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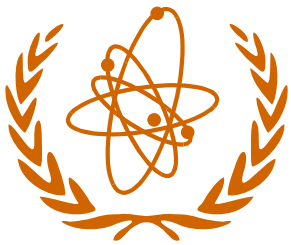

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SECTION B — ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

[See also **15**: no. 7411.]

7355 **Food and Agriculture Organization of the United Nations, 1991.**
Trypanosomiasis control as an element of sustainable agricultural production. (Report of a Meeting of the FAO Panel of Experts on Technical and Ecological Aspects of the Programme for the Control of African Animal Trypanosomiasis and Related Development, Harare, Zimbabwe, 24-26 June 1991.) Rome; FAO. 22 pp.
FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.
More data are needed on trypanosomiasis incidence, its relative importance compared to other animal health problems and the cost effectiveness of control. Control is feasible and justifiable, provided the achievements are sustained and consolidated: this proviso is seldom met. Technical aspects of the diagnosis, treatment and prevention of animal trypanosomiasis and tsetse control, including insecticide, bait and biological techniques and the management of control programmes, are briefly reviewed. Staff training at professional and technical levels is assessed. Research and development must be appropriate to the farming systems involved and there is a need to define objectives more clearly, to avoid duplication and to target priority areas. The complex issues related to efficient land use following successful tsetse control, concerning existing and potential livestock management practices and climatic, social and other factors, need to be understood to avoid rapid and irreversible environmental degradation. Economic analysis can contribute to improved decisions about resource allocation in control operations. Whether the ultimate objective is control or eradication depends on numerous variables, including environmental, economic, technical and motivational aspects. When defining the strategy to be adopted it is necessary to consider all options and the comparative cost/benefits of the anticipated results. The report ends with a list of recommendations.

7356 **Food and Agriculture Organization of the United Nations, 1991.**
Report of the Sixth Session of the Commission on African Animal Trypanosomiasis (Harare, Zimbabwe, 27-28 June 1991). Rome; FAO. 34 pp.
FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.
This commission was established in 1979 to evaluate the progress of the FAO Programme for the Control of African Animal Trypanosomiasis and Related Development

and to advise on planning and implementation aspects. The action taken as a result of the recommendations of the fifth session is summarised. The Programme was discussed under the following headings: technical approach, training, research and development, environmental aspects, economic aspects and information systems and data collection. Recommendations concern the strengthening of national units for effective control, control techniques, staff training, research orientation, environmental considerations, economic aspects and information dissemination. The FAO field programme is briefly described and a list of regional and national projects according to country is given with costs and funding bodies. The relevant activities of other organisations (FAO/IAEA, WHO, OAU/IBAR, ICIPE, ILRAD, RTTCP, ODA, GTZ, TRL and the World Bank) and member nations (Burundi, Cameroon, Côte d'Ivoire, Malawi, Mozambique, Uganda, Tanzania, Zambia and Zimbabwe) are summarised.

7357 **International Laboratory for Research on Animal Diseases, 1991.** *ILRAD 1990: annual report of the International Laboratory for Research on Animal Diseases*. Nairobi; ILRAD. 119 pp.
ILRAD, P.O. Box 30709, Nairobi, Kenya.

This annual report is intended for the general reader and is published in conjunction with the *Annual scientific report* (see **14**: no. 6946). Current problems of trypanosomiasis control include drug resistance, environmental aspects of vector control and low availability and productivity of trypanotolerant animals. Research strategies include the identification of molecular mechanisms that could disrupt parasite development and/or render it more vulnerable to host defences, the development of new therapeutics, the improvement of immune responses in susceptible cattle and the identification of trypanosome antigens as a basis for vaccine research. The Trypanosomiasis Programme conducts research in diagnosis and epidemiology, trypanosome biology including drug resistance and trypanosome genetics, host immune responses, pathogenesis and the genetics of host resistance. Several important advances were made in 1990: ongoing characterisation of parasite molecules has improved understanding of the host immune response, knowledge of parasite genetics has been strengthened and more information was obtained on the role of host cytokines in parasite control. Bovine genome mapping was begun to search for genetic markers identifying

resistant animals for breeding programmes. Details of training programmes and support services are given.

7358 **International Laboratory for Research on Animal Diseases, 1992**. *Annual scientific report 1991*. Nairobi; ILRAD. 118 pp. ILRAD, P.O. Box 30709, Nairobi, Kenya.
This report contains individual research summaries grouped according to programme and project. The Trypanosomiasis Research Programme underwent major organisational change in 1991 although the summaries are grouped under the three major project areas on which the programme was based at the beginning of the year: epidemiology and drug resistance, including the development of DNA probes and other techniques for identifying and characterising trypanosomes; the biology and biochemistry of trypanosomes; and immunology and host resistance, including genetic studies of trypanotolerant cattle. Lists of publications, staff presentations at international meetings and visiting scientists are included.

7359 **International Livestock Centre for Africa, 1991**. *ILCA 1990: annual report and programme highlights*. Addis Ababa; ILCA. 84 pp. ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.
This popular summary of ILCA's achievements in 1990 is intended to complement a more detailed annual report, *ILCA annual programme report 1990*. All 12 isolates of *Trypanosoma congolense* from Zebu cattle in the Ghibe river valley in southwestern Ethiopia showed a high prevalence of trypanosomes resistant to Berenil and homidium chloride, and all but one showed resistance to isometamidium chloride. Studies are under way to determine the extent of this resistance, which is thought likely to become an increasingly serious problem. The ability of cattle to maintain high PCV levels, which is correlated with both trypanotolerance and increased productivity, is heritable and breeding programmes are being evaluated. The ELISA test is being used to identify `antigenaemic' animals which are better able to control parasitaemia and trials suggest that this ability may also be heritable. Other aspects of the Trypanotolerance Thrust programme include epidemiological studies, the effects of trypanosomiasis on animal health and performance, and the biological and economic evaluation of productivity responses to interventions. Lists of research collaborators, staff and publications and a financial summary are appended.

7360 **Marchot, P., Hursey, B. and Hendrickx, G., 1991**. Towards an integrated approach for tsetse flies and

trypanosomiasis control in Africa. *Tropicultura*, **9** (1): 42-44.
Animal Production and Health Division, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy; ibid.; Projet FAO Lutte contre la Trypanosomiase Animale, c/o Représentation FAO, B.P. 4388, Lomé, Togo.
Rapidly expanding human populations in Africa and the demand for more agricultural land require an integrated approach to tsetse and trypanosomiasis control for optimum livestock production. It is foreseen that with time the justification for control will strengthen and the argument that environmental protection justifies the deliberate maintenance of the disease will become increasingly less acceptable. Land use planning and tsetse control have lacked coordination within development programmes. A more integrated approach to tsetse control with the involvement of local people should be a component of rural development and will decrease costs and increase efficiency. The development of long-term sustainable action against trypanosomiasis will depend on the availability of inputs and the conviction that benefits will exceed costs. The collection of geographical and epizootiological data to monitor changes in land use patterns is vital. Techniques for trypanosomiasis and tsetse control exist and are affordable when used appropriately: control must not be regarded as the ultimate objective but as a contributing element to the realisation of optimum agricultural production.
7361 **Mortelmans, J., 1986**. Quelques aspects économiques en rapport avec la parasitologie vétérinaire. [Some economic aspects related to veterinary parasitology.] *Tropicultura*, **4** (3): 112-116.
Département Vétérinaire, Institut de Médecine tropicale, Nationale-straat 155, B-2000 Antwerp, Belgium.
Meat losses due to trypanosomiasis in sub-Saharan Africa are estimated at US $5000 million annually, not counting losses in milk production, traction and manure. Tsetse-transmitted trypanosomiasis affects some 10 million km^2, representing 37% of the continent and 38 countries, where about 30% of cattle are exposed to the disease. It has been estimated that the land could carry five times the number of livestock in the absence of tsetse. Control methods are briefly reviewed. Chemotherapy and chemoprophylaxis cost between US $1 and $2 per injection, with some 25 million doses required annually. Tsetse control is

cheaper. Insecticide-impregnated screens placed at 50-100 m intervals in gallery forest cost about US $50 per km^2 during the first year and US $20 thereafter. Car tyres cut into two or three pieces and coated inside with residual insecticides are effective and cost little. Challier-Laveissière biconical traps impregnated with deltamethrin can reduce the apparent density of *Glossina tachinoides* by 99.98% in 4 months; these cost US $100 per km in the first year and US $20 thereafter. Aerial or ground spraying at US $4-13 per ha and US $1.5-5.5 per ha respectively is impractical given the size of the affected area. The destruction of game as reservoir hosts has largely been abandoned, SIT is uneconomical because of the slow breeding rate of tsetse and antigenic variation has hindered the development of immunisation. Trypanotolerance may be the only realistic long-term economic solution in many African countries.

7362 **Shaw, A.P.M. and Hoste, C.H., 1991**. Les échanges internationaux de bovins trypanotolérants. I. Historique et synthèse. [International trade in trypanotolerant cattle. I. Historical analysis.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (2): 221-228.

A.P. Consultants, 1 Amport Park Mews, Amport, Andover, Hants SP11 8BS, UK; Projet régional de la FAO, GCP/RAF/190/ITA, P.M.B. 10, Banjul, Gambia.

An investigation into the historical origins of the trypanotolerant cattle found in the Central African countries and outside the natural area of distribution in West Africa provided details of over 50 different transactions involving 34,000 trypanotolerant breeding animals, exchanged between 37 different pairs of countries. The present populations of some 600,000 animals originating from introduced stocks clearly show the success with which these animals multiplied and with which effective cattle production systems were set up to receive them in the recipient countries. However, variable results were obtained, and the analysis of problems encountered and overcome contributes to determining future schemes for the introduction and multiplication of these breeds.

7363 **Shaw, A.P.M. and Hoste, C.H., 1991**. Les échanges internationaux de bovins trypanotolérants. II. Tendances et perspectives. [International trade in trypanotolerant cattle. II. Trends and outlook.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (2): 229-237.

A.P. Consultants, 1 Amport Park Mews, Amport, Andover, Hants SP11 8BS, UK; Projet régional de la FAO, RAF/88/100, P.M.B. 10, Banjul, Gambia.
The possible demand and potential availability of trypanotolerant breeding stock for export in nineteen countries of West and Central Africa were surveyed. Demand, in terms of beef, milk and traction requirements, cannot easily be measured, but national deficits, at least in beef production, can be quantified. Such a demand would need to be translated into definite government projects or requests from private investors. A study of production parameters in selected countries and production systems for the N'Dama and Savanna Shorthorn breeds was used to obtain an estimate of the extent to which traditional village systems can produce a surplus stock. A few ranches which have become important suppliers of high quality animals can be added to this principal source of breeding stock. This study indicates that in the West African village sector, there is a modest surplus of heifers (about 1%) relative to the requirements for replacing the breeding stock. This surplus is large enough to meet the current needs of the different African countries.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

7364 **Bogner, F., 1992**. Response properties of CO_2-sensitive receptors in tsetse flies (Diptera: *Glossina palpalis*). *Physiological Entomology*, **17** (1): 19-24.
Section of Neurobiology and Behavior, Cornell University, Ithaca, NY 14853-2702, USA.
Extracellular single cell recordings of CO_2-sensitive receptors in tsetse flies revealed a steep dose response over a range of stimuli of two to three orders of magnitude and a maximum response of approximately 70 impulses/s after exposure to a high, but naturally feasible, CO_2 concentration of 5%. These receptor neurones are slightly sensitive to CO_2 levels occurring in air (0.03%); the sensitivity to CO_2 above that level may be used to locate potential hosts. The CO_2-sensitive neurones did not respond to some other biologically relevant odours such as octenol, butanone of p-cresol; however, other receptor cells, some in the same sensillum, are sensitive to some of these odours. A striking feature of the CO_2 receptors is that they

appear not to adapt in their response frequencies. The spike numbers of the phasic-tonic response remain constant in the tonic portion during continuous (or repetitively pulsed) long-term stimulation (1 min). This unusual physiological ability would allow continuous monitoring of CO_2 values as well as detecting potential hosts that exhale CO_2. These electro-physiological results are compared to the behavioural findings in tsetse flies and to the physiological data on CO_2 receptors of other, non-bloodsucking insects.

7365 **Denlinger, D.L. and Zdárek J., 1991**. Intrapuparial development in the tsetse fly, *Glossina brevipalpis* (Diptera, Glossinidae): behaviour associated with pupation. *Acta Entomologica Bohemoslovaca*, **88** (6): 353-358.

ICIPE, P.O. Box 30772, Nairobi, Kenya; Denlinger: also Department of Entomology, Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210, USA (correspondence to this address); Zdárek: also Insect Chemical Ecology Unit, Institute of Organic Chemistry and Biochemistry, Czechoslovak Academy of Sciences, Prague, Czechoslovakia.

Intrapuparial development proceeds more slowly in tsetse than in most other flies. In our experiments with *G. brevipalpis* at 24□C, 29-33 days elapsed between pupariation and adult eclosion. Head evagination, a developmental landmark equivalent to pupal ecdysis in other Holometabola, was observed 5 days after pupariation. This event was accompanied by a stereotypic pattern of muscular contractions that could be monitored non-invasively by attachment of a mechanical strain gauge to the cuticle. Pressure pulses, with a frequency of about 25 pulses/h, progressively increased in amplitude during the first 2 h, remained steady for many hours, then gradually decreased in amplitude and frequency, and finally ceased 15-18 h after the onset. Through this series of rhythmic contractions, the head evaginated, pupal appendages inflated with haemolymph, the ultimate pupal form was defined, and the larval tracheal lining was expelled. Though pupation in tsetse is later and slower than in other flies, the qualitative aspects of the behaviour are very similar to those observed in other cyclorrhaphous Diptera.

7366 **Denlinger, D.L. and Zdárek, J., 1992**. Rhythmic pulses of haemolymph pressure associated with parturition and ovulation in the tsetse fly, *Glossina morsitans*. *Physiological Entomology*, **17** (2): 127-130.

ICIPE, P.O. Box 30772, Nairobi, Kenya; Denlinger: also Department of Entomology, Ohio State University, 1735 Neil Avenue, Columbus, Ohio 43210, USA (correspondence to this address); Zdárek: also Insect Chemical Ecology Unit, Institute of Organic Chemistry and Biochemistry, Czechoslovak Academy of Sciences, Prague, Czechoslovakia.

Expulsion of the tsetse larva from the uterus of the female is preceded by 1-2 h of rhythmic pulses of haemolymph pressure that can be detected using a barographic technique. At first baseline pressure is maintained and all pulses are positive in relation to baseline. Then, about 1 h before parturition, baseline pressure increases, pulse intensity increases, and the pulses become both positive and negative in relation to baseline. Each pulse correlates with `bobbing' action of the female's proboscis, the only external indication of this internal activity. A single large pressure pulse is observed at parturition, and thereafter the pressure level returns to the original baseline and pulsing action ceases. Around the presumptive time of ovulation, 1-2 h after parturition, another series of pressure pulses is observed. The pulses are the likely consequence of coordinated waves of muscular contraction that are essential preparation for successful parturition and ovulation.

7367 **Geoffroy, B., Baldet, T., Cuisance, D., D'Amico, F. and Bossy, J.-P., 1992**. Présence de chimiorécepteurs sur l'aile des tsé-tsé (Diptera: Glossinidae). [First report on chemoreceptors on the wing of tsetse flies.] *Comptes rendus des Séances de l'Académie des Sciences (III)*, **314** (8): 351-354.

ORSTOM (Geoffroy, Baldet, D'Amico) and CIRAD-IEMVT (Cuisance), Centre ORSTOM de Montpellier, B.P. 5045, 34032 Montpellier Cedex 01, France; Bossy: INRA, 30380 Saint-Christol-lez-Alès, France.

This is the first report describing the presence of chemoreceptive setae on the wings of tsetse flies. These setae are mainly located in the middle of the costal vein. The morphology of the wing chemoreceptors is identical to that of the chemoreceptive setae on the legs. The numbers of wing chemoreceptive hairs do not differ between conspecific males and females but vary with species suggesting that they are not involved in sexual interactions, but rather may play a role in short-distance reception of chemical cues from the environment. The study was conducted on six species or subspecies of tsetse: *Glossina tachinoides*, *G. morsitans*

morsitans, *G. m. submorsitans*, *G. austeni*, *G. palpalis gambiensis* and *G. fuscipes fuscipes*.

7368 **Gooding, R.H., 1992**. Genetic variation in tsetse flies and implications for trypanosomiasis. *Parasitology Today*, **8** (3): 92-95.

Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3, Canada.

This review article summarises recent developments in the estimation of genetic variation in tsetse and its implications with regard to population structure, vectorial capacity and control strategies. Significant differences in the mean heterozygosities of tsetse populations have been demonstrated. Three X chromosome mutations disrupt tryptophan metabolism in tsetse. The salmon eye allele in *Glossina morsitans morsitans* blocks the initial step and causes tryptophan to accumulate: this enhances the establishment of *Trypanosoma congolense* in females and its maturation in both sexes and the establishment of *T. brucei brucei* in both sexes and its maturation in males. Data from four species of tsetse suggest that the maturation of *brucei*-group infections may be under the control of a sex-linked recessive gene. Transmission may also be affected by the genetic control of lectin production, the occurrence of midgut trypanolysins and lectin bonding to tsetse salivary glands, and it may be possible to establish non-vector tsetse colonies. Genetic control of maternally-inherited rickettsia-like organisms in the midgut which affect the establishment and maturation of trypanosomes has not been demonstrated. There is evidence that tsetse have the genetic capacity to develop insecticide resistance.

7369 **Kokwaro, E.D., Otieno, L.H. and Chimtawi, M., 1991**. Salivary glands of the tsetse *Glossina pallidipes* Austen infected with *Trypanosoma brucei* and virus particles: ultrastructural study. *Insect Science and its Application*, **12** (5/6): 661-669.

ICIPE, P.O. Box 30772, Nairobi, Kenya.

The effects of infection by *T. brucei* and DNA virus on the ultrastructure of the salivary gland cells in *G. pallidipes* were investigated. Cytoplasm of uninfected cells contains a dense ribosomal population and rough endoplasmic reticulum, scattered Golgi areas and mitochondria. In infected cells of salivary glands the ultrastructural integrity of the cytoplasm is profoundly changed due to cellular proliferation giving rise to a stratified epithelium and gland enlargement; cell degeneration characterised by formation of cytoplasmic vacuoles, chromatin margination,

disorganisation and elimination of cell organelles and gland hypertrophy. The virus particles are found in the nucleoplasm as well as the cytoplasm of cells. The ultrastructural evidence indicates that the virus particles are largely assembled in nuclei of cells and virions pass through the nuclear membrane. The trypanosomes are found within the degenerating cytoplasm and lumen of the cell. The implications of the features observed in the infected cells are discussed, and possible suggestions are made regarding alteration of the metabolic functions due to infection.

7370 **Otter, C.J. den and Goes van Naters, W.M. van der, 1992**. Single cell recordings from tsetse (*Glossina m. morsitans*) antennae reveal olfactory, mechano- and cold receptors. *Physiological Entomology*, **17** (1): 33-42.

Sensory Physiology Group, Department of Animal Physiology, Uni-versity of Groningen, P.O. Box 14, 9750 AA Haren, Netherlands.

Action potentials from individual cells and receptor potentials were recorded from antennae (funiculi) of living tsetse flies, *G. m. morsitans*, using a `surface-contact' recording technique. Stimuli were pressure of the electrode, changes in temperature and the vapours of 1-octen-3-ol, acetone, 3-methylphenol, dichloromethane and CO_2. Two types of mechanoreceptive cells were found. One type fired action potentials only when pressure was increased, the other type continued firing when pressure was maintained. Of the 182 cells tested for their sensitivity to temperature change and the odour stimuli, 19% did not respond to any of the stimuli, suggesting that we are still unaware of cues which may be of import to the flies, and 4% responded to temperature only, increasing and decreasing their activity with a decrement and increment in temperature, respectively. Of the 141 cells which were olfactory receptors, 52% responded to 1-octen-3-ol and 40% were exclusively sensitive to this substance. For 3-methylphenol these percentages were 23 and 18, for acetone 13 and 11, for dichloromethane 12 and 7, for CO_2 13 and 13. No clustering of cell types in certain areas of the funiculi was found, nor was a difference apparent between the sexes. The majority of the olfactory cells responded by increasing their activities on odour stimulation. Inhibition was found in three cells only, in which spontaneous activity was suppressed on stimulation with 3-methylphenol. Spike responses were phasic-tonic and varied between two extremes: cells showing relatively

rapid cessation of spike activity after the end of stimulation, and cells which continued firing for several seconds or minutes after stimulation. Possible behavioural effects of the activities of the various cell types are discussed.

7371 **Tchicaya, T., 1990**. *Morphogenèse antennaire et sensibilité olfactive chez la glossine (Diptera, Glossinidae)*. [Antennal morphogenesis and olfactory sensitivity in the tsetse fly (Diptera, Glossinidae).] Thèse de Doctorat en Sciences biologiques, Université Montpellier II, France. (Unpublished thesis.) 147 pp.
IEMVT, 10 rue Pierre Curie, 94704 Maisons-Alfort Cedex, France.
The morphogenesis of the imaginal antenna of *Glossina palpalis gambiensis* has been studied. Development proceeds from distal to proximal regions: the funicle and arista separate first from the cephalic epidermis, followed by the pedicel and then the scape. Imaginal characters are precociously determined and the antenna has almost its complete shape as cuticulogenesis starts in 10 day old pupae. The differentiation of the olfactory sensilla is achieved shortly before emergence, towards day 25. The ultrastructure and ontogeny of the basiconic sensilla were investigated. The electroantennogram (EAG) responses of replete male and female *G. p. gambiensis*, *G. tachinoides*, *G. fuscipes fuscipes*, *G. morsitans morsitans* and *G. austeni* to different concentrations of acetone, 4-heptanone, 3-nonanone and 1-octen-3-ol were studied and compared. Male *G. m. morsitans* and *G. tachinoides* have higher EAG responses than females, whereas female antennae are more sensitive in the other three species. Olfactory sensitivity declines rapidly after emergence in *G. m. morsitans* and age is assumed to be an important factor. Starvation has a complex effect on olfactory sensitivity which is sex- and species-dependent.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **15**: no. 7388.]

7372 **Colvin, J. and Gibson, G., 1992**. Host-seeking behavior and manage-ment of tsetse. *Annual Review of Entomology*, **37**: 21-40.
NRI, Central Avenue, Chatham Maritime, Kent ME4 4TB, UK; Department of Medical Parasitology, LSHTM, Keppel Street, London WC1E 7HT, UK.
The host-seeking behaviour of tsetse is considered in relation to the improvement of bait efficacy. A rational approach to the study of host-seeking

behaviour began with the use of electric nets in Zimbabwe in the late 1960s and gave rise to the concept that behaviour could be exploited in control techniques. Research into the activation of resting tsetse and their olfactory and visual attraction to baits is reviewed. The use of female-mimics has significantly increased the number of males killed or sterilised. Any behavioural resistance might be counteracted by modifications to the stimuli produced by the bait or by use of a chemosterilant so that non-resistant tsetse might then affect resistant ones. Mathematical models can predict the percentage daily mortality levels required to eliminate tsetse populations. Insecticide-impregnated traps and targets have been developed which are highly successful against some species, to the extent that certain populations have been eradicated. However, suppression rather than total eradication may be the only realistic strategy over much of Africa.

7373 **Gibson, G., 1992**. Do tsetse flies `see' zebras? A field study of the visual response of tsetse to striped targets. *Physiological Entomology*, **17** (2): 141-147. Department of Medical Parasitology, LSHTM, Keppel Street, London WC1E 7HT, UK.

A field study in Zimbabwe of *Glossina pallidipes* and *G. morsitans morsitans* supported Waage's (1981) hypothesis that the striped pattern of zebras may protect them from being bitten by blood-sucking flies. In addition, the results suggest that the orientation of the stripes may be crucially important for the unattractiveness of zebras. The relative attractiveness of five different stationary targets (black, white, grey, vertically striped and horizontally striped; stripe width = 5 cm) were each tested on their own and in pairs of all combinations, with artificial host odour (CO_2 plus acetone) always present. Electric nets were used to catch flies as they attempted to land on or circle the targets. The results were similar for the two species of tsetse. When tested on their own, grey and vertically striped targets caught similar numbers of flies and both caught significantly fewer than black or white targets (*c*. 36% as many). Horizontally striped targets caught < 10% as many flies as any other single target. Although there was no significant difference between the attractiveness of grey and vertically striped targets when they were presented together, when paired with the other targets, grey was as attractive as black or white, but the vertically striped target

was significantly less attractive than black or white ($P < 0.001$). In other words, a difference between grey and vertical stripes was found only in their attractiveness in relation to other targets. The horizontally striped target, however, always caught the fewest flies, regardless of whether it was presented alone or alongside another target.

7374 **Hall, D.R., Gough, A.J.E., Adams, P.H., Beevor, P.S., Cork, A., Green, C.H., Smith, J.L., Taylor, J.H.L. and Warnes, M.L., 1991**. *Identification of host odour attractants for tsetse flies: final report 1986-1990*. Chatham, UK; NRI (on behalf of the 5th European Development Fund (RTTCP), NRI and TRL). 130 pp.

NRI, Central Avenue, Chatham Maritime, Kent ME4 4TB, UK.

Twenty-one compounds from host animals have been investigated as attractants to savanna tsetse species. Major components of cattle urine were 4-methylphenol and 3-propylphenol: a mixture of these compounds increased catches of *Glossina pallidipes* in traps already baited with acetone and 1-octen-3-ol by up to six times. A minor component, 2-methoxyphenol, was highly repellent to *G. pallidipes* and *G. morsitans morsitans*. This and another repellent, acetophenone, could have use in reducing tsetse challenge to cattle. Minor components eliciting strong electroantennographic responses were indole, 3-methylindole and the carotenoid metabolites *cis* and *trans* 3,3,5-trimethyl-4-hydroxy-4-(3-oxobutyl)-cyclohexanone. The effect of cattle sebum on tsetse behaviour was investigated and (*E*)-phytol identified as a major component. Bushpig bedding sacks were analysed to identify tsetse attractants: vanillin and acetovanillone gave positive results in the laboratory. Dispensing systems for these compounds were devised. Release rates from polythene tubes declined after about 10 weeks in the field. Polythene sachets containing an 8:1:4 mixture of 4-methylphenol, 3-propylphenol and octenol gave a highly linear release and remained attractive to tsetse for at least 3 months under field conditions. Close liaison was maintained with tsetse workers at CRTA in Burkina Faso and OCCGE in Côte d'Ivoire. Recommendations are given for future reasearch.

7375 **Küpper, W., Späth, J. and Kröber, T., 1991**. Attractiveness of chemicals to *Glossina tachinoides* Westwood (Diptera, Glossinidae) in Côte d'Ivoire. *Tropical Pest Management*, **37** (4): 436-438.

Projet de Lutte contre la Trypanosomiase Animale et les Vecteurs, B.P. 3301, Bouaké, Côte d'Ivoire; Späth: also

Ökologische Station der Universität Würzburg, Fabrikschleichach, 8602 Rauhenebrach, Germany.
Studies on the use of 22 chemical attractants for *G. tachinoides* were undertaken in Côte d'Ivoire following earlier work on *G. m. morsitans* and *G. pallidipes* in Zimbabwe. While catches of *G. m. morsitans* and *G. pallidipes* increased by several times when traps were baited with some of these substances, catches of *G. tachinoides* were only marginally increased. *G. tachinoides* is slightly attracted by octenol and acetone, alone or in combination, and its response to CO_2 is much weaker than that of the species tested in Zimbabwe. Phenol and indole mixtures both showed dose-response relationships with catch. The indoles were more potent in the lowest of the tested dosages (catch increase of 52%, $P < 0.001$) whereas the phenols showed better attractiveness in their higher concentrations (catch increase of 42%, $P < 0.05$). Odour is probably less important in host finding for the riverine species *G. tachinoides* than it is for the savanna species studied in Zimbabwe.

7376 **Muirhead-Thomson, R.C., 1991**. *Trap responses of flying insects: the influence of trap design on capture efficiency*. London, UK; Academic Press. 287 pp.
This book reviews experimental trap design and the various problems encountered in insect responses to traps. Tsetse responses to early animal model traps provided much information on behaviour. Tests using added attractants such as carbon dioxide and ox odour, combined with more effective methods for retaining trapped flies, showed that while visual stimuli are important, olfactory stimuli initially attract most tsetse to static traps. Most traps in current use are not animal models: provided the three-dimensional trap presents the necessary and correctly positioned contrast between light and dark areas, the animal shape is not an essential ingredient. Recent trends and improvements in trap design are exemplified by the vertical vane, Challier-Laveissière biconical and F2 traps. Water traps and coloured screens can supplement and improve biconical traps. Tsetse flight patterns have been studied with various arrangements of traps and electrified netting. The automatic trapping of insects attracted to live bait includes the use of electrified fences and an electrified back-pack for human bait in tsetse surveys. A section on trapping based on tsetse odour responses includes the interrelationship between visual and olfactory

responses, trap design and tests with various odour components.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

[See also **15**: nos. 7360, 7361, 7372, 7374, 7376.]

7377 **Blanc, F., Gouteux, J.P., Cuisance, D., Pounekrozou, E., Le Masson, A., N'Dokoue, F., Mainguet, M., D'Amico, F. and Le Gall, F., 1991**. La lutte par piégeage contre *Glossina fuscipes fuscipes* pour la protection de l'élevage en République Centrafricaine. III. Vulgari-sation en milieu Mbororo. [Control of *G. f. fuscipes* by trapping for the protection of livestock in the Central African Republic. III. Popularisation among the Mbororo herdsmen.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (3): 301-307.

Blanc: Kitchener House, 6 Garden Terrace, Edinburgh EH16 5QH, UK; Gouteux, D'Amico: ORSTOM, B.P. 893, Bangui, Central African Republic; Cuisance: IEMVT-CIRAD, c/o ORSTOM, B.P. 5045, 34032 Montpellier Cedex, France; other authors: ANDE, B.P. 1509, Bangui, Central African Republic.

The authors describe the problem of technology transfer presented by the adoption by the Mbororo herdsmen of trapping for tsetse control. This method is directed against the principal vector of cattle trypanosomosis, *G. f. fuscipes*, and utilises the bipyramidal trap. The ways and means of the popularisation of this technique, which is based on national structures provided in the Central African Republic for the development of livestock breeding, are described and discussed.

7378 **Boutrais, J., 1991**. *Les populations pastorales et les glossines en Adamaoua (Cameroun)*. [The pastoral population and tsetse flies in the Adamaoua region (Cameroon).] Maisons-Alfort, France; IEMVT (on behalf of République du Cameroun, Ministère de l'Elevage, des Pêches et des Industries Animales and Banque Mondiale, Département des Projets de l'Afrique de l'Ouest). 67 pp.

Despite 15 years of eradication campaigns, tsetse remain a serious problem in a large part of Adamaoua, the main cattle rearing area of Cameroon. Recent campaigns have failed, local farmers are not involved and the introduction of a tax on tsetse-free pasture did not encourage their participation. In contrast, farmers in the Ngaoundéré region are actively engaged in control, using small sprayers to treat their cattle with insecticide. This communal activity reinforces the responsibility of each farmer towards his herd,

although the supply of insecticides has been difficult. In the west of the Adamaoua region a massive reinfestation has taken place: 350,000 ha have already been lost and up to 200,000 cattle are threatened with trypanosomiasis. The farmers are unprepared and can only move their cattle to other areas, with serious social and economic consequences. Faced with growing tsetse pressure, trypanocidal drugs cannot give adequate protection. Trials of a new pour-on formulation, Galim, have been encouraging but new insecticide formulations are highly priced and difficult to obtain. The situation can only be improved by immediate aerial spraying, coupled with the treatment of cattle with pour-on formulations made available to farmers through grants. Once tsetse expansion is halted, the situation should be maintained by the farmers themselves, as at Ngaoundéré.

7379 **Cuisance, D., 1989**. *La lutte contre les glossines dans l'Adamaoua (Cameroun): compte rendu de situation en février 1989 et propositions de programme*. [Tsetse control in the Adamaoua region (Cameroon): report of the situation in February 1989 and programme proposals.] Maisons-Alfort, France; IEMVT (on behalf of Republique du Cameroun, Ministère de l'Elevage, des Pêches et des Industries Animales and Banque Mondiale, Département des Projets de l'Afrique de l'Ouest). 37 pp.

IEMVT-CIRAD, Centre ORSTOM, 2051 avenue du Val-de-Montferrand, B.P. 5045, 34032 Montpellier Cedex, France.

The activities of the special tsetse eradication programme in the Adamaoua region from 1986-89 are described. Financial restraints have resulted in a reduction of the area controlled. Furthermore, the abandonment of regular barrier maintenance and the opening of a livestock market in a sensitive area have contributed to a notable reinvasion, especially in the north (Mbakana) and west (Djem) of the Adamaoua area. Lack of vehicles, equipment and insecticides has not permitted the extent of the reinvasion to be evaluated and the means for reversing the situation are very reduced. The strategy of eradication, successful for the last 10 years in over 20,000 km^2, will only be maintained with regular financial backing. Future recommendations are: to evaluate the area affected; to set up a stock of screens and traps to establish an experimental barrier; to buy insecticides for aerial spraying of infested zones and to promote the use of insecticidal dips for livestock at the edge of the

barrier; and to encourage community participation. The action taken will depend on the entomological situation at the start of the next dry season and the means available for control. A minor research programme concerns the distribution of tsetse at high altitude and the possible `barrier' role of mountains.

7380 **Cuisance, D., 1990**. *La lutte contre les glossines en République Centrafricaine: prospection entomologique dans la commune d'élevage d'Ouro-Djafoun, programme de recherche et de lutte*. [Tsetse control in the Central African Republic: entomological survey in the farming district of Ouro-Djafoun, research and control programme.] Maisons-Alfort, France; IEMVT (on behalf of République Centrafricaine, Ministère du Développement Rural, Agence Nationale de Développe-ment de l'Elevage). 60 pp.

IEMVT-CIRAD, Centre ORSTOM, 2051 avenue du Val-de-Montferrand, B.P. 5045, 34032 Montpellier Cedex, France.

The survey of 12 rivers and a 40 km transect of savanna in the Ouro-Djafoun area has shown *Glossina fuscipes fuscipes* to be the dominant species of tsetse (although at low density), *G. fusca congolensis* to be rare and *G. morsitans submorsitans* to be absent. Experiments on trap design are aiming to develop a `combination' model which is considerably cheaper than the biconical trap. To ensure that the drop in tsetse density is accompanied by a drop in livestock trypanosomiasis, a classic parasitological survey should be carried out, including the examination of blood preparations and HCT, before, during and after the end of trapping. It is proposed that this should be followed up by more refined laboratory techniques, such as ELISA, IFI and DNA probes, to identify the species and strains of trypanosomes in the area. Other proposals include a study of the trophic preferences of *G. f. fuscipes* and the intensity of tsetse-livestock contact. Audio-visual programmes are needed to instruct and involve the local community.

7381 **Cuisance, D., 1991**. *Lutte contre les glossines dans l'Adamaoua (Cameroun): bilan de situation et recommandations, décembre 1990.* [Tsetse control in the Adamaoua region (Cameroon): assessment of the situation and recommendations, December 1990.] Maisons-Alfort, France; IEMVT (on behalf of République du Cameroun, Ministère de l'Elevage, des Pêches et des Industries Animales and Banque Mondiale, Département des Projets de l'Afrique de l'Ouest). 56 pp.

IEMVT-CIRAD, Centre ORSTOM, 2051 avenue du Val-de-Montferrand, B.P. 5045, 34032 Montpellier Cedex, France.
Tsetse eradication in the Adamaoua region is not being maintained. Financial support from farmers in the form of a tax of 200 CFA francs/head of cattle is not at present accessible and surveillance is not being carried out. The exchange of animals between infested and tsetse-free areas appears unavoidable but is irreconcilable with tsetse eradication. No money is available for establishing barriers of screens and traps, for purchasing insecticides or mobilising helicopters to treat reinfested areas. Surveys have shown the reinfested area to be doubling each year, being around 100,000 ha in 1988, 200,000 ha in 1989 and 400,000 ha at present. In view of the dramatic worsening of the situation, it is recommended that aerial spraying be urgently carried out, supplemented with treating cattle with pour-on formulations or manually-applied pyrethroids and erecting screen/trap barriers in the north and north-west. Studies on the trophic preferences of *Glossina morsitans submorsitans*, its occurrence above 1600 m altitude and an efficient trapping system for the Adamaoua region are recommended.

7382 **Cuisance, D., Colas, F., Müller. P., Nagel, P. and Krüger, J., [1989?].** *Rapport complémentaire sur la surveillance des résidus insecticides chez les oiseaux, les mammifères et dans les denrées alimentaires après l'application aérienne d'insecticides (endosulfan, deltaméthrine) dans la vallée du Zambèze au Zimbabwe (1987 et 1988) au cours de Programme Régional de Lutte contre les Tsé-Tsé et la Trypanosomiase*. [Additional report on the survey of insecticide residues in birds, mammals and foodstuffs after the aerial application of insecticides (endosulfan, deltamethrin) in the Zambezi Valley in Zimbabwe (1987 and 1988) during the Regional Tsetse and Trypanosomiasis Control Programme.] Maisons-Alfort, France; IEMVT and Germany; Université de Saarbrücken (on behalf of the 5th European Development Fund, RTTCP, Scientific Environmental Monitoring Group). 56 pp.
Cuisance: IEMVT-CIRAD, Centre ORSTOM, 2051 avenue du Val-de-Montferrand, B.P. 5045, 34032 Montpellier Cedex, France.
Five sequential aerial applications of endosulfan at 14-24 g a.i./ha were made during 1987 on Mzarabani communal land in the Zambezi Valley, Zimbabwe. No accumulation of endosulfan residues was detected in birds and mammals and levels in foodstuffs were non-existent or insignificant. In contrast, contamination

by the chlorinated hydrocarbon pesticides, particularly DDT, used before this campaign appears to be important. In 1988 similar applications of deltamethrin were made at 0.25 g a.i./ha and hardly any residues were found in birds, mammals and foodstuffs. Occasional liver samples from 79 elephants in the Gona-Re-Zhou National Park in south-east Zimbabwe showed only very low levels of chlorinated hydrocarbon residues.

7383 **Cuisance, D., Gouteux, J.P., Cailton, P., Kota-Guinza, A., Ndokoué, F., Pounékrozou, E. and Demba, D., 1990**. *Problèmatique d'une lutte contre les glossines pour la protection de l'élevage Zébu en République Centrafricaine.* [Problems of tsetse control to protect Zebu farming in the Central African Republic.] Paper presented at the 3rd Conférence Internationale des Entomologistes d'expression française, Gembloux, Belgium, 9-14 July 1990. 6 pp. (Unpublished report.)

IEMVT-CIRAD, Centre ORSTOM, 2051 avenue du Val-de-Montferrand, B.P. 5045, 34032 Montpellier Cedex, France; Centre ORSTOM, B.P. 893, Bangui, Central African Republic; Agence Nationale pour le Développement de l'Elevage, B.P. 1509, Bangui, Central African Republic; ibid.; ibid.; ibid.; ibid.

Since the beginning of this century increasing drought in the Sahel has forced Mbororo herdsmen south-east into tsetse-infested humid savanna. The Mbororo entered the Central African Republic in the 1920s and despite disease their Zebu cattle now number over 2 million. Trypanosomiasis control in this number of cattle by chemotherapy and chemoprophylaxis is not realistic in the long term: 1,500,000 doses were administered in 1986 at great cost and risk of developing resistance. The main vector is *Glossina fuscipes fuscipes* and control by trapping was initiated. The programme was directed, organised and planned by government agency but the traps were erected, maintained and surveyed by the herdsmen themselves. The feasibility of this method was demonstrated by a preliminary trial using 2-4 non-impregnated Challier-Laveissière biconical traps placed at each watering place in gallery forest. Trapping was then extended to 37 encampments in the Yérémo pastoral zone and after 2 years apparent fly densities had been reduced by between 68 and 98% at water holes. The problems of this control strategy include limited resources and cost, maintaining continuity of trapping within a transhumant society, optimal positioning of traps, seasonal behaviour of *G. f. fuscipes*, livestock distribution and quantification of the results.

7384 **Diaite, A., 1991**. La trypanosomiase animale africaine au Sénégal: la lutte anti-vectorielle. [African animal trypanosomiasis in Senegal: vector control.] *Insect Science and its Application*, **12** (5/6): 713-715.
LNERV, B.P. 2057, Dakar, Senegal.
The presence of tsetse (*Glossina palpalis gambiensis*, *G. morsitans submorsitans* and *G. longipalpis*) in some 36% of the area of Senegal has imposed severe restrictions on livestock rearing. Several tsetse control campaigns have been carried out. Ground spraying using dieldrin was started in the Niayes region in 1970 for three consecutive years, from March to May each time. Tsetse disappeared from most of the farms treated but several colonies persisted. Preliminary trials in 1975 led to a new control campaign being initiated in the early 1980s which combined ground spraying using endosulfan with the use of deltamethrin-impregnated screens and biconical traps. This was successful: no flies have been taken since 1983 and the area now supports imported dairy cattle. The efficacy of endosulfan- and deltamethrin-impregnated traps and screens for riverine tsetse control was investigated in 10 km of gallery forest in the Kolda area in the south of the country. After 2 months the *G. p. gambiensis* population had been reduced by 98%.

7385 **Geerts, S., 1986**. Contrôle des glossines dans le Bassin de la Kagéra. [Control of tsetse in the Kagera Basin.] *Tropicultura*, **4** (1): 29-30.
Institut de Médecine tropicale, Nationalestraat 155, B-2000 Antwerp, Belgium.
The Kagera River basin lies to the west of Lake Victoria in Burundi, Rwanda, west Tanzania and south-west Uganda. Low-cost and environmentally safe tsetse control methods have been investigated in this area. Half-tyres suspended from trees and treated inside with dieldrin or deltamethrin replaced every 3 months are attractive to tsetse, especially when the tyres are warm. This method has been used successfully to reduce populations of *Glossina morsitans centralis* and *G. pallidipes* in Akagéra National Park in Rwanda and promising results against the same species have been obtained in Tanzania. The tyres specifically attract tsetse; other flies are rarely found. Trypanosomiasis causes serious losses among the cattle of Ugandan refugees in the Nasho region of Rwanda and here odour-baited insecticide-impregnated traps and screens have been used with good results against *G. m. centralis, G. pallidipes* and *G. brevipalpis*. Four biconical traps baited with a mixture

of acetone and 1-octen-3-ol were deployed per km^2, at a cost per animal per year of Rw. Fr. 300, compared to the ground-spraying cost of Rw. Fr. 12,000. These methods are easily managed by local people but need to be evaluated under different field conditions and against different species of tsetse.

7386 **Gouteux, J.P., 1991**. La lutte par piégeage contre *Glossina fuscipes fuscipes* pour la protection de l'élevage en République Centrafricaine. II. Caractéristiques du piège bipyramidal. [Control of *G. f. fuscipes* by trapping for the protection of livestock in the Central African Republic. II. Characteristics of the bipyramidal trap.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (3): 295-299.

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

The author describes the bipyramidal trap and gives details of its construction. This trap is currently the object of a large-scale evaluation programme for tsetse control being conducted by the semi-nomadic herdsmen of the Central African Republic (Mbororo). It is easy to dismantle and transport and requires no complex manipulation. Its net cost is about 30 FF (1500 CFA francs).

7387 **Gouteux, J.P., Cuisance, D., Demba, D., N'Dokue, F. and Le Gall, F., 1991**. La lutte par piégeage contre *Glossina fuscipes fuscipes* pour la protection de l'élevage en République Centrafricaine. I. Mise au point d'un piège adapté à un milieu d'éleveurs semi-nomades. [Control of *G. f. fuscipes* by trapping for the protection of livestock in the Central African Republic. I. Design and development of a trap suitable for use by semi-nomadic herdsmen.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (3): 287-294.

ORSTOM, B.P. 893, Bangui, Central African Republic; IEMVT-CIRAD, Centre ORSTOM, 2051 avenue du Val-de-Montferrand, B.P. 5045, 34032 Montpellier Cedex, France; ANDE, B.P. 1509, Bangui, Central African Republic; ibid.; ibid.

Research on a new trap designed for use by the Central African Fulani herdsmen against *G. f. fuscipes* was carried out by means of separate studies on the capture system, the design of the trap and the materials. The result was the development of a bipyramidal trap in polyester mosquito netting and blue and black polyethylene sheets. It is not impregnated with insecticide, but uses a dry capture device which holds and kills the flies. Its efficiency is 3 to 4 times greater than that of the classical Roubaud cage. The trap was more

efficient than the biconical, pyramidal and monoconical traps already tested in the Central African Republic. Some problems linked to the latin square experimental method, and the use of the trap with or without insecticidal impregnation are discussed.

7388 **Harberd, A.J., 1988**. *Studies on the ecology and control of tsetse flies (Diptera: Glossinidae) in Somalia*. Ph.D. thesis, University of London, UK. (Unpublished thesis.) xxix + 366 + clx pp.

Department of Pure and Applied Biology, Imperial College, Silwood Park, Ascot, Berks, UK.

Glossina pallidipes is widespread in the Shabeelle river area of Somalia and the identification of 285 blood meals confirmed that most (53%) feeds were taken from Suidae, 15% from bushbuck, 13% from domestic livestock and 4% from humans. The flies rest under low narrow branches during the day and beneath small twigs in the lower to middle canopy at night. Challier-Laveissière biconical traps were used to obtain flies and a wing-fray index is proposed for the rapid ageing of large samples. Odours (acetone and cattle urine) did not significantly alter trap catches of *G. pallidipes* in southern Somalia. Laboratory and field assessment of the Electrodyn u.l.v. electrostatic sprayer has confirmed its narrow droplet spectrum, all-round coverage, low energy and minimal maintenance requirements and functional reliability. Used with λ-cyhalothrin, it has proved effective in controlling tsetse by treating diurnal resting sites and offers substantial advantages over conventional knapsack sprayers in treating insecticide-impregnated targets. Laboratory bioassay comparisons of Electrodyn u.l.v. insecticide formulations has shown them to be comparable in terms of toxicity and persistence to w.p. formulations. The simplicity and safety of the Electrodyn has enabled it to be used by villagers in southern Somalia in a community approach to vector control.

7389 **Mérot, P., 1990**. *Projet de recherches sur l'amélioration des techniques de piégeage des glossines: rapport d'exécution*. [Research project on the improvement of trapping techniques for tsetse: report on work carried out.] Maisons-Alfort, France; IEMVT (on behalf of République Française, Ministère de la Coopération et du Développement). 10 pp.

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

The object of this research was to improve the efficacy of traps used in the surveying and control of tsetse. Studies have been carried out on the form and colour of

traps and the use of chemicals as olfactory attractants, including meta-cresol, phytol, acetone and cattle urine. The results have been tested on a large scale by establishing an experimental barrier along the Comoé river, about 55 km from Bobo-Dioulasso, Burkina Faso.

7390 **Nitcheman, S., 1990**. *Etude en laboratoire chez des diptères du genre* Glossina: *des effets insecticides de 4 pyréthrinoïdes de synthèse et de leur incidence sur l'infection trypanosomienne*. [Laboratory study of Diptera of the genus *Glossina*: the insecticidal effects of four synthetic pyrethroids and their impact on trypanosome infection.] Thèse de Doctorat en Sciences naturelles, Université de Paris 6, France. (Unpublished thesis.) 261 pp.
IEMVT, 10 rue Pierre Curie, 94704 Maisons-Alfort Cedex, France.
The insecticidal effects of deltamethrin, permethrin, cyphenothrin and fenvalerate were compared in the laboratory on female *Glossina morsitans morsitans*, *G. palpalis gambiensis*, *G. austeni*, *G. fuscipes fuscipes* and *G. tachinoides*. Some of the flies were infected with *Trypanosoma congolense*. The insecticides caused fatal or reversible paralysis or knock-down, and susceptibility to the insecticide varied according to species: *G. p. gambiensis* was the most tolerant and *G. tachinoides* the most susceptible. Infected *G. m. morsitans* were more susceptible to the insecticides than uninfected flies and the longevity of infected flies was reduced in the absence of insecticide. The feeding behaviour of both infected and uninfected flies was affected by the insecticides. Pregnant females reacted to the insecticides by expelling larvae, and the pupae resulting from prematurely expelled third-stage larvae had a reduced rate of emergence. Through disturbing the physiology of the vector, the insecticides appeared to affect the vitality of the trypanosomes and the conditions of their transmission. It is concluded that trypanosome infection and insecticides act synergistically to make infected flies more susceptible to control. In control operations in the field, infected flies would be the first to be eliminated.

7391 **Nitcheman, S., 1990**. *Interaction parasitisme* (Trypanosoma congolense) - *insecticide (deltaméthrine) sur la mortalité des glossines* (Glossina morsitans morsitans). [The interaction of *T. congolense* infection and insecticide (deltamethrin) on the mortality of tsetse flies (*G. m. morsitans*).] Paper presented at the 7th International Congress of

Parasitology, Paris, 20-24 August 1990. 7 pp. (Unpublished report.)
IEMVT, 10 rue Pierre Curie, 94704 Maisons-Alfort Cedex, France.
Trypanosome infection alone significantly reduced the longevity of tsetse flies compared to uninfected controls. Pregnant female *G. m. morsitans* infected or not infected with *T. congolense* were treated with sublethal doses (0.05-0.2 ng/fly) of deltamethrin. Observations for 17 days after treatment showed that infected flies were significantly more susceptible to the pyrethroid than uninfected ones. The difference in mortality rate between infected and uninfected flies increased with insecticide dose. The results suggest that low levels of insecticide may be used to selectively kill infected flies in the field.

7392 **Pango, M.-C., 1990**. *Organisation de la lutte contre les trypanosomoses animale en Côte d'Ivoire: étude d'une campagne de lutte anti-glossines dans la région de Korhogo (novembre 1987 – novembre 1988*). [Organisation of animal trypanosomiasis control in Côte d'Ivoire: study of an anti-tsetse control campaign in the Korhogo region (November 1987 – November 1988).] Thèse de Doctorat vétérinaire, Université Claude Bernard, Lyon, France. (Unpublished thesis.) 94 pp.
16 B.P. 1212, Abidjan 16, Côte d'Ivoire.
Animal trypanosomiasis in Côte d'Ivoire is described with reference to the species of trypanosomes involved, the pathology of the disease, the species and biology of the tsetse vectors, mechanical vectors and epidemiology, including parasite-host, parasite-vector and vector-host relationships. Trypanosomiasis control is described with reference to chemoprophylaxis and chemotherapy and the problems of drug resistance. The potential of trypanotolerant livestock is considered, with reference to trypanotolerance factors and trypanotolerant breeds in Côte d'Ivoire. Vector control methods are discussed and include a historical survey of tsetse control in Côte d'Ivoire and the adaptation of control methods to different ecological zones. The thesis concludes with a study of a specific anti-tsetse control campaign in the Korhogo region, with a description of the methods used and an analysis of the results.

7393 **Thompson, J.W., Mitchell, M., Rees, R.B., Shereni, W., Schoenfeld, A.H. and Wilson, A., 1991**. Studies on the efficacy of deltamethrin applied to cattle for the control of tsetse flies (*Glossina* spp.) in southern Africa. *Tropical Animal Health and Production*, **23** (4): 221-226.

OAU/IBAR, P.O. Box 30786, Nairobi, Kenya; 2 Kenilworth Road, Highlands, Harare, Zimbabwe; 141 Lomagundi Road, P.O. Mabelreign, Harare, Zimbabwe; Department of Veterinary Services, Tsetse and Trypanosomiasis Branch, P.O. Box 8283, Causeway, Harare, Zimbabwe; Undinestrasse 9, 1000 Berlin 45, Germany; P.O. Box 2699, Harare, Zimbabwe. (Reprint requests to: M.S. Mitchell, Pitman Moore Europe, Breakspear Road South, Harefield, Uxbridge, Middlesex UB9 6LS, UK.)
In the Chesa area of Zimbabwe, where trypanosomiasis had been increasing, 331 cattle were dipped weekly in deltamethrin at 37.9 ppm. After 4 months the incidence of trypanosomiasis in these cattle had declined whereas it had doubled in non-treated cattle. Over 90% of *Glossina pallidipes* caught alighting on deltamethrin-treated oxen, one of which had been given a spray-wash at 46 ppm and the other a pour-on formulation (Spot On) containing 1% deltamethrin at a dose of 1 ml/10 kg, were knocked down in the 2 weeks following treatment and were rapidly predated. The pour-on formulation showed greater insecticidal activity after 10 weeks than the spray. On Zanzibar 700 cattle, 200 goats and a few donkeys were treated with a 1% pour-on formulation applied every 15-18 days. The apparent tsetse density dropped to zero within 37 days. In northern Zimbabwe, 26,244 cattle were given fortnightly dips in deltamethrin at 37.5 ppm and a further 11,667 received 4-weekly treatments with a 1% pour-on formulation. The incidence of trypanosomiasis fell to zero within 3 months in the dipped cattle and within 6 months in the cattle treated with pour-on. Cattle treated with deltamethrin can be effectively used to control tsetse, either alone or as part of an integrated programme. The method is recommended because of its relative simplicity, low cost and acceptability to cattle owners.

7394 **Warnes, M.L., 1991**. The control of savanna species of tsetse flies using odour baited traps and targets. *Pesticide Outlook*, **2** (4): 32-35.

TRL, Langford House, Langford, Bristol BS18 7DU, UK.
This review article shows that tsetse reproductive biology makes the flies vulnerable to extinction if an additional female mortality of 4% per day can be imposed. The control of tsetse populations with traps or insecticide-impregnated targets aims to apply this pressure. Visual and olfactory responses are exploited to attract tsetse to traps and targets. Experiments have shown that blue and black cloth is similarly

attractive although landing response is higher on black cloth. Thus most tsetse traps are blue with black portions inside, visible from the entrance, whereas insecticide-impregnated targets are black to maximise landing responses. The use of olfactory stimuli can increase the catch markedly. These include carbon dioxide, acetone and 1-octen-3-ol from cattle breath, the phenolic fraction of cow urine, and cattle sebum. Field trials have shown that tsetse populations can be reduced to near zero after one year, with targets at a higher density along the main invasion front serving as an effective barrier. Costs can be kept to a minimum by encouraging local tribespeople to make and maintain the traps. This approach is essentially one of tsetse management, not eradication, and could be used as part of an integrated control system.

4. EPIDEMIOLOGY: VECTOR-HOST AND VECTOR-PARASITE INTERACTIONS

[See also **15**: nos. 7368, 7369, 7406, 7411, 7446.]

7395 **Baker, R.D., 1991**. Modelling the probability of a single trypanosome infecting a tsetse fly. *Annals of Tropical Medicine and Parasitology*, **85** (4): 413-415.
Centre for OR and Applied Statistics, University of Salford, Salford M5 4WT, UK.
A simple model is fitted to recent data on tsetse infection rates to estimate the probability of a single trypanosome infecting a tsetse fly. At mean numbers of trypanosomes per tsetse of > 0.7, the data can be well fitted by a probability of infection from a single trypanosome of $P = 0.11$. The data are consistent with clumping or clustering of trypanosomes in blood, and if this is modelled the true probability could be much higher, perhaps as large as 1. More data at low trypanosome concentrations would be needed to determine the true value of P.

7396 **Claxton, J.R., Faye, J.A. and Rawlings, P., 1992**. Trypanosome infections in warthogs (*Phacochoerus aethiopicus*) in The Gambia. *Veterinary Parasitology*, **41** (3-4): 179-187.
C/o FCO (LIMA), King Charles Street, London SW1A 2AH, UK; ITC, P.M.B. 14, Banjul, Gambia; ibid.
The prevalence of trypanosome infections in warthogs (*P. aethiopicus*) in The Gambia was found to be 11% of a sample of 62 animals. All isolates were identified as *Trypanosoma simiae*. Serological evidence indicated a higher level of exposure to *T. simiae*, but results were inconclusive for the presence of *T. congolense*. The course of *T. simiae* infection in warthog piglets showed a

rapidly rising parasitaemia, with a concomitant fall in PCV, and resulted in a prolonged period of low-level parasitaemia. The same infections killed domestic piglets.

7397 **Imbuga, M.O., Osir, E.O., Labongo, V.L., Darji, N. and Otieno, L.H., 1992**. Studies on tsetse midgut factors that induce differentiation of bloodstream *Trypanosoma brucei brucei in vitro*. *Parasitology Research*, **78** (1): 10-15.
ICIPE, P.O. Box 30772, Nairobi, Kenya. (Offprint requests to Osir.)
An *in vitro* system for studying the transformation of bloodstream forms of *T. b. brucei* into procyclic (midgut) forms is described. In this system, trans-formation of the parasites was stimulated by *Glossina morsitans morsitans* midgut homogenates at 27□C but not at 4□C. The transformation-stimulating capacity was irreversibly destroyed by heating the midgut homogenates at 60□C for 1 h. A correlation was established between the transformation activity of the midgut homogenates and trypsin activity. The protease inhibitors (soybean trypsin inhibitor and *N*-*p*-tosyl-L-lysine-chloromethyl-ketone) inhibited trypsin activity and completely blocked the transformation of the parasites. Furthermore, the midgut homogenates could induce transformation only in the presence of blood. These results provide evidence for the involvement of trypsin or trypsin-like enzymes within the tsetse midgut in stimulation of the transformation of bloodstream trypanosomes.

7398 **Mattioli, R.C., 1991**. Fréquence des trypanosomes dans les populations de glossines du ranch de gibier de Nazinga (Burkina Faso). [Frequency of trypanosomes in populations of tsetse flies at the Nazinga game ranch (Burkina Faso).] Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux, 44 (2): 165-168.
ITC, P.M.B. 14, Banjul, Gambia.
The frequency of trypanosome infections was examined in tsetse from the Nazinga game ranch which, in the absence of human and domestic animal populations and trypanosomiasis control, is considered to approach a `natural' habitat for an epidemiological study. Tsetse were captured using Challier-Laveissière biconical traps and sexed, aged and examined for trypanosomes. Forty-two of 125 *Glossina morsitans submorsitans* and 49 of 247 *G. tachinoides* were infected, with a combined infection rate of 24.5%. Statistical analysis showed females were more infected than males ($P < 0.005$), *G. m. submorsitans* was more infected than *G. tachinoides* ($P < 0.001$)

and *Duttonella* infections were more frequent than *Nannomonas*, especially in *G. m. submorsitans* ($P < 0.005$). A positive correlation was shown between tsetse age and rate of infection. Temperature influenced the age composition of the tsetse population: reduced temperature resulted in an increased number of younger tsetse with a lower rate of infection. It is concluded that the sex ratio, the mean age of the population and the ambient temperature are important parameters affecting tsetse infection rate: an aged population is more heavily infected and females play the major role in transmission. These results are discussed in relation to previous findings on infection rates in wild animals.

7399 **Rickman, L.R., Ernest, A., Kanyangala, S. and Kunda, E., 1991**. Human serum sensitivities of *Trypanozoon* isolates from naturally infected hosts in the Luangwa Valley, Zambia. *East African Medical Journal*, **68** (11): 880-892.

Rickman: Riverdale, Winkleigh, Devon EX19 8AD, UK.

Of 235 *Trypanozoon* stocks isolated from naturally infected hosts in north-eastern Zambia and tested by the blood incubation infectivity test (BIIT), 176 came from man, 37 from wild-caught tsetse, 11 from wild animals and 11 from domestic livestock. Of those from man, two gave unexpected, human-serum-sensitive (HSS) reactions on first testing; all 15 stocks from tsetse in the northern area (Kampumbu) were strongly serum-resistant (HSR) while 22 other infections, from tsetse in the southern area (Kakumbi), gave one equivocal, 11 positive and 10 negative test responses. HSR *Trypanozoon* infections were found in a bushbuck, in a warthog, in a giraffe (for the first time) and in a `sentinel' goat used to monitor sleeping sickness transmission in a small sleeping sickness endemic village.

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

7400 **Golvan, Y.J. and Ambroise-Thomas, P., 1984**. *Les nouvelles techniques en parasitologie et immuno-parasitologie*. [New techniques in parasitology and immuno-parasitology.] 2nd Edn. Paris; Flammarion.

The first part of this book concerns the sampling and morphological diagnosis of human parasites of the gut, urino-genital system, blood and haematopoietic organs and skin. There is a section on the diagnosis of African human trypanosomiasis caused by *Trypanosoma brucei gambiense* and *T. b. rhodesiense*. Both present the same

diagnostic problems and cannot be differentiated morphologically. Methods include determining the presence of IgM in the host serum and CSF and the presence of Mott cells in the medulla and CSF; the microscopic examination of different blood preparations, ganglionic fluid, bone marrow, CSF and chancre; and animal inoculation. The second part of the book covers immunological methods and includes the diagnosis of African human trypanosomiasis by indirect immunofluorescence, ELISA, haem-agglutination, agglutination of latex particles and electrosyneresis.

7401 **Komba, E., Odiit, M., Mbulamberi, D.B., Chimfwembe, E.C. and Nantulya, V.M., 1992**. Multicentre evaluation of an antigen-detection ELISA for the diagnosis of *Trypanosoma brucei rhodesiense* sleeping sickness. *Bulletin of the World Health Organization*, **70** (1): 57-61.

National Institute for Medical Research, Tabora, Tanzania; UTRO, Tororo, Uganda; National Sleeping Sickness Control Programme, Jinja, Uganda; TDRC, Ndola, Zambia; ILRAD, P.O. Box 30709, Nairobi, Kenya. (Reprint requests to Nantulya.)

The performance of an enzyme-linked immunosorbent assay (antigen ELISA) for the detection, in serum or cerebrospinal fluid, of an invariant trypanosome antigen to diagnose *T. b. rhodesiense* sleeping sickness was evaluated in four clinical treatment centres. The test, which was carried out in polystyrene test-tubes, was positive in 88 (88.9%) of 99 parasitologically confirmed cases that were tested at the National Institute for Medical Research, Tabora, Tanzania; 99 (94.3%) of 105 cases tested at the National Sleeping Sickness Control Programme, Jinja, Uganda; 86 (87.8%) of 98 cases tested at UTRO, Tororo, Uganda; and 59 (96.7%) of 61 cases tested at TDRC, Ndola, Zambia. The overall detection rate was 91.5%. There was no cross-reactivity with the agents of the common bacterial, viral or parasitic diseases prevalent in the areas where the studies were conducted. The only false-positive result involved a blood donor from a trypanosomiasis endemic focus. The test was simple to perform, was read visually, and is therefore a potential tool for diagnosing human African trypanosomiasis.

7402 **Nantulya, V.M., Doua, F. and Molisho, S., 1992**. Diagnosis of *Trypanosoma brucei gambiense* sleeping sickness using an antigen detection enzyme-linked immunosorbent assay. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **86** (1): 42-45.

ILRAD, P.O. Box 30709, Nairobi, Kenya; PRCT, Daloa, Côte d'Ivoire; Bureau Central de la Trypanosomiase, Kinshasa, Zaire.
A monoclonal antibody-based enzyme-linked immunosorbent assay (antigen ELISA) developed for detection of trypanosome antigens in the serum and CSF of patients as a means for diagnosis of *T. b. gambiense* sleeping sickness was evaluated at the Bureau Central de la Trypanosomiase, Kinshasa, Zaire. Sixty-nine (89.6%) of 77 parasitologically confirmed cases examined at the Daloa clinic had antigens in serum; 35 (45.5%) had antigens in CSF and, in four of these, the antigens were detected in CSF only. Taking the serum and CSF results together, 73 (94.8%) of the 77 patients were positive in the assay. In the Kinshasa series, 168 (89.4%) of 188 parasitologically confirmed cases were positive by antigen ELISA. The controls, who included 165 blood donors and 40 patients with malaria, two with hydatidosis and 12 with leishmaniasis, were negative by antigen ELISA. Analysis of CSF results for 35 patients who had antigens in CSF revealed that 34 (97.1%) had elevated CSF white cell counts, 29 (82.9%) had elevated protein levels, and 23 (65.7%) had trypanosomes in their CSF. Moreover, analysis of results from 34 patients whose CSF had been shown to harbour trypanosomes by the double centrifugation technique showed that 24 (70.6%) had antigens in CSF, 28 (82.6%) had elevated protein levels, and 33 (97.1%) had elevated CSF white cell counts. Antigens were rapidly cleared from peripheral circulation following institution of treatment. Antigen clearance was accompanied by a rapid fall in CSF protein levels and white cell counts. These results demonstrate the potential of antigen ELISA, not only as a tool for diagnosis, but also for clinical staging and treatment follow-up of patients with *T. b. gambiense* sleeping sickness.

7403 **Scott, J.A.G., Davidson, R.N., Moody, A.H. and Bryceson, A.D.M., 1991**. Diagnosing multiple parasitic infections: trypanosomiasis, loiasis and schistosomiasis in a single case. *Scandinavian Journal of Infectious Diseases*, **23** (6): 777-780.
Scott: Lister Unit, Northwick Park Hospital, Harrow, Middlesex HA1 3UJ, UK; Departments of Clinical Tropical Medicine (Davidson, Bryceson) and Parasitology (Moody), Hospital for Tropical Diseases, London NW1, UK.

A case is reported of a 32-year-old traveller with loiasis, schistosomiasis and African trypanosomiasis. The patient had been working in oil exploration in Nigeria and Gabon and presented with Calabar swellings and carpal tunnel syndrome. Serology for all three diseases was positive but microfilariae of *Loa loa* and ova of schistosomiasis were not found. Treatment with diethyl-carbamazine and praziquantel was given for loiasis and schistosomiasis respectively. Trypanosomes were isolated from a lymph node aspirate only after repetition of the procedure 2 months later and the patient was treated with suramin. He developed a drug-induced nephritis and was then treated successfully with α-difluoromethylornithine. There is a discussion of the difficulties encountered making these diagnoses in Europeans particularly where there are atypical clinical features. The risks of rural work in West Africa are noted and the importance of considering all parasitic diseases relevant to the travel/occupational history is emphasised.

(b) PATHOLOGY AND IMMUNOLOGY

7404 **Pentreath, V.W., Owolabi, A.O. and Doua, F., 1992**. Survival of *Trypanosoma brucei brucei* in cerebrospinal fluid. *Annals of Tropical Medicine and Parasitology*, **86** (1): 29-34. Department of Biological Sciences, University of Salford, Salford M5 4WT, UK; ibid.; PRCT, B.P. 1425, Daloa, Côte d'Ivoire.

Different compositions of artificial CSF and the CSF from sleeping sickness patients both with and without late-stage (i.e. CNS) involvement were evaluated for their abilities to support survival of *T. b. brucei*. Artificial CSF, containing the major electrolytes, amino acids and carbohydrate components of healthy fluid, was equivalent to the CSF from patients without CNS involvement (survival time 20 h). Normal CSF does not therefore contain substances which deter the parasite. The CSF from the late-stage patients did not support survival for longer than 10 h, probably because it contained increased numbers of lymphocytes and antibodies.

(c) TREATMENT

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

7405 **Cheik Moussa, I., 1989**. *Contribution à l'épidémiologie de la trypanosomose caméline à* T. evansi *dans la République de Djibouti*.

[Contribution to the epidemiology of trypanosomiasis in camels due to *T. evansi* in the Djibouti Republic.] Thèse de Doctorat vétérinaire, Université Claude Bernard, Lyon, France. (Unpublished thesis.) 92 pp.
B.P. 205, Djibouti, République de Djibouti.
An epidemiological survey of *Trypanosoma evansi* in 150 camels in Djibouti in 1985 using the micro-ELISA technique showed that 22% of the animals were infected. This thesis describes a second survey carried out on 234 camels using several methods, including Testryp CATT which showed 15.8% of the animals to be infected. These two surveys show that trypanosomiasis is a major disease of camels in Djibouti.

7406 **Claxton, J.R., Leperre, P., Rawlings, P., Snow, W.F. and Dwinger, R.H., 1992**. Trypanosomiasis in cattle in Gambia: incidence, prevalence and tsetse challenge. *Acta Tropica*, **50** (3): 219-225.
C/o FCO (LIMA), King Charles Street, London SW1A 2AH, UK; ITC, P.M.B. 14, Banjul, Gambia; ibid.; ibid.; ibid.
The incidence of trypanosome infections, measured by a Berenil Index in experimental herds of ten Zebu and ten N'Dama cattle, was compared with tsetse challenge and with the prevalence of parasitaemia in local N'Dama at three villages in The Gambia. Tsetse challenge was more strongly correlated with the incidence of parasitaemia in the Zebu than in the N'Dama. There was a strong correlation between prevalence and incidence of infection in the N'Dama. There was no correlation, however, between prevalence of infection in cattle and tsetse challenge unless the data were offset by 3-5 months. The Berenil Index in the Zebu increased at about twice the rate of that in the N'Dama under corresponding levels of challenge. It is concluded that, whereas incidence of infection in susceptible animals is best measured independently, it can, under stable conditions, be inferred from an assessment of tsetse challenge.

7407 **Diall, O., Oumaré, A., Diarra, B., Sanogo, Y. and Coulibaly, Z., 1988**. Note sur la trypanosomose à *T. evansi* dans le secteur de Nara (Mali) et dans le Sud Mauritanien. [Note on *T. evansi* trypanosomiasis in the Nara sector (Mali) and in South Mauretania.] *Bulletin de Liaison du Groupe de Recherche sur les Petits-ruminants et les Camélidés*, **1988** (11): 14-17.
Service de l'Elevage, Ministère de Développement Rural, Bamako, Mali.
The presence of *Trypanosoma evansi* infection was investigated in 195 camels from Nara (Mali), Abel-Bagrou and Néma (Mauritania). Blood samples were

subjected to HCT followed by microscopic examination and the PCV was determined. The results showed that the rate of infection was 3% in the dry season and 20% in the rainy season, when about 90% of the positive cases were young animals aged between 0 and 5 years. The high incidence in the rainy season was related to the abundance of tabanid vectors at this time. Infections were more frequent in camels from the more northerly locations (Nara and Abel-Bagrou). A significant difference in PCV was recorded in infected and non-infected animals. It is concluded that *T. evansi* is an important pathogen of camels in the areas studied and that further research should be carried out to determine the most efficient use of the chemotherapeutic drug Antrycide. *T. evansi* was absent in the cattle and donkeys that were also examined but it was not possible to conclude that it never occurs in these species.

7408 **Falope, O.O., 1991**. Camel trypanosomiasis in Nigeria: new prevalent rate. *Bulletin of Animal Health and Production in Africa*, **39** (1): 1-2.

Pathology, Epidemiology and Statistics Division, NITR, P.M.B. 2077, Kaduna, Nigeria.

Camels are gaining in economic importance in northern Nigeria due to their increasing use as a source of meat in drought-affected areas. The present study was undertaken to appraise losses due to camel trypanosomiasis and to assess the need for a control programme. Blood samples from 61 slaughtered camels at the Kaduna abattoir were examined by wet film, Giemsa-stained film, mouse inoculation, micro-HCT and buffy coat techniques. *Trypanosoma evansi* was identified in four of the samples, giving a prevalence rate of 6.56%. This is lower than previous reports of prevalence rates of 15% in Jibiya and Sokoto and 27.6% in Mongonu, carried out at the same time of year. However, these higher rates were exhibited by sedentary animals watered in `small endemic foci' of trypanosomiasis.

7409 **Kalu, A.U., 1991**. An outbreak of trypanosomosis on the Jos Plateau, Nigeria. *Tropical Animal Health and Production*, **23** (4): 215-216.

Veterinary and Livestock Studies Division, NITR, P.M.B. 03, Vom, Plateau State, Nigeria.

An outbreak of animal trypanosomosis was reported in Bassa Local Government Area on the Jos Plateau in September 1987, a region generally accepted as tsetse-free. Non-peridomestic flies had first been noticed 10 months previously. Blood samples were collected

randomly from Zebu cattle and Yankassa sheep, the PCV estimated and the samples examined for trypanosomes by wet and thin film, HCT and buffy coat techniques. Of 629 bovine samples, 243 (38.6%) were infected with trypanosomes out of which 165 (67.9%) were *Trypanosoma vivax* infections and the rest were unidentified. Calves and cattle over 7 years old had a higher percentage of subclinical infections. Of 165 ovine samples, 34 (20.6%) were infected: 21 (61.8%) with *T. vivax*, three (8.8%) with *T. congolense* and ten (29.4%) were unidentified. The outbreak was controlled by treating infected animals with diminazene aceturate at 3.5 mg/kg and the others with prophylactic doses of isometamidium chloride. The 28 flies caught by hand net were all *Glossina tachinoides*, with 12 males and 16 females aged 18-32 days; only three were infected. The source of the flies and the factors which contributed to the outbreak were not determined, although Bassa is contiguous with a known *G. tachinoides* belt in Kaduna State.

7410 **Kalu, A.U., Uzoukwu, M., Ikeme, M.M. and Magaji, Y., 1991**. Trypanosomiasis in Nigeria: high prevalence among ruminants in Gboko Local Government Area. *Bulletin of Animal Health and Production in Africa*, **39** (1): 3-8.

NITR, P.M.B. 03, Vom, Nigeria; Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria; ibid.; NITR, P.M.B. 2077, Kaduna, Nigeria.

Three hundred and fifty-five blood samples collected from semi-nomadic/ peridomestic ruminants in various localities in Gboko Local Government Area, Nigeria, were screened for trypanosomes using six parasitological diagnostic techniques. The data suggest the area may be a hyperenzootic focus of ruminant trypanosomiasis: 33.2% of all animals had active trypanosome infections. The prevalence in the different ruminant species was 51.6% in sheep, 33.3% in goats and 24.6% in cattle. *Trypanosoma vivax* and *T. congolense* were the most prevalent species encountered and accounted for 51.7% and 11.9% of all positive cases, respectively. Mixed trypanosome stocks were encountered in 6.8% of all samples and 18.6% of trypanosome-positive ruminants, while 3.7% of the animals had sub-clinical infections. The prevalence of *T. brucei* subspecies was generally low but was higher in slaughter animals than in peridomestic livestock. Trypanosomes were also more prevalent in males than in females and this was associated with lower PCV values. Calves, lambs and kids suffered mostly from *T. vivax* infections. *Glossina tachinoides* was the only tsetse fly

species encountered and responded to acetone odour attractant in biconical traps.

7411 **Lobry, N., 1986**. *Trypanosomoses bovines dans le nord de la Côte d'Ivoire: épidémiologie et conséquences socio-économiques*. [Bovine trypanosomiasis in northern Côte d'Ivoire: epidemiology and socio-economic consequences.] Thèse de Doctorat vétérinaire, Université de Nantes, France. (Unpublished thesis.) 158 pp.
24 rue Albert Joly, 78000 Versailles, France.
Cattle rearing methods in northern Côte d'Ivoire are reviewed and the epidemiology of trypanosomiasis has been studied in order to evaluate the extent of the disease and variations in infection in different breeds of cattle. The socio-economic effects of trypanosomiasis fall into two main categories: direct effects with particular relevance to veterinary and economic planning, such as mortality, abortion, fecundity and productivity; and indirect effects on rearing methods, such as choice of trypanotolerant breeds and crossbreeds, and on agriculture, human health and the economy of the country as a whole.

(b) PATHOLOGY AND IMMUNOLOGY

7412 **Agyemang, K., Dwinger, R.H., Little, D.A., Leperre, P. and Grieve, A.S., 1991**. Interaction between physiological status in N'Dama cows and trypanosome infections and its effect on health and productivity of cattle in Gambia. *Acta Tropica*, **50** (2): 91-99.
ITC, P.M.B. 14, Banjul, Gambia; Agyemang, Little: also ILCA, P.O. Box 5689, Addis Ababa, Ethiopia. (Correspondence to Agyemang at ITC.)
Data collected for three years on incidence of trypanosome infections, degree of anaemia as assessed by PCV and liveweights of four groups of cows of varying physiological status were analysed. The animals were not harbouring trypanosomes during a period of 2-3 months before exposure to periods of increasing density of tsetse flies (*Glossina morsitans submorsitans*) while grazing in savanna woodlands. The groups of cows were formed on the following basis: pregnant and lactating (lactating-pregnant) (Group 1, n = 143); pregnant and not lactating (dry-pregnant) (Group 2, n = 69); non-pregnant and lactating (lactating-open) (Group 3, n = 160); non-pregnant and not lactating (dry-open) (Group 4, n = 49). Monthly trypanosome prevalence was highest (17.5%) in the cows with the highest physiological stress (Group 1), followed by Group 3 (11.1%) and Group 2 (10.0%) with

the lowest prevalence found in the least stressed cows, Group 4 (1.6%). Average PCV values for dry-pregnant cows (Group 2; 27.0%) and dry-open cows (Group 4; 26.2%), whether infected or not, were higher than for those lactating (Group 1; 25.3% and Group 3; 23.6%). A body weight gain of 4.3 kg between the month of October and the following June was recorded for dry-pregnant cows (Group 2) whereas a weight loss of 16 kg occurred in the lactating-pregnant and lactating-open cows (Groups 1 and 3), with more severe losses recorded in infected than uninfected cows. Dry-open cows (Group 4) maintained their weight during the observation period. It was concluded that the physiological states of pregnancy and lactation tended to predispose N'Dama cows to trypanosome infections, and that the interaction between physiological status and trypanosome infections appeared to have affected their ability to maintain PCV levels and body weights.

7413 **Bataille, J.-L.P.F., 1990**. *Impact d'une trypanosomose expérimentale sur la fonction sexuelle du taureau Baoulé*. [Impact of experimental trypanosomiasis on the sexual function of the Baoulé bull.] Thèse de Doctorat vétérinaire, Université Paul Sabatier, Toulouse, France. (Unpublished thesis.) 74 pp.

The sexual function of Baoulé bulls has been studied as part of a research programme into the physiology of this trypanotolerant breed at CRTA, Bobo-Dioulasso, Burkina Faso. After normal function had been established by collecting and analysing sperm, six bulls were infected with 10,000 *Trypanosoma congolense* in tsetse-free housing. Their rectal temperature, PCV, body weight, parasitaemia and sperm were monitored for 5 months after infection. The results showed an increase in rectal temperature and a reduction in weight, PCV, libido and sperm quality in five of the bulls. One bull showed no detectable parasitaemia and of the five affected, four had sufficiently high sperm counts to have been reproductively viable. Previous studies have shown that sexual function in infected Zebu is much more strongly affected.

7414 **Dwinger, R.H., Clifford, D.J., Agyemang, K., Gettinby, G., Grieve, A.S., Kora, S. and Bojang, M.A., 1992**. Comparative studies on N'Dama and zebu cattle following repeated infections with *Trypanosoma congolense*. *Research in Veterinary Science*, **52** (3): 292-298.

Dwinger: Proyecto UNA/RUU, Escuela de Medicina Veterinaria, Universidad Nacional, Apdo 86-3000, Heredia, Costa Rica; Gettinby: Department of Statistics and Modelling Science, University of Strathclyde, Glasgow; other authors: ITC, P.M.B. 14, Banjul, Gambia.

Twenty N'Dama and eight Zebu cattle were inoculated intradermally with bloodstream forms of a cloned strain of *T. congolense* originating from East Africa. All inoculated cattle became parasitaemic. Zebus showed consistently higher levels of parasitaemia and lower PCV percentages than did N'Damas. Three of the eight Zebus required treatment when high numbers of trypanosomes were present in the blood and PCV values dropped below 15%. None of the N'Dama cattle needed treatment. Statistical analysis was performed on the data to assess the variability of parasitaemia and PCV levels before and during infection of the N'Dama cattle. The variation in PCV values was large between individuals during the early stages of the disease and diminished as infection continued. After trypanocidal

drug treatment and a recovery period of 14 months, the same animals were inoculated intradermally with *T. congolense* bloodstream forms isolated and cloned in The Gambia. Differences in susceptibility to the ensuing disease were apparent when comparing N'Dama and Zebu cattle. Five Zebu cattle needed trypanocidal drug treatment, while none of the N'Damas needed drug intervention. Ranking the 20 infected N'Damas according to average PCV levels revealed that the animals responded similarly to both infections.

7415 **Katunguka-Rwakishaya, E., Murray, M. and Holmes, P.H., 1991**. The pathophysiology of *Trypanosoma congolense* infection in sheep. (Meeting abstract.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **85** (6): 841.

Departments of Veterinary Physiology (Katunguka-Rwakishaya, Holmes) and Medicine (Murray), University of Glasgow Veterinary School, Bearsden Road, Bearsden, Glasgow G61 1QH, UK.

Experimental infection of Scottish Blackface sheep with *T. congolense* resulted in fluctuating parasitaemia, pyrexia, macrocytic normochromic anaemia and leucocytosis which was principally a lymphocytosis. A significant correlation was observed between PCV and levels of parasitaemia. Infected sheep had significantly lower mean red cell volumes but higher plasma and blood volumes than control sheep, and also had enhanced erythropoietic activity. There was no evidence of dyserythropoiesis. Biochemical determination of blood lipids showed that infected sheep had marked reduction in total serum lipids.

7416 **Makinde, M.O., Otesile, E.B. and Fagbemi, B.O., 1991**. Studies on the relationship between dietary energy levels and the severity of *Trypanosoma brucei* infection: the effects of diet and infection on blood and plasma volumes and erythrocyte osmotic fragility of growing pigs. *Bulletin of Animal Health and Production in Africa*, **39** (2): 161-166.

Department of Preclinical Veterinary Studies, University of Zimbabwe, Mt Pleasant, Harare, Zimbabwe; Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria; ibid.

The effects of dietary energy level and *T. brucei* infection on plasma and blood volume and erythrocyte osmotic fragility of growing pigs were investigated. The mean corpuscular volume and erythrocyte osmotic fragility were not significantly ($P > 0.05$) affected by dietary energy level and/or infection. However, significant ($P < 0.05$) increases were observed in the plasma volumes of infected pigs at the three energy

levels but without corresponding increases in blood volumes except in pigs on low energy rations. The results indicated that high energy level may mitigate the pathogenic effects of *T. brucei*.

7417 **Masaninga, F., Kanyangala, P., Kunda, E. and Rickman, L.R., 1991.** Observations on a goat naturally infected with *Trypanosoma brucei rhodesiense*-like organisms. *Annals of Tropical Medicine and Parasitology*, **85** (5): 569.

TDRC, P.O. Box 71769, Ndola, Zambia; ibid.; ibid.; Riverdale, Winkleigh, Devon EX16 8AD, UK.

Twenty-five 3-5 month old trypanosomiasis-free goats were deployed in five villages in a tsetse-infested area. One became parasitaemic with a *Trypanozoon* infection and a parasite isolate was cryopreserved. The goat was not treated but transferred to a fly-screened house. Less than 1 month after infection trypanosomes could no longer be detected in the blood and the goat was clinically healthy. Five months after the initial infection the goat was rechallenged with the isolate: parasites were detected in the blood 15 and 22 days p.i. but by day 30 the animal was aparasitaemic. This study suggests that some central African indigenous goats are able to tolerate or resist trypanosome infection and could be of special value in small animal husbandry. However, further studies are necessary to establish whether such animals could serve as long-term reservoirs of trypanosomiasis.

7418 **Omeke, B.C.O., 1991.** Reproductive capacity of trypanosome-infected boars following diminazene aceturate therapy. *Bulletin of Animal Health and Production in Africa*, **39** (1): 9-13.

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

Thirty-two crossbred pubertal boars were used to study the reproductive capacity of boars naturally infected with *Trypanosoma brucei* and *T. congolense* and the effects of treatment with diminazene aceturate (Berenil). Infected boars were predisposed to anaemia and loss of condition. There were significant differences between trypanosome-infected (A), infected but treated (B), and uninfected control (C) boars in their mean slaughter body and gonad weights, testicular and epididymal sperm reserves ($P < 0.05$), and their daily sperm production (DSP) ($P < 0.01$). DSP correlated positively ($P < 0.001$) with body weights, testes weights, and total sperm reserves (R = + 0.95, + 0.98, and + 0.88), while DSP per gram of testis parenchyma correlated negatively (R = – 0.28) with testes weights. Timely Berenil

therapy cured the boars' trypanosomiasis and improved their reproductive capacity. However, in view of drug scarcity and short duration of action, parasite relapses, development of resistant strains and financial constraints, careful management practice, including rearing breeder boars in fly-proof houses, is paramount. Meanwhile the role of reproductive hormones in limiting the reproductive capacity of trypanosome-infected boars is being investigated.

7419 **Omeke, B.C.O. and Ugwu, D.O., 1991**. Pig trypanosomosis: comparative anaemia and histopathology of lymphoid organs. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (3): 267-272.

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

Anaemia with characteristic clinical symptoms, haematological changes and histopathology of lymphoid organs, was observed following experimental infection of pigs with pathogenic species of *Trypanosoma brucei brucei* and *T. congolense*, the former being more virulent than the latter. Mean incubation periods were 4 and 7 days, and generalised fluctuating levels of parasitaemia and pyrexia without mortality were observed. Other symptoms included hyperaemia, petechial haemorrhages leading to plaques or lesions, loss of appetite, dehydration and/or ascites. Trypanosomosis significantly ($P < 0.01$) lowered the PCV, haemoglobin concentration and red blood cells, but elevated white blood count (differentials) of infected pigs. Trypanosomes were localised in and destroyed the lymphoid tissues, the major lesions of which included haemorrhages, mono-nuclear infiltration proliferation and distortion of follicles, and tissue necrosis or fibrosis. Significant effects of resultant immunosuppression, erythrophagocytosis and hence secondary infections to pig production in trypanosome endemic areas are highlighted.

7420 **Otesile, E.B., Akpavie, S.O., Fagbemi, B.O. and Ogunremi, A.O., 1991**. Pathogenicity of *Trypanosoma brucei brucei* in experimentally infected pigs. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (3): 279-282.

Departments of Veterinary Medicine (Otesile, Ogunremi), Veterinary Pathology (Akpavie) and Veterinary Microbiology and Parasitology (Fagbemi), University of Ibadan, Ibadan, Nigeria.

An experimental infection of 4-5 month old pigs with a stock of *T. b. brucei* resulted in a high parasitaemia, anorexia, pyrexia and a decline in the PCV by one

third. Nervous signs of circling and wobbling of the hind legs occurred in one of the pigs which at necropsy revealed a very severe meningo-encephalitis and the presence of trypanosomes in the brain. These results confirm that *T. b. brucei* might cause a severe disease in pigs.

7421 **Sileghem, M. and Flynn, J.N., 1992**. Suppression of interleukin 2 secretion and interleukin 2 receptor expression during tsetse-trans-mitted trypanosomiasis in cattle. *European Journal of Immunology*, **22** (3): 767-773. ILRAD, P.O. Box 30709, Nairobi, Kenya.

Infection with *Trypanosoma congolense* in cattle was found to be associated with a profound suppression of the host's immune system. Lymph node cells from infected cattle were unable to secrete interleukin 2 (IL 2) *in vitro* following mitogenic stimulation, and the exogenous supply of IL 2 did not restore T cell proliferative responses. This was associated with an impaired expression of the α chain of the IL 2 receptor (IL 2Rα). Co-culture experiments, where cells from an infected animal were mixed with cells from a major histocompatibility complex-matched normal animal, demonstrated the presence of suppressor cells capable of blocking both IL 2 secretion and IL 2Rα expression. Removal of macrophages by fluorescence-activated cell sorting abrogated suppression in such co-cultures. Following depletion of macrophages, lymph node cells from an infected animal expressed IL 2Rα at a normal level, but remained incapable of producing IL 2. Hence, the unresponsiveness was associated with macrophage-like suppressor cells which operated at the level of both IL 2 secretion and IL 2Rα expression, and with an intrinsic unresponsiveness of the T cells which was restricted to IL 2 secretion. Inhibition of prostaglandin synthesis by addition of indomethacin failed to abrogate suppression of either IL 2 secretion or IL 2Rα expression. This revealed a major difference between the regulation of suppression in murine model infections where the suppression of IL 2 secretion is due to prostaglandin secretion, and the situation in cattle where prostaglandins would not appear to be involved.

(c) TRYPANOTOLERANCE

[See also **15**: nos. 7359, 7362, 7363, 7414, 7417.]

7422 **Cribiu, E.P., Meyer, C., Yesso, P., Durand, V. and Popescu, C.P., 1991**. Distribution de la translocation robertsonienne 1/29 chez les bovins trypanotolérants et les zébus de

Côte-d'Ivoire. [Prevalence of the 1/29 Robertsonian translocation in trypanotolerant and Zebu cattle in Côte d'Ivoire.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (2): 207-210.
Cribiu, Durand, Popescu: INRA, Centre de Recherche de Jouy, Laboratoire de Cytogénétique, 78350 Jouy-en-Josas, France; Meyer, Yesso: IDESSA, Centre de Recherches Zootechniques, B.P. 1152, Bouaké, Côte d'Ivoire.
In a cytogenetic survey of a local cattle population in Côte d'Ivoire, the 1/29 Robertsonian translocation was detected in the trypanoresistant Baoulé and N'Dama breeds and among Zebu cattle. An acrocentric Y chromosome was always found in all Zebu bulls examined, whereas in Baoulé and N'Dama bulls the Y chromosome was either metacentric as in the *Bos taurus* breeds or very rarely acrocentric, a fact which could indicate a Zebu crossing.

7423 **Djabakou, K., Grundler, G. and Lare, K., 1991**. Involution utérine et reprise de cyclicité post-partum chez les femelles bovines trypanotolérantes Ndama et Baoulé. [Post-partum uterine involution and oestrous cycle resumption in trypanotolerant N'Dama and Baoulé cows.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (3): 319-324.
CREAT, B.P. 27, Agou-Gare, Togo.
Thirty N'Dama and 30 Baoulé cows kept on pasture at CREAT, in the sudano-guinean savanna of West Africa, were studied. Two calving seasons were observed: during the dry season (December-January) and at the beginning of the rainy season (February-March). Cows calving in the dry season had lost about 10% of their body weight 30 days post-partum compared with 2% in the rainy season. The duration of uterine involution was not influenced by calving season but was completed more quickly in young cows (by 30 days post-partum). The criteria of behaviour, ovarian morphology and plasma progesterone levels indicated different times for resumption of the oestrous cycle. An increase in plasma progesterone concentration above 0.5 ng/ml showed that 50% of the N'Dama and Baoulé cows had resumed their oestrous cycle 34 and 40 days post-partum, respectively. Weight gain, which depended on feeding, seemed to be the main reason for the variations in resumption of the oestrous cycle and hence in the calving intervals.

7424 **Meyer, C. and Yesso, P., 1991**. Courbe de progestérone plasmatique du cycle oestral chez les races taurines

trypanotolérantes de Côte-d'Ivoire. [Plasma progesterone curve during the oestrous cycle of trypano-tolerant cattle breeds in Côte d'Ivoire.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (2): 193-198.
Institut des Savanes (IDESSA), Département Elevage, B.P. 1152, Bouaké, Côte d'Ivoire.
Plasma progesterone levels are used in temperate countries to monitor the reproductive state of cattle, i.e. to study cyclicity and anoestrus, puberty, embryonic death, infertility and for the early diagnosis of pregnancy 21-24 days after artificial insemination. The plasma concentration in blood samples collected daily from 12 N'Dama and 12 Baoulé cows for a period of 45 days showed a cycle length of 20.4 days for the N'Dama and 21.4 days for the Baoulé, comparable to that in European breeds. The curve rose from a minimum of 0.6 ng/ml at oestrus to a peak (plateau) of 9.5 ng/ml (N'Dama) or 9.3 ng/ml (Baoulé) from days 8-17, rather higher levels than those seen in European breeds. In some atypical cases (12%) progesterone level exceeded 3 ng/ml at oestrus. It is concluded that the practical uses of monitoring progesterone levels are equally applicable to trypanotolerant breeds.

7425 **Meyer, C. and Yesso, P., 1991**. Étude des chaleurs des vaches trypanotolérantes Ndama et Baoulé en Côte-d'Ivoire. I. Particularités des composantes comportementale et organique. [Study of oestrus in trypanotolerant N'Dama and Baoulé cows in Côte d'Ivoire. I. Behavioural and organic characteristics.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (2): 199-206.
Institut des Savanes (IDESSA), Département Elevage, B.P. 1152, Bouaké, Côte d'Ivoire.
Eleven N'Dama and 19 Baoulé cows were maintained with two androgenised cows fitted with a marking harness and their sexual behaviour studied for a whole year. Oestrus was detected mainly by variations in plasma progesterone levels, sexual behaviour and gynaecological examination. This study confirmed that oestrus is more difficult to detect in these breeds than in European breeds. On the day of oestrus, uterus rigidity, vulva oedema and the presence of clear mucus were not always seen, and some cows showed long and discontinuous oestrus. However, by taking as criteria of oestrus at least two acceptances of mounting per day, seen during two 30 min periods of observation (at

0700 and 1530 h), two-thirds of the occurrences of oestrus could be detected.

7426 **Teale, A.J. (ed.), 1991.** *Bovine genome mapping and trypanotolerance* (Proceedings of a Workshop held at ILRAD, Nairobi, Kenya, 9-11 April 1991). Nairobi; ILRAD. 72 pp. ILRAD, P.O. Box 30709, Nairobi, Kenya.

This workshop was held to assess the status of bovine genome mapping worldwide and to discuss the practicalities of developing an International Bovine Trypanotolerance Mapping Group. The identification of markers of genes controlling trypanotolerance would facilitate the exploitation of this trait as a means of controlling trypanosomiasis. Laboratory reports are presented from the Hebrew University of Jerusalem (Israel), Swiss Federal Institute of Technology, CSIRO Division of Tropical Animal Production (Australia), ILRAD (Kenya), Texas A & M University (USA), Institute of Animal Physiology and Genetics Research (UK), Trinity College Dublin (Ireland), INRA Laboratoire de Génétique Biochimique (France), University of Guelph (Canada), ITC (The Gambia) and ILCA (Kenya). Trypanotolerance is shown to involve a significant degree of genetic control, to be probably highly heritable and controlled by two or more genes, to be characterised by improved parasite control and not to be dependent on previous challenge and not to be parasite specific. Its mechanisms are unknown. Crossbreeding programmes at ITC and ILRAD aim for a transgenic approach to the design of trypanotolerant stock. A summary of the final discussion and a list of recommendations are included.

(d) TREATMENT

7427 **Otsyula, M., Kamar, K., Mutugi, M. and Njogu, A.R., 1992.** Preliminary efficacy trial of Cymelarsan, a novel trypanocide, in camels naturally infected with *Trypanosoma evansi* in Kenya. *Acta Tropica*, **50** (3): 271-273. KETRI, P.O. Box 362, Kikuyu, Kenya.

T. evansi is the most important pathogen of camels in Kenya, where suramin and quinapyramine resistance has led to an urgent need for new drugs. Over 200 camels in the Eastern Province of Kenya were screened for trypanosomiasis by HCT. Fourteen camels with demonstrable *T. evansi* were treated subcutaneously with Cymelarsan at a range of dose rates: 1.2 mg/kg (two camels), 0.6 mg/kg (three camels), 0.4 mg/kg (four camels) and 0.2 mg/kg (two camels), with three camels as controls. The animals were monitored by HCT for

determination of PCV and by buffy coat examination for parasitaemia. All treated camels were clear of circulating trypanosomes on days 7, 14 and 21 post-treatment, irrespective of dose rate, and those given 0.2 and 1.2 mg/kg were clear on days 4 and 90. Trypanosomes were detected in some camels given 0.4 mg/kg on days 4 (1/4) and 90 (1/4) and in some given 0.6 mg/kg on days 4 (2/3) and 90 (1/3). Camels treated at 0.4 mg/kg and higher dose rates showed systemic reactions during the first 2 h post-treatment and swellings at the site of injection. Cymelarsan is effective against *T. evansi* in camels and larger-scale trials are recommended.

7. EXPERIMENTAL TRYPANOSOMIASIS

(a) DIAGNOSTICS

[See **15**: no. 7473.]

(b) PATHOLOGY AND IMMUNOLOGY

[See also **15**: no. 7450.]

7428 **Akanji, M.A., 1990**. Urinary levels of some acid hydrolase enzymes during *Trypanosoma gambiense* infection in rats. *Nigerian Journal of Science*, **24** (1-2): 77-79.
Biochemistry Department, University of Ilorin, Ilorin, Nigeria.

7429 **Filutowicz, H., Schleifer, K.W. and Mansfield, J.M., 1992**. Character-ization of T helper cell responses to the variant surface glycoprotein (VSG) of African trypanosomes. [*T. b. rhodesiense*; mice.] (Meeting abstract no. 1639.) *FASEB Journal*, **6** (4): A1220.
University of Wisconsin, Madison, WI 53706, USA.

7430 **Hajduk, S.L., Hager, K. and Esko, J.D., 1992**. High-density lipoprotein-mediated lysis of trypanosomes. [*T. brucei*.] *Parasitology Today*, **8** (3): 95-98.
Department of Biochemistry, University of Alabama Schools of Medicine and Dentistry, Birmingham, AL 35294, USA.

7431 **Hunter, C.A., Gow, J.W., Kennedy, P.G.E., Jennings, F.W. and Murray, M., 1991**. Immunopathology of experimental African sleeping sickness: detection of cytokine mRNA in the brains of *Trypanosoma brucei brucei*-infected mice. *Infection and Immunity*, **59** (12): 4636-4640.
Murray: Department of Veterinary Medicine, University of Glasgow, Bearsden Road, Bearsden, Glasgow G61 1QH, UK.

7432 **Olsson, T., Bakhiet, M. and Kristensson, K., 1992**. Interactions between *Trypanosoma brucei* and $CD8^+$ T cells. *Parasitology Today*, **8** (7): 237-239.
Department of Neurology (Olsson, Bakhiet) and

Clinical Research Center (Kristensson), Karolinska Institute, Huddinge University Hospital, S-141 86 Huddinge, Stockholm, Sweden.

7433 **Otesile, E.B., Lee, M. and Tabel, H., 1991**. Plasma levels of proteins of the alternative complement pathway in inbred mice that differ in resistance to *Trypanosoma congolense* infections. *Journal of Parasitology*, **77** (6): 958-964.

Tabel: Department of Veterinary Microbiology, Western College of Veterinary Medicine, University of Saskatchewan, Saskatoon S7N 0W0, Canada.

7434 **Schleifer, K.W., Filutowicz, H. and Mansfield, J.M., 1992**. Nitric oxide and prostaglandin synergistically mediate immunosuppression in African trypanosomiasis. [*T. b. rhodesiense*; mice.] (Meeting abstract no. 1179.) *FASEB Journal*, **6** (4): A1140.

University of Wisconsin, Madison, WI 53706, USA.

7435 **Shakibaei, M. and Frevert, U., 1992**. Cell surface interactions between *Trypanosoma congolense* and macrophages during phagocytosis *in vitro*. *Journal of Protozoology*, **39** (1): 224-235.

Frevert: Institute of Pathology, New York University Medical Center, 550 First Avenue, New York, NY 10016, USA.

(c) CHEMOTHERAPEUTICS

7436 **Brown, J.E., Patterson, L.H., Williamson, J. and Brown, J.R., 1992**. Method for analysis, and distribution profile, of covalently-linked ferritin-daunorubicin conjugate in the blood of trypanosome-infected mice. [*T. b. rhodesiense*.] *Journal of Pharmacy and Pharmacology*, **44** (1): 48-51.

Brown: Department of Pharmaceutical Chemistry, School of Pharmacy, University of Bradford, Bradford BD7 1DP, UK.

7437 **Chitambo, H. and Arakawa, A., 1992**. *Trypanosoma congolense*: the *in vitro* akinetoplastic induction sensitivity assay. *Parasitology Research*, **78** (2): 136-141.

Department of Veterinary Medicine, College of Agriculture, University of Osaka Prefecture, 4-804 Mozuumemachi, Sakai-shi, Osaka 591, Japan.

7438 **Chitambo, H., Arakawa, A. and Ono, T., 1992**. *In vivo* assessment of drug sensitivity of African trypanosomes using the akinetoplastic induction test. [*T. congolense*, *T. b. brucei*; mice.] *Research in Veterinary Science*, **52** (2): 243-

249.

Department of Veterinary Science, College of Agriculture, University of Osaka Prefecture, 4-804 Mozuumemachi, Sakai-shi, Osaka 591, Japan.

7439 **Joshua, R.A. and Sinyangwe, L., 1991**. Resistance to diminazene aceturate and isometamidium chloride by *Trypanosoma congolense*. [Mice.] *Bulletin of Animal Health and Production in Africa*, **39** (2): 199-203.

Department of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria; FAO Trypanosomiasis Control Project, Central Veterinary Research Institute, P.O. Box 33980, Lusaka, Zambia.

7440 **Osman, A.S., Jennings, F.W. and Holmes, P.H., 1992**. The rapid development of drug-resistance by *Trypanosoma evansi* in immunosuppressed mice. *Acta Tropica*, **50** (3): 249-257.

Holmes: Department of Veterinary Physiology, Veterinary School, University of Glasgow, Bearsden Road, Glasgow G61 1QH, UK.

7441 **Sutherland, I.A., Mounsey, A. and Holmes, P.H., 1991**. Uptake of isometamidium chloride (Samorin$^{\varepsilon}$) by *Trypanosoma congolense*. (Meeting abstract.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **85** (6): 844.

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

7442 **Zhang, Z.Q., Giroud, C. and Baltz, T., 1991**. *In vivo* and *in vitro* sensitivity of *Trypanosoma evansi* and *T. equiperdum* to diminazene, suramin, MelCy, quinapyramine and isometamidium. *Acta Tropica*, **50** (2): 101-110.

Baltz: Laboratoire d'Immunologie et de Biologie Parasitaire, Université de Bordeaux II, 146 rue Léo-Saignat, 33076 Bordeaux, France.

8. TRYPANOSOME RESEARCH

(a) CULTIVATION OF TRYPANOSOMES

[See also **15**: no. 7467.]

7443 **Brun, R., 1992**. Cultivation of human pathogenic blood protozoa: a citation classic commentary on `Cultivation and *in vitro* cloning of procyclic culture forms of *Trypanosoma brucei* in a semi-defined medium' by Brun, R. and Schönenberger, M. (*Acta Tropica*, **36**: 289-292, 1979). *Current Contents (Agriculture, Biology and Environ-mental Sciences*), **23** (20): 8.

Swiss Tropical Institute, Socinstrasse 57, Postfach, CH-4002 Basel, Switzerland.

7444 **Duszenko, M., Mühlstädt, K. and Broder, A., 1992**. Cysteine is an essential growth factor for *Trypanosoma brucei*

bloodstream forms. *Molecular and Biochemical Parasitology*, **50** (2): 269-274.
Physiologisch-chemisches Institut, Universität Tübingen, Hoppe-Seyler-Strasse 4, D-7400 Tübingen, Germany.

7445 **Frame, I.A., Ross, C.A. and Luckins, A.G., 1991**. Variability of *in vitro* culture characteristics, including metacyclic trypomastigote production, in different stocks of *Trypanosoma congolense*. *Acta Tropica*, **50** (2): 135-140.
Ross: CTVM, Easter Bush, Roslin, Midlothian EH25 9RG, UK.

(b) TAXONOMY, CHARACTERISATION OF ISOLATES

7446 **Cibulskis, R.E., 1992**. Genetic variation in *Trypanosoma brucei* and the epidemiology of sleeping sickness in the Lambwe Valley, Kenya. *Parasitology*, **104** (1): 99-109.
Department of International Community Health, Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK.

A contingency table approach was used to explore the influence of location, host species and time on the genetic composition of a *T. brucei* population in Lambwe Valley, Kenya. Significant differences in zymodeme frequencies were noticed over comparatively short geographical distances suggesting that transmission of *T. brucei* is somewhat localised. A significant association was observed between zymodeme and the mammalian host from which *T. brucei* was derived. The association was consistent in different localities in Lambwe Valley and remained stable for a least 32 months. These observations indicate that zymodemes are adapted to different host species and that genetic exchange has not disrupted host associations over this time-scale. A major change in the composition of the *T. brucei* population during a sleeping sickness outbreak in 1980 was confirmed. But while new zymodemes emerged, a decline in overall diversity was noted during times of high sleeping sickness incidence. The results can be explained by selection of *T. brucei* zymodemes for particular transmission cycles. Although it is not necessary to invoke genetic exchange, sex may help *T. brucei* to adapt to changes in selection pressures. Such a hypothesis helps to explain why *T. brucei* appears largely clonal in the short term, even though population studies indicate that sex is responsible for much genetic diversity in the long term. It also explains why neighbouring populations of *T. brucei* are composed of a different range of zymodemes formed from the same alleles. Such a view implies that

genetic exchange has an important role in the microevolution of *T. brucei* populations.

7447 **Stevens, J.R. and Godfrey, D.G., 1992**. Numerical taxonomy of *Trypanozoon* based on polymorphisms in a reduced range of enzymes. *Parasitology*, **104** (1): 75-86.
TRL, Langford House, Langford, Bristol BS18 7DU, UK.

7448 **Stevens, J.R., Lanham, S.M., Allingham, R. and Gashumba, J.K., 1992**. A simplified method for identifying subspecies and strain groups in *Trypanozoon* by isoenzymes. *Annals of Tropical Medicine and Parasitology*, **86** (1): 9-28.
TRL, Langford House, Langford, Bristol BS18 7DU, UK.

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

[See also **15**: no. 7397.]

7449 **Adler, B.K., Harris, M.E., Bertrand, K.I. and Hajduk, S.L., 1991**. Modification of *Trypanosoma brucei* mitochondrial rRNA by posttranscriptional 3′ polyuridine tail formation. *Molecular and Cellular Biology*, **11** (12): 5878-5884.
Hajduk: Department of Biochemistry, University of Alabama at Birmingham Schools of Medicine and Dentistry, Birmingham, AL 35294, USA.

7450 **Agur, Z., 1992**. Mathematical models for African trypanosomiasis. (Letter, including reply by D. Barry and M. Turner.) *Parasitology Today*, **8** (4): 128-129.
Department of Applied Mathematics and Computer Science, Weizmann Institute of Science, Rehovot 76100, Israel.

7451 **Aslam, N. and Turner, C.M.R., 1991**. Does variable antigen expression influence growth rates in *Trypanosoma brucei*. (Meeting abstract.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **85** (6): 838.
Laboratory for Biochemical Parasitology, Department of Zoology, University of Glasgow, Glasgow G12 8QQ, UK.

7452 **Bakalara, N., Kendall, G., Michels, P.A.M. and Opperdoes, F.R., 1991**. *Trypanosoma brucei* glycosomal glyceraldehyde-3-phosphate dehydrogenase genes are stage-regulated at the transcriptional level. *EMBO Journal*, **10** (12): 3861-3868.
Kendall: Department of Medical Parasitology, LSHTM, Keppel Street, London WC1E 7HT, UK.

7453 **Bender, K., Betschart, B., Schaller, J., Kämpfer, U. and Hecker, H., 1991**. Biochemical properties of histone-like proteins of procyclic *Trypanosoma brucei brucei*. *Acta Tropica*, **50** (2): 169-184.
Hecker: Swiss Tropical Institute, Socinstrasse 57, Postfach, CH-4002 Basel, Switzerland.

7454 **Birkett, C.R., Parma, A.E., Gerke-Bonet, R., Woodward, R. and Gull, K., 1992**. Isolation of cDNA clones encoding proteins of complex structures: analysis of the *Trypanosoma brucei* cytoskeleton. *Gene*, **110** (1): 65-70.

Gull: Department of Biochemistry and Molecular Biology, Manchester University, Stopford Building, Oxford Road, Manchester M13 9PT, UK.

7455 **Callens, M. and Opperdoes, F.R., 1992**. Some kinetic properties of pyruvate kinase from *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **50** (2): 235-244.

Opperdoes: Research Unit for Tropical Diseases, International Institute of Cellular and Molecular Pathology, 74 avenue Hippocrate, B-1200 Brussels, Belgium.

7456 **Coppens, I., Bastin, P., Opperdoes, F.R., Baudhuin, P. and Courtoy, P.J., 1992**. *Trypanosoma brucei brucei*: antigenic stability of its LDL receptor and immunological cross-reactivity with the LDL receptor of the mammalian host. *Experimental Parasitology*, **74** (1): 77-86.

Coppens: Cell Biology Unit, University of Louvain Medical School and International Institute of Cellular and Molecular Pathology, 75 avenue Hippocrate, B-1200 Brussels, Belgium.

7457 **Erondu, N.E. and Donelson, J.E., 1991**. Characterization of trypano-some protein phosphatase 1 and 2A catalytic subunits. [*T. b. rhodesiense*.] *Molecular and Biochemical Parasitology*, **49** (2): 303-314.

Donelson: Department of Biochemistry, University of Iowa, Iowa City, IA 52242, USA.

7458 **Erondu, N.E. and Donelson, J.E., 1992**. Differential expression of two mRNAs from a single gene encoding an HMG1-like DNA binding protein of African trypanosomes. [*T. b. rhodesiense*.] *Molecular and Biochemical Parasitology*, **51** (1): 111-118.

Donelson: Department of Biochemistry, University of Iowa, Iowa City, IA 52242, USA.

7459 **Field, M.C., Menon, A.K. and Cross, G.A.M., 1992**. Developmental variation of glycosylphosphatidylinositol membrane anchors in *Trypanosoma brucei: in vitro* biosynthesis of intermediates in the construction of the GPI anchor of the major procyclic surface glycoprotein. *Journal of Biological Chemistry*, **267** (8): 5324-5329.

Laboratory of Molecular Parasitology, Rockefeller University, 1230 York Avenue, New York, NY 10021, USA.

7460 **Gajendran, N., Vanhecke, D., Bajyana Songa, E. and Hamers, R., 1992**. Kinetoplast minicircle DNA of *Trypanosoma evansi*

encode guide RNA genes. *Nucleic Acids Research*, **20** (3): 614.
Institute of Molecular Biology, Vrije Universiteit Brussel, Paardenstraat 65, 1640 Sint-Genesius-Rode, Belgium.

7461 **Gibson, W., Garside, L. and Bailey, M., 1992**. Trisomy and chromo-some size changes in hybrid trypanosomes from a genetic cross between *Trypanosoma brucei rhodesiense* and *T. b. brucei*. *Molecular and Biochemical Parasitology*, **51** (2): 189-199.
Gibson: Department of Pathology and Microbiology, University of Bristol Veterinary School, Langford, Bristol BS18 7DU, UK.

7462 **Grab, D.J., Russo, D., Naessens, J. and Verjee, Y., 1992**. Transferrin binding proteins in *Trypanosoma brucei*. (Meeting abstract no. 5580.) *FASEB Journal*, **6** (5): A1900.
ILRAD, P.O. Box 30709, Nairobi, Kenya.

7463 **Haghighat, N.G. and Ruben, L., 1992**. Purification of novel calcium binding proteins from *Trypanosoma brucei*: properties of 22-, 24- and 38-kilodalton proteins. *Molecular and Biochemical Parasitology*, **51** (1): 99-110.
Ruben: Department of Biological Sciences, Southern Methodist University, Dallas, TX 75275, USA.

7464 **Hemphill, A., Affolter, M. and Seebeck, T., 1992**. A novel microtubule-binding motif identified in a high molecular weight microtubule-associated protein from *Trypanosoma brucei*. *Journal of Cell Biology*, **117** (1): 95-103.
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