

section b - abstracts

1. general (including land use)

9887 **Artzrouni, M. and Gouteux, J.-P., 1996.** A compartmental model of sleeping sickness in Central Africa. *Journal of Biological Systems*, **4** (4): 459-477.

Artzrouni: Department of Applied Mathematics, University of Pau, 64000 Pau, France.

We present a five-variable compartmental model for the spread of *Trypanosoma brucei gambiense*, the parasite responsible for the transmission (through tsetse flies) of sleeping sickness in Central Africa. The model's equilibrium points depend on two 'summary parameters':  $g$ , the proportion removed among human infectives, and  $R_0$ , the basic reproduction rate. Stability results are obtained for the origin but not for other equilibrium points. A two-variable simplified version of the model is presented and the stability of all its equilibrium points can be investigated analytically. Both models are applied to the Niari focus of Central Africa and used to test the impact of a vector control strategy. The models' results are in agreement with the extinction of the epidemic that was brought about by a 50% decrease in vector density.

9888 **Bureau, P., 1996.** Historique et evolution de la maladie du sommeil en République Centrafricaine. [History and evolution of sleeping sickness in the Central African Republic.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 78-86 (epidemiological data 87-89).

Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon.

While human African trypanosomiasis existed in the Central African Republic before colonisation, the latter was nevertheless accompanied by an epidemic outbreak along all the main communication axes (Sangha and Oubangui valleys, roads from Chad). It was not until the early 1960s that the endemic disease was brought under control. Since 1970 the foci have revived one after the other, except for that of the Oubangui valley itself which has remained quiescent. Analysis of the data suggests that there is a real risk of a new outbreak in the four border foci.

9889 **Bureau, P., 1996.** Historique et evolution de la maladie du sommeil au Tchad. [History and evolution of sleeping sickness in Chad.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 90-97 (epidemiological data 98-100).

Laboratoire de Recherche sur les Trypanosomiasés,  
OCEAC, B.P. 288, Yaoundé, Cameroon.

After describing the first appearance of the different foci of human African trypanosomiasis in the south of Chad from a review of the literature, the author presents a geographical, historical and entomological account of the four foci still active (Tapol, Goré, Moïssala, Bodo). He concludes that the distinctive evolution of human trypanosomiasis in Chad is essentially linked to the retreat of the vectors of the disease in the face of unfavourable climatic conditions.

9890 **Bureau, P., Bodo, J.M., Grébaud, P., Herder, S., Morlais, I., Penchenier, L. and Eouzan, P., 1996.** Le principe de la lutte antivectorielle dans le contrôle de la trypanosomiase humaine africaine: rappels historiques et considerations pour l'avenir. [The principle of vector control in the control of human African trypanosomiasis: historical recollections and considerations for the future.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (4): 39-44.

Bureau: Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon. From a review of the literature on the control of human African trypano-somiasis in the old French Equatorial Africa between 1909 and 1945, the authors point out that a vector control component existed as far back as that time. After 1945, decisive progress was made in the use of new drugs (pentamidine, melarso-prol), the widespread use of immunological screening and the improvement of diagnosis by parasite concentration methods. As a result of this changed emphasis, vector control was neglected. Nevertheless, notable progress has been made in this field, particularly in trapping techniques. The recent spread of the disease could provide the opportunity of rekindling interest in vector control.

9891 **Bureau, P. and Chandenier, J., 1996.** Historique et evolution de la maladie du sommeil au Gabon. [History and evolution of sleeping sickness in Gabon.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 56-64 (epidemiological data 65-68).

Bureau: Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon. The discovery and subsequent disappearance or maintenance of the different foci of human trypanosomiasis in Gabon are described from a review of the medical literature from 1913 to 1990. If one takes

account of extinct foci, all provinces of the country have been affected by the disease at one time or another of their history. The risk of revival of certain foci, considered extinct, is stressed.

9892 **Gouteux, J.-P., 1995.** La tsétsé: une mouche pas comme les autres. [The tsetse: a fly unlike any other.] *Insectes*, no. 99: 2-5.

Laboratoire de Mathématiques Appliquées, URA CNRS 1204, IPRA-UPPA, avenue de l'Université, 64000 Pau, France. A brief account is given of the tsetse fly's appearance and taxonomy, its medical and veterinary importance, its haematophagous habit and its unique viviparous method of reproduction. The fact that, unlike mosquitoes and tabanids, males as well as females are haematophagous, and therefore potential vectors of trypanosomiasis, makes the sterile insect technique unsatisfactory. On the other hand their slow reproductive rate makes trapping an efficient control strategy which, as well as being non-polluting, is simple and can be carried out by rural communities. Research into olfactory attractants continues in order to find suitable substances for the different tsetse groups and species. Cultural factors are also important in achieving a successful transfer of responsibility to rural communities. Some unresolved epidemiological problems ('familial contamination', cases of infection in villages without peridomestic tsetse, the presence of two mutually exclusive tsetse species in one focus) and the development of epidemiological models are briefly discussed.

9893 **Hide, G., Mottram, J.C., Coombs, G.H. and Holmes, P.H. (eds), 1997.** *Trypanosomiasis and leishmaniasis: biology and control*. Wallingford, UK; CAB International. 366 pp. (ISBN 0 85199 139 4.) Hide: Wellcome Unit of Molecular Parasitology, University of Glasgow, Anderson College, 56 Dumbarton Road, Glasgow G11 6NU, UK.

This book was conceived as a tribute to the hundred years of studies on trypanosomiasis since David Bruce's seminal paper reporting the association between trypanosomes and disease in cattle in Africa. Many of the authors of the 22 individual chapters were selected from participants at the 1995 Trypano-somiasis and Leishmaniasis Seminar held in Glasgow, UK. The reviews are not, however, records of the Seminar programme but overviews of topics carefully selected to cover the range of research being carried out into trypanosomiasis (both African and South American) and leishmaniasis, with emphasis on a comparative approach

to the parasites and the diseases they cause. The reviews, which contain both background information and updates, cover historical aspects of trypanosomatid research, molecular biology of the parasites, their biochemistry and cell biology, their interactions with mammalian hosts and vectors, and the effects of the diseases they cause at the level of the whole community. For abstracts of and references to individual chapters, see **20**: nos. 9894, 9895, 9902, 9914, 9918, 9923, 9929, 9940, 9973, 9976, 9978, 9980-9982, 9984, 9987-9989, 9997 and 10002.

9894 **James, A., 1997.** The socio-economic impact of African trypanosomiasis. *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 327-334.

Veterinary Epidemiology and Economics Research Unit, University of Reading, Reading RG6 6AT, UK.

The methods applicable to the economic assessment of trypanosomiasis are reviewed and illustrated by examples from economic studies. Important methodological problems arise in the estimation of livestock productivity, in the evaluation of trypanosomiasis as a constraint to many forms of agricultural land use, and in the valuation of human welfare effects. Trypanosomiasis control often results in far-reaching changes of land use, and increase in agricultural production may have implications for wildlife and tourism. Different interest groups are unlikely to agree on the valuation of some effects of trypanosomiasis control, and so it is concluded that economic studies should be designed to provide a quantitative framework for decision-making that will also involve some subjective value-judgements.

9895 **Molyneux, D.H., 1997.** Current public health status of the trypano-somiasis and leishmaniases. *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 39-50.

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

Sleeping sickness, Chagas' disease and the leishmaniases are separated by very distinct clinical and epidemiological characteristics despite the inherent similarity of their kinetoplastid structure. They also share several common features which pose problems for disease control as well as treatment of individual cases: (i) difficulty of diagnosis; (ii) high cost, limited availability and toxicity of drugs and need for hospitalisation during treatment; (iii) need for vector control to reduce transmission; (iv) difficulty in developing vaccines. Limited information

is available on the precise current endemicity of sleeping sickness. Several countries have suffered civil disruption and conflict with consequent breakdown of surveillance and treatment. Despite the availability of new tools which have been developed over the last two decades (diagnostics, vector control, a new drug), the public health situation has not improved nor is it likely that it will. Sleeping sickness is a low priority, rural disease, drugs are expensive and not readily available, diagnosis is difficult, surveillance is too costly and vector control, even at community level, difficult to sustain. 9896 **Muangirwa, C.J. and Sikay, M., 1994.** Forecasting of likelihood of tsetse control through community participation of Maasai pastoralists in Selela area, northern Tanzania. *TPRI Miscellaneous Report*, no. 1064: 40-52.

TPRI, P.O. Box 3024, Arusha, Tanzania.

A decision analysis study was undertaken to assess the likelihood of the semi-nomadic Maasai pastoralists of Selela area, northern Tanzania, participating in tsetse control as a community-based activity. A questionnaire was designed consisting of questions on the objectives of the pastoralists, their perception of problems and options for solving them, action taken and outcome of decisions. The questionnaire was administered at village level through group discussions. Cattle keeping is the main objective of the pastoralists, but is not a commercial activity. Animals are grazed around an underground water forest during the dry season and in a semi-arid area during the wet season. However, this practice is threatened by an increasing tendency to cultivate around the forest. Tsetse and trypanosomiasis are perceived as the main problems to cattle keeping and pastoralists are already administering trypanocides for trypanosomiasis control. Symptoms of animal trypanosomiasis are known, but those of human trypanosomiasis (sleeping sickness) are not recognised until late when a patient is taken to a health centre. Other problems include tick-borne and helminthic diseases, in which case acaricides and antihelminthics are used. The pastoralists have not participated in tsetse control but perceived aerial and ground spraying as adequate measures against tsetse. They also consider tsetse traps as potential tools, and pledged to participate in tsetse control. This information was assessed alongside technical information, and it is thought that community-based

control measures for key tsetse species in the area would include attractive targets baited with cow urine for *Glossina pallidipes*, acetone-baited targets for *G. swynnertoni* (until a cheaper attractant is found) and use of cattle treated with synthetic pyrethroid acaricides. A pilot programme on community-based tsetse control is proposed for Selela area. For effective implementation and sustainability it is strongly suggested that the Maasai pastoralists be guided to improve their objective, i.e. keep cattle as a commercial activity which would require improvement of entrepreneurial skills. Other changes in the community would include provision of tsetse control related technical information, reduction of gender bias in distribution of work, strengthening of leadership, and introduction of community participation in conservation and tourism in the area.

9897 **Penchenier, L., 1996.** Historique et evolution de la maladie du sommeil au Cameroun. [History and evolution of sleeping sickness in Cameroon.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 23-36 (epidemiological data 37-41).

Laboratoire de Recherche sur les Trypanosomiasés,  
OCEAC, B.P. 288, Yaoundé, Cameroon.

Cameroon is one of the historical Meccas of human trypanosomiasis. It was there, in the Nyong valley, that Jamot put into practice his control principles which had a profound effect on the endemic disease services of central and West Africa. The disease then devastated the south-east of the country, from Bafia to the Kadeï, the coast, the valleys of the Logone and the Chari at the border with Chad, and the mountains in the west which, at that time, were under British jurisdiction. Thanks to the efforts undertaken, human trypanosomiasis practically disappeared, leading to a complete relaxation of surveillance and, in 1996, total ignorance of the situation. The historical review which is presented shows that the risk of resurgence is ever present in the historic foci and that a rapid resumption of monitoring is essential.

9898 **Penchenier, L., 1996.** Historique et evolution de la maladie du sommeil au Congo. [History and evolution of sleeping sickness in the Congo.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 42-51 (epidemiological data 52-55).

Laboratoire de Recherche sur les Trypanosomiasés,  
OCEAC, B.P. 288, Yaoundé, Cameroon.

It seems that the low population of the Congo (2 million inhabitants for a country with an area equal to two-thirds that of France) could be attributable in large measure to trypanosomiasis. Towards the end of the first decade of the twentieth century, trypanosomiasis was almost at its maximum geographical extent. It regressed above all thanks to the campaigns of pentamidine treatment undertaken from 1945 to 1950. These campaigns began, in the Congo, at Kayes in 1947 and extended progressively throughout the country. Mossaka, in 1951, was one of the last regions to benefit. The history of the disease was profoundly altered by these campaigns. In 1953 the results were spectacular and in 1956 all the indices used to evaluate the disease situation fell to *c.* 0%. In 1964, throughout the Congo, only 75 new cases were diagnosed out of 468,000 persons visited (total population 860,000). At the end of the 1970s, trypanosomiasis suddenly returned to the Congo. Since then, despite the efforts of successive teams in the field, in the Bouenza focus, the cumulative prevalence has remained very high with, in particular, a prevalence of 6.47% in 1992, the year in which the most cases were detected throughout the Congo since the 1950s. The modern history of trypanosomiasis in the Congo began in 1895. A century later, the disease is always dangerously present.

9899 **Penchenier, L., Simarro, P. and Ndongo Asumo, P., 1996.**

Historique et evolution de la maladie du sommeil en Guinée Equatoriale. [History and evolution of sleeping sickness in Equatorial Guinea.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 69-74 (epidemiological data 75-77).

Penchenier: Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon. Equatorial Guinea is the smallest and least populated of the OCEAC countries. Nevertheless, human trypanosomiasis there has been very severe. Since 1980 measures have been taken which have resulted in a marked decline in the prevalence of the disease, raising hopes of its almost complete disappearance if efforts are maintained.

9900 **Penchenier, L., Wang Sonne and Bureau, P., 1996.** Historique et evolution de la maladie du sommeil dans les pays de l'OCEAC. [History and evolution of sleeping sickness in the OCEAC countries.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (3): 11-22.

Penchenier: Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon. Since the 1970s, we have witnessed a general resurgence of human African trypanosomiasis. The epidemics of the last few years have all developed at the site of the historic foci of the dramatic pandemics of the end of the last century and of the 1930s, which has suggested a 'genie of trypanosomiasis outbreaks'. To try to ascertain the causes of the revival of foci, and their maintenance, it is necessary to know their history and dynamics, not in a national context but on a much larger scale. This is what we have tried to do here for the countries of the Organisation de Coordination pour la lutte contre les Endémies en Afrique Centrale (OCEAC) by concentrating on discovering the origin of the foci in order to determine whether they existed before colonisation (primary foci) or whether they are the consequence of population movements linked to colonial expansion. (See also 20: nos. 9888, 9889, 9891, 9897-9899.)

9901 **Tropical Pesticides Research Institute, 1994.** Evaluation of efficiency of artificial attractive devices and odours for control and monitoring of tsetse flies through community participation in Tanzania. End of project report 1991-1993. *TPRI Miscellaneous Report*, no. 1064: 52 pp.

TPRI, P.O. Box 3024, Arusha, Tanzania.

Tsetse flies infest about two-thirds of Tanzania where they transmit both animal and human trypanosomiasis, mainly and directly affecting rural communities. Recently simple tsetse control techniques have been developed to facilitate community participation in tsetse control in various countries of Africa. A series of experiments were carried out in northern Tanzania to evaluate the efficiency of available artificial tsetse attractive devices so far developed, in both East and West Africa, against tsetse species found in northern Tanzania (*Glossina swynnertoni*, *G. pallidipes* and *G. morsitans centralis*) and to determine the most effective way of involving pastoral communities in the management of such devices on a self-help sustainable inter-community basis. Separate chapters in this report are devoted to flyround patrol sampling techniques (see 20: no. 9910), assessment of various odour attractants used with biconical traps (no. 9911), assessment of the efficiency of various traps (no. 9912), use of alphacyper-methrin-impregnated targets in the control of *G. swynnertoni* (no. 9915), and forecasting

the likelihood of community participation in tsetse control (no. 9896).

9902 **Vickerman, K., 1997.** Landmarks in trypanosome research. *In: Hide, G. et al. (eds), 1997 (see 20: no. 9893), pp. 1-37.*

Division of Environmental and Evolutionary Biology, University of Glasgow, Glasgow G12 8QQ, UK.

One hundred years have elapsed since the discovery by David Bruce of the trypanosome as causative agent of nagana and of the tsetse fly as its transmitter. This essay gives some background to this monumental discovery and surveys landmarks in the history of trypanosome research since then, showing how fashions, ideas and techniques have dictated both emphasis of interest and the pace of progress of our understanding of the trypanosome's way of life and how the parasite relates to its two very different hosts. Topics discussed include: vector transmission (a clutch of centenarians); David and Mary Bruce (a unique partnership); the trypanosome and disease; Koch's postulates and the divorce of protozoology from microbiology; Paul Ehrlich and selective staining (the foundations of chemotherapy); Romanowsky and the heyday of parasitic protozoology; tsetse (bane or saviour of Africa?); the revolution in cell biology; the kinetoplast and cyclical development; evasion of the host's immune response by antigenic variation; population biology, evolution and the species question.

## 2. tsetse biology

### (a) REARING OF TSETSE FLIES

9903 **Gooding, R.H., Feldmann, U. and Robinson, A.S., 1997.** Care and maintenance of tsetse colonies. *In: Crampton, J.M., Beard, C.B. and Louis, C. (eds), Molecular biology of insect disease vectors: a methods manual (London, UK; Chapman & Hall), pp. 41-55.*

Gooding: Department of Biological Sciences, CW405A, Biological Sciences Centre, University of Alberta, Edmonton, Alberta T6G 2E9, Canada.

A detailed account of the care and maintenance of tsetse colonies is given under the following headings: Introduction (classification, distribution and economic importance; life history of tsetse: constraints upon colony maintenance; uses of tsetse colonies; strategies for establishing tsetse colonies), Materials (general information on materials; tsetse cages; trays for holding cages) and Methods (environmental requirements for holding flies; environmental requirements for manipulating flies; feeding tsetse - general comments,

*in vivo* and *in vitro* feeding systems; breeding tsetse - collecting and holding puparia, sexing teneral flies, mating flies and holding breeding stock, transporting tsetse). Notes are also provided on collecting and checking blood and control of blood quality, and on quality control of colonised tsetse - phenotypic measures of quality (puparial weight, emergence rate, quality control populations, mortality rates, fecundity, and genetic measures of quality in laboratory colonies).

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

9904 **Deken, R. de, Bossche, P. van den, Sangare, M., Gnanvi, C., Missanda, J.H. and Hees, J. van, 1997.** Effect of the life-span of female *Glossina palpalis gambiensis* on the weight and size of its progeny. *Medical and Veterinary Entomology*, **11** (1): 95-101.

Deken: Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

Pupae and teneral flies of *G. p. gambiensis* originating from three successive reproductive cycles were compared for their size and weight. In general, pupal weight and fly weight increased, whereas fly size, measured as wing vein length, decreased with the number of reproductive cycles. The linear regression observed between weight and wing vein length of the fly demonstrated that, particularly for flies originating from the first and second larvipositions, small changes in wing vein length reflected substantial differences in weight. The results of these laboratory experiments were compared with some field data on *G. morsitans* from Zambia and related literature. The life span of the female tsetse, affecting the size of her progeny, could clarify partially some of the field observed seasonal changes in size, whereas the correlation between fly size and weight could eventually explain the differential mortality of some size classes of tsetse flies. However, whether these laboratory observations can be extrapolated to the field has still to be confirmed.

9905 **Denlinger, D.L. and Zdárek, J., 1997.** A hormone from the uterus of the tsetse fly, *Glossina morsitans*, stimulates parturition and abortion. *Journal of Insect Physiology*, **43** (2): 135-142.

Denlinger: Department of Entomology, Ohio State University, 1735 Neil Avenue, Columbus, OH 43210, USA. Unlike most insects, the tsetse female gives birth to a single, fully grown larva at the culmination of each

pregnancy cycle. The expulsion of the larva is regulated by a hormone present in rich abundance within the female's uterus. The hormone elicits parturition when injected into neck-ligated females at late stages of pregnancy, and abortion when injected at earlier stages. We refer to this highly active material (0.043 uterus equivalents stimulates parturition in 50% of the females) as parturition hormone. Injection of the active extract, which appears to be a peptide or small protein, initiates the series of blood pressure pulsations and uterine contractions normally associated with parturition. The discovery that a uterus extract from the flesh fly also elicits parturition in tsetse suggests that this hormone may be widely distributed in insects.

9906 **Nicolson, S.W. and Isaacson, L.C., 1996.** Mechanism of enhanced secretion in the warmed Malpighian tubule of the tsetse fly, *Glossina morsitans morsitans*. *Journal of Insect Physiology*, **42** (11-12): 1027-1033.

Nicolson: Department of Zoology, University of Cape Town, Rondebosch 7700, South Africa.

Warming increased the rate of fluid secretion (as measured using the Ramsay technique) by cAMP-stimulated Malpighian tubules of the tsetse fly *G. m. morsitans*. The mechanism of this effect was explored by examining the temperature-induced changes in the current/voltage relationship, and in the equivalent electrical circuit, of isolated perfused tubules. Warming the unstimulated tubule from 20 to 30°C induced only a reversible decrease in slope resistance, consistent with the known effect of temperature on the conductance of mixed electrolyte solutions. Tubules exposed to cAMP at room temperature showed a much larger fall in slope resistance, with little or no further fall on subsequent warming by 10°C. In terms of the simple equivalent electrical circuit: (a) warming unstimulated tubules induced a fall in  $E_{Na}$  (a measure of the electromotive force of the  $Na^+$  transport mechanism), with no change in the calculated secretion rate; and (b) tubules exposed to cAMP at room temperature exhibited a 90% fall in series resistance ( $R_{series}$ ), with no change in  $E_{Na}$ , and doubling of the calculated secretion rate. On subsequent warming,  $R_{series}$  remained unchanged, but both  $E_{Na}$  and the calculated secretion rate increased markedly. Warming also tended to reduce the shunt resistance, which would contribute to the increase in secretion rate.

9907 **Voskamp, K.E. and Otter, C.J. den, 1995.** Single cell recordings from olfactory receptors of tsetse flies: a field study. *Proceedings of the section Experimental and Applied Entomology of the Netherlands Entomological Society*, **6**: 171-172. Sensory Physiology Group, Department of Animal Physiology, Uni-versity of Groningen, P.O. Box 14, 9750 AA Haren, Netherlands.

A portable EAG/Single-Cell module was used to record the electrical responses of individual olfactory cells in the antennae of *Glossina pallidipes* to host odours in the field in Zimbabwe. Cell responses were recorded at 0.2, 1 and 5 m downwind and 10 m upwind from an ox concealed in a pit fitted with fan and pipe. The results suggest that odours emanating from a host arrive at the insect's olfactory cells as short puffs.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **20**: no. 9919.]

9908 **Groenendijk, C.A. and Takken, W., 1996.** Host odour composition affects host location efficiency of tsetse (Diptera, Glossinidae). *Physiological Entomology*, **21** (3): 203-211.

Groenendijk: C.P. 75, Cidade de Inhambane, Mozambique. Marked *Glossina pallidipes* were released downwind of an odour source in the field in Zimbabwe and the percentage recaptured at the source on the same day was measured. In the absence of odour, 1.3% of the marked tsetse released from a box or refuge were recaptured, independent of the distance between release point and odour source. The distance was varied from 10 to 100 m. When natural ox odour or a blend of carbon dioxide, acetone, octenol and phenols was dispensed, untransformed recapture percentages of box-released tsetse decreased from 18% for tsetse released at 10 m to 2% for tsetse released at 100 m. Recapture percentages were significantly higher than in the absence of odour at all release distances for ox odour and for release distances up to 75 m downwind for the artificial odour. When a combination of acetone, octenol and phenols or carbon dioxide on its own was dispensed, recapture percentages decreased from 6% for tsetse released at 10 m to 0% for tsetse released at 100 m. With these odours, recapture percentages were higher than in the absence of odour when tsetse were released at 20 m from the source, but were lower than recaptures in the presence of ox odour or the artificial mixture with carbon dioxide. Recapture

percentages of flies spontaneously leaving refuges were higher than those of box-released tsetse. Proximity of source had no effect on the recapture percentage of refuge-leaving tsetse, and host-location efficiency was close to 100% when host odour was detected at 30 m or less. The results are discussed in relation to the host-location strategy of tsetse.

9909 **Jarry, M., Khaladi, M., Hossaert-McKey, M. and Gouteux, J.-P., 1996.** Modèles matriciels et dynamique des populations. Deux exemples d'application en biologie végétale et en entomologie. [Matrix models and population dynamics. Two examples of application in plant biology and entomology.] *In: Sabatier, P. et al. (eds), Méthodes et problématiques de modélisation dynamique. Caractérisation des formes biologiques et spatiales* (Actes du séminaire INRA/ENVL d'Avignon, 5-6 décembre 1994) (Versailles, France; INRA-SAD), pp. 47-61.

Jarry: Laboratoire de Mathématiques Appliquées, URA CNRS 1204, IPRA-UPPA, avenue de l'Université, 64000 Pau, France.

Matrix models offer an overall framework of study of the dynamics of structured populations. This 'natural' approach, which is based on the life cycle of a given species, assumes a 'discrete' view of the phenomena which often corresponds to the nature of the field data which the biologist has at his disposal. The model can be written in the form  $X(t+1) = M \cdot X(t)$  where  $X(t)$  is a vector of dimension  $n$  of which each of the components represents the number of individuals of a given stage at date  $t$ , and  $M$  is a squared 'transition' matrix which integrates the demographic parameters of the population. The characteristics of this matrix (actual values and vectors) are interpreted in terms of the rate of growth and of the stationary distribution of the stages. Two examples of applications are given. In one of the applications (entomology: tsetse flies) the linear model proves satisfactory; in the other application (plant biology: *Sesbania vesicaria*) the introduction of density-dependent effects enriches the model which then becomes non-linear. The numerous developments allowed by this approach are discussed.

9910 **Muangirwa, C.J., Matechi, H.T., Macha, P.S.M., Doriye, R. and Sikay, M., 1994.** Flyround patrol techniques for sampling tsetse flies (*Glossina swynnertoni*, *G. pallidipes* and *G. morsitans centralis*) in northern and central Tanzania. *TPRI Miscellaneous Report*, no. 1064: 2-12.

TPRI, P.O. Box 3024, Arusha, Tanzania. Experiments were carried out to assess catches of tsetse flies (*G. swynnertoni*, *G. pallidipes* and *G. m. centralis*) using various flyround patrol techniques. *G. swynnertoni* were easily caught by all techniques tested, very few *G. pallidipes* were caught, while the *G. morsitans* population was too low in the study area for conclusive deductions to be made. The men, screen and acetone (MSA) flyround patrol technique had significantly the highest catches of *G. swynnertoni*, with an index of increase of 8.4 when compared to the conventional manned patrols (M), which had the least catches. Catches of *G. swynnertoni* on the vehicle-mounted monoconical screen trap and acetone (VTA) and the knapsack monoconical screen trap and acetone (KTA) did not differ significantly from each other but they were 0.4-0.7 times lower than catches on the MSA ( $P < 0.05$ ). It is concluded that acetone is an attractant of *G. swynnertoni*. Sampling of *G. swynnertoni* can be improved in extensive motorable areas by using the VTA. Equally intensive sampling of *G. swynnertoni* in small areas can be improved by using MSA instead of the conventional manned flyround. The KTA eliminates dependence on the ability of 'flyboys' to catch tsetse flies, hence it can be used by inexperienced staff and by the local community.

9911 Muangirwa, C.J., Matechi, H.T., Macha, P.S.M., Mbise, S.R., Sikay, M. and Doriye, R., 1994. Assessment of catches of tsetse flies (*Glossina pallidipes*, *G. swynnertoni* and *G. morsitans centralis*) in biconical traps baited with various odour attractants in northern and central Tanzania. *TPRI Miscellaneous Report*, no. 1064: 13-22.

TPRI, P.O. Box 3024, Arusha, Tanzania. Studies were carried out to assess catches of tsetse flies (*G. pallidipes*, *G. swynnertoni* and *G. centralis*) in biconical traps baited with odour attractants. A total of five types of odours were used singly and in combination resulting in eight treatments: acetone (A); fermented cow urine (U); acetone and urine (AU); acetone and 1-octen-3-ol (AO); acetone, 1-octen-3-ol and fermented urine (AOU); acetone, 1-octen-3-ol and 3-n-propyl phenol (AOP); acetone, 1-octen-3-ol, 3-n-propyl phenol and 4-methyl phenol (AOPM). Generally a combination of AOU was an effective attractant for the three tsetse species. Critical odour attractants for *G. swynnertoni* were acetone and 1-octen-3-ol (index of increase above control 1.6-2.6); and for *G. pallidipes* were acetone and urine (index 3.2-4.9). When acetone and cow urine were applied simultaneously, catches of both sexes of *G.*

*swynnertoni* were synergistically suppressed while catches of both sexes of *G. pallidipes* were synergistically increased. When synthetic components of cow urine (3-n-propyl phenol and 4-methyl phenol) were used with 1-octen-3-ol, catches of *G. pallidipes* were increased (index 1.6-2.5) but the catches were significantly lower than when cow urine was used (index 4.2). The synthetic components of cow urine did not increase catches of *G. swynnertoni* and *G. morsitans*. No firm conclusion could be made on *G. m. centralis* because of low population density in the study area, but there were indications that it would behave as *G. swynnertoni*. The difference in response of *G. pallidipes* and *G. swynnertoni* to odour attractants reflects differences in host-seeking strategy, *G. pallidipes* depending on stationary hosts (urine and acetone) and *G. swynnertoni* seeking moving hosts (acetone without urine). Cow urine would suffice for sampling and control of *G. pallidipes*, but efforts should be made to find an alternative inexpensive odour to replace acetone in the sampling and control of *G. swynnertoni*. The observations were used to design a trial on the control of *G. swynnertoni*, using acetone-baited insecticide-impregnated targets (see 20: no. 9915).

9912 **Muangirwa, C.J., Matechi, H.T., Macha, P.S.M., Sikay, M., Doriye, R. and Mbise, S.R., 1994.** Assessment of catches of tsetse flies (*Glossina pallidipes*, *Glossina swynnertoni* and *Glossina morsitans*) in various traps in northern and central Tanzania. *TPRI Miscellaneous Report*, no. 1064: 23-31.

TPRI, P.O. Box 3024, Arusha, Tanzania.

Experiments were carried out between April 1992 and January 1993 to compare the efficiency of known tsetse traps in sampling *G. pallidipes*, *G. swynnertoni* and *G. morsitans* in northern and central Tanzania. The index of increase of mean catches, compared to catches in biconical traps, was low (up to 2.1). Generally, the 'conical family' of traps were the most efficient. Significantly higher catches of *G. pallidipes* were obtained with the monopyramidal four-sided trap (MP4, index of increase over catches in biconical trap 1.7) and with the monopyramidal three-sided trap (MP3, index 1.5). Catches in F3 traps (index 1.2) were similar to catches in NGU traps (index 1.1); catches in Epsilon traps (index 0.9) were the lowest. For *G. swynnertoni* mean catches in the monoconical screen trap (MSc, index 1.4), MP4 trap (index 0.9) and NGU trap (index 0.9) were similar to mean catches in the biconical trap, while mean catches in F3, MP3 and Epsilon traps were

significantly lower (index 0.3-0.6). Mean catches of *G. swynnertoni* on an electric trap (index 2.1) were significantly higher than in biconical and MP3 traps, while the reverse was true for *G. pallidipes*. Very few *G. morsitans* were caught in traps. The observed difference in behaviour of *G. swynnertoni* and *G. pallidipes* to different traps may influence choice of attractive device for control. Insecticide-impregnated screens may be most suitable for the control of *G. swynnertoni*, while traps (with or without insecticide) may be most suitable for *G. pallidipes*.

9913 **Paynter, Q. and Brady, J., 1996.** The effect of wind speed on the flight responses of tsetse flies to CO<sub>2</sub>: a wind-tunnel study. *Physiological Entomology*, **21** (4): 309-312. Brady: Imperial College, Silwood Park, Ascot, Berks SL5 7PY, UK.

Female *Glossina morsitans morsitans* were video-recorded in a wind-tunnel as they entered, in cross-wind flight, a broad plume of CO<sub>2</sub> (a component of host odour). At a wind speed that corresponds with peak catches in the field (c. 0.6 m/s) odour produced both significant upwind turning responses (in-flight anemotaxis) and kinetic responses (reduced flight speed and increased sinuosity (°/m)). At a wind speed of c. 0.2 m/s flies displayed anemotactic, but not kinetic, responses to odour. At very low wind speeds (0.1 m/s) neither upwind turning responses nor kinetic responses to odour were detected. The results are discussed with regard to current theory of host-location by tsetse.

3. tsetse control (including environmental side-effects)

[See also **20**: nos. 9887, 9890, 9896, 9911, 9912.]

9914 **Barrett, J., 1997.** Control strategies for African trypanosomiasis: their sustainability and effectiveness. In: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 347-359.

Natural Resources Systems Programme, Systems Management Office, ODA, 94 Victoria Street, London SW1E 5JL, UK. In tsetse-affected parts of Africa, where trypanosomiasis is of major economic importance because of its effects upon both man and his domestic livestock, principally cattle, there are three broad approaches to control: (i) disease management using drugs and/or vaccines; (ii) use of trypanotolerant cattle; and (iii) vector (tsetse) control. Although trypanocidal drugs can be very effective, resistance has become a problem and there is a lack of new drug development. It has been shown that trypanotolerant

cattle are suited to areas with low to medium trypanosome prevalence but that the import of tolerant stock is not necessarily profitable. Tsetse control methods are outlined. Case studies, mainly in Zimbabwe, compared the costs of controlling savanna tsetse species using four major techniques. Where feasible, the cheapest method of control was to treat cattle with appropriate insecticides. The costs of using odour-baited insecticide-treated targets compared well with ground spraying using DDT. Sequential aerial spraying with non-residual insecticides was generally the most expensive of the four techniques evaluated. The relative costs vary considerably from one situation to another, and factors other than cost will also influence the choice of technique for a specific programme. However, bait techniques will probably be of increasing importance in the future, offering the scope for a more measured approach to tsetse control than was feasible with ground or aerial spraying. This should lead to more sustainable and cost-effective tsetse control, coordinated with rural development in the affected areas more effectively than in the past. Tsetse population suppression may now be feasible and worthwhile as an alternative to eradication.

9915 **Muangirwa, C.J., Sikay, M., Matechi, H.T. and Doriye, R., 1994.**

Residual effectiveness of insecticide (alphacypermethrin, sc) impregnated targets on population of tsetse flies (*Glossina swynnertoni*) in northern Tanzania. *TPRI Miscellaneous Report*, no. 1064: 32-39.

TPRI, P.O. Box 3024, Arusha, Tanzania.

An experiment was carried out between January and July 1993 to assess residual effectiveness of insecticide-impregnated targets on a population of *G. swynnertoni* in northern Tanzania. Suspended swinger targets were treated with alphacypermethrin, 0.1% s.c., and deployed at a rate of c. 8 per km<sup>2</sup> in an area of c. 15 km<sup>2</sup>. Half the number of (alternate) targets were baited with acetone c. 458 mg/h. The tsetse population was sampled by a patrol party of men carrying acetone. Residual toxicity of insecticide deposits was assessed by using wild caught pregnant *G. pallidipes*. Generally catches of *G. swynnertoni* declined in the area during 7 months of observation. Daily reduction of catches in the treated plot was 1.02%, at the edge of the plot 0.71%, in the neighbouring area 0.82% and in the control (untreated) area 0.29%. One month after deployment of the targets, catches of tsetse flies in the middle of the treated

area had decreased by 54.5%, at the edge of the area by 43.6% and in the neighbouring area by 19.3%; catches in the control area increased by 70%. Residual toxicity of the insecticide to wild caught pregnant *G. pallidipes* was 100% up to 90 days after deployment of targets, 90% at 120 days, 60% at 151 days and 40% at 181 days. Reduction in catches of tsetse flies in the treated block was 71% at 120 days and 88% at 181 days. Respective reductions in catches at the edge of the treated area were 57% and 80%, in the neighbouring area 62% and 80% and in the control area 29% and 36%. Greater reductions in tsetse population would be expected if the treated area was larger and free from immigration. The target used in the experiment is simple to make and service, hence suitable for community participation. It is desirable to locate an alternative odour attractant to acetone and also use an insecticide formulation with longer residual toxicity.

9916 **Omolo, E.O., James, M.D., Osir, E.O. and Thomson, J.A., 1997.** Cloning and expression of a *Bacillus thuringiensis* (L1-2) gene encoding a crystal protein active against *Glossina morsitans morsitans* and *Chilo partellus*. *Current Microbiology*, **34** (2): 118-121.

Thomson: Microbiology Department, University of Cape Town, Private Bag, Rondebosch 7700, South Africa. A local isolate of *B. thuringiensis*, designated L1-2, that is toxic to *C. partellus* was found to be toxic to the adult tsetse fly, *G. m. morsitans*. The  $\delta$ -endotoxin crystals derived from the isolate gave a major protein band with a molecular weight of M<sub>w</sub> 130,000-140,000 on denaturing polyacrylamide gel electrophoresis. The sequence of the cloned gene was found to be similar to that of the *B. thuringiensis* subsp. *kurstaki* HD-73 *cryIA(c)* gene, having one amino acid difference at position 148 and four additional DNA differences.

9917 **Omolo, E.O., Osir, E.O., Thomson, J.A. and James, D., 1996.** Cloning and expression of *Bacillus thuringiensis* (*Tikki* and L1-2) gene encoding a M<sub>w</sub> 130,000-140,000 crystal protein active against *Glossina morsitans morsitans* and *Chilo partellus*. (Meeting abstract no. 46.) *Cellular and Molecular Biology*, **42** (Suppl.): S-35.

ICIPE, P.O. Box 30772, Nairobi, Kenya. Kenyan isolates of *B. thuringiensis*, designated L1-2 and *Tikki*, were found to be toxic to adult tsetse flies, *G. m. morsitans*, and larvae of the stem-borer, *C. partellus*, in bioassays. The  $\delta$ -endotoxin crystals derived from these isolates gave a major protein band of molecular weight of M<sub>w</sub> 130,000-140,000 on denaturing polyacrylamide gel

electrophoresis. Both *LI-2* and *Tikki* were expressed in *E. coli*. The complete nucleotide sequences of the coding regions of the cry *LI-2* and cry *Tikki* genes were determined. Bioassay experiments using recombinant *LI-2* and *Tikki* demonstrated that these isolates retained their insecticidal properties against adult *G. m. morsitans* and *C. partellus* larvae. In *G. m. morsitans*, the LC<sub>50</sub> for the *LI-2* wild type endotoxin crystals was 42.55 µg/ml while the LC<sub>50</sub> for the recombinant *pLI2-7.4* was 74 µg/ml. These are the first *B. thuringiensis* isolates shown to be insecticidal to adult tsetse flies.

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

[See also **20**: 9887-9889, 9891, 9897-9900, 9907, 9908, 9911, 9913, 9925, 9926, 9938.]

9918 **Hide, G., 1997.** The molecular epidemiology of trypanosomatids. In: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 289-303.

Wellcome Unit of Molecular Parasitology, University of Glasgow, Anderson College, 56 Dumbarton Road, Glasgow G11 6NU, UK.

This review discusses the technologies and approaches available to the molecular epidemiologist to assist with the identification and diagnosis of trypanosomatids in their hosts and vectors (including hybridisation, *in situ* hybridisation, RFLP analysis, DNA sequencing, PCR, PCR-SHELA and riboprinting), reviews some of the ways in which these approaches have been used to give epidemiological information, and illustrates one approach with reference to human sleeping sickness epidemics caused by *Trypanosoma brucei rhodesiense* in Uganda. While a great deal still needs to be done to develop the tools and reagents for epidemiological analysis, suitable tools are now available to begin to analyse large populations of parasites, vectors and hosts to provide both qualitative and quantitative data which, in combination with classical parasitological approaches, will help to provide a fuller understanding of the epidemiology of these diseases and make a contribution to overall control programmes.

9919 **Makumi, J.N., Green, C.H. and Baylis, M., 1996.** The role of cattle as hosts of *Glossina longipennis* at Galana Ranch, south-eastern Kenya. *Medical and Veterinary Entomology*, **10** (4): 331-336.

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

*G. longipennis* were recorded visiting and engorging on cattle in an enclosure and on a single ox in a crush using transparent electrocuting nets in an incomplete ring. Of the total flies caught, 3-6% of males and 5-6% of females in the total catches were engorged (a feeding success rate of up to 16.6% and 12.6%, respectively, depending on assumptions made about the proportion which had an opportunity to feed). Direct observation of tsetse from an observation pit showed 57% landing on the front legs, 13% on the hind legs and 11% on the belly of the host. The largest number of bloodmeals was taken from the front legs, although only 14% of landings there terminated in feeding; a higher proportion of the flies alighting on the hind legs and flank succeeded in feeding (28% and 21% respectively). *G. longipennis* were attracted to targets baited with ox odour from an underground pit in a dose-dependent manner. Odour of humans was much less attractive to *G. longipennis* than that of oxen (for equivalent biomass). Analysis of bloodmeal samples from tsetse caught in two sites on the ranch showed that *G. longipennis* preferentially feeds on suids, bovids and hippopotamus.

9920 **Mihok, S., Kock, R. and Masake, R., 1995.** Health implications of translocations of endangered species in Africa: trypanosomiasis in rhinoceros. In: Junge, R.E. (ed.), *Proceedings of a Joint Conference of American Association of Zoo Veterinarians, Wildlife Disease Association and American Association of Wildlife Veterinarians, East Lansing, Michigan, USA, 12-17 August 1995*, pp. 423-424.

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

Areas such as Tsavo National Park in Kenya that once harboured black rhinoceros are now being restocked with surplus animals from a variety of sanctuaries. These areas are mostly in the lowlands where tsetse and trypanosomiasis are prevalent. Following the death of a translocated rhino in 1989, possibly from complications arising from a *Trypanosoma brucei* infection, introductions have been planned to minimise tsetse challenge and disease risk. To date rhinos have survived infections of *T. congolense*, *T. vivax* and a new genotype of *Nannomonas* without the need for chemotherapy. However, haematological monitoring has revealed indications of stress following translocation, and antigen-ELISA tests have suggested that most animals harbour cryptic infections, particularly of *T. brucei*. Recently, similar monitoring of translocated white rhinos has shown *T. brucei* infections with mild

anaemia in animals moved to low-challenge tsetse areas and active infections in high-challenge areas. It is clear that the white rhino is a particularly good wildlife host for *T. brucei*, and therefore moving white rhinos into and out of areas with human sleeping sickness could pose real dangers of inadvertently introducing human-infective forms of *T. brucei* to new areas.

9921 **Nguu, E.K., Osir, E.O., Imbuga, M.O. and Olembo, N.K., 1996.** The effect of host blood in the *in vitro* transformation of bloodstream trypanosomes by tsetse midgut homogenates. *Medical and Veterinary Entomology*, **10** (4): 317-322.

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

Midgut homogenates prepared from *Glossina morsitans morsitans*, that had previously been fed on different host blood samples, were tested for their abilities to transform bloodstream *Trypanosoma brucei* into procyclic (midgut) forms *in vitro*. Compared to rat and goat blood samples, eland blood had the least capacity to support trypanosome transformation, whereas buffalo blood showed intermediate capacity. Fractionation of rat blood showed the importance of the cellular portion since both rat and eland red blood cells (RBCs) supported the process. Virtually no transformation was observed in rat and eland plasma or serum fractions. Suspending rat blood cells in eland plasma led to a reduction in parasite transformation rates. Further experiments showed that the RBC membranes were also capable of supporting the process. These results clearly show the important role played by blood, especially the RBCs, in the transformation of bloodstream trypanosomes. In addition, the low transformation rates observed in eland blood is due to an inhibitory factor(s) present in the plasma fraction.

9922 **Solano, P., Reifenberg, J.M., Amsler-Delafosse, S., Kabore, I., Cuisance, D. and Duvallet, G., 1996.** Trypanosome characterization by polymerase chain reaction in *Glossina palpalis gambiensis* and *G. tachinoides* from Burkina Faso. *Medical and Veterinary Entomology*, **10** (4): 354-358.

Reifenberg: CIRAD/EMVT, c/o Centre ORSTOM, B.P. 5045, 34032 Montpellier Cedex 1, France.

Following the discovery of four cases of African human trypanosomiasis, an entomological survey was conducted along the Mouhoun river in southwest Burkina Faso to collect *G. p. gambiensis* and *G. tachinoides*. Among 226 flies dissected, 4.87% (11 individuals) were infected in midgut or proboscis, but never in the salivary glands. Polymerase chain reaction analysis was undertaken, and

was able to characterise all the proboscis infections, and half of the midgut infections. Only *Trypanosoma simiae* and *T. vivax* were found in the organs of infected flies, in single or mixed-species infections. Ten more flies, negative with parasitological examination, were tested with *Trypanozoon* primers and remained negative. The epidemiological significance of the absence of *T. brucei* group infections in wild tsetse populations and the presence of *T. simiae* in *G. p. gambiensis* is discussed.

9923 **Welburn, S.C. and Maudlin, I., 1997.** Current trends in parasite vector interactions. *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 315-325.

Welburn: Division of Molecular Genetics, University of Glasgow, Anderson College, 56 Dumbarton Road, Glasgow G11 6NU, UK.

This review discusses the interactions between trypanosomes (*Trypanozoon* and *Nannomonas*) and *Leishmania* and their insect vectors (tsetse and sandflies) which play a crucial role in determining establishment of the parasite in the vector and its maturation into the mammalian infective form. The important role of the parasite-vector interface in the processes that lead to the production of mature, transmissible parasites is highlighted. To date little is known about the genes and molecular mechanisms which are responsible for controlling and coordinating these processes. However, some recent advances in molecular technology (e.g. PCR techniques) provide the opportunity to examine parasite-specific gene expression during transmission and development through the insect vector. In addition to providing new information on parasite self-regulation and maturation, these approaches provide a window into the parasite life cycle which may in turn lead to novel targets for control of disease.

## 5. human trypanosomiasis

### (a) SURVEILLANCE

[See also **20**: nos. 9888, 9889, 9891, 9897-9899.]

9924 **Asonganyi, T., Bedifeh, B.A., Ade, S.S. and Ngu, J.L., 1994.** An evaluation of the reactivity of the card agglutination test for trypanosomiasis (CATT) reagent in the Fontem sleeping sickness focus, Cameroon. *African Journal of Medicine and Medical Sciences*, **23** (1): 39-46.

Asonganyi: Centre Universitaire des Sciences de la Santé, Université de Yaoundé, B.P. 337, Yaoundé, Cameroon.

The Testryp<sup>®</sup> card agglutination test for trypanosomiasis (CATT) used for the serodiagnosis of

*Trypanosoma brucei gambiense* trypanosomiasis is based on the variant antigen type LiTat 1.3. This antigen is rarely expressed by trypanosomes in the Fontem focus of Cameroon, but the CATT has been used for serodiagnosis in the focus since 1985. We give here a summary of results obtained with the CATT in Fontem from 1985 to 1989. The CATT is specific for trypanosome antibodies since: (a) sera from persons with other parasitoses from areas non endemic for trypanosomiasis fail to react, and (b) an ELISA based on the detection of antibodies to somatic antigens of *T. b. gambiense* from Fontem concurred with the CATT. CATT reactions in Fontem seem to be specific for the variant surface glycoprotein since absorption of CATT reactive sera with formalin fixed bloodstream *T. b. gambiense* from Fontem and with culture produced procyclics of *T. b. gambiense* from Fontem failed to abrogate CATT reactivity. CATT on serum failed to confirm 37% of CATT positive cases on whole blood. Although immunoconglutinin, anti-human red blood cell (RBC) antibodies and complement fixing immune complexes were found in sera from Fontem, our results failed to incriminate immunoconglutination of RBCs, reactions of RBCs with their autoantibodies and immune adherence haemagglutination as contributory factors in this lack of agreement between CATT on serum and whole blood. Further, comparison of whole blood and serum CATT results of parasitologically confirmed patients leads to the conclusion that screening with the CATT in the Fontem focus should be done on whole blood, not serum or plasma. CATT reactions in Fontem are based on cross-reactions with as yet undefined VATs.

9925 **Penchenier, L., Dumas, V., Grébaud, P., Reifenberg, J.M. and Cuny, G., 1996.** Nouvelle technique de preparation du sang, applicable sur le terrain, pour le diagnostic des trypanosomoses humaines et animales par P.C.R. [A new technique of blood preparation, applicable in the field, for the diagnosis of human and animal trypanosome infections by PCR.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (4): 45-49.

Penchenier: Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon. Detection of trypanosomes in blood is difficult: PCR technology can bring the required sensitivity and specificity compared to classical methods of parasitology. However, direct amplification from blood is inhibited by haemo-globin derivatives. We have therefore developed a simple and efficient technique

for detecting 1 trypanosome in 1 ml of blood, without DNA purification, and applied it for detection of parasites in midguts for tsetse flies. This technique shows great promise for human and animal health problems because it can be easily performed in field conditions and can greatly facilitate epidemiological studies.

9926 **Penchenier, L., Dumas, V., Grébaud, P., Reifenberg, J.M. and Cuny, G., 1996.** Improvement of blood and fly gut processing for PCR diagnosis of trypanosomiasis. *Parasite*, **3** (4): 387-389.

Cuny: Laboratoire des Rétrovirus, ORSTOM, 911 avenue Agropolis, B.P. 5045, 34032 Montpellier Cedex 1, France.

We have adapted a simple and efficient technique for PCR detection of trypanosomes in human blood, without DNA purification, and increased the sensitivity threshold to 1 parasite in 1 ml. We have then applied it for detection of parasites in midguts of tsetse flies, negative by microscopy. This technique has been developed for field conditions and could greatly facilitate epidemiological studies.

(b) PATHOLOGY AND IMMUNOLOGY

9927 **Dumas, M. and Bouteille, B., 1996.** Trypanosomose humaine africaine. [Human African trypanosomiasis.] *Comptes Rendus des Séances de la Société de Biologie et de ses Filiales*, **190** (4): 395-408.

Dumas: Institut d'Epidémiologie Neurologique et de Neurologie Tropicale, Faculté de Médecine, 2 rue du Docteur-Marcland, 87025 Limoges Cedex, France.

The reactions between the invading trypanosomes and the host's immune system are reviewed in relation to the four stages of human African trypanosomiasis (local inflammatory reaction at point of inoculation, haemolymphatic phase, invasion of the CNS, and terminal demyelination). Diagnosis of CNS involvement is difficult to establish in the early neurological phase, an important problem in view of the ineffectiveness of pentamidine and suramin in the late stages of the disease and the toxicity of melarsoprol. Research aimed at developing new drugs seeks to target the trypanosome's metabolic peculiarities. Various nitroimidazole derivatives appear promising. The development of an effective vaccine seems unlikely in view of the trypanosome's antigenic variability.

9928 **Hommel, M., 1996.** Physiopathologie des infections à Protozoaires. [Pathophysiology of protozoal

infections.] *Comptes Rendus des Séances de la Société de Biologie et de ses Filiales*, **190** (4): 341-355.

Liverpool School of Tropical Medicine, Liverpool L3 5QA, UK.

The pathophysiology of diseases produced by protozoal infections is caused not only by a direct effect of the parasites on their host (e.g. host cell lysis or parasite adherence), but also by indirect effects, where molecules of parasite origin exert an effect on host cells, which in turn produces a cascade of events (including the secretion of inflammatory cytokines, prostaglandins and nitric oxide) responsible for the symptomatology observed. The role of the host itself in the pathogenic events is not negligible and its genetic background, nutritional and immunological status will influence the outcome of the infection (which will result in asymptomatic infections in some individuals and severe disease in others). The general and specific features of a variety of protozoal infections of medical and veterinary importance (including malaria, babesiosis, trypanosomiasis, toxoplasmosis, cryptosporidiosis, amoebiasis, giardiasis and trichomoniasis) are discussed in this review and a number of common patterns are identified.

#### (c) TREATMENT

[See also **20**: nos. 9972, 9973.]

9929 **Croft, S.L., Urbina, J.A. and Brun, R., 1997.** Chemotherapy of human leishmaniasis and trypanosomiasis. *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 245-257.

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

The treatment of early stages of sleeping sickness is still dependent on two drugs: pentamidine and suramin. Pentamidine, as the isethionate salt, is used only against *Trypanosoma brucei gambiense* as primary resistance of *T. b. rhodesiense* has been observed. Suramin is effective against early stage *T. b. gambiense* and *T. b. rhodesiense* infections but is used mainly against the latter. The only available drug for treatment of late stage (CNS involvement) *T. b. gambiense* and *T. b. rhodesiense* disease is melarsoprol. Despite extensive use in West and Central Africa over four decades, the rates of relapse have been stable, suggesting that resistance to the drug is not increasing. The only new drug developed for late stage sleeping sickness since the introduction of melarsoprol in 1949 is eflornithine which shows good

CNS penetration and has been used successfully for *T. b. gambiense* infections; it is, however, ineffective against *T. b. rhodesiense*. All these drugs have undesirable side-effects and/or long or complicated treatment regimes. Different treatment schedules and combination treatments are being tried, and nifurtimox (used for Chagas' disease) has shown promise against *T. b. gambiense*. Several biochemical targets in the trypanosomes, including polyamine biosynthesis, glycolytic enzymes, trypanothione reductase and membrane transport, are being studied and potential inhibitors are being evaluated.

9930 **Doua, F., Miezan, T.W., Sanon Singaro, J.R., Boa Yapo, F. and Baltz, T., 1996.** The efficacy of pentamidine in the treatment of early-late stage *Trypanosoma brucei gambiense* trypanosomiasis. *American Journal of Tropical Medicine and Hygiene*, **55** (6): 586-588.

Doua: PRCT, B.P. 1425, Daloa, Côte d'Ivoire. Fifty-eight patients in the early-late stage (early CNS involvement) of *T. b. gambiense* trypanosomiasis were treated with pentamidine and divided into four groups according to CSF indicators; white blood cell (WBC) count, protein level (CSF protein) and the presence or absence of trypanosomes. Group G1 consisted of eight patients with normal CSF WBC counts and CSF protein levels, and trypanosomes in the CSF. Group G2 consisted of nine patients with elevated CSF WBC counts, normal levels of CSF protein, and trypanosomes in the CSF. Group G3 consisted of 31 patients with high CSF WBC counts, normal CSF protein levels, but no trypanosomes in the CSF. Group G4 consisted of 10 patients with normal CSF WBC counts and CSF protein levels, and trypanosomes demonstrated by CSF culture. Post-treatment follow-up of all patients for at least one year revealed three relapses. There were two deaths from diseases unrelated to trypanosomiasis or to the treatment protocol. Of these patients, 52 were followed for more than two years, the time necessary to confirm a complete cure, indicating a cure rate of 94%. Pentamidine is therefore effective in treating the early-late stage of *T. b. gambiense* trypanosomiasis, and is comparable with melarsoprol or eflornithine in terms of its tolerance and availability.

9931 **Gradoni, L., 1996.** Chemotherapy of leishmaniasis and trypanosomiasis: advances and failures. *Current Opinion in Infectious Diseases*, **9** (6): 435-438.

Laboratorio di Parassitologia, Istituto Superiore di Sanità, Viale Regina Elena 299, 00161 Rome, Italy.

Although major advances have been made during the last year in the treatment of visceral leishmaniasis, no significant progress has been made in the chemotherapy of trypanosomiasis. Instead, further evidence of the toxicity and low efficacy of the few available drugs has been provided, showing the urgent need for more effective and less toxic drugs.

#### 6. animal trypanosomiasis

##### (a) SURVEY AND DISTRIBUTION

[See also **20**: nos. 9925, 9926.]

9932 **Abebe, G. and Jobre, Y., 1996.** Trypanosomiasis: a threat to cattle production in Ethiopia. *Revue de Médecine vétérinaire*, **147** (12): 897-902.

Abebe: Department of Pathology and Parasitology, Faculty of Veterinary Medicine, Addis Ababa University, P.O. Box 34, Debre Zeit, Ethiopia.

Blood samples from a total of 14,193 cattle of various age and sex groups originating from nine tsetse-infested and tsetse-free areas in Ethiopia were examined for the presence trypanosomes by dark ground buffy coat technique. Anaemia was estimated by PCV assessment. The overall prevalence of trypanosomiasis was 13.19%, the rates in tsetse-infested and tsetse-free areas being 17.67% and 8.71% respectively. In the former study site, *Trypanosoma congolense* (58.5%), *T. vivax* (31.28%) and *T. brucei* (3.53%) were detected. More than 99% of cattle infections in tsetse-free areas were due to *T. vivax*. Generally, PCV values ranging between 16 and 25% were obtained in infected subjects. Results are discussed in comparison with previous works of other researchers. The authors emphasise the need to control trypanosomiasis in tsetse-free zones as this is a potential threat to the huge highland livestock population of Ethiopia.

9933 **Basu, A.K., Nawathe, D.R. and Kollere, M.A., 1995.**

Trypanosomiasis in sheep and goats in a tsetse free zone in Nigeria. *Journal of Veterinary Parasitology*, **9** (2): 147-148.

Department of Veterinary Microbiology and Parasitology, Faculty of Veterinary Medicine, University of Maiduguri, Maiduguri, Nigeria.

A survey of trypanosome infection in sheep and goats from an abattoir in Maiduguri, a tsetse-free zone of Nigeria, was carried out from November 1991 to April 1992. Blood samples were collected from 314 sheep (147 Uda and 167 Yankasa) and 350 goats (273 Borno White and 77 Sokoto Red) and examined for parasites. Only six

animals (two Uda sheep and four Borno White goats) were positive for *Trypanosoma vivax*.

9934 **Egbe-Nwiyi, T.N. and Chaudhrai, S.U.R., 1996.** Haematological studies on haemoparasites of different breeds of cattle in arid zone of north-eastern Nigeria: preliminary observations. *Pakistan Veterinary Journal*, **16** (3): 149-151.

Department of Veterinary Pathology, University of Maiduguri, P.M.B. 1069 Maiduguri, Borno State, Nigeria.

The incidence of haemoparasites and their effect on haematological parameters were investigated in six breeds of cattle in Maiduguri, Nigeria. Blood from 50 infected and 50 uninfected cattle from each of the Kuri, white Fulani, red Fulani, Bui red, Wadara and Sokoto Gudali breeds was examined and compared. The incidence of anaplasmosis and babesiosis was high in all the breeds while that of theileriosis was low.

Only one animal (white Fulani) was infected with *Trypanosoma congolense*; *T. vivax* and *T. brucei* were absent.

9935 **Kayang, B.B., Bosompem, K.M., Assoku, R.K.G. and Awumbila, B., 1997.** Detection of *Trypanosoma brucei*, *T. congolense* and *T. vivax* infections in cattle, sheep and goats using latex agglutination. *International Journal for Parasitology*, **27** (1): 83-87.

Kayang: Department of Animal Science, Box 226, University of Ghana, Legon, Accra, Ghana.

A monoclonal antibody-based latex agglutination test for detection of circulating trypanosome antigens in animal serum was evaluated for the ability to detect natural *T. brucei*, *T. congolense* and *T. vivax* infections in cattle, sheep and goats in Ghana. The test detected antigens in 180/422 (42.7%) of cattle, 27/131 (20.6%) of sheep and 14/79 (17.7%) of goats. By comparison, the microplate-based antigen-ELISA gave similar results ( $P > 0.01$ ), detecting the trypanosome antigens in 41.7% of the cattle, 19.8% of the sheep and 17.7% of the goats. Trypanosomes were demonstrated in the blood of 30 (7.2%) cattle, 7 (5.3%) sheep and 3 (3.8%) goats using the buffy coat technique. Of these, 26 cattle (86.7%), 6 sheep (85.7%) and all 3 goats (100%) were antigenaemic. The most prevalent single infection in all three animal species involved *T. vivax*, and the most common mixed infection involved all three trypanosome species in cattle and sheep. There was no mixed infection in goats. Compared with the antigen-ELISA, the sensitivity of the latex agglutination test was 98.3% in cattle and 100% in both sheep and goats, whilst the specificity was 97.2% in cattle, 99% in sheep and 100% in goats. False positivity with the

latex agglutination test was 3.9% in cattle and 3.7% in sheep. There were no false-positive reactions with the test in goats. The latex agglutination assay promises to be ideal for testing small numbers of animals under field conditions.

9936 **Mattioli, R.C. and Faye, J.A., 1996.** A comparative study of the parasitological buffy coat technique and an antigen enzyme immunoassay for trypanosome diagnosis in sequential *Trypanosoma congolense* infections in N'Dama, Gobra zebu and N'Dama  $\times$  Gobra crossbred cattle. *Acta Tropica*, **62** (2): 71-81.

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

The buffy coat/dark ground technique (BCT) and an antigen enzyme immunoassay (Ag-ELISA) were compared for the diagnosis of trypanosome infection in N'Dama, Gobra zebu and N'Dama  $\times$  Gobra (F1) crossbred cattle following two sequential experimental *T. congolense* infections. Both first and second challenge were performed by intradermal needle inoculation of trypanosome bloodstream forms. During the course of the first challenge, the overall trypanosome percentage of positive cases detected by BCT in blood samples was higher ( $P < 0.001$ ) in comparison with that obtained by Ag-ELISA in tested serum samples of the three cattle breeds. Conversely, in the second infection the overall number of infections detected by BCT was lower in N'Dama ( $P < 0.005$ ) and F1 ( $P < 0.001$ ) than that obtained using Ag-ELISA; nearly identical positive rates were detected by the two diagnostic techniques in Gobra zebus. In both the first and second *T. congolense* challenge, the positive rate obtained using BCT significantly decreased as the infection progressed. On the other hand, the positive rate given by Ag-ELISA and its sensitivity manifested a significant opposite trend during the course of the first infection. No relationship between progression of infection and Ag-ELISA positive rate as well as Ag-ELISA sensitivity was found in the second *T. congolense* challenge. The Ag-ELISA was less than 50% sensitive in detecting circulating antigens during the first 2 months of the primary infection. However, it showed a high and stable sensitivity throughout the second trypanosome infection. It was concluded that the Ag-ELISA was suitable for use in detecting chronic or repeated infections but needs to be combined with BCT to provide reliable results.

9937 **Penchenier, L., Bodo, J.M., Bureau, P., Morlais, I., Grébaud, P., Djoha, S. and Herder, S., 1996.** Utilisation de la P.C.R. sur

sang pour le diagnostic des trypanosomoses porcines. [Use of the PCR technique on blood for the diagnosis of trypanosome infections in pigs.] *Bulletin de Liaison et de Documentation de l'OCEAC*, **29** (4): 50-53.

Penchenier: Laboratoire de Recherche sur les Trypanosomiasés, OCEAC, B.P. 288, Yaoundé, Cameroon. The polymerase chain reaction (PCR) was carried out on the blood of pigs in a village in Cameroon using *Trypanosoma brucei s.l.*, *T. congolense*, *T. simiae* and *T. vivax* primers. The results showed that, whereas parasitological examination demonstrated trypanosomes in 15.8% of the pigs, the PCR was able to diagnose infection in 84.2% of them. The prospects opened up by this technique for the study of the trypanosomoses are discussed.

9938 **Snow, W.F., Wachter, T.J. and Rawlings, P., 1996.** Observations on the prevalence of trypanosomosis in small ruminants, equines and cattle, in relation to tsetse challenge, in The Gambia. *Veterinary Parasitology*, **66** (1-2): 1-11.

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

The prevalence of trypanosome infections in Djallonké sheep and West African Dwarf goats at different sites in The Gambia showed a significant, positive correlation with contemporary assessments of tsetse (*Glossina palpalis gambiensis*, *G. morsitans submorsitans*) challenge. A similar correlation was observed in village N'Dama cattle which showed comparable prevalence values in the same areas. Trypanosome prevalences also tended to be higher in horses and donkeys in areas with high tsetse challenge compared with sites with relatively few flies. A ranking of the numbers of tsetse blood-meals from cattle, small ruminants and equines (1:0.06:>0.03) corresponded with the estimated biomass of these livestock groups (1:0.09:0.05). Observations on the grazing ranges of livestock showed that, while cattle foraged widely into tsetse-infested habitat, sheep, goats and donkeys remained closer to the villages. This difference indicated that, under the management system practised in The Gambia, small ruminants and equines were probably exposed to a lower level of tsetse attack than cattle.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **20**: no. 9928.]

9939 **Bealby, K.A., Connor, R.J. and Rowlands, G.J., 1996.**

*Trypanosomosis in goats in Zambia*. Nairobi, Kenya; ILRI. 88 pp.

Bealby: Department of Veterinary and Tsetse Control Services, Chipata, Zambia.

Over a four-year period, a series of experiments was performed at Kakumbi Tsetse Research Station in eastern Zambia to study the effects of trypanosomosis on the health and productivity of local goats. Thirty-nine female weaner goats were purchased from tsetse-free areas in May 1988 and used in the first experiment in 1989. The goats were randomly allocated into groups. A 'protected' group received prophylactic treatment with isometamidium chloride at a dose rate of 0.5 mg/kg body weight at 12-week intervals. An 'unprotected' group received individual, curative treatments with diminazene aceturate at a dose rate of 7.0 mg/kg body weight when goats became parasitaemic and PCV fell to 20% or below. Another group in this year received no trypanocidal treatment. In the following years, surviving goats and their offspring were again randomly placed into similar 'protected' and 'unprotected' groups with 'unprotected' goats receiving curative treatments as described above. Every year, a weekly protocol was followed: goats were weighed, rectal temperatures were taken and blood samples were collected to determine PCV and detect parasitaemia. Tsetse were trapped in the grazing area used by the goats, and flies were dissected. Apparent densities of tsetse populations and tsetse challenges were calculated and matched with weekly prevalences of trypanosomal parasitaemias. The goats were housed at night in a lion-proof house with a raised, slatted floor to separate them from their droppings. A male goat was introduced in a different month each year to ensure that the breeding cycle coincided with different seasonal changes in the prevalence of trypanosomal infections in goats.

The practice of herding goats and allowing them to browse extensively, coupled with the use of raised flooring in the goat house, was effective in preventing the build-up of helminth infection. Therefore, trypanosomosis was not complicated by helminthosis. The prevalence of trypanosomal infections peaked seasonally, generally between July and October, following seasonal increases in tsetse challenge. However, the timing and intensity of tsetse challenge varied each year. In 1989, mortality (42%) was alarmingly high in untreated goats: sick goats had significantly reduced PCV and body weight, and their rectal temperatures were generally elevated. When 'protected' and 'unprotected' goats were compared in 1989, 1990 and 1991, small differences in PCV, body

weight and rectal temperature occurred when prevalences of trypanosomal infections were high. However, trypanosomosis had a major impact on fertility. In 1990 and 1991, increases in prevalences of trypanosomal infections in late pregnancy were associated with a 28% parentage reduction in fertility of 'unprotected' goats. In 1990, trypanosomal parasitaemias in late pregnancy were individually associated with abortions and stillbirths. Chemoprophylaxis maintained high levels of fertility: 91% of 'protected' goats kidded successfully in 1989, 1990 and 1991. The degree of protection conferred by isometamidium, in terms of reduced trypanosomal parasitaemia, was estimated to be 70%. In 1992, goats were placed randomly into 'protected' and 'unprotected' groups at the time of mating, which was chosen to coincide with the time of peak prevalence of trypanosomal infections. Only 57% of the 'unprotected' goats kidded compared with 79% of the 'protected' group. There was strong evidence that older goats were more susceptible to the effects of trypanosomosis than younger goats. In addition, the goats brought to Kakumbi from tsetse-free areas had significantly lower PCVs than their offspring throughout periods of high incidence of infection in 1990, 1991 and 1992. This indicated that goats born under tsetse challenge may have developed a degree of protective immunity against the effects of trypanosomosis.

Despite clear evidence that chemoprophylaxis significantly reduced the effects of trypanosomosis in goats, it is difficult to make practical recommendations for control under village conditions. The seasonal peak of tsetse challenge varied from year to year, a breeding season is not used in traditional systems and the use of isometamidium requires skilful administration. We concluded that, before recommending control measures, farmers must first be made aware of the losses that trypanosomosis can cause.

9940 **Jeffcoate, I.A. and Holmes, P.H., 1997.** Effects of trypanosomiasis on reproduction in domestic ruminants. *In: Hide, G. et al. (eds), 1997 (see 20: no. 9893), pp. 335-346.*

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

The effects of *Trypanosoma* infection on domestic ruminant reproduction are reviewed. Recent studies have shown that major endocrinological changes occur in

trypanosome-infected ruminants which are considered to be responsible for their impaired reproductive performance. A major feature of the endocrino-logical disturbance centres around the hypothalamic-pituitary axis and the release of pituitary hormones. However, endocrine changes also occur in the gonads and these may in part be due to local effects. The most detailed studies to date have been conducted in male animals infected with *T. congolense* but similar and equally significant changes are expected to occur in females.

9941 **Katunguka-Rwakishaya, E., 1997.** The influence of dietary protein on some blood biochemical parameters in Scottish Blackface sheep experimentally infected with *Trypanosoma congolense*. *Veterinary Parasitology*, **68** (3): 227-240. Department of Veterinary Medicine, Makerere University, P.O. Box 7062, Kampala, Uganda.

The present study investigated the influence of dietary protein on some blood biochemical parameters, namely lipids, proteins, iron, glucose and B-hydroxybutyrate, in Scottish Blackface sheep infected with *T. congolense*, and given either a low protein (51.5 g digestible crude protein per day) or a high protein (116 g digestible crude protein per day) diet. Both low and high protein diets were isocaloric and animals were monitored for 10 weeks after infection. It was observed that infection was associated with marked reduction in the concentrations of plasma total lipids, cholesterol, phospholipids and non-esterified fatty acids in both dietary groups. Control animals on a high protein diet had higher concentrations of plasma total lipids and cholesterol than those on a low protein diet.

Infection caused severe hypoalbuminaemia and reduction in total iron-binding capacity only in the low protein infected group compared to their controls while the changes in the high protein infected and control groups were similar. Control animals receiving a high protein diet had higher concentrations of plasma albumin and total iron-binding capacity than those receiving a low protein diet. These observations suggest that *T. congolense* infection in sheep is associated with marked changes in blood biochemical parameters, some of which are influenced by dietary protein.

9942 **Katunguka-Rwakishaya, E., Murray, M. and Holmes, P.H., 1997.** Pathophysiology of *Trypanosoma congolense* infection in two breeds of sheep, Scottish Blackface and Finn Dorset. *Veterinary Parasitology*, **68** (3): 215-225.

Katunguka-Rwakishaya: Department of Veterinary Medicine, Makerere University, P.O. Box 7062, Kampala,

Uganda.

The pathophysiology of *T. congolense* infection was studied in two breeds of sheep, the Scottish Blackface (SB) and Finn Dorset (FD), which were known from previous studies to differ significantly in their susceptibility to haemonchosis, in which anaemia is also the primary pathophysiological effect. It was found that infected SB and FD lambs developed similar intensities of parasitaemia. However, infected SB lambs developed a higher degree of anaemia, more severe thrombocytopenia and hypoalbuminaemia than infected FD lambs. Following infection, the concentrations of plasma cholesterol, serum phospholipids and total lipids decreased. The decline in these lipid components appeared to be greater in infected SB than in infected FD lambs.

9943 **Wassink, G.J., Fishwick, G., Parkins, J.J., Gill, M., Romney, D.L., Richard, D. and Holmes, P.H., 1997.** The patho-physiology of *Trypanosoma congolense* in Scottish Blackface sheep: influence of diet on digestive function. *Animal Science*, **64** (1): 127-137.

Wassink: University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.

The influence of types of roughage, barley straw (diet B) versus lucerne hay (diet L) on the pathophysiology of a *T. congolense* infection was compared in eight pairs of Scottish Blackface male twin lambs. One animal of each twin pair was infected and the other used as a pair-fed control. Voluntary food intake, body weight, digestive function, various blood haematological and biochemical measurements were made. Voluntary organic matter intake decreased significantly after the *T. congolense* infection, the decrease being greater in the diet L group than in the diet B group lambs ( $P < 0.01$ ). The apparent digestibility coefficients of crude protein and organic matter were significantly lower in the infected lambs ( $P < 0.01$ ). Mean retention time of the roughage through the digestive tract in the animals given barley straw was significantly longer ( $P < 0.05$ ) due to a lower rumen outflow rate constant ( $P < 0.01$ ). Infection resulted in longer mean retention times ( $P < 0.01$ ). PCV was significantly lower before infection in the animals given diet B ( $P < 0.01$ ). After infection, diet ( $P < 0.01$ ) and infection ( $P < 0.01$ ) had an additive effect on PCV. The anaemia was both macrocytic ( $P < 0.05$ ) and hypochromic ( $P < 0.01$ ). Diet B resulted in higher plasma cholesterol ( $P < 0.05$ ), but lower plasma urea ( $P < 0.01$ ) and albumin ( $P < 0.01$ ) concentrations before infection than diet L.

The *T. congolense* infection significantly lowered plasma cholesterol ( $P < 0.01$ ) and increased plasma urea ( $P < 0.01$ ) concentrations compared with the uninfected controls. Plasma albumin concentrations decreased, but were more affected by nutrition ( $P < 0.01$ ) than by infection ( $P < 0.05$ ). It was concluded that the pathophysiological effects of the *T. congolense* infection in the Scottish Blackface lambs were affected by the type of roughage offered, but that these effects were additive rather than interactive to the effects of infection.

(c) TRYPANOTOLERANCE

[See **20**: no. 9951.]

(d) TREATMENT

[See also **20**: nos. 9939, 9973.]

9944 **Eisler, M.C., 1996.** Pharmacokinetics of the chemoprophylactic and chemotherapeutic trypanocidal drug isometamidium chloride (Samorin) in cattle. *Drug Metabolism and Disposition*, **24** (12): 1355-1361.  
University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK.

Pharmacokinetics of the prophylactic and therapeutic trypanocidal drug isometamidium chloride were examined comprehensively for the first time in cattle using a recently described, highly sensitive ELISA. Cattle were administered single intravenous ( $n = 4$ ) or intramuscular ( $n = 5$ ) doses of isometamidium at a rate of 1.0 mg/kg body weight. Concentration data were analysed over at least 14 days (i.v. treatment) or 30 days (i.m. treatment) using compartmental and noncompartmental methods. After i.v. administration, apparent volumes of the central compartment (mean = 0.695 l/kg; range = 0.59-0.95) were large, and volumes of distribution at steady-state (mean = 24.5 l/kg; range = 18.5-39.3) were particularly large. After i.m. administration, there was considerable individual variability in  $C_{\max}$  (mean = 111 ng/ml; range = 37-197) and other pharmacokinetic parameters. Absorption kinetics seemed to be multifunctional, with fast and slow components; the mean  $t_{\max}$  was only 36 min (range = 20-60), although the mean absorption time was 282 h, and the mean terminal elimination phase half-life after i.m. administration (286 h; range = 215-463) was over twice that after i.v. administration (mean = 135 h; range = 123-165). The overall absolute bioavailability of i.m. administered isometamidium was 65.7%. These findings were consistent with extensive tissue binding at the i.m. injection site to form a primary depot

responsible for most of the prolonged chemoprophylactic effect of isometamidium, and an additional role for significant secondary drug depots formed by tissue binding elsewhere, particularly after i.v. administration.

## 7. EXPERIMENTAL TRYPANOSOMIASIS

### (a) DIAGNOSTICS

9945 **Zillmann, U., Konstantinov, S.M., Berger, M.R. and Braun, R., 1996.**

Improved performance of the anion-exchange centrifugation technique for studies with human infective African trypanosomes. *Acta Tropica*, **62** (3): 183-187.

Zillman: Zentrales Tierlabor, Deutsches Krebsforschungszentrum, Im Neuenheimer Feld 280, 69120 Heidelberg, Germany.

### (b) PATHOLOGY AND IMMUNOLOGY

[See also **20**: nos. 9991, 10001.]

9946 **Beschin, A., Brys, L., Magez, S. and Baetselier, P. de, 1996.**

Macrophages elicit tissue and infection stage dependent suppressive mechanisms during *T. brucei* infection.

[Mice.] (Meeting abstract no. CP1.) *European Journal of Haematology*, **57** (Suppl. 59): 29.

Beschin: Cellular Immunology, Flemish Interuniversity Institute of Biotechnology, Free University of Brussels, Brussels, Belgium.

9947 **Hertz, C.J. and Mansfield, J.M., 1997.** Host resistance to the African trypanosomes is interferon-gamma (IFN- $\gamma$ ) dependent. [*T. b. rhodesi-ense*; mice.] (Meeting abstract no. 1847.) *Journal of Allergy and Clinical Immunology*, **99** (1, part 2): S455.

University of Wisconsin-Madison, Madison, WI 53706, USA.

9948 **Iyayi, E.A., 1996.** Response of adrenal gland, plasma cortisol and glucose to *T. congolense* infection in rabbits. *Tropical Veterinarian*, **14** (1-2): 31-38.

Department of Animal Science, University of Ibadan, Ibadan, Nigeria.

9949 **Jibike, G.I., Onyeyili, P.A. and Aku, C.E., 1994.** The effects of trypanosome infection on the response of rabbit jejunal segments to histamine, carbachol and serotonin. [*T. brucei*.] *Tropical Veterinarian*, **12** (3-4): 194-201.

Jibike: Department of Veterinary Physiology and Pharmacology, Faculty of Veterinary

- Medicine, University of Maiduguri, Maiduguri, Nigeria.
- 9950 **Jithendran, K.P. and Rao, J.R., 1996.** Effect of dexamethasone and gamma irradiation on the course of experimental *Trypanosoma evansi* infection in albino mice. *International Journal of Animal Sciences*, **11** (1): 91-93.  
Jithendran: Division of Parasitology, Indian Veterinary Research Institute, Izatnagar 243 122, U.P., India.
- 9951 **Kemp, S.J., Darvasi, A., Soller, M. and Teale, A.J., 1996.** Genetic control of resistance to trypanosomiasis. [*T. congolense*; mice.] *Veterinary Immunology and Immunopathology*, **54** (1-4): 239-243.  
Kemp: Department of Genetics and Microbiology, Donnan Laboratories, Liverpool University, Liverpool L69 3BX, UK.
- 9952 **Montmayer, A., Banzet, S., Roux, A. and Buguet, A., 1994.** Evolution du cycle veille-sommeil chez le rat après infestation par *Trypanosoma brucei brucei*. [Time-related changes of the sleep-wake cycle of rats infected with *T. b. brucei*.] *Travaux scientifiques des Chercheurs du Service de Santé des Armées*, **1994** (15): 257-258.  
Montmayer: Unité de Physiologie de la Vigilance, CRSSA, B.P. 87, 38702 La Tronche Cedex, France.
- 9953 **Mustafa, E., Bakhiet, M., Jaster, R., Bittorf, T., Mix, E. and Olsson, T., 1997.** Tyrosine kinases are required for interferon- $\gamma$  stimulated proliferation of *Trypanosoma brucei brucei*. [Mice.] *Journal of Infectious Diseases*, **175** (3): 669-673.  
Bakhiet: Division of Neurology (R54), Huddinge University Hospital, S-14186 Huddinge, Stockholm, Sweden.
- 9954 **Raisinghani, G., Gupta, M.L., Kumar, D. and Bhan, A.K., 1996.** Effect of some immunomodulatory drugs on the course of *Trypanosoma evansi* infection in experimentally infected rats. *Indian Veterinary Journal*, **73** (11): 1122-1126.  
Raisinghani: National Research Centre on Camel, Jorbeer, Bikaner 334 001, India.
- 9955 **Saeki, N., Komatsu, T., Sakamoto, I., Funato, T. and Nakanishi, K., 1996.** Trypanocidal activity of guinea pig serum and BSA in the presence of an FBS component or cysteine. [*T. b. gambiense*.] *Japanese Journal of Parasitology*, **45** (4): 280-289.  
Komatsu: Department of Immunology and Medical Zoology, Hyogo College of Medicine, 1-1 Mukogawa-cho, Nishinomiya, Hyogo 663, Japan.
- 9956 **Schofield, L. and Tachado, S.D., 1996.** Regulation of host cell function by glycosylphosphatidylinositols of the

parasitic Protozoa. [Incl. *T. brucei*.] (Review.)

*Immunology and Cell Biology*, **74** (6): 555-563.

Schofield: Walter and Eliza Hall Institute of Medical Research, P.O. Royal Melbourne Hospital, Vic. 3050, Australia.

9957 **Wakelin, D., 1997.** Parasites and the immune system: conflict or compromise? *BioScience*, **47** (1): 32-40.

Department of Life Science, University of Nottingham, Nottingham NG7 2RD, UK.

(c) CHEMOTHERAPEUTICS

[See also **20**: nos. 9982, 9988, 9994.]

9958 **Chafe, U.M., Daneji, A.I. and Ibrahim, M.A., 1994.** Preliminary observations on the acute toxicity and antitrypanosomal activity of *Cassytha filiformis* (Linn.) in mice. [*T. vivax*.] *Tropical Veterinarian*, **12** (3-4): 147-157.

Chafe: Department of Veterinary Medicine, Surgery and Therio-genology, Usmanu Danfodiyo University, Sokoto, Nigeria.

9959 **Craciunescu, D.G., Doadrio-Villarejo, J.C., Gutierrez Rios, M.T., Frutos, M.I. de, Parrondo Iglesias, E., Alonso, M.P., Molina, C., Ercoli, N. and Gaston de Iriarte, E., 1992.** Actividades farmacológicas 'in vivo' duales (antitripanosómicas y antitumorales) de algunos nuevos complejos del Platino (II) y del Platino (IV). [Dual pharmacological *in vivo* activity (trypanocidal and antitumour) of some new platinum (II) and platinum (IV) complexes.] [*T. b. rhodesiense*, *T. congolense*, *T. equiperdum*, *T. evansi*; rats.] (With English summary.)

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Craciunescu: Departamento de Química Inorgánica y Bioinorgánica, Facultad de Farmacia, Universidad Complutense de Madrid, 28040 Madrid, Spain.

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The combined use of difluoromethylornithine (DFMO) and iso-metamidium in the treatment of experimental late-stage *Trypanosoma brucei* infection in rats. *Tropical Veterinarian*, **11** (1-2): 57-67.

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

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Petroleum ether, dichloromethane, methanol and water extracts from 24 plants, belonging to 19 families, which are reported in the literature as traditional remedies for sleeping sickness, were screened for *in vitro* activity against *Trypanosoma brucei rhodesiense* as well as for cytotoxicity for a human fibroblast cell-line (WI-38). The plants were collected in Tanzania, Uganda, Côte d'Ivoire and Zaire. The trypanocidal activity of the natural compounds berberine and harmaline, both documented as being trypanocidal, was also evaluated. Promising trypanocidal activity with IC<sub>50</sub> values below 10 µg/ml was found in 32 extracts of 13<sup>50</sup> plant species. The most active extracts, with IC<sub>50</sub> values below 1 µg/ml, were derived from *Annona senegalensis*, *Bussea occidentalis* and *Physalis angulata*. Berberine and harmaline had IC<sub>50</sub> values of 0.4 and 2.3 µg/ml, respectively. The<sup>50</sup> plant

extracts showed a modest selectivity index, in contrast to commercially available trypanocides which have a more distinct selective toxicity against trypanosomes. 1969 **Jennings, F.W., Atouguia, J.M. and Murray, M., 1996.** The importance of 2,3-dimercaptopropinol (British anti-lewisite, BAL) in the trypanocidal activity of topical melarsoprol. [*T. b. brucei*; mice.] *Acta Tropica*, **62** (2): 83-89.

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Loiseau: Biologie et Contrôle des Organismes Parasites, Faculté de Pharmacie, Université de Paris-Sud, 92296 Châtenay-Malabry Cedex, France.

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Antifilarial and trypanocidal properties of phenothiazines and related polycyclics as new lead structures. [Incl. *T. b. brucei*.] *International Journal for Parasitology*, **26** (10): 1115-1117.

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19972 **Matovu, E., Iten, M., Enyaru, J.C.K., Schmid, C., Lubega, G.W., Brun, R. and Kaminsky, R., 1997.** Susceptibility of Ugandan *Trypanosoma brucei rhodesiense* isolated from man and animal reservoirs to diminazene, isometamidium and melarsoprol. *Tropical Medicine and International Health*, **2** (1): 13-18.

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

Cattle, pigs and dogs have been implicated in harbouring *T. b. rhodesiense* in south-eastern Uganda, and one of the sleeping sickness control strategies employed there is the treatment of infected domestic animals with veterinary drugs. Thirty-six *T. brucei* spp. stocks isolated from man and domestic animals were studied for susceptibility to diminazene, isometamidium and melarsoprol *in vitro*. All stocks were susceptible to melarsoprol. One *T. b. rhodesiense* stock isolated from a sleeping sickness patient showed reduced susceptibility to the veterinary drugs

diminazene and isometamidium. More than 100 ng/ml diminazene or 0.78 ng/ml isometamidium were required to eliminate that stock during 10 days drug exposure. In contrast, the remaining stocks were eliminated by 0.8-6.3 ng/ml diminazene and 0.01-0.20 ng/ml isometamidium. Clones derived from the resistant *T. b. rhodesiense* stock showed reduced susceptibility to isometamidium and diminazene comparable to the parental population. Control of sleeping sickness by treatment of the animal reservoir could, therefore, face serious problems since drug-resistant stocks as reported here would most likely not be eliminated by recommended doses of diminazene and isometamidium.

9973 **Ross, C.A. and Sutherland, D.V., 1997.** Drug resistance in trypanosomatids. *In: Hide, G. et al. (eds), 1997 (see 20: no. 9893), pp. 259-269.*

Ross: 2 Parkside Terrace, Edinburgh EH16 5BN, UK. The current state of knowledge of drug resistance in pathogenic trypanosomes and *Leishmania* is reviewed. Resistance to some of the drugs used is only just beginning to be understood, in terms of their effects on parasite metabolism, and changes to transport mechanisms such as uptake or efflux of toxic compounds. Clearly, much more work must be carried out before an understanding of drug resistance mechanisms can be translated into more efficient chemotherapeutic treatment. However, without studying resistant parasites isolated after treatment failures in the field, models for drug resistance cannot progress towards being accepted as a reflection of the clinical situation. More effort should be made, therefore, to overcome possible obstacles to the use of field isolates, such as access to, and ease of working with, these stocks. Some important aspects of drug resistance which, until now, have received little attention, include factors which affect the diversity of response to drugs, both within and between parasite populations. These aspects may become easier to investigate on identification of actual resistance mechanisms. Modern research techniques can provide valuable information on these mechanisms.

9974 **Sufrin, J.R., Rattendi, D., Spiess, A.J., Lane, S., Marasco, C.J. and Bacchi, C.J., 1996.** Antitrypanosomal activity of purine nucleosides can be enhanced by the conversion to O-acetylated derivatives. [*T. b. brucei*, *T. b. rhodesiense*.] *Antimicrobial Agents and Chemotherapy*, **40** (11): 2567-2572.

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#### 8. TRYPANOSOME RESEARCH

##### (a) CULTIVATION OF TRYPANOSOMES

19975 **Otigbuo, I.N. and Oyerinde, J.P., 1993.** A modified medium for the *in vitro* cultivation of trypanosomes. [*T. b. brucei*, *T. b. gambiense*, *T. vivax*.] *African Journal of Medicine and Medical Sciences*, **22** (4): 63-71.

Otigbuo: Department of Medical Microbiology and Parasitology, College of Medicine, University of Lagos, P.M.B. 12003, Lagos, Nigeria.

##### (b) TAXONOMY, CHARACTERISATION OF ISOLATES

19976 **Tibayrenc, M., 1997.** Evolutionary genetics of *Trypanosoma*, *Leishmania* and other microorganisms: epidemiological, taxonomical and medical implications. *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 305-314.

UMR CNRS/ORSTOM 9926, Génétique Moléculaire des Parasites et des Vecteurs, ORSTOM, B.P. 5045, 34032 Montpellier Cedex 01, France.

The introduction of genetic markers (mainly multilocus isoenzyme electrophoresis) in medical protozoology since the 1970s has facilitated substantial progress in both strain characterisation and species identification in the Trypanosomatidae. Evolutionary genetics has two main facets which cannot be separated: interpretation in terms of evolutionary genetics is indispensable for understanding the biological significance of genetic diversity, while detailed epidemiological and clinical information considerably helps genetic interpretation. Different approaches and different markers are required for different situations. The following topics are considered: clonality versus sexuality; are zymodemes and schizodemes real genotypes or mere plastic phenotypes?; what is the impact of the selection bias on population structure?; and some preliminary comparisons between Trypanosomatidae. The author calls for the development of a comparative evolutionary genetic analytical system usable whatever the microorganism considered.

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

19977 **Bakker, B.M., Michels, P.A.M., Opperdoes, F.R. and Westerhoff, H.V., 1997.** Glycolysis in bloodstream form *Trypanosoma brucei* can be understood in terms of the kinetics of the

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- 9980 **Borst, P., Bitter, W., Blundell, P., Cross, M., McCulloch, R., Rudenko, G., Taylor, M.C. and Leeuwen, F. van, 1997.** The expression sites for variant surface glycoproteins of *Trypanosoma brucei*. (Review.) *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 109-131.  
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- 9981 **Boshart, M. and Mottram, J.C., 1997.** Protein phosphorylation and protein kinases in trypanosomatids. [Incl. *T. brucei.*] (Review.) *In*: Hide, G. *et al.* (eds), 1997 (see **20**: no. 9893), pp. 227-244.  
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