

section B - abstracts

1. general (including land use)

8983 **Allsopp, R., 1994.** Operational procedures for the control of tsetse flies and African animal trypanosomiasis; a review of current activities and prospects including research and training requirements for the future. *In*: FAO, 1994 (see **18**: no. 8987), pp. 137-147.

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

The currently available methods of trypanosomiasis control are reviewed. Despite huge expenditure over many years on operational control, research and training, trypanosomiasis is not decreasing, nor is the distribution of tsetse. Since it is unrealistic to expect any major new developments in the near future, we must seek to improve the effectiveness and sustainability of the existing methods. The recommendations of the FAO Commission, the Panel of Experts and the Inter-Secretariat Coordinating Group on African Animal Trypanosomiasis and Related Development (1991) are reviewed. Trypanosomiasis control as an element of sustainable agricultural production, and the role of FAO in coordinating activities, were stressed. Apart from greater emphasis on community participation and land use, including socio-economic evaluation, few radically different issues were raised. The value of computerised techniques and satellite data to clarify intricate epidemiological situations was recognised and the importance of regional collaboration stressed. Some practical considerations are discussed in more detail, particularly the use of computer technology at both strategic and national/regional levels. A large amount of data exists, for example in veterinary departments, but in disparate forms which are not easily accessible. Computerisation of such records would allow better data management and exchange. Geographical information systems allow 'layers' of data, including those obtained from satellite remote sensing, to be correlated to reveal how land use patterns change over time, how natural resources are affected by changes in agricultural practice and how land use changes are affected by tsetse control. Much training will be required in these techniques. Ultimately, however, trypanosomiasis control still depends on established methods. This situation might be improved by making better use of such methods through adaptive research, aiming at control rather

than eradication, and involving the local community. Responsibility for tsetse/trypanosomiasis control might perhaps be transferred partially or wholly from government or donor support to the private sector to ensure greater stability and sustainability.

8984 **Chadenga, V., 1994.** Epidemiology and control of trypanosomiasis. *Onderstepoort Journal of Veterinary Research*, **61** (4): 385-390.

Tsetse and Trypanosomiasis Control Branch, P.O. Box CY 52, Causeway, Zimbabwe.

Tsetse-transmitted trypanosomiasis remains a major constraint to the development of agriculture, particularly to that of livestock production in sub-Saharan Africa. It is estimated that 10 million km² of Africa are tsetse infested, exposing some 50 million people and 60 million cattle to the risk of trypanosomiasis. The epidemiology of the disease is complex and is greatly influenced by management and farming practices. The different control strategies are reviewed and their comparative advantages assessed. It is concluded that eradication of tsetse flies, while desirable, is rarely achieved. It is perhaps more realistic to aim for disease suppression, with vector control campaigns linked to sustainable land use programmes. Nevertheless, progressive tsetse eradication remains the long-term goal.

8985 **Connor, R.J., 1994.** The impact of nagana. *Onderstepoort Journal of Veterinary Research*, **61** (4): 379-383.

RTTCP, P.O. Box A 560, Avondale, Harare, Zimbabwe.

The disease in cattle, called nagana in Zululand, was linked with trypanosomal parasitaemia and tsetse flies. Nagana occurs in livestock through the tsetse belts of Africa. Wild animals are tolerant of trypanosomal infections. Nagana affects individual animals, herds and socio-economic development. In susceptible animals nagana may be acute, but chronic infections are more common. The host-parasite interaction produces extensive pathology and severe anaemia. Clinically affected animals lose condition and become weak and unproductive. Nagana is often fatal and, at herd level, its impact is wide ranging. All aspects of production are depressed: fertility is impaired; milk yields, growth and work output are reduced; and the mortality rate may reduce herd size. Africa has to feed its rapidly growing human population, and animal products are a vital dietary component. However, in most tsetse areas, there is not enough meat and milk. Furthermore, animal draught power is often not available, which limits cultivation and local transport. These factors lower household incomes and retard socio-economic development. Sustainable rural development requires that nagana be controlled. This

in turn needs considerable resources, whichever control strategy is adopted.

8986 **Cook, G.C., 1993.** Some early British contributions to tropical disease. *Journal of Infection*, **27** (3): 325-333.

Hospital for Tropical Diseases, St Pancras Way, London NW1 0PE, UK.

The diseases reviewed include filariasis, malaria, sleeping sickness and leishmaniasis. The section on sleeping sickness outlines the contributions of Livingstone, Bruce, Winterbottom, Dutton, Todd, Low, Castellani, Christy, Nabarro, Stephens, Fantham, Kinghorn and Yorke from around 1847 to 1911.

8987 **Food and Agriculture Organization of the United Nations, 1994.** *A systematic approach to tsetse and trypanosomiasis control.* (Proceedings of the FAO Panels of Experts, Rome, 1-3 December 1993.) Rome; FAO. (FAO Animal Production and Health Paper, no. 121.) 195 pp.

FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy.

The Panels of Experts to the FAO Programme for the Control of African Animal Trypanosomiasis and Related Development met in Rome from 1 to 3 December 1993 to advise the Organisation on Ecological, Technical and Development aspects. The working papers produced by individual experts formed the basis for deliberation and are published in full in these proceedings (most of them in French as well as in English). Abstracts of all nine papers are given in this issue of *TTIQ* (see nos. 8983, 8989, 8992, 8995, 8997, 8999, 9002, 9006, 9026). For the report of the meeting, see *TTIQ*, **17** (3): no. 8452.

8988 **Itty, P., Swallow, B.M., Rowlands, G.J., Mulatu, W. and d'Ieteren, G.D.M., 1995.** The economics of village cattle production in a tsetse-infested area of southwest Ethiopia.

Preventive Veterinary Medicine, **22** (3): 183-196.

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

Cattle raised in the Ghibe valley of southwest Ethiopia are exposed to medium to high levels of trypanosomiasis risk and are often given trypanocidal drugs. A benefit-cost analysis was undertaken to evaluate the financial and economic returns generated by cattle raised in the area under a systematic regime of drug therapy. The results show that, despite the high level of trypanosomiasis risk and the prevalence of drug-resistant trypanosomes, cattle production can generate attractive economic returns for herd owners and the overall Ethiopian economy. Sensitivity analyses show that most herd owners would continue to obtain good returns on their investments even if they paid higher

prices for trypanocidal drugs and the full costs of veterinary services.

8989 **Jordan, A.M., 1994.** Arguments for and against considering trypano-somiasis as different from other animal diseases. *In*: FAO, 1994 (see **18**: no. 8987), pp. 96-99.

Holly House, Plud Street, Wedmore, Somerset BS28 4BE, UK.

Although other animal diseases also cause heavy losses of domestic livestock, there is no evidence that any one disease has had the same profound influence on the distribution of livestock in Africa as has trypanosomiasis. Perhaps to this extent trypanosomiasis should be considered as different from other diseases, but does this justify a different approach to the control of trypanosomiasis compared with other diseases? The use of trypanocidal drugs is the main control method in most areas. Although ideally their application should be under the control of qualified veterinary authorities to avoid inappropriate drug usage, under-dosing and consequent development of drug resistance, in fact most trypanocidal drugs are, as with other veterinary products, applied by the livestock owners themselves. Although the control of trypanosomiasis by drugs can be considered as no different from the day by day control of any other animal disease, vector control is a different matter, requiring specialised techniques and specially trained personnel, with no relevance to the control of any other animal disease. Since trypanosomiasis is only one of a plethora of diseases affecting health and productivity, there are strong arguments in favour of considering its control within an overall strategy of animal husbandry. Where it differs from all other major diseases is in its ability to exclude cattle from extensive areas. It is with respect to the implications for resource conservation and changing patterns of land use in such areas, following successful control of trypanosomiasis, by use of drugs as much as by vector control, that the strongest case can be made for considering trypanosomiasis as different from other diseases.

8990 **Koerner, T., Raadt, P. de and Maudlin, I., 1995.** The 1901 Uganda sleeping sickness epidemic revisited: a case of mistaken identity? *Parasitology Today*, **11** (8): 303-306. Maudlin: Tsetse Research Group, Department of Clinical Veterinary Science, Langford, Bristol BS18 7DU, UK.

The great sleeping sickness epidemic that occurred in Busoga at the turn of the century has classically been ascribed to *Trypanosoma brucei gambiense*, said to have been imported from the Congo basin or by Sudanese soldiers. It is suggested that this epidemic was actually of *T. b. rhodesiense* sleeping sickness and that this disease existed in southeast Uganda long before the 1901 epidemic which came about as a result of the environmental, historical and socio-economic changes which occurred in the late 19th century. These changes included inter-tribal warfare, the rinderpest epizootic, the introduction of cash crops, missionary influence on social organisation, taxation, and colonial interference in patterns of land control. As a result, more people were brought into closer contact with the tsetse population in Busoga, creating the conditions for an epidemic of sleeping sickness.

8991 **Langley, P.A., 1994.** Understanding tsetse flies. *Onderstepoort Journal of Veterinary Research*, **61** (4): 361-367. University of Wales, PABIO, P.O. Box 915, Cardiff CF1 3TL, UK.

The discovery that tsetse flies are the vectors of African trypanosomiasis, causing sleeping sickness in man and nagana in cattle, occurred at the start of a rapidly expanding colonialism in sub-Saharan Africa. Hence, the first research on the fly was largely taxonomic, coupled with a painstaking ecological approach to determine the identities and distribution limits of the different species. This was followed by closer attention to the physiology of the fly, both from the academic standpoint as related to its survival and reproduction in the field, and from the standpoint of its vectorial capacity. There are still conflicting hypotheses concerning the maturation of trypanosomes within the fly. Increasing concern for the environment led to a ban in the developed nations on the use of DDT as an insecticide which had been used successfully for tsetse control in Africa. This was followed by a ban on the use of organochlorine insecticides in general, and no doubt the next restrictions will be on the use of organophosphates and upon synthetic pyrethroids which have already been banned in the UK for the control of houseflies. Fortunately, research on the role of olfactory and visual stimuli of the tsetse, in the location of potential hosts, led to an improvement in methods for monitoring fly populations by means of traps and targets upon which the flies alight. So successful are such devices that, when treated with an

insecticide, they can be used to sustain an increase in natural mortality in fly populations to such an extent that these populations decline to manageable levels. The techniques constitute an appropriate technology for the countries of Africa, and attention is now focused on replacing conventional insecticides with more environmentally acceptable compounds whose development is based on a sound knowledge of the physiology of the insect. Perhaps the next major step will be to understand the physiological basis of the acquisition and maturation of trypanosome infections in tsetse. Modern genetic techniques may then permit the engineering of flies which cannot transmit trypanosomosis and are therefore reduced to the level of nuisance flies.

8992 **Lovemore, D.F., 1994.** The influence of tsetse distributions on settlement and land utilisation in Zimbabwe with reference to the EC-funded Regional Tsetse and Trypanosomiasis Control Programme (RTTCP) of Malawi, Mozambique, Zambia and Zimbabwe. *In*: FAO, 1994 (see **18**: no. 8987), pp. 90-95.

RTTCP, P.O. Box A 560, Avondale, Harare, Zimbabwe. Following the rinderpest epizootic of 1896 which destroyed a large proportion of their natural food hosts, tsetse infestation within Zimbabwe was rapidly reduced to a few small foci within the Zambezi drainage. As the food host populations recovered, tsetse rapidly spread so that by 1931 the infested area covered over 20,000 square miles. The spread of the Zambezi fly-belt had been contained by the early 1940s but reduced control measures during and after the Second World War resulted in further spread. Control was regained, only to be lost once more in 1960 when game elimination operations were terminated. In 1964/65 extensive and costly control measures were commenced in both the north and southeast of the country and by 1975 the situation was being satisfactorily maintained by host- and cattle-free fenced corridors. Thereafter, the Liberation War resulted in a deteriorating situation with a considerable loss of the land previously reclaimed. In order to achieve permanency, Zimbabwe decided that the ultimate goal should be the eradication of tsetse flies from within the country. Zimbabwe joined the RTTCP as there was a clear need to be able to work in Mozambique and Zambia to prevent reinvasion from these countries. The policy of progressive tsetse eradication necessitates operating over all land categories within

the infested area, including the various forms of agricultural land, wildlife land and forest land. Planned resettlement of cleared areas is essential. A national coordinating committee has been established to facilitate the linking of land use planning and tsetse control activities.

8993 **McKendrick, I.J., Gettinby, G., Gu, Y.Q., Peregrine, A. and Revie, C., 1994.** Hybrid Information Systems for agriculture: the case of cattle trypanosomiasis in Africa. *Outlook on Agriculture*, **23** (4): 261-267.

McKendrick: Department of Statistics and Modelling Science, University of Strathclyde, Glasgow G1 1XH, UK. An increase in food production in sub-Saharan Africa is imperative to match population growth. Many techniques and technologies to implement an increase in cattle productivity already exist but the problem lies in transferring this know-how to farmers. This paper describes the use of Hybrid Information Systems to effect this transfer, using the topic of cattle trypanosomiasis as an example of an area in which expert advice and techniques can be transmitted and interpreted for a wider audience. A Hybrid Information System is an integrated package of software components combined in one system to allow user-friendly access to all the information contained within a computer. Components comprise database management systems, geographical information systems, expert systems to interpret information provided by the user and proffer advice, mathematical models, and multi-media systems with hypertext to provide supplementary information on particular topics. The authors are currently developing a prototype Hybrid Information System in association with the International Livestock Research Institute with support from the UK Government.

8994 **Mott, K.E., Nuttall, I., Desjeux, P. and Cattand, P., 1995.** New geographical approaches to control of some parasitic zoonoses. *Bulletin of the World Health Organization*, **73** (2): 247-257.

Mott: Division of Control of Tropical Diseases, WHO, 1211 Geneva 27, Switzerland.

This review describes the evolution of geographical approaches and methodology, particularly the introduction of geographical information systems (GIS), as applied to understanding the epidemiology of parasitic diseases with animal intermediate hosts (excluding use of remote sensing and satellite image data). The control of African trypanosomiasis requires a geographical approach to acquire information on the

distribution of infected persons, infected animals, tsetse flies and of various environmental factors such as water bodies, forests, roads, villages and plantations. The geographical analysis of various environmental factors seen in particular sleeping sickness control programmes (Vavoua focus, Côte d'Ivoire; Nola Bilolo area, Central African Republic; southern Uganda; Moundou, Chad; Luba district, Equatorial Guinea) is discussed. The use of GIS now offers the potential to facilitate analysis of data from different sources in multiple databases to identify disease risk and determine the best control strategy, as well as encouraging intersectoral cooperation.

8995 **Nagel, P., 1994.** The effect of tsetse control on natural resources. *In*: FAO, 1994 (see **18**: no. 8987), pp. 104-119.

Institut für Biogeographie, Zentrum für Umweltforschung, Universität des Saarlandes, Beethovenstrasse/AmMarkt, D-6602 Saabrudden-Dudweiler, Germany.

As part of a GTZ project, the possible effects of tsetse control measures on natural resources were studied from 1991 to 1993 in northern and central Côte d'Ivoire. One area with a long history of tsetse control (Korhogo) and two areas in which tsetse control has only just begun (Tortiya, Bouaké) were selected. Vegetation and land use were studied by means of aerial photography and field studies. In Korhogo (sudanese woodland, tsetse control since 1978) grazing degradation could only be detected along the main routes of transhumance and occasionally in the area of sedentary cattle farming. The woodland areas also displayed degradation as a result of excessive grazing. The area of settlement more than doubled in the 20 years prior to tsetse control and has trebled in the last 20 years. The agricultural areas trebled in the pre-control period but have grown by only 20% since then. Since 1955, areas of gallery forest have been reduced by 42% and areas of dense woodland by 47%. In Tortiya (sudanese woodland/ guinea savanna/forest transition, tsetse control since 1992) landscape changes were similar, with the gallery forest area reduced by 34% between the mid 1960s and the end of the 1970s and a further 56% since then, and dense woodland reduced by 52% overall. The cultivated area increased by 11 times and much settlement was also due to diamond mining. An increase in cattle breeding has been

registered since 1960. The two ethnic groups, the subsistence-orientated agricultural Sénoufo and the pastoral but increasingly sedentarised Peul, are now competing for scarce resources. In Bouaké (guinea savanna/forest transition, tsetse control since 1990) no drastic changes in land use or vegetation cover took place between the 1950s and the 1990s, and the population is currently stagnating. From this study it appears that expansion of cultivation and of animal breeding in these areas have taken place independently of tsetse control which is a subordinate factor compared to the general social and economic development. The tsetse control technique using odour-baited, insecticide-impregnated traps/targets which has been implemented in Côte d'Ivoire represents an environmentally safe technique, although long-term monitoring is advisable.

8996 **Otsyina, R.M., 1993.** Would agroforestry and afforestation risk tsetse reinvasion? *Agroforestry Today*, **5** (1): 6-8.

International Centre for Research in Agroforestry, Shinyanga, Tanzania.

Sukumaland, in the Shinyanga region of north-west Tanzania, is an area where, over the past 50 years, vegetation clearance to destroy tsetse habitats has resulted in severe deforestation and land degradation through overgrazing. Shortage of wood for fuel and construction, and lack of fodder, resulted in the initiation of tree planting in the late 1970s, and conservation issues have increasingly been brought to the attention of farmers, who nevertheless are concerned that reforestation could recreate favourable tsetse habitats. Based on an analysis of tsetse habitats and responses from interviewed farmers, possible agroforestry technologies or systems in this arid environment would include: boundary planting, windbreaks, woodlots, fodderbanks, improved fallow systems and mixed intercropping of multipurpose trees. While dense and unmanaged tree lots would pose a risk of tsetse reinvasion, agroforestry systems with intense management on small units of land are considered unlikely to pose such a risk, although close monitoring would be required.

8997 **Perry, B.D., Kruska, R.L. and Reid, R.S., 1994.** The development and use of geographic information systems to assist trypanosomiasis control. *In*: FAO, 1994 (see **18**: no. 8987), pp. 7-23.

Perry: ILRI, P.O. Box 30709, Nairobi, Kenya.

In order to enhance the quality of future decisions on the implementation of sustainable livestock development programmes in Africa, ILRAD [now ILRI] is attempting to determine how trypanosomiasis control, economic, environmental, demographic and socio-cultural factors influence land use decisions, and to quantify the impact of land use change associated with trypanosomiasis control on ecological and socio-economic properties at different levels of resolution (local, national and continental). The three methodologies of study – geographic information systems (GIS), field case studies and modelling – are linked by a conceptual model of interdisciplinary conditions and variables. Databases on cattle and human population density, vegetation, soils, crop use intensity, protected areas, land use, etc. have been supplied by a variety of collaborating organisations, with ILRAD developing otherwise unavailable data layers. The hardware and software being used are described. Some preliminary analyses to determine whether a relationship actually exists between tsetse distribution and agricultural land use are described. Because no adequate continental land use database exists, the hypothesis that human population density can be used as a surrogate for land use intensity was tested for three countries with adequate data: Burkina Faso, Mali and Zambia. As anticipated, there was a strong positive relationship between land use intensity and human population density. In Zambia tsetse zones coincided, as expected, with low agricultural use. However, in Mali tsetse were associated with both high and low land use intensity, depending on the rainfall zone. Unexpectedly, in Burkina Faso, tsetse presence was associated consistently with more intensive land use. These results are discussed.

8998 **Politi, C., Carrin, G., Evans, D., Kuzoe, F.A.S. and Cattand, P.D., 1995.** Cost-effectiveness analysis of alternative

treatments of African *gambiense* trypanosomiasis in Uganda. *Health Economics*, **4** (4): 273-287.

Carrin: WHO/ ICO, 1211 Geneva 27, Switzerland.

The focus of this paper is on the cost-effectiveness of alternative drug treatments for patients in the late stage of *gambiense* trypanosomiasis. Melarsoprol has been used for many decades. More recently, eflornithine has been developed. It has fewer side effects and improves the overall cure rate. It is much more expensive than melarsoprol, however. The objective of the present cost-effectiveness is to

identify the costs and benefits that would be involved in switching from melarsoprol to eflornithine in the treatment of late stage sleeping sickness. Benefits are expressed in lives saved as well as in disability adjusted life years (DALYs). The analysis is applied to the case of Uganda. The implications for affordability are also considered, by taking account of how the treatment costs would be shared between the national government, donors and patients. The baseline results indicate that melarsoprol treatment is associated with an incremental cost per life and DALY saved of \$209 and \$8, respectively. Each additional life saved by switching from melarsoprol alone to a combination of melarsoprol and eflornithine would cost an extra \$1,033 per life saved, and an extra \$40.9 per DALY gained. Shifting from this second alternative to treatment of all patients with eflornithine leads to an incremental cost per life saved of \$4,444 and an incremental cost of \$166.8 per DALY gained.

8999 **Pollock, J.N., 1994.** Training. *In*: FAO, 1994 (see 18: no. 8987), pp. 183-186.

RAF/91/022, Tsetse Training, FAO, Lusaka, Zambia. The Lusaka Training Centre, Zambia, has been in operation since early 1980. The training offered, mainly to middle level operators, has been designed to give an introduction to the epidemiological complex of trypanosomiasis, with emphasis on the vector; to give hands-on familiarity with certain field techniques; to be strongly field oriented; to be not strongly academic; to transfer new technology to a wider target group; to concentrate on *Glossina morsitans* and *G. pallidipes* control; to pay attention to environmental issues, direct and indirect; and to envisage trypanosomiasis control in the context of rural development. How these aims are currently being met, and how they might ideally be met in the future in a coordinated network of purpose-built regional centres, is discussed.

9000 **Reid, R.S., Ellis, J.E., Swallow, B.M., Perry, B.D. and Kruska, R.L., 1993.** Ecological implications of controlling tsetse-transmitted trypanosomiasis in Africa: GIS case studies. (Meeting abstract.) *Bulletin of the Ecological Society of America*, **74** (2 Suppl.): 406.

Reid: ILRI, P.O. Box 30709, Nairobi, Kenya.

More effective control of tsetse-transmitted trypanosomiasis may open vast areas of Africa to livestock production, increasing food production potential and endangering the continent's last reservoirs of biodiversity. We determined how

tsetse/trypanosomiasis control affected land use change and how altered land use patterns modified natural stocks. We conducted country-wide case studies in GIS using discriminant analysis to distinguish the importance of tsetse presence, ecological properties and human populations in determining the extent of human land use. GIS was linked to field studies in sites where trypanosomiasis had and had not been controlled. Cattle and tsetse distributions overlapped by c. 40%, suggesting that more effective control will not initiate a massive influx of cattle to ungrazed land. Field studies further suggest that cattle numbers and production increase with control, allowing the expansion and intensification of cultivation and enhancing human wealth. Tsetse absence or control was closely associated with zones of extensive human land use, lower wood biomass, and diminished natural habitat important to wildlife.

9001 **Reid, R.S., Wilson, C.J., Kruska, R.L. and Swallow, B.M., 1994.**

Ecological consequences of controlling a livestock disease: changes in land-use and vegetative cover in Ethiopia. (Meeting abstract.) *Bulletin of the Ecological Society of America*, **75** (2 Suppl. part 2): 190.

Reid: ILRI, P.O. Box 30709, Nairobi, Kenya.

Our objective was to determine how tsetse/trypanosomiasis control affects the expansion of agricultural land use and how, in turn, altered land use modifies vegetation and landscape pattern in Ghibe Valley, southwestern Ethiopia. Characteristics of the vegetation were sampled during ground surveys while measurements of current patterns and recent changes in land use were made using satellite imagery and interviews with farmers. At the farm level, tsetse control has spurred a substantial increase in livestock numbers, changes in herd composition, expansion of cultivated areas and has encouraged human immigration. Expansion of cultivated areas has created a patchwork of fields within a matrix of lesser-used woodlands. Woody and herbaceous cover were similar on small-scale farms to that in uncultivated woodlands but trees, shrubs and grass patches were almost entirely removed on large-scale farms. Maintenance of vegetative cover thus may be related more to the scale of farming than to the presence or absence of human land use.

9002 **Rogers, D.J., 1994.** Modelling tsetse and trypanosomiasis in Africa. *In*: FAO, 1994 (see **18**: no. 8987), pp. 42-55.

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The problems of modelling tsetse and trypanosomiasis in Africa are discussed. There are two different problems, those of distribution on the one hand and abundance (or prevalence) on the other, distribution generally being easier to model than abundance. The two different solutions involve either a statistical or a biological approach. The latter is always preferable but requires a clear understanding of the determinants of disease risk and their interactions, and unfortunately there is seldom enough information. All biological systems consist of a series of input processes (e.g. birth, immigration, infection) contributing to an increase (in number per unit area, or in disease prevalence) and output processes (death, emigration, recovery) contributing to a decrease. Input and output processes are rarely equal, leading to change. It is clearly vital to try to include density dependent regulatory factors in statistical as well as biological models. In order to illustrate these points, four examples are given, two statistical and two biological: the distribution of *Glossina morsitans* in Kenya and Tanzania, the abundance of *G. palpalis* in Nigeria, the prevalence of trypanosomiasis among cattle in Togo, and the incidence and prevalence of trypanosomiasis in cattle in The Gambia. Plans for future progress in modelling are suggested.

9003 **Rogers, D.J., Hendrickx, G. and Slingenbergh, J.H.W., 1994.**

Tsetse flies and their control. *Revue scientifique et technique de l'Office International des Epizooties*, **13** (4): 1075-1124.

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

The authors use a quantitative modelling framework to describe and explore the features of the biology of tsetse flies (*Glossina* spp.) which are important in determining the rate of transmission of the African trypanosomiasis between hosts. Examples are presented of the contribution of previous research on tsetse to quantified epidemiological and epizootiological understanding, and areas of current ignorance are identified for future study. Spatial and temporal variations in risk are important (but rarely studied) determinants of the impact of trypanosomiasis on humans, domestic animals and agricultural activities. Recent grid-based sampling surveys of Togo provide valuable data sets on tsetse, cattle and trypanosomiasis throughout the country. A combination

of ground-based meteorological and remotely-sensed satellite data, within linear discriminant analytical models, enables description of the observed distributions of the five species of tsetse occurring in Togo, with accuracies of between 72% (*G. palpalis* and *G. tachinoides*) and 98% (*G. fusca*). Abundance classes of the two most widespread species, *G. palpalis* and *G. tachinoides*, are described with accuracies of between 47% and 83%. This is especially remarkable given the relatively small differences between the average values of the predictor variables in areas of differing fly abundance. Similar analyses could be used to predict the occurrence and abundance of flies in other areas, which have not been surveyed to date, in order to plan tsetse control campaigns or explore development options. Finally, some recent tsetse control campaigns are briefly reviewed. The shift of emphasis from fly eradication to fly control is associated with a devolution of responsibility for control activities from central government to local areas, communities or even individuals. The future role of central governments will remain crucial, however, in determining the areas in which different control options are practised, in facilitating control by local communities and in protecting controlled areas from re-invasion by flies from other areas.

9004 **Treinish, N.J., 1993.** Developing drugs for tropical diseases rare in the United States: a case study on African sleeping sickness. *Food and Drug Law Journal*, **48** (4): 533-535.

Marion Merrell Dow Inc.

This article discusses the development of drugs in the USA for tropical diseases which are rare in that country, through a case study of Ornidyl (eflornithine hydrochloride, DFMO). The drug was originally discovered and developed in the mid-1970s by Merrell Dow as an anti-cancer agent. Its first clinical use against *Trypanosoma brucei gambiense* was in Sudan in 1981. After further development, Marion Merrell Dow Inc. has now offered the rights, patent and technological know-how for the manufacture of Ornidyl to WHO on a royalty-free, at-cost basis. The part played by the Orphan Drug Act (1983) in facilitating the development and approval of drugs for diseases 'rare in the States' but prevalent in developing countries is discussed.

9005 **Wilson, C.J. and Reid, R.S., 1994.** Ecological consequences of controlling the tsetse fly in southwestern Ethiopia: influence of land cover/land-use on bird species

richness. (Meeting abstract.) *Bulletin of the Ecological Society of America*, **75** (2 Suppl. part 2): 251.

Wilson: ILRI, P.O. Box 30709, Nairobi, Kenya.

Successful control of tsetse-transmitted trypanosomiasis in Ghibe Valley, Ethiopia, appears to accelerate conversion of woodland/grassland into cropland. Land conversion, in turn, may fragment wildlife habitat. Our objective was to assess the influence of different land cover/land use types on bird species richness under different levels of conversion. We sampled bird species richness (using timed-species counts) and habitat structure (using ground surveys, remote sensing and GIS) in four land cover/land use classes, in tsetse control and non-control areas. Across all sites there was no significant difference in bird species numbers between tsetse control and non-control areas. However, at peak vegetative growth, bird species numbers and vegetative complexity were greater in the small-holder, oxen-ploughed fields and riparian woodlands than in woodland/grasslands or in tractor-ploughed fields. These results suggest that moderate land use by humans (e.g. small-holder field mosaics) increases habitat heterogeneity and bird species richness but that high levels of use (e.g. tractor-ploughed fields) reduce habitat complexity and thus bird species richness. This implies that trypanosomiasis control that causes land conversion from woodland/grasslands to small-holder farming in this region may have no adverse impacts on bird biodiversity.

9006 **Wispelaere, G. de, 1994.** Contribution of satellite remote sensing to the mapping of land use and of potential *Glossina* biotopes. Case study of the Adamawa plateaux in Cameroon. In: FAO, 1994 (see **18**: no. 8987), pp. 74-89.

The objective of this study was to test the capabilities of high resolution satellite imagery (SPOT) for the mapping of potential tsetse habitats in a test area on the Adamawa plateau in Cameroon. In particular, the aim was to distinguish woody plant formations with *Monotes kerstingii* and *Uapaca togoensis* which have been suggested as even greater potential biotopes for *Glossina morsitans submorsitans* than woodlands occupied by *Isobertinia doka*. Extensive field surveys were carried out to determine the actual ground situation. The main problem encountered lay in the spectral variability of plant formations depending on their topographical position. It proved impossible to distinguish reliably

between shrub savanna and tree and bush savanna, and differentiation of groups of species was not possible. It would appear that potential *G. m. submorsitans* habitats in savanna regions cannot be detected by mapping woody formations with satellite imagery alone, even using high resolution data.

9007 **Worboys, M., 1994.** The comparative history of sleeping sickness in East and Central Africa, 1900-1914. *History of Science*, **32** (95): 89-102. Sheffield Hallam University, Pond Street, Sheffield S1 1WB, UK.

This comparative study of sleeping sickness in British East Africa (Uganda), the Belgian Congo and German East Africa (Tanzania) shows that there were significant inter-imperial differences in approach to the disease which were shaped by the interplay of two main factors: (i) the medical and scientific advice given to colonial administrations, and (ii) the colonial structures and policies of the respective imperial powers. The epidemic which affected many colonial territories in east and central Africa in the early years of the century was understood to have its origins in the increased movement of the indigenous population resulting from pacification, migration and trade. In Uganda, after initial attempts at disease containment by control of population movement, the British administrative and medical personnel preferred to attack the tsetse vector which they found more tractable, using bush clearance and game management. In the Belgian Congo, the militaristic administration controlled human movement and sought to defend uninfected areas from the disease enemy and to contain sufferers in infected areas. In German East Africa, medical men first endeavoured to strike at the parasite with the advanced tools of laboratory screening and chemotherapy, though later there was a shift towards fly control. The dominant approach was thus entomological in Uganda, epidemiological in the Congo and microbiological in German East Africa.

9008 **Yu, P., Habtemariam, T., Oryang, D., Obasa, M., Nganwa, D. and Robnett, V., 1995.** Integration of temporal and spatial models for examining the epidemiology of African trypanosomiasis. *Preventive Veterinary Medicine*, **24** (2): 83-95. Yu: Center for Computational Epidemiology, School of Veterinary Medicine, Tuskegee University, Tuskegee, AL 36088, USA.

A stochastic model was first developed to study the spatial dispersal of a tsetse fly population, and

subsequently integrated with a time oriented epidemiologic model. Such an integrated model was needed to understand better the epidemiology of cattle trypanosomiasis. Pre-existing data were used to determine the distributions of the random variables involved in the model. We used the model to assess several alternatives of preventing the spatial progression of trypanosomiasis. We address the following question: what size of protective barrier is required to prevent the spatial progression of trypanosomiasis? The vector control alternatives considered in this study included insecticide applications, vegetation clearing, wild animal depopulation, use of tsetse traps, and combinations of the above methods within a protective barrier. Simulation results indicated that a protective barrier, about 100 m wide, was effective in stopping the spatial spread of cattle trypanosomiasis.

2. tsetse biology

(a) REARING OF TSETSE FLIES

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

[See also **18**: nos. 8991, 9022.]

9009 **Abubakar, L., Osir, E.O. and Imbuga, M.O., 1995.** Properties of a blood-meal-induced midgut lectin from the tsetse fly *Glossina morsitans*. *Parasitology Research*, **81** (4): 271-275.

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

The properties of a blood-meal-induced lectin (agglutinin) from the midgut of *G. morsitans* capable of agglutinating *Trypanosoma brucei* were studied *in vitro*. The midgut homogenate from flies that had been fed twice had the highest agglutination activity, followed by that from the once-fed flies and that from the unfed insects. As compared with the bloodstream-form trypanosomes, a much lower concentration of the midgut homogenate was required for agglutination of the procyclic parasites. Further, the agglutination process was specifically inhibited by D-glucosamine. Soybean trypsin inhibitor abrogated agglutination of the bloodstream-form parasites, whereas the procyclics were unaffected. The agglutination process was temperature-sensitive, with little activity being evident between 4°C and 15°C. Similarly, heating the midguts to 60°C - 100°C led to loss of activity. When the midgut homogenate was separated by anion-exchange chromatography, the agglutination activity co-eluted

with trypsin activity at approximately 50% NaCl. These results suggest a very close relationship between midgut trypsin-like enzyme and the agglutinin. Since successful agglutination of bloodstream-form trypanosomes requires protease activity, it may be that the enzyme cleaves off some surface molecules on the parasite surface, thus exposing the lectin-binding sites.

9010 **Aksoy, S., 1995.** Molecular analysis of the endosymbionts of tsetse flies: 16S rDNA locus and over-expression of a chaperonin. *Insect Molecular Biology*, **4** (1): 23-29.

Department of Internal Medicine, Yale University School of Medicine, 60 College Street, New Haven, CT 06510, USA.

Based on 16S rDNA sequence comparison, intracellular mycetome-associated endosymbionts (P-endosymbionts) of tsetse flies form a distinct lineage within the γ -3 subdivision of Proteobacteria, related to the free-living bacterium *Escherichia coli*, midgut S-endosymbionts of various insects including tsetse flies, and to the P-endosymbiont lineage of aphids, *Buchnera aphidicola*. Gene organisation and expression of several loci in intracellular microorganisms have revealed differences from free-living bacteria. This study analyses two of these characteristics in tsetse endosymbionts: the copy number and gene organisation of rDNA operons and the nature of the abundant protein(s) synthesised by these microorganisms. Results indicate that *Glossina morsitans morsitans* S-endosymbionts have multiple (seven) rDNA operons coding for 16S (rrs) followed by 23S (rrl) gene sequences, whereas tsetse P-endosymbionts have a single, similarly organised rDNA operon. In tsetse mycetocytes *in vitro*, P-endosymbionts synthesise a predominant protein of 60 kDa in size (p60) which by Western blot analysis shows immunological cross-reactivity with the abundant 63 kDa (p63) protein of *B. aphidicola*. p63 (also referred to as symbionin) has been characterised as a molecular chaperone, structurally and functionally similar to the groEL protein of *E. coli*. Under *in vitro* conditions, tsetse S-endosymbionts synthesise high levels of a similarly sized protein that cross-reacts with p63 chaperonin. Antisera against the tsetse p60 protein also recognises p63 protein of *B. aphidicola*, suggesting that the abundant tsetse endosymbiont protein is a chaperonin.

9011 **Aksoy, S. and Beard, C.B., 1994.** Expression of foreign genes in tsetse flies. (Meeting abstract.) *In vitro Cellular and Developmental Biology Animal*, **30A** (3 part 2): 29. Aksoy: Department of Internal Medicine, Yale University School of Medicine, 60 College Street, New Haven, CT 06510, USA.

The ability of insects to transmit disease-causing pathogens can be modified if the insect genes involved in establishing susceptibility to infections can be identified and subsequently genetically modified. Alternatively, the introduction and expression of foreign anti-parasitic genes into insects can also interfere with disease transmission. Many arthropods, including tsetse flies, harbour symbiotic microorganisms permanently associated with their midgut cells. It is possible to introduce desirable genes into these symbionts so that anti-parasitic products may have an effect on adjacent midgut parasites. The presence of *Wolbachia*-like bacteria in the ovaries of some species suggests that cytoplasmic incompatibility phenomena may be used to spread desirable anti-parasitic tsetse fly phenotypes in nature.

9012 **Aksoy, S., Pourhosseini, A.A. and Chow, A., 1995.** Mycetome endosymbionts of tsetse flies constitute a distinct lineage related to Enterobacteriaceae. *Insect Molecular Biology*, **4** (1): 15-22.

Aksoy: Department of Internal Medicine, Yale University School of Medicine, 60 College Street, New Haven, CT 06510, USA.

Tsetse flies harbour two morphologically different endosymbionts intracellularly associated with gut tissue: a primary (P) and a secondary (S) organism. The P-endosymbiont is a gram-negative rod, 8-10 μm in size, and resides intracellularly within specialised cells, mycetocytes which are organised into an organelle (mycetome), in the anterior portion of the gut. The S-endosymbiont is a smaller (1-2 μm) gram-negative rod and is harboured in the epithelial sheath cells in midgut. Phylogenetic characterisation of S-endosymbionts from taxonomically distant insects including tsetse flies has shown that they are related to the free-living bacterium, *Escherichia coli*, and are members of the family Enterobacteriaceae within the γ -3 subdivision of Proteobacteria. In this study, a polymerase chain reaction (PCR) based assay was designed utilising the conserved sequences of 16S rDNA in order to phylogenetically characterise the mycetome-associated P-endosymbionts directly from tsetse

mycetome tissue. Analysis from five species of flies representing the three major subgenera of the genus *Glossina* (*G. m. morsitans*, *G. brevipalpis*, *G. tachinoides*, *G. p. palpalis* and *G. austeni*) indicates that P-endosymbionts constitute a distinct lineage within the γ -3 subdivision of Proteobacteria. Mycetome endosymbiont phylogeny appears to parallel the classic taxonomic assignments independently developed for their insect host species. This suggests an ancient association for this symbiosis, which may have subsequently radiated with time, giving rise to the current species of tsetse flies and their modern-day endosymbionts. Based on endosymbiont phylogeny, the *fusca* flies constitute the most ancient sub-genus, followed by the *morsitans* and *palpalis* groups.

9013 **Blanchetot, A. and Gooding, R.H., 1995.** Identification of a *mariner* element from the tsetse fly, *Glossina palpalis palpalis*. *Insect Molecular Biology*, **4** (2): 89-96.

Blanchetot: Department of Biochemistry, University of Saskatchewan, Saskatoon, Sask. S7N 0W0, Canada. In the present study, the polymerase chain reaction was used initially to demonstrate the presence of *mariner* sequences in seven species/subspecies of tsetse flies (*G. morsitans morsitans*, *G. m. submorsitans*, *G. m. centralis*, *G. p. palpalis*, *G. p. gambiensis*, *G. pallidipes* and *G. brevipalpis*). DNA hybridisation experiments show *mariner* sequences to be dispersed within the tsetse genome and that there are large variations in copy numbers among the various taxa. A genomic library was used to isolate and characterise a full-length *mariner* element from *G. p. palpalis*. The results indicate that this element is 1257 bp in length, flanked by two 32 bp inverted repeats differing at only one position, and belongs to the *mellifera* subfamily. The nucleotide sequence that is translated into a reading frame of 337 amino acids requires the introduction of two frame shifts and one stop codon to maximise sequence homology with a *mariner* element from *Drosophila erecta*. Based on this evidence, we conclude that the *G. p. palpalis mariner* element clearly represents a non-functional transposable element and that the protein product is not an active transposase.

9014 **Goldring, J.P.D. and Read, J.S., 1993.** Insect acetyl-CoA carboxylase: activity during the larval, pupal and adult stages of insect development. *Comparative Biochemistry and Physiology (B)*, **106** (4): 855-858.

Goldring: Department of Biochemistry, University of the Witwatersrand, P.O. 2050 Wits, Johannesburg, South Africa.

The activity of the lipogenic enzyme acetyl-CoA carboxylase was investigated in *Bombyx mori*, *Tenebrio molitor*, *Glossina morsitans* and *Sarcophaga nodosa*. Acetyl coenzyme A carboxylase activity in larvae, pupae and adults was compared with the saponifiable lipid mass at each stage of the life cycle, and was found to follow similar patterns, except for *T. molitor*. The results are examined in relation to known metabolic requirements for each insect.

9015 **Miyan, J.A., Chohan, S.N., Evans, P. and Tyrer, N.M., 1994.**

Hemocyte involvement in muscle cell death in flies.

Annals of the New York Academy of Sciences, **712**: 361-364.

Miyan: Department of Biochemistry and Applied Molecular Biology, University of Manchester Institute of Science and Technology, P.O. Box 88, Manchester M60 1QD, UK.

The thoracic ventral longitudinal eclosion muscle, the dorsal anterior eclosion muscle and the ptilinum eclosion muscles in *Glossina morsitans*, *Sarcophaga bullata* and *Calliphora vomitoria* were investigated using light and electron microscopy, gel electrophoresis of muscle protein and DNA, and electrophysiology in order to characterise the mode of cell death. The death of the muscles is clearly not necrotic but programmed. However, it shows none of the characteristics of apoptosis (chromatin condensation, DNA laddering on gels, formation of apoptotic bodies), nor is degeneration by programmed cell deletion demonstrated (no ultrastructural breakdown by nuclei, continuous protein synthesis). Death appears to involve single haemocytes in a non-phagocytic role, it requires intact innervation and it exhibits continuous synthetic activity.

9016 **Odinokov, V.N., Ishmuratov, G.Y., Kharisov, R.Y., Yakovleva, M.P. and Tolstikov, G.A., 1991.**

Pheromones of insects and their analogs. XXIX. Methyl-branched pheromones from 4-methyltetrahydropyran 4: synthesis of \square 15,19,23-trimethylheptatriacontane - a pheromone of *Glossina morsitans morsitans*. *Chemistry of Natural Compounds*, **27** (3): 361-363.

Institute of Chemistry, Bashkir Scientific Center, Urals Branch, Academy of Sciences of the USSR, Ufa, Russia.

The synthesis of the \square -diastereomeric 15,19,23-trimethylheptatriacontane (a pheromone of *G. m. morsitans*) was performed previously in 12 stages from geranylinalool, an ester of 3-ketoglutaric acid, and methylcyclopropyl ketone. Now, the sex pheromone has been synthesised from 1,5-dibromo-3-methyl-pentane, a

product of the acid hydrolysis of 4-methyltetrahydropyran.

9017 **Osir, E.O., Abubakar, L. and Imbuga, M.O., 1995.** Purification and characterization of a midgut lectin-trypsin complex from the tsetse fly *Glossina longipennis*. *Parasitology Research*, **81** (4): 276-281.

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

A blood-meal-induced lectin (agglutinin) with proteolytic activity was isolated from midgut extracts of *G. longipennis* by a two-step procedure involving anion-exchange chromatography. It is a glycoprotein (native molecular weight M_r , 61000 \pm 3000 Da) composed of two noncovalently linked subunits designated α (M_r , ~27000 Da) and β (M_r , ~33000 Da). The trypsin activity and the glycosyl residues were present on the α - and β -subunits, respectively. The native protein was capable of agglutinating both bloodstream-form and procyclic trypanosomes as well as rabbit red blood cells. This activity was strongly inhibited by D-glucosamine and weakly inhibited by N-acetyl-D-glucosamine. Similarly, soybean trypsin inhibitor abrogated agglutination of bloodstream-form parasites, whereas the procyclics were unaffected. The agglutination activity was sensitive to temperatures above 40°C but was unaffected by chelators of metal ions. Antibodies raised against the protein were used in immunoblotting experiments to show the presence of a similar protein in several members of the *Glossina* species. However, no cross-reactivity was detected with midgut extracts prepared from sandflies, mosquitoes or stable flies. It is proposed that this molecule might play an important role in differentiation of bloodstream-form trypanosomes into procyclic (midgut) forms.

9018 **Otter, C.J. den, Goes van Naters, W.M. van der and Belemtougri, R.G., 1995.** Responses of tsetse (*Glossina* spp.) olfactory cells to analogues of the attractant 1-octen-3-ol. (Meeting abstract no. 205.) *Chemical Senses*, **20** (1): 174.

Otter: Sensory Physiology Group, Department of Animal Physiology, University of Groningen, Netherlands.

Antennal cells of *Glossina morsitans morsitans* sensitive to 1-octen-3-ol have been stimulated with analogues of this substance in order to investigate the effects of chain length, and of the double bond and OH-group, on the intensity of response.

9019 **Voskamp, K.E. and Otter, C.J. den, 1995.** Recording from antennal receptors of tsetse flies in an odour plume. (Meeting abstract no. 109.) *Chemical Senses*, **20** (1): 129.

Voskamp: University of Groningen, Netherlands. Field experiments have been initiated in Zimbabwe using a portable EAG/Single-Cell recording module to investigate the responses of antennal olfactory cells of *Glossina morsitans morsitans* in an odour plume. Individual cells in the antennae are stimulated with air from the environment, offering the possibility of monitoring the spatial and temporal distribution of kairomones under natural conditions.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also 18: nos. 9002, 9003, 9006.]

9020 **Baylis, M. and Mbwabi, A.L., 1995.** Feeding behaviour of tsetse flies (*Glossina pallidipes* Austen) on *Trypanosoma*-infected oxen in Kenya. *Parasitology*, **110** (3): 297-305. Baylis: Department of Arbovirology, Institute for Animal Health, Ash Road, Pirbright, Surrey GU24 0NF, UK.

An incomplete ring of electric nets was placed around oxen which were either uninfected, infected with *T. vivax*, or infected with *T. congolense*. The numbers of fed and unfed *G. pallidipes* caught on the nets were used to estimate the attractiveness of the oxen to tsetse, and the feeding success of the tsetse on the oxen. Oxen infected with *T. congolense* attracted more *G. pallidipes* than the other groups of oxen. Taking into consideration daily variation in the abundance or activity of the flies, oxen infected with *T. congolense* were about 70% more attractive to *G. pallidipes* than were uninfected oxen or oxen infected with *T. vivax*. The latter two groups mostly attracted high numbers of *G. pallidipes* on days when the flies were especially abundant or active. The feeding success of *G. pallidipes* declined with increase in the rate at which oxen made anti-fly movements. Taking this movement rate into consideration, the feeding success of *G. pallidipes* on oxen infected with *T. congolense* was approximately 60% greater than on uninfected oxen or oxen infected with *T. vivax*. It is suggested that vasodilation induced by *T. congolense* may account for the difference in feeding success. The level of parasitaemia of *T. congolense* or *T. vivax* was not found to affect either the attractiveness of oxen or the feeding success on oxen. There was significant daily variation in the mean fat content of male *G. pallidipes* caught around the oxen but no effect of mean daily fat content on the proportion of males that fed. The mean haematin

content of fed male *G. pallidipes* was positively correlated with the PCV of the ox on which they fed.

9021 **Gouteux, J.P., Blanc, F., Cuisance, D., D'Amico, F. and Guinza, A.K., 1995.** Trials of olfactory attractants to enhance trap catches of *Glossina fuscipes fuscipes* (Diptera: Glossinidae) in the Central African Republic. *Veterinary Research*, **26** (4): 335-340.

Gouteux: ORSTOM, Département de Mathématiques Appliquées, URA-CNRS 1204, IPRA-UPPA, avenue de l'Université, 64000 Pau, France.

The use of host odours to increase trap catches of *G. f. fuscipes* in cattle breeding areas of the Central African Republic was investigated using bipyramidal traps with and without olfactory bait. The baits used were sponges impregnated with zebu urine, dung or sebum, and caged live animals: crocodile, monitor lizard, snake, rabbit or chicken. (In cattle breeding areas of the Central African Republic, reptiles account for 14-26% of the blood meals of *G. f. fuscipes*.) Catches were higher with all baited traps except zebu sebum. The increase was significant with zebu urine (\exists 1.4) and the monitor lizard (\exists 1.7). The greatest effect (\exists 4.2) was obtained for male *G. f. fuscipes* with zebu urine when fly densities were less than 5 males/trap/day. These results suggest that olfactory baits could improve the control of *G. f. fuscipes* by trapping. The attractant effect of reptile odour is particularly interesting and should be investigated further.

9022 **Hargrove, J.W. and Williams, B.G., 1995.** A cost-benefit analysis of feeding in female tsetse. *Medical and Veterinary Entomology*, **9** (2): 109-119.

Hargrove: ODA/IPMI Tsetse Research Project, c/o Tsetse Control, P.O. Box CY 52, Causeway, Zimbabwe.

Three models for feeding in female tsetse are considered. Model I: there is a prolonged non-feeding phase after each meal followed by feeding at a constant rate, with a constant probability of dying as a consequence of feeding. Model II: the feeding rate increases linearly after each meal. Model III: the feeding rate increases exponentially after each meal. In Models II and III the feeding hazard is a linear function of the probability of feeding. Production of viable female offspring is estimated under each model, making allowance for losses of adults due to starvation and to background and feeding mortality, losses of pupae due to predation and parasitisation, and losses of young flies if their mothers take insufficient blood during pregnancy. Under Model I, if females require

three meals to produce viable pupae in 9 days, then for a non-decreasing population with a background mortality of 1%/day, and 25% pupal losses due to predation and parasitism, the feeding risk must be $\leq 5\%$ /feed. At this maximum level the non-feeding phase should be 2-2.5 days for optimal productivity, with a mean feeding interval of 60-72 h. If the background mortality is 2%/day, feeding losses cannot exceed 1%/feed for a non-decreasing population. If four or five meals are required for the production of fully viable pupae, the optimal values of the non-feeding phase and mean feeding interval tend towards 1 and 2 days respectively. Under Models II and III the mean feeding interval is 50-60 h for optimal productivity (with variances 3 times as large as for Model I), in good agreement with estimates from recent models for feeding and digestion. Field evidence suggests that feeding tsetse take greater risks as their fat levels dwindle. This should result in feeding (and feeding mortality) rates which increase during the feeding phase - as assumed in Models II and III but not in Model I. These models allow greater flexibility than Model I, because flies can feed early in the hunger cycle, at low probability, as long as the feeding risk is also low. 9023 **Madubunyi, L.C., 1995.** Bloodmeal evacuation from the midgut of *Glossina pallidipes* in relation to tsetse foraging activity and trappability. *Ecological Entomology*, **20** (2): 146-152.

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

Foraging for bloodmeals is the most frequently recurrent and probably the most targetable of all activities that render tsetse vulnerable to interception with static trapping devices. Surgical monitoring of the midgut every 24 h during three successive days of food deprivation showed that a full bloodmeal, irrespective of its size or source, vacated the midgut of both sexes of *G. pallidipes* in eight progressive stages. Probing responsiveness in both sexes increased exponentially during the first four stages of their midgut evacuation, reaching a peak between stages 3 and 5. Thereafter it decreased, also exponentially. Most *G. pallidipes* caught by NG2G traps baited with cow urine and acetone had midguts in the last three stages (6-8) of bloodmeal evacuation. The same was true of the majority of those that failed to feed on a calf shortly after entrapment. The implications of the foregoing for tsetse foraging activity and trappability as well as for the potency of

cattle urine and acetone as odour-bait for tsetse are discussed.

9024 **Warnes, M.L., 1995.** Field studies on the effect of cattle skin secretion on the behaviour of tsetse.

Medical and Veterinary Entomology, **9** (3): 284-288.

IPMI Tsetse Project, c/o Tsetse and Trypanosomiasis Control Branch, P.O. Box CY 52, Causeway, Harare, Zimbabwe.

The effect of ox skin secretions (sebum) on the behaviour of tsetse flies (*Glossina pallidipes* and *G. morsitans morsitans*) was investigated in the field using electrified targets, some of which operated intermittently, and by direct observations of flies landing on treated and untreated cloth. As the off-period of an intermittently operating electrified target increased, the catch decreased both with and without the sebum present. Targets with sebum always caught more flies than targets without sebum, but there was no evidence to suggest that sebum increased the duration of stay on a target. Direct observations of flies on cloth targets revealed that for both species the presence of sebum reduced the duration of contact and for *G. pallidipes* the number of return contacts was increased. The results from direct observations were used to predict the number of repeat landings that would need to be made by flies in order to account for the catch of tsetse at intermittently electrified targets.

3. tsetse control (including environmental side-effects)

[See also **18**: nos. 8984, 8991, 8992, 8995, 9000, 9001, 9003, 9005, 9008, 9021.]

9025 **Allsopp, R., 1992.** Current trends and future prospects for tsetse control. *Pesticide Outlook*, **3** (3): 17-24.

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

The article reviews current tsetse control techniques, including ground spraying, aerial spraying, pyrethroid cattle dips, sprays and pour-ons, impregnated traps and targets, and the sterile insect technique. In discussing the future for tsetse control as a means of suppressing trypanosomiasis, the following questions are considered: do we ever actually eradicate a tsetse population and do we really need to; are we making the best use of the tsetse control techniques available; can we be confident of preventing reinvasion; and are there more effective alternatives for the control of

trypanosomiasis? It is concluded that future strategic planning should give due consideration to the following: tsetse control should not be carried out in isolation but within multi-disciplinary programmes aimed more generally at increasing agricultural production; community participation should be encouraged; tsetse eradication is seldom if ever achievable, therefore control authorities should aim at the lowest level of control to guarantee a given objective; barriers will slow down reinvasion but cannot be guaranteed to prevent it; all current tsetse control techniques should be retained and integrated where appropriate; the potential danger in relying too heavily upon any one control technique should be recognised; and the cautious and responsible use of insecticides cannot be de-emphasised.

9026 **Alsop, N.J., 1994.** A review of recent approaches to sustainable control and an analysis of the potential of modern techniques for large scale use. *In: FAO, 1994* (see **18:** no. 8987), pp. 149-166.

`Carlton', Meadow Lane, Houghton, Huntingdon, Cambridgeshire PE17 2BP, UK.

The problems encountered with previous tsetse and trypanosomiasis control strategies are discussed. In an effort to ensure long-term sustainability of future programmes in a perhaps more difficult funding climate, there is currently an on-going reappraisal of tactics. The concerns of donors have encouraged a more analytical approach to the problem and are also helping to ensure that a much wider view is taken of trypanosomiasis control within rural development as a whole. The options of localised eradication as opposed to long-term control are discussed. In view of the acute shortage of national funding for the foreseeable future, and the donors' reluctance to support open-ended, long-term recurrent control projects, attention is being focused on possible community involvement to help ensure sustainability of any control measures: the possible limitations of this approach are discussed. The various control/eradication techniques presently available are discussed as to their relative merits and drawbacks, especially with reference to their potential for large-scale use and amenability for community participation. A fully analysed approach to the use of these various techniques should lead to a policy of using integrated techniques in any large-scale programme. Co-ordinated regional intervention programmes are to be encouraged as a more credible approach to the

problem.

9027 **Jordan, A.M., 1995.** Control of tsetse flies (Diptera: Glossinidae) with the aid of attractants. *Journal of the American Mosquito Control Association*, **11** (2 pt 2): 249-255.

Holly House, Plud Street, Wedmore, Somerset BS28 4BE, UK.

A high degree of control of some *Glossina* spp. can be achieved by trapping. This is mainly because of their adenotrophic viviparity, and consequently very low intrinsic rates of population increase. Calculations based on basic life table data have shown that it is only necessary to catch some 1-4% of the female population per day in order to achieve effective control. This is at least 8 times less than that required for *Anopheles albimanus*. Much attention has been given to the size and shape of traps. In general for the *palpalis* group of species, the vertically oriented biconical trap and its derivatives are highly effective, whereas for the *morsitans* group compact or horizontally oriented shapes are more attractive. Royal blue is highly attractive, and strongest landing responses are induced either on dark surfaces or those strongly reflective in the ultraviolet. Only carbon dioxide has been identified as an attractant for the *palpalis* group, but its use in traps is impractical. In contrast, a number of attractive compounds have been identified for the *morsitans* group, but there is much variation between species and within a species at various locations. A cocktail of all known attractants, except carbon dioxide, can increase trap captures of *G. pallidipes* by 15-20 times. Attractive substances in host breath include acetone, and in urine, 4-methyl phenol and 3-n-propyl phenol. The new generation of traps, or so-called targets, usually insecticide-impregnated, that do not retain attracted flies, can be highly effective for controlling tsetse populations. However, the problem with tsetse control is primarily one of sustainability, in particular the problem of economically containing the threat of reinvasion of areas cleared of the fly.

9028 **Lambert, M.R.K., 1994.** Ground-spray treatment with deltamethrin against tsetse flies in NW Zimbabwe has little short term effect on lizards. *Bulletin of Environmental Contamination and Toxicology*, **53** (4): 555-561.

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

The possible short-term effect of ground-spraying deltamethrin against tsetse flies on lizards in

northwestern Zimbabwe was investigated. Observations of numbers of lizards basking on tree trunks in mopane woodland were made during the cool, dry season at seven sites in the Omay Communal Area and one in the Siabuwa Communal Area before and from 1 to 45 days after spraying. No significant difference in species composition before and after treatment with deltamethrin was found, the relative density was not affected and numbers did not decrease significantly after treatment. A short-term increase in sightings of *Mabuya striata wahlbergii*, the predominant species, in the first month after spraying may have reflected a short-term decline in numbers of invertebrate prey and consequent need for more active hunting by the lizards.

9029 **Lancien, J. and Obayi, H., 1993.** La lutte contre les vecteurs de la maladie du sommeil. [Control of the vectors of sleeping sickness.] *Bulletin de la Société française de Parasitologie*, **11** (1): 107-117.

Lancien: ORSTOM, 213 rue Lafayette, 75480 Paris, France.

The use of traps to control *Glossina fuscipes fuscipes* in the Busoga region of southeastern Uganda is described. Over a period of 4 years (1988-91), 12,000 bipyramidal traps impregnated with deltamethrin were deployed in an area of 3000 km². Apparent tsetse densities fell by more than 90% and the number of cases of *Trypanosoma brucei rhodesiense* sleeping sickness was reduced from 6674 to 270. The success of this campaign was due to the involvement of the local community who, after training, were responsible for placing the traps and collecting data. Continuity of the programme is guaranteed by a national structure comprising trained personnel at all levels. It is hoped that this structure may be used in future to diversify and consolidate agricultural and health care activities at the community level.

9030 **Phelps, R.J. and Holloway, M.T.P., 1992.** Catches of Tabanidae in response to visual and odour attractants in Zimbabwe. *Journal of African Zoology*, **106** (5): 371-380.

Phelps: Department of Biological Sciences, University of Zimbabwe, P.O. Box MP 167, Harare, Zimbabwe.

Large numbers of Tabanidae have sometimes been caught in F3 tsetse traps baited with phenols and acetone. This suggests a possible seasonal reduction in effectiveness of the traps in catching tsetse flies by tabanids choking up the retaining cages. Shape of trap, and/or the proportions of blue to black in the cloth covering the trap, affects the number of tabanids caught. In February, in the Zambezi Valley, Zimbabwe,

80% of the catch consisted of *Tabanus pullulus* and *T. copemani*. Catches of these two species from a moving ox were far lower than from traps although members of the Philolichini were caught from the ox only. Traps baited with 1-octen-3-ol (octenol) or 4-methylphenol separately, or with a mixture of 3-*n*-propylphenol, octenol and 4-methylphenol in the proportions of 1:4:8, gave significantly greater catches of *T. pullulus* and *T. copemani*. 3-*n*-Propylphenol alone was not effective as a bait. The addition of acetone to octenol, or to the 1:4:8 mixture of octenol and phenols, increased catches but not significantly. Experiments with a range of dilutions of the 1:4:8 mixture in acetone indicated that trap catches of *T. pullulus* were increased even at a dilution of 1:200, compared with catches in traps baited with acetone alone. Catches of *T. unilineatus*, *Haematopota nocens* and *Atylotus agrestis* in F3 traps were also increased by using the 1:4:8 bait together with acetone.

9031 **Stiles, J.K. and Davies-Cole, J.O.A., 1994.** The 'devils of the dust' (ant-lions: Myrmeleontidae) find new food source at tsetse fly control traps in Nguruman. *Discovery and Innovation*, **6** (3): 235-236.

Stiles: 880 Grand-Jean, Apt. 335 Ste-Foy Quebec, G1W 3Z3, Canada.

During monitoring of tsetse control traps at Nguruman in the Rift Valley of Kenya, a striking association was observed between larval ant-lion pits and the ICIPE NG2G traps. Pits were aggregated around the trap base over a radius of 1.5-3.3 m from the centre pole and numbers ranged from 25 to 71 per trap. This association apparently appeared in 1992, about 5 years after 100 tsetse traps were deployed in an area of 100 km². It seems that the adult *Myrmeleon* has learned to deposit its eggs around the traps so that the larval ant-lions can prey on the large numbers of ants which are attracted to the dead tsetse flies in the traps.

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

[See also **18**: nos. 8990, 8991, 9004, 9008, 9009, 9011, 9017, 9020, 9024.]

9032 **Dale, C., Welburn, S.C., Maudlin, I. and Milligan, P.J.M., 1995.**

The kinetics of maturation of trypanosome infections in tsetse. *Parasitology*, **111** (2): 187-191.

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

Estimates of the time delay between the infective bloodmeal and maturation (incubation or maturation time) for four trypanosome stocks (two *Trypanozoon* and two *Trypanosoma congolense*) show that maturation time in tsetse is not a parasite species-specific constant. The mean incubation time of a *T. brucei rhodesiense* stock (EATRO 2340, 18 days) was not significantly different from one *T. congolense* stock (SIKUDA88, 15.5 days) but was significantly greater than another (1/148 FLY9, 12.5 days). There was no significant difference in incubation times between male and female *Glossina morsitans morsitans* for any of the stocks but in both of the *Trypanozoon* stocks the proportion of female flies producing mature infections was significantly less than in males. However, estimates of gene frequency, assuming a model in which maturation is controlled by an X-linked recessive allele, gave inconsistent results, indicating that maturation cannot be controlled by a single sex-linked gene. Maturation was shown to be a tsetse sex-dependent phenomenon in *Trypanozoon* but not in *T. congolense* infections. Incubation time was quite variable even for a single trypanosome stock (e.g. standard deviation of 5 days for one *Trypanozoon* stock). We discuss how this variability can affect disease transmission, and the interpretation of age-prevalence data.

9033 **McNamara, J.J., Laveissière, C. and Masiga, D.K., 1995.**

Multiple trypanosome infections in wild tsetse in Côte d'Ivoire detected by PCR analysis and DNA probes. *Acta Tropica*, **59** (2): 85-92.

McNamara: MRC Trypanosomiasis Research Group, University of Bristol, Churchill Building, Langford, Bristol BS18 7DY, UK.

Trypanosomes were isolated from the midguts of *Glossina palpalis palpalis*, *G. pallicera pallicera* and *G. nigrofusca nigrofusca* captured around the village of Guediboua, southwest of Daloa in Côte d'Ivoire. Seventy of the 124 isolates, obtained from 688 flies, were examined for four different kinds of trypanosome using the polymerase chain reaction (PCR). Prevalences were: *Trypanozoon* 46%, riverine-forest *T. congolense* 86% and savanna *T. congolense* 54%. Only 29 samples were examined for *T. simiae* but it was not detected. Just 30% of the infections involved a single kind of trypanosome; the remainder were mixtures either of two (37%) or all three (27%) of the target organisms. 30 of the 70 isolates examined by PCR were successfully amplified to provide material for DNA probe hybridisation. To a large extent, DNA probes

confirmed the PCR results; all (28/28) of the riverine-forest and 82% (18/22) of the savanna *T. congolense* infections were identified. However, only 8% (1/13) of the PCR positives for *Trypanozoon* hybridised with the appropriate DNA probe. No *T. simiae* or *T. godfreyi* infections were identified using DNA probes but a large proportion (97%) (29/30) of the probed midguts were shown to contain Kilifi *T. congolense*. Four isolates out of 70 could not be identified by any method. There was no obvious association between the different species of flies and the infecting trypanosomes.

9034 **Mihok, S., Machika, C., Darji, N., Kang'ethe, E.K. and Otieno, L.H., 1995.** Relationships between host blood factors and proteases in *Glossina morsitans* subspecies infected with *Trypanosoma congolense*. *Medical and Veterinary Entomology*, **9** (2): 155-160.

Mihok: ICIPE, P.O. Box 30772, Nairobi, Kenya. Host blood effects of *T. congolense* establishment in *G. m. morsitans* and *G. m. centralis* were investigated using goat, rabbit, cow and rhinoceros blood. Meals containing goat erythrocytes facilitated infection in *G. m. morsitans*, whereas meals containing goat plasma facilitated infection in *G. m. centralis*. Goat blood effects were not observed in the presence of complementary rabbit blood components. N-acetyl-glucosamine (a midgut lectin inhibitor) increased infection rates in some, but not all, blood manipulations. Cholesterol increased infection rates in *G. m. centralis* only. Both compounds together added to cow blood produced superinfection in *G. m. centralis*, but not in *G. m. morsitans*. Midgut protease levels did not differ 6 days p.i. in flies maintaining infections versus flies clearing infections. Protease levels were weakly correlated with patterns of infection, but only in *G. m. morsitans*. These results suggest that physiological mechanisms responsible for variation in infection rates are only superficially similar in these closely related tsetse.

9035 **Mihok, S., Maramba, O., Munyoki, E. and Kagoiya, J., 1995.** Mechanical transmission of *Trypanosoma* spp. by African Stomoxyinae (Diptera: Muscidae). *Tropical Medicine and Parasitology*, **46** (2): 103-105.

Mihok: ICIPE, P.O. Box 30772, Nairobi, Kenya. Ten taxa of Stomoxyinae were tested for their ability to transmit *T. brucei*, *T. vivax*, *T. evansi* and *T. congolense* to mice within 3 min of interrupted feeding on highly parasitaemic blood. *T. brucei* was the easiest parasite to transmit with an 11.5% success rate, followed by *T. vivax* at 3.4% and *T. evansi* at 0.9%. *T. congolense* was not

transmitted in 129 attempts. *Stomoxys niger* spp. and four unstudied species (*S. varipes*, *S. taeniatus*, *S. pallidus*, *Haematobosca squalida*) were capable of transmitting trypanosomes mechanically.

9036 **Moloo, S.K., Grootenhuis, J.G., Jenni, L., Brun, R., Meirvenne, N. van and Murray, M., 1995.** *Trypanosoma brucei rhodesiense*: variation in human serum resistance after transmission between bushbuck and domestic ruminants by *Glossina morsitans morsitans*. *Acta Tropica*, **59** (3): 255-258.

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

The human serum sensitivity of *T. b. rhodesiense* clone Etat 1/10 transmitted by *G. m. morsitans* from an infected bushbuck (*Tragelaphus scriptus*) to a Boran steer and a goat, and from the infected domestic ruminants to bushbuck, was investigated. *T. b. rhodesiense* from the infected bushbuck or Boran steer developed in *G. m. morsitans* but with a very low infection rate. Those tsetse which became infected after feeding on the bushbuck transmitted the infection to a Boran steer and a goat, and the tsetse infected by the Boran steer also transmitted the infection to another bushbuck and to mice. The bloodstream trypomastigotes were resistant to human serum during the course of infection in 5 out of 9 populations from the bushbuck, 2 out of 5 from the Boran steer and in all 5 from the goat. Trypanosomes in the mice were sensitive to human serum. Metacyclic trypanosomes from *G. m. morsitans* infected by feeding on the infected bushbuck or Boran steer were sensitive to human serum. The reasons for, and implications of, these results are discussed.

9037 **Moloo, S.K. and Okumu, I.O., 1995.** A comparison of susceptibility to stocks of *Trypanosoma vivax* of *Glossina pallidipes* from allopatric populations in Kenya. *Medical and Veterinary Entomology*, **9** (2): 202-204.

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

Ten male *Glossina morsitans centralis* infected with *Trypanosoma vivax* stock IL 2337 (Kenya) were used to infect a Boran steer whose parasitaemia and PCV were subsequently monitored. The susceptibility of two laboratory strains of *G. pallidipes* originating from Nguruman, Rift Valley Province, and Shimba Hills, Coast Province, Kenya, was investigated by feeding teneral males and females simultaneously on the Boran steer at the first peak of parasitaemia, and subsequently on uninfected goats. On day 25 after the infected bloodmeal, the surviving tsetse were dissected and their labra and hypopharynxes examined for trypanosomes. The

experiment was repeated using *T. vivax* stock IL 3096 (Nigeria). Female *G. pallidipes* from Nguruman were significantly more susceptible than males to Kenyan *T. vivax* whereas the opposite was observed with *G. pallidipes* from Shimba Hills. However, females of both strains were significantly more susceptible than males to Nigerian *T. vivax*. Infection rates by both *T. vivax* stocks were markedly high (62.0-94.3%). Combined (male + female) infection rates were higher in the Nguruman strain.

9038 **Moloo, S.K., Zweygarth, E. and Sabwa, C.L., 1995.** A comparison of susceptibility to stocks of *Trypanosoma simiae* of *Glossina pallidipes* originating from allopatric populations in Kenya. *Medical and Veterinary Entomology*, **9** (3): 224-228.

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

A colony of *G. pallidipes* which originated from Nguruman, Rift Valley Province, Kenya, was significantly more susceptible than a colony of the same species which originated from Shimba Hills, Coast Province, Kenya, to infection with a stock of *T. simiae* CP 11 isolated from wild *G. austeni* in Coast Province, Kenya, irrespective of whether pigs or goats were used as infecting hosts. Male *G. pallidipes* from both the colonies were more susceptible than females to this *T. simiae* stock. Similarly, a *G. pallidipes* colony of Nguruman origin was significantly more susceptible than the colony of Shimba Hills origin to infection with another stock of *T. simiae* CP 813 isolated from wild *G. pallidipes* in Coast Province, Kenya, again irrespective of whether pigs or goats were used as infecting hosts. The susceptibility of the sexes of *G. pallidipes* from both the colonies to *T. simiae* CP 813 did not differ significantly when pigs were used as infecting hosts, but male *G. pallidipes* from both the colonies were significantly more susceptible than female tsetse to this *T. simiae* stock when goats were used as infecting hosts. Nevertheless, if the observed differences in susceptibility of the two *G. pallidipes* colonies reflect transmission of trypanosomes by the two allopatric populations of tsetse in the field, then the epidemiology of *simiae*-trypanosomiasis probably differs between these two areas of Kenya.

9039 **Sasaki, H., Kang'ethe, E.K. and Kaburia, H.F.A., 1995.** Blood meal sources of *Glossina pallidipes* and *G. longipennis* (Diptera: Glossinidae) in Nguruman, southwest Kenya. *Journal of Medical Entomology*, **32** (3): 390-393.

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

In total, 1952 *G. pallidipes* and 1098 *G. longipennis* adults

were collected in forest and savanna habitat in Nguruman, southwestern Kenya, by NG2G traps during the dry season of 1992. Of these, 339 individuals (11.1%) had blood meals, of which 155 (45.7%) were identified by direct enzyme-linked immunosorbent assay. The most frequent blood meal source was bushbuck, followed by ostrich, elephant, buffalo and warthog. Few meals were taken from cattle. The finding of frequent blood meals from ostriches is new for *G. pallidipes* and may indicate that ostriches are an important host. More detailed work on the role of ostriches in the epidemiology of trypanosomiasis is required.

5. human trypanosomiasis

(a) SURVEILLANCE

[See also **18**: nos. 9041, 9044.]

9040 **McNamara, J.J., Bailey, J.W., Smith, D.H., Wakhooli, S. and Godfrey, D.G., 1995.** Isolation of *Trypanosoma brucei gambiense* from northern Uganda: evaluation of the kit for *in vitro* isolation (KIVI) in an epidemic focus. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89** (4): 388-389.

McNamara: MRC Trypanosomiasis Research Group, University of Bristol, Churchill Building, Langford, Bristol BS18 7DY, UK.

Eight hundred and sixty seven individuals from three sites near the town of Adjumani in the East Moyo region of north-west Uganda were investigated clinically and serologically for evidence of current trypanosome infections. Blood samples were taken from 94 persons with a positive card agglutination test for trypanosomiasis (CATT) and clinical suspects and inoculated into the kit for *in vitro* isolation of *T. b. gambiense* (KIVI). Amongst this group, 30 parasitaemic individuals were identified by microhaematocrit centrifugation and the quantitative buffy coat technique. Only 80% of these isolates, and one isolate from an aparasitaemic individual, grew in culture. The success or failure of cultures from parasitaemic patients was unrelated to the size of the trypanosome inoculum. The implications of these results and possible reasons for the failure of KIVI are discussed.

(b) PATHOLOGY AND IMMUNOLOGY

[See also **18**: no. 9050.]

9041 **Damian, M.S., Dorndorf, W., Burkardt, H., Singer, I., Leinweber, B. and Schachenmayr, W., 1994.** Polyneuritis und Myositis bei Trypanosoma-gambiense-Infektion. [Polyneuritis and myositis in *T. gambiense* trypanosomiasis.] *Deutsche Medizinische Wochenschrift*, **119** (49): 1690-1693.

Damian: Neurologische Klinik, Universität Giessen, D-35385 Giessen, Germany.

During a 4 week trip to Nigeria a 54-year-old German developed a fever and later lymphadenopathy, pretibial oedema, dyspnoea and weight loss. After 16 weeks a wreath-like pale pink skin rash, increased pulse rate with pulse deficit and hepatosplenomegaly were noted. Laboratory tests showed various blood abnormalities. An electrocardiogram was suggestive of myocarditis: the cardiac symptoms were controlled with digoxin and verapamil. Despite antibiotic treatment, the patient's condition deteriorated. CSF showed an increased cell count and albumin. There was a mild, predominantly proximal, tetraplegia which, on the basis of electromyographic and biopsy findings, was thought to be due to polyneuritis and myositis. At this stage blood smear and CSF examination revealed trypanosomes. He thereupon received suramin (1.0 g) and prednisolone (120 mg down to 40 mg) daily, to which melarsoprol was added after 6 days (0.5 ml up to 5.0 ml daily for 36 days). Almost all symptoms then regressed within 6 weeks.

9042 **Ekanem, J.T., Akanji, M.A. and Odutuga, A.A., 1994.** Host and trypanosome derived factors during mammalian African trypano-somiasis. *Biokemistri*, **4** (2): 103-116.

Department of Biochemistry, University of Ilorin, Ilorin, Nigeria.

Trypanosome infections leading to African sleeping sickness cause alterations in the immune responses of the mammalian host leading to diverse pathological consequences despite the fact that the African trypanosome does not, at any of its developmental stages, penetrate any cell of the mammalian host. Trypanosome-derived biologically active substances or trypanosome-induced substances from the host or an interplay of both appear to be the basis of these pathological changes. Trypanosome-derived factors such as proteases, sialidases, phospholipases and others yet unknown are probably released extracellularly to cause the observed pathological changes and to activate lymphocytes, astrocytes and macrophages to produce other active substances that encourage host immunosuppression and somnolence as well as trypanosome proliferation. In addition to an initial immune-mediated lysis, trypanosome-killing host substances include serum high density lipoprotein (HDL) subpopulations, eosinophils and perhaps an acid lipase.

9043 **Hamon, J.F. and Camara, P., 1993.** Information processing

disturbances are similar in sleeping sickness patients to those of sleep deprived subjects: an auditory event-related potential study. *Homeostasis in Health and Disease*, **34** (3-4): 154-160.

Hamon: Laboratoire de Psychologie Expérimentale et Comparée, Université de Nice-Sophia Antipolis, 98 boulevard Eduard-Herriot, B.P. 209, 06204 Nice, France. We studied auditory event-related-potentials (ERPs) in sixteen patients with encephalic stage sleeping sickness (*Trypanosoma brucei gambiense*). The aim was to know how the disturbance of vigilance present in this illness reflected in the ERP. The latency of the late negative and positive components of auditory evoked potential was increased while the amplitude of the negative component was decreased. The amplitude of the contingent negative variation was also decreased. The reaction time was increased in a sub-group of patients selected for a more serious clinical state. The results suggest that the disorder in sleeping sickness subjects can be compared with that in subjects deprived of sleep.

9044 **Hepburn, B.C., Wolfe, R.D. and Vestal, M.A., 1995.** East African trypanosomiasis in the United States.

(Letter.) *American Family Physician*, **52** (2): 381.

Hepburn: U.S. Air Force Academy Hospital, Colorado Springs, CO, USA.

A case of trypanosomiasis in a 67-year-old man returning from a trip to Africa is described. The patient initially developed a tender purple-black lesion on his calf secondary to a tsetse fly bite while on safari in Tanzania. Two weeks later he had the onset of fever, fatigue and severe myalgias followed 4 weeks later by a pruritic rash on his torso.

Peripheral blood smear revealed trypanosomes and CSF showed elevated protein and IgM levels. The case was successfully treated with i.v. suramin followed by melarsoprol/dimercaprol.

9045 **Okomo-Assoumou, M.C., Geffard, M., Daulouède, S., Chaugier, C., Lemesre, J.L. and Vincendeau, P., 1995.** Circulating antibodies directed against tryptophan-like epitopes in sera of patients with human African trypanosomiasis. *American Journal of Tropical Medicine and Hygiene*, **52** (5): 461-467.

Vincendeau: Laboratoire de Parasitologie, Université de Bordeaux II, 146 rue Léo Saignat, F-33076 Bordeaux Cedex, France.

Human African trypanosomiasis is often associated with an intense proliferation of B lymphocytes, leading to polyclonal antibody synthesis. Using a modified

enzyme-linked immunosorbent assay method, we have found highly significant levels of circulating anti-conjugated tryptophan-like epitope antibodies in sera of patients with sleeping sickness. These antibodies were immuno-globulins (Ig) of the M isotype. There was no correlation between immunologic binding and the Ig levels found in sera of patients with human African trypanosomiasis. Higher antibody levels in stage II of the disease than in stage I may be related to damage to the central nervous system. The specificity of this immunologic binding was evaluated by (i) comparison with that obtained with other related conjugates and (ii) serum titration. Anti-conjugated tryptophan-like epitope antibodies were not found in other neurologic diseases tested. Their involvement in this pathology remains unknown.

9046 **Pentreath, V.W., 1995.** Trypanosomiasis and the nervous system: pathology and immunology. (Review.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89** (1): 9-15. Department of Biological Sciences, University of Salford, Salford M5 4WT, UK.

Damage to the nervous system occurs in both African and American trypanosomiasis, but it differs considerably in form and extent in each disease, and with different strains and disease stages. With *Trypanosoma brucei* infections there is a progressive central nervous system (CNS) pathology which involves the meninges, choroid, blood-brain barrier, and immunopathological changes, including perivascular infiltrations, astrocyte activation and alterations in the cytokine/mediator network. These changes underlie the altered behaviour in the late or secondary disease stages, prevalent in the chronic gambian form, characterised by hypersomnia leading, if untreated or if treatment is followed by reactive changes, to coma and death. In *T. cruzi* infections there is an acute stage with destructive and inflammatory changes in the CNS which can be life-threatening, an intermediate stage with effective parasite suppression and a chronic stage with progressive autoimmune destruction of peripheral nerve components, especially the autonomic innervation of the heart and gut.

9047 **Pentreath, V.W., Baugh, P.J. and Lavin, D.R., 1994.** Sleeping sickness and the central nervous system. *Onderstepoort Journal of Veterinary Research*, **61** (4): 369-377.

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

Chronic African trypanosomiasis is associated with

progressive behavioural deficits, for which there is a complex underlying CNS pathology. This has been extensively studied in man and a range of experimental animals. An initial meningitis, which can occur quite early in the infection, is followed by a breakdown of the choroid plexus, movement of the parasite into certain localised brain areas, and subsequent encephalitis. The encephalitis consists of a chronic, widespread inflammation with perivascular infiltration of B-cells, plasma cells, inactivated T-cells and macrophages. The blood-brain barrier is damaged and a vasogenic oedema ensues. Astrocytes and microglia become reactive and the cytokine/mediator network is perturbed. The alterations in some of these signalling substances, e.g. the prostaglandins, may induce some of the behavioural changes, e.g. the hypersomnia. The immunopathology in the CNS may be brought about by elevated levels of active substances in the cerebrospinal fluid, caused by parasite infection.

9048 **Radomski, M.W., Buguet, A., Montmayeur, A., Bogui, P., Bourdon, L., Doua, F., Lonsdorfer, A., Tapie, P. and Dumas, M., 1995.** Twenty-four-hour plasma cortisol and prolactin in human African trypanosomiasis patients and healthy African controls. *American Journal of Tropical Medicine and Hygiene*, **52** (3): 281-286.

Radomski: Defence and Civil Institute of Environmental Medicine, Toronto, Canada.

We have previously demonstrated that human African trypanosomiasis (sleeping sickness) at the stage of meningoencephalitis results in a major disruption of the circadian rhythmicity of sleep and wakefulness that is proportional to the severity of the disease. This paper examines the corresponding 24-hourly secretion in cortisol and prolactin and compares it with the hourly distribution of sleep composition in infected patients and healthy African subjects. The secretion of cortisol in humans follows a circadian rhythm relatively independent of the sleep-wake cycle, whereas that of prolactin exhibits fluctuations over the 24 h day that are strongly related to the sleep-wake cycle. After the clinical classification of the patients according to the severity of the disease, hourly blood samples were taken over 24 h via an indwelling catheter. Plasma cortisol and prolactin were analysed by radioimmunoassay, and the variations in the hourly concentrations were analysed for the presence of a potential 24 h rhythm (circadian). All of the healthy African subjects showed significant circadian rhythms

in both cortisol and prolactin secretion, similar to data on humans from temperate regions, and a sleep-related anamnestic afternoon peak of prolactin. Major disruptions in the circadian rhythms of plasma cortisol and prolactin were found in the three patients with the most severe illness, in contrast to the four who were less severely ill and the healthy controls. Thus, it appears that, as the disease progresses in severity, major disruptions begin to occur in body circadian rhythms, not only in the sleep-wake cycle as reported elsewhere, but also in cortisol and prolactin secretion, suggesting that sleeping sickness affects the circadian timing system.

(c) TREATMENT

[See also **18**: nos. 8998, 9004.]

9049 **Burri, C., Blum, J. and Brun, R., 1995.** Alternative application of melarsoprol for treatment of *T. b. gambiense* sleeping sickness: preliminary results. *Annales de la Société de Médecine tropicale*, **75** (1): 65-71.

Blum: Swiss Tropical Institute, P.O. Box, CH-4002 Basel, Switzerland.

The protocols for treatment of human African trypanosomiasis (sleeping sickness) with the organoarsenical drug melarsoprol are based on empirical observations. Therapy is often accompanied by serious side effects and relapses. Additionally, the duration of treatment, which is up to 40 days, is a major drawback in African countries. Based on pharmacokinetic investigations an alternative therapy protocol for *gambiense* sleeping sickness has recently been proposed which consists of ten consecutive injections of 2.2 mg/kg melarsoprol given at intervals of 24 h. In a preliminary study, eleven patients were treated in Vanga, Zaire, following this alternative protocol which reduces the duration of the treatment to 10 days. The results indicate that the alternative schedule was as effective as the traditional protocol, showed similar adverse reactions but required a much shorter treatment period.

9050 **Heppner, C., Petzke, F., Arlt, W., Mbulamberi, D., Siekmann, L., Vollmer, D., Ossendorf, M., Winkelmann, W., Allolio, B. and Reincke, M., 1995.** Adrenocortical insufficiency in Rhodesian sleeping sickness is not attributable to suramin. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89** (1): 65-68.

Heppner: Medizinische Klinik II, Ostmerheimerstrasse 200, 51109 Köln, Germany.

Suramin is known to cause adrenocortical insufficiency in doses exceeding the quantity used for treatment of human African trypanosomiasis (HAT). We have previously reported that *Trypanosoma brucei rhodesiense* infection causes a combined central and peripheral adrenal insufficiency. To evaluate whether suramin therapy acts as an additional adrenotoxic factor, we assessed adrenocortical function in 72 patients suffering from HAT at different times during treatment with either suramin or melarsoprol by a rapid adrenocortico-tropic hormone test. We found a significantly diminished peak cortisol response to stimulation in the acutely ill patients ($P = 0.001$), indicating impaired adrenocortical function, as well as a high incidence of partial adrenocortical insufficiency (27%). During and after trypanocidal therapy the incidence of partial adrenal insufficiency gradually declined (to 25% and 18% respectively). Stimulated peak cortisol levels did not differ significantly between patients receiving suramin and those given melarsoprol. No correlation was found between serum suramin concentration and the cortisol response to stimulation ($r = 0.09$, $P = 0.47$). Thus we conclude that suramin in trypanocidal doses neither causes nor worsens the adrenocortical dysfunction observed in rhodesian HAT.

9051 Pépin, J., Milord, F., Khonde, A.N., Niyonsenga, T., Loko, L., Mpia, B. and Wals, P. de, 1995. Risk factors for encephalopathy and mortality during melarsoprol treatment of *Trypanosoma brucei gambiense* sleeping sickness. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **89** (1): 92-97.

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

This paper reviews the incidence of, and risk factors for, drug-induced encephalopathy and mortality (from all causes) during treatment with melarsoprol of 1083 patients with *T. b. gambiense* sleeping sickness in Nioki hospital, Zaire, between 1983 and 1990. Sixty-four patients (5.9%) developed encephalopathy and 62 (5.7%) died: 43 from reactive encephalopathy and 19 from other causes. Univariate and multivariate analyses showed that the administration of prednisolone reduced significantly the incidence of encephalopathy and mortality during treatment, especially in patients with trypanosomes observed in the cerebrospinal fluid (CSF) and/or with a CSF white blood cell (WBC) count of 100 or more per mm³. The risk of encephalopathy was

associated more strongly with the CSF WBC count than with the presence of CSF trypanosomes. In the subgroup of patients with a CSF WBC of 100 or more per mm³, changing the melarsoprol regimen to 3 series of 3 injections instead of 3 series of 4 injections halved the mortality rate during treatment. Treatment of patients who do develop reactive encephalopathy with the heavy metal chelator dimercaprol, in addition to i.v. steroids and anticonvulsants, may be harmful. The data suggest that a further reduction of the total dose of melarsoprol may decrease toxicity without jeopardising efficacy.

6. animal trypanosomiasis

(a) SURVEY AND DISTRIBUTION

[See also **18**: no. 9002.]

9052 **Kalu, A.U., 1995.** Prevalence of trypanosomiasis among trypanotolerant cattle at the lower Benue River area of Nigeria. *Preventive Veterinary Medicine*, **24** (2): 97-103.

Department of Veterinary Public Health and Preventive Medicine, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria.

The prevalence of trypanosome infection among trypanotolerant breeds of cattle (Muturu, N'Dama and Keteku) and their crosses was investigated in the lower Benue area of northern Nigeria. Prevalence was negative in yearlings of all breeds and low in N'Dama (5.9%; confidence interval (CI) \square 6%), high in Keteku (25%; CI \square 30%) and with an average of 9.0% (CI \square 3%) in all animals sampled. *Trypanosoma vivax* was the most prevalent species encountered; it was diagnosed in 3.4% of all 268 heads of cattle and accounted for 37.5% of all 24 positive cases. Corresponding figures for *T. congolense* were 3.0% and 33.3%, respectively. *T. brucei* sspp. and mixed infections each accounted for 8.3% of all positive cases, with unidentified species accounting for 12.5%. Prevalence was influenced by age and breed (but not sex) of animal, and by intensity of management and season of year. It was highest among old (6-9 year) animals (11.9%; CI \square 9%), extensively managed stock (14.4%; CI \square 6%), cross breeds (12.1%; CI \square 11%), and during the rains (10.2%; CI \square 4%). Mean PCV among infected (28.9 \square 5.7%) and healthy (33.0 \square 3.8%) animals did not differ significantly, and clinical signs of the disease were rarely observed. It is suggested that these breeds be incorporated into animal production programmes at the local government level.

9053 **Nawathe, D.R., Srivastava, G.C. and Sinha, P.K., 1994.** *Survey of*

animal trypanosomiasis and its vectors in the arid zone of Borno State.

Maiduguri, Nigeria; Faculty of Veterinary Medicine, University of Maiduguri. 26 pp.

A survey of trypanosomiasis and its vectors was undertaken in cattle, sheep and goats in the arid zone of Borno State following an outbreak of acute bovine trypanosomiasis at Dalori Government Farm in 1986. Blood samples for parasitological diagnosis were collected from the slaughter house at Maiduguri and from randomly selected nomadic and sedentary herds for 6-8 months (November to March or June) over a period of 3 years from 1989-91. Both acute and chronic forms of trypanosomiasis were noticed in cattle. No clinical disease was seen in sheep and goats. Only *Trypanosoma vivax* was observed in the peripheral blood of cattle, sheep and goats, with higher prevalence rates in cattle. Overall percentage of chronic infection was 2.5% in cattle, 0.6% in sheep and 1.1% in goats. Up to 72.7% was seen in acute outbreaks in cattle. *T. vivax* has high spreading potential, being very active and able to survive in the mouth parts of biting flies during interrupted feedings. No tsetse flies were caught but scores of *Tabanus* (777), *Stomoxys* (267), *Hippobosca* (109) and *Lyperosia* (198) were trapped. These biting flies were preponderant during the early rainy season (July, August) when 'fly menance' was frequently reported. By comparison with trypanosomiasis in the tsetse-infested area, the prevalence in cattle in the arid zone is not so high. Drastic measures to control the fly menance or mass chemo-prophylaxis are not warranted. However, it is advisable to treat herds showing obvious clinical signs with a combination of Berenil and Novidium. In addition to trypanosomiasis, infections with contagious bovine pleuropneumonia, foot and mouth disease, black quarter, anaplasmosis, coccidiosis and pink-eye were noticed in cattle and peste des petits ruminants and enterolithiasis in sheep and goats. Suitable steps should be undertaken by the veterinary authorities to control these endemic diseases.

(b) PATHOLOGY AND IMMUNOLOGY

[See also 18: nos. 8985, 8993, 9042.]

9054 **Andrianarivo, A.G., Muiya, P., Opollo, M. and Logan-Henfrey, L.L., 1995.** *Trypanosoma congolense*: comparative effects of a primary infection on bone marrow progenitor cells from N'Dama and Boran cattle. *Experimental Parasitology*, **80** (3): 407-418.

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

Using *in vitro* clonogenic assays, the changes in haemopoietic progenitor cell levels were compared in the bone marrow of three adult trypanotolerant N'Dama cattle and three age-matched trypanosusceptible Boran cattle over 17 weeks (119 days) of a primary *T. congolense* (clone IL 1180) infection. As the infection progressed, a clear tendency of the parasitaemia to decrease was seen in the N'Damas, while it remained high throughout the infection in the Borans. The decline in the colony-forming units-granulocyte macrophage (CFU-GM) between 7 and 42 days p.i. corresponded with the decreased numbers of neutrophils and monocytes in the blood observed in both breeds. Thereafter, a further significant drop in the CFU-GM levels was observed in the Borans which may partially explain the continued decrease in the numbers of neutrophils and monocytes in blood. In contrast, a significant peak of CFU-GM above preinfection levels was observed in the N'Damas on day 49 p.i., which could partially explain the subsequent recovery of the numbers of neutrophils and monocytes in blood. When compared to the N'Damas, the Borans had a more dramatic drop in PCV from 25 days p.i. onwards, resulting in significantly lower PCV. From 46-49 days p.i. onwards, the mean PCV stabilised at significantly lower levels in the Borans than in the N'Damas. The mean corpuscular volume (MCV) levels increased in both breeds, but at a much faster rate in the Borans. The clonogenic assays demonstrated an erythropoietic response, characterised by peaks above preinfection levels of both the early and late erythroid progenitor cells (respectively, burst-forming units-erythroid, BFU-E, and colony-forming units-erythroid, CFU-E), occurring between 35 and 70 days p.i. in both breeds of cattle. However, despite a more severe anaemia in the Borans, the magnitude of their erythroid response was similar to that of the N'Damas, suggesting that the response of the Borans was insufficient to compensate for the greater degree of anaemia. Moreover, the mean PCV did not improve in the Borans, indicating the ineffectiveness of their erythropoietic response. An increased rate of erythrocyte destruction and/or a defective differentiation and maturation of erythroid precursors have also been shown to be partially responsible for this persistent anaemia. From 98 days p.i. onwards, despite the persistent low PCV, the MCV decreased to preinfection levels and low CFU-E numbers were observed in the Borans. Over the same period, in

the N'Damas the mean PCV progressively increased to reach 25%, which fell within the low normal range for cattle. This may partially explain the return of the BFU-E to preinfection levels and the slight decrease in the CFU-E in the N'Damas. During the acute phase of a *T. congolense* infection, both the granulomonocytic and erythroid progenitors were increased more effectively in the N'Dama cattle than in the Boran cattle, when compared to the degree of cytopenia in blood; this might correlate with the superior ability of the N'Damas to maintain higher numbers of granulocytes, monocytes and erythrocytes in blood.

9055 **Cosivi, O., 1991.** Tripanosomiasi e riproduzione animale. [Trypano-somiasis and animal reproduction.] *Obiettivi e Documenti Veterinari*, **12** (3): 23-26.

CTVM, Easter Bush, Roslin, Midlothian EH25 9RG, UK. The article reviews the reproductive disturbances of both sexes frequently seen in domestic ruminants affected with trypanosomiasis. These include irregularity of the oestrous cycle, infertility, abortion and decreased libido, also birth of premature young with poor vitality. Treatment of infected animals brings about a slow recovery. In trypanotolerant races infertility is of a transitory character.

9056 **Elhassan, E., Ikede, B.O. and Adeyemo, O., 1995.**

Trypanosomosis and reproduction: II. Effect of *Trypanosoma vivax* infection on pregnancy and post-partum cyclicity in ewes. *Tropical Animal Health and Production*, **27** (1): 9-14.

Elhassan: Pathology Division, NITR, Kaduna, Nigeria. The effect of infection with *T. vivax* on pregnancy and post-partum cyclicity in ewes was investigated. Of the five ewes infected in the first trimester, three died without aborting and two after aborting. Intrauterine infection occurred in two of the foetuses removed at *post mortem*. Of the five infected in the third trimester, one ewe died without aborting, one lambed prematurely and three at term. Intrauterine infection occurred in one of the lambs born at term. None of the lambs were viable. The termination of pregnancy may be as a result of stress. The ewes infected in the third trimester commenced irregular cyclicity 13-23 days *post partum*.

9057 **Romney, D.L., Njie, A., Holmes, P. and Gill, M., 1994.** The effect of plane of nutrition on the response by trypanotolerant cattle to infection with trypanosomiasis. (Meeting abstract no. 148.) *Animal*

Production, **58** (3): 464.

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

Thirty-two N'Dama heifers were offered andropogon hay *ad libitum* plus 10.2 g/kg groundnut hay (GNH) (L) or GNH and 3.9 g/kg groundnut cake (GNC) (H). After 4 weeks on this diet, half of each group were inoculated intradermally with *Trypanosoma congolense* (LI and HI). Peak parasitaemia occurred 6-8 days p.i. and started to decrease c. 56 days later. No differences in parasitaemia levels were observed between LI and HI animals. Intakes of GNH and GNC remained constant during the trial but infected animals decreased ($P < 0.05$) intakes of andropogon hay. LI animals lost significantly ($P < 0.001$) more weight 0-96 days p.i. than controls (L), while HI animals gained less weight ($P < 0.001$) than H. PCV levels fell in all treatments (L 5.4, LI 13.8, H 3.7 and HI 9.4 units 49-63 days p.i.) and significant effects of both infection and diet were observed ($P < 0.001$). However, the effects of infection were less severe for animals on the H diet.

9058 **Rowlands, G.J., Mulatu, W., Nagda, S.M., Dolan, R.B. and d'Ieteren, G.D.M., 1995.** Genetic variation in packed red cell volume and frequency of parasitaemia in East African Zebu cattle exposed to drug-resistant trypanosomes. *Livestock Production Science*, **43** (1): 75-84.

Rowlands: ILRI, P.O. Box 30709, Nairobi, Kenya.

Nine hundred and thirty-six East African Zebu village calves in an area of high trypanosomiasis risk in south-western Ethiopia were monitored monthly with their dams from birth to 3 years of age. Mean PCV and the frequency of detected parasitaemia were calculated for each offspring and its dam measured simultaneously over 6-month 'wet' and 'dry' seasons from March 1986 to February 1992. Six-month residual values for offspring, corrected for solutions of fixed environmental effects, herd, year, season, etc., estimated by least squares analysis of variance, were regressed against corresponding residual values for their dams. The common environment component of variance, not already corrected for and remaining in these residual values, was estimated by regression of offspring values against those for the cows that gave birth closest to the offspring's own date of birth. When corrected for this component, offspring-dam regression coefficients for mean PCV, averaged over calves for each dam, were found to increase from 0.08 □

0.05 (SE) to 0.26 \pm 0.06 from 4 to 21 months of age. When also corrected for frequency of parasitaemia and treatment, regression coefficients were reduced, but the increasing trend with age was maintained. Offspring-dam regression coefficients for frequency of parasitaemia showed, if anything, an opposite trend. Application of an 'animal model' to offspring over 21 months of age and their dams gave heritability estimates of 0.32 \pm 0.07 for PCV, 0.18 \pm 0.07 for PCV corrected for frequency of parasitaemia, and 0.08 \pm 0.05 for frequency of parasitaemia.

9059 **Rowlands, G.J., Mulatu, W., Nagda, S.M. and d'Ieteren, G.D.M., 1995.** Variations in packed red cell volume and trypanosome prevalence and relationships with reproductive traits in East African Zebu cows exposed to drug-resistant trypanosomes. *Acta Tropica*, **59** (2): 105-116.

Rowlands: ILRI, P.O. Box 30709, Nairobi, Kenya. Approximately 320 East African Zebu cows over 36 months of age were monitored monthly from 1986 to 1992 in nine village herds in an area of high trypanosomiasis risk in southwest Ethiopia where there was resistance to all available trypanocidal drugs. Cows were individually treated with diminazene aceturate, either when they were detected parasitaemic and their PCV decreased below 26%, or when they showed clinical signs of trypanosomiasis. The average annual monthly trypanosome prevalence was 24% and the number of treatments of diminazene aceturate per cow per year was 3.1, both of which increased with age. Mean PCV decreased and mean trypanosome prevalence increased during lactation. There was a significant linear association between the time detected parasitaemic during the first 150 days of lactation and calving interval. When corrected for frequency of parasitaemia and treatment there was also an average reduction of 8.4 \pm 2.6 days in calving interval per % unit increase in PCV. Age at first calving decreased by 0.44 \pm 0.26 months per % unit increase in mean PCV maintained between 24 and 30 months corrected for parasitaemia and treatment. The percentage of pregnancies terminating in abortions significantly increased from 6.8 \pm 1.0% to 10.4 \pm 1.3% when cows detected parasitaemic at least once during the last 3 months of pregnancy were compared with cows not detected parasitaemic. The largest increase to 19.4 \pm 4.3% was in cows with low mean PCVs < 22%. It was concluded that cows which were able to maintain higher than average PCVs when

parasitaemic showed superior reproductive performance than those with lower than average PCVs.

9060 **Sileghem, M. and Naessens, J., 1995.** Are CD8 T cells involved in control of African trypanosomiasis in a natural host environment? *European Journal of Immunology*, **25** (7): 1965-1971.

Sileghem: ILRI, P.O. Box 30709, Nairobi, Kenya.

Murine models have suggested that CD8 T cells might play a major parasite-promoting role in African trypanosomiasis. To assess the role of these cells in a natural host environment, we have depleted CD8 cells from Boran cattle *in vivo* and subsequently infected these animals with *Trypanosoma congolense* by tsetse fly challenge. Following administration of a mouse monoclonal anti-bovine CD8 antibody, we have been able to achieve a depletion of more than 99.9% in peripheral blood, spleen, prescapular lymph nodes, prefemoral lymph nodes, mesenteric lymph nodes and Peyer's patches. Depletion could be maintained over a 4-5 week infection period. Despite the almost total absence of CD8 cells, no effect whatsoever was observed on parasitaemia. In addition, anaemia, which is the main factor determining the mean survival time in cattle, was not affected by the CD8 depletion.

(c) TRYPANOTOLERANCE

[See also **18**: no. 9058.]

9061 **Dehoux, J.P. and Verhulst, A., 1994.** Une race trypanotolérante méconnue: la Borgou. [An unrecognised trypanotolerant breed: the Borgou.] *Animal Genetic Resources Information*, **3** (13): 43-50.

Dehoux: Projet de Développement de l'Élevage dans le Borgou-Est, B.P. 23, Parakou, Benin.

The Borgou breed offers interesting potential because of its adaptation to, and its productivity in, an environment infested by tsetse flies. Mainly located in north Benin and northwestern Nigeria, this trypanotolerant breed is, however, threatened by increasing interbreeding with Zebu cattle. Within the framework of the promotion and development of trypanotolerant breeds in the fight against animal trypanosomiasis, the Borgou's potential should prompt regional and international institutions to implement a programme of conservation of this genetic resource.

(d) TREATMENT

[See also **18**: nos. 8988, 9059.]

9062 **Eisler, M.C., Gault, E.A., Smith, H.V., Peregrine, A.S. and Holmes,**

P.H., 1993. Evaluation and improvement of an enzyme-linked immunosorbent assay for the detection of isometamidium in bovine serum. *Therapeutic Drug Monitoring*, **15** (3): 236-242.

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

The control of bovine trypanosomiasis in Africa continues to rely heavily on the chemoprophylactic drug isometamidium chloride. However, despite many years of use, no methods are available that are sufficiently sensitive to measure drug levels in treated cattle. An enzyme-linked immunosorbent assay (ELISA) for the detection of isometamidium in the serum of treated cattle has been developed and evaluated. Liquid-phase isometamidium (sample) competes with solid-phase bound isometamidium-protein conjugate for biotinylated sheep anti-isometamidium IgG. The specific IgG is detected by streptavidin-peroxidase, using tetramethylbenzidine for colour development. Assay calibration is by four-parameter logistic curve-fitting. Factors contributing to absorbance variance were considered in assay optimisation and improvement of precision and the lower limit of detection (approximately 0.1 ng/ml in serum). The ELISA was shown to detect serum isometamidium for several months after treatment of cattle in a trypanosomiasis endemic country. The potential uses of this assay include the development of rational prophylactic drug regimens, and the indirect detection of drug-resistant trypanosomes.

9063 **Mdachi, R.E., Murilla, G.A., Omukuba, J.N. and Cagnolati, V., 1995.** Disposition of diminazene aceturate (Berenil[®]) in trypanosome-infected pregnant and lactating cows. *Veterinary Parasitology*, **58** (3): 215-225.

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

Three cows were repeatedly infected with different strains of *Trypanosoma congolense* and treated i.m. each time with a different dose of diminazene aceturate. Biphasic decline was observed of the maximal plasma drug levels, which were attained at 15 min after the first treatment and at 30 min after the second and third treatments. The rate constants for the distribution and terminal phases depended on the period of exposure to parasitaemia of the animal at the time of treatment. Maximal diminazene aceturate residue levels were found in milk 8 h post treatment and declined biexponentially to 4.56 ng/ml and 8.76 ng/ml at 21 days post treatment after 3.5 mg/kg and 7.0

mg/kg doses, respectively. In the three cows, higher drug residues were found in the kidney (7.04, 3.92 and 7.99 µg/g) than in liver (3.26, 2.87 and 1.24 µg/g) and heart (1.79, 1.25 and 1.03 µg/g). The results of this study indicate that the level of parasitaemia (degree of anaemia) in the animal at the time of treatment affects the distribution, disposition and elimination of diminazene aceturate in the animal. Furthermore, the residue level in milk after treatment depends on the treatment dose and could easily be bioavailable to the consumer.

9064 **Stevenson, P., Sones, K.R., Gicheru, M.M. and Mwangi, E.K., 1995.**

Comparison of isometamidium chloride and homidium bromide as prophylactic drugs for trypanosomiasis in cattle at Nguruman, Kenya. *Acta Tropica*, **59** (2): 77-84. Stevenson: KETRI, P.O. Box 362, Kikuyu, Kenya.

The duration of prophylaxis provided by isometamidium chloride and homidium bromide, each at a dose rate of 1 mg/kg bodyweight, was compared in a 12-month field trial involving groups of 30 Zebu cattle in south-west Kenya. The trial took place between February 1990 and February 1991 and included several months of high trypanosome challenge. Cattle in the prophylaxis groups were re-treated on a group basis when 10% of the group had become infected since the previous group treatment. On this basis the mean intervals between re-treatment were 7.5 ± 1.9 and 4.6 ± 2.1 weeks for the isometamidium and homidium groups, respectively. Weight gains in the two groups were similar. In spite of the need for more frequent treatment in the homidium group as compared to the isometamidium group, total drug costs were lower in the former. There was evidence of *Trypanosoma congolense* resistant to homidium and some evidence of *T. vivax* resistant to isometamidium.

7. experimental trypanosomiasis

(a) DIAGNOSTICS

[See also **18**: no. 9099.]

(b) PATHOLOGY AND IMMUNOLOGY

[See also **18**: no. 9095.]

9065 **Bakhiet, M., Eneroth, A., Olsson, T. and Kristensson, K., 1994.**

Interactions between *Trypanosoma brucei brucei* and dorsal root ganglia neurons. [Rat.] (Meeting abstract.) *Journal of Neuro-immunology*, **54** (1-2): 151.

Bakhiet: Division of Neurology, Department of Clinical Neuroscience, Huddinge University

Hospital, S-141 86 Huddinge, Stockholm, Sweden.

9066 **Grassi-Zucconi, G., Harris, J.A., Mohammed, A.H., Ambrosini, M.V., Kristensson, K. and Bentivoglio, M., 1995.** Sleep fragmentation, and changes in locomotor activity and body temperature in trypanosome-infected rats. [*T. b. brucei*.] *Brain Research Bulletin*, **37** (2): 123-129.

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

9067 **Mabbott, N. and Sternberg, J., 1995.** Bone marrow nitric oxide production and development of anemia in *Trypanosoma brucei*-infected mice. *Infection and Immunity*, **63** (4): 1563-1566.

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

9068 **Mabbott, N.A., Sutherland, I.A. and Sternberg, J.M., 1995.** Suppressor macrophages in *Trypanosoma brucei* infection: nitric oxide is related to both suppressive activity and life span *in vivo*. [Mice.] *Parasite Immunology*, **17** (3): 143-150.

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

9069 **Nok, A.J., Onyenekwe, P.C., Ibrahim, S., Bature, A. and Ogbadoyi, E., 1995.** Glutathione reductase (EC 1.6.4.2.) in experimental trypano-somiasis. [*T. congolense*; rats.] *Cell Biochemistry and Function*, **13** (2): 149-151.

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

9070 **Smith, A.B., Esko, J.D. and Hajduk, S.L., 1995.** Killing of trypano-somes by the human haptoglobin-related protein. [*T. b. brucei*.] *Science*, **268** (5208): 284-286 [see also p. 204].

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

9071 **Tomlinson, S., Jansen, A.-M., Koudinov, A., Ghiso, J.A., Choi-Miura, N.-H., Rifkin, M.R., Ohtaki, S. and Nussenzweig, V., 1995.** High-density-lipoprotein-independent killing of *Trypanosoma brucei* by human serum. *Molecular and Biochemical Parasitology*, **70** (1-2): 131-138.

Tomlinson: Michael Heidelberger Division of Immunology, Department of Pathology, New York University Medical Center, 550 First Avenue, New York, NY 10016, USA.

(c) CHEMOTHERAPEUTICS

[See also 18: nos. 9102, 9122.]

9072 **Benghuzzi, H.A., England, B.G., Bajpai, P.K. and Giffin, B.F., 1994.** Successful antidote of multiple lethal infections using sustained delivery of difluoromethylornithine by means of ceramic drug delivery devices. [*T. b. brucei*; rats.] *Clinical Materials*, **15** (3): 151-160.

Benghuzzi: Department of Health Science and Department of Pathology, University of Mississippi Medical Center, Jackson, MS 39216-4505, USA.

9073 **Berger, B.J. and Fairlamb, A.H., 1994.** Properties of melarsamine hydrochloride (Cymelarsan) in aqueous solution. *Antimicrobial Agents and Chemotherapy*, **38** (6): 1298-1302.

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

9074 **Bogaert, I. van, Haemers, A., Bollaert, W., Meirvenne, N. van, Brun, R., Smith, K. and Fairlamb, A.H., 1993.** Synthesis and antitrypano-somal evaluation of some thiazole-containing amino acids and peptides. [*T. b. brucei*, *T. b. rhodesiense*; mice.] *European Journal of Medicinal Chemistry*, **28** (5): 387-397.

Bogaert: Department of Pharmaceutical Chemistry, University of Antwerp, Universiteitsplein 1, B-2610 Antwerp, Belgium.

9075 **Burudi, E.M.E., Karanja, S.M., Njue, A.I., Githiori, J.B. and Ndung'u, J.M., 1995.** Establishment of a partly DFMO-sensitive primate model of *Trypanosoma rhodesiense* sleeping sickness. [*Cercopithecus aethiops*.] *Acta Tropica*, **59** (1): 71-73.

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

9076 **Dreyfuss, G., Loiseau, P.M., Lachâtre, G., Pénicaut, B., Nicolas, J.A. and Craciunescu, D.G., 1995.** *Trypanosoma brucei brucei*: antitrypanosomal evaluation of stilbamidinium hexachloroiridiate on the murine CNS model and iridium serum kinetics in infected sheep. *Tropical Medicine and Parasitology*, **46** (1): 41-44.

Dreyfuss: Laboratoire de Parasitologie, Faculté de Pharmacie, 2 rue du Docteur Marcland, F-87025 Limoges Cedex, France.

9077 **Mamman, M., Gettinby, G., Murphy, N.B., Kemei, S. and Peregrine, A.S., 1995.** Frequency of diminazene-resistant trypanosomes in populations of *Trypanosoma congolense* arising in infected animals following treatment with diminazene aceturate. [Mice.] *Antimicrobial Agents and Chemotherapy*, **39** (5): 1107-1113.

Peregrine: ILRI, P.O. Box 30709, Nairobi, Kenya.

- 9078 **Obexer, W., Schmid, C., Barbe, J., Galy, J.P. and Brun, R., 1995.** Activity and structure relationship of acridine derivatives against African trypanosomes. [*T. b. brucei*, *T. b. rhodesiense*.] *Tropical Medicine and Parasitology*, **46** (1): 49-53.
Obexer: Swiss Tropical Institute, P.O. Box, CH-4002 Basel, Switzerland.
- 9079 **Obexer, W., Schmid, C. and Brun, R., 1995.** A novel *in vitro* screening assay for trypanocidal activity using the fluorescent dye BCECF-AM. [*T. b. rhodesiense*, *T. evansi*, *T. equiperdum*, *T. congolense*.] *Tropical Medicine and Parasitology*, **46** (1): 45-48.
Obexer: Swiss Tropical Institute, P.O. Box, CH-4002 Basel, Switzerland.
- 9080 **Shapiro, T.A., 1994.** Drugs affecting trypanosome topoisomerases. [Incl. *T. b. gambiense*.] (Review.) *Advances in Pharmacology*, **29B**: 187-200.
Division of Clinical Pharmacology, Department of Medicine, Johns Hopkins University School of Medicine, Baltimore, MD 21205, USA.
- 9081 **Wang, C.C., 1995.** Molecular mechanisms and therapeutic approaches to the treatment of African trypanosomiasis. (Review.) *Annual Review of Pharmacology and Toxicology*, **35**: 93-127.
Department of Pharmaceutical Chemistry, University of California, San Francisco, CA 94143-0446, USA.
8. trypanosome research
(a) CULTIVATION OF TRYPANOSOMES
- 9082 **Hesse, F., Selzer, P.M., Mühlstädt, K. and Duszenko, M., 1995.** A novel cultivation technique for long-term maintenance of bloodstream form trypanosomes *in vitro*. [*T. brucei*.] *Molecular and Biochemical Parasitology*, **70** (1-2): 157-166.
Duszenko: Physiologisch-chemisches Institut der Universität, Tübingen, Hoppe-Seyler-Strasse 4, 72076 Tübingen, Germany.
- (b) TAXONOMY, CHARACTERISATION OF ISOLATES
[See also **18**: no. 9084.]
- 9083 **Baker, J.R., 1995.** The subspecific taxonomy of *Trypanosoma brucei*. (Review.) *Parasite*, **2** (1): 3-12.
Royal Society of Tropical Medicine and Hygiene, Manson House, 26 Portland Place, London W1N 4EY, UK.
- (c) LIFE CYCLE, MORPHOLOGY, BIOCHEMICAL AND MOLECULAR STUDIES
- 9084 **Alvarez, F., Robello, C. and Vignali, M., 1994.** Evolution of codon usage and base contents in kinetoplastid protozoans. [Incl. *T. brucei*.] *Molecular Biology and Evolution*, **11** (5): 790-802.

Alvarez: Sección Genética Evolutiva, Facultad de Ciencias, Tristán Narvaja 1674, CP 11200 Montevideo, Uruguay.

9085 **Berberof, M., Vanhamme, L. and Pays, E., 1995.** *Trypanosoma brucei*: a preferential splicing at the inverted polyadenylation site of the VSG mRNA provides further evidence for coupling between trans-splicing and polyadenylation. *Experimental Parasitology*, **80** (3): 563-567.

Pays: Department of Molecular Biology, Free University of Brussels, 67 rue des Chevaux, B-1640 Rhode St Genèse, Belgium.

9086 **Blattner, J., Dörsam, H. and Clayton, C.E., 1995.** Function of N-terminal import signals in trypanosome microbodies. [*T. brucei*.] *FEBS Letters*, **360** (3): 310-314.

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

9087 **Bodley, A.L. and Shapiro, T.A., 1995.** Molecular and cytotoxic effects of camptothecin, a topoisomerase I inhibitor, on trypanosomes and *Leishmania*. [Incl. *T. brucei*, *T. equiperdum*.] *Proceedings of the National Academy of Sciences of the United States of America*, **92** (9): 3726-3730.

Shapiro: Johns Hopkins University School of Medicine, 301 Hunterian Building, 725 North Wolfe Street, Baltimore, MD 21205-2185, USA.

9088 **Coulter, L.J. and Hide, G., 1995.** *Trypanosoma brucei*: characterisation of a life cycle stage-specific G-protein. *Experimental Parasitology*, **80** (2): 308-318.

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

9089 **Degen, R., Pospichal, H., Enyaru, J. and Jenni, L., 1995.** Sexual compatibility among *Trypanosoma brucei* isolates from an epidemic area of southeastern Uganda. *Parasitology Research*, **81** (3): 253-257.

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

9090 **Donelson, J.E., 1995.** Mechanisms of antigenic variation in *Borrelia hermsii* and African trypanosomes. (Review.) *Journal of Biological Chemistry*, **270** (14): 7783-7786.

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

9091 **Eid, J.E. and Sollner-Webb, B., 1995.** ST-1, a 39-kilodalton protein in *Trypanosoma brucei*, exhibits a dual affinity for the duplex form of the 29-base-pair subtelomeric repeat and its C-rich strand. *Molecular and Cellular Biology*, **15** (1): 389-397.

- Eid: Department of Biological Chemistry, Johns Hopkins University School of Medicine, 725 N. Wolfe Street, Baltimore, MD 21205, USA.
- 9092 **Gray, A., 1995.** *Trypanosoma brucei brucei*: uptake and metabolism of pyridoxine and pyridoxal. *Experimental Parasitology*, **80** (3): 390-400.
Department of Biochemistry, University of Dundee, Dundee DD1 4MN, UK.
- 9093 **Hannaert, V. and Michels, P.A.M., 1994.** Structure, function, and biogenesis of glycosomes in Kinetoplastida. [*T. brucei*.] (Review.) *Journal of Bioenergetics and Biomembranes*, **26** (2): 205-212.
Hannaert: Research Unit for Tropical Diseases, International Institute of Cellular and Molecular Pathology, avenue Hippocrate 74, B-1200 Brussels, Belgium.
- 9094 **Hehl, A., Pearson, T.W., Barry, J.D., Braun, R. and Roditi, I., 1995.** Expression of GARP, a major surface glycoprotein of *Trypanosoma congolense*, on the surface of *Trypanosoma brucei*: characterization and use as a selectable marker. *Molecular and Biochemical Parasitology*, **70** (1-2): 45-58.
Roditi: Institut für Allgemeine Mikrobiologie, Universität Bern, Baltzerstrasse 4, CH-3012 Bern, Switzerland.
- 9095 **Hemphill, A. and Ross, C.A., 1995.** Flagellum-mediated adhesion of *Trypanosoma congolense* to bovine aorta endothelial cells. *Parasitology Research*, **81** (5): 412-420.
Hemphill: Institute for Parasitology, University of Bern, Laenggass-strasse 122, CH-3012 Bern, Switzerland.
- 9096 **Hua, S.B., Li, X.Q., Coffino, P. and Wang, C.C., 1995.** Rat antizyme inhibits the activity but does not promote the degradation of mouse ornithine decarboxylase in *Trypanosoma brucei*. *Journal of Biological Chemistry*, **270** (17): 10264-10271.
Wang: Department of Pharmaceutical Chemistry, Box 0446, University of California, San Francisco, CA 94143, USA.
- 9097 **Hug, M., Hotz, H.-R., Hartmann, C. and Clayton, C., 1994.** Hierarchies of RNA-processing signals in a trypanosome surface antigen mRNA precursor. [*T. brucei*.] *Molecular and Cellular Biology*, **14** (11): 7428-7435.
Clayton: Zentrum für Molekulare Biologie Heidelberg, Im Neuenheimer Feld 282, D-69120 Heidelberg, Germany.
- 9098 **Hunt, M. and Köhler, P., 1995.** Purification and characterization of phosphoenolpyruvate carboxykinase

from *Trypanosoma brucei*. *Biochimica et Biophysica Acta*, **1249** (1): 15-22.

Köhler: Institute of Parasitology, University of Zürich, Winter-thurerstrasse 266a, 8057 Zürich, Switzerland.

9099 **Imboden, M., Müller, N., Hemphill, A., Mattioli, R. and Seebeck, T., 1995.** Repetitive proteins from the flagellar cytoskeleton of African trypanosomes are diagnostically useful antigens. [*T. b. brucei*.] *Parasitology*, **110** (3): 249-258.

Imboden: Institute of General Microbiology, University of Bern, Baltzerstrasse 4, 3012 Bern, Switzerland.

9100 **Kiaira, J.K. and Njogu, M.R., 1994.** Oligomycin-sensitivity of hexose-sugar catabolism in the bloodstream form of *Trypanosoma brucei brucei*. *Biotechnology and Applied Biochemistry*, **20** (3): 347-356.

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

9101 **Klein, K.G., Olson, C.L. and Engman, D.M., 1995.**

Mitochondrial heat shock protein 70 is distributed throughout the mitochondrion in a dyskinetoplastic mutant of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **70** (1-2): 207-209.

Engman: Department of Pathology, Northwestern University Medical School, 303 E. Chicago Avenue, Chicago, IL 60611, USA.

9102 **Loiseau, P.M., 1995.** Action of DNA-gyrase inhibiting derivatives of 4-oxo-1,4-dihydro-3-pyridine carboxylic acid against *Trypanosoma brucei*. *International Journal for Parasitology*, **25** (3): 403-405.

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

9103 **Lun, Z.-R. and Desser, S.S., 1995.** Is the broad range of hosts and geo-graphical distribution of *Trypanosoma evansi* attributable to the loss of maxicircle kinetoplast DNA? *Parasitology Today*, **11** (4): 131-133.

Lun: Department of Zoology, University of Toronto, Toronto, Ontario M5S 1A1, Canada.

9104 **Mutharia, L.M. and Steele, M., 1995.** Characterization of concanavalin A-binding glycoproteins from procyclic culture forms of *Trypanosoma congolense*, *T. simiae* and *T. brucei brucei*. *Parasitology Research*, **81** (3): 245-252.

Mutharia: Department of Microbiology, College of Biological Sciences, University of Guelph, Guelph, Ontario, N1G 2W1, Canada.

- 9105 **Nakaar, V., Dare, A.O., Hong, D., Ullu, E. and Tschudi, C., 1994.** Upstream tRNA genes are essential for expression of small nuclear and cytoplasmic RNA genes in trypanosomes. [*T. brucei.*] *Molecular and Cellular Biology*, **14** (10): 6736-6742.
Tschudi: Department of Internal Medicine, Yale University School of Medicine, P.O. Box 208022, 333 Cedar Street, New Haven, CT 06520, USA.
- 9106 **Nakaar, V., Tschudi, C. and Ullu, E., 1995.** An unusual liaison: small nuclear and cytoplasmic RNA genes team up with tRNA genes in trypanosomatid protozoa. (Review.) *Parasitology Today*, **11** (6): 225-228.
Tschudi: Department of Internal Medicine, Yale University School of Medicine, P.O. Box 208022, 333 Cedar Street, New Haven, CT 06520, USA.
- 9107 **Nandan, D., Daubenberger, C., Mpimbaza, G. and Pearson, T.W., 1994.** A rapid, single-step purification method for immunogenic members of the hsp 70 family: validation and application. [Incl. *T. b. brucei.*] *Journal of Immunological Methods*, **176** (2): 255-263.
Nandan: ILRI, P.O. Box 30709, Nairobi, Kenya.
- 9108 **Parsons, M., Carter, V., Muthiani, A. and Murphy, N., 1995.** *Trypanosoma congolense*: developmental regulation of protein kinases and tyrosine phosphorylation during the life cycle. *Experimental Parasitology*, **80** (3): 507-514.
Parsons: Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109, USA.
- 9109 **Piller, K.J., Decker, C.J., Rusché, L.N., Harris, M.E., Hajduk, S.L. and Sollner-Webb, B., 1995.** Editing domains of *Trypanosoma brucei* mitochondrial RNAs identified by secondary structure. *Molecular and Cellular Biology*, **15** (6): 2916-2924.
Sollner-Webb: Department of Biological Chemistry, Johns Hopkins University School of Medicine, 725 N. Wolfe Street, Baltimore, MD 21205, USA.
- 9110 **Piller, K.J., Decker, C.J., Rusché, L.N., and Sollner-Webb, B., 1995.** *Trypanosoma brucei* mitochondrial guide RNA-mRNA chimera-forming activity cofractionates with an editing-domain-specific endonuclease and RNA ligase and is mimicked by heterologous nuclease and RNA ligase. *Molecular and Cellular Biology*, **15** (6): 2925-2932.
Sollner-Webb: Department of Biological Chemistry, Johns Hopkins University School of

Medicine, 725 N. Wolfe Street, Baltimore, MD 21205, USA.

9111 **Read, L.K., Göringer, H.U. and Stuart, K., 1994.** Assembly of mitochondrial ribonucleoprotein complexes involves specific guide RNA (gRNA)-binding proteins and gRNA domains but does not require preedited mRNA. [*T. b. brucei*.] *Molecular and Cellular Biology*, **14** (4): 2629-2639.

Stuart: Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109-1651, USA.

9112 **Redman, C.A., Green, B.N., Thomas-Oates, J.E., Reinhold, V.N. and Ferguson, M.A.J., 1994.** Analysis of glycosylphosphatidylinositol membrane anchors by electrospray ionization-mass spectrometry and collision induced dissociation. [*T. brucei*.] *Glycoconjugate Journal*, **11** (3): 187-193.

Ferguson: Department of Biochemistry, University of Dundee, Dundee DD1 4HN, UK.

9113 **Rusché, L.N., Piller, K.J. and Sollner-Webb, B., 1995.** Guide RNA-mRNA chimeras, which are potential RNA editing intermediates, are formed by endonuclease and RNA ligase in a trypanosome mitochondrial extract. [*T. brucei*.] *Molecular and Cellular Biology*, **15** (6): 2933-2941.

Sollner-Webb: Department of Biological Chemistry, Johns Hopkins University School of Medicine, 725 N. Wolfe Street, Baltimore, MD 21205, USA.

9114 **Sabatini, R. and Hajduk, S.L., 1995.** RNA ligase and its involvement in guide RNA/mRNA chimera formation: evidence for a cleavage-ligation mechanism of *Trypanosoma brucei* mRNA editing. *Journal of Biological Chemistry*, **270** (13): 7233-7240.

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

9115 **Samson, I., Kerremans, L., Rozenski, J., Samyn, B., Beeumen, J. van, Aerschot, A. van and Herdewijn, P., 1995.** Identification of a peptide inhibitor against glycosomal phosphoglycerate kinase of *Trypanosoma brucei* by a synthetic peptide library approach. *Bioorganic and Medicinal Chemistry*, **3** (3): 257-265.

Herdewijn: Laboratory of Medicinal Chemistry (F.F.W.), Rega Institute for Medical Research, Katholieke Universiteit Leuven, Minderbroedersstraat 10, B-3000 Leuven, Belgium.

9116 **Shapiro, T.A., 1994.** Mitochondrial topoisomerase II activity is essential for kinetoplast DNA minicircle

segregation. [*T. equiperdum*.] *Molecular and Cellular Biology*, **14** (6): 3660-3667.

Department of Medicine, Johns Hopkins University School of Medicine, 301 Hunterian Building, 725 N. Wolfe Street, Baltimore, MD 21205-2185, USA.

9117 **Stebeck, C.E., Beecroft, R.P., Singh, B.N., Jardim, A., Olafson, R.W., Tuckey, C., Prenevost, K.D. and Pearson, T.W., 1995.** Kinetoplastid membrane protein-11 (KMP-11) is differentially expressed during the life cycle of African trypanosomes and is found in a wide variety of kinetoplastid parasites. [*T. brucei* spp., *T. congolense*, *T. simiae*.] *Molecular and Biochemical Parasitology*, **71** (1): 1-13.

Pearson: Department of Biochemistry and Microbiology, Petch Building, University of Victoria, P.O. Box 3055, Victoria, B.C. V8W 3P6, Canada.

9118 **Turner, C.M.R., Hide, G., Buchanan, N. and Tait, A., 1995.** *Trypanosoma brucei*: inheritance of kinetoplast DNA maxicircles in a genetic cross and their segregation during vegetative growth. *Experimental Parasitology*, **80** (2): 234-241.

Turner: Laboratory for Biochemical Parasitology, I.B.L.S., Joseph Black Building, University of Glasgow, Glasgow G12 8QQ, UK.

9119 **Urakawa, T., Eshita, Y., Fukuma, T., Hirumi, H., Hirumi, K. and Majiwa, P.A.O., 1995.** Expression of *Trypanosoma congolense* antigens in *Spodoptera frugiperda* insect cells. *Experimental Parasitology*, **80** (4): 633-644.

Urakawa: Chemo-Sero-Therapeutic Research Institute, Kikuchi Laboratories, Kyokushi Kikuchi, Kumamoto 861-15, Japan.

9120 **Ürményi, T.P. and Ploeg, L.H.T. van der, 1995.** PARP promoter-mediated activation of a VSG expression site promoter in insect form *Trypanosoma brucei*. *Nucleic Acids Research*, **23** (6): 1010-1018.

Ploeg: Department of Genetics and Molecular Biology, Merck Research Laboratories, P.O. Box 2000, Rahway, NJ 07065, USA.

9121 **Vanhamme, L. and Pays, E., 1995.** Control of gene expression in trypanosomes. [*T. brucei*.] (Review.) *Microbiological Reviews*, **59** (2): 223-240.

Pays: Department of Molecular Biology, Free University of Brussels, 67 rue des Chevaux, B-1640 Rhode Saint Genèse, Belgium.

9122 **Verlinde, C.L.M.J., Callens, M., Calenbergh, S. van, Aerschot, A. van, Herdewijn, P., Hannaert, V., Michels, P.A.M., Opperdoes, F.R. and Hol, W.G.J., 1994.** Selective inhibition of trypanosomal

glyceraldehyde-3-phosphate dehydrogenase by protein structure-based design: toward new drugs for the treatment of sleeping sickness. *Journal of Medicinal Chemistry*, **37** (21): 3605-3613.

Verlinde: Department of Biological Structure, SM-20, School of Medicine, University of Washington, Seattle, WA 98195, USA.