identification of drug-resistant parasites.

(c) LIFE CYCLE, MORPHOLOGY, BIOCHEMICAL AND MOLECULAR STUDIES

8541 **Aline, R.F., Myler, P.J., Gobright, E. and Stuart, K.D., 1994.** Early expression of a *Trypanosoma brucei* VSG gene duplicated from an incomplete basic copy. *Journal of Eukaryotic Microbiology*, **41** (1): 71-78.
Stuart: Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109-1651, USA.

8542 **Allen, T.E. and Ullman, B., 1993.** Cloning and expression of the hypoxanthine-guanine phosphoribosyltransferase gene from *Trypano-soma brucei*. *Nucleic Acids Research*, **21** (23): 5431-5438.
Ullman: Department of Biochemistry and Molecular Biology, Oregon Health Sciences University, Portland, OR 97201-3098, USA.

8543 **Barrett, M.P., Phillips, C., Adams, M.J. and LePage, R.W.F., 1994.** Overexpression in *Escherichia coli* and purification of the 6-phospho-gluconate dehydrogenase of *Trypanosoma brucei*. *Protein Expression and Purification*, **5** (1): 44-49.

Barrett: Laboratoire d'Immunologie et de Parasitologie Moleculaire, Université de Bordeaux II, 146 rue Léo Saignat, 33076 Bordeaux Cedex, France.

8544 **Bastin, P., Coppens, I., Saint-Remy, J.-M., Baudhuin, P., Opperdoes, F.R. and Courtoy, P.J., 1994.** Identification of a specific epitope on the extracellular domain of the LDL-receptor of *Trypanosoma brucei brucei*. *Molecular and Biochemical Parasitology*, **63** (2): 193-202.

Bastin: Cell Biology Unit, Catholic University of Louvain, avenue Hippocrate 75, UCL 75.41, B-1200 Brussels, Belgium.

8545 **Beattie, D.S., Obungu, V.H. and Kiaira, J.K., 1994.** Oxidation of NADH by a rotenone and antimycin-sensitive pathway in the mitochondrion of procyclic *Trypanosoma brucei brucei*. *Molecular and Biochemical Parasitology*, **64** (1): 87-94.

Beattie: Department of Biochemistry, University of Nairobi, Nairobi, Kenya.

8546 **Benaim, G., Lopez-Estraño, C., Docampo, R. and Moreno, S.N.J., 1993.** A calmodulin-stimulated Ca^{2+} pump in plasma-membrane vesicles from *Trypanosoma brucei*; selective inhibition by pentamidine. *Biochemical Journal*, **296** (3): 759-763.

Moreno: Department of Veterinary Pathobiology, University of Illinois, Urbana, IL 61801, USA.

8547 **Benne, R., 1994.** RNA editing in trypanosomes. (Review.) *European Journal of Biochemistry*, **221** (1): 9-23.

E.C. Slater Institute, University of Amsterdam, Academic Medical Centre, Meibergdreef 15, 1105 AZ Amsterdam, Netherlands.

8548 **Bringaud, F. and Baltz, T., 1994.** African trypanosome glucose transporter genes: organization and evolution of a multigene family. [*T. b. brucei*.] *Molecular Biology and Evolution*, **11** (2): 220-230.

Bringaud: Laboratoire d'Immunologie et de Parasitologie Moléculaire, Université de Bordeaux II, URA CNRS 1637, 146 rue Léo Saignat, F-33076 Bordeaux Cedex, France.

8549 **Buxbaum, L.U., 1994.** Myristate exchange in glycolipid A and VSG of African trypanosomes. [*T. brucei*.] *Brazilian Journal of Medical and Biological Research*, **27** (2): 115-119.

Department of Biological Chemistry, Johns Hopkins School of Medicine, 725 N. Wolfe

Street, Baltimore, MD 21217, USA.

8550 **Callens, M., Roy, J. van, Zeelen, J.P., Borchert, T.V., Nalis, D., Wierenga, R.K. and Opperdoes, F.R., 1993.** Selective interaction of glycosomal enzymes from *Trypanosoma brucei* with hydrophobic cyclic hexapeptides. *Biochemical and Biophysical Research Communications*, **195** (2): 667-672.

Opperdoes: Research Unit for Tropical Diseases, International Institute of Cellular and Molecular Pathology, avenue Hippocrate 74.39, B-1200 Brussels, Belgium.

8551 **Cenas, N.K., Arscott, D., Williams, C.H. and Blanchard, J.S., 1994.** Mechanism of reduction of quinones by *Trypanosoma congolense* trypanothione reductase. *Biochemistry*, **33** (9): 2509-2515.

Blanchard: Department of Biochemistry, Albert Einstein College of Medicine, 1300 Morris Park Avenue, Bronx, NY 10461, USA.

8552 **Chapman, A.B. and Agabian, N., 1994.** *Trypanosoma brucei* RNA polymerase II is phosphorylated in the absence of carboxyl-terminal domain heptapeptide repeats. *Journal of Biological Chemistry*, **269** (7): 4754-4760.

Agabian: Intercampus Program in Molecular Parasitology, University of California, San Francisco, CA 94143-1204, USA.

8553 **Corell, R.A., Myler, P. and Stuart, K., 1994.** *Trypanosoma brucei* mitochondrial CR4 gene encodes an extensively edited mRNA with completely edited sequence only in bloodstream forms. *Molecular and Biochemical Parasitology*, **64** (1): 65-74.

Stuart: Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109, USA.

8554 **Cunningham, M.L., Zvelebil, M.J.J.M. and Fairlamb, A.H., 1994.** Mechanism of inhibition of trypanothione reductase and glutathione reductase by trivalent organic arsenicals. *European Journal of Biochemistry*, **221** (1): 285-295.

Fairlamb: Parasite and Vector Biochemistry Unit, Department of Medical Parasitology, LSHTM, Keppel Street, London WC1E 7HT, UK.

8555 **Fantoni, A., Dare, A.O. and Tschudi, C., 1994.** RNA polymerase III-mediated transcription of the trypanosome U2 small nuclear RNA gene is controlled by both intragenic and extragenic regulatory elements. [*T. brucei*.] *Molecular and Cellular Biology*, **14** (3): 2021-2028.

Tschudi: Department of Internal Medicine, Section of Infectious Diseases, Yale University School of Medicine, P.O. Box 20822, 333 Cedar Street, New Haven, CT 06520-8022, USA.

8556 **Gommers-Ampt, J.H., Leeuwen, F. van, Beer, A.L.J. de, Vliegenthart, J.F.G., Dizdaroglu, M., Kowalak, J.A., Crain, P.F. and Borst, P., 1993.** β-D-glucosyl-hydroxymethyluracil: a novel modified base present in the DNA of the parasitic protozoan *T. brucei*. *Cell*, **75** (6): 1129-1136.

Gommers-Ampt: Division of Molecular Biology, Netherlands Cancer Institute, Plesmanlaan 121, 1066 CX Amsterdam, Netherlands.

8557 **Göringer, H.U., Koslowsky, D.J., Morales, T.H. and Stuart, K., 1994.** The formation of mitochondrial ribonucleoprotein complexes involving guide RNA molecules in *Trypanosoma brucei*. *Proceedings of the National Academy of Sciences of the United States of America*, **91** (5): 1776-1780.

Stuart: Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109, USA.

8558 **Gottesdiener, K.M., 1994.** A new VSG expression site-associated gene (ESAG) in the promoter region of *Trypanosoma brucei* encodes a protein with 10 potential transmembrane domains. *Molecular and Biochemical Parasitology*, **63**(1): 143-151.

Department of Medicine, Columbia College of Physicians and Surgeons, Room PH8-Stem, 630 W. 168th Street, New York, NY 10032, USA.

8559 **Güther, M.L.S., Masterson, W.J. and Ferguson, M.A.J., 1994.** The role of glycolipid C in the GPI biosynthetic pathway in *Trypanosoma brucei* bloodstream forms. *Brazilian Journal of Medical and Biological Research*, **27** (2): 121-126.

Güther: Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK.

8560 **Hehl, A., Vassella, E., Braun, R. and Roditi, I., 1994.** A conserved stem-loop structure in the 3′ untranslated region of procyclin mRNAs regulates expression in *Trypanosoma brucei. Proceedings of the National Academy of Sciences of the United States of America*, **91** (1): 370-374.

Institut für Allgemeine Mikrobiologie, Universität Bern, CH-3012 Bern, Switzerland.

8561 **Hide, G., Graham, T., Buchanan, N., Tait, A. and Keith, K., 1994.** *Trypanosoma brucei*: characterization of protein kinases that are capable of autophosphorylation *in vitro*. *Parasitology*, **108** (2): 161-166.

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