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# TSETSE AND TRYPANOSOMIASIS INFORMATION QUARTERLY

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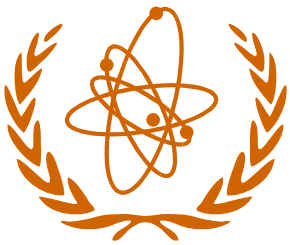


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SECTION B — ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

[See also **16**: no. 7659.]

7626 **ODA Review Panel, 1991**. *Review of livestock research supported by ODA (Natural Resources and Environment Department) during the period 1986-1990* (Report of the Review Panel Meeting, Cambridge, 15-18 January 1991). London; ODA. 24 pp.

ODA, 94 Victoria Street, London SW1E 5JL, UK.

This review was undertaken against a background of policy change to meet the need for improved efficiency and to assess the scientific quality of individual projects. ODA has supported 13 projects on trypanosomiasis, ranging from the mechanism of gene expression in *Trypanosoma brucei* to a survey of the epidemiology of the disease in Indonesia. Trypanosome genetics could lead to a better understanding of VSG with the improvement of drug therapy and prospects for effective vaccines. Work by ILRAD on drug assay and by CTVM on aspects of *T. evansi* and the *in vitro* culture of this species and *T. congolense* were commended. Several projects have concerned the behaviour and physiology of tsetse flies with a view to improving the efficiency of trap design. It is recommended that studies on the *Glossina morsitans* group should now be reduced and more attention be given to *G. palpalis* and *G. fusca*.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

7627 **Feldmann, U., Luger, D., Barnor, H., Dengwat, L., Ajagbonna, B., Vreysen, M.J.B. and Vloedt, A. van der, 1992**. Tsetse fly mass rearing: colony management, deployment of sterile flies, related research and development. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 167-180.

Entomology Unit, Joint FAO/IAEA Division, IAEA Seibersdorf Laboratories, A-2444 Seibersdorf, Austria; ibid.; ibid.; Federal Department of Livestock and Pest Control Services, BICOT, Vom, Plateau State, Nigeria; ibid.; Insect and Pest Control Section, Joint FAO/IAEA Division, IAEA, P.O. Box 100, A-1400 Vienna, Austria; ibid.

Seven tsetse species (*Glossina palpalis palpalis*, *G. tachinoides*, *G. fuscipes fuscipes*, *G. austeni*, *G. brevipalpis*, *G. pallidipes* and *G. morsitans submorsitans*) are maintained at the IAEA Agriculture Laboratory at Seibersdorf, Austria, without host animals and fed exclusively by the membrane technique. Strains of the first five species have been adapted to mass-rearing procedures and are maintained in numbers sufficient to meet the needs for field releases and

laboratory experiments. Topics requiring research and development for the large-scale use of SIT include the simplification and automation of routine colony maintenance. Emphasis has been placed on procedures that offer potential for sex differentiation in pre-adult stages or better synchronisation of adult emergence with minimal overlapping of sexes. The development of methods for extending the duration of the pupal period would increase flexibility in long-distance transport of pupae to SIT projects. Radiation dose response data have been collected for all seven species and the quality of the treated material evaluated. The receptivity of irradiated virgin females to mating has been studied to ascertain their potential use as indicator or sentinel insects for the detection and monitoring of wild male populations existing at low density or being subjected to control measures.

7628 **Warnes, M.L. and Maudlin, I., 1992**. An analysis of supernumerary or B-chromosomes of wild and laboratory strains of *Glossina morsitans morsitans*. *Medical and Veterinary Entomology*, **6** (2): 175-176.
TRL, Langford House, Langford, Bristol BS18 7DU, UK.
The presence of B chromosomes in insects has been associated with lack of fitness. A gradual decline in certain behavioural parameters in the laboratory colony of *G. m. morsitans* at TRL prompted the study of B chromosomes within past and present individuals from this colony and a comparison with a population of wild flies from Zimbabwe. Brain preparations were made from 5-7 day old puparia. Preparations from 398 individuals dissected in 1979 and 100 in 1991 from the laboratory colony and 40 from the wild population were examined under a microscope and B chromosome frequencies compared. Analysis of variance revealed significant differences ($P < 0.001$) between the groups. The proportion of laboratory flies with five or more B chromosomes was 47% in 1979 and 63% in 1991. In contrast, only 17.5% of the wild flies had five or more B chromosomes. The results suggest a progressive reduction in fitness of the laboratory population and that regular back-crossing with wild-collected flies would be advantageous.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY
[See also **16**: no. 7628.]

7629 **Abbeele, J. van den and Decleir, W., 1992**. Study of the vectorial capacity of *Glossina palpalis palpalis* related to

its digestive physiology and rearing conditions. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 91-103.
Laboratory of Biochemistry and General Zoology, State University of Antwerp (RUCA), Groenenborgerlaan 171, B-2020 Antwerp, Belgium.
The digestive physiology of *G. p. palpalis* has been investigated. Various factors such as lectins, trypanolysins, digestive enzymes and possibly others make the midgut environment hostile for ingested bloodstream form trypanosomes. A preliminary *in vivo* study suggests that trypsin activity may be involved in the elimination and/or transformation of bloodstream forms. The purification and partial characterisation of midgut trypsin are described: at least three different enzymes with trypsin activity are present. *In vitro* fed flies seemed able to establish a procyclic midgut infection of *Trypanosoma brucei brucei* more easily than *in vivo* fed flies, but the infection had a lower rate of maturation.

7630 **Gooding, R.H., 1992**. Genetic studies on *Glossina morsitans* and *Glossina palpalis* related to genetic control. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 151-165.
Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3, Canada.
Genetic studies have been carried out on *G. m. morsitans*, *G. m. centralis*, *G. m. submorsitans*, *G. p. palpalis* and *G. p. gambiensis*. Most genetic variants were detected by electrophoretic procedures but five visible markers (*ocra*, *salmon* and *sabr* in *G. m. morsitans*; *tan* and *brick* in *G. p. palpalis*) were also maintained. Fourteen marker genes have been mapped in *G. m. morsitans*, four in *G. m. submorsitans* and two in *G. p. palpalis*. Other biochemical markers have been assigned to autosomes or the X chromosome. Inbred lines were established for mapping four X chromosome genes and four autosomal genes in *G. p. palpalis* for studies of the genetic basis of hybrid male sterility, potential for introgressive hybridisation, sperm use by double-mated females, genetic stability of tsetse colonies and genetics of mating behaviour. It has been established that an X-Y incompatibility is a major factor in the male sterility produced by hybridising *G. m. morsitans* and *G. m. centralis*, *G. m. submorsitans* and *G. m. morsitans*, and *G. p. palpalis* and *G. p. gambiensis*. In subspecies of *G. morsitans* maternally inherited factors create asymmetries in the ability of flies to hybridise. It has been established that some twice-mated females use sperm from both matings but in some cases sperm use is influenced by whether the male is from the same subspecies as the

female: this suggests a severe limitation on the use of satyrs as genetic control agents.

7631 **Hargrove, J.W. and Packer, M.J., 1992**. Fat and haematin contents of male tsetse flies *Glossina pallidipes* and *G. m. morsitans* (Diptera: Glossinidae) caught in odour-baited traps and artificial refuges in Zimbabwe. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 65-89.

TRL, University of Bristol, Langford House, Langford, Bristol BS18 7DU, UK; Papua New Guinea Institute of Medical Research, Madang, Papua New Guinea.

Male *G. morsitans morsitans* and *G. pallidipes* caught in artificial refuges had 27-31% more fat than those caught in traps and mean haematin levels were 6.8-7.7 times higher. A differential equation model for bloodmeal metabolism was developed which removes 99% of the variance in fat levels of male *G. m. morsitans* fed and then starved in the laboratory and 79% of this variance for *G. pallidipes* field data. The model predicts a mean feeding interval (T) of 53 h and fat levels of 3.1 mg in newly fed flies, close to the observed value of 3.2 mg for flies containing more than 150 μg haematin. Haematin frequency data suggested T = 71 h with a 60 h non-feeding phase, but fat levels predicted by simulation were 40% lower than observed. For constant feeding rates, fat levels were well simulated for T = 53 h, but death rates (> 5% per day due to starvation alone) were impossibly high. An alternative model, based on known changes in activities related to feeding, suggests that feeding rates increase linearly during the trophic cycle. For T = 53 h the model gives good predictions of fat levels in *G. pallidipes*, with starvation rates < 1% per day. It is suggested that a proportion of tsetse with high fat and haematin feed off mobile hosts early in the trophic cycle and that over-estimates of T result from the failure to consider these flies.

7632 **Lambremont, E.N. and Taher, M., 1992**. Biosynthesis of lipids in female tsetse flies following matings with radiation-sterilized or normal males. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 105-117.

Nuclear Science Center, Louisiana State University, Baton Rouge, LA 70803-5820, USA; FAO/IAEA Entomology Unit, IAEA Seibersdorf Laboratories, Vienna, Austria.

*Glossina palpalis palpalis* females mated to radiation-sterilised males have a pattern of lipid synthesis identical to those mated normally through nearly all levels of lipid content except one. Synthesis of lipids from injected [$^{14}$C]-1,2-acetate shows no mating

condition correlation for total lipids, total phospholipids, total neutral lipids or for major sub-classes of phospholipids or most neutral lipids. Only the 1,2-diacylglycerols show a distinct depression of synthesis and then only in the uterine gland of a female mated to an irradiated male. Thus, without carrying lipid analyses to a level distinguishing isomeric forms in a specific type of tissue, it was not possible to discern an ultimate difference in the lipid biochemistry of the abnormally mated female.

7633 **Ochanda, J.O., Osir, E.O., Nguu, E.K. and Olembo, N.K., 1992**. Isolation and properties of 600-kDa and 23-kDa haemolymph proteins from the tsetse fly, *Glossina morsitans*: their possible role as biological insecticides. *Scandinavian Journal of Immunology*, **36** (Suppl. 11): 41-47.

Ochanda, Nguu, Olembo: Department of Biochemistry, University of Nairobi, P.O. Box 30197, Nairobi, Kenya; Osir: Biochemistry Laboratory, ICIPE, P.O. Box 30772, Nairobi, Kenya.

The haemolymph of the tsetse fly *G. m. morsitans* contains a high (lipophorin) and a low molecular weight protein of high densities, 1.11 and 1.29 g/ml, respectively. The purification of the proteins was achieved by a combination of density gradient ultracentrifugation and reported gel permeation chromatography. The lipophorin is of high molecular weight ($M_r \simeq$ 600,000) and consists of two apoproteins, apolipophorin I ($M_r \simeq$ 250,000) and apolipophorin II ($M_r \simeq$ 80,000), both of which are glycosylated. Lipophorin also has a pI of 6.1. However, electrophoresis under non-denaturing and denaturing conditions showed the low molecular weight protein to be a single polypeptide chain ($M_r \simeq$ 23,000). Amino acid analysis revealed a relatively high content of the amino acids as well as serine and glycine. The protein contained lipids as shown by Sudan Black staining but was unglycosylated. Using rabbit antiserum against the isolated protein in immunodiffusion and immunoblotting experiments, no cross-reactivity was detected with haemolymph samples from insects representing six orders. In conclusion, the finding of lipophorin suggests that, although flies primarily utilise proline for their energy needs, there is an active transport mechanism for the supply of lipid requirements. However, the results for the low molecular weight protein indicate that the protein is unique to *Glossina*, suggesting that it may have an important role in the physiology of this insect and is therefore a significant target for vector management.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **16**: nos. 7658, 7661, 7689.]

7634 **Gouteux, J.P., Sinda, D. and Forest, H. de, 1991**. Répartition et écodistribution de *Glossina frezili* (Diptera: Glossinidae) au Congo. [Geographical and ecological distribution of *G. frezili* in the Congo.] *Annales de la Société entomologique de France*, **27** (4): 483-494.

Centre ORSTOM, B.P. 893, Bangui, Central African Republic; Centre DGRST-ORSTOM, B.P. 181, Brazzaville, Congo; Antenne ORSTOM au BIOTROP, P.O. Box 17, Bogor, Java, Indonesia.

The distribution of *G. (Nemorhina) frezili* was studied in 1987-88 on the coastal region of the Congo where it was recently discovered. Flies were caught at 58 sites in pyramidal traps over periods of a few days to 3 months. The study confirmed the very restricted distribution of this species in the Congo. It is confined to a strip 5 km long and less than 1 km wide between Bas-Kouilou and Madingo-Kayes (4□29⌠-4□27⌠S and 11□41⌠-11□42⌠E) where it is concentrated on some hundreds of metres of extremely varied vegetation (dry littoral forest, swamp forest and mangroves). Ecodistribution studies showed that *G. frezili* is the dominant species in littoral forest, with strong concentrations at ecotones between littoral forest and swamp forest bordering on mangroves. In contrast, *G. tabaniformis* is the dominant species in swamp forest and it is suggested that the presence of this species plays a role in the geographical restriction of *G. frezili*. A palaeobiogeographical hypothesis on the evolution of the morphologically very similar *G. medicorum* and *G. frezili* from a relatively xerophilic ancestral species is discussed.

7635 **Hargrove, J.W. and Brady, J., 1992**. Activity rhythms of tsetse flies (*Glossina* spp.) (Diptera: Glossinidae) at low and high temperatures in nature. *Bulletin of Entomological Research*, **82** (3): 321-326.

Tsetse and Trypanosomiasis Control Branch, Department of Veterinary Services, Harare, Zimbabwe; Imperial College, Silwood Park, Ascot, Berks SL5 7PY, UK. (Correspondence to Brady.)

*Glossina morsitans morsitans* and *G. pallidipes* were caught hourly on electric nets from dawn to dusk in the Zambesi Valley, Zimbabwe, in cold and hot weather. When middle of the day temperatures reached only 24□C, activity of *G. morsitans* was at a low level from dawn to early afternoon but then rose to a dusk peak (most marked in

males); *G. pallidipes* behaved similarly, but showed almost no activity before noon. When dawn temperatures rose above *c*. 24□C (and afternoon temperatures above 38□C) the evening peak disappeared, to be replaced by a peak at dawn (and with almost no activity occurring through the rest of the day). This reversal of the more usual field activity pattern of late afternoon maxima reveals that the positive correlation between activity level and temperature at dusk breaks down above *c*. 33□C, although the earlier conclusion that the typical U-shaped activity pattern of tsetse flies is mainly driven by endogenous timing is still valid for moderate temperatures.

7636 **Oloo, F.P., 1992**. Comparison of baited and unbaited NGU and biconical traps for *Glossina pallidipes* and *G. longipennis* and the contribution of odour combinations in Nguruman, Kajiado District, Kenya. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 233-241.

Veterinary Research Laboratory, Ministry of Livestock Develop-ment, P.O. Kabete, Nairobi, Kenya.

The efficiency of baited and unbaited NGU and biconical traps for catching *G. pallidipes* and *G. longipennis* was compared. Different combinations of acetone (dispensed at 150 mg/h), cow urine (1000 mg/h) and 1-octen-3-ol (20 mg/day) were employed as odour attractants, used singly and in pairs. The NGU trap was more effective than the biconical trap, especially when its relative cheapness and simplicity are considered. Both the NGU and biconical traps improved catches 8-11 times when baited. Cow urine and acetone appeared to be the most effective odour pair for *G. pallidipes*, the odours acting either synergistically or supplementarily. They contributed to over 90% of the total catch. The results were similar for *G. longipennis* but at a lower level. Taken individually, cow urine was the dominant odour attractant for *G. pallidipes*, being responsible for nearly 60% of the catch. For *G. longipennis* 1-octen-3-ol appeared dominant but with a lower margin.

7637 **Randolph, S.E., Williams, B.G., Rogers, D.J. and Connor, H., 1992**. Modelling the effect of feeding-related mortality on the feeding strategy of tsetse (Diptera: Glossinidae). *Medical and Veterinary Entomology*, **6** (3): 231-240.

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

Free-living haematophagous insects risk death through host grooming responses or through increased susceptibility to predation whenever they take a bloodmeal. The effects of these risks on the feeding

strategy of tsetse have been investigated. A model is presented that allows for death of tsetse by starvation if they do not succeed in feeding within a fixed time (set at 6 days in the first instance) and for mortality specifically associated with feeding. In addition there is background mortality that applies to all flies at all times. The model is used to compute the individual life-time fertility (number of female puparia per female) as a function of the probability of obtaining a meal (indicated by field data to be very high, usually > 0.85 per day) and the day on which flies start to search for a meal. It is suggested that the feeding strategy that would be selected for is that which allows the maximum reproductive output. The model shows that this strategy involves making no attempts to feed for 3-4 days after the previous meal and then attempting to feed with the greatest possible probability until a meal is obtained. The predicted feeding interval, obtained independently of any trapping data, agrees closely with all previous estimates from field studies using a variety of methods. Preliminary results from a laboratory experiment reveal an increased risk of predation of recently fed as compared with hungry tsetse. The lower the actual feeding mortality the more frequently will flies be able to feed should conditions so demand. It is adaptive, however, for tsetse to delay attempting to feed for as long as they can, which is made possible by the near certainty of locating and feeding on a host within 1 day, using their sophisticated sensory systems.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

[See also **16**: nos. 7630, 7666.]

7638 **Allan, G.G., Allan, R.G., Carroll, J.P. and Neogi, A.N., 1992**. Simple creation of controlled release formulations of insecticides by a polymeric spray tank additive. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 197-204.

Department of Chemical Engineering and College of Forest Resources, University of Washington, Seattle, WA 98195, USA.

The mechanisms whereby sprayed insecticides are rendered biologically inactive are identified and the diminution of these effects by dissolution of the pesticide in a polymeric matrix is discussed. The problems of the controlled release delivery system so created are analysed in terms of its decreasing concentration of pesticide with time. The theory of a

proposed method to circumvent the laws of diffusion by dissolving the polymer in the insecticide, rather than *vice versa*, and the addition of a bioinactive co-leaving component is explained. The practicality of this new concept is demonstrated by the creation of a simple spray tank additive which forms a constant rate, polymeric, controlled release delivery system on the substrate sprayed. This method should be applicable to the improved chemical control of the tsetse fly and may permit the application of insecticides currently not being considered because of their fugitive characteristics or cost.

7639 **Biwi, K.M., 1992**. Trypanosomiasis control and eradication of *Glossina austeni* from Zanzibar using an integrated approach. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 211.

Department of Livestock Development, Veterinary Office, P.O. Box 159, Zanzibar, Tanzania.

The eradication of *G. austeni* from Unguja Island, Zanzibar, appears feasible by using an integrated approach. Cattle treated with a 1% deltamethrin pour-on oil formulation combined with drug treatment of infected animals was successful in some grazing areas. Where other tsetse hosts are present or where cattle are absent, stationary targets impregnated with alphacypermethrin 10% e.c. were effective in reducing tsetse populations. When these methods alone do not result in tsetse eradication, they may be reinforced by SIT. Studies on the transportation and deployment of sterile flies and on the population structure of *G. austeni* have recently commenced.

7640 **Chadenga, V., 1992**. Tsetse and trypanosomiasis control in Zimbabwe. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 205.

Tsetse and Trypanosomiasis Control Branch, Department of Veterinary Services, P.O. Box 8783, Causeway, Zimbabwe.

Zimbabwe has achieved significant progress in tsetse and trypanosomiasis control, with a total of 48,000 $km^2$ being cleared of tsetse since 1980. Planned human settlement of the cleared areas, with the introduction of cattle to provide much-needed traction power, has increased agricultural production. Tsetse flies are now confined to an area of 25,000 $km^2$ along the Zambezi Valley. Several strategies for tsetse control are being used. Odour-baited insecticide-impregnated targets, used at a density of four targets per $km^2$, have been found to be extremely effective against the

species of tsetse found in Zimbabwe.

7641 **Desquesnes, M., 1990**. Note sur des essais d'immunisation de lapins contre des tsé-tsé, *Glossina fuscipes fuscipes* (Diptera: Glossinidae). [Note on attempts to immunise rabbits against tsetse flies, *G. fuscipes fuscipes*.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **43** (4): 511-513.
Institut Pasteur, 97300 Cayenne, France.
Attempts were made to immunise rabbits against tsetse flies by injecting them with homogenised guts or crops of *G. fuscipes fuscipes*, together with Freund's complete or incomplete adjuvant. The effect of the inoculations was assessed by monitoring the mortality and reproductive performance of flies which were fed on the rabbits. The results showed a small but statistically significant increase in mortality in flies fed on immunised rabbits when compared with control flies.

7642 **Höreth-Böntgen, D.W., 1992**. Control of *Glossina austeni* and cattle trypanosomiasis in Unjuga [Unguja] Island by deltamethrin pour-on application to livestock and with stationary targets in cattle-free zones. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 213-218.
FAO Animal Disease Control Project, Zanzibar, Tanzania.
The sequential topical application of deltamethrin to cattle, goats and donkeys is being used as part of a large-scale project aimed at the complete eradication of *G. austeni* from Unguja Island, Zanzibar. A pour-on formulation of deltamethrin acaricide (Spoton) was applied at a dose rate of 10 ml/100 kg bodyweight. Five applications were made at intervals of 2 weeks followed by two more at 3 week intervals. *G. austeni* population density was assessed before and during treatment by the use of sticky panels and the animals were monitored for trypanosomiasis. Four different control blocks were established in addition to the pilot trial area at Mangapwani. The number of treated animals ranged from nine to 28 per $km^2$, at least double the density used with stationary targets. *G. austeni* appears to have been successfully controlled in all areas except one, where low level populations persisted as a result of fly invasion from the nearby Jozani Forest. Cloth screens impregnated with 0.05% alphacypermethrin were placed at 200 m intervals along transects 100 m apart in the forest and fly catches declined markedly within 3 weeks.

7643 **Hussain, M. and Perschke, H., 1992**. A study of factors affecting the persistence of deltamethrin applied to cotton fabric for tsetse fly control. *In*: IAEA, 1992

(see **16**: no. 7644), pp. 183-190.
FAO/IAEA Agrochemicals Unit, IAEA Seibersdorf Laboratories, A-2444 Seibersdorf, Austria.
The effect of selected lipophilic materials on the loss of deltamethrin applied to cotton fabric and washed with water was studied. Corn oil, paraffin, linseed oil and silicone oil were most effective in reducing the leaching of deltamethrin from the fabric. The cumulative sum of four washings of treated cotton strips resulted in a total loss of 37.7% of deltamethrin from the strip without protectant and 9.9% from the strip treated with corn oil. Corresponding figures for paraffin (mp 52□C), linseed oil, silicone oil and paraffin (mp 42□C) were 11.8%, 11.3%, 13.6% and 14.2% respectively. Cetyl and stearyl alcohols were not so effective, resulting in losses of 27.3% and 29.2% of deltamethrin respectively. Photodegradation was much less on blue or black fabric than on white fabric, and 2,4-dihydroxy-benzophenone (a UV absorber compound) reduced the photodegradation of deltamethrin applied to cotton fabric.

7644 **International Atomic Energy Agency, 1992**. *Tsetse control, diagnosis and chemotherapy using nuclear techniques* (Proceedings of a Seminar jointly organised by the International Atomic Energy Agency and the Food and Agriculture Organization of the United Nations and held in Muguga, Kenya, 11-15 February 1991). Vienna, Austria; IAEA. (IAEA-TECDOC-634.) 259 pp.
IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.
Abstracts of the 40 papers presented at this seminar are included in this issue of *TTIQ* (nos. 7627, 7629-7632, 7636, 7638-7640, 7642, 7643, 7645, 7647-7653, 7656, 7657, 7660, 7667, 7671, 7688-7694, 7711-7716, 7723-7725). The main focus was on recent advances in the use of nuclear techniques for the control of tsetse-transmitted trypanosomiasis. The seminar consisted of five sessions: the diagnosis of animal trypanosomiasis; chemotherapy; tsetse biology, ecology and vectorial capacity; control using genetics and SIT; and control by trapping, use of targets and community participation. Overall summaries are presented for each session. The development of practices for area-wide tsetse eradication or control with emphasis on suppressive techniques and SIT continues to be of major importance. It is recommended that more strategically sited mass-rearing centres be established where sterile flies could be used across state borders in the most

cost-effective way. Important research topics recommended for more in-depth study include tsetse population genetics and reproduction biology.

7645 **Langley, P.A., Mauchamp, B., Royer, C. and Oouchi, H., 1992.** The durability of pyriproxyfen, a juvenile hormone mimic, for insect control. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 143-150.

TRL, University of Bristol, Langford House, Langford, Bristol BS18 7DU, UK; Laboratoire de Physiologie de l'Insecte, INRA, Versailles, France; ibid.; Sumitomo Chemical Company, Osaka, Japan.

Topical applications of the juvenile hormone mimic, pyriproxyfen, to adult female *Glossina morsitans morsitans* resulted in the production of offspring which failed to metamorphose. Exposure by tarsal contact to netting surfaces treated with an oil formulation of radiolabelled pyriproxyfen resulted in adult female *G. m. morsitans* producing non-viable pupae for life. Netting stored under laboratory conditions showed no sign of loss or degradation of pyriproxyfen for 8 months. Similar netting exposed to natural conditions in the field in Zimbabwe also showed no signs of degradation or loss of the original amount of pyriproxyfen with which it was treated. The prospects of using pyriproxyfen as a safe substitute for conventional insecticides are promising.

7646 **Langley, P.A., Perschke, H. and Hussain, M., 1992.** Oil formulation of pyrethroids for contamination of tsetse flies (*Glossina* spp.) through tarsal contact with treated targets. *Pesticide Science*, **35** (4): 309-313.

TRL, Langford House, Langford, Bristol BS18 7DU, UK; Agrochemicals Unit, Joint FAO/IAEA Programme, IAEA Laboratories, A-2224 Seibersdorf, Austria; ibid.

Mosquito netting side panels of targets used for tsetse control were treated with lambda-cyhalothrin, either dissolved in a mixture of acetone and a chloro-hydrocarbon oil, `Cereclor' (ICI, UK), or as a conventional w.p. formulation suspended in water. Treated netting samples were weathered under natural conditions in full sun in Zimbabwe. Following brief tarsal contact of test insects (adults of *Glossina morsitans morsitans*) with treated netting, the w.p. induced 100% knockdown for 4 months after treatment but 24 h mortality levels were reduced from the third month onwards. The oil formulation induced 100% knockdown for up to 10 months following treatment and 100% mortality at 24 h for up to 8 months. Chemical assay showed that after 2 months there had been a rapid

reduction in the amount of active ingredient to only 20% of that applied using the w.p., whereas the oil formulation took 7 months to fall to this level. Provided that at least 5% of the original amount of pyrethroid remained on the fabric it was quite effective and the superiority of the oil formulation was further enhanced by the observation that the starting concentration was only 25% of that of the w.p.

7647 **Matechi, H.T., Maeda, D.N., Macha, P.S.M., Mbise S.R. and Sikay, M., 1992**. Development of controlled release formulations of pesti-cides using nuclear techniques for the control of tsetse flies. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 195.
Tropical Pesticides Research Institute, P.O. Box 3024, Arusha, Tanzania.
The efficiency of controlled release formulations for tsetse control has been tested. Strips of cotton fabric impregnated with $^{14}$C-labelled deltamethrin formulations, some containing oils, UV light absorber (Glossinex) or both, were tested at 2-3 week intervals for about 6 months. Tsetse flies were bioassayed to determine which formulations had the longest residual toxicity and the amount of radioactivity left in the strips was also determined. Total radioactivity and fly mortality decreased with time, the decrease being most rapid on unprotected strips or those containing oil. Strips containing UV light absorber also had high losses of radioactivity but retained high mortality up to day 175. Strips containing both oil and UV light absorber performed best, with 85% mortality and radioactivity loss of 41% on day 175, by which time all the other strips had lost more that 75% of their radioactivity.

7648 **Mohamed-Ahmed, M.M., Otieno, L.H. and Muchuri, J., 1992**. An evaluation of the suppression of *Glossina pallidipes* by the odour-baited insecticide-coated targets in the Lambwe Valley, Kenya. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 251.
Tsetse Research Programme, ICIPE, P.O. Box 30772, Nairobi, Kenya.
Odour-baited insecticide-coated targets have been maintained every 3 months in the Ruma National Park, Lambwe Valley, Kenya, since August 1988. The effect on populations of *G. pallidipes* was assessed by monthly sampling from January to December 1990. Monthly reduction rates in absolute and apparent densities varied between 96.5% and 99%, respectively. The highest reductions occurred consistently during the

first month following target maintenance. Both sexes of all age groups persisted throughout and mark-release-recapture studies showed that flies could mate, reproduce and survive over two successive target maintenance occasions. Therefore, although a relatively high rate of tsetse suppression took place, total eradication was not achieved.

7649 **Molyneux, D.H. and Stiles, J.K., 1992**. Effect of irradiation on tsetse flies. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 127.

Liverpool School of Tropical Medicine, Pembroke Place, Liverpool L3 5QA, UK; Department of Biological Sciences, University of Salford, Salford M5 4WT, UK.

Irradiation of *Glossina* spp. at doses used in SIT was found to damage the midgut, causing changes in peritrophic membrane structure, a reduction in lectin and lysin secretion and the inhibition of protease production, creating conditions for the enhanced growth of trypanosomes. Major differences in the biochemical profiles of *G. palpalis palpalis* and *G. p. gambiensis* with respect to midgut lectins and lysins show the former to be refractory to *Trypanozoon*. The vectorial capacity of target species must therefore be precisely assessed and the cost-effectiveness of inputs in relation to control benefits evaluated.

7650 **Ogwal, L.M., Kangwagye, T.N., Semakula, L., Ndyabahika, C. and Esiru, P., 1992**. Tsetse and trypanosomiasis control for the rural development of Buvuma Island, Lake Victoria, Uganda. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 247.

Department of Zoology, Makerere University, P.O. Box 7062, Kampala, Uganda; Tsetse Control Department, Ministry of Animal Industry and Fisheries, Kampala, Uganda; ibid.; ibid.; ibid.

Tsetse infestation of the Lake Victoria area of Uganda has restricted human settlement and severely limited the development of the livestock industry. The Busoga region including Buvuma Island is one of the most heavily affected areas. *Glossina fuscipes fuscipes* has recently been shown to be the main vector on the island, where it has become peridomestic. Intensive tsetse surveys have been carried out since 1987-88. Using 20-25 pyramidal traps impregnated with deltamethrin at a rate of 400 mg/trap for 20-22 days/month, tsetse populations around reference villages were reduced by 90-95% after 7-9 months. Studies are being carried out to evaluate insecticide treatment of domestic livestock and the feasibility of

mass rearing of *G. f. fuscipes* for SIT.

7651 **Opiyo, E.A. and Omuse, J.K., 1992**. Experience with odour baited insecticide impregnated targets for control of tsetse flies in Kenya. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), pp. 191-192.

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

Field trials using odour-baited deltamethrin-impregnated targets were carried out in Kenya to assess the effectiveness of this method as an additional trypanosomiasis control strategy and to involve the local communities in tsetse control. At Galana Ranch targets baited with acetone and octenol were deployed at four per $km^2$ in riverine bush spanning the Galana River. Tsetse density was assessed using unbaited biconical traps for 3 weeks prior to installation and thereafter at 3 week intervals. A 99.95% reduction in trap catches was recorded in most areas. *Glossina pallidipes*, the major vector, was the first to be affected, followed by *G. austeni*; *G. longipennis* persisted. In the Lambwe Valley, where *G. pallidipes* is the only vector, targets baited with acetone, octenol and cow urine were installed in the Ruma National Park. The central area has remained free of flies for 2 years after the targets were installed whereas those sited near the borders have continued to catch reinvading flies; an overall reduction of 99.96% in trap catches was recorded. The incidence of trypanosomiasis in cattle decreased markedly as a result of both trials.

7652 **Opiyo, E.A., Omuse, J.K., Hussain, M. and Kiragu, J., 1992**. Field testing of improved insecticide formulation for control of tsetse using baited targets. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 193.

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

A field trial to assess the persistence of insecticide in impregnated blue cloth strips was begun in the Lambwe Valley, Kenya, in October 1990. Samples of cloth are taken every 20 days and subjected to chemical analysis and bioassay using teneral *Glossina morsitans*. All flies that came into contact with samples taken on days 0, 20 and 40 died but after varying intervals. Observations are continuing.

7653 **Phillemon-Motsu, T.K., 1992**. Activities of the tsetse control unit, Botswana. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), pp. 243-244.

Division of Tsetse Fly Control, Department of Animal Health, Ministry of Agriculture, Private Bag 32, Gaborone, Botswana.

The Okavango Delta is the major tsetse habitat in

Botswana, which is at the extreme southern limit of the African tsetse belt. Odour-baited traps and chemically-impregnated targets are unfortunately both ineffective and impractical in Botswana. *Glossina morsitans*, the only species present, inhabits more open country and relies more on sight and movement than on odour attractants and so is less liable to enter traps than riverine species. The deployment of traps in the large areas involved would also be impractical. Control has therefore depended on the aerial application of non-persistent insecticides, namely endosulfan and an endosulfan/pyrethroid cocktail. Spraying trials with fixed-wing aircraft were begun in 1972-73 but eradication was not achieved until 1977 when 3000 $km^2$ of the south-eastern part of the Delta were cleared. Due to limited funds and the extent of the fly belt, total eradication has not been possible. Instead annual spraying campaigns are carried out by the Division of Tsetse Fly Control in an attempt to obtain a major reduction in tsetse populations.

7654 **Thomson, J.W. and Wilson, A., 1992**. A review of developments in tsetse fly (*Glossina* spp.) control by application of insecticide to cattle. *Bulletin of Animal Health and Production in Africa*, **40** (1): 1-4.

Department of Veterinary Services, P.O. Box 8012, Causeway, Zimbabwe; Cooper (Zimbabwe) Ltd, P.O. Box 2699, Harare, Zimbabwe.

The use of deltamethrin applied directly to cattle as a means of controlling tsetse flies is reviewed. The results of some experimental studies and field trials are summarised. Limited work on alphacypermethrin and flumethrin indicates that they are less effective than deltamethrin. This method has ecological, social and economic advantages over other control methods. It is suggested that cattle treated with chemoprophylactic drugs and deltamethrin could be introduced into tsetse infested areas and used, in conjunction with baited traps in non-grazed areas, to control tsetse in previously unexploited regions. While the density of both cattle and tsetse flies will affect the time required for eradication, it is considered that one to four cattle per $km^2$ could be sufficient to achieve control within 12 months.

7655 **Thomson, J.W. and Wilson, A., 1992**. The control of tsetse flies and trypanosomiasis by the application of deltamethrin to cattle. *Bulletin of Animal Health and Production in Africa*, **40** (1): 5-8.

Department of Veterinary Services, P.O. Box 8012,

Causeway, Zimbabwe; Cooper (Zimbabwe) Ltd, P.O. Box 2699, Harare, Zimbabwe.
An extensive field trial was undertaken in a 2500 $km^2$ area in north-east Zimbabwe from January 1986 to June 1988 to assess the efficacy of deltamethrin cattle dip to control tsetse. There was a high and rising incidence of typanosomiasis in the area and at the time of the trial no other tsetse control methods were being used. Thirteen dip tanks in the area serving 20,000 head of cattle were cleaned and refilled with 0.00375% deltamethrin (Decatix) and 80-90% of the cattle were dipped at fortnightly intervals. As a result trypanosomiasis was eliminated from most of the trial area and was reduced to a low level where there was tsetse reinvasion pressure over the border with Mozambique. This method is recommended as a simple, effective and cheap method of tsetse control. In this trial, which utilised a pre-existing dipping infrastructure, the cost of insecticide was US $45 per $km^2$, compared with over US $500 per $km^2$ for aerial spraying and US $200 per $km^2$ for ground spraying.
7656 **Tikubet, G., 1992**. Integrated tsetse management in southwestern Ethiopia. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), pp. 207-208.
Biology Department, Addis Ababa University, P.O. Box 1176, Addis Ababa, Ethiopia.
The utilisation of tsetse-infested areas with high agricultural potential is a major priority in Ethiopia. In order to try and overcome the constraints caused by trypanosomiasis, farms and settlement schemes initially relied heavily on mechanised cultivation but maintenance problems have required a shift to more traditional systems of agriculture depending on animal traction power. A research programme has been initiated to develop a practical tsetse management model which combines cost effective tsetse control, strategic drug use and environmentally sound land use. Improved methods of tsetse control include NGU traps baited with acetone and cow urine and biconical traps baited with cow urine, hippo dung, octenol, pig urine and acetone. A new trap design, the tetra trap, baited with cow urine, acetone and a 4:8:1 mixture of octenol, methyl phenol and propyl phenol, was tested against NGU and biconical traps and found to be more efficient.
7657 **Vreysen, M.J.B., Mramba, F. and Khamis, I., 1992**. Laboratory and field observations in relation to the release of sterile *Glossina austeni* on Unjuga [Unguja] (Zanzibar) Island. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 219-

230.
Insect and Pest Control Section, Joint FAO/IAEA Division, IAEA, P.O. Box 100, A-1400 Vienna, Austria; TTRI, P.O. Box 1068, Tanga, Tanzania; Tsetse Control Unit, Department of Livestock Development, P.O. Box 159, Zanzibar, Tanzania.
Radiation treatment of male *G. austeni* had no detectable effect on viability, insemination potential or competitiveness. A total of 22,563 sterile males was transported from Tanga to the Jozani Forest, Unguja Island, under two different release schedules. On average, 91.6% of the males transported were released. Direct transport and release in the morning (average transport time 2.5 □ 0.5 h) was superior (release rate of 94.7%) to transport in the evening and release the following morning (release rate of 85.8%). Pre-release studies in the northern Jozani Forest demonstrated the efficiency of the sticky panel as a monitoring device for the collection of baseline data on apparent densities and age structure of the *G. austeni* population. Sterile female *G. austeni* were also released in the middle of the experimental block to test their usefulness as tracer insects. Treated females recaptured 5 or more days after release were all found to have been inseminated by wild males.

7658 **Williams, B., Dransfield, R. and Brightwell, R., 1992**. The control of tsetse flies in relation to fly movement and trapping efficiency. *Journal of Applied Ecology*, **29** (1): 163-179.
Department of Zoology, University of Oxford, South Parks Road, Oxford OX1 3PS, UK; ICIPE, P.O. Box 30772, Nairobi, Kenya; ibid.
The control of tsetse fly populations using traps or targets depends on the movement patterns of the flies, which determines how many flies find the traps, and on the efficiency of the traps, which determines the proportion of these flies that are killed. Models have been developed to predict population loss rates under various trapping regimes. The parameters in the models are the range of attraction of the traps, the mortality rate imposed by the traps, the rate at which the flies diffuse through an area, the fly population growth rate and the distribution of the traps or targets. Analytical results are derived for two limiting cases: very mobile flies and inefficient traps; relatively immobile flies and very efficient traps. If the flies are very mobile and the traps relatively inefficient, the rate at which the fly population is reduced is

limited by the range of attraction, the trapping mortality rate and the population growth rate; if the flies are relatively immobile and the traps very efficient, the rate of reduction is limited by the mobility of the flies and the population growth rate. The actual situation will lie within these limits. Numerical simulations are used to test the validity of the analytical results. Data from field studies in Africa are used to test the predictions of the models and to confirm their validity. The efficiency of barriers constructed from lines of traps or targets depends on the width of the barrier, the mobility of the flies and the mortality rate within the barrier. The distance beyond the range of attraction of a trap over which the trap will reduce the fly population density significantly is calculated. The relationship between trap catches and population densities is investigated and the factors that affect the calibration of traps as sampling devices for the two limiting cases are determined. The rate at which a fly front will advance into country cleared of or previously unoccupied by flies is investigated and an explanation is provided for observations regarding the relatively slow rate at which fly fronts advance. Extending the models to inhomogeneous habitats and combining them with knowledge of tsetse biology and information on climate and vegetation should make it possible to predict spatial and seasonal changes in tsetse fly densities and so provide a sound basis for planning tsetse control operations.

7659 **World Wildlife Fund, 1987**. *Tsetse fly eradication in Africa*. Gland, Switzerland; WWF International. 16 pp. (WWF Position Paper, Autumn 1987.)

WWF International, 1196 Gland, Switzerland.

Large-scale tsetse eradication projects may cause environmental damage and usually lead to uncontrolled settlement and widespread land degradation, especially in areas of marginal agricultural potential or special ecological significance. The WWF recommends that tsetse eradication should not be undertaken in such areas as an independent activity but only within the context of rational land management. In particular it recommends that the agricultural potential of land outside fly belts should be examined first; that full and specific consideration should be given to methods minimising the effects of eradication; that priority should be given to sustainable land management and alternative means of controlling trypanosomiasis; and

that genuine efforts to achieve effective land management should not be allowed to fail through lack of funding. Multispecies wildlife utilisation is seen to be a primary land use option in many tsetse infested areas. Past and present methods of tsetse control are reviewed.

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

[See also **16**: nos. 7629, 7649, 7731.]

7660 **Djiteye, A., Bauer, B., Vloedt, A. van der, Feldmann, U. and Vreysen, M.J.B., 1992**. Vectorial capacity of *Glossina palpalis gambiensis* after combined radiation and low temperature treatment during the late pupal stage. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), pp. 123-125. Laboratoire Central Vétérinaire, B.P. 2295, Bamako, Mali; CRTA, Bobo-Dioulasso, Burkina Faso; Joint FAO/IAEA Division of Nuclear Techniques in Food and Agriculture, IAEA, P.O. Box 100, A-1400 Vienna, Austria; ibid.; ibid.

Late-stage *G. p. gambiensis* pupae (25, 28 or 30 days after larviposition) were exposed to a combined regime of γ-irradiation and low temperature (15□C for 5 days before or immediately after irradiation). After emergence, male flies were allowed to feed on animals infected with *Trypanosoma vivax*, *T. congolense* or *T. brucei brucei*. *T. vivax* infected flies were dissected from day 10 and *T. congolense* and *T. b. brucei* infected flies were dissected from days 20 and 25 onwards. Irradiated (100 Gy on day 30) flies had infection rates of 71.2% (*T. vivax*, non-teneral flies), 58.2% and 64.8% (*T. congolense*, teneral and non-teneral flies respectively) and 35.7% and 34.1% (*T. b. brucei*, teneral and non-teneral flies respectively). Corresponding figures for flies which had received low temperature treatment alone were 87.8%, 71.3% and 54.2%, and 77.0% and 44.9%. For flies which had received combined low-temperature treatment and irradiation (80 or 100 Gy on day 30), the figures were 96.8% and 95.7% (*T. vivax*, teneral and non-teneral flies respectively), no data for *T. congolense*, and 62.7% and 44.4% (*T. b. brucei*, teneral and non-teneral flies respectively). Controls showed infection rates of 98.9% and 97.9%, 77.5% and 34.7%, and 91.1% and 54.7% respectively.

7661 **Gouteux, J.P., D'Amico, F., Kounda Gboumbi, J.C., Noutoua, L. and Bailly, C., 1992**. *Glossina fuscipes fuscipes* and *Glossina palpalis palpalis* as joint vectors of sleeping sickness in the focus of Nola-Bilolo in the Central African Republic. *Acta*

*Tropica*, **51** (2): 163-166.
Centre ORSTOM, B.P. 893, Bangui, Central African Republic; ibid.; DMPGE, Bangui, Central African Republic; ibid.; ibid. (Correspondence to Gouteux.)
The Nola-Bilolo or Sangha-M'Baere focus of human *gambiense* trypanosomiasis is the largest in the Central African Republic and is currently reviving. In January 1991 109 new cases were notified and 836 suspected cases were identified with Testryp CATT. From four to 15 bipyramidal traps were deployed for 10-25 days at each of 11 villages in the focus during January-March 1991 at the end of the dry season. The examination of male fly genitalia showed that both *G. p. palpalis* and *G. f. fuscipes* were present in the focus with the interspecies frontier passing through the villages of Anam and Domissili, where both species coexist. A screening survey showed both species to be effective vectors of sleeping sickness, and their vectorial capacities did not appear to be significantly different. The presence of *G. p. palpalis* from Nola to Siembo is thought to represent a relict population. This species favours coffee plantations whereas *G. f. fuscipes* prefers the presence of water: man-fly contact points therefore differ according to species, at least during the dry season.

7662 **Guedegbe, B., Verhulst, A., Meirvenne, N. van, Pandey, V.S. and Doko, A., 1992**. Indications sérologiques de l'existence d'un réservoir sauvage du *Trypanosoma brucei gambiense* dans la réserve de la biosphère de la Pendjari en République du Benin. [Serological evidence of the existence of wild animal reservoirs of *T. b. gambiense* in the Pendjari national park, Benin.] *Annales de la Société belge de Médecine tropicale*, **72** (2): 113-120.
Services de Production Animale et de Sérologie, Institut de Médecine Tropicale, Nationalestraat 155, B-2000 Antwerp 1, Belgium. (Correspondence to Pandey.)
In the national park of Pendjari, situated in the north-west of Benin, 91 wild animals, belonging to seven species, were darted. Thick and thin blood smears were examined for trypanosomes, and plasma for trypanolytic antibodies against six antigenic variants of *T. b. gambiense*. Parasites were found in 13.92% and trypanolytic antibodies in 20.88% of the samples. A total of 28.57% of animals were positive by at least one of the two test systems used. Morphologically *T. congolense*, *T. vivax* and *T. brucei* were identified. Overall prevalence was 40% in *Adenota kob* (n = 50), 13.63% in *Alcelaphus buselaphus* (n = 22), 10% in *Hippotragus equinus* (n =

10), 33% in *Kobus defassa* (n = 3), and 0% in *Phacochoerus aethiopicus* (n = 3) and *Syncerus caffer* (n = 2). The only lion (*Panthera leo*) examined was serologically positive. The results indicate that these wild animals are reservoirs of animal trypanosomes and suggest that among them *Adenota kob* and *Panthera leo* are carriers of *T. b. gambiense*, one of the etiological agents of human trypanosomiasis.

7663 **Kazadi, J.M.L., Hees, J. van, Jochems, M. and Kageruka, P., 1991**. Etude de la capacité vectorielle de *Glossina palpalis gambiensis* (Bobo Dioulasso) vis-à-vis de *Trypanosoma brucei brucei* EATRO 1125. [Study of the vectorial capacity of *G. p. gambiensis* (Bobo Dioulasso) for *T. b. brucei* EATRO 1125.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (4): 437-442.

Department of Animal Health, Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp 1, Belgium.

A total of 440 teneral *G. p. gambiensis* received one single bloodmeal on a guinea pig infected chronically with *T. b. brucei* EATRO 1125. Metacyclic infections were present in 11.29% of the flies; in 2.32% infections were limited to procyclic stages. No significant difference in vectorial capacity was observed between male and female flies, the level of metacyclic infections being 13.19% in the former and 9.55% in the latter. The parasitaemia level, the percentage of stumpy forms at the moment of the blood meal and fly maintenance conditions seemed to influence the infection of the flies.

7664 **Mattioli, R.C., Jean, O. and Belem, A.M.G., 1990**. Incidence de la trypanosomose sur la faune sauvage d'un ranch de gibier au Burkina Faso. [Incidence of trypanosomiasis in wild animals on a game ranch in Burkina Faso.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **43** (4): 459-465.

ITC, P.M.B. 14, Banjul, Gambia; Institut de Développement Rural de l'Université, Ouagadougou, Burkina Faso; ibid.

Blood samples from 203 wild animals representing eight species from a game ranch at Nazinga, Burkina Faso, were examined for trypanosomes by the buffy coat technique after microHCT and the microscopical examination of smears and films. The infection rate and parasitaemia were assessed for each host species and the sex, age, weight, ectoparasites and trypanosome species were recorded for each animal. The average trypanosome infection rate was 15.3% but health was

apparently unaffected. *Nannomonas* was the most frequent trypanosome group, occurring in five of 76 warthogs (*Phacochoerus aethiopicus*), four of 35 oribi (*Ourebia ourebi*), one of 31 common duiker (*Sylvicapra grimmia*), five of 25 roan (*Hippotragus equinus*), four of 21 bushbuck (*Tragelaphus scriptus*) and two of two reedbuck (*Redunca redunca*). *Trypanozoon* occurred in two warthogs, *Duttonella* was present with *Nannomonas* in two roan and three bushbuck and *Megatrypanum* was found with *Duttonella* and *Nannomonas* in one bushbuck. No trypanosomes were found in the 12 hartebeest (*Alcelaphus buselaphus*) and single waterbuck (*Kobus ellipsiprymnus*) examined. The study confirms the importance of wild animals as reservoir hosts. Their role in the epizootiology of animal trypanosomiasis depends on the interaction between host, tsetse and trypanosome species in a given situation.

7665 **Mihok, S., Otieno, L.H., Darji, N. and Munyinyi, D., 1992**. Influence of D(+)-glucosamine on infection rates and parasite loads in tsetse flies (*Glossina* spp.) infected with *Trypanosoma brucei*. *Acta Tropica*, **51** (3-4): 217-228.
ICIPE, P.O. Box 30772, Nairobi, Kenya.

Teneral *Glossina morsitans centralis*, *G. m. morsitans* and *G. pallidipes* were infected with three different clones of *T. brucei* in blood containing D(+)-glucosamine, an inhibitor of tsetse midgut lectin. On average, 5 days of D(+)-glucosamine treatment tripled infection rates, without affecting the proportion of infections that matured. Total infection rates were equal in males and females, but twice as many infections matured in males. Counts of parasites in the guts and salivary glands of 277 flies revealed order of magnitude differences among flies, with females consistently having 2-3 times as many parasites as males. Parasite numbers varied in a sex-specific manner among tsetse-clone combinations, but these differences were not correlated with similar large differences in infection rates. D(+)-glucosamine treatment had no significant effect on parasite loads.

7666 **Mihok, S., Otieno, L. H. and Tarimo, C.S., 1992**. Trypanosome infection rates in tsetse flies (Diptera: Glossinidae) and cattle during tsetse control operations in the Kagera River region of Rwanda. *Bulletin of Entomological Research*, **82** (3): 361-367.
ICIPE, P.O. Box 30772, Nairobi, Kenya.

Trypanosome infections were monitored in three species of tsetse fly (*Glossina pallidipes*, *G. morsitans centralis* and *G. brevipalpis*) at four locations in the Kagera River region of Rwanda from May 1989 to September 1990. Two of the four areas (Mpanga Ranch and Bukora Ranch) were

subjected to tsetse fly suppression operations with odour-baited traps. Proboscis infections of the *Trypanosoma congolense* and *T. vivax* types accounted for roughly equal numbers of the 207 mature infections detected (3.8%). Variation in infection rates was area-specific rather than tsetse species-specific. Order of magnitude differences in tsetse fly densities among areas were not correlated with differences in infection rates at the start of tsetse fly suppression operations. Similarly, declines in population density in both control and experimental areas were not associated with significant changes in infection rates. The prevalence of trypanosomiasis in cattle at Bukora Ranch was not affected by a roughly 90% reduction in *Glossina* densities. *T. congolense* accounted for 79% of the infections at an overall prevalence rate of 5.5%. Trypanosomiasis in cattle persisted at extremely low densities of about 0.1 fly/trap/day. Treatment of cattle with diminazene aceturate (Berenil) suggested that many *T. congolense* parasites were drug resistant and were cycling among cattle due to the few *Glossina* present.

7667 **Moloo, S.K., 1992**. Comparative study on the susceptibility of different *Glossina* species to *Trypanosoma vivax*, *T. congolense* or *T. b. brucei*. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), pp. 119-121. ILRAD, P.O. Box 30709, Nairobi, Kenya.

Laboratory-reared tsetse, representing seven species and subspecies of *Glossina*, were allowed to feed on animals infected with various strains of *T. vivax, T. congolense* and *T. brucei brucei* and were then dissected. Cyclical development of Likoni and Galana strains of *T. vivax* (both from Kenya) was best in *G. morsitans centralis* (with infection rates of 61.1% and 32.2%) and *G. brevipalpis* (75.3% and 58.2%) but poor in *G. austeni* (1.8% and 5.0%) and four *palpalis* group tsetse (0-4.9%). Infection rates of Bamburi (Kenya) and Nigerian *T. vivax* strains were high in all seven *Glossina* used. Cyclical development of both Tanzanian and Nigerian *T. congolense* was best in *G. m. centralis* (35.5% and 49.2%) and poorest in *G. austeni* (2.0% and 3.0%) and the four *palpalis* group tsetse (0.3-6.0%) with *G. brevipalpis* intermediate (15.7% and 6.3%). Infection rates of both Tanzanian and Nigerian *T. b. brucei* were high in *G. m. centralis* (40.4% and 6.8%) but low in the other tsetse species (0-2.0%). The results showed innate differences in the susceptibility of different species and subspecies of *Glossina* to different strains of trypanosomes.

7668 **Moloo, S.K., Olubayo, R.O., Kabata, J.M. and Okumu, I.O., 1992**. A comparison of African buffalo, N'Dama and Boran cattle as reservoirs of *Trypanosoma congolense* for different *Glossina* species. *Medical and Veterinary Entomology*, **6** (3): 225-230.
Moloo, Kabata, Okumu: ILRAD, P.O. Box 30709, Nairobi, Kenya; Olubayo: National Veterinary Research Centre, KARI, Kabete, Kenya.
Teneral *Glossina morsitans centralis* were fed on the flanks of African buffalo (*Syncerus caffer*), N'Dama (*Bos taurus*) or Boran (*Bos indicus*) cattle infected with *T. congolense*. The infected tsetse were maintained on rabbits and on day 30 after the infected feed, the surviving tsetse were dissected to determine the infection rates. The mean infection rates (% □ SE) in the midgut of tsetse fed on buffalo, N'Damas and Borans were 23.5 □ 3.3, 31.6 □ 2.7 and 33.7 □ 4.6, respectively. The differences were not significant. However, the mean mature infection rate in tsetse fed on the buffalo (13.2 □ 2.1%) was significantly lower compared to the rates in tsetse fed on the N'Dama (20.4 □ 1.4) or the Boran cattle (21.4 □ 1.1). When groups of teneral *G. m. centralis, G. pallidipes, G. p. gambiensis, G. f. fuscipes, G. brevipalpis* and *G. longipennis* were fed simultaneously on either an infected buffalo, an N'Dama or a Boran steer, the mature infection rates ranged from 0 to 16.1%. Irrespective of the host species used, the *T. congolense* infection rate was highest in *G. m. centralis* and lowest in the *palpalis* and *fusca* group tsetse, with *G. pallidipes* being intermediate. Nevertheless, the trypanoresistant African buffalo and N'Dama may serve as reservoirs of *T. congolense*, as can trypanosusceptible Boran cattle.

7669 **Moloo, S.K., Sabwa, C.L. and Kabata, J.M., 1992**. Vector competence of *Glossina pallidipes* and *G. morsitans centralis* for *Trypanosoma vivax*, *T. congolense* and *T. b. brucei*. *Acta Tropica*, **51** (3-4): 271-280.
ILRAD, P.O. Box 30709, Nairobi, Kenya.
Vector competence of *G. pallidipes* for pathogenic *Trypanosoma* species was compared to that of *G. m. centralis*. Cattle or goats were the hosts used to infect teneral tsetse; rabbits were used to maintain tsetse which were dissected on day 30. Mean infection rates of *G. pallidipes* and *G. m. centralis* by *T. vivax* isolated from a cow in Kenya were respectively 39.5 □ 8.9% and 32.1 □ 10.3% whilst, for *T. vivax* isolated from a cow in Nigeria, they were 30.0 □ 7.5% and 19.8 □ 4.3%. Differences were not significant. Differences in infection rates between the sexes of flies were also not significant.

Transmission capability to goats by either tsetse species was good for the two *T. vivax* isolates. Mean infection rates by *T. congolense* isolated from a lion in Tanzania were significantly lower in *G. pallidipes* (8.5 1.8%) than in *G. m. centralis* (22.5 2.0%). Males of either tsetse were more susceptible than females. The transmission rate to goats and mice by both tsetse species was 100%. *G. pallidipes* (3.5%) was less susceptible than *G. m. centralis* (25.1%) to *T. congolense* isolated from a cow in Nigeria, but the transmission rate to goats and mice by either tsetse was 100%. Also, *G. pallidipes* (2.7 0.4%) was significantly less susceptible than *G. m. centralis* (18.4 1.1%) to *T. b. brucei* isolated from a hartebeest in Tanzania. Males of either tsetse species were more susceptible than females. The transmission rate to goats and mice by either tsetse was 100%. *G. pallidipes* (0%) was not susceptible to *T. b. brucei* isolated from a pig in Nigeria whilst *G. m. centralis* showed an infection rate of 9.3%. When male *G. pallidipes* and *G. m. centralis* were fed every day for 27 days on a goat infected with this *T. b. brucei* from Nigeria, the infection rates were 8.7% and 20.2%, respectively. The transmission rate to mice by either tsetse species was 100%. In conclusion, *G. pallidipes* has a vector competence equal to that of *G. m. centralis* for *T. vivax*, and a lower vector competence than *G. m. centralis* for *T. congolense* and *T. b. brucei*.

7670 **Ndegwa, P.N., Irungu, L.W. and Moloo, S.K., 1992**. Effect of puparia incubation temperature: increased infection rates of *Trypanosoma congolense* in *Glossina morsitans centralis*, *G. fuscipes fuscipes* and *G. brevipalpis*. *Medical and Veterinary Entomology*, **6** (2): 127-130.

Zoology Department, University of Nairobi, P.O. Box 30197, Nairobi, Kenya; ibid.; ILRAD, P.O. Box 30709, Nairobi, Kenya.

Puparia of *G. m. centralis*, *G. f. fuscipes* and *G. brevipalpis* were incubated at 25 1□C, 28 1:25 1□C day:night or 29 1□C throughout the puparial period, and maintained at 70-80% relative humidity. Puparial mortality was higher at 29 than at 25□C (optimum temperature) in all three species, particularly in *G. f. fuscipes* and *G. brevipalpis*. Adults of *G. m. centralis* from puparia incubated at 29□C, and those of this subspecies, *G. f. fuscipes* and *G. brevipalpis* from puparia incubated at 28:25□C day:night or 25□C throughout, were infected as tenerals (27 h old) by feeding them at the same time on goats infected with *T. congolense* IL 1180 after the parasites were detected in the wet blood film Infection rates on day 25 post-

infected feed were higher in *G. m. centralis* from puparia incubated at 29□C, and in adults of the three different tsetse species from puparia incubated at 28:25□C day:night, than in those from puparia incubated at 25□C. However, in *G. f. fuscipes* the labral and hypopharyngeal infection rates were not significantly different from those of the tsetse produced by puparia kept at 25□C.

7671 **Soldán, T., Matha, V., Kopácek, P., Volf, P. and Weyda, F., 1992**. Study of tsetse-host immunity relationships with respect to mass rearing and tsetse eradication. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 129-140.

Soldán, Matha, Weyda: Institute of Entomology, Czechoslovak Academy of Sciences, Branisovská 31, 370 05 Ceské Budejovice, Czechoslovakia; Kopácek: Laboratory of Analytical Chemistry, South Bohemian Biological Centre, Czechoslovak Academy of Sciences, Ceské Budejovice, Czechoslovakia; Volf: Department of Parasitology, Faculty of Natural History, Charles University, Prague, Czechoslovakia.

Repeated tsetse bites on experimental hosts induce high titres of antibodies and increased mortality of sucking flies. An attempt has been made to characterise these antibodies with regard to their persistence, specificity and direct influence on tsetse longevity. The direct involvement of circulating antibodies on fly mortality was not confirmed; instead a serum `killing factor' was associated with behavioural changes, possibly induced by bioactive amines released from host blood cells as a result of repeated intradermal hyper-sensitisation by salivary gland antigens. Circulating immunoglobulins persist in host blood for at least 70 days and cross-react with a wide spectrum of tsetse glycoproteins. They are probably not directly responsible for fly mortality but their role in fly longevity, reproduction and vector-parasite interaction has been determined. Several bands cross-reacting with rabbit anti-Glossina antibodies were detected in the lysate of procyclic forms of Trypanosoma brucei and living procyclic forms treated with serum from the same rabbit were immobilised in 20 min. Anti-tsetse antibodies could play an important role in vector immunology.

## 5. HUMAN TRYPANOSOMIASIS

### (a) SURVEILLANCE

[See also **16**: nos. 7661, 7731.]

7672 **Aerts, D., Truc, P., Penchenier, L., Claes, Y. and Le Ray, D., 1992**. A kit for *in vitro* isolation of trypanosomes in the field:

first trial with sleeping sickness patients in the Congo Republic. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **86** (4): 394-395.
Aerts, Claes, Le Ray: Laboratory of Protozoology, Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp 1, Belgium; Truc: TRL, Langford House, Langford, Bristol BS18 7DU, UK; Penchenier: Centre ORSTOM, B.P. 181, Brazzaville, Congo.
A kit for *in vitro* isolation of trypanosomes (KIVI) has been developed which allows direct introduction of patients' blood into culture medium with the subsequent transformation to, and multiplication of, procyclic trypanosomes. The medium comprised glucose, lactalbumin, serum and haemoglobin diluted with an equal volume of Hanks's solution and complemented with 3 mM *cis*-aconitate. Ten sleeping sickness patients with low grade parasitaemias were sampled from the Bouenza focus, Congo. Seven provided a positive culture in KIVI whereas only three were infective to rats. The operational value of KIVI in field work was demonstrated by the long period (average 40 days) during which it sustained the growth and viability of procyclic trypanosomes.

7673 **Jannin, J., Penchenier, L., Eozenou, P., Ventrou, P., Mialebama, J., Louya, F., Bobenda, T., Samba, F. and Coddy Zitsamele, R. 1992.**
Recrudescence actuelle de la trypanosomiase humaine dans le foyer de la Sangha (Cuvette) au Congo. [Present recrudescence of sleeping sickness in the Sangha focus (Cuvette) in Congo.] *Bulletin de la Société de Pathologie exotique et de ses Filiales*, **85** (1): 31-38.
Jannin, Mialebama, Louya, Bobenda: Programme National de Lutte contre la Trypanosomiase, B.P. 1066, Brazzaville, Congo; Penchenier, Samba: ORSTOM, B.P. 181, Brazzaville, Congo; Eozenou, Coddy Zitsamele: Direction des la Médecine Préventive, Brazzaville, Congo; Ventrou: Association des Volontaires du Progrès, Mossaka, Congo.
The Sangha focus of human trypanosomiasis in the Congo was the centre of a pandemic in the early years of this century which claimed some 500,000 lives. Since the early 1980s new cases of trypanosomiasis have been reported from this area after many years of quiescence. In 1987 a parasitological survey of five villages in the region found 43 cases of trypanosomiasis, and this number was increased to 74 with immunological detection methods. In December 1989 96 cases were confirmed parasitologically, with 115 cases for the whole year.

Passive detection in 1990 showed 99 cases, three times the number reported in 1988. These results suggest that the Sangha focus is expanding rapidly and has now become the second most important focus in the Congo, after Bouenza. The surveys have shown that the proportion of patients with the late stage of the disease is increasing. Access to the Sangha area is limited to river transport and the situation will probably worsen in the future.

7674 **Penchenier, L., Jannin, J., Moulia-Pelat, J.P., Elfassi de la Baume, F., Fadat, G., Chanfreau, B. and Eozenou, P., 1991**. Le problème de l'interprétation du CATT dans le dépistage de la trypanosomiase humaine à *Trypanosoma brucei gambiense*. [The problem of interpretation of the CATT in mass screening for *T. b. gambiense* sleeping sickness.] *Annales de la Société belge de Médecine tropicale*, **71** (3): 221-228.

Laboratoire d'Epidémiologie des Grandes Endémies Tropicales, Centre ORSTOM, B.P. 181, Brazzaville, Congo; Programme National de Lutte contre la Trypanosomiase, Brazzaville, Congo; Laboratoire National de Santé Publique, Brazzaville, Congo; ENS, Brazzaville, Congo; OCEAC, Yaoundé, Cameroon; Centre Inter Etats d'Enseignement Supérieur de Santé, Brazzaville, Congo; Service de l'Epidémiologie et des Grandes Endémies, Direction de la Médecine Préventive, Brazzaville, Congo.

Mass screening for *T. b. gambiense* sleeping sickness is usually carried out using CATT in series (total blood CATT followed by serum CATT if the first test is positive) and microscopic examination of blood and ganglionic fluid for trypanosomes. Instances where microscopic examination proved positive and CATT negative prompted a survey of 2030 people in Boko Songho in the Bouenza region of Congo. Using blood and serum CATT in series, trypanosome prevalence was determined at 6.8%; the prevalence of positive cases to either or both CATTs used in parallel was 19.0%. The 12.2% extra cases determined by CATT in parallel were reexamined 1 month later with CATT and IFAT: of these, 22.3% had become positive to both blood and serum and 30.6% had become negative and presented the problem of cross-reaction. Using *T. congolense* as antigen, IFAT was performed on 18 of the cases determined by CATT in parallel. All were positive to a 1/50th threshold, whereas some remained negative when *T. b. gambiense* was used as antigen. The results are discussed and the choice of CATT in series or in parallel for screening is evaluated.

7675 **Pérez Martín, O., Davies, M., Miyar, R. and Lastre Gonzalez, M., 1991**. Evaluación de la respuesta humoral en pacientes infectados con *Trypanosoma rhodesiense* en Mozambique. [Evaluation of the humoral response in patients infected with *T. rhodesiense* in Mozambique.] *Revista Cubana de Medicina Tropical*, **43** (2): 139-141.
Pérez Martín: Instituto de Medicina Tropical `Pedro Kouri', Apartado 601, Marianao 13, Ciudad de La Habana, Cuba.
About 100 new cases of *T. b. rhodesiense* human trypanosomiasis are reported each year in Mozambique; the actual number is probably much higher. Simple immunodiffusion and indirect immunofluorescence techniques were normalised and used to determine the immune response of patients infected with *T. b. rhodesiense*. Three groups were studied: patients with parasitaemia (256); patients without parasitaemia from the same endemic area in Tête province (18); people living outside the endemic area (145). A high percentage of group 1 patients was positive to immunodiffusion (92.5%) and immunofluorescence (99.6%). Groups 2 and 3 showed 5.5% and 6.2% infection respectively using immunodiffusion; neither gave positive results with immunofluorescence. These techniques are recommended for epidemiological studies and for individual diagnosis in cases of low parasitaemia.

(b) PATHOLOGY AND IMMUNOLOGY

7676 **Bert, J., Buguet, A., Sparkes, B., Gati, R., Tapie, P., Tabaraud, F., Doua, F., Lonsdorfer, J., Bogui, P. and Dumas, M., 1991**. Essai d'analyse physiopathologique des troubles du sommeil dans la maladie du sommeil. [Physiopathological analysis of sleep disturbances in sleeping sickness.] (Meeting abstract.) *Médecine tropicale*, **51** (4): 477-478. (See **16**: no. 7677.)
Bert, Tapie, Tabaraud, Dumas: Institut de Neurologie Tropicale, Limoges, France; Buguet, Gati: Centre de Recherches du Service de Santé des Armées, B.P. 87, La Tronche Cedex, France: Sparkes: Defense and Civil Institute of Environmental Medicine, Toronto, Canada; Doua: Projet de Recherches Cliniques sur la Trypanosomiase Humaine Africaine, Daloa, Côte d'Ivoire; Lonsdorfer, Bogui: Faculté de Médecine, Abidjan, Côte d'Ivoire.
Studies of trypanosomiasis patients in the early stage of meningoencephalitis have shown that sleep-wake disturbance concerns the induction of sleep-disturbing activating mechanisms, the low efficiency and

functional anomaly of waking and cortical activation mechanisms and the disorganisation of the biological clock. These disturbances are reversible with appropriate treatment and are probably provoked by an inflammatory process. Only certain brain structures appear to serve as targets, as suggested by the integrity of the endocrine hypothalamo-hypophysis axis.

7677 **Buguet, A., 1991**. Modifications du sommeil et de l'éveil dans la trypanosomiase humaine africaine et comparaison avec les encéphalites spongiformes à virus non conventionnels (Table Ronde sur le Sommeil dans la Trypanosomiase Humaine Africaine s'est tenue dans la cadre du Congrès de Neurologie Tropicale, Université de Limoges, France, 27 septembre 1991). [Modifications of sleep and wakening in African human trypanosomiasis and comparison with non-conventional viral spongiform encephalitis (Round Table on Sleep in Human African Trypanosomiasis held during the Congress of Tropical Neurology, University of Limoges, France, 27 September 1991).] *Médecine tropicale*, **51** (4): 471.

Unité de Physiologie de la Vigilance, Centre de Recherches du Service de Santé des Armées, B.P. 87, La Tronche Cedex, France.

Papers presented at this round table on sleeping sickness have shown that modification of the sleep-wake cycle commences at the beginning of the meningoencephalitic stage and that only certain neuronal networks are affected. The specificity and reversibility of the sleep-wake circadian rhythm has been confirmed in five patients observed before and after treatment over several weeks: the polyphasic aspect of the cycle was normalised after only 2-3 days treatment with arsenicals. A comparison with non-conventional viral spongiform encephalopathies has shown that these diseases, with their progressive and irreversible neuronal loss, are fundamentally different from African human trypanosomiasis. Extended summaries in French and English of the presented papers are given (see nos. 7676, 7678, 7681-7683).

7678 **Buguet, A., Gati, R., Bert, J., Tapie, P., Tabaraud, F., Sèvre, J.P., Develoux, M., Doua, F., Lonsdorfer, J., Bogui, P. and Dumas, M., 1991**. Le cycle veille-sommeil dans la trypanosomiase humaine africaine. [The sleep-wake cycle in human African trypanosomiasis.] (Meeting abstract.) *Médecine tropicale*, **51** (4): 475-476. (See **16**: no. 7677.)

Buguet, Gati: Centre de Recherches du Service de Santé des Armées, B.P. 87, La Tronche Cedex, France; Bert, Tapie, Tabaraud, Dumas: Institut de Neurologie

Tropicale, Limoges, France; Sèvre, Develoux: Faculté de Sciences de la Santé, Niamey, Niger; Doua: Projet de Recherches Cliniques sur la Trypanosomiase Humaine Africaine, Daloa, Côte d'Ivoire; Lonsdorfer, Bogui: Faculté de Médecine, Abidjan, Côte d'Ivoire.
Electroencephalogram (EEG) recordings were made for 24 h from nine patients with untreated trypanosomiasis at the early stage of meningoencephalitis. Sleep disturbances were major in the most severely sick, with sleep episodes as numerous and as long by day as by night. It is concluded that sleeping sickness does not cause hypersomnia but a disturbance of the circadian sleep-wake cycle, at least in the early stages of the disease. When maximal this disturbance resembles the effects of a suprachiasmatic lesion. Its progressive nature and its reversal under treatment suggest a relationship with lympho-plasmocytic infiltration in certain areas of the hypothalamus.

7679 **Hunter, C.A. and Kennedy, P.G.E., 1992**. Immunopathology in central nervous system human African trypanosomiasis. (Review.) *Journal of Neuroimmunology*, **36** (2-3): 91-95. Glasgow University Department of Neurology, Institute of Neurological Sciences, Southern General Hospital, Glasgow G51 4TF, UK.
African human trypanosomiasis shows successive waves of parasitaemia, each characterised by a different VAT. Parasites appear to invade the CNS through areas with a poorly-developed blood-brain barrier (BBB), such as the area postrema, pineal gland and median eminence, and this distribution may relate to clinical symptoms of disturbed sleep patterns culminating in hypersomnia and coma. The drugs melarsoprol and DFMO are used in cases with neurological complications since they can cross the BBB. Melarsoprol is associated with post-treatment reactive encephalopathy and death in 5-10% of treated cases. However, the CNS pathology may be due to an autoimmune reaction as a consequence of persistent antigenic stimulation by successive waves of parasites. The role of immune complexes in mediating inflammatory processes in the CNS is unclear and conflicting results have been obtained. There is evidence to suggest that reactive encephalopathies may result from sub-curative chemotherapy which leaves parasites to provoke a violent inflammatory response. Recent work on the role of astrocytes shows they are capable of producing cytokines such as interleukin 1 which are also able to mediate inflammatory events in the CNS.

7680 **Mbadinga-Mupangu and Mirouze, J., 1992**. Les anomalies

glucidiques au cours de la trypanosomiase humaine africaine. [Glucidic anomalies during African human trypanosomiasis.] *Médecine d'Afrique noire*, **39** (4): 304-305. Service de Maladies Métaboliques et Endocriniennes, B.P. 2725, Brazzaville, Congo; Service de Maladies Métaboliques et Endocriniennes, CHU de Montpellier, Montpellier, France.

An oral test for hyperglycaemia was carried out on 24 patients infected with African human trypanosomiasis. Ten patients were in the first or lymphatic-blood phase of the disease, characterised by fever, adenopathies and hepato-splenomegaly; 14 patients were in the second or meningoencephalitic phase, characterised by perivascular mesenchymatous encephalitis. The results showed a significant ($P < 0.05$) disturbance of glycoregulation, especially in the meningoencephalitic stage.

7681 **Sparkes, B., Buguet, A., Lonsdorfer, A., Doua, F., Bogui, P. and Dumas, M., 1991**. Médiateurs neuro-immunologiques et trypano-somiase humaine africaine. [Neuroimmunological mediators in human African trypanosomiasis. (Meeting abstract.) *Médecine tropicale*, **51** (4): 476-477. (See **16**: no. 7677.)

Sparkes: Defense and Civil Institute of Environmental Medicine, Toronto, Canada; Buguet: Centre de Recherches du Service de Santé des Armées, B.P. 87, La Tronche Cedex, France; Lonsdorfer, Bogui: Faculté de Médecine, Abidjan, Côte d'Ivoire; Doua: Projet de Recherches Cliniques sur la Trypanosomiase Humaine Africaine, Daloa, Côte d'Ivoire; Dumas: Institut de Neurologie Tropicale, Limoges, France.

Hypergammaglobulinaemia in trypanosomiasis patients is a result of excessive B lymphocyte activity under aberrant T cell regulatory control. Faulty sleep regulation was found to accompany plasmocytic meningoencephalitis, with thickening of the pia-arachnoid which became infiltrated with B cells. It is thought that trypanosomes may produce an antigen similar to interleukin 1 (IL1) which triggers the disruption of sleep and immune response patterns. A study of immune and endocrine parameters made in a group of eight patients showed that immunoendocrinal regulation is grossly disturbed, indicating an aberrant production of lymphokines characteristic of uncontrolled inflammatory processes.

7682 **Tabaraud, F., Hugon, J., Tapie, P., Buguet, A., Gati, R., Lonsdorfer, J., Bogui, P., Doua, F. and Dumas, M., 1991**. Les potentiels évoqués dans la trypanosomiase humaine africaine.

[Evoked potentials in human African trypanosomiasis.] (Meeting abstract.) *Médecine tropicale*, **51** (4): 473. (See **16**: no 7677.)
Tabaraud, Hugon, Tapie, Dumas: Institut de Neurologie Tropicale, Limoges, France; Buguet, Gati: Centre de Recherches du Service de Santé des Armées, B.P. 87, La Tronche Cedex, France; Lonsdorfer, Bogui: Faculté de Médecine, Abidjan, Côte d'Ivoire; Doua: Projet de Recherches cliniques sur la Trypanosomiase Humaine Africaine, Daloa, Côte d'Ivoire.
Visual (VEP), auditory (AEP), somesthesic (SEP) and motor (MEP) evoked potentials were analysed in 16 sleeping sickness patients at an early stage of meningoencephalitis to determine whether neuronal networks had been disturbed, especially at brain stem level. All the patients exhibited normal VEP and AEP; a lengthening in SEP and MEP latencies in five and three patients respectively may have been due to an additional infection. It is concluded that in most patients evoked potentials are normal and that disturbance of the sleep-wake cycle observed in these patients was not related to changes in brain stem effector networks.

7683 **Tapie, P., Buguet, A., Tabaraud, F., Gati, R., Bogui, P., Doua, F., Lonsdorfer, J., Dumas, M. and Bert, J., 1991**. Aspects morphologiques de l'électroencéphalogramme de la veille et de sommeil dans la trypanosomiase humaine africaine. [Morphological aspects of sleeping and wakening electroencephalogram patterns in human African trypanosomiasis.] (Meeting abstract.) *Médecine tropicale*, **51** (4): 474-475. (See **16**: no. 7677.)
Tapie, Tabaraud, Dumas, Bert: Institut de Neurologie Tropicale, Limoges, France; Buguet, Gati: Centre de Recherches du Service de Santé des Armées, B.P. 87, La Tronche Cedex, France; Bogui, Lonsdorfer: Faculté de Médecine, Abidjan, Côte d'Ivoire; Doua: Projet de Recherches Cliniques sur la Trypanosomiase Humaine Africaine, Daloa, Côte d'Ivoire.
Electroencephalogram (EEG) patterns were analysed over a period of 24 h in eight patients with sleeping sickness at the early stage of meningoencephalitis. The results showed that sleep in these patients was characterised by the multiplication of phasic elements dependent on an activator system. This demonstrates the integrity of sleep-wake regulation when it is exposed to sensorial afferences stimulated by the presence of trypanosomes and plasmocytic infiltration of the spinal ganglia. In contrast, the abnormal sleep

patterns and slow activity of severely ill patients shows a disturbance of the factors regulating cortical activation.

(c) TREATMENT

7684 **Arnott, M.A., Cairns, D. and Hay, J., 1992**. Pentamidine in blood. (Letter.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **86** (4): 460.

Department of Pharmacy, Leicester Polytechnic, P.O. Box 143, Leicester LE1 9BH, UK.

The results of a recent study (see *TTIQ*, **15** (2): no. 7257) showed that the concentration of pentamidine in whole blood was generally 2-3 times higher than the corresponding plasma level after the first dose of treatment for trypanosomiasis with pentamidine (dimesylate). This suggests that pentamidine is associated with blood cells. A brief review of the literature shows that pentamidine can induce metabolic changes in human neutrophilic granulocytes and that the drug is present within the membrane-bound NADPH-oxidase system of the cells. It is thought unlikely that there are important differences in the pharmacological properties of different pentamidine drugs.

7685 **Golden, M.H.N., 1992**. Arsenic, selenium, and African trypanosomiasis. (Letter.) *Lancet*, **339** (8806): 1413.

Department of Medicine and Therapeutics, University of Aberdeen, Aberdeen AB9 2ZD, UK.

The arsenical trypanocide melarsoprol has a fatality rate of 2-10% and post-arsenical reactive encephalopathy (PARE) has restricted the use of the drug to final stage patients who are usually severely malnourished. Organic arsenicals chelate elements of the sulphur/selenium group and are trypanocidal by depriving the parasite of a unique low MW thiol (trypanothione). If a patient is either sulphur or selenium deficient an organic arsenical is likely to be more toxic than usual. Severe malnutrition, infection-associated immunosuppression, protozoal infection and a low sulphur amino acid intake can all lead to a depletion of tissue glutathione, which has a high affinity for melarsoprol. These conditions are frequently present in African human trypanosomiasis and make patients more vulnerable to arsenic toxicity. It is hypothesised that PARE associated with arsenical treatment arises in patients with selenium deficiency, which is common in the tropics. If the morbidity and mortality associated with melarsoprol could be reduced by prior nutritional supplementation, the use of this drug could be extended to the earlier stages of the

disease.

7686 **Milord, F., Pépin, J., Loko, L., Ethier, L. and Mpia, B., 1992.** Efficacy and toxicity of eflornithine for treatment of *Trypanosoma brucei gambiense* sleeping sickness. *Lancet*, **340** (8820): 652-655.

Milord, Pépin, Ethier: Department of Medicine, University of Sherbrooke, Canada; Milord, Loko, Ethier, Mpia: Zone de Santé Rurale de Nioki, Zaire. (Correspondence to Milord: Département de Santé Communautaire, Hôpital Maisonneuve-Rosemont, 5565 Sherbrooke Est, Montréal, Québec H1N 1A2, Canada.)

Two hundred and seven patients with late-stage *T. b. gambiense* sleeping sickness were treated in rural Zaire with three different regimens of eflornithine (DFMO) in an open-trial design. During treatment, trypanosomes disappeared from the CSF of all 87 patients in whom parasites had been seen before DFMO administration, and there was a sharp fall in CSF white cell count from a mean of 186/μl to 21/μl. Only 13 (9%) patients relapsed out of 152 which were followed for at least a year after DFMO treatment. Treatment failures were more common in children under 12 years, among patients treated with oral DFMO only, and among patients who received DFMO as the initial treatment of their recently diagnosed trypanosomiasis. Toxicity was acceptable. Only four patients died during or shortly after treatment. Bone marrow suppression resulting in anaemia (43%) or leucopenia (53%) was common but bore little consequence. This open trial shows that DFMO is as active as and possibly less toxic than melarsoprol. For economic and logistic reasons DFMO may not be the first-choice therapy in rural Africa but for the vast majority of patients who relapse after melarsoprol DFMO will be curative.

## 6. ANIMAL TRYPANOSOMIASIS

### (a) SURVEY AND DISTRIBUTION

[See also **16**: nos. 7666, 7698, 7717.]

7687 **Bocquentin, R., Very, P. and Duvallet, G., 1990.** Cinétique des anticorps après traitement trypanocide chez des bovins infectés expérimentalement ou naturellement. Intérêt épidémiologique. [Kinetics of antibodies after trypanocide treatment of experimentally or naturally infected cattle. Epidemiological implications.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **43** (4): 479-483.

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

Five Zebu and nine Baoulé cattle were cyclically infected with *Trypanosoma congolense* using *Glossina morsitans*

*submorsitans*; five Baoulé were experimentally infected by s.c. injection of $10^4$ *T. congolense*; and ten naturally infected cattle were selected from an area of high tsetse pressure. All infected animals, together with seven uninfected controls, were treated with 7 mg/kg diminazene. The kinetics of antitrypanosomal antibodies were studied using the indirect immunofluorescence (IFI) and ELISA techniques. Sera were sampled before trypanocidal treatment and at intervals thereafter. Antibody titres fell progressively until they were no longer detectable by ELISA 4 months after treatment and by IFI 6 months after treatment. These results suggest that (in the absence of cross-reactions) a positive reaction to IFI or ELISA can be taken to indicate an active infection provided trypanocidal treatment has not taken place in the previous 4 months for ELISA or 6 months for IFI.

7688 **Doku, C.K. and Mahama, C.I., 1992**. Interim strategies to control animal trypanosomiasis in two selected villages along the White Volta River in the onchocerciasis free zone of northern Ghana. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 209.

Tsetse and Trypanosomiasis Control Unit, Animal Health and Production Department, P.O. Box 97, Pong-Tamale, Ghana.

Recent tsetse and trypanosomiasis surveys along the White Volta River indicated that livestock development in this area would be impractical without some form of intervention to control animal trypanosomiasis. Apparent tsetse densities were in the order of 5-10 flies/biconical trap/day, with fly infection rates of 1-8%. Trypanosomiasis was found to be particularly prevalent in small ruminants, with infection rates of 12-30% and reported cases of abortion. Because of the sparse human population, large-scale control programmes would not be feasible without a clear land use plan. However, it is recommended that efforts be made to control the disease at village level.

7689 **Ekejindu, G.O.C., Nnamani, U.C. and Ogamba, O.C., 1992**. Tsetse, trypanosomiasis and cattle raising in southern Anambra State, Nigeria. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 231.

Department of Parasitology and Entomology, Anambra State University, Akwa Campus, Akwa, Anambra State, Nigeria.

A tsetse and trypanosomiasis survey has been carried out in the Akwa zone on the northern fringes of the rain forest belt of Anambra State, Nigeria, where large

numbers of resident and trade cattle are kept. Parts of the greater Mamu Forest Reserve and seven other patches of forest totalling 800 $km^2$ were studied. With the exception of two small forests, the rest were infested with *Glossina palpalis palpalis*: 84 flies were captured and only one of these was infected with *Trypanosoma vivax*. The examination of 443 slaughterhouse cattle revealed only four infected with *T. vivax*. The low level of trypanosomiasis in this zone, where cattle were formerly thought to be at high risk, is related to deforestation due to industrialisation and development.

7690 **Gamurorwa, E.G., 1992**. Animal trypanosomiasis control in Uganda. (Abstract only.) *In*: IAEA, 1992 (see **16**: no 7644), p. 245.

Department of Veterinary Services and Animal Industry, P.O. Box 7141, Kampala, Uganda.

Except in the highland areas, animal trypanosomiasis is endemic to all 34 districts of Uganda where there are correspondingly high levels of tsetse infestation. The country has been divided into high, medium and low risk zones. Each zone has a slightly different integrated control regime, with curative and prophylactic drugs being used as short-term control measures. The long-term aim is total eradication but this is hampered by lack of funding and equipment.

7691 **Mihok, S., Munyoki, E., Jonyo, J.F., Röttcher, D., Brett, R.A. and Majiwa, P.O., 1992**. Tsetse and trypanosomiasis at the Ngulia rhino sanctuary. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 249.

Mihok, Munyoki: ICIPE, P.O. Box 30772, Nairobi, Kenya; Jonyo, Röttcher, Brett: Kenya Wildlife Service; Majiwa: ILRAD, P.O. Box 30709, Nairobi, Kenya.

The black rhinoceros (*Diceros bicornis*) is particularly susceptible to *Trypanosoma brucei* infection: its translocation to protected sanctuaries may exacerbate health problems through stress or through the movement of non-immune animals into tsetse-infested areas. There is also some concern about the possibility of facilitating genetic exchange in *T. brucei* through the artificial movement of animals over long distances. Surveys have been carried out in the Ngulia rhino sanctuary in the Tsavo West National Park, where trypanosomiasis challenge involves several *Trypanosoma* spp. with most belonging to the savanna group of *T. congolense*. One rhino succumbed to a cryptic *T. congolense* infection but eventually recovered. Future work will examine the susceptibility of rhinos to trypanosomiasis and the use of drugs to manage the disease.

7692 **Nantulya, V.M., Lindquist, K.J. and Masake, R.A., 1992**. The development and application of antigen-detection enzyme immunoassays (antigen-ELISA) for diagnosis and control of African trypanosomiasis. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 21-24.
ILRAD, P.O. Box 30709, Nairobi, Kenya.
Antigen-trapping enzyme immunoassays (Ag-ELISA) for the detection of circulating trypanosome antigens in the blood of infected animals have been developed by ILRAD and CTVM and have shown encouraging results. Applied to the diagnosis of bovine trypanosomiasis, a sensitivity of 96% was observed at ILRAD with good specificity. The assays are easy to perform, the results can be read visually if necessary and large numbers of sera can be analysed at one time. A number of practical problems, such as transportability of biological reagents, the water quality required for the assay and the future assay quality assurance system are currently being addressed. Once these problems have been solved, the assays should be employed as a sensitive diagnostic tool in national tsetse and trypanosomiasis control programmes to determine the effectiveness of these programmes and to assess the efficacy and strategic use of trypanocidal drugs.

7693 **Okuna, N.M., 1992**. Validation of the ELISA technique for diagnosis of trypanosomiasis in cattle in Uganda. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 31.
UTRO, P.O. Box 96, Tororo, Uganda.
Negative reference sera were collected from 44 cattle at Kapchorwa, a tsetse-free area. These cattle were free of *Trypanosoma congolense*, *T. brucei* and *T. vivax* by the haematocrit buffy coat technique but three were positive for *T. vivax*, one for both *T. congolense* and *T. vivax* and one for *T. congolense* using the ELISA technique. The calculated optical density (OD) cut-off point was 50 for both *T. brucei* and *T. vivax* but was 60 for *T. congolense*. Sera from five cattle which had *T. theileri* and two which had microfilariae all gave negative results by ELISA, proving its specificity. Positive reference sera from 40 cattle in a high tsetse challenge area were examined by the haematocrit buffy coat technique which showed five to have *T. vivax*, two to have *T. brucei* and one to have *T. congolense*. When checked by ELISA only four cattle were found to be free of all three trypanosome species. All 40 cattle were treated with diminazene aceturate at 7 mg/kg body weight. After 2 weeks the ELISA test showed that ten animals were free of antigenaemia and

those still positive had lower OD readings.

7694 **Olaho-Mukani, W., Munyua, W.K., Omuse, J.K., Njogu, A.R. and Mutugi, M.W., 1992**. Application of antigen-ELISA for the diagnosis of surra in selected camel herds in Kenya. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 25-30.
KETRI, P.O. Box 362, Kikuyu, Kenya.
Trypanosomiasis or surra due to *Trypanosoma evansi* is the most important disease affecting camels in Kenya. It can cause up to 70% mortality, abortions and weight loss in affected herds. In recent years, the application of enzyme immunoassays has greatly improved diagnosis. In an antigen-ELISA test which employs a monoclonal antibody, it was possible to detect 94-100% of patent infections in affected camels. This test is sensitive, specific and easy to perform. The disappearance of circulating trypanosomal antigens may be an indication of successful chemotherapeutic intervention while persistent antigens may be an indication of persisting parasitaemia in cryptic foci. The antigen-ELISA technique may therefore be an ideal tool for evaluating the success of drug treatment for the control of surra.

(b) PATHOLOGY AND IMMUNOLOGY

7695 **Anika, S. and Jibike, I., 1991**. Porcine trypanosomiasis: effect of infection on feeding and subsequent treatment with DFMO. (Paper presented at the 5th Congress of the European Association for Veterinary Pharmacology and Toxicology, Copenhagen, Denmark, 18-22 August 1991.) *Acta Veterinaria Scandinavica*, Suppl. 87: 400-401.
Department of Physiology and Pharmacology, Faculty of Veterinary Medicine, University of Nigeria, Nsukka, Nigeria.
Seventeen healthy 4-10 week old pigs were housed in five groups in fly-proof pens. Group A (two pigs) was experimentally infected with *Trypanosoma brucei brucei* but not treated; Group B (four pigs) was infected and treated with 4% DFMO given orally at 300 mg/kg body weight/day for 10 days; Group C (four pigs) was infected and treated with DFMO and 7% diminazene given i.m. at 7 mg/kg; Group D (three pigs) was infected and received diminazene alone. The remaining four pigs were uninfected and untreated controls. Food intake was significantly ($P < 0.05$) increased in infected animals, which developed severe parasitaemia and clinical signs within 1 week of infection. These disappeared following all treatment regimes but relapse occurred in all cases. Increased food intake cannot be

attributed to thermostatic eating and may be due to the stimulation of the CNS feeding centres, possibly the lateral hypothalamus, following the invasion of parasites into the brain. The diarrhoea exhibited by DFMO treated animals may have reduced the efficacy of oral doses of this drug.

7696 **Anosa, V.O., Logan-Henfrey, L.L. and Shaw, M.K., 1992**. A light and electron microscopic study of changes in blood and bone marrow in acute hemorrhagic *Trypanosoma vivax* infection in calves. *Veterinary Pathology*, **29** (1): 33-45.

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

Eleven 6 month old calves were tsetse fly challenged with a stock of *T. vivax* (IL 2337) that causes haemorrhagic infection. The calves were randomly euthanatised every 4 to 6 days; two other calves served as controls. Peripheral blood changes included anaemia, thrombocytopenia and an initial leukopenia. Later in the course of infection, leukocytosis associated with lymphocytosis and neutropenia developed. Moderate reticulocytosis (highest mean count 3.6 □ 3.7%, maximum count 9.4%) accompanied the first wave of parasitaemia but poor response (highest mean 0.4 □ 0.0%) occurred during the second wave, despite the persistence of severe anaemia. Light microscopic examination of bone marrow samples showed a drop in the myeloid:erythroid ratio with a decrease in granulocytes, particularly metamyelocytes, bands and segmenters. Increase in lymphocyte counts corresponded with the appearance of lymphoid nodules within the marrow. Megakaryocytic volume increased significantly in infected animals and some megakaryocytes showed emperipolesis of red cells, neutrophils and lymphocytes. Transmission electron microscopic examination of the bone marrow revealed that trypanosomes had crossed the sinusoidal endothelium into the haematopoietic compartment as early as the second day of parasitaemia. Macrophages proliferated in the bone marrow. From the second day of parasitaemia until the end of the experimental infection, on day 46, the macrophages phagocytosed normoblasts, eosinophil and neutrophil myelocytes, metamyelocytes, bands and segmenters, as well as reticulocytes, erythrocytes and thrombocytes. Therefore, dyserythropoiesis and dysgranulocytopoiesis were responsible, in part, for the observed anaemia and granulocytopenia, respectively.

7697 **Boly, H., Thombiano, D., Humblot, P. and Thibier, M., 1991**.

Influence de *Trypanosoma congolense* sur la fonction sexuelle de taurins Baoulé. [Effect of *T. congolense* on the sexual function of Baoulé bulls.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (4): 475-480.
ISN/IDR, Université de Ouagadougou, Burkina Faso; CRTA, B.P. 454, Bobo Dioulasso, Burkina Faso; Laboratoire pour le Contrôle des Reproducteurs, UNCEIA, B.P. 65, 94703 Maisons-Alfort, France; ibid.
Five young, reputedly trypanoresistant, Baoulé bulls were experimentally infected with $10^4$ *T. congolense* to study the effect of the trypanosomes on various aspects of their sexual function: libido, semen characteristics and hormone levels. Weekly semen collection from an artificial vagina before and after infection showed a significant decrease in libido: mean reaction time to mounting doubled 2 weeks after infection. Quantitative semen parameters were affected from the 6th week, with semen volume and sperm concentration being reduced significantly by 47% and 49% respectively. Qualitative parameters were significantly affected from the 10th week, with reductions of 44% and 87% respectively for motility and percentage of living sperms, while the percentage of abnormal cells increased by 33%. These changes were associated with a reduction in LH and testosterone concentrations, although some residual pulsatility could be seen. This could explain the relatively rapid recovery of the sexual function within 13-15 weeks after infection, or 5-6 weeks after the disappearance of parasites from the blood. This experimental infection of Baoulé bulls shows that, although they are considered trypanoresistant, their sexual function can still be seriously affected but that recovery is possible within 3-4 months after infection.

7698 **Bwangamoi, O., Buoro, I.B.J., Price, J.E., DaCosta, R.P.R. and Mbugua, S.W., 1989**. Natural *Trypanosoma vivax* infection in a domestic cat in Nairobi. *Bulletin of Animal Health and Production in Africa*, **1989** (Special issue): 147-157.
Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Nairobi, Kenya.
A 10 month old male domestic cat from Kawangware on the outskirts of Nairobi was brough to a clinic for veterinary treatment. Clinical signs included fever, severe anaemia, emaciation, increased pulse and heart beat, oedema of the periorbital tissues with exophthalmus, bilateral glaucoma and enlarged superficial lymph nodes. Blood samples were stained with Giemsa and revealed large numbers of trypanosomes

which were identified as *T. vivax*. Both typical and atypical (polymorphic) forms of the parasite were present. The cat was treated with melarsoprol at a dose of 1.8 mg/kg body weight on four consecutive days. The animal died of pneumonia on the fourth day. The post mortem examination is described in detail. This appears to be the first recorded case of a natural *T. vivax* infection in the domestic cat.

7699 **Chicoteau, P., Bassinga, A., Sidibé, I., Pobel, T., Richard, X. and Clausen, P., 1990**. Influence de l'exposition à un risque trypanosomien élevé sur la reproduction de vaches Baoulé au Burkina Faso. [Influence of high-risk exposure to trypanosome infection on the reproduction of Baoulé cows in Burkina Faso.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **43** (4): 473-477.

Groupe Roullier, 27 avenue Franklin-Roosevelt, B.P. 158, 35408 Saint-Malo, France; CRTA, 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso; ibid.; ibid.; ibid.; ibid.

Trypanosome infection has been found to influence reproductive function in trypanotolerant cattle. Sixty-six Baoulé cattle, including 23 cows, and 20 Zebus from an area with strong tsetse pressure 50 km north-east of Bobo-Dioulasso were examined at intervals for weight, haematocrit value, parasitaemia and progesterone level. All the animals were naturally infected with *Trypanosoma vivax* alone or in association with *T. congolense*. Nine of the 23 Baoulé cows were susceptible to trypanosomes and required Berenil treatment. Abortions and anoestrus associated with weight loss, anaemia and hyperthermia were recorded among the Baoulé cattle and there was considerable individual variation among both tolerant and susceptible animals. The results favour a polygenic origin for trypanotolerance.

7700 **Dwinger, R.H., Grieve, A.S., Snow, W.F., Rawlings, P., Jabang, B. and Williams, D.J.L., 1992**. Maternal antibodies in N'Dama calves kept under natural trypanosomiasis risk in The Gambia. *Parasite Immunology*, **14** (3): 351-354.

Proyecto UNA/RUU, Escuela de Medicina Veterinaria, Universidad Nacional, Apartado 86-3000, Heredia, Costa Rica; ITC, P.M.B. 14, Banjul, Gambia; ibid.; ibid.; ibid.; ILRAD, P.O. Box 30709, Nairobi, Kenya. (Correspondence to Dwinger.)

Trypanotolerant N'Dama calves and their dams were monitored for the presence of antibodies against trypanosomes using an IFAT. In 50% (47) of newborn calf sera antibodies to *Trypanosoma congolense* and *T. vivax* were demonstrated, and nine calves showed high antibody

titres to both these species. No trypanosomes were detected by the microscopic examination of blood samples. The antibody levels in calves corresponded with the levels detected in their respective dams and it is concluded that antibodies in newborn calves are probably maternally derived. These antibodies were detected up to 3 months after birth. Monoclonal antibodies were used to determine the isotype of trypanosome-specific antibodies in 20 randomly selected calf serum samples: calves with high levels of antibody had a greater detectable diversity of isotypes than calves with low levels. Follow-up studies showed that older calves, once weaned and grazing with the herd, were as susceptible to trypanosome infection as calves which lacked the initial passively acquired immunity.

7701 **Edeghere, H., Elhassan, E., Abenga, J., Osue, H.O., Lawani, F.A.G. and Falope, O., 1992**. Effects of infection with *Trypanosoma brucei brucei* on different trimesters of pregnancy in ewes. *Veterinary Parasitology*, **43** (3-4): 203-209. Pathology, Epidemiology and Statistics Division, NITR, Kaduna, Nigeria.

The effects of *T. b. brucei* infection during the first, second or third trimesters of pregnancy in 13 ewes were studied. All infected ewes were anaemic with the anaemia being most severe, moderate and least in ewes infected in the second, third and first trimesters, respectively. Weight loss occurred in all infected ewes but was most severe in ewes infected in the third trimester. Three of the four ewes infected in the first trimester died without aborting while one aborted and later died. Of the four ewes infected in the second trimester, three died without aborting while one lambed and later died. In the third trimester ewes, one aborted, two lambed and all three later died while one died without aborting. None of the lambs was viable. The control ewe lambed normally. The infection resulted in 16.7% abortion, 100% death and 33.3% neonatal deaths. This study demonstrates that *T. b. brucei* has a devastating effect on pregnancy irrespective of the trimester of infection.

7702 **Kaufmann, J., Dwinger, R.H., Hallebeek, A., Dijk, B. van and Pfister, K., 1992**. The interaction of *Trypanosoma congolense* and *Haemonchus contortus* infections in trypanotolerant N'Dama cattle. *Veterinary Parasitology*, **43** (3-4): 157-170. Kaufmann, Pfister: Department of Veterinary Parasitology, University of Berne, P.O. Box 2735, CH-3001 Berne, Switzerland; Dwinger: ITC, P.M.B. 14, Banjul, Gambia; Hallebeek, Dijk: Department of

Infectious Diseases, University of Utrecht, Yalelaan 1, 3508 TD Utrecht, Netherlands.
The interactions between *T. congolense* and *H. contortus* infections were studied in N'Dama calves. A total of 38 N'Dama bulls was divided into four groups and each group infected either with *H. contortus* 1 week after infection with *T. congolense* or with *T. congolense* 4 weeks after infection with *H. contortus*, or with either infection singly. Parasitological (faecal egg counts, parasitaemia), haematological (PCV, white blood cell counts, albumin) and clinical parameters (body weight change, mortality rate) were compared among the various groups. The results showed a reduced prepatent period and a markedly increased pathogenicity of *H. contortus* infections in animals with a concurrent *T. congolense* infection. The most harmful combination was a *H. contortus* infection 1 week after the *T. congolense* infection which resulted in a progressive and severe anaemia, accompanied by hypoalbuminaemia, increased weight loss and high mortality. The anaemia induced by dual infections showed a low responsiveness to chemotherapy and in several cases supportive treatment did not help recovery. The results also showed that animals with a concurrent *T. congolense* and *H. contortus* infection ran a higher risk of succumbing during the infection, and also during 10 weeks following treatment. Although infections with *T. congolense* alone produced no clinical signs, they were found to significantly reduce the ability of infected animals to mount a normal response to a subsequent *H. contortus* infection. It was concluded that the increased *H. contortus* egg excretion observed in animals infected with both parasites might significantly increase the risk of nematode infections and that the reduced prepatent period might necessitate more frequent anthelmintic treatments. These interactions should, therefore, be considered wherever attempts are made to control these two diseases.
7703 **Kimeto, B.A., 1989**. Erythrophagocytosis in cattle experimentally infected with *Trypanosoma vivax*. *Bulletin of Animal Health and Production in Africa*, **1989** (Special issue): 143-146.
Department of Veterinary Pathology and Microbiology, University of Nairobi, P.O. Box 29053, Kabete, Kenya.
The buffy coat from centrifuged blood samples, aspirated bone marrow and various organs removed post mortem from steers infected with *T. vivax* were examined by electron microscopy. Erythrophagocytosis was observed in the spleen, liver, lymph nodes, bone

marrow, peripheral leucocytes and myocardium and is thought to contribute significantly to the anaemia shown by infected animals. Antigen-antibody complexes deposited on the surface of erythrocytes lead to erythrophagocytosis which is a feature of haemolytic anaemia. Erythrophagocytosis occurred mostly in the spleen which became enlarged; the iron was not released for erythropoiesis and this resulted in low PCV. Chemotherapy to eliminate the trypanosome antigen arrested erythrophagocytosis in the reticuloendothelial organs and restored the PCV to normal.

7704 **Naessens, J. and Williams, D.J.L., 1992**. Characterization and measurement of $CD5^+$ B cells in normal and *Trypanosoma congolense*- infected cattle. *European Journal of Immunology*, **22** (7): 1713-1718.

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

$CD5^+$ B cells in cattle are present in peripheral blood and spleen, but not in lymph nodes, tonsils or Peyer's patches. Compared to classical B cells, they express similar levels of B cell surface markers, but have higher levels of surface IgM. We failed to find evidence for IgD on bovine B lymphocytes. The $CD5^+$ B cells expressed CD11b (Mac-1). Another small subpopulation of B cells carried CD11b but not CD5. In cattle infected with *T. congolense*, a dramatic increase in the percentage of $CD5^+$ B cells in blood and spleen was observed. This increase occurred 7-10 days after parasites were first detected in the blood and correlated with the increase in serum IgM and the increase in the absolute number of B cells that is typical of trypanosome-infected animals. The increase in B cells was found to be due mainly to the expansion of the $CD5^+$ B cell subpopulation. The cause of the amplification of the $CD5^+$ B cells and their possible involvement in the production of autoantibodies and non-parasite-specific antibodies which have been described in trypanosome-infected animals are discussed.

7705 **Sileghem, M. and Flynn, J.N., 1992**. Suppression of T-cell responsiveness during tsetse-transmitted trypanosomiasis in cattle. *Scandinavian Journal of Immunology*, **36** (Suppl. 11): 37-40.

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

Lymph node cells from cattle infected with *Trypanosoma congolense* through tsetse fly challenge were unable to proliferate *in vitro* following activation with the T cell mitogen Concanavalin A. This was associated with a simultaneous suppression of interleukin 2 (IL-2)

production and interleukin 2 receptor (IL-2R) expression. However, the capacity of the cells to secrete interferon γ following the mitogenic activation was not affected by the infection.

7706 **Williams, D.J.L., Logan-Henfrey, L.L., Authié, E., Seely, C. and McOdimba, F., 1992**. Experimental infection with a haemorrhage-causing *Trypanosoma vivax* in N'Dama and Boran cattle. *Scandinavian Journal of Immunology*, **36** (Suppl. 11): 34-36.

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

N'Dama cattle control experimental infections with clones of *T. congolense* of varying degrees of virulence, but nothing is known about their capacity to control infections caused by highly virulent, East African stocks of *T. vivax*. Thus four N'Damas and four trypanosusceptible Borans were infected with a tsetse-transmitted stock of *T. vivax* IL2337. In Ayrshire cattle this stock is known to cause severe haemorrhagic disease. No differences were observed in the parasitaemia between the two groups. Both groups became anaemic. The mean PCV fell to 16.8 □ 5.0% in the N'Dama cattle and to 24.2 □ 2.2% in the Borans on day 26 p.i. These differences were not significant. Antibody responses to invariant trypanosome antigens were analysed. No differences were observed between the groups in the pattern of recognition or the isotype elicited. Antibody bound to the surface of erythrocytes was occasionally detected. No anti-platelet activity was observed. The results show that N'Dama cattle, which are known to be resistant to disease caused by *T. congolense* and by *T. vivax* stocks from West Africa, were highly susceptible to an infection of *T. vivax* which causes acute haemorrhagic disease.

(c) TRYPANOTOLERANCE

[See also **16**: nos. 7699, 7706.]

7707 **Chicoteau, P., Ouedraougo, A., Cloé, C. and Bassinga, A., 1990**. Note sur l'insémination artificielle de vaches Baoulé en élevage contrôlé au Burkina Faso. [Note on the artificial insemination of Baoulé cows under controlled conditions in Burkina Faso.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **43** (4): 541-542.

Groupe Roullier, 27 avenue Franklin-Roosevelt, B.P. 158, 35408 Saint-Malo, France; CRTA, 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso; ibid.; ibid.

Attempts were made to synchronise the ovarian cycle of trypanotolerant Baoulé cows for artificial insemination using injections of prostaglandin F2α or implants of a

progestogen (norgestomet). Within 5 days of treatment 67.6% of cows given the injections of prostaglandin and 48.6% of cows given an implant had come into heat. The results show that a programme of artificial insemination based on the control of the ovarian cycle is possible for Baoulé cattle.

7708 **Chicoteau, P., Thiombiano, D., Boly, H. and Cloé, C., 1990**. Contribution à l'étude de la puberté chez les bovins de race Baoulé. [Contribution to the study of puberty in Baoulé cattle.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **43** (4): 535-539.

Groupe Roullier, 27 avenue Franklin-Roosevelt, B.P. 158, 35408 Saint-Malo, France; CRTA, 01 B.P. 454, Bobo-Dioulasso 01, Burkina Faso; ibid.; ibid.

Reproductive function or puberty commences at 14 months in female Baoulé cattle and at 18 months in males, when body weight averages 120 kg and 155 kg respectively. This represents approximately two-thirds of the adult body weight (57% and 61% respectively). Sperm collected during puberty is of poor quality and cannot be frozen. The sexual development of trypanotolerant Baoulé cattle appears to be more precocious than that of other tropical breeds.

(d) TREATMENT

[See also **16**: nos. 7687, 7695.]

7709 **Clausen, P.-H., Sidibe, I., Kabore, I. and Bauer, B., 1992**. Development of multiple drug resistance of *Trypanosoma congolense* in Zebu cattle under high natural tsetse fly challenge in the pastoral zone of Samorogouan, Burkina Faso. *Acta Tropica*, **51** (3-4): 229-236.

Institute for Veterinary Medicine (Robert von Ostertag-Institute) of the Federal Health Office, Diedersdorfer Weg 1, D-1000 Berlin 48, Germany; CRTA, B.P. 454, Bobo-Dioulasso, Burkina Faso; ibid.; ibid.

Preliminary data from an ongoing epidemiological survey in the pastoral zone of Samorogouan (Kénédougou) indicate the occurrence of multiple-drug-resistant *T. congolense*. Despite frequent trypanocidal drug treatments with diminazene aceturate at 7 mg/kg body weight (bw) at intervals of 2-4 weeks, no significant drop in the prevalence of trypanosomiasis was observed. To examine a suspected drug resistance, 20 Zebu cattle, naturally infected with *T. congolense* and/or *T. vivax*, were transferred in December 1989 from Samorogouan into a fly-proof stable. Diminazene aceturate at 7 mg/kg bw cured infections of *T. vivax*, but was ineffective against

*T. congolense*. Likewise, treatments with homidium bromide at 1 mg/kg bw and isometamidium chloride at 1 mg/kg bw, respectively, proved to be ineffective. Corresponding chemotherapeutic trials in previously unexposed Zebu bulls and Sahelian goats infected with one primary *T. congolense* isolate from Samorogouan demonstrated a high level of resistance to diminazene aceturate (7 mg/kg bw in cattle and 17.5 mg/kg bw in goats), isometamidium chloride (1 and 2 mg/kg bw i.v. in goats) and quinapyramine sulphate (5 mg/kg bw in goats). The appearance of a multiple-drug-resistant strain of *T. congolense* emphasises the urgent need for new chemical substances as trypanocidal drugs and the increasing importance of efficient vector control.

7710 **Dolan, R.B., Stevenson, P.G.W., Alushula, H. and Okech, G., 1992**. Failure of chemoprophylaxis against bovine trypanosomiasis on Galana Ranch in Kenya. *Acta Tropica*, **51** (2): 113-121.

P.O. Box 24437, Nairobi, Kenya; KETRI, Kikuyu, Kenya; ibid.; ibid.

The duration of prophylaxis provided by 1 mg/kg body weight of homidium bromide was compared with that provided by 1 mg/kg body weight of isometamidium chloride in a 12 month field trial involving 90 Boran cattle exposed to trypanosome challenge on Galana Ranch in Kenya. Weekly trypanosome (*Trypanosoma vivax, T. congolense*) prevalences of over 30% were observed during 4 of the 12 months. During these periods of heavy challenge, parasites were detected 2-3 weeks after administration of both homidium bromide and isometamidium chloride. Both prophylactic drugs were administered, on a group basis, eight times over the 12 month trial and in addition individual infections were also treated with diminazene aceturate. Isometamidium chloride provided slightly longer periods of prophylaxis than homidium bromide, 28.4 days compared with 25.4 days. There was a highly significant difference in the productivity of the two groups during a period of poor grazing: 27% of the isometamidium chloride herd died from a severe wasting condition with substantial liver damage evident on post mortem. This condition was not observed in the homidium bromide herd. The surviving animals in the isometamidium chloride herd had a mean annual weight gain of 24 kg less than that recorded in the homidium bromide herd.

7711 **Kratzer, R.D., Ismail, A., Omukuba, J. and Cagnolati, V., 1992**. Pharmacokinetics of diminazene aceturate (Berenil$^{\varepsilon}$), homidium bromide (Ethidium$^{\varepsilon}$) and isometamidium chloride

(Samorin$^{\varepsilon}$) after intravenous application in Boran steers. (Abstract only.) *In*: IAEA, 1992 (see **16**: no 7644), p. 35.
KETRI, P.O. Box 362, Kikuyu, Kenya.
$^{14}$C-Labelled trypanocides were administered i.v. to Boran steers and radioactivity levels measured in plasma, tissue fluid, urine, faeces and tissues. Peak plasma levels of Berenil and Ethidium were approximately 3-7 times higher after i.v. administration compared with after i.m. administration. With Samorin they were 18-36 times higher using the i.v. route. Tissue fluid levels were lower than plasma levels after i.v. treatment with Berenil and Ethidium but higher with Samorin. Excretion rates were initially higher after i.v. treatment. After 10 days the rate was still two-fold higher and after 60 days 50% higher with Samorin, whereas after 10 days the rates with Berenil and Ethidium had dropped to the level following i.m. treatment. Tissue residues were higher after i.v. treatment. The results show that Samorin shows higher tissue fluid than plasma levels and higher initial peaks following i.v. treatment. This increases the curative effects of the drug in areas with resistant trypanosome strains but this is offset by practical difficulties in i.v. administration.

7712 **Kratzer, R.D., Karanja, W.M. and Murilla, G., 1992**. Sorbent extraction and high performance liquid chromatography (HPLC) of homidium bromide and isometamidium chloride in bovine plasma. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 41.
KETRI, P.O. Box 362, Kikuyu, Kenya.
Previous methods for determining the level of drug concentrations in bovine plasma could not overcome the problem of protein binding which reduced the measured concentrations to just 10% of the actual concentrations. Using homidium bromide and isometamidium chloride, protein binding was overcome by enzyme digestion and alteration of the pH before adding the plasma sample directly on clean-up columns. In this way drug recovery rates above 80% were obtained. The drugs were detected using HPLC with a C18 reversed phase analytical column and UV detection.

7713 **Kratzer, R.D., Loehr, K.F., Maloo, S., Muenstermann, S., Ismail, A., Omukuba, J. and Murilla, G., 1992**. Investigations of intra-muscularly induced diminazene aceturate (Berenil$^{\varepsilon}$) plasma levels in cattle under high tsetse and trypanosome challenge in the field. (Abstract only.)

*In*: IAEA, 1992 (see **16**: no. 7644), p. 37.
Kratzer, Ismail, Omukuba, Murilla: KETRI, P.O. Box 362, Kikuyu, Kenya; Loehr, Maloo, Muenstermann: Veterinary Investigation Laboratory, P.O. Box 204, Mariakani, Kenya.
The prophylactic effect of trypanocides is significantly reduced under high tsetse and trypanosome challenge. Cattle kept on the Kenyan coast under conditions of high challenge and cattle herded at KETRI under no challenge were treated repeatedly with Berenil and plasma drug levels established using the high performance liquid chromatography (HPLC) technique. It was shown that neither the height of the initial peak nor the half lives of the plasma drug levels were significantly different in the two groups of cattle, demonstrating that plasma drug levels are not reduced by trypanosomes at the time of treatment and challenge.

7714 **Kratzer, R.D., Turkson, P.K., Ismail, A., Omukuba, J. and Cagnolati, V., 1992**. A comparison of intramuscularly induced plasma levels of diminazene aceturate (Berenil$^{\varepsilon}$), homidium bromide (Ethidium$^{\varepsilon}$) and isometamidium chloride (Samorin$^{\varepsilon}$) in infected and uninfected cattle. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 39.
KETRI, P.O. Box 362, Kikuyu, Kenya.
$^{14}$C-Labelled Berenil, Ethidium and Samorin were i.m. administered to uninfected cattle and cattle infected with *Trypanosoma congolense* and the radioactivity levels measured in plasma. The results showed a slight but non-significant reduction in the initial plasma drug level in infected cattle and it is concluded that the amount of drug taken up by trypanosomes does not influence the plasma drug level and does not therefore lower the curative and prophylactic effects of the drug.

7715 **Mdachi, R.E., Murilla, G.A. and Kratzer, R.D. 1992**. Metabolite studies of isometamidium in cattle. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 53-57.
KETRI, P.O. Box 362, Kikuyu, Kenya.
The lack of detection of isometamidium in serum and urine within 24 h following either i.v. or i.m. administration of the non-labelled drug would suggest either insensitivity of the methods used or rapid metabolism. A preliminary study was carried out using liver, kidney, bile, blood and urine samples from two groups of steers, one of which had been treated with $^{14}$C-isometamidium labelled on the homidium molecule and the other with $^{14}$C-isometamidium labelled on the

benzamidine molecule and slaughtered 21 and 60 days after treatment. Isometamidium was detected in the liver up to 21 days post-treatment but not 47 and 60 days post-treatment. Metabolites which corresponded to homidium and benzamidine derivatives were detected in liver, kidney, bile and urine samples. No isometamidium was detected in urine collected 24 h after treatment. It appears that the prophylactic activity of isometamidium is due to homidium and/or its derivatives.

7716 **Murilla, G.A., Mdachi, R.E., Kratzer, R.D. and Karanja, W.M., 1992**. Solid phase extraction and reversed-phase high performance liquid chromatography of homidium in animal tissues. *In*: IAEA, 1992 (see **16**: no. 7644), pp. 45-51. KETRI, P.O. Box 362, Kikuyu, Kenya.

The trypanocide homidium bromide has been in use for about 40 years for chemotherapy and limited chemoprophylaxis but no specific and accurate method for its detection at sub-microgram levels in tissues was available. The HPLC method described uses a C18 reversed phase analytical column with UV detection after basic sample extraction and clean-up on a 3 ml cyano Bond Elut disposable extraction column. Drug recoveries of up to 80% were obtained. All tissues analysed were from animals treated with $^{14}$C-labelled homidium at a dose of 1 mg/kg body weight and slaughtered at 14, 21 and 28 days after treatment. Recoveries were determined by comparing radiometric and HPLC results. The detection limit was 50 ng per g wet tissue. This method is simple, fast, accurate and sufficiently sensitive to be used for monitoring drug levels in meat destined for human consumption.

7717 **Olaho-Mukani, W., Munyua, W.K., Njogu, A.R., Mutugi, M.W. and Otsyula, M., 1992**. Trypanosomal antigen and antibody levels in field camels following treatment with two trypanocidal drugs. *Tropical Medicine and Parasitology*, **43** (3): 170-172.

Olaho-Mukani, Njogu, Mutugi, Otsyula: KETRI, P.O. Box 362, Kikuyu, Kenya; Munyua: Faculty of Veterinary Medicine, University of Nairobi, Nairobi, Kenya.

The efficacy of treatment in 61 naturally trypanosome-infected camels was evaluated by antigen and antibody detection. Following treatment of 14 infected field camels with an arsenical drug (RM110), no trypanosomal antigens could be detected in the animals which were treated with 0.6 mg/kg body weight and 1.2 mg/kg body weight 90 days thereafter. In two out of three camels treated with 0.4 mg/kg body weight no trypanosomal

antigens could be detected by day 90 post-treatment. However, there was evidence of trypanosomal antigens in camels treated with 0.2 mg/kg body weight and untreated positive controls. Antibody levels were still high in all 14 camels 90 days post-treatment. In another group of 55 field camels, of which 47 camels were parasite-positive and eight parasite-negative, trypanosomal antigens could not be detected in 42 camels 28 and 48 days post-treatment with quinapyramine prosalt. However, antigen levels were still high in five parasite-positive camels 48 days post-treatment. In all the parasite-positive camels, antibody levels were still high 48 days after treatment. In the eight parasite-negative camels, antigens were detected in four camels before treatment. By day 48 post-treatment, all four camels were antigen-negative. However, four of the eight parasite-negative camels were still antibody-positive by day 48 post-treatment. These observations indicated that antigen-detection could be used to evaluate the success of therapeutic trials where trypanosome detection tests may fail to pick up low patent infections.

7. EXPERIMENTAL TRYPANOSOMIASIs
(a) DIAGNOSTICS
(b) PATHOLOGY AND IMMUNOLOGY

7718 **Hunter, C.A., Jennings, F.W., Kennedy, P.G.E. and Murray, M., 1992**. Astrocyte activation correlates with cytokine production in central nervous system of *Trypanosoma brucei brucei*-infected mice. *Laboratory Investigation*, **67** (5): 635-642.

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

7719 **Nok, A.J., Esievo, K.A.N., Ajibike, M.O., Achoba, I.I., Tekdek, K., Gimba, C.E., Kagbu, J.A. and Ndams, I.S., 1992**. Modulation of the calcium pump of the kidney and testes of rats infected with *Trypanosoma congolense*. *Journal of Comparative Pathology*, **107** (1): 119-123.

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

7720 **Perito, S., Calabresi, A., Romani, L., Puccetti, P. and Bistoni, F., 1992**. Involvement of the Th1 subset of $CD4^+$ T cells in acquired immunity to mouse infection with *Trypanosoma equiperdum*. *Cellular Immun-ology*, **143** (2): 261-271.

Department of Experimental Medicine and Biochemical Sciences, University of Perugia, 06100 Perugia, Italy.

7721 **Shapiro, S.Z. and Black, S.J., 1992**. Identification of an acute-phase reactant in murine infections with *Trypanosoma brucei*. *Infection and Immunity*, **60** (9): 3921-3924.
Shapiro: Department of Veterinary Pathobiology, University of Illinois, Urbana, IL 61801, USA.

7722 **Tabel, H. and Wei, G., 1991**. *Trypanosoma congolense* infections in complement C5-deficient mice. (Meeting abstract.) *Complement and Inflammation*, **8** (3-4): 228.
Department of Veterinary Microbiology, University of Saskatchewan, Saskatoon, Canada.

(c) CHEMOTHERAPEUTICS

[See also **16**: nos. 7744, 7759.]

7723 **Kaminsky, R., 1992**. Current status of *in vitro* assays for identifying drug-resistant trypanosomes. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 33.
ILRAD, P.O. Box 30709, Nairobi, Kenya.
Different drug susceptibilities of trypanosomes in cattle or mice usually correlate with different susceptibilities to drugs in *in vitro* cultures when bloodstream or metacyclic forms are used. Criteria used to determine susceptibility are infectivity, metabolism ($^{3}$H-hypoxanthine incorporation), growth (24 h inhibition) and mortality rate in long-term cultures. The use of insect-form trypanosomes has several advantages over the use of bloodstream forms. Most *Trypanosoma brucei brucei* and *T. congolense* trypomastigotes transform easily into procyclic forms *in vitro*. However, in many cases drug-induced inhibition of growth or $^{3}$H-hypoxanthine incorporation does not correlate with different drug susceptibilities *in vivo*.

7724 **Kaminsky, R., Zweygarth, E. and Kratzer, R.D., 1992**. Preliminary studies on the uptake and efflux of radiolabelled drugs by susceptible and drug-resistant *Trypanosoma brucei brucei*. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 59.
ILRAD, P.O. Box 30709, Nairobi, Kenya; KETRI, P.O. Box 362, Kikuyu, Kenya; ibid.
The uptake of $^{14}$C-labelled diminazene aceturate and isometamidium chloride by bloodstream-form *in vitro* cultures of drug-sensitive and drug-resistant *T. b. brucei* was followed for 24 h. Similar drug concentrations to those in treated animals were used. With isometamidium chloride, no differences were detected in uptake by one sensitive and two resistant stocks/clones and the rate

of efflux was also similar between sensitive and resistant cultures. With diminazene aceturate, drug uptake was about four times higher in two sensitive clones when compared with two resistant clones.

7725 **Lemecha, H., 1992**. Use of radiolabelled trypanocides for sensitivity screening. (Abstract only.) *In*: IAEA, 1992 (see **16**: no. 7644), p. 61.

Shola Zonal Veterinary Laboratory, P.O. Box 62347, Addis Ababa, Ethiopia.

One of the major constraints of trypanosomiasis control using trypanocides is the development of drug resistance. The use of radiolabelled trypanocides could be of immense practical significance in elucidating the mechanisms of this resistance and in determining whether trypanosomes develop actual resistance to the drug or evade its effects by retreating to inaccessible (cryptic) sites in the body. Some irregular trypanosome forms observed in tissues of mice exposed to trypanocides suggest that trypanosomes may be able to revert to forms less susceptible to attack.

7726 **Onyeyili, P.A., Egwu, G.O., Zaria, L.T. and Orjiude, B.A., 1991.** DL-α-difluoromethylornithine (DFMO$^{\varepsilon}$) - Berenil$^{\varepsilon}$ combination: therapeutic and prophylactic activity against *Trypanosoma brucei brucei* infection in mice. *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **44** (4): 443-445.

Faculty of Veterinary Medicine, University of Maiduguri, Maiduguri, Nigeria.

7727 **Sones, K.R. and Holmes, P.H., 1992**. The influence of the size of the initial inoculum on the efficacy of isometamidium (Samorin) on a stock of *Trypanosoma congolense*. [Mice.] *Acta Tropica*, **51** (3-4): 213-216.

Sones: P.O. Box 24270, Nairobi, Kenya.

## 8. TRYPANOSOME RESEARCH

### (a) CULTIVATION OF TRYPANOSOMES

[See also **16**: nos. 7672, 7735, 7758.]

7728 **Carruthers, V.B. and Cross, G.A.M., 1992**. High-efficiency clonal growth of bloodstream- and insect-form *Trypanosoma brucei* on agarose plates. *Proceedings of the National Academy of Sciences of the United States of America*, **89** (18): 8818-8821.

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

7729 **Hirumi, H., Hirumi, K., Moloo, S.K. and Shaw, M.K., 1992**. *Trypanosoma brucei brucei*: *in vitro* production of metacyclic forms. *Journal of Protozoology*, **39** (5): 619-627.

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

7730 **Zweygarth, E., Moloo, S.K., Kaminsky, R. and Gray, M.A., 1992**. Axenic *in vitro* cultivation of *Trypanosoma simiae* bloodstream trypomastigotes. *Acta Tropica*, **52** (1): 79-81.
Zweygarth: KETRI, P.O. Box 362, Kikuyu, Kenya.

(b) TAXONOMY, CHARACTERISATION OF ISOLATES

7731 **Dukes, P., Gibson, W.C., Gashumba, J.K., Hudson, K.M., Bromidge, T.J., Kaukus, A., Asonganyi, T. and Magnus, E., 1992**. Absence of the LiTat 1.3 (CATT antigen) gene in *Trypanosoma brucei gambiense* stocks from Cameroon. *Acta Tropica*, **51** (2): 123-134.
Dukes: MRC, 20 Park Cresent, London W1N 4AL, UK.
Antibodies to the VAT designated LiTat 1.3 are common in sera from parasitologically confirmed patients with gambian sleeping sickness. For this reason, LiTat 1.3 has been considered a suitable antigen for detecting *T. b. gambiense* in the CATT (Testryp-CATT, Smith Kline-RIT). However, surveys in the *T. b. gambiense* endemic focus of Fontem in Cameroon have suggested that expression of LiTat 1.3 might be rare or absent. It is confirmed that the gene for LiTat 1.3 was indeed absent from some *T. b. gambiense* stocks isolated from this focus and that a LiTat 1.3-like gene was present in others. The divergent gene differed from the cloned version of LiTat 1.3. In addition, antibodies to LiTat 1.3 could not be detected in rabbits infected with either of the two kinds of *T. b. gambiense* from the Fontem area. It is suggested that the absence of LiTat 1.3 expression in this focus may have important implications for the epidemiology and control of sleeping sickness, especially if heavy reliance is placed on the CATT.

7732 **Tibayrenc, M., Kjellberg, F. and Ayala, F.J., 1991**. The clonal theory of parasitic Protozoa. *Bioscience*, **41** (11): 767-774.
Laboratoire de Génétique des Parasites et des Vecteurs, Institut Français de Recherche pour le Développement en Coopération, F-34032 Montpellier Cedex, France; Centre d'Ecologie Fonctionnelle et Evolutive, CNRS, F-34033 Montpellier, France; Department of Ecology and Evolutionary Biology, University of California, Irvine, CA 92717, USA.
Clonal reproduction in parasitic Protozoa can only be resolved by obtaining genetic data from populations that can be used to determine the frequency distribution of genotypes in nature, and whether such distribution is consistent with the occurrence of segregation and recombination. Population genetic

criteria for clonal reproduction are presented and discussed. When applied to *Trypanosoma brucei* these criteria are satisfied and strongly indicate a clonal population structure. With *T. congolense* there is evidence for clonality but the limited number of markers prevents equating the strains with actual clones. Possible sources of error and the implications for systematics and nomenclature are discussed. It is proposed that individual clones within a named species be identified by the binomial followed by two capital letters and a sequential number, e.g. *T. brucei* TA1 and TA2. Any clone that has been characterised and named should be deep-frozen for future reference. The term clonet is proposed for independently sampled isolates that appear to be genetically identical, to be used in preference to the terms natural clone and strain.

7733 **Uche, U.E., Ross, C.A. and Jones, T.W., 1992**. Identification of the surface components of *Trypanosoma evansi. Research in Veterinary Science*, **53** (2): 252-253.

Uche: Department of Veterinary Pathology, Royal Veterinary College, Royal College Street, London NW1 0TU, UK.

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

7734 **Aboagye-Kwarteng, T., Smith, K. and Fairlamb, A.H., 1992**. Molecular characterization of the trypanothione reductase gene from *Crithidia fasciculata* and *Trypanosoma brucei*: comparison with other flavoprotein disulphide oxidoreductases with respect to substrate specificity and catalytic mechanism. *Molecular Microbiology*, **6** (21): 3089-3099.

Fairlamb: Department of Medical Parasitology, LSHTM, Keppel Street, London WC1E 7HT, UK.

7735 **Arnold, K., Gooday, G. and Chappell, L., 1992**. Chitinases in Trypanosomatidae: a cautionary note. [*T. b. brucei*.] (Letter.) *Parasitology Today*, **8** (8): 273. (See also **16**: no. 7758.)

Arnold: Department of Molecular and Cell Biology, Marischal College, Aberdeen AB9 1AS, UK.

7736 **Bangs, J.D., Crain, P.F., Hashizume, T., McCloskey, J.A. and Boothroyd, J.C., 1992**. Mass spectrometry of mRNA cap 4 from trypanosomatids reveals two novel nucleosides. [Incl. *T. brucei*.] *Journal of Biological Chemistry*, **267** (14): 9805-9815.

Boothroyd: Department of Microbiology and Immunology, D-305 Fairchild Building, Stanford

University School of Medicine, Stanford, CA 94305, USA.

7737 **Beals, T.P. and Boothroyd, J.C., 1992**. Genomic organization and context of a trypanosome variant surface glycoprotein gene family. [*T. b. brucei*.] *Journal of Molecular Biology*, **225** (4): 961-971.
Boothroyd: Department of Microbiology and Immunology, D-305 Fairchild Building, Stanford University School of Medicine, Stanford, CA 94305, USA.

7738 **Beals, T.P. and Boothroyd, J.C., 1992**. Sequence divergence among members of a trypanosome variant surface glycoprotein gene family. [*T. brucei*.] *Journal of Molecular Biology*, **225** (4): 973-983.
Boothroyd: Department of Microbiology and Immunology, D-305 Fairchild Building, Stanford University School of Medicine, Stanford, CA 94305, USA.

7739 **Bender, K., Betschart, B. and Hecker, H., 1992**. Histone-DNA interactions in the chromatin of procyclic *Trypanosoma brucei brucei*. *Parasitology Research*, **78** (6): 495-500.
Hecker: Swiss Tropical Institute, Postfach, CH-4002 Basel, Switzerland.

7740 **Bender, K., Betschart, B., Marion, C., Michalon, P. and Hecker, H., 1992**. Structural differences between the chromatin of procyclic *Trypanosoma brucei brucei* and of higher eukaryotes as probed by immobilized trypsin. *Acta Tropica*, **52** (1): 69-78.

Hecker: Swiss Tropical Institute, Postfach, CH-4002 Basel, Switzerland.

7741 **Byers, T.L., Casara, P. and Bitonti, A.J., 1992**. Uptake of the antitrypanosomal drug 5∫-([*Z*)-4-amino-2-butenyl]methylamino)-5∫-deoxyadenosine (MDL 73811) by the purine transport system of *Trypanosoma brucei brucei*. *Biochemical Journal*, **283** (3): 755-758.

Bitonti: Marion Merrell Dow Research Institute, 2110 E. Galbraith Road, Cincinnati, OH 45215, USA.

7742 **Cazzulo, J.J., 1992**. Aerobic fermentation of glucose by trypano-somatids. (Review.) [Incl. *T. brucei*.] *FASEB Journal*, **6** (13): 3153-3161.

Instituto de Investigaciones Bioquímicas `Luis F. Leloir', Fundación Campomar - CONICET - Facultad de Ciencias Exactas y Naturales, Universidad de Buenos Aires, 1405 Buenos Aires, Argentina.

7743 **Harris, M.E. and Hajduk, S.L., 1992**. Kinetoplastid RNA editing: *in vitro* formation of cytochrome b gRNA-mRNA chimeras from synthetic substrate RNAs. [*T. brucei*.] *Cell*, **68** (6): 1091-1099.

Department of Biochemistry, Schools of Medicine and Dentistry, University of Alabama, Birmingham, AL 35294, USA.

7744 **Hunter, W.N., Bailey, S., Habash, J., Harrop, S.J., Helliwell, J.R., Aboagye-Kwarteng, T., Smith, K. and Fairlamb, A.H., 1992**. Active site of trypanothione reductase: a target for rational drug design. *Journal of Molecular Biology*, **227** (1): 322-333.

Hunter: Department of Chemistry, University of Manchester, Oxford Road, Manchester M13 9PL, UK.

7745 **Irvine, J.W., Coombs, G.H. and North, M.J., 1992**. Cystatin-like cysteine proteinase inhibitors of parasitic protozoa. [Incl. *T. brucei*.] *FEMS Microbiology Letters*, **96** (1): 67-72.

Irvine: Laboratory for Biochemical Parasitology, Department of Zoology, University of Glasgow, Glasgow G12 8QQ, UK.

7746 **Koenig-Martin, E., Yamage, M. and Roditi, I., 1992**. A procyclin-associated gene in *Trypanosoma brucei* encodes a polypeptide related to ESAG 6 and 7 proteins. *Molecular and Biochemical Parasitology*, **55** (1-2): 135-145.

Roditi: Institut für Allgemeine Mikrobiologie, Baltzerstrasse 4, CH-3012 Bern, Switzerland.

7747 **Kuile, B.H. ter, Wiemer, E.A.C., Michels, P.A.M. and Opperdoes, F.R., 1992**. The electrochemical proton gradient in the bloodstream form of *Trypanosoma brucei* is dependent on the temperature. *Molecular and Biochemical Parasitology*, **55** (1-2): 21-27.

Opperdoes: Research Unit for Tropical Diseases, International Institute of Cellular and Molecular Pathology, ICP-TROP 74.39, Avenue Hippocrate 74, B-1200 Brussels, Belgium.

7748 **Kuntz, D.A., Osowski, R., Schudok, M., Wierenga, R.K., Müller, K., Kessler, H. and Opperdoes, F.R., 1992**. Inhibition of triosephosphate isomerase from *Trypanosoma brucei* with cyclic hexapeptides. *European Journal of Biochemistry*, **207** (2): 441-447.

Opperdoes: Research Unit for Tropical Diseases, International Institute of Cellular and Molecular Pathology, ICP-TROP 74.39, Avenue Hippocrate 74, B-1200 Brussels, Belgium.

7749 **Kuntz, D.A., Phillips, M.A., Moore, T.D.E., Craig, S.P., Bass, K.E. and Wang, C.C., 1992**. The translation initiation site of recombinant *Trypanosoma brucei* ornithine decarboxylase varies with different promoters. *Molecular and Biochemical Parasitology*, **55** (1-2): 95-104.

Wang: Department of Pharmaceutical Chemistry, University of California, San Francisco, CA 94143-0446, USA.

7750 **Leichus, B.N., Bradley, M., Nadeau, K., Walsh, C.T. and Blanchard, J.S., 1992**. Kinetic isotope effect analysis of the reaction catalyzed by *Trypanosoma congolense* trypanothione reductase. *Biochemistry*, **31** (28): 6414-6420.

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

7751 **Li, X. and Coffino, P., 1992**. Regulated degradation of ornithine decarboxylase requires interaction with the polyamine-inducible protein antizyme. [*T. brucei*.] *Molecular and Cellular Biology*, **12** (8): 3556-3562.

Coffino: Department of Microbiology and Immunology, University of California, San Francisco, CA 94143, USA.

7752 **McNally, K.P. and Agabian, N., 1992**. *Trypanosoma brucei* spliced-leader RNA methylations are required for *trans* splicing *in vivo*. *Molecular and Cellular Biology*, **12** (11): 4844-4851.

Agabian: Intercampus Program in Molecular Parasitology, Laurel Heights Campus, University of California, San Francisco and Berkeley, San Francisco, CA 94143-1204, USA.

7753 **Milne, K.G., Ferguson, M.A.J. and Masterson, W.J., 1992**. Inhibition of the GLcNAc transferase of the glycosylphosphatidylinositol anchor biosynthesis in African trypanosomes. [*T. brucei*.] *European Journal of Biochemistry*, **208** (2): 309-314.

Milne: Department of Biochemistry, Medical Sciences Institute, University of Dundee, Dundee DD1 4HN, UK.

7754 **Misek, D.E. and Saltiel, A.R., 1992**. An inositol phosphate glycan derived from a *Trypanosoma brucei* glycosyl-phosphatidylinositol mimics some of the metabolic actions of insulin. *Journal of Biological Chemistry*, **267** (23): 16266-16273.

Saltiel: Department of Signal Transduction, Parke-Davis Pharmaceutical Research Division, Warner-Lambert Co., Ann Arbor, MI 48105, USA.

7755 **Nolan, D.P. and Voorheis, H.P., 1992**. The mitochondrion in bloodstream forms of *Trypanosoma brucei* is energized by the electrogenic pumping of protons catalysed by the $F_1F_0$-ATPase. *European Journal of Biochemistry*, **209** (1): 207-216.

Voorheis: Department of Biochemistry, Trinity College, Dublin 2, Ireland.

7756 **Palfi, Z. and Bindereif, A., 1992**. Immunological characterization and intracellular localization of *trans*-spliceosomal small nuclear ribonucleoproteins in *Trypanosoma brucei*. *Journal of Biological Chemistry*, **267** (28): 20159-20163.

Bindereif: Max-Planck-Institut für Molekulare Genetik, Otto-Warburg-Laboratorium, Ihnestrasse 73, D-1000 Berlin 33 (Dahlem), Germany.

7757 **Pollard, V.W., Harris, M.E. and Hajduk, S.L., 1992**. Native mRNA editing complexes from *Trypanosoma brucei* mitrochondria. *EMBO Journal*, **11** (12): 4429-4438.

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

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