

section b - abstracts

1. general (including land use)

8706 **Bado, J.-P., 1993.** De l'observation du sommeil à la découverte du trypanosome et de la glossine. [From the observation of sleeping sickness to the discovery of the trypanosome and the tsetse fly.] *Médecine tropicale*, **53** (2): 149-157.

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Sleeping sickness constitutes one of the fascinating subjects of research in the expansion of European biomedical science in Africa. This article throws light on the scientific climate in which the investigations took place. In trying to discover the cause of the disease, the researchers made mistakes and took steps backwards as well as forwards, resulting eventually in the discovery of the trypanosome in 1901 and the recognition of the tsetse fly as vector in 1903. However, much more research was required before the complex links between vectorial transmission and pathogenesis could be properly understood and effective prevention and treatment initiated.

8707 **Bendiner, E., 1992.** Louise Pearce: a 'magic bullet' for African sleeping sickness. *Hospital Practice*, **27** (1): 207-212, 214-215, 218, 221.

The life and work of Louise Pearce (1885-1959) is described. After being awarded an M.D. degree by Johns Hopkins University in 1912 she became the first female 'fellow' on the staff of the Rockefeller Institute where she joined the war against syphilis and helped conquer trypanosomiasis. In 1920, during a rampant epidemic in the Belgian Congo (now Zaire), she conducted a field investigation on the efficacy of the arsenical tryparsamide in treating trypanosomiasis, work for which she was awarded the King Leopold II prize in Brussels in 1953 and granted the Royal Order of the Lion.

8708 **Diaite, A., 1988.** La trypanosomiase animale africaine au Sénégal. Lutte antivectorielle et développement intégré. [African livestock trypano-somiasis in Senegal. Vector control and integrated development.] (Réunion du Group d'Experts FAO, Accra, 7-9 novembre 1988.) Dakar, Senegal; ISRA-LNERV. 7 pp.

ISRA-LNERV, B.P. 2057, Dakar, Senegal.

A number of *Glossina palpalis gambiensis* control campaigns were carried out during the 1970s and early 1980s in the Niayes region of Senegal (vestiges of Guinean forests

on the western Atlantic coast). A combination of ground spraying with insecticide and setting traps and screens impregnated with insecticide eradicated the tsetse fly in Niayes. Since that time agricultural and grazing operations have undergone large-scale development, with the introduction of intensive dairy farming.

8709 **Kreier, J.P. and Baker, J.R. (eds), 1992.** *Parasitic Protozoa, Volume 2* (2nd edition). San Diego, USA and London, UK; Academic Press. xvii + 323 pp.

This book has been completely rewritten since its first edition in 1978. Sections include 'Trypanosomes causing disease in man in Africa' (J.R. Seed and J.E. Hall, pp. 85-155), 'Animal trypanosomiasis in sub-Saharan Africa' (L.L. Logan-Henfrey, P.R. Gardiner and M.M. Mahmoud, pp. 157-276) and 'Salivarian trypanosomes causing disease in livestock outside sub-Saharan Africa' (P.R. Gardiner and M.M. Mahmoud, pp. 277-314). All aspects of the disease process are covered, from the morphology, taxonomy, life cycle, cultivation, transmission, antigenic variation and biochemistry and physiology of the parasites, to the pathology, immunology, diagnosis and treatment of the host, host-parasite relationships, trypanotolerance, epidemiology and control of vectors.

## 2. tsetse biology

### (a) REARING OF TSETSE FLIES

[See also **18**: no. 8721.]

8710 **Ahmed, A.B. and Onyiah, J.A., 1994.** Observations on the effects of antibiotics in the blood meal of *Glossina* species. *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 103-104.

Entomology and Parasitology Division, NITR, P.M.B. 2077, Kaduna, Nigeria.

Reduced productivity of two self-producing colonies of *Glossina palpalis palpalis* and *G. tachinoides* maintained *in vivo* on rabbits whose diets contained oxytetracycline and salinomycin antibiotics was observed. Fecundity of both of the species declined, but not their survival rates. Examination of their reproductive systems revealed a high proportion of *G. p. palpalis* females in a less advanced stage of their reproductive cycle with few abnormalities, while *G. tachinoides* females showed a deep degeneration of developing follicles. A considerable reduction in the number of mycetocytes was observed in *G. tachinoides*, while *G. p. palpalis* showed only slight damage. Use of animal hosts on additive-free

diets resulted in an improved productivity of *G. p. palpalis*, but not *G. tachinoides*. It is recommended that the use of additives in the diet of animals used for feeding tsetse colonies be avoided. The attempt to use a locally formulated diet based on soyabeans and maize supplemented with vitamin C gave excellent results.

8711 **Ahmed, A.B. and Onyiah, J.A., 1994.** Residual effects of benzyl benzoate parasiticide tested on *Glossina p. palpalis* Robineau Desvoidy (Diptera: Glossinidae). *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 104-106. Entomology and Parasitology Division, NITR, P.M.B. 2077, Kaduna, Nigeria.

The effects of benzyl benzoate (BP) parasiticide on the survival and reproductive performance of *G. p. palpalis* were evaluated in the laboratory using rabbits as feeding hosts in order to determine the safety margin post drug application. None of the flies fed on animals offered 30 min (group A) post drug application took any meal during the first two days. The survival of the batch was poor in that 40.0% died by day +35 with a total puparia production of 12. Except for a slight ( $P > 0.05$ ) improvement in their feeding response and fecundity, the performance of flies fed on animals 2 and 5 days (groups B and C) post drug application was poor, similar to that recorded for group A. The survival and productivity of flies fed 7 days (group D) post drug application were good, but those of flies fed 14 days (group E) post drug application were better and not different ( $P > 0.05$ ) from the control group. The quality of puparia produced by group A-C flies was low, with a mean of  $19.6 \pm 1.1$  mg compared to  $26.8 \pm 1.4$  mg and  $28.1 \pm 0.9$  mg for group D and E flies, respectively. The results indicate a gradual improvement in both feeding response and productivity with time post drug application. Minimum duration considered safe for feeding tsetse flies on benzyl benzoate treated animals without fear of residual effects is 3 weeks.

8712 **Davies-Cole, J.O.A., Olubayo, R.O., Mihok, S. and Mwamisi, P., 1994.** Reproductive performance of field-caught *Glossina pallidipes* maintained on different host bloods. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 77-79.

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

The reproductive performance of field-caught female *G. pallidipes* maintained for 41 days on fresh defibrinated bloods of rabbit, buffalo, eland, waterbuck or goat was investigated in the laboratory. Mean puparial weight was highest (37.2 mg) for rabbit-fed flies and lowest

(30.8 mg) for waterbuck-fed flies. Mean puparial weights for rabbit-, eland- and buffalo-fed flies were significantly different from goat- and waterbuck-fed flies. The highest number of puparia produced per 90 females was by rabbit-fed flies (83) whereas the lowest was by goat-fed flies (60). Mortality was high (84-99%) irrespective of the group.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY  
[See also 18: no. 8740.]

8713 **Baldet, T., Geoffroy, B., D'Amico, F., Cuisance, D. and Bossy, J.-P., 1992.** Structures sensorielles de l'aile de la glossine (Diptera: Glossinidae). [Sensory organs on the wing of the tsetse fly.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 295-302.

Baldet: Antenne ORSTOM auprès du Centre Pasteur, B.P. 1274, Yaoundé, Cameroon.

A scanning electron microscope study was performed on six *Glossina* species: *G. tachinoides*, *G. palpalis gambiensis*, *G. fuscipes fuscipes*, *G. austeni*, *G. morsitans morsitans* and *G. m. submorsitans*. Photographs show the distribution of sensory organs on the wings, especially tactile spines and bristles, chemoreceptor hairs and mechanoreceptors. The occurrence of chemoreceptor hairs is limited to the costal vein and they are more abundant in the dorsal zone of the median part. Mechanoreceptors occur notably in three groups on the dorsal surface of the subcostal vein as well as elsewhere.

8714 **Beard, C.B., O'Neill, S.L., Mason, P., Mandelco, L., Woese, C.R., Tesh, R.B., Richards, F.F. and Aksoy, S., 1993.** Genetic transformation and phylogeny of bacterial symbionts from tsetse. *Insect Molecular Biology*, **1** (3): 123-131.

Beard: Malaria Branch, Mail stop F-12, Division of Parasitic Diseases, Centers for Disease Control, 1600 Clifton Road, Atlanta, GA 30333, USA.

Two isolates of bacterial endosymbionts, GP01 and GM02, were established in cell free medium from haemolymph of *Glossina pallidipes* and *G. morsitans*. These microorganisms appear similar to rickettsia-like organisms reported previously from various tsetse species. The 16S rRNA sequence analysis, however, placed them within the gamma subdivision of the Proteobacteria, phylogenetically distinct from most members of the Rickettsiaceae which align with the alpha subdivision. Distinct multiple endogenous plasmids are harboured by GP01 and GM02, suggesting that the two isolates are different. Restriction mapping analysis showed that one of the conserved plasmids is present in high copy number and is at least 80 kb in size. A heterologous

plasmid pSUP204, which contains the broad host range *oriV* replication origin, was used to transfect bacterial cultures. The symbiont GM02 was transformed, and it expressed plasmid encoded resistance to the antibiotics ampicillin, tetracycline and chloramphenicol. Transformation of these symbionts may provide a novel means for expressing anti-parasitic genes within tsetse populations.

8715 **Blanchetot, A. and Gooding, R.H., 1994.** Isolation and characterization of hypervariable sequences from tsetse fly genome. *Insect Bio-chemistry and Molecular Biology*, **24** (9): 937-941.

Blanchetot: Department of Biochemistry, University of Saskatchewan, Saskatoon, Saskatchewan S7N 0W0, Canada. A *Glossina brevipalpis* genomic library, constructed using a Charomid 9-36 vector, was used to isolate putative clones that hybridise to polymorphic regions of the tsetse genome. Five types of probes, that reveal individual DNA polymorphic in humans and higher animal species, were used to screen 300 tsetse Charomid clones; 15% of the clones hybridised with at least one probe. Twenty-four recombinants were further characterised by Southern blotting hybridisation using DNA isolated from individual *G. morsitans centralis*. Two classes of DNA profiles were obtained upon hybridisation with the recombinant inserts. The first, termed the 'multilocus profile', displayed a complex DNA pattern of multiple components whilst the second, referred to as the 'single locus profile', revealed one or two bands in each individual. Of the 24 recombinant inserts tested, 13 were multilocus probes and the remainder were single locus probes, each of which hybridised to a single location when *G. m. centralis* DNA had been cleaved with *EcoRI*. These single locus probes revealed a low level of genetic variability among individual flies from an inbred colony. The hybridisation profiles using multilocus and single locus probes were also obtained on DNA from individual *G. palpalis palpalis* and *G. p. gambiensis* and some of the *G. brevipalpis* recombinant clones also detected multilocus profiles in honey bees and man.

8716 **Bogner, F., 1989.** Single cell recordings of antennal CO<sub>2</sub>-receptors in tsetse flies (*Glossina palpalis*, Diptera: Glossinidae). *Verhandlungen der Deutschen Zoologischen Gesellschaft*, **82**: 272-273.

Universität Regensburg, Zoologie II,  
Universitätsstrasse 31, D-8400 Regensburg, Germany.

Single cell recordings of the response to carbon dioxide stimulation were made from sensilla located on the basal inner surface of the flagellum of antennae of 1-4 day old wild-caught *G. palpalis*. Several types of receptors could be distinguished physiologically but not morphologically under 210 $\times$  magnification. Different cells were found to respond selectively to carbon dioxide and to 1-octen-3-ol, p-cresol and other odorants, fewer than 1% of cells tested being responsive to carbon dioxide. Higher levels of carbon dioxide gave stronger responses (3% CO<sub>2</sub> 96 imps/s; 1% 62 imps/s; 0.1% 24 imps/s); ambient air evoked no response. Continuous stimulation with carbon dioxide did not lead to accommodation.

8717 **Deportes, I., Geoffroy, B., Cuisance, D., Otter, C.J. den, Carlson, D.A. and Ravallec, M., 1994.** Les chimiorécepteurs des ailes chez la glossine (Diptera: Glossinidae). Approche structurale et électro-physiologique chez *Glossina fuscipes fuscipes*. [Chemoreceptors on the wings of the tsetse fly. A structural and electrophysiological study in *G. f. fuscipes*.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 81-88.

Deportes: ORSTOM, Centre ORSTOM de Montpellier, Département Santé, 911 avenue Agropolis, B.P. 5045, 34032 Montpellier Cedex 01, France.

Recent studies show that hair-shaped sensillae are present on the front side of the wings of *G. f. fuscipes*. The external appearance of these hairs suggests that they have a gustatory chemoreceptor function probably in association with a mechanoreceptor. The use of two modern techniques, i.e. transmission electron microscopy and electrophysiology, confirms this hypothesis. At least four nerve cells were shown to be associated with each sensillum. Three of them had a gustatory function and one had a tactile function. The gustatory cells were stimulated by different substances (tsetse fly excrements, Ringer solution, sex pheromones).

8718 **El Messoussi, S., 1988.** *Mise en évidence et caractérisation d'une phéromone aphrodisiaque de l'espèce Glossina tachinoides (Diptera: Glossinidae)*. [Isolation and characterisation of a sex pheromone of *G. tachinoides*.] Thèse de Diplôme de Doctorat, Université de Paris VII. (Unpublished thesis.) 109 pp.

A biologically active extract was obtained by rinsing the cuticle of female *G. tachinoides* with hexane, and its chemical composition analysed by gas chromatography and mass spectrometry. The only fraction having an effect

equivalent to the whole extract was a saturated, branched, long-chain (37 carbon) hydrocarbon with two methyl groups (dimethylheptatriacontane). A cuticular extract of males showed a 31 carbon compound to be the longest chain fraction. A comparative developmental study of male and female pupae showed that this sexual dimorphism takes effect only in the last few days before emergence. Maturation of males commenced 5-6 days after eclosion and 3 day old females were found to have the maximum stimulatory effect on them. The sex pheromone of *G. tachinoides* is not found in any other tsetse species in comparable quantities though it is fairly abundant also in female *G. morsitans morsitans*.

8719 **Gooding, R.H., 1993.** Genetic analysis of sterility in hybrids from crosses of *Glossina morsitans submorsitans* and *Glossina morsitans centralis* (Diptera: Glossinidae). *Canadian Journal of Zoology*, **71** (10): 1963-1972.

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

When genetically marked *G. m. submorsitans* were mated to *G. m. centralis*, viable offspring were obtained when using *G. m. submorsitans* females but not when using *G. m. centralis* females. The maternally inherited sterility factor, from *G. m. submorsitans*, that causes this asymmetry was inactivated or replaced during recurrent backcrossing to *G. m. centralis*. F<sub>1</sub> hybrid males were sterile but most F<sub>1</sub> hybrid females were fertile. There was little evidence for differential transmission of *G. m. submorsitans* and *G. m. centralis* chromosomes by hybrid females. Almost all backcross males were sterile if they had an X and a Y chromosome from two different taxa; the exceptional males had recombinant X chromosomes. The X chromosome locus for X/Y compatibility lies closer to the locus for esterase-X than to the locus for glucose-6-phosphate dehydrogenase. Heterozygosity in linkage group II is also a factor in causing hybrid male sterility; the locus for compatibility is closer to the locus for octanol dehydrogenase than to the locus for esterase-1. Among the backcross males that had an X and a Y chromosome from the same taxon, 12% of those obtained by backcrossing to *G. m. centralis* were fertile and 65% of those obtained by backcrossing to *G. m. submorsitans* were fertile. Backcrossing F<sub>1</sub> hybrid females to *G. m. submorsitans* produced females that were equally likely to be fertilised by *G. m. submorsitans* and *G. m. centralis*. However, backcrossing to *G. m. centralis* produced females that had a much lower probability of being fertilised by *G. m. submorsitans* than by *G. m. centralis*.

8720 **Ingram, G.A. and Molyneux, D.H., 1993.** Comparative study of haemagglutination activity in the haemolymph of three tsetse fly *Glossina* species. *Comparative Biochemistry and Physiology (B)*, **106** (3): 563-573.

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

*Glossina morsitans morsitans*, *G. palpalis gambiensis* and *G. tachinoides* haemolymph possessed multiple, glycoproteinaceous haemagglutinins. Tsetse haemagglutinins bind to human erythrocyte surface glycoprotein/glycopeptide residues or, with *G. m. morsitans* and *G. p. gambiensis* anti-O activity, glycolipid moieties. Variations in haemagglutinin physico-chemical properties occurred between *G. m. morsitans* and the *palpalis* group flies (*G. p. gambiensis* and *G. tachinoides*) and amongst the *palpalis* group flies with respect to relative heat-lability, susceptibility to dithiothreitol reduction, resistance to  $\gamma$ -radiation exposure and sensitivity to urea treatment. *G. tachinoides* and *G. m. morsitans* required acid and acid to neutral conditions respectively, and  $\text{Ca}^{2+}$  ion presence, for optimum agglutination activity whilst *G. p. gambiensis* required neutral to alkaline pH and  $\text{Mg}^{2+}$  ions. The findings reported here provide further information regarding haemagglutinin (lectin) properties in different species of the genus *Glossina*, member of the Diptera, a little studied order with respect to insect vector immunity.

8721 **Vreysen, M.J.B. and Vloedt, A.M.V. van der, 1992.** The use of gamma irradiated *Glossina austeni* females as sentinel insects for entomological monitoring in tsetse control programmes. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 303-309.

Vreysen: Department of Livestock Development, Ministry of Agriculture, P.O. Box 159, Zanzibar, Tanzania.

A 60 Gy gamma irradiation treatment administered to female *G. austeni* on day 2 or 9 following emergence, and likewise a 50 Gy gamma treatment given to pupae on day 33 following larviposition, induced complete sterility in the female flies without altering their mating behaviour. Treated females remained receptive to mating with untreated males up to 15 days following emergence (mating response of 84%). The timing of treatment (on day 33 post larviposition, on day 2 and 9 following emergence) influenced significantly the dynamics of follicle development. Females, irrespective of their age when treatment was received, showed a normal development pattern of the follicles in position  $A_1$  and  $C_1$ , i.e. normal vitellogenesis,

maturation and ovulation. Females treated as pupae, however, revealed no visible signs of development of follicles in position B and D. From day 15 on, females displayed inactive ovaries characterised by atrophied oocytes and nurse cells. Treating females on day 2 or 9 of their adult life resulted in various degrees of development of the B and D follicles. During laboratory cage tests, untreated males exposed to equal numbers of virgin untreated and treated females showed no significant preference for mating with either type of female. A high degree of multiple mating was observed when untreated and treated females were offered several mating opportunities. On day 9 following emergence, 24.0% of untreated and 23.8% of females treated with 60 Gy (on day 2) accepted a male during a fourth mating occasion. The receptivity to remating decreased with a higher radiation dose (120 Gy) and when treatment was given later in the female life (day 5). The results of the laboratory experiments are discussed with a view to deploying gamma sterilised female *G. austeni* for entomological monitoring in those areas where low fly densities exist and especially to expose potential relic fly pockets after control operations have been completed.

8722 **Wirtz, H.P., 1989.** Struktur, Funktion und Eindringungsweise der Mundwerkzeuge von *Glossina palpalis palpalis* (Diptera, Glossinidae). [Structure, function and mode of membrane penetration of the mouthparts of *G. p. palpalis*.] *Entomologische Mitteilungen aus dem Zoologischen Museum Hamburg*, **9** (136/137): 295-304.

Zoologisches Institut und Zoologisches Museum, Martin-Luther-King-Platz 3, D-2000 Hamburg 13, Germany.

A series of 18 scanning electron micrographs illustrate the mouthparts of *G. p. palpalis* both in a resting position and in the process of piercing a silicon membrane and sucking blood.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **18**: no. 8754.]

8723 **Cuisance, D., Demba, D., Vallat, B., Kota-Guinza, A., D'Amico, F. and Ndokoué, F., 1994.** Répartition des glossines dans la zone d'action agropastorale de Yérémo en République centrafricaine. [Tsetse fly distribution in agropastoral areas of Yérémo in the Central African

Republic.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 69-75.

Cuisance: CIRAD-EMVT, c/o Centre ORSTOM, B.P. 5045, 34032 Montpellier Cedex, France.

The number of Mbororo Zebu cattle in the Central African Republic has considerably increased in the last few years (2,200,000 heads) due to various factors such as new pastoral potential. With a view to improving the management of this resource, agropastoral activity areas (ZAGROP) were created. Along with the increased forage potential, the rearing of livestock in humid areas is subject to enhanced pathological constraints mainly caused by trypanosomiasis. To prevent problems related to the present massive use of trypanocidal drugs by the cattle owners, the National Agency for Development of Livestock Production (ANDE) has started to identify control methods for use against tsetse flies. In one of these agropastoral areas (60,000 ha), the first step was to establish an accurate map of the distribution of vector species using a systematic trapping method (biconical traps). *Glossina fuscipes fuscipes* (10,805 flies trapped) was found throughout the whole hydrographic system with a low to moderate density (3 tsetse flies/ trap/day). *G. fusca congolensis* was seldom caught (7 individuals trapped), and *G. morsitans submorsitans*, which was formerly present, seemed to have disappeared. Data on species abundance, diversity and distribution are discussed. They are being used as a basis for choosing a control method by trapping which is currently being set up in this pastoral area.

8724 **Griffiths, N. and Brady, J., 1994.** Analysis of the components of 'electric nets' that affect their sampling efficiency for tsetse flies (Diptera: Glossinidae). *Bulletin of Entomological Research*, **84** (3): 325-330.

Brady: Imperial College, Silwood Park, Ascot, Berks, SL5 7PY, UK.

The efficiency of electrocuting devices currently used for sampling tsetse flies (*Glossina* spp.) and similar insects was studied in Zimbabwe by recording approaches, kills and escapes with video. The kill rate of an electrified netting screen increased with the discharge frequency of the device up to 200 Hz (c. the highest practicable frequency) reaching c. 90% at best. The same kill rate was achieved by an electrified black cloth target. However, 'two-choice' comparisons of electric nets and their components showed avoidance by the tsetse of the black mosquito

netting between the electric wires, and even of the electric wires on their own, though probably not of the black metal frame that supported them. The proportion of tsetse avoiding a standard electric net was c. 27% in full sun, c. 40% in shade, implying an overall sampling efficiency of, at best, c. 65% at the optimum 200 Hz discharge rate in sunshine, and c. 40-50% with the 67 Hz nets used currently in Africa. Potential for improvements therefore lies mainly in reducing the visibility of the nets; suggestions are offered.

8725 **Leak, S.G.A. and Mulatu, W., 1993.** Advance of *Glossina morsitans submorsitans* and *G. pallidipes* along the Ghibe-river system in southwest Ethiopia. *Acta Tropica*, **55** (1-2): 91-95.

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

Tsetse fly populations were monitored from 1986 to 1993 using biconical traps in two study areas, Abelti/Ghibe and Gullele/Tolley, in the Ghibe river system in southwest Ethiopia in order to assess trypanosomiasis risk to cattle. From 1986 to 1992, *G. pallidipes* and *G. fuscipes* were detected, largely in thicket vegetation along the gallery forest. In October 1989, *G. m. submorsitans* was detected for the first time in the western, upstream study site, Gullele/Tolley, the numbers caught increasing gradually until January 1991 when tsetse control using cypermethrin pour-on was initiated. The first specimen of *G. m. submorsitans* was detected in the downstream, eastern site, Abelti/Ghibe, in June 1992 and numbers peaked in November 1992. Reports of the distribution of the three species in the area since 1956 are reviewed. Two possible sources of the recent invasion of the upper Ghibe by *G. m. submorsitans* are northwards from the Omo valley or eastwards from the Didessa river via the Gilgel Ghibe river, the latter appearing more likely. Since *G. m. submorsitans* has a more widespread habitat than *G. pallidipes* and is also a very efficient vector of pathogenic trypanosomes, its advance into the Ghibe valley could be of great importance in the epidemiology of bovine trypanosomiasis and human settlement.

8726 **Sékétéli, A. and Kuzoe, F.A.S., 1994.** Lieux de repos diurnes de *Glossina palpalis palpalis* (Robineau-Desvoidy) dans une zone préforestière de Côte d'Ivoire. [Diurnal resting sites of *G. p. palpalis* in a preforest zone of Côte d'Ivoire.] *Insect Science and its Application*, **15** (1): 75-85.

Sékétéli: OMS/OCP, B.P. 549, Ouagadougou, Burkina Faso. The diurnal resting sites of *G. p. palpalis* were studied from October 1981 to December 1982 in the human

trypanosomiasis focus at Bouaflé (Côte d'Ivoire). A total of 1382 resting tsetse (970 males and 412 females) were found after 757 h of searching in their natural habitats. At any season, over 80% of the flies were resting on lianas (*Acacia pennata* in particular), on coffee trees (*Coffea indica*) and on *Eupatorium odoratum*. Almost all the flies showed a preference for resting on the underside of the woody parts of the plants selected. The heights of the resting sites ranged from 10 cm to 2.5 m above the ground and the diameters of the woody supports ranged from 0.1 cm to 8 cm. It must be stressed that both in the dry and in the rainy seasons, more than 50% of the flies rested below 50 cm from the ground, and over 90% of these favoured stems and branches measuring 3 cm in diameter or less. In the vegetation surrounding villages or along the main access roads and bush pathways, *G. p. palpalis* were found resting between 1 m and 5 m from the edge of its vegetation habitat. About 27% of flies were engorged or showed at least some sign of a blood meal in their guts. The catching of resting flies therefore appears to be an excellent way of collecting fresh blood meals for identification of the natural vertebrate hosts of *G. p. palpalis* in the study area. The practical implications of the study are discussed and recommendations made for the selective application of residual insecticides to control the vectors of sleeping sickness in the Bouaflé focus.

8727 **Siziya, S., 1994.** *Movement and distribution of tsetse flies in Nguruman, south-western Kenya.* Ph.D. thesis, University of Zambia. (Unpub-lished thesis.)

Department of Community Medicine, Faculty of Medicine, University of Zimbabwe, P.O. Box A178, Avondale, Harare, Zimbabwe.

Mark-release-recapture studies and biconical and Nguruman traps baited with cow urine, acetone and octenol were used to obtain coordinated information on the movement and distribution of *Glossina pallidipes* and *G. longipennis* within and between the Sampu and Oloibortoto valleys in Nguruman, south-western Kenya, with a view to modelling the dispersal and providing a sound basis for the control of tsetse flies in Nguruman. *G. pallidipes* had coefficients of determination of 89.6% and 76.7% in the Sampu and Oloibortoto valleys, respectively; *G. longipennis* 57.4% and 48.6% respectively. The *G. pallidipes* population was at its peak at the beginning of the long rains, probably due to reinvasion of the flies from neighbouring uncontrolled areas; it decreased during

the wet period, probably due to increased pupal mortality because of flooding of the larviposition sites. During the rainy season, there was more movement of female *G. pallidipes* into the Sampu valley from the Oloibortoto valley (60.9%) than the reverse (11.1%), while no marked male was observed to have moved between the two valleys. No movement of either sex was seen between the valleys in the dry season. *G. pallidipes* preferred woodland vegetation to more open areas, while *G. longipennis* preferred more open environments to thickets. Tsetse flies spread out into the more open areas during the wet period when marginal vegetation refooliates. With a rise in the maximum temperature, *G. pallidipes* moved from the edge of the woodland to the inner woodland, with a reverse movement when the temperature dropped. A temperature of 32°C and a relative humidity of 32% appeared to be optimum for activity of both sexes of *G. pallidipes*, while female *G. pallidipes* was inactive below 20.4°C. Nguruman traps baited with cow urine, acetone and octenol appeared to provide an effective trap barrier for *G. pallidipes* and *G. longipennis* at a spacing of 25 m.

8728 **Torr, S.J., 1994.** Responses of tsetse flies (Diptera: Glossinidae) to warthog (*Phacochoerus aethiopicus* Pallas). *Bulletin of Entomological Research*, **84** (3): 411-419.

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

In Zimbabwe, living and stuffed warthogs were placed within an incomplete ring of electric nets and observations were made of the numbers of *Glossina pallidipes* and *G. morsitans morsitans* attracted to the hogs, the alighting position and feeding responses of tsetse, and the grooming behaviour of the warthogs. Between 26 and 31% of tsetse landed on the head region of an adult live warthog compared to 8% for a juvenile and 4% for a stuffed warthog. The number of tsetse alighting adjacent to the eye of a stuffed warthog increased 20 times if dark patches were fixed there. The percentage of tsetse alighting on the head region of the adult warthog increased from 25% to 50% as the number of tsetse caught on the ring of nets increased from < 100 to > 800. There was a concurrent increase in the rate of skin twitches and ear flicks by the warthog. For an adult warthog, 26% of tsetse leaving the vicinity had fed compared to only 1% for a juvenile. It is suggested that the concentration of tsetse on the head of adult warthogs is a visual response to the dark patch produced by the pre-orbital glands of a mature

warthog and to density-dependent changes in the grooming responses of warthogs.

8729 **Willemse, L.P.M. and Takken, W., 1994.** Odor-induced host location in tsetse flies (Diptera: Glossinidae).

*Journal of Medical Entomology*, **31** (6): 775-794. (The missing figure captions are given in **32** (1): 71-73.)

Willemse: Laurastraat 67, 6471 JH Eygelshoven, Netherlands.

Four aspects of olfaction in host location by tsetse flies, *Glossina* spp. (mainly *G. morsitans morsitans* and *G. pallidipes*), are reviewed as follows: (1) host location and its mechanism, (2) factors affecting host location, (3) kairomones and host location, and (4) kairomones and host selection. Flight behaviour in the various phases of host location (i.e. ranging, activation, orientation and landing) in the absence and presence of olfactory cues is summarised. Movement toward an odour source is effected *inter alia* through optomotor-steered, upwind anemotaxis. It is still unclear how tsetse employ upwind anemotaxis to realise host location, considering the often highly variable wind direction. Olfactorily induced activation is governed by the olfactory cue perceived and threshold levels set by the internal state of the fly. The former depends on the odour source and distance from it; the latter is determined by species, sex and physiological state. Wind direction and speed, as well as vegetation and the mobility of the host, interfere with successful completion of odour-induced host location. Close-range olfactory cues (including composition and concentration gradients), visual cues and nutritional state determine whether a fly, having reached the host animal, will land on it. Carbon dioxide is important in host location because it induces landing and long-range attraction. The role of the other kairomones (acetone, 1-octen-3-ol, 4-methyl-phenol, and 3-*n*-propyl-phenol) is less clear. Apart from the complacency of various host species under tsetse attack, host choice by tsetse is predominantly opportunistic and primarily the result of the frequency of successful tsetse-host encounters. Nevertheless, host selection based on olfactory cues cannot be ruled out.

3. tsetse control (including environmental side-effects)

[See also **18**: nos. 8708, 8721, 8745.]

8730 **Amsler, S. and Filledier, J., 1994.** Attractivité pour les Tabanidae de l'association méta-crésol/octénol: résultats obtenus au Burkina Faso. [Attractiveness for

Tabanidae of a mixture of metacresol and octenol: results obtained in Burkina Faso.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 93-96. CIRDES (CRTA), 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso.

Tabanidae have long been known to be capable of mechanically transmitting trypanosomes, principally *Trypanosoma vivax* and *T. evansi*, in areas without tsetse, and they may play a significant role as vectors of trypanosomes in areas cleared of tsetse or where control has considerably reduced the initial tsetse population. They are frequently caught in tsetse traps and appear to be attracted by odours. In Burkina Faso, the efficiency against Tabanidae of three different types of traps baited or not with a mixture of odour attractants (meta-cresol/octenol) was compared in two experiments during the dry season. Catches increased 1.5 to 3 fold when the traps were baited with odour attractants. The NG-2G trap and the screen-trap gave comparable results and were significantly more attractive than the F3 trap. The advancing dry season did not alter these findings. It was also noted that the trap catches in both experiments decreased the longer trapping continued, probably as a consequence of a trapping effect.

8731 **Amsler, S., Filledier, J. and Millogo, R., 1994.** Attractivité pour les Tabanidae de différents pièges à glossines avec ou sans attractifs olfactifs. Résultats préliminaires obtenus au Burkina Faso. [Attractiveness for Tabanidae of various tsetse traps with or without olfactory attractants. Preliminary results obtained in Burkina Faso.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 63-68.

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

During the dry season three experiments were performed in the sub-humid savanna area of Burkina Faso with a view to comparing the attractiveness and efficacy of five different tsetse traps for Tabanidae, together with the evaluation of two olfactory attractants. The NG-2G and F3 traps and the screen-trap were significantly more effective ( $\exists$  1.7 to 8.7) than the biconical and monoconical traps. Metacresol increased the catches by an average of 1.5 fold, and the metacresol/octenol mixture (3/1) 2.5 fold in comparison with the control trap with no attractant.

8732 **Braun, J.P., Cuisance, D., Bénard, P., Thouvenot, J.P. and Rico, A.G., 1988.** Aerial spraying of endosulfan for tsetse control

in Africa: consequences on wild birds as evaluated by clinical biochemistry. In: *VI Tagung der Fachgruppe 'Geflügelkrankheiten', München, 3-4 März 1988. Thema: Vogelkrankheiten* (Giessen, Germany; Deutsche Veterinärmedizinische Gesellschaft), pp. 244-247.

Ecole Nationale Vétérinaire, F-31076 Toulouse, France. An analysis of serum biochemical constituents was undertaken on three species of wild birds, *Phyllastrephus terrestris*, *Pycnonotus barbatus* and *Tudoides jardineii*, as well as some domestic fowls in an endosulfan-sprayed and a control area in north-eastern Zimbabwe. In birds taken from treated areas, most serum parameters were not significantly disturbed compared with controls. The only significant change was a decrease of proteins, due to a decrease of prealbumins and albumins ( $P < 0.05$ ), in *Tudoides*; similar, but not statistically significant, effects were also observed in the other species, as well as in the domestic chicken.

8733 **Dehoux, J.P., 1993.** Lutte contre *Glossina tachinoides* au Bénin. Utilisation particulière de piège-pneus imprégnés de deltaméthrine. [Control of *G. tachinoides* in Benin using deltamethrin-impregnated tyre-traps.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **46** (4): 581-589.

59 rue Grande, 5100 Wierde, Belgium.

Two models of deltamethrin-impregnated targets, Hanotier's tyre-trap and Laveissière's screen, were tested during the 1992 and 1993 dry seasons in north-eastern Benin to study their efficacy in the control of *G. tachinoides* around reservoirs serving as watering places for taurine cattle. The screens were rapidly very effective (80-100% reduction in apparent density) whereas the use of tyre-traps did not lead to a significant reduction of tsetse density.

8734 **Hartley, R.R. and Douthwaite, R.J., 1994.** Effects of DDT treatments applied for tsetse fly control on the African Goshawk in north-west Zimbabwe. *African Journal of Ecology*, **32** (4): 265-272.

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

Levels of  $\Sigma$ DDT and DDE in African Goshawk eggs were correlated with number of past spray treatments of the nest site. DDE content was inversely related to eggshell thickness. Mean DDE levels in four out of six clutches from sprayed areas exceeded 130 ppm dry weight, the highest critical level associated with population decline in other raptor species. Cracked eggshells were found at two sprayed sites. The small

number of occupied nest sites and higher rate of site desertion in the sprayed area, compared with the unsprayed area, suggest tsetse spraying operations caused a population decline.

8735 **Kaaya, G.P., 1990.** Pathogenicity and biocontrol potentials of *Beauveria bassiana* and *Metarhizium anisopliae* for tsetse *Glossina morsitans*. In: Pinnock, D.E. (ed.), *Proceedings and abstracts, Vth International Colloquium on Invertebrate Pathology and Microbial Control, Adelaide, Australia, 20-24 August 1990* (Glen Osmond, SA, Australia; Department of Entomology, University of Adelaide), p. 106.

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

In laboratory studies to evaluate pathogenicities and biocontrol potentials of the fungi *B. bassiana* and *M. anisopliae* for tsetse flies, it was found that both fungi caused 90-100% mortality in adults of *G. m. morsitans* by 2 weeks post-exposure to  $2 \times 10^7$  conidia/ml in distilled water. A dose-mortality relationship was demonstrated with conidia of both fungal species at 25°C, apparently unaffected by r.h. of 65% or above. Abortion rates did not increase in infected females, but mortality of pupae (though not longevity of emerging adults) from infected females did so. Exposure of larvae to dry spores of both fungi gave rise to no increase in pupal mortality, but 90% of resultant adults from *B. bassiana*-infected (as against 2-5% from *M. anisopliae*-infected and control) pupae had died by post-emergence day 10. Cross-transmission of both fungi occurred in cages from infected to uninfected *G. m. morsitans*, regardless of sex, resulting in 60-75% mortality by day 30 of previously uninfected flies. This suggests a control method utilising release of infected flies into field populations to initiate fungal epizootics.

8736 **Laveissière, C. and Sane, B., 1994.** Régulateur de croissance et piégeage pour la lutte contre *Glossina palpalis palpalis* en Côte d'Ivoire: essai sur le terrain de l'OMS 3019 (Pyriproxyfen<sup>®</sup> Sumitomo). [Growth regulation and traps for controlling *G. p. palpalis* in Côte d'Ivoire: field trial of WHO 3019 (Pyriproxyfen<sup>®</sup>, Sumitomo).] *Insect Science and its Application*, **15** (1): 105-110. IPR/OCCGE, B.P. 1500, Bouaké, Côte d'Ivoire.

A trial of Pyriproxyfen for the control of *G. p. palpalis* was undertaken in two villages in the Bouaflé sleeping sickness focus within the forest zone of Côte d'Ivoire, using modified biconical traps. Pyriproxyfen was applied once only at a rate of 2 mg/cm<sup>2</sup> to a filter paper cone held within part of a plastic bottle. This growth regulator proved very effective, reducing the

apparent density of the flies by 87% after 2 months and maintaining it at a low level for 150 days. The percentage of nulliparous females remained at 0 from days 40 to 120. Pyriproxyfen may be recommended for the control of animal trypanosomiasis vectors if its cost compares favourably with that of insecticides; however, its slower effect does not favour its use for the control of human trypanosomiasis which needs a drastic and immediate reduction of vector populations.

8737 **Swallow, B.M. and Woudyalew, M., 1994.** Evaluating willingness to contribute to a local public good: application of contingent valuation to tsetse control in Ethiopia. *Ecological Economics*, **11** (2): 153-161.

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

African animal trypanosomiasis constrains the production of milk, meat and animal traction across much of sub-Saharan Africa. The tsetse-transmitted disease is particularly important in Ethiopia where at least six million cattle are exposed to the disease. In 1990 a trypanosomiasis control programme that used baited targets to kill tsetse flies was initiated in a case-study area in south-west Ethiopia (Ghibe valley). Major reductions in the density of tsetse flies and the prevalence of trypanosomiasis in cattle achieved during the first year were spoiled by the theft of a large number of the targets. It was postulated that part of the problem stemmed from a lack of local involvement. A survey of household heads was conducted to assess the prospects for greater local involvement. When asked what ought to be done to stop theft, respondents indicated their willingness to become more active in guarding the targets and detecting thieves. They also suggested roles for the research organisation (ILCA) and local authorities. When asked contingent valuation questions about the maximum amounts of money and/or labour that they would be willing to contribute to the programme, 59% volunteered both money and labour and only 3% volunteered neither money nor labour. Willingness to contribute money was related to the gender of the household head, the number of cattle held by the household and the participation of the household in a monitoring exercise being conducted by the research organisation. Willingness to contribute labour was related to employment status and the information available to the respondent about the programme. We conclude that contingent valuation, when integrated into a participatory research approach, can generate practical results for evaluating the prospects

for local participation in the provision of local public goods.

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

[See also **18**: nos. 8720, 8725, 8728-8731, 8753, 8754, 8756, 8763, 8808.]

8738 **Averbeck, G.A., Bjork, K.E., Packer, C. and Herbst, L., 1990.**

Prevalence of hematozoans in lions (*Panthera leo*) and cheetah (*Acinonyx jubatus*) in Serengeti National Park and Ngorongoro Crater, Tanzania. *Journal of Wildlife Diseases*, **26** (3): 392-394.

Averbeck: Department of Veterinary Pathobiology, University of Minnesota, St Paul, MN 55108, USA.

Lions and cheetah from the Serengeti National Park and Ngorongoro Crater Conservation Area, Tanzania, were examined for the presence of blood protozoans. In the Serengeti, trypanosomes were present in 28% (32 of 113) of the lions and in none of the cheetah. Trypanosomes were not found in any lion or cheetah sampled in the Ngorongoro Crater. There was significant variation in the prevalence of trypanosome infections in the four Serengeti habitats sampled, prevalences being highest in lions from the Serengeti woodlands, a habitat where tsetse flies are very common. The small number and quality of trypanosome specimens examined precluded identification to species.

8739 **Dale, C., Welburn, S.C. and Milligan, P.J.M., 1993.** The genetics of maturation of trypanosome infections in tsetse flies. (Meeting abstract.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **87** (3): 343.

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

We have suggested that maturation of *Trypanozoon* infections in tsetse is controlled by a single, recessive sex-linked gene. We now show that a sex-linkage model involving a single gene but also incorporating a sex-limiting effect can be fitted to stocks of *Trypanosoma congolense* as well as to *Trypanozoon*. The model shows a significantly better fit than a multiple gene model invoked to explain apparent variations in gene frequency between stocks. We propose that the sex-limiting effects are mediated by lectin levels in the fly midgut which could reduce maturation in female flies by competitive inhibition with the galactosyl lectin.

8740 **Kazadi, J.M.L., Elsen, P., Jochems, M., Hees, J. van, Abbeele, J. van den and Kageruka, P., 1994.** Amélioration de la technique de dissection du tractus digestif et des glandes salivaires des glossines pour la mise en évidence des divers stades de développement des trypanosomes. [Improvement of the technique of digestive tract and salivary gland dissection in the tsetse fly for determining the different stages of trypanosome development.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 89-92.

Kazadi: Département de Santé Animale, Institut de Médecine Tropicale Prince Léopold, Nationalestraat 155, B-2000 Antwerp 1, Belgium.

An improved technique of midgut and salivary gland dissection in the tsetse fly is described. The incorporation of the proventriculus in the dissection procedure gives a far better picture of trypanosome development in the infected fly.

8741 **Ladikpo, E., 1989.** *Relations vecteur-parasite au cours du cycle de Trypanosoma (Nannomonas) congolense chez Glossina morsitans morsitans: étude structurale et ultrastructurale.*

[Vector-parasite relationships during the life cycle of *T. (N.) congolense* in *G. m. morsitans*: study of structure and ultrastructure.] Thèse de Doctorat, Université des Sciences et Techniques du Languedoc, Montpellier. (Unpublished thesis.) 144 pp.

The object of this study was to understand particular aspects of the relationship between *T. congolense* and its insect vector *G. m. morsitans*. Research focused on the digestive tract anatomy of the vector. A study of the epithelial cells of the midgut showed proteinic ribbon-like intracytoplasmic and perinuclear formations. The spatio-temporal development of *T. congolense* throughout its life cycle in the mesenteron of *G. m. morsitans* is followed and a detailed description is given of the various sites of the trypanosomes. In conclusion, the author shows that the complex relationship between the parasite and its vector have consequences for the transmission and epidemiology of animal trypanosomiasis.

8742 **Meda, A.H., Laveissière, C., Muynck, A. de, Doua, F. and Diallo, P.B., 1993.** Les facteurs de risque de la trypanosomiase humaine africaine dans les foyers endémiques de Côte d'Ivoire. [Risk factors for human African trypanosomiasis in the endemic foci of Côte d'Ivoire.] *Médecine tropicale*, **53** (1): 83-92.

Meda: OCCGE/IPR, 01 B.P. 1500, Bouaké 01, Côte d'Ivoire.

A case-control study on risk factors of *Trypanosoma brucei gambiense* human African trypanosomiasis was carried out in 111 patients diagnosed in the three main foci of Côte d'Ivoire. Each case was age- and sex-matched with one seronegative control living in the same locality. Based upon previous epidemiological surveys conducted in similar areas, the potential risk factors were identified and assessed using a standard questionnaire. The study demonstrates that in the forest area of Côte d'Ivoire human trypanosomiasis affects mainly coffee and cocoa farmers. The alloigenous populations coming from the sudano-sahelian savanna are more exposed to the disease than other ethnic groups. People sleeping at the encampments are more likely to become infected than those living in the villages (ODDS-Ratio = 4.5). People fetching water from natural holes and pools have an increased risk (ODDS-Ratio = 3.6), as do dealers in foodstuffs travelling between the plantations and the villages (ODDS-Ratio = 13.0). These results are consistent with data from previous studies. We identified preventable risk factors, upon which action could be taken to reduce the incidence of the disease. The possibility of using these findings to improve the sleeping sickness control programme in the forest areas of Côte d'Ivoire is discussed.

- 8743 **Moloo, S.K., Kabata, J.M. and Sabwa, C.L., 1994.** A study on the maturation of procyclic *Trypanosoma brucei brucei* in *Glossina morsitans centralis* and *G. brevipalpis*. *Medical and Veterinary Entomology*, **8** (4): 369-374.

Moloo: ILRAD, P.O. Box 30709, Nairobi, Kenya.  
Teneral *G. m. centralis* and *G. brevipalpis* were fed *in vitro* upon medium containing procyclic *T. b. brucei* derived from the midguts of *G. m. centralis* or *G. brevipalpis* which had immature trypanosome infections. The tsetse were then maintained on rabbits and, on day 31, were dissected to determine the infection rates. In *G. m. centralis* the midgut and salivary gland infection rates by *T. b. brucei* were 46.0% and 27.0% with procyclic trypanosomes from *G. m. centralis*, and 45.4% and 24.7% with procyclic trypanosomes from *G. brevipalpis*, respectively. In *G. brevipalpis* the rates were 20.2% and 0.0% with procyclic trypanosomes from *G. m. centralis*, and 28.0% and 0.0% with procyclic trypanosomes from *G. brevipalpis*, respectively. Teneral *G. m. centralis* and *G. brevipalpis* were also fed similarly upon procyclic *T. b. brucei* derived from *G. m. centralis* or *G. brevipalpis* on day 31 of infection: the former tsetse species had mature infections while the latter were without infections in the salivary glands. In *G. m. centralis* the infection rates in the midgut and salivary glands were 48.9% and 17.0%, and 38.0% and 17.0% when fed on procyclic trypanosomes from *G. m. centralis* and *G. brevipalpis*, respectively. In *G. brevipalpis* the rates were 21.5% and 0.0%, and 10.7% and 0.0% with procyclic trypanosomes of *G. m. centralis* and *G. brevipalpis* origin, respectively. Thus, procyclic *T. b. brucei* from susceptible *G. m. centralis* could not complete cyclical development in refractory *G. brevipalpis*, whereas those from *G. brevipalpis* developed to metatrypanosomes in the salivary glands of *G. m. centralis*. Teneral and 15-day-old non-teneral *G. m. centralis* were fed *in vitro* upon heparinised goat's blood containing *T. b. brucei* bloodstream trypomastigotes, or upon medium containing procyclic *T. b. brucei* derived from *G. m. centralis* with mature infections. On day 31 their infection rates were determined. The infection rates by *T. b. brucei* in the midgut and salivary glands of *G. m. centralis* fed on the infected blood were 70.4% and 40.4% when fed as teneral tsetse, as against 15.3% and 4.0% when fed as non-teneral tsetse. Those tsetse which were fed on the medium containing procyclic trypanosomes showed rates of 50.0% and 25.6%, as against 11.6% and 2.5%, respectively. It would appear, therefore, that maturation of *T. b. brucei* in

tsetse is probably not determined simply by an interaction between lectin and procyclic trypanosomes in the midgut of non-teneral tsetse, but is the result of a complex interaction between many interrelated physiological factors of both the trypanosome and the tsetse vector.

8744 **Ngeranwa, J.J.N. and Kilalo, D.C., 1994.** The ability of *Stomoxys calcitrans* and mechanical means to transmit *Trypanosoma (brucei) evansi* from goats to camels in Kenya. *Veterinary Research Communications*, **18** (4): 307-312.

Ngeranwa: Department of Veterinary Tropical Diseases, University of Pretoria, Private Bag X04, 0110 Onderstepoort, South Africa.

*S. calcitrans* failed to transmit *T. (b.) evansi* from infected goats to other goats or camels, but the trypanosomal infection was transmitted by needle prick from infected goats to camels.

8745 **Simarro, P.P., Mas, J., Lancien, J., Ona Sima, F., Mateo, M.J. and Roche, J., 1990.** Epidemiología de la tripanosomiasis humana en el foco de Luba, en Guinea Ecuatorial. [Epidemiology of human trypanosomiasis in the Luba focus, Equatorial Guinea.] *Revista de Sanidad e Higiene Publica*, **64** (9-10): 517-534.

Simarro: Centro de Control de la Tripanosomiasis, AECI, Apartado 560, Bata, Equatorial Guinea.

In Equatorial Guinea, human trypanosomiasis seemed to be under control by the end of the 1960s following intensive surveillance throughout the previous three decades. However, subsequent lack of surveillance led to upsurges in the old foci in the early 1980s. The grave situation in 1985 in the Luba focus on the island of Bioko prompted a sero-parasitological and entomological survey to delimit the focus, evaluate the prevalence of the disease, find out the distribution and behaviour of the vector and evaluate the impact of the monopoly trap as a method of tsetse control. The overall prevalence in the focus was found to be 3.8%. An area of four villages with a prevalence of 11% was considered to be the epicentre from which the disease had spread to cover an area with a radius of 25 km. The prevalence in the other areas varied, depending not only on distance from the epicentre but also on their altitude. Because transmission takes place mostly in the cocoa plantations, men were more affected than women ( $P < 0.01$ ) because of their agricultural activity. Although those most exposed were 21-40 years old, prevalence was highest in the 41-50 year old group, perhaps because of an additive

effect through the years. *Glossina palpalis palpalis* was shown to be the vector, with a homogeneous distribution and high mobility throughout the area. The monopyramidal trap, without insecticide but with a system of permanent capture, was an effective control method, reducing the apparent density by 72% in the first month.

8746 **Woolhouse, M.E.J., Bealby, K., McNamara, J.J. and Silutongwe, J., 1994.** Trypanosome infections of the tsetse fly *Glossina pallidipes* in the Luangwa Valley, Zambia. *International Journal for Parasitology*, **24** (7): 987-993.

Woolhouse: Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK.

Trypanosome infections of *G. pallidipes* were investigated at a site in the Luangwa Valley, Zambia, between June 1991 and September 1992. Almost 3700 flies were captured, dissected, screened for trypanosome infection, and aged using both wing fray and (for females) ovarian categories. DNA probes were used to identify midgut infections. Prevalences of mature infections were 6.2% *Trypanosoma vivax*-type and 3.1% *T. congolense*-type (including low prevalences of *T. brucei*, *T. simiae* and another *Nannomonas* species). The prevalence of infection increased with age. For both types of infection this relationship could be described by a simple 'catalytic' model which generates estimates of *per capita* rates of infection. Prevalences varied significantly with time independently of any changes in the age structure of the tsetse population. This may reflect temporal variation in the *per capita* rates of infection.

## 5. human trypanosomiasis

### (a) SURVEILLANCE

[See **18**: nos. 8742, 8745.]

### (b) PATHOLOGY AND IMMUNOLOGY

8747 **Buguet, A., Bert, J., Gati, R., Tapie, P., Doua, F., Bogui, P., Lonsdorfer, J., Tabaraud, F. and Dumas, M., 1990.** Distribution du sommeil et de la veille dans la trypanosomiase humaine africaine. [Sleep-wake distribution in human African trypanosomiasis.] *Travaux scientifiques des Chercheurs du Service de Santé des Armées*, **1990** (11): 303-304.

Buguet: CRSSA, La Tronche-Grenoble, France.

Polysomnographic 24 h recordings were taken in eight patients with human African trypanosomiasis due to *Trypanosoma brucei gambiense*, at the meningo-encephalitic stage of sleeping sickness. The sleep-wake cycle followed an ultradian rather than a circadian distribution.

8748 **Kazumba, M., Kazadi, K. and Mulumba, M.P., 1993.**

Caractéristiques de la trypanosomiase de l'enfant. A propos de 19 observations effectuées au CNPP, Cliniques Universitaires de Kinshasa, Zaire. [Characteristics of trypanosomiasis in children: concerning 19 observations made at the Centre Neuro-Psycho-Pathologique, Cliniques Universitaires, Kinshasa, Zaire.] *Annales de la Société belge de Médecine tropicale*, **73** (4): 253-259.

Kazumba: CNPP, Cliniques Universitaires, UNIKIN, B.P. 825, Kinshasa XI, Zaire.

The clinical study of 19 cases of trypanosomiasis in children aged 2 to 13 years showed a picture similar to that in adults but the circumstances of infection and particularly the course of the disease are worthy of special attention. It was interesting to note that maternal trypanosomiasis was frequently an anamnestic element in the diagnosis of the children. The short- and long-term progress of the patient depends on the gravity of the neuropsychological sequelae which are themselves related to the gravity of the infection at initial examination. Late diagnosis and the consequent delay in institution of treatment are discussed.

8749 **Lucas, R., Magez, S., Bajyana Songa, [E.], Darji, A., Hamers, R. and Baetselier, P. de, 1993.** A role for TNF during African trypano-somiasis: involvement in parasite control, immunosuppression and pathology. *Research in Immunology*, **144** (5): 370-376.

Lucas: Laboratory of Cellular Immunology, Vrije Universiteit Brussel, Paardenstraat 65, 1640 Sint-Genesius-Rode, Belgium.

Both tumour necrosis factor (TNF) and interferon (IFN)-gamma are believed to play a key role in trypanosomiasis. The production of both cytokines is elicited by trypanosome components. IFN-gamma, produced by CD8<sup>+</sup> T cells, is believed to serve as a growth stimulator for the parasite while TNF, produced by macrophages, exerts a direct trypanocidal effect. This suicidal TNF-inducing capacity of trypanosomes may represent a mechanism against growing too fast and killing the host too soon. Both cytokines serve as potent mediators of T-cell immunosuppression, and some pathological effects of trypanosomiasis, such as

anaemia and daytime sleep, may be the result of chronic activation of macrophages. TNF is believed to contribute directly to inflammatory reactions in the CNS. Treatment with trypanocidal drugs, which causes massive release of trypanosome components in the circulation, may switch on hyperproduction of TNF which, in turn, may exert noxious effects on the host.

(c) TREATMENT

[See also **18**: no. 8798.]

8750 **Gherardi, R.K., Chariot, P., Vanderstigel, M., Malapert, D., Verroust, J., Astier, A., Brun-Buisson, C. and Schaeffer, A., 1990.** Organic arsenic-induced Guillain-Barré-like syndrome due to melarsoprol: a clinical, electrophysiological, and pathological study. *Muscle and Nerve*, **13** (7): 637-645. Gherardi: Département de Pathologie (Unité de Neuropathologie-Médecine Légale), Hôpital Henri Mondor, 94010 Créteil Cedex, France.

A young woman suffering from *gambiense* sleeping sickness was treated with melarsoprol. Thirty-eight days after the first administration of this organo-arsenic compound, myalgias, distal paresthesias and rapidly progressive weakness developed in all four limbs. Electrophysiological studies were misleading for Guillain-Barré syndrome. Neuropathological data included massive distal wallerian degeneration in peripheral nerves and abnormalities in dorsal ganglia and spinal cord where vacuolation of anterior horn cells and axonal neurofilamentous masses were observed. Very high concentrations of arsenic were found in the spinal cord, contrasting with undetectable levels in peripheral nerves. Our findings are consistent with an arsenic neuronopathy manifested by initial proximal demyelination and delayed distal axonal damage. Renal and hepatic dysfunctions, which were implicated in the toxic arsenic accumulation, should be systematically detected before administration of melarsoprol. The diagnosis of Guillain-Barré syndrome must be considered with caution in patients treated with this compound.

8751 **Kirchhoff, L.V., 1994.** American trypanosomiasis (Chagas' disease) and African trypanosomiasis (sleeping sickness). *Current Opinion in Infectious Diseases*, **7** (5): 542-546.

Department of Internal Medicine, University of Iowa College of Medicine, 300 G EMRB, Iowa City, IA 52242, USA.

Some recent progress in the control of African human trypanosomiasis, such as the development of

eflornithine, is briefly reviewed.

8752 **Robinson, C.P., 1991.** Eflornithine hydrochloride.

*Drugs of Today*, **27** (7): 447-455.

College of Pharmacy, Health Science Center, University of Oklahoma, Oklahoma City, OK 73190, USA.

The action and uses of eflornithine are outlined.

Evaluations of the drug's effectiveness in cell culture, in animals and in humans are reviewed.

Details of dosage and administration, and of adverse reactions and advice for safe use, are also given.

#### 6. animal trypanosomiasis

##### (a) SURVEY AND DISTRIBUTION

8753 **Bula, M., 1988.** Etudes épidémiologiques des trypanosomoses: détection des immunoglobulines G1 et G2 trypanosomiques par la méthode ELISA. [Epidemiological study of trypanosomiasis: detection of IgG1 and IgG2 by ELISA.] *In: Premières Journées Vétérinaires Africaines, Hammamet, Tunisie, 31 mai - 2 juin 1987* (Paris, France; OIE), pp. 69-80.

Faculté de Médecine Vétérinaire, UNILU, B.P. 1825, Lubumbashi, Zaire.

IgG1 and IgG2 were measured in 1457 serum samples from cattle, including 672 cattle which had responded positively by an immune response to trypanosomal stimulation. On a ranch in Kayembe-Mukulu heavily infested with tsetse flies, 70.29% of cattle were positive to ELISA. Out of 58 serum samples from cattle on the Masisi Plateau at Kivu (altitude 2000 m), 7 were positive. Trypanosomiasis was maintained in Masisi by the weekly holding of a market at Mushake, which involved taking cattle from low altitude areas infested with tsetse flies to healthy zones at high altitude, where trypanosomes were transmitted mechanically through biting flies. Animal trypanosomiasis caused by *Trypanosoma brucei* and human trypanosomiasis caused by *T. b. gambiense* and *T. b. rhodesiense* both occurred in the Luala Valley at Songololo, Sona-Mpangu, Kamiji, Kambay ranch, Lodja and Katakokombe, also at Kongolo in North Shaba. These cases illustrate an important epidemiological problem. The occurrence of trypanosomes resistant to trypanocides is discussed. A reduced immune response of pubescent heifers to brucellosis vaccine was attributed to immunosuppression.

8754 **Daniel, A.D., Dadah, A.J., Kalejaiye, J.O. and Dalhatu, A.D., 1993.**

Prevalence of bovine trypanosomiasis in Gongola State of Northern Nigeria. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **46** (4): 571-574.

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

A study of bovine trypanosomosis was carried out in Gongola State, Northern Nigeria, a supposedly tsetse-free region, during the months of April-July 1990. Blood samples were collected from 1065 cattle and examined by buffy coat and stained smear methods. PCV was determined simultaneously. Forty-two (3.9%) of the animals examined were infected with trypanosomes. *Trypanosoma vivax* was more frequently encountered than other species. Infection rate was high in tsetse flies as 27 (22.7%) of 119 *Glossina tachinoides* caught, dissected and examined were positive for *T. vivax* and *T. congolense* infections. Further studies are desirable in areas claimed to be tsetse-free in Nigeria.

8755 **Idriss, A., Nassingar, M., Chedanne, P., N'Garygam, K. and Oumate, O., 1988.** Enquête sur le parasitisme intestinal et la trypanosomiase des bovins dans une région de développement rural en zone Sahélienne au Tchad. [Survey of intestinal parasitism and trypanosomiasis of cattle in a rural development region in the Sahelian zone of Chad.] In: *Premières Journées Vétérinaires Africaines, Hammamet, Tunisie, 31 mai - 2 juin 1987* (Paris, France; OIE), pp. 81-90.

Laboratoire de Recherches Vétérinaires et Zootechniques de Farcha, B.P. 433, Ndjamena, Chad. Blood sampling of 324 cattle and 239 camels showed that 0.6% were infected with trypanosomes (*Trypanosoma vivax*). Confirmation of this low incidence is necessary in order to assess the influence of the previous dry season on this disease.

8756 **Jacquet, P., Cheikh, D., Thiam, A. and Dia, M.L., 1993.** La trypanosomose à *Trypanosoma evansi* (Steel 1885), Balbiani 1888 chez les petits ruminants de Mauritanie: résultats d'inoculation expérimentale et d'enquêtes sur le terrain. [Trypanosomosis due to *T. evansi* in small ruminants in Mauritania: results of experimental inoculation and field surveys.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **46** (4): 574-578.

Service de Parasitologie, Centre National d'Elevage et de Recherches Vétérinaires, B.P. 167, Nouakchott, Mauritania.

In order to clarify the possible role of small ruminants in the epidemiology of *T. evansi* infection of camels in southern Mauritania, a ewe and a goat were inoculated i.v. with a local strain of *T. evansi* isolated from a dairy camel, and surveys of small ruminant flocks which graze with infected camels in the south of the Trarza region were carried out. The experimental inoculation confirmed that local sheep and goats are

receptive. Only the ewe showed a clinical episode with loss of weight and abortion. During 220 days after inoculation the blood of the goat remained constantly infectious to mice, whereas in the same period the ewe's blood showed an alternation of infectious and non-infectious phases. However, in the field, none of 381 blood smears of small ruminants (207 goats, 174 sheep) and none of 187 sera (109 goats, 78 sheep) were positive. Therefore, it seems that the small ruminants of southern Mauritania do not play any role in the epidemiology of *T. evansi* camel trypanosomosis despite being receptive to experimental inoculation.

8757 **Jacquet, P., Dia, M.L., Cheikh, D. and Thiam, A., 1994.** La trypanosomose cameline à *Trypanosoma evansi* (Steel 1885), Balbiani 1888, en République islamique de Mauritanie: résultats d'enquêtes dans le Trarza. [Camel trypanosomosis due to *T. evansi* in Mauritania: results of surveys in the Trarza region.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 59-62.

Centre National d'Elevage et de Recherches Vétérinaires, Service de Parasitologie, B.P. 167, Nouakchott, Mauritania.

A first survey on camel trypanosomosis due to *T. evansi* was carried out in the Trarza region, south-western Mauritania. Blood smears were made from 218 animals and 160 were submitted to an indirect immunofluorescence test. Young calves below one year old seem to be free of *T. evansi* infection, while in dairy females, average rates of infection of 7.3% (blood smears) and 24.5% (serological results) were found. The type of herd management seems to be an important risk factor: the herds that frequent, even temporarily, the wooded areas of the Senegal river valley or permanent water collections (R'kiz lake) show the highest infection rates. Recommendations are presented to camel owners, especially those with dairy camel herds in the south of the country.

8758 **Kanwe, A.B., Bengaly, Z., Saulnier, D. and Duvallet, G., 1992.** Evaluation du test de détection des antigènes circulants de trypanosomes à l'aide d'anticorps monoclonaux. Infections expérimentales et naturelles. [Evaluation of the antigen detection test for the diagnosis of trypanosomes using monoclonal antibodies. Experimental and natural infections.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 265-271.

CRTA, 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso. An antigen detection ELISA based on species-specific monoclonal antibodies, was evaluated at CRTA during

experimental infections in small ruminants (sheep and goats) and with sera from naturally infected cattle, using reagents kindly supplied by ILRAD. Forty sera from cattle sampled in France were also tested and gave optical densities (OD) from 0.007 to 0.009 with three monoclonal antibodies against *Trypanosoma congolense*, *T. vivax* and *T. brucei*. These OD values were well below the 0.050, which is considered by ILRAD as a positive threshold OD reading. In the small ruminant experimental infections, the sensitivity of the test was 63.2% for *T. congolense*-infected animals and 9.9% for *T. vivax*-infected animals. The sensitivity of parasitological tests was 55.1% and 48.6%, respectively. The combination of the antigen- and parasite-detection tests increased the sensitivity to 82.4% and 52.8%, respectively. Means of OD values, for the naturally infected cattle sera, were  $0.116 \pm 0.030$  for *T. congolense*, and  $0.011 \pm 0.028$  for *T. vivax*-infected animals. Sixteen out of 20 *T. congolense*-infected sera (sensitivity 80%) and one out of 20 *T. vivax*-infected sera (sensitivity 5%) gave an OD value exceeding 0.050. The determination of a threshold OD reading lower than 0.050 would greatly improve the sensitivity of the test. This determination could be done by studying either the preinfection sera or a local population of animals living in an area free from trypanosomiasis. Our results have been obtained during the acute phase of infection. Results from ILRAD show that this test is much more reliable during the aparasitaemic chronic phase. Other evaluations for epidemiological surveys in the field are being carried out at CRTA.

8759 **Kashiwazaki, Y., Snowden, K., Smith, D.H. and Hommel, M., 1994.**

A multiple antigen detection dipstick colloidal dye immunoassay for the field diagnosis of trypanosome infections in cattle. *Veterinary Parasitology*, **55** (1-2): 57-69.

Hommel: Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK.

Monoclonal antibodies (McAbs) were developed against aspartate aminotransferase purified from *Trypanosoma brucei rhodesiense* bloodstream form (bf) soluble extracts using a combination of anion-exchange and hydrophobic interaction chromatography. McAb 1A1 was *Trypanozoon* and *Nannomonas* specific while 2F1 was *Trypanozoon* bloodstream form specific. A dipstick colloidal dye immunoassay (DIA) was employed as a field diagnostic test for African trypanosome infections and designed using affinity purified polyclonal antibodies (PCAbs) raised

against *T. b. rhodesiense* bf and the two McAbs, 1A1 and 2F1. PcAbs were adsorbed onto Palanil Red dye particles and used as dye reagents. Dipsticks were dotted with the three different antibodies, which captured trypanosomal antigens in samples tested, while the dye reagent bound to the captured antigens; the presence of coloured dots on the dipstick identified trypanosome infections. A field trial of the DIA was carried out in south-eastern Uganda. A total of 1686 cattle from seven areas were bled and tested by DIA and HCT. A total of 798 cattle (47.3%) were found to be trypanosomal antigen positive by DIA while only 162 (9.6%) were revealed to harbour trypanosomes by HCT, of which 151 (93%) were also positive by DIA.

8760 **Kulo, E.A., 1989.** *Contribution à l'étude de la trypanosomose bovine au Togo: enquête sérologique par immunofluorescence indirecte (IFI) dans la région d'Avétonou.* [Contribution to the study of bovine trypanosomiasis in Togo: serological investigation using indirect immunofluorescence in the Avetonou area.] Thèse pour le Doctorat en Médecine Vétérinaire, Sidi Thabet, Tunisia. (Unpublished thesis.) 148 pp. Three parasitological and two serological (IFI) surveys of bovine trypanosomiasis were carried out between July and October 1988 on 104 cattle from large-scale rearing areas in the Avetonou region. The sample consisted of 35 Zebu, 25 Lagunaire and 44 N'Dama. In the first survey we found 5 parasitologically positive animals as against 39 seropositive by IFI. At the third parasitological survey, we found 16 positive animals, while the second IFI survey, conducted at the same time, found 41 animals positive. All infections were due to *Trypanosoma vivax* except three which were due to *T. congolense*. None was caused by *T. brucei*. Most of the serological positives were at dilutions of 1/40 and 1/160; none was positive at 1/640. It is concluded that (i) IFI is more sensitive than parasitological screening by stained smear and the Woo method; (ii) in natural conditions, animals often have a sub-patent infection with low parasitaemia but permanent anaemia; (iii) the Avetonou region is more infected than anticipated from recently established estimates; (iv) *T. brucei* does not occur in the area; and (v) serologically, differences in the degree of positivity were not related to cattle breed, but rather to the animals' exposure to tsetse.

8761 **Nantulya, V.M., 1990.** Trypanosomiasis in domestic animals: the problems of diagnosis. *Revue scientifique et technique de l'Office International des Epizooties*, 9 (2): 357-367.

ILRAD, P.O. Box 30709, Nairobi, Kenya. Animal trypanosomiasis presents special problems with regard to diagnosis. The clinical signs are not pathognomonic and the standard techniques for the detection of trypanosomes are not sufficiently sensitive. Although significant improvements have been made in diagnosis, a high proportion of infections still remain undetected as the chronic, more common form of the disease is often aparasitaemic. In the face of these constraints, alternative methods of diagnosis have been developed, most of which are for the detection of antibody responses to the antigens of the infecting trypanosomes. The most useful of these tests, in view of their sensitivity and specificity, are the indirect immunofluorescent antibody test, enzyme immunoassay (ELISA) and the card agglutination test for trypanosomiasis (CATT) which is used for the diagnosis of *Trypanosoma evansi* infections. However, there are several shortcomings in antibody detection tests: the antigens used are ill-defined, thus making standardisation of the tests rather difficult with regard to sensitivity and specificity. Furthermore, some of the tests are not applicable to the field. Moreover, the presence of antibody in the serum does not necessarily reflect an existing infection, as antibodies may persist for several months following recovery. Recently, development of assays for the detection of circulating trypanosomal antigens in the blood of infected animals has circumvented this problem since antigen-positivity indicates existing infection. These new assays have not yet been fully evaluated in the field, but the data generated so far do indicate that the diagnostic strategy for the future is likely to be a combination of one of the more sensitive standard trypanosome detection techniques with antigen-trapping ELISA.

8762 **Rowlands, G.J., Mulatu, W.A., Authié, E., d'Ieteren, G.D.M., Leak, S.G.A., Peregrine, A.S. and Trail, J.C.M., 1990.** Prevalence of *Trypanosoma congolense* in East African Zebu cattle under high tsetse challenge. In: Thrusfield, M.V. (ed.), *Proceedings of a meeting of the Society for Veterinary Epidemiology and Preventive Medicine, held at the Queen's University of Belfast, 4-6 April 1990* (Roslin, Midlothian, UK; SVEPM), pp. 145-152.

Rowlands: ILCA, P.O. Box 46847, Nairobi, Kenya. A baseline survey in seven traditionally managed village Zebu herds in the Ghibe Valley in south-west Ethiopia, based on monthly sampling between January 1988 and June 1989, showed *T. congolense* to be the

predominant species (prevalence 3.0% at < 9 months old, 14.1% at 9-32 months old, and 30.7% at > 32 months old), followed by *T. vivax* and *T. brucei*. The data on *T. congolense* parasitaemia and PCV were re-analysed, with regard to the number of consecutive preceding months in which blood samples were negative: a 'new infection' was defined as one which occurred in an animal which had had three consecutive samples with PCV > 26% and no parasitaemia. The rates of 'new infection' were then 7.8% in those 9-32 months and 14.1% in those > 32 months. Two of the seven herds (39 and 60 animals) were selected for more frequent sampling in June 1989, to compare the efficacy of diminazene aceturate (Berenil) at 3.5 and 7.0 mg/kg. Only 53% of controls (parasitaemic but not treated) were detected parasitaemic again 10 days later, but by day 20, 81% had been detected parasitaemic on at least one of the two occasions. Treatment of animals with PCV  $\bar{20}$ % produced significant reductions in numbers with parasitaemia at day 10 and day 20 in those given the higher dose. With the lower dose, the difference was only significant at day 10. In those with PCV < 20%, treatment resulted in a rapid increase from 17.4% on day 0 to 23.2% on day 10. Even at 7.0 mg/kg, relapses occurred, suggesting the possible existence of drug resistance among some stocks.

8763 **Singh, B.B., Kazadi, L., Welu, M. and Mushaghala, R., 1988.**

Epidémiologie de la trypanosomiase bovine chez la race N'dama élevée dans une zone glossinaire. [Epidemiology of bovine trypano-somiasis among N'Dama reared in a tsetse-infested zone.] (Abstract only.) *In: Premières Journées Vétérinaires Africaines, Hammamet, Tunisie, 31 mai - 2 juin 1987* (Paris, France; OIE), pp. 121-123.

Faculté de Médecine Vétérinaire, UNILU, B.P. 1825, Lubumbashi, Zaire.

An epidemiological survey of trypanosomiasis was conducted during the rainy season in N'Dama cattle at Mushie, in south-western Zaire. Examination of blood smears and lymph node fluid revealed infection in 10.18% of adult cattle, and none in calves under 1 month old. Swollen lymph nodes and emaciation accompanied by general weakness were encountered in 3.7% of infected animals. Three of 27 infected cows aborted. Infection with *Trypanosoma congolense* occurred in 46.3% of cases, with *T. vivax* in 40.7%, and mixed infection with both species in 13%. An entomological survey showed that the vectors of the disease were *Glossina tabaniformis*, *G. fuscipes* and *Tabanus* sp.

8764 **Wosene, A., 1991.** Traditional husbandry practices and major health problems of camels in the Ogaden (Ethiopia). *Nomadic Peoples*, no. 29: 21-30.

Department of Pathology and Parasitology, Faculty of Veterinary Medicine, Addis Ababa University, Ethiopia. The health problems of Ogaden camels were studied during a 6 month period from December 1987 to May 1988. Blood examination of 320 camels demonstrated the presence of *Trypanosoma evansi* in 21 cases (6.5%) The chronic form of trypanosomiasis is very common in Ogaden camels and only rarely is the acute form encountered. Permanent or temporary waters are conducive to the breeding of biting insect vectors and the disease is consequently very common in river areas such as Fafem and Bombas.

8765 **Wosu, L.O. and Nwanta, J.A., 1989.** Incidence of trypanosomes in settled Fulani cattle in the Anambra State, Southern Nigeria. *Archives roumaines de Pathologie expérimentale et de Microbiologie*, **48** (4): 367-372.

Department of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria.

The incidence of trypanosomes in Fulani Zebu cattle settled in the Anambra State in Southern Nigeria for at least three continuous years was found to be significantly higher than the incidence in Northern Nigeria. Despite this situation, the cattle in the Anambra State were reported to show better reproductive performance, and generally looked healthier and more robust than cattle in Northern Nigeria. The presence of tsetse flies and trypanosomes *per se* appears not to constitute a complete hindrance to cattle production in this area. The factors contributing to the animals' acquired resistance to infection in Southern Nigeria are discussed.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **18**: no. 8749.]

8766 **Adah, M.I., Otesile, E.B. and Joshua, R.A., 1992.** Changes in levels of transaminases in goats experimentally infected with *Trypanosoma congolense*. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 284-286.

Adah: Department of Veterinary Medicine, University of Maiduguri, Maiduguri, Nigeria.

Goats were experimentally infected with *T. congolense* and then treated with Berenil after 9 days of infection. The infection produced increases in glutamate oxalacetate transaminase (GOT) and glutamate pyruvic transaminase (GPT) values. Mean GOT values in infected

West African Dwarf goats were generally lower than in infected Red Sokoto goats. Treatment with Berenil did not produce any significant effect on their levels, probably because of the relapse infection recorded in this study.

8767 **Agyemang, K., Little, D.A., Mattioli, R., Sonko, E. and Janneh, L., 1993.** Effects of trypanosome infection and postpartum liveweight change on resumption of reproduction activity in N'Dama cows. *Theriogenology*, **39** (4): 985-995. Agyemang: ILCA, P.M.B. 2248, Kaduna, Nigeria. Data on reproduction, liveweight and trypanosome infection of N'Dama cattle raised under traditional husbandry systems in The Gambia were analysed to quantify the relative effects of postpartum liveweight change and infection with pathogenic trypanosomes on two parameters of reproductive efficiency: the ability to calve within 21 months after the initial parturition and the length of the calving interval. Information for the study was obtained from a database on an epidemiological survey begun in 1985 in The Gambia. Calving records ( $n = 294$ ) from three locations were classified on the basis of body weight change and prevalence of trypanosome infection between 1 and 4 months postpartum. Least-squares analyses adjusted for effects of location, season of calving, viability of calf, and parity showed that the proportion of cows that calved within 21 months was 50% for cows which maintained or lost less than 5% of the initial postpartum weight and 31% for cows which lost a higher percentage of weight. Corresponding mean calving intervals were 567 and 666 days, respectively ( $P < 0.05$ ). With regard to trypanosome infection, 49% of uninfected cows and 32% of infected cows ( $P < 0.05$ ) calved again within 21 months, with calving intervals of 581 and 651 days, respectively ( $P < 0.05$ ). The interaction between liveweight change and trypanosome infection status was not significant. Furthermore, the findings suggest that while postpartum body weight loss impairs reproductive performance, trypanosome infection does likewise, and these effects may act independently of each other.

8768 **Andrianarivo, A.G., Muiya, P., McOdimba, F.A., Gettinby, G. and Logan-Henfrey, L.L., 1994.** Kinetics of haemopoietic progenitor cells during a *Trypanosoma congolense* rechallenge infection in Boran cattle. *Comparative Haematology International*, **4** (1): 1-10. Andrianarivo: ILRAD, P.O. Box 30709, Nairobi, Kenya. In a preliminary study, using clonogenic assays, the *in*

*in vitro* kinetics of committed haemopoietic progenitors were monitored during a *T. congolense* rechallenge infection in five trypanosusceptible Boran cattle. Early in the infection (week 2), in the absence of any detectable parasitaemia, a drop in the number of nucleated marrow cells was recorded. This was accompanied by a marked but transient decrease in the levels of the colony-forming units-erythroid (CFU-E) followed by a partial recovery by weeks 3-4 after infection. The burst-forming units-erythroid (BFU-E) and the colony-forming units-granulocyte macrophage (CFU-GM) also significantly decreased between weeks 2 and 4. After a transient rise at weeks 3-5 p.i., the CFU-GM steadily declined and remained below preinfection levels throughout the infection. The BFU-E remained below preinfection levels until the end of the experiment. The drop in nucleated marrow cells associated with the decreased numbers of CFU-E, BFU-E and CFU-GM was suggestive of a defect at the pluripotential stem cell level early in the infection (week 2). The erythrocyte indices, i.e. mean corpuscular volume (MCV) and mean corpuscular haemoglobin concentration (MCHC), were unchanged until week 10 p.i. Two animals became severely anaemic; one was euthanised at week 8 and one treated at week 9. The three remaining animals developed chronic anaemia with mean PCV fluctuating around 18-19% between weeks 11 and 14. Low parasitaemia levels were recorded during that period. A CFU-E peak above preinfection levels was noted at week 12 and BFU-E appeared in the peripheral blood culture of two animals between weeks 11 and 14. A progressive rise in MCV associated with a gradual decrease in MCHC also characterised that period. A return to near preinfection levels was recorded for the numbers of all three progenitors 3 weeks after trypanocidal treatment followed by a full recovery 5 months after treatment. Although ineffective haemopoiesis has been suggested to contribute to the anaemia of bovine trypanosomiasis, this is the first demonstration of a negative effect on erythroid development in cultures of bone marrow of trypanosome-infected cattle.

8769 **Bengaly, Z., Clausen, P.H., Boly, H., Kanwe, A. and Duvallet, G., 1993.** Comparaison de la trypanosomose expérimentale chez certaines races de petits ruminants au Burkina Faso. [Comparison of experimental trypanosome infection of some small ruminant breeds in Burkina Faso.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **46** (4): 563-

570.

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

Twenty-four dwarf Djallonké sheep and goats, and 16 Sahelian Fulani sheep and goats, were inoculated with strains of *Trypanosoma vivax* and *T. congolense* to compare their degree of susceptibility to trypanosomosis. One animal from each breed was used as a control. Anaemia was observed in all inoculated animals. In the group of animals inoculated with *T. vivax*, 1 Djallonké goat out of 6, 3 Sahelian Fulani goats out of 4, and 2 Sahelian Fulani sheep out of 4 died within the experimental period of 16 weeks. One single Sahelian Fulani sheep out of 4 died among animals inoculated with *T. congolense*. During a period of 8 weeks, no significant difference was observed between Djallonké and Sahelian Fulani in the decrease of body weight and leucocyte count.

Results in this study show a better resistance of Djallonké sheep and goats to infection by *T. vivax*, whereas there was no significant difference between the breeds for sheep and goats inoculated with *T. congolense*.

8770 **Dwinger, R.H., Agyemang, K., Kaufmann, J., Grieve, A.S. and Bah, M.L., 1994.** Effects of trypanosome and helminth infections on health and production parameters of village N'Dama cattle in The Gambia. *Veterinary Parasitology*, **54** (4): 353-365.

Dwinger: Proyecto UNA/RUU, Escuela de Medicina Veterinaria, Universidad Nacional, Apartado 86, 3000 Heredia, Costa Rica.

The effects of trypanosome and helminth infections on health and production parameters in 2000 village N'Dama cattle were assessed periodically. Blood examination showed *Trypanosoma congolense* and *T. vivax* to be prevalent, while strongylid-type eggs were those most frequently encountered in faecal samples. A distinct seasonal fluctuation was detected for both blood levels of trypanosomes and helminth egg output. Strongylid burden and trypanosome infection had significant negative effects on PCV levels and body weights mainly in animals 2-3 years old. Clear indications of an increased susceptibility to trypanosomosis were found in animals affected by helminths. Similarly, animals infected with trypanosomes were more frequently infested with strongyles and egg counts were higher than in cattle in which no trypanosomes were detected.

8771 **Hussein, K.S.M. and Gasmir, G.S., 1993.** Presence of ketones in the serum of *Trypanosoma evansi* infected camels (*Camelus dromedarius*) in the Sudan. *Revue d'Elevage et de Médecine vétérinaire*

*des Pays tropicaux*, **46** (4): 578-579.

Eastern State Veterinary Research Laboratory, P.O. Box 237, Kassala, Sudan.

One hundred serum and two urine samples collected from camels (*Camelus dromedarius*) were analysed at the Eastern State Veterinary Research Laboratory, Kassala, Sudan, for the presence of ketones. All fifty sera from trypanosome-infected camels gave positive results. Forty-five out of the 50 serum samples of trypanosome-negative camels showed negative results. The five positive samples were also positive with the mercuric chloride test.

8772 **Igbokwe, I.O. and Mohammed, A., 1992.** Some plasma biochemical changes in experimental *Trypanosoma brucei* infection of Sokoto Red goats. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 287-290.

Igbokwe: Department of Veterinary Pathology, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria.

Plasma biochemical changes were studied for 8 consecutive weeks in Sokoto Red goats experimentally infected by i.v. injection of  $1.6 \times 10^7$  *T. brucei*. The strain 8/18 was highly infective. The mean PCV significantly decreased from 1 to 8 weeks p.i. ( $P < 0.05$ ). During this period, the mean plasma total bilirubin concentrations significantly increased ( $P < 0.05$ ). The mean plasma direct and indirect bilirubin concentrations significantly increased from 2 to 8 weeks p.i. ( $P < 0.05$ ). The mean plasma albumin concentrations did not vary significantly ( $P > 0.05$ ), but the mean total plasma proteins and mean plasma globulin concentrations significantly increased between 5 and 8 weeks p.i. ( $P < 0.05$ ). There were no significant changes in the mean plasma bicarbonate, creatinine and cholesterol concentrations ( $P > 0.05$ ).

8773 **Lepierre, P. and Claxton, J.R., 1994.** Comparative study of trypano-somosis in Zebu and N'Dama cattle in The Gambia. *Tropical Animal Health and Production*, **26** (3): 139-145. Claxton: 128/8 Nicolson Street, Edinburgh, EH8 9EH, UK. An experiment was conducted in The Gambia to compare trypanosomosis incidence between Zebu and N'Dama cattle. It was considered important to compare the two breeds under identical management conditions and the animals were maintained together at three locations, traditionally managed and under a range of tsetse challenges. The results show that trypanosomosis incidence was significantly higher in Zebu than in N'Dama. The titre of antibody against *Trypanosoma vivax* measured by an IFAT showed a significant difference

between Zebu and N'Dama. Variations in PCV were greater in Zebu than in N'Dama.

8774 **Nwosu, C.O. and Ikeme, M.M., 1992.** Parasitaemia and clinical manifestations in *Trypanosoma brucei* infected dogs. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 273-277.

Nwosu: Department of Veterinary Microbiology and Parasitology, University of Ibadan, Ibadan, Nigeria. Four dogs were infected with *T. brucei* (Mkar strain) while another four were used as uninfected controls. Two of the dogs showed acute disease and died in the first wave of parasitaemia on days 7 and 8 p.i. while the other two died from the sub-acute disease on days 24 and 28 p.i. corresponding to the second wave of parasitaemia. In the first wave of parasitaemia there was a sharp decrease in the PCV, red blood cell, haemoglobin, total leucocytes, eosinophil, neutrophil and lymphocyte values, but during the intermediate period of low parasitaemia there was a slight recovery of the values of total leucocytes and lymphocytes although these and the other values showed a continuous decrease during the second wave of parasitaemia. In contrast, there was a consistent monocytosis in both acute and sub-acute diseases. The general picture was that of loss of condition, anaemia, leucopenia, monocytosis, ocular impairment, elevated temperature, pulse and respiratory rates, the difference between the acute and sub-acute diseases being in the degree of intensity. The degree of anaemia noted and the circulatory disturbances associated with the infection could have caused death of all the infected dogs.

8775 **Ogunsanmi, A.O., Akpavie, S.O. and Anosa, V.O., 1994.** Haematological changes in ewes experimentally infected with *Trypanosoma brucei*. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **47** (1): 53-57.

Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria.

Changes in the haematological values were studied in West African Dwarf ewes infected with *T. brucei*. This disease was characterised by a normocytic normochromic anaemia in the acute phase and a severe macrocytosis during the chronic phase. The observed changes suggest inadequate erythropoiesis in the acute phase while the chronic phase had a superior but still inadequate erythropoietic response with persistent anaemia. Normal total leucocyte values were observed during the acute phase while leucocytosis was a permanent feature in the chronic phase.

8776 **Omotainse, S.O. and Anosa, V.O., 1992.** Erythrocyte response to *Trypanosoma brucei* in experimentally infected dogs. *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **45** (3-4): 279-283.

Omotainse: NITR, P.M.B. 03, Vom, Plateau State, Nigeria.

*T. brucei* infection produced an acute and fatal disease in Nigerian mongrel dogs due to a rapidly developing anaemia. Infected dogs responded with increased reticulocytosis, which was not sustained with chronicity. In comparison the response to artificially induced haemolytic anaemia was progressive, marked and sustained. The anaemia of *T. brucei* infection of dogs was either normocytic normochromic in acute infection or microcytic normochromic in chronic infection. Artificially induced haemolytic anaemia was either macrocytic normochromic or normocytic normochromic. The erythropoietic potential of plasma *in vivo* in mice increased in *T. brucei*-infected dogs except at the terminal parasitaemia. The anaemia in *T. brucei*-infected dogs is therefore initially responsive but becomes poorly involved with chronicity.

8777 **Rowlands, G.J., Mulatu, W., Authié, E., d'Ieteren, G.D.M., Leak, S.G.A. and Nagda, S.M., 1994.** Effects of trypanosomiasis on growth and mortality of young East African Zebu cattle exposed to drug-resistant trypanosomes. *Preventive Veterinary Medicine*, **21** (1): 87-101.

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

Approximately 390 East African Zebu calves from birth to 3 years of age and their dams were monitored monthly from 1986 to 1992 in nine village herds in an area of high trypanosomiasis risk in south-west Ethiopia where there was resistance to all available trypanocidal drugs. Cattle were individually treated with diminazene aceturate when they were detected to be parasitaemic and their PCV decreased below 26%, or when they showed clinical signs of trypanosomiasis. The average monthly trypanosome prevalence among cattle between 6 and 36 months of age was 18%. Within this environment, animals achieved average body weights of 79  $\pm$  14 (SD) kg, 134  $\pm$  21 kg and 183  $\pm$  22 kg at 12, 24 and 36 months of age respectively. Annual mortalities ranged from 8 to 24%, from 6 to 15% and from 4 to 16% in the age ranges 0-12, 13-24 and 25-36 months respectively. Calves parasitaemic in any one month in 1988, when early rains failed, had a higher average mortality in that month (3.1%) than those that were aparasitaemic (1.4%). Live weight gains of calves born

to the dams detected as parasitaemic on more than half the occasions during the first 6 months postpartum were 14% lower than those of calves from dams not detected as parasitaemic over this period. An effect of parasitaemia in the calf on weight gain to 12 months could not be demonstrated, but animals detected as parasitaemic on more than six of the 12 monthly samples between 13 and 24 or 25 and 36 months of age had growth rates on average 22% lower than those of animals not detected as parasitaemic. All these effects of trypanosomiasis on productivity, however, were temporary and animals later compensated for periods of poor growth. Regular trypanocidal chemotherapy in a situation of high levels of drug resistance may have helped to maintain the health and productivity of these young cattle.

8778 **Samy, M. and Gadir, F.A., 1991.** Pathomorphological and clinicopathological studies on camel trypanosomiasis in United Arab Emirates. *Egyptian Journal of Comparative Pathology and Clinical Pathology*, **4** (1): 47-56.

Department of Pathology, Faculty of Veterinary Medicine, Cairo University, Cairo, Egypt.

Four clinically healthy male camels were i.v. infected with *Trypanosoma evansi* and examined by the mercuric chloride and buffy coat methods. A complete haematological profile showed macrocytic normochromic anaemia. Lymphopenia was found during parasitaemia while lymphocytosis was found at the end of the experiment. Histopathological examinations showed erythro-phagocytosis and destruction of lymphoid follicles during parasitaemia and hyperplastic proliferation of lymphocytes at the end of the experiment.

8779 **Schmid, G., 1991.** *In vitro*-Untersuchungen über die Bildung von Interleukin-2 und Interleukin-2-Rezeptoren an peripheren Blutlymphozyten des Pferdes durch Stimulation mit löslichem Antigen von *Trypanosoma evansi* (Steel, 1885). [In vitro tests on the formation of interleukin 2 and its receptors on peripheral lymphocytes from horses, following stimulation with the soluble antigen of *T. evansi*.] Inaugural-Dissertation, Fachbereich Veterinärmedizin, Freie Universität, Berlin, Germany. (Unpublished thesis.) 84 pp. When equine lymphocytes were exposed to membrane-fraction soluble antigen of *T. evansi*, interleukin 2 was formed and there was evidence of the formation of receptors for interleukin 2. It is suggested that such activation may be responsible for immunosuppression during surra.

## (c) TRYPANOTOLERANCE

[See also **18**: nos. 8767, 8769.]

8780 **Demey, F., 1987.** *Contribution à l'étude des paramètres pour l'identification et la sélection d'animaux trypanotolérants.* [Contribution to the study of parameters for the identification and selection of trypano-tolerant animals.] Thèse de Doctorat de Haute Spécialisation (Ph.D.) en Production Animale Tropicale, Institut de Médecine Tropicale Prince Léopold, Antwerp. (Unpublished thesis.) 200 pp. While the development of trypanotolerant cattle is an appropriate means of combating animal trypanosomiasis in Africa, their selection is difficult because the genetic heterogeneity of the animals and the variable environmental factors encountered makes evaluation of parameters of trypanotolerance difficult. A laboratory model consisting of susceptible and resistant mouse strains was developed and a series of parameters evaluated after infection with metacyclic *Trypanosoma brucei brucei*: length of survival, morning rectal temperature, body weight, parasitaemia, PCV, immunoglobulins of classes IgA, IgM and IgG, electrophoresis of plasma proteins, variant specific indirect immunofluorescence, and variant specific trypanolysis. The validity of selected parameters was tested in the same model after infection with bloodstream form *T. b. brucei* and also in a population of unrelated mice. The substitution of experimental infection by an avirulent antigen was also tested. The prospects of applying this test of trypanotolerance to domestic animals in the field have also been evaluated experimentally and by serological survey.

8781 **Murray, M., Trail, J.C.M. and d'Ieteren, G.D.M., 1990.** Trypano-tolerance in cattle and prospects for the control of trypanosomiasis by selective breeding. *Revue scientifique et technique de l'Office International des Epizooties*, **9** (2): 369-386.

Murray: Department of Veterinary Medicine, University of Glasgow Veterinary School, Bearsden, Glasgow G61 1QH, UK.

Tsetse-transmitted trypanosomiasis is one of the major constraints on the expansion of the livestock and agricultural industries in Africa. Current prophylactic efforts must rely on tsetse control by the use of insecticides and on trypanocidal drugs.

However, recent advances in our knowledge of tsetse and trypanosome biology are offering hope for alternative methods of trapping tsetse, new drugs and even vaccination. Possibly of even greater significance is

the increasing sense that Africa herself might be able to contribute to the resolution of this problem. Over a period of several thousand years, she has generated cattle, such as the taurine N'Dama and West African Shorthorn breeds of West and Central Africa, that are now known to possess a significant degree of innate resistance to trypanosomiasis and several other important infectious diseases. These cattle are extremely well adapted to the environment and are now recognised as having considerable production potential. The ability to resist the development of anaemia in the face of infection, as assessed by PCV, has been shown to be correlated with the capacity to be productive, thereby identifying regulation of PCV as a key trait of trypanotolerance. Thus, an estimate of the ability of an infected animal to maintain PCV, following either experimental or field infection, could be used as a method for identifying trypanotolerant individuals. This could provide a means of estimating trypanotolerance heritability, thereby permitting rational breeding programmes to be instituted.

8782 **Olubayo, R.O., 1991.** *Expression of trypanotolerance by African wild Bovidae with special reference to the buffalo (Syncerus caffer)*. Utrecht, Netherlands; Rijksuniversiteit Utrecht, Faculty of Veterinary Medicine. 194 pp. ICIPE, P.O. Box 30772, Nairobi, Kenya.

The expression of trypanotolerance is discussed in six chapters. Chapter 1 reviews the basis of trypanoresistance in trypanotolerant cattle, laboratory mice and wild animals. Chapter 2 discusses the management of experimental animals kept in captivity and disease problems encountered in these animals. Chapter 3 provides evidence showing that one of the traits of trypanoresistance in buffalo is the ability to control parasitaemia and parasite-induced anaemia, this mechanism having an immunological basis. Chapter 4 provides evidence showing the presence of naturally occurring trypanocides in buffalo and eland serum, which may be partly responsible for trypanotolerance. Chapter 5 discusses the response of waterbuck to trypanosome infection and how the inter-relationship between the host, parasite and vector can affect the infection in the host. Chapter 6 examines and discusses the mechanisms responsible for trypanotolerance in buffalo and waterbuck and speculates how these mechanisms may be exploited to increase trypanotolerance in susceptible livestock.

8783 **Trail, J.C.M., Wissocq, N., d'Ieteren, G.D.M., Kakiess, O. and**

**Murray, M., 1994.** Patterns of *Trypanosoma vivax* and *T. congolense* infection differ in young N'Dama cattle and their dams. *Veterinary Parasitology*, **55** (3): 175-183.  
d'Ieteren: ILCA, P.O. Box 46847, Nairobi, Kenya.  
Trypanosome infection was detected by the dark ground/phase contrast buffy coat microscopic technique in N'Dama cattle in a high natural tsetse challenge situation in Zaire. The data were used to compare the pattern of infection in very young animals and in their dams, and to evaluate how the pattern evolved in calves from birth to maturity, and thereafter in the different age groups represented by their dams. Five hundred and fourteen calves were evaluated at 3 week intervals for an average of 26 months each, over varying periods between birth and 42 months of age. Two hundred and sixty nine dams had matching records from parturition to calf weaning at 10 months. One month after weaning, animals were equally infected with *T. vivax* and *T. congolense*. From then until 42 months, the proportion of time an animal was infected with *T. vivax* relative to *T. congolense* gradually decreased. In the dams this trend continued from 4 years to at least 8 years of age by which time *T. vivax* infection was only one-third that of *T. congolense* infection. This finding is regarded as strong evidence of the ability of N'Dama cattle, in this region of Africa, to acquire significant control of the development of parasitaemia following *T. vivax* infection but apparently not following *T. congolense* infection. Pre-weaner calves, grazing with their dams, appeared to have considerable protection from, or be more resistant to, both *T. vivax* and *T. congolense* infections compared with their dams and to their own immediate post-weaning situations. More sensitive diagnostic techniques such as antibody and antigen-detection enzyme immuno-assays may help differentiate between pre-weaners that may not be infected and those that may be capable of controlling the development of detectable parasitaemia.

8784 **Trail, J.C.M., Wissocq, N., d'Ieteren, G.D.M., Kakiese, O. and Murray, M., 1994.** Quantitative phenotyping of N'Dama cattle for aspects of trypanotolerance under field tsetse challenge. *Veterinary Parasitology*, **55** (3): 185-195. d'Ieteren: ILCA, P.O. Box 46847, Nairobi, Kenya. Matching animal health and performance data were recorded over the 2 year period from weaning at 10 months of age on 255 N'Dama cattle in a high natural tsetse challenge situation in Zaire. Four parameters that are regarded as possible indicators of trypanotolerance, species of trypanosomes detected, length of time parasitaemic, intensity of parasitaemia (parasitaemia score), and anaemic condition as estimated by PCV values, were measured and the relative effects of changes in these parameters on trypanocidal drug requirements and growth were assessed. The effects of species of trypanosome on drug requirements and growth were directly measurable. In the case of the other three indicators, the effects on drug requirements and growth that would be brought about by a change of one standard deviation in each were calculated. This allowed comparison of similar sized changes in these three indicators that are of necessity recorded in dissimilar units. *Trypanosoma vivax* and *T. congolense* infections had equal effects on the number of trypanocidal drug treatments required, an average of 0.61 treatments being administered to each infected post-weaner. A reduction of one standard deviation (SD) in length of time infected reduced the number of treatments required by 0.23 and 36% and an increase of 1 SD in PCV reduced the number required by 0.27 or 43%. Changes in parasitaemia score were not important. In the case of growth, a *T. congolense* infection reduced growth by 12.4 g/day or 8% more than a *T. vivax* infection. A reduction of 1 SD in length of time infected increased growth by 9.8 g/day or 6.5%, a reduction of 1 SD in parasitaemia score increased growth by 9.0 g/day or 6.0%, and an increase of 1 SD in average PCV increased growth by 8.4 g/day or 5.6%. The necessity to simultaneously measure the four criteria is clearly indicated by their approximately equal effects on the final performance trait of daily liveweight gain. Thus, absence of information on any of these criteria would significantly affect the accuracy of the estimate of an animal's overall trypanotolerance phenotype in this central African situation and reduce the progress possible in production projects involving N'Dama cattle.

## (d) TREATMENT

[See also **18**: no. 8762.]

8785 **Diaite, A., Vassiliades, G., Seye, M., Mane, A. and Ndiaye, T., 1988.**

*Essais de traitement de la trypanosomiase animale africaine par le Pirobenz.*

[A trial of Pirobenz for the treatment of African animal trypanosomiasis.] Dakar, Senegal; ISRA-LNERV. 18 pp.

Diaite: ISRA-LNERV, B.P. 2057, Dakar, Senegal.

A new trypanocide, Pirobenz, was found to be at least as effective as Berenil.

8786 **Diaite, A., Vassiliades, G., Seye, M., Mane, A., Ndiaye, T. and Kebe, B., 1992.**

*Essais de traitement de la trypanosomiase animale africaine par l'Agriidine.*

[A trial of Agriidine for the treatment of African animal trypanosomiasis.] *Revue sénégalaise des Recherches agricoles et halieutiques*, **4** (1): 85-101.

Diaite: ISRA-LNERV, B.P. 2057, Dakar, Senegal.

A new trypanocide, Agriidine (Pfizer), was tested against *Trypanosoma congolense* infection in goats and found to be as effective as Berenil.

8787 **Peregrine, A.S., 1994.** Chemotherapy and delivery systems: haemo-parasites. *Veterinary Parasitology*, **54** (1-3): 223-248.

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

Chemotherapy of haemoparasitic diseases in domestic animals is dependent on a limited number of compounds, many of which are chemically closely related. In this review, a summary is given of each of the drugs currently available for treatment and prophylaxis of trypanosomiasis and the tick-borne diseases theileriosis, babesiosis, anaplasmosis and cowdriosis. In contrast to the situation with the drugs used for tick-borne diseases, drug resistance appears to be becoming an increasing problem associated with the compounds used for trypanosomiasis. The literature that has been reviewed, therefore, is that which relates to the methods used to identify and quantify drug resistance in trypanosome populations, reports of resistance to trypanocides, and cross-resistance between trypanocides. The possible reason(s) for the apparent lack of development of resistance to the compounds used for treatment of tick-borne diseases is also discussed. Local toxicity at the site of injection is a problem that is particularly associated with many of the trypanocides when used on a long-term basis in individual animals. Various alternative preparations of the currently used trypanocides therefore have been evaluated in an attempt to reduce

this toxicity, and are summarised. Finally, future developments in haemoparasitic chemo-therapy are considered and, for trypanosomiasis, highlight the importance of integrating chemotherapeutic and chemoprophylactic programmes with control of the vector when drug resistance becomes a significant constraint.

#### 7. experimental trypanosomiasis

##### (a) DIAGNOSTICS

[See also **18**: no. 8759.]

8788 **Gichuki, C.W., Nantulya, V.M. and Sayer, P.D., 1994.** *Trypanosoma brucei rhodesiense*: use of an antigen detection enzyme immunoassay for evaluation of response to chemotherapy in infected vervet monkeys (*Cercopithecus aethiops*). *Tropical Medicine and Parasitology*, **45** (3): 237-242.

Gichuki: KETRI, P.O. Box 362, Kikuyu, Kenya.

##### (b) PATHOLOGY AND IMMUNOLOGY

[See also **18**: no. 8826.]

8789 **Hajduk, S.L., Hager, K.M. and Esko, J.D., 1994.** Human high density lipoprotein killing of African trypanosomes. (Review.) *Annual Review of Microbiology*, **48**: 139-162.

Hajduk: Department of Biochemistry and Molecular Genetics, Schools of Medicine and Dentistry, University of Alabama, Birmingham, AL 35294, USA.

8790 **Igbokwe, I.O., Esievo, K.A.N., Saror, D.I. and Obagaiye, O.K., 1994.** Increased susceptibility of erythrocytes to *in vitro* peroxidation in acute *Trypanosoma brucei* infection of mice. *Veterinary Parasitology*, **55** (4): 279-286.

Igbokwe: Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria.

8791 **Peng, Z.-C., Kristensson, K. and Bentivoglio, M., 1994.**

Dysregulation of photic induction of Fos-related protein in the biological clock during experimental trypanosomiasis. [*T. brucei*; rats.] *Neuroscience Letters*, **182** (1): 104-106.

Bentivoglio: Institute of Anatomy and Histology, Medical Faculty, University of Verona, Strada Le Grazie, 37134 Verona, Italy.

8792 **Sarmah, P.C. and Bhattacharyulu, Y., 1991.** Passive transfer of immunity in mice against *Trypanosoma evansi*. *Annals of Biology (Ludhiana)*, **7** (2): 187-189.

Department of Parasitology, College of Veterinary Science, Assam Agricultural University, Guwahati 781022, India.

8793 **Swarnkar, C.P., Raisinghani, P.M. and Kumar, D., 1994.** Immuno-prophylactic response against *Trypanosoma evansi*: effects

on erythron values in rats immunized with gamma-irradiated *T. evansi*. *Indian Veterinary Journal*, **71** (8): 848-850.

Swarnkar: Central Sheep and Wool Research Institute, Avikanagar 304501, Rajasthan, India.

**8794 Tachado, S.D. and Schofield, L., 1994.**

Glycosylphosphatidylinositol toxin of *Trypanosoma brucei* regulates IL-1 $\alpha$  and TNF- $\alpha$  expression in macrophages by protein tyrosine kinase mediated signal transduction. *Biochemical and Biophysical Research Communications*, **205** (2): 984-991.

Tachado: Walter and Eliza Hall Institute of Medical Research, Royal Melbourne Hospital, Parkville, Victoria 3050, Australia.

**8795 Taverne, J., Playfair, J., Bate, C. and Jakobsen, P.H., 1994.** More on endotoxins and their significance for murine trypanosomiasis. (Letter.) *Parasitology Today*, **10** (11): 434-435. (Also reply by V.W. Pentreath, p. 435.)

Taverne: Department of Immunology, UCL Medical School, 40-50 Tottenham Street, London W1P 9PG, UK.

**8796 Tolson, D.L., Jardim, A., Schnur, L.F., Stebeck, C., Tuckey, C., Beecroft, R.P., Teh, H.-S., Olafson, R.W. and Pearson, T.W., 1994.** The kinetoplastid membrane protein 11 of *Leishmania donovani* and African trypanosomes is a potent stimulator of T-lymphocyte proliferation. [*T. b. brucei*, *T. b. rhodesiense*, *T. simiae*, *T. congolense*.] *Infection and Immunity*, **62** (11): 4893-4899. Pearson: Department of Biochemistry and Microbiology, Petch Building, University of Victoria, P.O. Box 3055, Victoria, B.C. V8W 3P6, Canada.

(c) CHEMOTHERAPEUTICS

**8797 Agbe, S.A.O. and Yielding, K.L., 1993.** Effect of verapamil on antitrypanosomal activity of drugs in mice. [*T. b. brucei* .] *Acta Tropica*, **55** (1-2): 11-19.

Yielding: University of Texas Medical Branch, Galveston, TX 77550, USA.

**8798 Bogaert, I. van and Haemers, A., 1989.** Eflornithine: a new drug in the treatment of sleeping sickness. (Review.) *Pharmaceutisch Weekblad: Scientific Edition*, **11** (3): 69-75. Department of Pharmaceutical Sciences, University of Antwerp, Universiteitsplein 1, B-2610 Antwerp, Belgium. The pathways of polyamine and trypanothione biosynthesis, and the action of eflornithine as an inhibitor of ornithine decarboxylase, are described. Pharmacokinetics and clinical data, tolerance and side effects are briefly reviewed.

- 8799 **Chan, M.M. and Fong, D., 1994.** Plant microtubule inhibitors against trypanosomatids. [Incl. *T. brucei*.] *Parasitology Today*, **10** (11): 448-451.  
Chan: Department of Biological Sciences, Rutgers State University of New Jersey, Piscataway, NJ 08855-1059, USA.
- 8800 **Clement, B., 1989.** Verbindungen zur Behandlung von Trypanosomen-infektionen. [Compounds for the treatment of trypanosome infections.] (Review.) *Pharmazie in unserer Zeit*, **18** (4): 97-111.  
Pharmazeutisches Institut der Universität, Marbacher Weg 6, D-3550 Marburg, Germany.
- 8801 **Craciunescu, D.G., Scarcia, V., Furlani, A., Papaioannou, A., Parrondo-Iglesias, E. and Alonso, M.P., 1991.** Pharmacological and toxicological studies on new Rh(I) organometallic complexes. *In Vivo*, **5** (4): 329-332.  
Institute of Pharmacology and Pharmacognosy, Faculty of Pharmacy, Via Valerio 32, I-34100 Trieste, Italy.
- 8802 **Delmas, F., Gasquet, M., Timon-David, P., Madadi, N., Vanelle, P., Vaille, A. and Maldonado, J., 1993.** Synthesis and *in vitro* anti-protozoan activity of new 5-nitrothiophene oxime ether derivatives. [Incl. *T. brucei*.] *European Journal of Medicinal Chemistry*, **28** (1): 23-27.  
Maldonado: Laboratoire de Chimie Organique, Faculté de Pharmacie, 27 boulevard Jean-Moulin, 13385 Marseille Cedex 5, France.
- 8803 **Gray, M.A., Kimarua, R.W., Peregrine, A.S. and Stevenson, P., 1993.** Drug sensitivity screening *in vitro* of populations of *Trypanosoma congolense* originating from cattle and tsetse flies at Nguruman, Kenya. *Acta Tropica*, **55** (1-2): 1-9.  
Gray: KETRI, P.O. Box 362, Kikuyu, Kenya.
- 8804 **Loiseau, P.M. and Depreux, P., 1994.** Microtubules as therapeutic target in *Trypanosoma brucei brucei* and *Molnema dessetae*: action of 2-(amino-methyl) acrylophenone derivatives. *Tropical Medicine and Parasitology*, **45** (3): 229-231.  
Loiseau: Biologie et Contrôle des Organismes Parasites, Université de Paris-Sud, F-92296 Châtenay-Malabry Cedex, France.
- 8805 **Mutugi, M.W., Boid, R. and Luckins, A.G., 1994.** Experimental induction of suramin-resistance in cloned and uncloned stocks of *Trypanosoma evansi* using immunosuppressed and immunocompetent mice. *Tropical Medicine and Parasitology*, **45** (3): 232-236.  
Mutugi: KETRI, P.O. Box 362, Kikuyu, Kenya.
- 8806 **Nok, A.J., Ibrahim, S., Arowosafe, S., Longdet, I., Ambrose, A., Onyenekwe, P.C. and Whong, C.Z., 1994.** The trypanocidal effect

of *Cannabis sativa* constituents in experimental animal trypanosomiasis. [*T. b. brucei*; rats.] *Veterinary and Human Toxicology*, **36** (6): 522-524.

Nok: Department of Biochemistry, Ahmadu Bello University, Zaria, Nigeria.

8807 **Soliman, M.A., 1990.** Phase-contrast study of the efficacy of Lampit (BAY 2502, nifurtimox) on experimental infection with *Trypanosoma rhodesiense*. [Rats.] *Journal of the Egyptian Society of Parasitology*, **20** (2): 821-826.

Department of Parasitology, Faculty of Medicine, Al-Azhar University, Egypt.

#### 8. trypanosome research

(a) CULTIVATION OF TRYPANOSOMES

(b) TAXONOMY, CHARACTERISATION OF ISOLATES

8808 **Enyaru, J.C.K., Stevens, J.R., Odiit, M., Okuna, N.M. and Carasco, J.F., 1993.** Isoenzyme comparison of *Trypanozoon* isolates from two sleeping sickness areas of south-eastern Uganda. *Acta Tropica*, **55** (3): 97-115.

Stevens: UMR CNRS-ORSTOM 9926, Laboratoire Génétique Moléculaire des Parasites et des Vecteurs, ORSTOM, 911 Avenue Agropolis, B.P. 5045, 34032 Montpellier, France. The study characterised 151 *Trypanozoon* isolates from south-east Uganda by isoenzyme electrophoresis. Stocks were from a range of hosts, including man, cattle, pigs, dogs and *Glossina fuscipes fuscipes*; 104 isolates were from the Busoga area, 47 were from the Tororo district. Stocks were characterised on thin layer starch gel using eight enzyme systems: ALAT, ASAT, ICD, MDH, ME, NHD, NHI, PGM. Enzyme profiles were generally typical of East Africa; new patterns of ICD and ME were detected. Trypanosomes were classified on the basis of their profile by similarity coefficient analysis and the unweighted pair-group method using arithmetic averages (UPGMA). The majority of trypanosomes were classified in one or other of two genetically distinct groups which corresponded to the strain groups *busoga* and *zambezi*, both of which are associated with Rhodesian sleeping sickness in East Africa. Contingency table analyses indicated associations between certain isoenzymes of ICD and PGM, according to host and geographical origin. Significant relationships between trypanosome strain group and geographic origin were also demonstrated for some host groups.

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

[See also **18**: no. 8804.]

- 8809 **Affolter, M., Hemphill, A., Roditi, I., Müller, N. and Seebeck, T., 1994.** The repetitive microtubule-associated proteins MARP-1 and MARP-2 of *Trypanosoma brucei*. *Journal of Structural Biology*, **112** (3): 241-251.  
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- 8812 **Cenas, N., Bironaite, D., Dickancaite, E., Anusevicius, Z., Sarlauskas, J. and Blanchard, J.S., 1994.** Chinifur, a selective inhibitor and 'subversive substrate' for *Trypanosoma congolense* trypanothione reductase. *Biochemical and Biophysical Research Communications*, **204** (1): 224-229.  
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