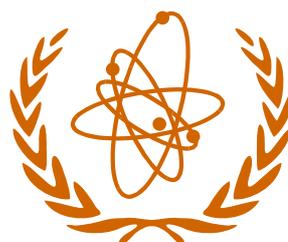


TSETSE AND TRYPANOSOMIASIS INFORMATION QUARTERLY

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section b - abstracts

1. general (including land use)

8586 **Bauer, B. and Amsler, S., 1993.** The various vector control activities of the Centre de Recherches sur les Trypanosomoses Animales (CRTA). *In*: IAEA, 1993 (see **17**: no. 8587), pp. 619-623.

Bauer: CRTA, B.P. 454, Bobo-Dioulasso 01, Burkina Faso. CRTA is in a transitional stage. Financed by the EC, France and Italy, it is soon to become the Centre International de Recherche-Développement sur l'Élevage en Zone Sub-humide (CIRDES), an institution with a regional mandate that covers, apart from vector control, various other aspects, such as the epidemiology and economics of parasitic diseases and their control, animal production and husbandry systems, including characterisation of trypanotolerant cattle, resistance of crossbreeds, training of national staff at different levels, and extension activities in the field. Tsetse control studies in the laboratory are being carried out on olfactory attractants to the riverine species *Glossina palpalis gambiensis* and *G. tachinoides*, for instance from reptiles (monitor lizards, crocodiles, snakes). The persistence and efficiency of pyrethroids are being tested, after impregnation of the tissues used for traps and targets, and after application on cattle. The rearing of ticks is also beginning and CRTA is continuing to rear different species of tsetse fly that can be used by other countries or organisations for their SIT programmes. In the field, many experiments are being carried out to improve traps and targets (shapes, colours, attractants, etc.) and entomological surveys are being carried out regularly in co-ordination with other programmes.

8587 **International Atomic Energy Agency, 1993.** *Management of insect pests: nuclear and related molecular and genetic techniques* (Proceedings of an International Symposium jointly organised by the International Atomic Energy Agency and the Food and Agriculture Organisation of the United Nations, and held in Vienna, Austria, 19-23 October 1992). Vienna, Austria; IAEA (STI/PUB/909). 669 pp. IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

The presentations in this Symposium focused on advances and trends in insect control and eradication, genetic engineering and molecular biology, insect genetics, operational SIT programmes, F₁ sterility and behaviour, biocontrol, tsetse fly research and development, and

quarantine. Of the 60 papers and four posters presented and included in these Proceedings, abstracts of the 10 on tsetse are given in this issue of *TTIQ* (see nos. 8586, 8588, 8589, 8592, 8594, 8597, 8604, 8605, 8607, 8609).

2. tsetse biology

(a) REARING OF TSETSE FLIES

[See also **17**: no. 8589.]

8588 **Feldmann, U., 1993.** Rearing tsetse flies for use in sterile insect technique vector control programmes.

In: IAEA, 1993 (see **17**: no. 8587), pp. 579-601.

Insect and Pest Control Section, Joint FAO/IAEA Division, IAEA, Wagramerstrasse 5, P.O. Box 100, A-1400 Vienna, Austria.

In past years, considerable progress has been achieved in the mass rearing of tsetse flies for use in vector control programmes. This was made possible through the introduction of the membrane feeding system and the development of strict quality control procedures for different developmental stages of tsetse and for various aspects that are relevant to insect production, such as blood diet quality screening. The maintenance of large tsetse fly colonies, e.g. more than 100,000 producing females that may provide more than 12,000 reproductively sterile males and equal numbers of surplus female material, is feasible without major efforts. Calculations of labour requirements and the costs involved for different mass rearing systems can now be conducted. Depending on the purpose for which the insects are reared, different types of mass rearing facilities may be erected (a small stationary insect factory, large breeding centre or mobile production plant). Sexually sterile tsetse from a mass rearing system may be used for different reasons in tsetse control or eradication campaigns, namely for eradication or control through the SIT, for ecological monitoring of a target tsetse population, particularly if it is under advanced control, and for transtaxon control of closely related species (or subspecies). Bottlenecks for a larger scale field use of mass reared tsetse remain for the time being: (a) the relatively long process of strain adaptation to mass rearing conditions, (b) laborious sexing procedures of mature insects upon emergence and after mating, and (c) unavailability of simple genetic tools to collect baseline information on the suitability of a mass reared strain to combat an identified target population and to assess the degree of isolation of a target

population.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

8589 **Blanchetot, A. and Gooding, R.H., 1993.** Genetic fingerprinting applied to tsetse fly species. *In*: IAEA, 1993 (see **17**: no. 8587), pp. 167-173.

Blanchetot: Department of Biochemistry, University of Saskat-chewan, Saskatoon, Saskatchewan, S7N 0W0, Canada.

The bacteriophage M13 was used as a probe to detect DNA fingerprinting (DNAfp) profiles in adults from laboratory colonies of the three subgenera of tsetse flies (*Austenina* [*Glossina brevipalpis*, *G. longipennis*], *Nemorhina* [*G. p. palpalis*, *G. p. gambiensis*] and *Glossina* [*G. pallidipes*, *G. m. morsitans*, *G. m. submorsitans*, *G. m. centralis*]). In all three subgenera, the probe revealed profiles of multiple components similar to those found in other organisms. The general complexity of the profiles varied between subgenera and between species and subspecies. A common overall DNAfp pattern was observed within a subspecies but variations occurred at the intrapopulation level. Evidence is presented that DNAfp provides a means for population biology studies, such as comparisons between field collected flies and those from established laboratory colonies. Pedigree analysis was performed in the context of further development of a genetic linkage map using DNAfp markers and studies related to the molecular basis of hybrid sterility in tsetse flies. A pedigree established by mating a male and a female from different lines ('RUCA' \times 'Cent') of *G. m. centralis* showed, in addition to a Mendelian inheritance of DNAfp fragments, an amplification of the intensity of certain bands in the offspring. It is suggested that DNAfp offers a tool for analysing the molecular genetic aspects of mating flies from different geographical areas.

8590 **Blanchetot, A. and Gooding, R.H., 1994.** Genetic variability and segregation analysis in *Glossina morsitans morsitans* (Diptera: Glossinidae) using DNA fingerprinting. *Genome*, **37** (2): 289-295.

Blanchetot: Department of Biochemistry, University of Saskat-chewan, Saskatoon, Saskatchewan, S7N 0W0, Canada.

DNA hybridisation, using the M13 sequence as a probe, was used to analyse the genetic variability in four inbred lines of *G. m. morsitans*. An average of 11.2 bands (ranging from 2 to 20 kb) were found per fly. An

average of nine loci were detected in each line; 40% of the loci were polymorphic and the mean heterozygosity per locus varied from 0.098 to 0.29. Averaging the data across the four inbred lines, the band sharing estimates were 82.5% in males and 81.2% in females, and the mean band frequency estimates were 0.71 and 0.70 for males and females, respectively. Segregation of fragments, determined in 'three generation' pedigrees, conformed to expected Mendelian ratios and two of seven fragments studied were linked to an X chromosome marker gene, *ocra* (body colour).

8591 **Goldring, J.P.D. and Read, J.S., 1994.** Insect acetyl-CoA carboxylase: enzyme activity during adult development and after feeding in the tsetse fly, *Glossina morsitans*. *Comparative Biochemistry and Physiology (B)*, **108** (1): 27-33.
Goldring: Department of Biochemistry, University of the Witwatersrand, P.O. 2050 Wits, Johannesburg, South Africa.

Acetyl-CoA carboxylase (EC 6.1.4.2) activity in adult *G. morsitans* increased 2-3 days after pupation to reach a plateau of between 0.4 and 0.6 $\mu\text{mol}/\text{min}/\text{mg}$ after 7 days, and between 0.6 and 0.8 $\mu\text{mol}/\text{min}/\text{mg}$ after 6 days in the abdomens of male and female flies, respectively. The enzyme showed a 50-70% increase in specific activity within 20 h after a blood meal in previously starved flies. Lipogenesis and acetyl-CoA carboxylase activity were detected in the thorax, the abdominal cuticle and, in greatest quantity, in the fat body.

8592 **Gooding, R.H., 1993.** Hybridization of *Glossina swynnertoni* with subspecies of *Glossina morsitans* (Diptera: Glossinidae): implications for use of hybrid sterility and satyrs for genetic control of tsetse. *In*: IAEA, 1993 (see **17**: no. 8587), pp. 603-617.
Department of Entomology, University of Alberta, Edmonton, Alberta, T6G 2E3, Canada.

Adult *G. swynnertoni* that emerged from puparia collected during 1989 and 1991 near Makuyuni, Tanzania, and their progeny were hybridised with *G. morsitans centralis*, *G. m. morsitans* or *G. m. submorsitans*. All the *G. swynnertoni* females were receptive and mated readily, regardless of whether they were placed with conspecifics or members of a subspecies of *G. morsitans*. *G. swynnertoni* males attempted to mate with females of all three subspecies of *G. morsitans*; the order of increasing success in pair formation was *G. m. centralis*, *G. m. morsitans* and *G. m. submorsitans*. About 50% of the *G. swynnertoni* females were fertilised by conspecific males, about 25% by *G. m. centralis* and none were fertilised by *G. m. morsitans* or *G. m. submorsitans*. *G.*

swynnertoni males fertilised from 35% (*G. m. submorsitans*) to 68% (*G. m. morsitans*) of their mates. All the F₁ hybrid males were sterile, but most of the F₁ hybrid females were fertile and could be backcrossed¹ to either parental taxon. Recurrent backcrossing produced sterile and fertile males, and an X chromosome marker gene was used to demonstrate that a major cause of male hybrid sterility was an incompatibility of the sex chromosomes of *G. swynnertoni* with those of *G. m. centralis* and *G. m. morsitans*.

8593 **Matsuyama, K. and Mori, K., 1994.** Pheromone synthesis. 159. Synthesis of a stereoisomeric mixture of 13,25-, 11,21- and 11,23-dimethylheptatriacontane, the contact sex pheromone of the tsetse fly, *Glossina tachinoides*.

Bioscience Biotechnology and Biochemistry, **58** (3): 539-543.

Mori: Department of Agricultural Chemistry, University of Tokyo, 1-1-1 Yayoi, Bunkyo-ku, Tokyo 113, Japan.

13,25- and 11,23-dimethylheptatriacontane, the major components of the cuticular hydrocarbons of *G. tachinoides*, as well as 11,21-dimethyl-heptatriacontane, the minor component, were synthesised as stereoisomeric mixtures by synthetic routes in which the molecular symmetry of the target hydrocarbons was taken advantage of.

8594 **Volf, P., Grubhoffer, L. and Muska, M., 1993.** Detection and identification of tissue specific lectins of the tsetse fly, *Glossina tachinoides*: midgut lectin activity with lipopolysaccharide binding specificity. *In*: IAEA, 1993 (see **17**: no. 8587), pp. 557-565.

Volf: Department of Parasitology, Charles University, Vinicna 7, CS-12844 Prague 2, Czech Republic.

Lectin that agglutinates human and animal red blood cells (RBCs) was demonstrated in midgut extracts of *G. tachinoides*. The highest haemagglutination titres were against pig and rabbit RBCs. Treatment of rabbit RBCs with pronase, trypsin, neuraminidase, bromelain, glutaraldehyde and periodate reduced the agglutination titres. The lectin is specific for amino, methyl and deoxy derivatives of glucose, amino and methyl derivatives of mannose, D-galactosamine, N-acetylneuraminic acid and trehalose. In addition, very high reactivity against the lipopolysaccharide of *E. coli* K 235 was found. Lectin is secreted to the midgut lumen. It consists of a 27 kDa protein component that is not glycosylated. Sandwich ELISA permits quantification of lectin in tissue samples.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION

STUDIES

8595 **Davies-Cole, J.O.A., Morgan, H.G., Chaudhury, M.F.B. and Kaaya, G.P., 1993.** Some aspects of sexual receptivity and refractory behaviour in female *Glossina morsitans morsitans* Westwood. *Insect Science and its Application*, **14** (5/6): 723-727. Davies-Cole: African Biodiversity Institute, AACC Building, Waiyaki Way, P.O. Box 14126, Nairobi, Kenya. Sexual receptivity after mating was investigated in female *G. m. morsitans*. When females mated with immature males, the degree of insemination and duration of copulation could have an effect on subsequent sexual receptivity. However, matings with mature males showed no effect. The 'jerking phase' appears to be an important mechanical factor in female post-mating refractory behaviour.

8596 **Gouteux, J.-P., Blanc, F., Pounékrozou, E., Cuisance, D., Mainguet, M., D'Amico, F. and Le Gall, F., 1994.** Tsé-tsé et élevage en République Centrafricaine: le recul de *Glossina morsitans submorsitans* (Diptera, Glossinidae). [Tsetse and livestock production in the Central African Republic: the retreat of *G. m. submorsitans*.] *Bulletin de la Société de Pathologie exotique*, **87** (1): 52-56.

Gouteux: ORSTOM, c/o Laboratoire de Mathématiques Appliquées, Université de Pau et des Pays de l'Adour, F-64000 Pau, France.

In the early 1960s, the greater part of the Central African Republic lay within the distribution area of *G. m. submorsitans*. Since the last distribution studies of this species in 1963, the number of cattle has increased dramatically from 400,000 to approximately 2 million, mainly of the Mbororo Zebu breed. To discover the present distribution of *G. m. submorsitans*, a large study was under-taken in 27 livestock areas, comprising about 1200 pastoralists' settlements. In addition, north-south transects were made by means of both trapping (bipyramidal traps placed every 2000 m) and net-catching (slow-moving vehicle). Results have shown the disappearance of *G. m. submorsitans* from the main livestock areas in the west (Bouar, Bozoum, Bocaranga, Batangafo, Bossangoa, Paoua), centre (Bossembélé, Bouca, Dékoa) and east (Bambari, Grimari, Ippy). The southern border of the distribution area has moved northwards by up to 400 km in the west of the country. The possible reasons for this retreat are discussed. As a result, the pastures available to the Mbororo pastoralists have considerably increased, though access is still restricted in the north-central and eastern parts of the country where wild game reserves harbour

G. m. submorsitans.

8597 **Hargrove, J.W., 1993.** Age dependent sampling biases in tsetse flies (*Glossina*): problems associated with estimating mortality from sample age distributions.

In: IAEA, 1993 (see 17: no. 8587), pp. 549-556.

Insect Pest Management Initiative, Tsetse and Trypanosomiasis Control Branch, P.O. Box 8283, Causeway, Harare, Zimbabwe.

For a closed (island) population of *G. morsitans morsitans*, the probability per week of capturing females on ox fly rounds was about 0.3 in the first week of life, less than 0.2 for 27 to 35-day-old flies and greater than 0.4 for flies more than 80 days old. For open populations, the relative changes in capture probability were measured from the ovarian age distributions of trap and ox fly round samples. They were used (with the island data) to show that the age-dependent sampling bias of traps for female *G. m. morsitans* increased more than sixfold over the first 80 days of life. The age dependent bias for *G. pallidipes* taken from odour-baited traps is probably at least as serious as for *G. m. morsitans*. Estimates of daily mortality from the mark-recapture studies were always (up to 20 times) higher than estimates from ovarian age samples taken at the same times. The mortalities recalculated from samples adjusted for sampling biases were closer to, but still lower than, the mark-recapture estimates. Odour-baited targets are successful in controlling tsetse populations, despite the relatively low probability of treating young females. If sterilants instead of insecticides were used on the targets, young females could be treated indirectly via treated males, which transfer the sterilant to virgin females during copulation.

8598 **Kyorku, C. and Brady, J., 1994.** A free-running bimodal circadian rhythm in the tsetse fly *Glossina longipennis*.

Journal of Insect Physiology, 40 (1): 63-67.

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

In nature, the tsetse fly *G. longipennis* restricts its activity to ~1 h around sunset and a lesser peak at dawn. This markedly crepuscular rhythm was investigated in actographs under constant conditions in the laboratory. In LD 12:12 with 30-min dawns and dusks, the evening activity started as the lights dimmed, peaked in the first hour of darkness, and then declined rapidly to near zero, to peak again for ~1 h at dawn. Virtually no activity occurred through the

central 8 light hours of the photophase. In constant darkness, this pattern of a major 'dusk' and minor 'dawn' peak was repeated in the males for at least three cycles, with a free-running period of ~23 h. This is the first demonstration of a fully endogenous bimodal rhythm in tsetse flies.

8599 **Mohamed-Ahmed, M.M., Abdel Karim, E.I. and Rahman, A.H.A., 1993.** Reproductive status, catch and age compositions of a natural population of *Glossina morsitans submorsitans* in Bahr El Arab fly belt, Sudan. *Insect Science and its Application*, **14** (4): 445-453.

Mohamed-Ahmed: Livestock Pests Research Programme, ICIPE, P.O. Box 30772, Nairobi, Kenya.

Studies were conducted during the dry period February to May 1986 in River Shelliekha, Bahr El Arab fly belt, Sudan, to obtain baseline data on catch and age compositions, reproductive status and trypanosome infection rates of trapped and fly round samples of *G. m. submorsitans*. The objective was to assess the tsetse situation before the establishment of trypanosomiasis treatment stations at the northern limits of the fly belt. Trapped tsetse included significantly higher proportions of teneral and non-teneral females and a lower male:female ratio. Insemination rates were over 98% in both samples. In any one group, the frequency of pregnancy with egg predominated, followed by the second, first and lastly the third instar larva. There were significant differences between the two groups of females in the proportions of nullipars and pregnancy with any one of the larval instars. Abortion was the predominant reproductive abnormality and no relationship could be found between abortion rate and the sampling method, age or trypanosome infection rate of females. Age compositions were similar in the two samples, save for age categories 0 and 1 for females and 2 and 4 for males. Flies were infected with *Trypanosoma vivax* and *T. congolense* only, though *T. brucei* infections could also be diagnosed in livestock.

8600 **Moloo, S.K., 1993.** The distribution of *Glossina* species in Africa and their natural hosts. *Insect Science and its Application*, **14** (4): 511-527.

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

The distribution of 31 *Glossina* spp. and subspecies belonging to *fusca*, *palpalis* and *morsitans* groups is given for 38 African countries. The natural hosts of 17 tsetse species and subspecies from many areas within different regions of Africa are also given. These were collated from the results of both published and

unpublished work, for the period 1953 to 1991 inclusive, comprising altogether 47,697 bloodmeals. This review is aimed at providing current knowledge on the distribution as well as the natural hosts of tsetse.

8601 **Owaga, M.L.A., Okelo, R.O. and Chaudhury, M.F.B., 1993.** Diel activity pattern of the tsetse fly *Glossina austeni* Newstead (Diptera: Glossinidae) in the field and in the laboratory. *Insect Science and its Application*, **14** (5/6): 701-705.

Owaga: ICIPE, P.O. Box 30772, Nairobi, Kenya. The diel activity pattern of *G. austeni* was studied on the south coast of Kenya and in the laboratory. In the field, flies were sampled hourly by continuous catch from a standing vehicle or by traps. In the laboratory, observations were made of the flies' take-off responses to host odour at various times of the diel cycle in a flight chamber. The results showed that *G. austeni* is day-active with some activity throughout daylight hours (06.00-18.00 h) but with significant peaks occurring at 09.00-10.00 h and between 14.00 and 17.00 h, i.e. a roughly V-shaped pattern.

8602 **Williams, B., 1994.** Models of trap seeking by tsetse flies: anemotaxis, klinokinesis and edge detection. *Journal of Theoretical Biology*, **168** (1): 105-115.

LSHTM, Keppel Street, London WC1E 7HT, UK.

Odour-baited traps and targets provide a powerful method for controlling tsetse flies and the trypanosome diseases of which they are the vectors. In this paper we present three models of the way in which tsetse flies might locate odour-baited traps or targets. The first model is one of anemotaxis in which tsetse use directional information in the wind to locate the source of an odour. Anemotaxis is likely to be useful when the wind is steady and the vegetation is open. The second model is one of klinokinesis in which there is no directional information available to the fly which is only able to detect the presence or absence of the odour. Klinokinesis might be used when the wind is very variable or the vegetation is closed. The third model is 'edge detection' in which the flies are only able to detect the edge of odour plumes. This strategy might be useful if the odour is evenly dispersed. Anemotaxis is a very efficient way of locating the source of an odour even when the directional information in the wind is slight. Klinokinesis increases the probability of a fly locating the source

of an odour but the best strategy is still not very efficient. Edge detection is very efficient but depends on the spatial distribution of the odour. The strategies available within each model can be regarded as 'careful navigation', 'point-and-shoot' or 'intensive searching'. Which of these is used by the flies depends critically on the amount of time for which a tsetse can remain in flight, the rate at which the flies sample the wind direction (for anemotaxis) and the turning rate (for klinokinesis). More detailed experimental information is needed in order to assess the relative merits of the various strategies in field situations.

3. tsetse control (including environmental side-effects)

[See also **17**: nos. 8586, 8588, 8592, 8597, 8607, 8609.]

8603 **Fox, R.G.R., Mmbando, S.O., Fox, M.S. and Wilson, A., 1993.**

Effect on herd health and productivity of controlling tsetse and trypanosomiasis by applying deltamethrin to cattle. *Tropical Animal Health and Production*, **25** (4): 203-214. R.G.R. Fox: Mkwaja Ranch, c/o Amboni Ltd, P.O. Box 117, Tanga, Tanzania. (Reprint requests to: Martin Mitchell, Export Business Group, Pitman-Moore Ltd, Breakspear Road South, Harefield, Uxbridge, Middlesex UB9 6LS, UK.)

A large cattle ranch was established in 1954 in a heavily tsetse-infested part of north-east Tanzania. Trypanosomiasis was controlled for 30 years by prophylactic drugs but in 1988 drug resistance seemed to be developing as cases of trypanosomiasis were being confirmed 4 or 5 weeks after treatment with isometamidium chloride (Samorin). Herd health had deteriorated and productivity was uneconomically low. In order to control the tsetse population, the 8000 cattle, grazing over 250 km², were regularly dipped in the synthetic pyrethroid deltamethrin (Decatix Cattle Dip and Spray formulation). Within a year the tsetse population, as monitored by traps, had decreased by more than 90%. Disease mortality decreased by 66% and a range of productivity measures such as calving percentages and weaning weights were raised to levels above those prevailing before the decline in herd health.

8604 **Offori, E.D., 1993.** Tsetse sterile insect technique programmes in Africa: review and analysis of future prospects. *In*: IAEA, 1993 (see **17**: no. 8587), pp. 345-357.

Forint Enterprise, P.O. Box 47, Achimota, Ghana.

Following the successful eradication of the screwworm, *Cochliomyia hominivorax*, from the island of Curaçao and the south-eastern USA, the SIT was tested against several other noxious insects, including the tsetse fly. Between 1967 and 1987, experiments were conducted in Zimbabwe and Tanzania (East Africa) and in Burkina Faso and Nigeria (West Africa) to test the feasibility of the new technique in eradicating selected species of tsetse fly. For the Zimbabwe programme, sterile *Glossina morsitans morsitans* were obtained from field-collected pupae treated with the chemosterilant Tapa[®]. Complete eradication was not achieved, primarily because of insufficient sterile males emerging from the wild pupae. In later programmes in Tanzania (*G. m. morsitans*), Burkina Faso (*G. palpalis gambiensis* and *G. tachinoides*, also *G. m. submorsitans*) and Nigeria (*G. p. palpalis*), flies were obtained from laboratory-bred mass-reared colonies. Males were sterilised either as pupae (Tanzanian project) or as young adults using gamma irradiation from a ⁶⁰Co or ¹³⁷Cs source. Efforts currently in progress to apply the technique to eradicate *G. austeni* from Zanzibar Island, Tanzania, have attracted considerable interest and funding from several international organisations. Past and current tsetse SIT programmes are reviewed and future prospects of the technique in large-scale tsetse/trypanosomiasis programmes are discussed.

8605 Osir, E.O., Magoma, G.N., Vundla, M.W. and Kenya, E., 1993.

Bacillus thuringiensis endotoxins active against *Chilo partellus* and *Glossina morsitans morsitans*. In: IAEA, 1993 (see 17: no. 8587), pp. 513-522.

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

B. thuringiensis crystal endotoxins were isolated by centrifugation on linear sucrose gradients. Analysis of the crystals by gel electrophoresis revealed that the major component of the *C. partellus* active crystal endotoxin was a protein of $M_r \sim 130$ kDa. The *G. m. morsitans* active crystal endotoxin gave a major protein band of $M_r \sim 120$ kDa. Upon solubilisation under alkaline pH and reducing conditions, the *C. partellus* and *G. m. morsitans* crystal endotoxin yielded protoxins of $M_r \sim 63$ and $M_r \sim 64$ kDa, respectively. Activation of the ^r*C. partellus* protoxin with bovine trypsin resulted in no apparent change in the molecular weight. However, treatment with bovine chymotrypsin or *C. partellus* midgut homogenate resulted in a shift in the molecular weight of the protoxin to a toxin of $M_r \sim 60$ kDa. Similarly, treatment of *G. m. morsitans* protoxin with bovine trypsin gave a toxin of $M_r \sim 62$ kDa, but bovine chymotrypsin

gave a toxin of $M \sim 60$ kDa. Staining with periodic acid Schiff reagent revealed that both the crystal endotoxins were glycosylated. The carbohydrate moieties were of the high mannose type, as shown by staining with fluorescein isothiocyanate conjugated-concanavalin A. Rabbit antibodies against *C. partellus* protoxin crossreacted with the *G. m. morsitans* toxin.

8606 **Torr, S.J., 1994.** The tsetse (Diptera: Glossinidae) story: implications for mosquitoes. *Journal of the American Mosquito Control Association*, **10** (2): 258-265.

ODA Insect Pest Management Initiative, c/o Tsetse Control Branch, P.O. Box 8283, Causeway, Harare, Zimbabwe.

In Zimbabwe, tsetse flies (*Glossina* spp.) are controlled using insecticide-impregnated baits. About 60,000 targets, baited with a blend of acetone, 1-octen-3-ol, 4-methylphenol and 3-n-propylphenol, are deployed in tsetse-infested areas. The development of this control technology has been based on an understanding of the responses of tsetse to their hosts, using research tools that quantify single specific responses. This understanding required the development of new research tools, such as electrocuting devices and video techniques to analyse behavioural responses and gas chromatography linked to an electroantennogram to analyse responses of tsetse to components of host odour. The development of bait technology also required close interdisciplinary collaboration among entomologists, chemists and electrophysiologists. It is suggested that the same approach to analysing the responses of mosquitoes to their hosts will produce improved baits for mosquitoes. The low reproductive rate of tsetse, their sensitivity to insecticides, and, so far, the absence of insecticidal or behavioural resistance to insecticide-impregnated targets, makes them particularly susceptible to baits. These factors are not all present with other pests, including mosquitoes. Nonetheless, baits offer the prospect of being an important component in an integrated approach to controlling pests of man and his livestock, both as a complementary control technique and as a powerful monitoring tool.

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

[See also **17**: nos. 8594, 8600, 8653, 8654.]

8607 **Djiteye, A., Bauer, B., Vloedt, A. van der, Feldmann, U. and Vreysen, M.J.B., 1993.** Influence combinée de la basse température

et de l'irradiation durant la dernière phase pupale sur la capacité vectorielle des mâles de *Glossina palpalis gambiensis*. [Combined influence of low temperature and irradiation during the last pupal phase on the vectorial capacity of *G. p. gambiensis* males.] In: IAEA, 1993 (see 17: no. 8587), pp. 567-578.

Djiteye: Laboratoire Central Vétérinaire, B.P. 2295, Bamako, Mali.

G. p. gambiensis pupae 25, 28 or 30 days old irradiated under ambient conditions with doses of 60 Gy, 80 Gy or 100 Gy (1 Gy = 100 rad) were exposed (or not exposed) for five days at 15°C (or incubated) before or after irradiation. The adult flies, whether in the teneral state or not, were fed for three successive days on animals infected with *Trypanosoma vivax*, *T. congolense* or *T. brucei brucei* at the peak of parasitaemia. As of the tenth day p.i., the rate of infection with *T. vivax* for flies in the teneral and the non-teneral state were, respectively: 98.9% and 97.9% for the control group and 96.8% and 95.7% for those incubated and irradiated with 100 Gy on day 30. As of the twentieth day, the percentages of infection with *T. congolense* were, respectively, for the different states (teneral and non-teneral): 77.5% and 34.7% for the controls, 71.3% and 54.2% for the incubated group, 83.9% and 50.0% for those irradiated with 80 Gy on day 30, and 58.2% and 64.8% for those irradiated with 100 Gy on day 30. The rates of infection of the flies with *T. b. brucei* as of the twenty-fifth day were, respectively, for flies infected in the teneral state and in the non-teneral state: 91.1% and 54.7% for the controls, 77.0% and 44.9% for the incubated group, 51.3% and 35.0% for those irradiated with 80 Gy on day 30, and 73.1% and 69.5% for those irradiated with 80 Gy on day 28 and incubated. The percentages of sterility in males irradiated with various doses are: 71% (60 Gy on day 25), 75% (incubated and 60 Gy on day 25), 82% (incubated and 60 Gy on day 28), 100% (80 Gy on day 28) and 100% (100 Gy on day 30).

8608 Gouteux, J.P., D'Amico, F., Cuisance, D., Blanc, F., Demba, D., Staak, C., Clausen, P.H., Kota-Guinza, A. and Le Gall, F., 1994. Les hôtes de *Glossina fuscipes fuscipes* Newstead, 1910 (Diptera: Glossinidae) dans 2 zones d'élevage de la République centrafricaine. [Feeding behaviour of *G. f. fuscipes* in two cattle breeding areas of the Central African Republic.] *Veterinary Research*, 25 (1): 16-28.

Gouteux: Place Jean-Sénac, F-32170 Miélan, France.

From 1987 to 1993, a survey on the feeding behaviour of

G. f. fuscipes was conducted in two cattle-breeding areas in the Central African Republic. A total of 556 blood-meal samples was analysed by ELISA. According to the results, the number of blood meals from cattle was rather low (12% on average). During the rainy season, this number increased significantly and varied according to the sampling area. Along the riverine forests, this amounted to 5%, while blood meals from wild ruminants amounted to 87%. In the neighbourhood of watering-places, the number of cattle blood meals reached 9-22%. Reptiles were found to be important hosts (17-35%). In all cases, man represented a non-negligible host (4-14%), similar to Suidae (2-19%). The authors discuss the relevance of these results in evaluating tsetse challenge and the risk of trypanosome transmission.

8609 **Maudlin, I. and Welburn, S.C., 1993.** Inheritance of refractoriness to trypanosome infection in tsetse. *In*: IAEA, 1993 (see 17: no. 8587), pp. 195-200.

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

Differences in susceptibility to midgut infection between teneral flies from susceptible and outbred stocks disappear in non-teneral flies, showing that maternally inherited susceptibility to midgut infection is a condition expressed only in teneral flies. The increased susceptibility of colonised *Glossina morsitans morsitans* to trypanosome infection compared with wild flies can be related to the spread of flies carrying rickettsia-like organisms through colonisation. The relative refractoriness of non-teneral flies suggests that flies fed prior to release in an SIT programme would not play a significant part in the spread of *Trypanozoon* or *Trypanosoma congolense* infections.

8610 **Moloo, S.K., Zwegarth, E. and Sabwa, C.L., 1994.** Comparative study on the susceptibility of different laboratory strains of *Glossina* species to *Trypanosoma simiae*. *Medical and Veterinary Entomology*, 8 (3): 225-230.

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

Teneral tsetse of four *Glossina* species from laboratory-reared colonies were fed on four Large White pigs infected with three different stocks of *T. simiae* isolated in Coast Province, Kenya. Thereafter the tsetse were maintained on goats and dissected on day 28 to determine the trypanosome infection rates. *G. brevipalpis* was as susceptible as *G. pallidipes* whilst *G. palpalis gambiensis* was not susceptible to *T. simiae* CP 11, a stock

causing acute infection, which was isolated from a wild *G. austeni*. *G. brevipalpis* was as susceptible as *G. pallidipes* to another stock causing acute infection, *T. simiae* CP 813 isolated from a wild *G. pallidipes*. *G. morsitans centralis* was also as susceptible as *G. brevipalpis* and *G. pallidipes* whilst *G. p. gambiensis* was not susceptible to this *T. simiae* stock. *G. m. centralis* showed very low susceptibility to a stock causing chronic infection, *T. simiae* CP 1896 isolated from a bushpig, whilst *G. brevipalpis*, *G. p. gambiensis* and *G. pallidipes* could not be infected by this *T. simiae* stock. Male *Glossina* were generally more susceptible than females to the three *T. simiae* stocks.

8611 **Okia, M., Mbulamberi, D.B. and Muyenck, A. de, 1994.** Risk factors assessment for *T. b. rhodesiense* sleeping sickness acquisition in S.E. Uganda: a case-control study. *Annales de la Société belge de Médecine tropicale*, **74** (2): 105-112. Okia: National Sleeping Sickness Control Programme, P.O. Box 1241, Jinja, Uganda.

The major risk factors associated with acquisition of *Trypanosoma brucei rhodesiense* sleeping sickness in the Busoga focus, south-east Uganda, were investigated using a case-control study. 122 cases and 244 matched controls were used in the study. For each case two age-, sex- and residence controls (one matched nearest neighbour control and one village control) were selected. Patients and controls answered the same questionnaire which had been developed and field tested before the field study started. A logistic regression model for a 1:2 matched case control design was fitted to the data. The following factors were found to be significant. Cases spent more time outside their village of residence than controls and visited more sleeping sickness high-risk areas than controls. More cases than controls collected firewood in the forests. Generally, cases had fewer domestic animals grazing near the places of man-fly contact, especially near water and firewood collecting and bathing points, and near farms and gardens, than controls. Cases had more antecedents of sleeping sickness in the family. Generally cases had a less well developed information network than controls, and belonged economically to a less powerful group. Based on these results we may conclude that the risk of developing *T. b. rhodesiense* sleeping sickness depends upon a multitude of economic, cultural and human behaviour factors. These factors should be taken into account in the planning and monitoring of sleeping sickness control programmes.

8612 **Wacher, T.J., Milligan, P.J.M., Rawlings, P. and Snow, W.F., 1994.**

Tsetse-trypanosomiasis challenge to village N'Dama cattle in The Gambia: field assessments of spatial and temporal patterns of tsetse-cattle contact and the risk of trypanosomiasis infection. *Parasitology*, **109** (2): 149-162.

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

The severity of the trypanosomiasis problem in a particular location is traditionally assessed in terms of a challenge index - the product of some measure of tsetse abundance and infection rate - which is assumed to be proportional to the force of infection. However, this index masks variation in the force of infection between herds and among individuals within herds. It is also not comparable between sites since the relative abundance of tsetse to hosts may vary. We have studied spatial distribution of herds of cattle in relation to tsetse in The Gambia and calculated an index of challenge based on the ratio of vectors to hosts over the livestock ranging area. This index is strongly correlated with estimates of the force of infection calculated from the incidence of infection in susceptible Zebu; and it provides information on heterogeneity in exposure of different herds to tsetse.

5. human trypanosomiasis

(a) SURVEILLANCE

8613 **Bailey, J.W. and Smith, D.H., 1994.** The quantitative buffy coat for the diagnosis of trypanosomes. *Tropical Doctor*, **24** (2): 54-56.

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

The use of quantitative buffy coat (QBC^e) tubes developed for malaria diagnosis is described in the diagnosis of African trypanosomiasis. One hundred and thirty-four patients with *Trypanosoma brucei gambiense* were examined using QBC plus either haematocrit (HCT) or mini anion exchange centrifugation (MAEC) or both. QBC was the only method that detected all 134 patients. QBC proved to be the most sensitive diagnostic test for the detection of trypanosomes in blood. It is simple to use, gives fast results and would be a useful test at the district hospital level.

8614 **Frean, J.A., Bush, J.B. and Maeder, S., 1993.** False positive trypanosome identification. (Letter.) *South African Medical Journal*, **83** (3): 222-223.

Frean: Department of Tropical Diseases, School of Pathology, South African Institute for Medical Research and University of the Witwatersrand, Johannesburg, South Africa.

Two cases of mistaken trypanosome identification are reported. Elongated spindle-shaped objects in blood films superficially resembling trypanosomes but lacking nucleus, kinetoplast, undulating membrane and anterior flagellum were subsequently identified as distorted platelets.

8615 **Miézan, T.W., Meda, A.H., Doua, F. and Cattand, P., 1994.**

Evaluation des techniques parasitologiques utilisées dans le diagnostic de la trypanosomose humaine à *Trypanosoma gambiense* en Côte d'Ivoire. [Evaluation of parasitological techniques in the diagnosis of *T. b. gambiense* human trypanosomiasis in Côte d'Ivoire.]

Bulletin de la Société de Pathologie exotique, **87** (2): 101-104.

Miézan: PRCT, B.P. 1425, Daloa, Côte d'Ivoire.

The authors carried out a comparative laboratory evaluation of twelve parasitological techniques currently used in the diagnosis of human trypanosomiasis. The tests were performed on 64 suspects testing positive to CATT. The sensitivity of the different techniques varied greatly. The least sensitive was CSF inoculation into *Mastomys* (17.2%). Direct blood examination and thick blood smears had a sensitivity of 22.4% and 34.5% respectively. The most sensitive techniques were lymph fluid examination (58.6%), double centrifugation of CSF (69%) and mAECT (84.5%). Combining two or three techniques increased the sensitivity: combination of lymph fluid examination and mAECT detected 91.4% of infected subjects and lymph fluid examination/mAECT/double centrifugation of CSF was the most sensitive (98.3%). The authors discuss the results and recommend that a similar study be done in field conditions to assess methods demonstrating better sensitivity or greater suitability for field use.

8616 **Penchenier, L., Sarda, J. and Jannin, J., 1993.** Où en est le foyer de trypanosomiase humaine de Mossaka (Congo)? [How is the Mossaka sleeping sickness focus (Congo) evolving?] *Bulletin de la Société de Pathologie exotique*, **86** (5): 347-350.

Penchenier: Laboratoire d'Epidémiologie des Grandes Endémies Tropicales, ORSTOM, B.P. 181, Brazzaville, Congo.

The Mossaka focus (on the lower Sangha, Cuvette area, Congo) has been evolving during the last few years in

an alarming way. In 1989, after carrying out a survey in the focus, we stressed the urgent need for measures to be taken. Since then the situation has deteriorated with regard to both the number of new cases detected (74 in 1987, 171 in 1989, 200 in 1991) and the population at risk: the focus has expanded, the number of villages where cases were detected having risen from 3 in 1987 to 12 in 1989 and 17 in 1991. If measures are not taken quickly, a dramatic expansion of the lower Sangha focus can be expected.

8617 Truc, P., Bailey, J.W., Doua, F., Laveissière, C. and Godfrey, D.G., 1994. A comparison of parasitological methods for the diagnosis of gambian trypanosomiasis in an area of low endemicity in Côte d'Ivoire. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88** (4): 419-421.

Truc: IPR/OCCGE, B.P. 1500, 01 Bouaké, Côte d'Ivoire. The card agglutination test for trypanosomiasis (CATT) was used to examine 8974 inhabitants in 14 village areas south-west of Daloa, Côte d'Ivoire; 114 (1.3%) were CATT+ or □, and were further examined by one or more of six methods for the direct detection of trypanosomes: lymphatic gland puncture, stained thick blood film (TBF), haematocrit centrifugation technique (HCT), mini-anion exchange column (MAEC), quantitative buffy coat method (QBC), and kit for *in vitro* isolation of trypanosomes (KIVI). Trypanosomes were seen by at least one method in 16 (14.0%) of the CATT+ group. Blood from 356 of the 8860 CATT- group was inoculated into KIVI; trypanosomes grew from the blood of one person. Eleven of the 17 patients with detectable trypanosomes were screened by all six methods: 6 were HCT+; 7 were gland+; 10 were MAEC+; 10 were KIVI+; 11 were both TBF+ and QBC+. One CATT+ patient was KIVI+ but otherwise negative, although TBF was not done. The overall prevalence of trypanosomes was 0.2% rising to 0.8% in one village area. The results support previous evidence that a reappraisal of procedures is required in the customary system of surveillance for gambian sleeping sickness.

8618 Villanueva, M.S., 1993. Trypanosomiasis of the central nervous system. *Seminars in Neurology*, **13** (2): 209-218. Infectious Disease Section LCI 803, Yale University School of Medicine, 333 Cedar Street, New Haven, CT 06510, USA.

This review discusses the neurological manifestations of both African and American trypanosomiasis, with a view to warning physicians in developed countries who are dealing with travellers or immigrants from endemic

areas. In the case of African trypanosomiasis, symptoms such as fever, confusion, lethargy, headaches and anorexia should be regarded as suspicious.

(b) PATHOLOGY AND IMMUNOLOGY

8619 **Kimata, D.M., Makawiti, D.W., Tengekyon, K.M., Dadzie, S. and Waindi, E.N., 1994.** Delayed recovery of adrenocortical and testicular function after chemotherapy of human trypanosomiasis. *Acta Tropica*, **57** (1): 69-74.

Makawiti: Department of Biochemistry, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.

The following indicators of pituitary, adrenocortical and testicular function were measured in 58 male African trypanosomiasis patients from western Kenya: plasma cortisol, luteinising hormone (LH) and testosterone levels. The measurements were carried out by specific radioimmunoassay methods in early and late stage infected patients on admission to hospital and in both groups of patients after one month of chemotherapy. PCV and haemoglobin levels were also measured in all the patients to determine the extent of their anaemia and success of recovery. High parasitaemia, anaemia and clinical symptoms of human trypanosomiasis were found in the infected patients and were eliminated with chemotherapy in the infected/treated patients. Increased levels of cortisol and decreased concentrations of testosterone without significant changes in LH levels were evident in the infected patients: this condition remained unchanged even after one month of chemotherapy. Evidence is thus provided of persistent hormonal perturbations which probably indicate residual endocrine organ damage.

8620 **Lorenz, P., James, R.W., Owen, J.S. and Betschart, B., 1994.**

Hetero-geneity in the properties of the trypanolytic factor in normal human serum. *Molecular and Biochemical Parasitology*, **64** (1): 153-164.

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

Although it seems clear that the trypanolytic factor in human serum capable of killing *Trypanosoma brucei brucei* is high density lipoprotein (HDL), it nevertheless remains controversial as to whether the trypanolytic properties of HDL are confined to a specific subclass or whether all particles have activity. In the present study, we have compared the lytic activities of serum fractions from six normal individuals prepared by gradient ultracentrifugation and also, to avoid

ultracentrifugally-induced loss of HDL apolipoproteins, by gel filtration using fast protein liquid chromatography (FPLC). All sera displayed trypanolytic activity in fractions corresponding to the general density ($\rho = 1.06-1.20$ g/ml) and size (59-440 kDa) limits conventionally used to describe bulk human HDL, the particles between $\rho = 1.18$ and 1.20 g/ml and between 214 and 440 kDa being particularly lytic. But some sera additionally contained fractions with powerful activity outside these density ($\rho > 1.24$ g/ml) and size (> 1000 kDa) ranges. Nevertheless, such fractions were considered to contain material with HDL characteristics; apolipoprotein A-I, the major protein of HDL, was always present, and the lytic activity of the sera could be completely neutralised by absorption with HDL antiserum. We conclude that all of the trypanolytic activity in human sera is associated with HDL particles and that it is a property of several HDL subpopulations with very different density and size characteristics. Presumably the well recognised wide variation in trypanocidal activity of normal human sera reflects differences in the quantities of these HDL subpopulations rather than in the total amount of a single, uniquely lytic particle.

8621 **Triolo, N., Parody, A. and Brito, A., 1992.** Eight (8) cases of congenital *gambiense* trypanosomiasis admitted in Fontem Hospital from 1977 to 1991. *Mediterranean Journal of Infectious and Parasitic Diseases*, **7** (4): 327-332.

Triolo: General Hospital Mary Health of Africa, Fontem, Cameroon.

The case histories of eight mothers and their babies with *Trypanosoma brucei gambiense* infection are reported. From these cases it is apparent that trypanosomiasis can be present at any stage of intrauterine life as well as after birth in hyperendemic areas, passage of trypanosomes through the placenta probably being more frequent than is generally admitted. In all these cases, different stages of the disease were present in the mothers and their new-borns. It appears that the disease follows a relatively autonomous course in the mother and the foetus: in the foetus the disease is more rapid and trypanosomes invade the CNS earlier.

(c) TREATMENT

8622 **Pépin, J., Milord, F., Khonde, A., Niyonsenga, T., Loko, L. and Mpia, B., 1994.** *Gambiense* trypanosomiasis: frequency of, and risk factors for, failure of melarsoprol therapy.

Transactions of the Royal Society of Tropical Medicine and Hygiene, **88** (4): 447-452.

Pépin: Infectious Diseases Section, Centre Hospitalier Universitaire, 3001 12^{ème} Avenue Nord, Sherbrooke, Quebec, J1H 5N4, Canada.

1083 patients with late-stage *Trypanosoma brucei gambiense* sleeping sickness were treated with melarsoprol in Nioki hospital, Zaire, between 1983 and 1990. Sixty-two (5.7%) died during treatment. Of the 1021 patients who survived the treatment, 63 (6.2%) subsequently relapsed, 58 (92%) of whom were diagnosed within 2 years of melarsoprol treatment. There was no evidence of an increase in the frequency of treatment failures during the study period, and the rate of relapses that we documented is comparable to that reported from Zaire more than 30 years ago. Relapses were more frequent among patients who had trypanosomes seen in the CSF at the time of the initial diagnosis (odds ratio [OR] = 2.76, 95% confidence interval [CI] = 1.65-4.63, $P = 0.0001$). Male patients had twice as many relapses as females (OR = 2.00, 95% CI = 1.19-3.36, $P = 0.009$), which was partly explained by males having trypanosomes in the CSF more often than females. There were important geographical variations in the frequency of relapses within the territory of the Nioki rural health zone, suggesting that the circulation of trypanosomes was geographically limited. Prednisolone treatment did not increase the risk of treatment failure, nor did decreasing the total dose of melarsoprol from 12 to 9 injections for patients with > 100 white blood cells/mm³ of CSF. Since patients with trypanosomes in the CSF are also those who are at the highest risk of melarsoprol-induced encephalopathy, more aggressive treatment regimens cannot be recommended. Indeed our data suggest that there may be a threshold above which further increasing the total dosage of melarsoprol will not reduce the risk of relapse.

6. animal trypanosomiasis

(a) SURVEY AND DISTRIBUTION

8623 **Bornstein, S., 1993.** Camel health and disease: veterinary projects. In: Hjort af Ornäs, A. (ed.), *The multi-purpose camel: interdisciplinary studies on pastoral production in Somalia* (Uppsala, Sweden: Environmental Policy and Society (EPOS), Department of Social and Economic Geography, Uppsala University), pp. 189-205 (Chapter 18). National Veterinary Institute, P.O.Box 1703, Uppsala, Sweden.

The chapter summarises veterinary projects undertaken within the Somali Camel Research Project, including the investigation by M.F. Dirie of the prevalence of *Trypanosoma evansi* trypanosomiasis (see *TTIQ*, **13** (2): no. 6231). Dirie screened 3000 camels from most regions of Somalia and found 160 infected with *T. evansi*, one with *T. congolense* and one with *T. brucei*. Some studies on resistance to trypanocidal drugs and on the efficiency of Cymelarsan have been started.

8624 **Diall, O., Bajyana Songa, E., Magnus, E., Kouyate, B., Diallo, B., Meirvenne, N. van and Hamers, R., 1994.** Evaluation d'un test sérologique d'agglutination directe sur carte dans le diagnostic de la trypanosomose caméline à *Trypanosoma evansi*. [Evaluation of a direct serological card agglutination test in the diagnosis of camel trypanosomiasis due to *T. evansi*.] *Revue scientifique et technique de l'Office International des Epizooties*, **13** (3): 793-800.

Diall: Section Protozoologie, Laboratoire Central Vétérinaire du Mali, B.P. 2295, Bamako, Mali. The results of a novel direct serological card agglutination test for the diagnosis of camel trypanosomiasis due to *T. evansi* (CATT/*T. evansi*) were compared with those obtained by direct detection of parasites in a study using 1093 sera from camels raised in northern Mali. A good correlation was revealed between the percentage of positive results obtained by CATT and the presence of trypanosomes (89%), as well as a good coincidence between the percentage of positive results obtained by CATT and low PCV values. CATT revealed an overall serological prevalence of 30.6%, whereas trypanosomes were found in only 5.85% of the corresponding animals. CATT/*T. evansi* is a quick and easy-to-read test, which merits further evaluation in camel-rearing countries.

8625 **Dirie, M.F., 1993.** Trypanosomiasis due to *Trypanosoma evansi*. In: Hjort af Ornäs, A. (ed.), *The multi-purpose camel: interdisciplinary studies on pastoral production in Somalia* (Uppsala, Sweden: Environmental Policy and Society (EPOS), Department of Social and Economic Geography, Uppsala University), pp. 207-211 (Chapter 19).

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

The history of *T. evansi* in camels and its vectors in Somalia are reviewed. The intensity of disease outbreak is closely associated with increases in the numbers of biting flies during the rainy season, and the disease therefore usually occurs where suitable vegetation for tabanids is found. During the dry seasons and droughts, camels are forced to move to

tsetse-infested areas where they are liable to infection with *T. brucei*, *T. congolense* and *T. vivax*. However, trypanosomiasis caused by *T. evansi* is probably the major disease of camels in Somalia, causing huge economic losses. It occurs mainly in chronic form, characterised by emaciation and anaemia. The most sensitive methods of parasitological diagnosis are microHCT and animal inoculation. The animal facing the sun during 15.00 - 17.00 h and a specific pungent smell of the urine are claimed to indicate infection. Currently available drugs are efficient if properly used. Although underdosing is common, drug-resistant *T. evansi* has not yet been reported in Somalia. Culling, evacuation of infested areas and night-time grazing are employed as preventive measures.

8626 **Kihurani, D.O., Nantulya, V.M., Mbiuki, S.M., Mogo, E., Nguhiu-Mwangi, J. and Mbithi, P.M.F., 1994.** *Trypanosoma brucei*, *T. congolense* and *T. vivax* infections in horses on a farm in Kenya. *Tropical Animal Health and Production*, **26** (2): 95-101.

Kihurani: Department of Clinical Studies, Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Kabete, Kenya.

Equines are particularly susceptible to infection with *T. evansi* and *T. brucei*, but rarely is natural *T. congolense* and *T. vivax* infection seen in horses. An outbreak of trypanosomiasis occurred in a herd of horses used for patrolling the pineapple fields on the Del Monte Farm, Thika, Kenya, initially involving six horses. On subsequent screening of the entire group, *T. brucei*, *T. congolense* and *T. vivax* infections were detected in 16 of the 35 horses. The tests used for diagnosis included microscopic examination of stained blood smears, buffy coat technique, mouse inoculation and antigen detection enzyme immunoassay (antigen ELISA).

8627 **Mattioli, R.C., Zinsstag, J. and Pfister, K., 1994.** Frequency of trypanosomosis and gastrointestinal parasites in draught donkeys in The Gambia in relation to animal husbandry. *Tropical Animal Health and Production*, **26** (2): 102-108.

Mattioli: ITC, P.M.B. 14, Banjul, Gambia.

Prevalence of trypanosomosis, gastrointestinal strongyles and level of strongyle egg outputs were studied in relation to husbandry practices in the draught donkey population in The Gambia. Feeding regime, number of working hours per day and overnight penning practices of donkeys affected significantly ($P < 0.05$) the level of gastrointestinal strongyle egg output, but not ($P > 0.05$) trypanosomosis prevalence.

Dual trypanosome and gastrointestinal strongyle infection significantly reduced PCV ($P < 0.001$). Animals positive for gastro-intestinal strongyles alone did not show a significantly ($P > 0.05$) lower PCV than those found negative. Husbandry practices to improve the situation are recommended.

8628 **Mihok, S., Zwegarth, E., Munyoki, E.N., Wambua, J. and Kock, R., 1994.** *Trypanosoma simiae* in the white rhinoceros

(*Ceratotherium simum*) and the dromedary camel (*Camelus dromedarius*). *Veterinary Parasitology*, **53** (3-4): 191-196.

Mihok: Livestock Pests Research Programme, ICIPE, P.O. Box 30772, Nairobi, Kenya.

T. simiae was identified as the cause of a disease outbreak in dromedary camels introduced to Tsavo East National Park, confirming the susceptibility of camels to this pathogen. *T. simiae* was also isolated from a new host, the white rhinoceros, through xenodiagnosis with a susceptible tsetse species (*Glossina morsitans centralis*). A white rhinoceros showed some evidence of anaemia and lymphopenia when harbouring *T. simiae*, but did not suffer any long-term health effects.

8629 **Waithanji, E.M., Nantulya, V.M. and Mbiuki, S.M., 1993.** Use of antigen capture tube enzyme-linked immunosorbent assay for the diagnosis of *Trypanosoma evansi* infections in dromedary camels (*Camelus dromedarius*). *Revue scientifique et technique de l'Office International des Epizooties*, **12** (2): 665-672.

Waithanji: Clinical Studies Department, Faculty of Veterinary Medicine, University of Nairobi, P.O. Box 29053, Nairobi, Kenya.

Parasitological diagnosis of *T. evansi* infection in camels is hampered by the small number of parasites in blood circulation, coupled with the tendency of this trypanosome to invade tissues. To overcome this, a more sensitive assay, an antigen enzyme-linked immunosorbent assay (ELISA), was developed, capable of detecting trypanosome antigens released into the bloodstream by dying parasites. To evaluate the usefulness of this assay in assisting chemotherapy, an experiment was designed to compare the ability of a *Trypanozoon* subgenus-specific monoclonal antibody (TR7) to capture antigens in whole blood and serum of camels in a *T. evansi*-endemic area of the Marsabit district in northern Kenya. The tests were performed in polystyrene tubes coated with TR7. Antigen ELISA using whole blood was performed in the field, while serum collected on the same day from the same animals was stored at -20°C and tested in the laboratory at a later date. A total of 100 camels were examined: 12% of the

camels were found to be antigenaemic when whole blood was tested, compared to 13% detected using serum. Thus, the results obtained so far do not show a significant difference in the sensitivity of tube ELISA when detecting antigens either in whole blood or serum.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **17**: nos. 8603, 8620, 8625, 8627.]

8630 **Boly, H., Hochereau-de Reviere, M.T., Humblot, P. and Thibier, M., 1993.** Effets pathogènes de *Trypanosoma congolense* sur le testicule des taurins Baoulé: histologie quantitative et morphométrique. [Pathogenic effects of *T. congolense* infection on the testis of Baoulé bulls: quantitative histology and morphometry.] *Reproduction Nutrition Development*, **33** (6): 541-550.

Boly: Institut du Développement Rural, University of Ouagadougou, B.P. 7021, Ouagadougou 03, Burkina Faso. The effect *T. congolense* on the testis was studied in 53 trypanoresistant Baoulé bulls by quantitative histology and morphometry. The daily spermatozoa production per testis of control groups ($n = 45$) was $382 \pm 334 \times 10^6$ (mean \pm s.d.) and the epididymis contained $0.6 \pm 1 \times 10^9$ spermatozoa in the caput, $0.3 \pm 0.3 \times 10^9$ in the corpus and $1.2 \pm 1.8 \times 10^9$ in the cauda. The infected bulls ($n = 8$) showed no significant difference ($P > 0.05$) when compared to the controls despite their lower average value (30%), there being great individual variations. The morphometric analysis during infection revealed a significant ($P < 0.05$) decrease (32%) of total Leydig cell volume per testis, $4.4 \pm 0.9 \text{ cm}^3$ for the control ($n = 5$) and $3.0 \pm 0.8 \text{ cm}^3$ for infected bulls ($n = 8$). The number of round spermatids per Sertoli cell and the daily round spermatid production (DRSP) per testis were also significantly reduced in infected bulls when compared to controls ($P < 0.05$): 5.2 ± 0.7 and 2.8 ± 2 for round spermatid per Sertoli cell and 6.1 ± 2.0 and $3.1 \pm 1.9 \times 10^8$ for DRSP. These observations indicate that *T. congolense* infection alters the interstitial tissue and meiotic divisions of germinal cells leading to low daily round spermatid production per gram of testis.

8631 **Boly, H., Humblot, P., Tillet, Y. and Thibier, M., 1994.** Effects of *Trypanosoma congolense* infection on the pituitary gland of Baoulé bulls: immunohistochemistry of LH- and FSH-secreting cells and response of plasma LH and testosterone to combined dexamethasone and GnRH treatment. *Journal of Reproduction and Fertility*, **100** (1): 157-162.

Boly: Institut du Développement Rural, University of Ouagadougou, B.P. 7021, Ouagadougou 03, Burkina Faso. The effects of *T. congolense* infection were investigated at the pituitary level on trypanosome resistant Baoulé bulls (aged 3-6 years), using immuno-histochemistry of LH- and FSH-secreting cells and a combined dexamethasone and GnRH challenge. The pituitaries of two control and five naturally infected Baoulé bulls were removed after slaughter and the LH- and FSH-secreting cells were examined immunohistochemically, using specific polyclonal antibodies against β LH and β FSH. No significant impairment of the labelling and distribution of LH- and FSH-secreting cells was seen in infected bulls when compared with control animals. No parasites were found in the pituitary glands. Plasma LH and testosterone concentrations were determined in eight control and eight infected bulls by enzyme-immunoassay and radio-immunoassay techniques, respectively. Blood samples were collected at intervals of 30 min two times before and nine times after dexamethasone treatment (20 mg i.m.). GnRH (Busereline: 20 μ g, i.m.) was injected 4.5 h later and samples were collected every 15 min for 180 min. After dexamethasone treatment, LH and testosterone concentrations declined dramatically in both groups. Four hours after treatment, the mean testosterone concentration for both groups was 0.44 ng/ml. After GnRH injection, LH concentrations in the infected group increased rapidly to a mean maximum value of 30 ng/ml by 165 min. In contrast, the increase in LH concentration in non-infected bulls was more gradual and the mean maximum value, reached at the same time, was only 20 ng/ml. Testosterone concentration increased rapidly and in a similar manner in both groups for the first 90 min (0.08 \pm 0.04 ng/ml). There was almost no further increase in testosterone concentration in the infected group (different from controls; $P < 0.05$) although LH concentrations continued to rise. The testosterone concentration of the non-infected group increased steadily, up to the end of the sampling period. It is concluded from the immunohistochemical study and from the pituitary response to GnRH that the parasites do not alter pituitary function but that they do affect testicular function.

8632 **Flynn, J.N. and Sileghem, M., 1994.** Involvement of $\gamma\delta$ T cells in immunity to trypanosomiasis. *Immunology*, **83** (1): 86-92.

Flynn: MRC Retrovirus Laboratory, Department of Veterinary Pathology, University of Glasgow, Bearsden, Glasgow G61 1QH, UK.

In this study the involvement of peripheral $\gamma\delta$ T cells, prepared by flow cytometry, in the immune response of cattle to primary infection with *Trypanosoma congolense* was assessed. Negligible *in vitro* proliferative responses were observed in $\gamma\delta$ T cells isolated from trypanosusceptible Boran (*Bos indicus*) cattle at all stages examined post-infection when stimulated *in vitro* with parasite antigens. In contrast, both CD8⁺ T cells and $\gamma\delta$ T cells from trypanotolerant N'Dama (*Bos taurus*) cattle proliferated markedly when stimulated *in vitro* with a complex of invariant trypanosome antigens with MW between 100,000 and 140,000 (100,000 MW complex). Neither species of cattle exhibited significant T-cell recognition of trypanosome variable surface glycoprotein (VSG). To study further the functional and phenotypic characteristics of the $\gamma\delta$ T-cell response, four T-cell lines were established from infected N'Dama cattle. These cell lines comprised up to 96% $\gamma\delta$ (WC1⁺) T cells, the remainder being CD8⁺ T cells. Two of these $\gamma\delta$ T-cell lines exhibited 100,000 MW complex antigen specificity which was not major histocompatibility complex (MHC) restricted in one line.

8633 **Sekoni, V.O., 1994.** Reproductive disorders caused by animal trypano-somiasis: a review. *Theriogenology*, **42** (4): 557-570.

National Animal Production Research Institute, Ahmadu Bello University, Shika - Zaria, Nigeria.

Pathogenic animal trypanosomes are causative agents of the most common livestock diseases which have an important economic impact on many African countries. These diseases usually cause debilitating symptoms manifested by anaemia and cachexia which may result in death. Recent studies show that they cause a wide range of reproductive disorders in animals, including degeneration of the hypothalamus, pituitary glands and gonads with consequent disruptions in the secretions and plasma concentrations of the hormones necessary for normal reproductive processes in both sexes. Reproductive disorders caused in male animals include delayed puberty, loss of libido, and severe degenerative changes of the genitalia manifested by the production of very poor quality semen or the cessation of semen production. In female animals trypanosomiasis cause severe genital lesions, temporary or permanent

anoestrus, and abnormal oestrous cycles. Additionally, trypanosomal-induced death during pregnancy, abnormal pregnancy, dystocia, abortion, premature birth, low birth weight, stillbirth, transplacental foetal infection, neonatal death and other pathogenic effects on foetuses and offspring have been reported. Early treatment with trypanocides may prevent some of the trypanosomal-induced reproductive disorders and lead to the resolution of mild genital lesions. Trypanosomal-induced reproductive disorders in animals are of significant economic importance, especially in sub-Saharan Africa, where tsetse-transmitted trypanosomiasis are endemic.

(c) TRYPANOTOLERANCE

[See also 17: no. 8632.]

8634 **Dwinger, R.H., Agyemang, K., Snow, W.F., Rawlings, P., Leperre, P. and Bah, M.L., 1994.** Productivity of trypanotolerant cattle kept under traditional management conditions in The Gambia. *Veterinary Quarterly*, **16** (2): 81-86.

Dwinger: Escuela de Medicina Veterinaria, Universidad Nacional, Apdo 149, 3000 Heredia, Costa Rica.

The productivity of trypanotolerant N'Dama cattle, kept under traditional management conditions in The Gambia, was assessed by the regular monthly collection of health and production parameters in two study areas. The study areas were selected because of differences in tsetse challenge. Performance traits were used to build up an index to estimate the productivity of village N'Dama cattle. The productivity index per 100 kg cow maintained per year varied from 37.2 kg in the study area of Keneba village (with a low tsetse challenge) to 21.4 kg for cattle kept near the villages of Tuba and Sambelkunda, an area which had a high tsetse challenge. Average age at first calving was 4.5 or 5.0 years depending on the study area, calving intervals were 623 or 703 days and there was an average 12% loss of body weight in adult females during the dry season. The productivity indices of village N'Dama cattle in The Gambia compare favourably with similar indices for trypanotolerant and trypanosusceptible breeds elsewhere in Africa, and show that even under harsh conditions and with high tsetse challenge, they are able to effectively produce milk and meat for the rural population.

(d) TREATMENT

7. experimental trypanosomiasis

(a) DIAGNOSTICS

(b) PATHOLOGY AND IMMUNOLOGY

[See also 17: nos. 8620, 8670, 8681, 8691, 8695.]

8635 **Bentivoglio, M., Grassi-Zucconi, C., Olsson, T. and Kristensson, K., 1994.** *Trypanosoma brucei* and the nervous system. [Rats.] *Trends in Neurosciences*, **17** (8): 325-329.

Bentivoglio: Institute of Anatomy and Histology, University of Verona, Italy.

8636 **Mansfield, J.M., 1994.** T-cell responses to the trypanosome variant surface glycoprotein: a new paradigm? [*T. b. rhodesiense*; mice.] *Parasitology Today*, **10** (7): 267-270.

Laboratory of Immunology, Department of Animal Health and Biomedical Sciences, University of Wisconsin, 1655 Linden Drive, Madison, WI 53706, USA.

8637 **Ortiz, J.C., Sechelski, J.B. and Seed, J.R., 1994.**

Characterization of human serum-resistant and serum-sensitive clones from a single *Trypanosoma brucei gambiense* parental clone. [Mice.] *Journal of Parasitology*, **80** (4): 550-557.

Ortiz: Biochemistry Unit, Centro Internacional de Entrenamiento e Investigaciones Medicas, CIDEIM, Apartado Aereo 5390, Cali, Colombia.

8638 **Peng, Z.-C., Mohammed, A.H., Olsson, T., Edlund, C. and Kristensson, K., 1994.** Interferon- γ and a factor derived from trypanosomes cause behavioural changes in the rat. [*T. b. brucei*.] *Behavioural Brain Research*, **62** (2): 171-175.

Mohammed: Division of Geriatrics, Department of Clinical Neuroscience, Karolinska Institute, Huddinge University Hospital, S-14186 Huddinge, Sweden.

8639 **Sacco, R.E., Hagen, M., Donelson, J.E. and Lynch, R.G., 1994.** B lymphocytes of mice display an aberrant activation phenotype and are cell cycle arrested in G₀/G_{1A} during acute infection with *Trypanosoma brucei*. *Journal of Immunology*, **153** (4): 1714-1723.

Sacco: Department of Pathology, 375 Medical Research Center, University of Iowa College of Medicine, Iowa City, IA 52242, USA.

8640 **Toth, L.A., Tolley, E.A., Broady, R., Blakely, B. and Krueger, J.M., 1994.** Sleep during experimental trypanosomiasis in rabbits. [*T. b. brucei*.] *Proceedings of the Society for Experimental Biology and Medicine*, **205** (2): 174-181.

Toth: Animal Resource Center, St Jude Children's Research Hospital, 332 North Lauderdale, Memphis, TN 38105, USA.

8641 **Velthuysen, M.-L.F. van, Mayen, A.E.M., Rooijen, N. van, Fleuren, G.J., Heer, E. de and Bruijn, J.A., 1994.** T cells and macrophages in *Trypanosoma brucei*-related glomerulopathy. [Mice.] *Infection and Immunity*, **62** (8): 3230-3235.

Velthuysen: Department of Pathology, University of Leiden, P.O. Box 9600, L1Q, 2300 RC Leiden, Netherlands.

(c) CHEMOTHERAPEUTICS

[See also **17**: no. 8686.]

8642 **Biswas, R.K. and Hunter, A.G., 1993.** Effect of stage of infection with *Trypanosoma evansi* on Cymelarsan therapy. [Rabbits.] *Tropical Animal Health and Production*, **25** (4): 223-224.

Hunter: CTVM, University of Edinburgh, Easter Bush, Roslin, Midlothian EH25 9RG, UK.

8643 **Kaminsky, R., Chuma, F. and Wasike, R.P.N., 1994.** Time-dose response of *Trypanosoma congolense* bloodstream forms to diminazene and isometamidium. *Veterinary Parasitology*, **52** (3-4): 235-242.

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

8644 **Lun, Z.R., Burri, C., Menzinger, M. and Kaminsky, R., 1994.** Antiparasitic activity of diallyl trisulphide (Dasuansu) on human and animal pathogenic protozoa (*Trypanosoma* sp., *Entamoeba histolytica* and *Giardia lamblia*) *in vitro*. [*T. b. brucei*, *T. b. rhodesiense*, *T. b. gambiense*, *T. evansi*, *T. congolense*, *T. equiperdum*.] *Annales de la Société belge de Médecine tropicale*, **74** (1): 51-59.

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

8645 **Miézan, T.W., Bronner, U., Doua, F., Cattand, P. and Rombo, L., 1994.** Long term exposure of *Trypanosoma brucei gambiense* to pentamidine *in vitro*. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **88** (3): 332-333.

Bronner: Division of Infectious Diseases, Huddinge University Hospital, S-14186 Huddinge, Sweden.

8646 **Zhang, Z.Q., Giroud, C. and Baltz, T., 1993.** *Trypanosoma evansi*: *in vivo* and *in vitro* determination of trypanocide resistance profiles. [+ *T. equiperdum*; mice; Berenil, Cymelarsan, suramin, isometamidium, quinapyramine.] *Experimental Parasitology*, **77** (4): 387-394.

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

8647 **Zweygarth, E., Kaminsky, R. and Moloo, S.K., 1994.** Evaluation of a short-term *in vitro* growth-inhibition test to determine susceptibility of *Trypanosoma vivax* stocks to various trypanocides. *Onderstepoort Journal of Veterinary Research*, **61** (2): 189-191.
Zweygarth: Onderstepoort Veterinary Institute, Private Bag X5, Onderstepoort, 0110 South Africa.

8. trypanosome research

(a) CULTIVATION OF TRYPANOSOMES

8648 **Agbe, S.A.O. and Yielding, K.L., 1994.** An axenic propagation of animal infective morphologically normal and dyskinetoplastic forms of *Trypanosoma brucei* at room temperature. *Experimental Parasitology*, **79** (1): 77-80.

Agbe: Human Biological Chemistry and Genetics, Internal Medicine and Pharmacology and Toxicology, University of Texas Medical Branch, Galveston, TX 77550, USA.

8649 **Sternberg, J.M. and McGuigan, F., 1994.** *Trypanosoma brucei*: mammalian epidermal growth factor promotes the growth of the African trypanosome bloodstream form. *Experimental Parasitology*, **78** (4): 422-424.

Sternberg: Department of Zoology, University of Aberdeen, Tillydrone Avenue, Aberdeen AB9 2TN, UK.

8650 **Webster, P. and Griffiths, G., 1994.** A novel method for mean cell volume estimation. [*T. brucei*.] *Journal of Microscopy*, **174** (2): 85-92.

Webster: Department of Cell Biology, Yale University School of Medicine, 333 Cedar Street, New Haven, CT 06510, USA.

8651 **Yabu, Y., 1993.** An axenic culture system for the transformation of bloodstream forms to procyclic forms of *Trypanosoma brucei brucei* *in vitro*. *Southeast Asian Journal of Tropical Medicine and Public Health*, **24** (4): 706-711.

Department of Medical Zoology, Nagoya City University Medical School, Nagoya 467, Japan.

(b) TAXONOMY, CHARACTERISATION OF ISOLATES

8652 **Garside, L., Bailey, M. and Gibson, W., 1994.** DNA content and molecular karyotype of trypanosomes of the subgenus *Nannomonas*. *Acta Tropica*, **57** (1): 21-28.

Garside: Department of Pathology and Microbiology, University of Bristol Veterinary School, Langford, Bristol BS18 7DU, UK.

8653 **Gashumba, J.K., Komba, E.K., Truc, P., Allingham, R.M., Ferris, V.**

and Godfrey, D.G., 1994. The persistence of genetic homogeneity among *Trypanosoma brucei rhodesiense* isolates from patients in north-west Tanzania. *Acta Tropica*, **56** (4): 341-348.

Godfrey: Department of Clinical Veterinary Science, University of Bristol, Langford House, Langford, Bristol BS18 7DU, UK.

Trypanosomes isolated during 1991 from nine patients with Rhodesian sleeping sickness in north-west Tanzania were genetically characterised by electrophoresis of ten enzymes. Eight isolates were allocated to a known zymodeme (Z306); another had an enzyme profile (Z379) not previously encountered. An example of Z306 has been previously isolated in 1971, nearby in a part of Rwanda adjacent to the border with Tanzania; in addition, a closely related isolate, Z307, was collected in 1959 from a patient in north-west Tanzania. The new zymodeme (Z379) was 94% similar to Z306, and both had a close similarity of 89% to Z307. All these isolates belonged to the zambezi strain group of related zymodemes, and evidence is presented that other examples of the group have been collected from man in Tanzania since 1959. Such apparent long-term genetic stability is similar to circumstances further south in an endemic area of Zambia, where 12 examples of Z306 and two of Z307 were acquired over a period of 12 years from patients. The similar genetic homogeneity among trypanosomes in endemic parts of both Tanzania and Zambia contrasted markedly with the heterogeneity described to the north of Tanzania in that different strain groups circulate in epidemic areas of Kenya and Uganda.

8654 Hide, G., Welburn, S.C., Tait, A. and Maudlin, I., 1994.

Epidemiological relationships of *Trypanosoma brucei* stocks from South East Uganda: evidence for different population structures in human infective and non-human infective isolates. *Parasitology*, **109** (1): 95-111.

Hide: Wellcome Unit of Molecular Parasitology, Department of Veterinary Parasitology, University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.

This study represents an analysis of trypanosome strains circulating within a confined location over a short period of time during a sleeping sickness epidemic in south-east Uganda. A large number of *T. brucei* isolates (88) were collected from a variety of hosts (man, cattle, pigs and tsetse) from villages within a 10 km radius and were analysed for variation

in isoenzyme patterns, restriction fragment length polymorphism (RFLP) in repetitive DNA sequences and susceptibility to human serum. The human infective stocks form a clearly distinguishable population when compared with other stocks circulating in the domestic cattle reservoir. The data here support the occurrence of genetic exchange between the cattle stocks while an 'epidemic' population structure involving limited genetic exchange is a characteristic of the human infective stocks. Furthermore, it is shown that when both RFLP and isoenzyme analysis are carried out most stocks appear to have individual genotypes. Stocks which were formerly grouped as zymodemes are better considered as a collection of distinct individuals.

8655 **Zhang, Z.Q. and Baltz, T., 1994.** Identification of *Trypanosoma evansi*, *Trypanosoma equiperdum* and *Trypanosoma brucei brucei* using repetitive DNA probes. *Veterinary Parasitology*, **53** (3-4): 197-208.

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

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

8656 **Alarcon, C.M., Son, H.J., Hall, T. and Donelson, J.E., 1994.** A monocistronic transcript for a trypanosome variant surface glycoprotein. [*T. brucei*.] *Molecular and Cellular Biology*, **14** (8): 5579-5591.

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

8657 **Barnard, J.P. and Pedersen, P.L., 1994.** Alteration of pyruvate metabolism in African trypanosomes during differentiation from bloodstream into insect forms. [*T. brucei*.] *Archives of Biochemistry and Biophysics*, **313** (1): 77-82.

Pedersen: Laboratory for Molecular and Cellular Bioenergetics, Johns Hopkins University School of Medicine, 725 North Wolfe Street, Baltimore, MD 21205, USA.

8658 **Borst, P., Gommers-Ampt, J.H., Ligtenberg, M.J.L., Rudenko, G., Kieft, R., Taylor, M.C., Blundell, P.A. and Leeuwen, F. van, 1993.** Control of antigenic variation in African trypanosomes. [*T. brucei*.] *Cold Spring Harbor Symposia on Quantitative Biology*, **58**: 105-114.

Borst: Netherlands Cancer Institute, Division of Molecular Biology, 1066 CX Amsterdam, Netherlands.

- 8659 **Boulangé, A. and Authié, E., 1994.** A 69 kDa immunodominant antigen of *Trypanosoma (Nannomonas) congolense* is homologous to immuno-globulin heavy chain binding protein (BiP). *Parasitology*, **109** (2): 163-173.
Boulangé: ILRAD, P.O. Box 30709, Nairobi, Kenya.
- 8660 **Brown, S.D. and Ploeg, L.H.T., van der, 1994.** Single-stranded DNA-protein binding in the procyclic acidic repetitive protein (PARP) promoter of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **65** (1): 109-122.
Ploeg: Department of Genetics and Molecular Biology, Merck Research Laboratories, Rahway, NJ 07065, USA.
- 8661 **Chaudhri, M., Steverding, D., Kittelberger, D., Tjia, S. and Overath, P., 1994.** Expression of a glycosylphosphatidylinositol-anchored *Trypanosoma brucei* transferrin-binding protein complex in insect cells. *Proceedings of the National Academy of Sciences of the United States of America*, **91** (14): 6443-6447.
Overath: Max-Planck-Institut für Biologie, Abteilung Membran-biochemie, Corrensstrasse 38, D-72076 Tübingen, Germany.
- 8662 **Clayton, C., 1992.** Developmental regulation of nuclear gene expression in *Trypanosoma brucei*. (Review.) *Progress in Nucleic Acid Research and Molecular Biology*, **43**: 37-66.
Zentrum für Molekulare Biologie, Im Neuenheimer Feld 282, D-69120 Heidelberg, Germany.
- 8663 **Doering, T.L., Pessin, M.S., Hart, G.W., Raben, D.M. and Englund, P.T., 1994.** The fatty acids in unremodelled trypanosome glycosyl-phosphatidylinositols. [*T. brucei*.] *Biochemical Journal*, **299** (3): 741-746.
Englund: Department of Biological Chemistry, Johns Hopkins University School of Medicine, Baltimore, MD 21205, USA.
- 8664 **Else, A.J., Clarke, J.F., Willis, A., Jackman, S.A., Hough, D.W. and Danson, M.J., 1994.** Dihydrolipoamide dehydrogenase in the *Trypanosoma* subgenus, *Trypanozoon*. *Molecular and Biochemical Parasitology*, **64** (2): 233-239.
Danson: Department of Biochemistry, University of Bath, Bath BA2 7AY, UK.
- 8665 **Ferguson, M.L., Torri, A.F., Pérez-Morga, D., Ward, D.C. and Englund, P.T., 1994.** Kinetoplast DNA replication: mechanistic differences between *Trypanosoma brucei* and *Crithidia fasciculata*. *Journal of Cell Biology*, **126** (3): 631-639.
Englund: Department of Biological Chemistry, Johns Hopkins School of Medicine, 725 N. Wolfe Street, Baltimore, MD 21205, USA.

- 8666 **Gale, M., Carter, V. and Parsons, M., 1994.** Cell cycle-specific induction of an 89 kDa serine-threonine protein kinase activity in *Trypanosoma brucei*. *Journal of Cell Science*, **107** (7): 1825-1832.
Parsons: Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98105, USA.
- 8667 **Gibson, W. and Bailey, M., 1994.** Genetic exchange in *Trypanosoma brucei*: evidence for meiosis from analysis of a cross between drug-resistant transformants. *Molecular and Biochemical Parasitology*, **64** (2): 241-252.
Gibson: Department of Pathology and Microbiology, University of Bristol Veterinary School, Langford, Bristol BS18 7DU, UK.
- 8668 **Grab, D.J., Shaw, M.K., Wells, C.W., Verjee, Y., Russo, D.C.W., Webster, P., Naessens, J. and Fish, W.R., 1993.** The transferrin receptor in African trypanosomes: identification, partial characterization and sub-cellular localization. [*T. b. brucei*.] *European Journal of Cell Biology*, **62** (1): 114-126.
Shaw: ILRAD, P.O. Box 30709, Nairobi, Kenya.
- 8669 **Guther, M.L.S., Masterson, W.J. and Ferguson, M.A.J., 1994.** The effects of phenylmethylsulfonyl fluoride on inositol-acylation and fatty acid remodeling in African trypanosomes. [*T. brucei*.] *Journal of Biological Chemistry*, **269** (28): 18694-18701.
Ferguson: Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK.
- 8670 **Hager, K.M., Pierce, M.A., Moore, D.R., Tytler, E.M., Esko, J.D. and Hajduk, S.L., 1994.** Endocytosis of a cytotoxic human high density lipoprotein results in disruption of acidic intracellular vesicles and subsequent killing of African trypanosomes. [*T. brucei*.] *Journal of Cell Biology*, **126** (1): 155-167.
Hajduk: Department of Biochemistry and Molecular Genetics, University of Alabama, Birmingham, AL 35294-0005, USA.
- 8671 **Hua, S.-B. and Wang, C.C., 1994.** Differential accumulation of a protein kinase homolog in *Trypanosoma brucei*. *Journal of Cellular Bio-chemistry*, **54** (1): 20-31.
Hua: Department of Pharmaceutical Chemistry, University of California, San Francisco, CA 94143-0446, USA.
- 8672 **Janz, L. and Clayton, C., 1994.** The PARP and rRNA promoters of *Trypanosoma brucei* are composed of dissimilar sequence elements that are functionally interchangeable. *Molecular and Cellular Biology*, **14** (9): 5804-5811.

Clayton: Zentrum für Molekulare Biologie,
University of Heidelberg, Im Neuenheimer Feld
282, D-69120 Heidelberg, Germany.

8673 **Janz, L., Hug, M. and Clayton, C., 1994.** Factors that bind to RNA polymerase I promoter sequences of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **65** (1): 99-108.

Clayton: Zentrum für Molekulare Biologie,
University of Heidelberg, Im Neuenheimer Feld
282, D-69120 Heidelberg, Germany.

8674 **Kishan, K.V.R., Zeelen, J.P., Noble, M.E.M., Borchert, T.V. and Wierenga, R.K., 1994.** Comparison of the structures and the crystal contacts of trypanosomal triosephosphate isomerase in four different crystal forms. *Protein Science*, **3** (5): 779-787.

Wierenga: European Molecular Biology
Laboratory, Postfach 10.2209, D-69012
Heidelberg, Germany.

8675 **Köller, J., Norskau, G., Paul, A.S., Stuart, K. and Göringer, H.U., 1994.** Different *Trypanosoma brucei* guide RNA molecules associate with an identical complement of mitochondrial proteins *in vitro*. *Nucleic Acids Research*, **22** (11): 1988-1995.

Göringer: Laboratorium für Molekular Biologie,
Genzentrum, D-82152 Martinsried, Germany.

8676 **Ligtenberg, M.J.L., Bitter, W., Kieft, R., Steverding, D., Janssen, H., Calafat, J. and Borst, P., 1994.** Reconstitution of a surface transferrin binding complex in insect form *Trypanosoma brucei*. *EMBO Journal*, **13** (11): 2565-2573.

Borst: Division of Molecular Biology,
Netherlands Cancer Institute, Plesmanlaan 121,
1066 CX Amsterdam, Netherlands.

8677 **Lu, Y., Alarcon, C.M., Hall, T., Reddy, L.V. and Donelson, J.E., 1994.** A strand bias occurs in point mutations associated with variant surface glycoprotein gene conversion in *Trypanosoma rhodesiense*. *Molecular and Cellular Biology*, **14** (6): 3971-3980.

Donelson: Department of Biochemistry, 300
EMRB, University of Iowa, Iowa City, IA 52242,
USA.

8678 **Masake, R.A., Nantulya, V.M., Pellé, R., Makau, J.M., Gathuo, H. and ole-MoiYoi, O.K., 1994.** A species-specific antigen of *Trypanosoma (Duttonella) vivax* detectable in the course of infection is encoded by a differentially expressed tandemly reiterated gene. *Molecular and Biochemical Parasitology*, **64** (2): 207-218.

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

8679 **Matthews, K.R. and Gull, K., 1994.** Evidence for an interplay between cell cycle progression and the initiation of differentiation between life cycle forms

of African trypanosomes. [*T. b. rhodesiense*.] *Journal of Cell Biology*, **125** (5): 1147-1156.

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