

TSETSE AND TRYPANOSOMIASIS INFORMATION QUARTERLY

Volume 16
Part 3, 1993
Numbers 7901–8037



DFID



section b - abstracts

1. general (including land use)

7901 **Allsopp, R., 1992.** A review of progress in research and development to support tsetse control field programmes, with recommendations for the future. *In*: FAO, 1992 (see **16**: no. 7908), pp. 69-79.

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

The objectives of tsetse and trypanosomiasis control, tsetse control techniques and research associated with tsetse control are reviewed to assess whether research has satisfactorily contributed to the control of trypanosomiasis. Control inevitably includes some environmental change which must be justified by increased productivity. Little justification is seen for much further research into control technology.

Tsetse research has included all four categories of agricultural research: basic, strategic, applied and adaptive. Adaptive research, which adjusts technology to specific environmental or socio-economic conditions, is perhaps the most important and the most neglected; it is illustrated by reference to developments in odour-bait technology. General recommendations for future research are that tsetse control must cease to be an end in itself, farming systems must be defined and understood, and research should be appropriate and must be translated into practical operational procedures. More specifically, geographical information systems (GIS) and remote sensing should be used to integrate data and monitor changes; mathematical modelling can translate GIS data into practical information. More research into epidemiology, tsetse distribution, disease transmission and trypanotolerance would be appropriate, with emphasis on integrated and multidisciplinary research.

7902 **Barrett, J.C., 1992.** The role of the economist in planning and appraisal of tsetse and trypanosomiasis control operations: lessons from Zimbabwe. *In*: FAO, 1992 (see **16**: no. 7908), pp. 89-103.

Tsetse and Trypanosomiasis Control Branch, Department of Veterinary Services, P.O. Box 8283, Causeway, Harare, Zimbabwe.

More attention should be given to the economic analysis of tsetse and trypanosomiasis control and its role in decision making. To this end, national veterinary economic units should be strengthened and/or regional units should be set up to support national agencies. The two main objectives are cost-benefit analysis and

comparative cost analysis. The role of the economist has been actively explored in Zimbabwe, where studies have shown that economic analysis can improve the distribution of resources in control operations. A 4-year project was begun in 1987. A cost-benefit analysis has taken into account both anticipated environmental degradation associated with accelerated livestock production and profits from the increased use of draught animals. Comparative cost studies have examined ground spraying with DDT and synthetic pyrethroids, aerial spraying of non-residual insecticides (most expensive), the use of odour-baited insecticide-impregnated screens, and the direct application of pyrethroids to livestock (cheapest). The Zimbabwe study has provided a methodology which is applicable to other parts of southern Africa. The strengthening of control programmes in the sphere of agricultural economics may contribute to more effective communication with other agencies involved in rural development.

7903 **Bouchet, B., 1992.** Quels paramètres choisir pour le bilan initial d'un foyer? [What parameters to choose for the initial assessment of a focus?] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 219-221.

Préfecture Sanitaire du Logone Occidental, B.P. 144, Moundou, Chad.

The assessment of a human African trypanosomiasis focus must define its priority in relation to other health problems in the region, determine its importance with a view to control, and measure the impact, effect and efficiency of a control programme. The parameters for such an assessment are listed as follows: prevalence of the disease, annual incidence, total population exposed to infection, prevalence rate, annual incidence rate, fly density, rate of fly infection, extent of the focus and number of affected villages. This list is not intended to be exhaustive although it includes those parameters necessary to describe the epidemiology of a focus in terms of time and space.

7904 **Cattand, P., 1992.** Factors influencing sustainability of national programmes for the prevention and control of trypanosomiasis. *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 123-128.

WHO, Via Appia, CH-1211 Geneva 27, Switzerland.

The main factors believed to be responsible for difficulties encountered by managers in structuring and maintaining control programmes are discussed. Five

interdependent baseline factors are identified: demand, political will, personnel, financial input and programme outcome. Demand is probably the most important factor and community health education is essential so that people living in areas at risk are made aware of the relationship between control activities and the disease itself. Without continued pressure from a demanding population, the implementation of prevention and control becomes impossible. Political will is expressed by the commitment of authorities to meet demand, by establishing a national control programme under the supervision of a responsible officer who will elaborate and propose an action plan, timetable and budget. Staff motivation is essential to maintain programme quality and there must be a suitable level of financial input for salaries, equipment, materials and drugs. Tangible results, in the form of detailed progress reports, are necessary to enable national health authorities to assess performance and evaluate cost-effectiveness. Programme success in the long term is auto-destructive since it will diminish demand, and independent mechanisms for continual surveillance must be developed.

7905 **Chizyuka, H.G.B., 1992.** Addressing training needs at technical level for tsetse and trypanosomiasis control field personnel. *In*: FAO, 1992 (see **16**: no. 7908), pp. 49-55.

Department of Veterinary and Tsetse Control Services, Mulungushi House, Lusaka, Zambia.

The organisation and staffing of the tsetse control services in Zambia are outlined. The shortage of trained and experienced staff to carry out vital control operations is recognised as a serious constraint, particularly since the introduction of traps and targets for tsetse control. Technical staff should be trained not only to improve their knowledge of control methods but to enable them to gain the confidence of the communities within which they work. A training centre was established at Lusaka with a fully equipped field centre at Lutale, which trained 17-23 middle level personnel annually between 1985 and 1989 by means of a six and a half month course. It is recommended that future courses should be held on a more local basis with emphasis on a more integrated approach to control, including other disciplines such as environmental protection, ecology and extension methods.

7906 **Connor, R.J., 1992.** Review of postgraduate training needs for professional tsetse and trypanosomiasis control staff and future proposals. *In*: FAO, 1992 (see **16**: no. 7908), pp. 39-47.

RTTCP, P.O. Box A560, Avondale, Harare, Zimbabwe.

Lack of funding has contributed to the current deficit of trained personnel for tsetse and trypanosomiasis control in many sub-Saharan countries. The RTTCP has recognised the need for training at postgraduate level, to include aspects of administration, planning, management, monitoring and reporting. The development of these skills, together with technical skills, is considered essential for the effective implementation of control measures. A proposal for part-time postgraduate training within the RTTCP is presented, to consist of a series of modules between which on-the-job training will be provided. There will be three core modules on general tsetse and trypanosome biology, planning, and data analysis and reporting, and students will then choose between three more modules on either tsetse or trypanosome biology, surveys and control. Students who satisfactorily complete the course will receive a diploma.

7907 **Cuisance, D., 1992.** Trypanosomoses: justification pour le contrôle ou l'éradication. [Trypanosomiasis: justification for control or eradication.] *In*: FAO, 1992 (see **16**: no. 7908), pp. 177-199.

CIRAD-EMVT, Centre ORSTOM, B.P. 5045, 34032 Montpellier Cedex, France.

The traditional management of Zebu cattle is mobile and unpredictable, involving migration between the sub-Saharan and humid savanna zones of West and Central Africa. The tsetse situation is varied and complex, and national and international funding is difficult to secure. Under these conditions the feasibility of control is greater than that of eradication.

Environmental issues and the current trend towards privatisation of animal health activities require control techniques to be simple and adaptable. Traps and screens and the use of cattle as live targets are appropriate in the humid zone and are adaptable to local needs. Their permanent use over large areas requires the active participation of livestock owners to compensate for lack of support from tsetse control services, which in turn must adapt control methods to meet local socio-economic conditions (production systems, funds available, owner cooperation) with the aim of reducing tsetse density. The alternative

approach would be to rely on the large-scale use of chemotherapy and chemoprophylaxis which can result in serious veterinary, technical and economic problems. In many countries the choice between control and eradication no longer exists.

7908 Food and Agriculture Organization of the United Nations, 1992.

Programme for the control of African animal trypanosomiasis and related development: ecological and technical aspects. (Proceedings of the FAO Panel of Experts, Harare, Zimbabwe, 24-26 June 1991.) Rome; FAO. (FAO Animal Production and Health Paper, no. 100.) 204 pp.

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

This document contains the full text of the papers which formed the basis for the deliberations of the meeting of the FAO Panel of Experts at Harare in 1991 (see **15**: no. 7355). A list of participants is appended. Abstracts of the papers are included separately in this issue of *TTIQ* (see **16**: nos. 7901, 7902, 7905, 7906, 7907, 7910, 7916, 7922, 7942, 7943, 7948, 7951, 7983).

7909 Food and Agriculture Organization of the United Nations, 1992.

The influence of trypanosomiasis on African animal production. (Comment.) *World Animal Review*, no. 70/71: [2 pp. inside cover].

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

Recently there has been a shift from the control of human sleeping sickness to the containment of tsetse-transmitted animal trypanosomiasis, which is classified as severe in most of the 37 sub-Saharan countries affected. Despite control attempts, the situation remains much the same or worse than it was in the early 1960s and is likely to deteriorate further due to changing priorities and lack of funding.

Trypanosomiasis control must be combined with appropriate farming and land use practices to achieve natural resource conservation. This depends on the mobilisation of international support, national commitment and farmer participation. The effects of tsetse and trypanosomiasis on the economic and social aspects of agricultural systems need to be quantified.

7910 Gyening, K.O., 1992. Assessment of training requirements. *In*: FAO, 1992 (see **16**: no. 7908), pp. 57-68.

FAO Regional Office for Africa, P.O. Box 1628, Accra, Ghana.

The approach to tsetse and trypanosomiasis control is changing with the development of new techniques, increased understanding of epidemiology and

environmental awareness: training courses must change accordingly. Middle level training was provided by ELAT, which ceased to operate in 1984. The FAO/UNDP project RAF/88/100 collaborates with ITC to provide national and subregional training courses. The SADCC Regional Training Centre in Lusaka provides for students from southern Africa, and Kenya, Tanzania, Zimbabwe, Ethiopia, Nigeria and Côte d'Ivoire have established training programmes to meet their own needs. Professional postgraduate courses are held in France/Burkina Faso and UK/Zambia/Zimbabwe and fellowships are offered by ILRAD, ICIPE, ODA, RTC Lusaka, ITC, UNDP/FAO and several universities outside Africa. The assessment of training needs should consider prospects for developing community participation, estimated attainable land reclamation rate and a modular estimate of trained staff requirements per unit area for a determined period. Incentives, such as career opportunities, adequate equipment and finance, must be provided.

7911 **Habbema, J.D.F. and the Centre for Decision Sciences in Tropical Disease Control, 1992.** Some features of microsimulation. *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 135-140.

Department of Public Health and Social Medicine, Erasmus University, P.O. Box 1738, 3000 DR Rotterdam, Netherlands.

The use of simulation models in medical decision making is discussed. They are useful for the evaluation of control strategies and provide a conceptual framework for relating apparently disparate facts. Simulation is a specific numerical, computer-based technique for quantifying the parameters of a model. Some features of microsimulation are discussed, including its application to disease epidemiology and control. It is concluded that simulation and more specifically stochastic microsimulation, which implies simulation of life histories of individuals, is a potentially powerful tool for describing the dynamics of infectious diseases and the impact of control. New data and expert opinion can be translated into additions or alterations of the model. The success of the ONCHOSIM model in analysing the potential of ivermectin for onchocerciasis control in West Africa suggests that the same methodology should be applied to other tropical infectious diseases, such as trypanosomiasis. (Two papers describing the ONCHOSIM model, one describing its applications, the other giving a formal description

and parameter quantification, are included in the seminar report, pp. 141-150 and 207-217 respectively.)

7912 **Habbema, J.D.F. and Muynck, A. de (eds), 1992.** *Rapport final du séminaire de modélisation appliquée pour l'optimisation des prises de décisions et du suivi des programmes de contrôle de la maladie du sommeil* (Daloa, Côte d'Ivoire, 28-30 octobre 1991). [Final report of the seminar on applied modelling for optimising decision making and programme monitoring in the control of sleeping sickness (Daloa, Côte d'Ivoire, 28-30 October 1991).] Rotterdam, Netherlands; Erasmus University. 222 pp. Department of Public Health and Social Medicine, Erasmus University, B.P. 1738, 3000 DR Rotterdam, Netherlands.

This seminar was sponsored by the Commission of the European Communities and organised by the Prince Leopold Institute of Tropical Medicine (Belgium), Erasmus University (Netherlands) and PRCT and OCCGE (Côte d'Ivoire). The objectives were to review current knowledge of the biology, transmission and control of *Trypanosoma brucei gambiense* sleeping sickness; to examine previous work on sleeping sickness modelling; and to explore the possibilities of a new simulation model, TRYPANOSIM. Each section of this report is preceded by a short introduction, and the abstracts of the papers are included in this issue of *TTIQ* (see nos. 7903, 7904, 7911, 7915, 7918-7921, 7923-7927, 7953, 7955, 7956, 7958, 7960-7964, 7966, 7967).

7913 **Habtemariam, T., 1987.** Epidemiologic modeling to select the best method for the control of African trypanosomiasis. *Tropical Veterinarian*, **5** (1-4): 1-6. Biomedical Information Management System, School of Veterinary Medicine, Tuskegee University, Tuskegee, AL 36088, USA.

The epidemiology of cattle trypanosomiasis was analysed using quantitative methods, including multivariate techniques, systems analysis and linear programming with emphasis on optimisation methodology to quantify the determinants of African trypanosomiasis in order to recommend the best method for the control of this disease in Ethiopia. The recommendations are: the combined use of insecticidal spraying, resettlement, vegetation clearing and the use of therapy in infected cattle.

7914 **Habtemariam, T., 1987.** Computer modeling of African trypano-somiasis. *Tropical Veterinarian*, **5** (1-4): 7-12.

Biomedical Information Management System, School of Veterinary Medicine, Tuskegee University, Tuskegee, AL 36088, USA.

The application of systems analysis and simulation modelling to describe and enhance the understanding of the quantitative epidemiology of trypanosomiasis is presented. The model was computerised using a Continuous Systems Modelling Programme (CSMP) with integration time intervals of one day. The performance of the model was then tested and, when found satisfactory, simulation experiments were conducted to evaluate the best approach to the control of trypanosomiasis in Ethiopia. These showed that the most effective means of controlling trypanosomiasis was via the combined use of insecticide sprays, vegetation clearing, game reduction and chemotherapy.

Insecticides were used for one year after a steady state prevalence of 27.3% was established. The use of insecticides decreased the prevalence to 19.6% at the end of one year. During the subsequent 5 years, vegetation clearing, game reduction and therapy were utilised in combination. This decreased the prevalence to 2.8%. During the last few years of the simulation, all vector control activities were stopped and only chemotherapy of infected cattle was allowed to continue. Using the above sequences, at the end of the 19th year the prevalence decreased to 0%, indicating eradication of trypanosomiasis in the study area. Using such simulation models, judicious decisions can be made in evaluating disease control alternatives and strategies.

7915 **Hervouët, J.P., 1992.** Facteurs humains de la THA: implications pour le contrôle et la pérennité des résultats. [Human factors of human African trypanosomiasis: implications for control and the duration of the results.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 33-34.

Muraz/OCCGE, B.P. 171, Bobo-Dioulasso, Burkina Faso. The results of control are most effective and lasting when treatment is not just limited to the epicentre of the focus where the disease is apparent but is extended to include populations of reservoir hosts. Early intervention is also essential and actual and potential foci must be identified rapidly. Remote sensing can identify environmental areas at risk by showing the relative distribution of ecotones and other changes due to human activity. Prevention of the disease depends

on the ability to determine the combination of different ecological elements which favour human/vector contact. The reactivation of historic foci demonstrates clearly that control has been directed at the consequences and not at the real causes of epidemics. Effective control requires intervention in environmental management and so may pose ethical problems. The potential for outbreaks of sleeping sickness should be considered in development plans. The disease cannot be controlled using a thematic approach; a much more integrated approach is necessary. 7916 **Jordan, A.M., 1992.** Environmental and ecological considerations relating to tsetse control. *In*: FAO, 1992 (see **16**: no. 7908), pp. 81-87.

Ekpoma, Ladymead Lane, Langford, Bristol BS18 7ED, UK. Tsetse control can have both direct and indirect environmental and ecological consequences. Environmental monitoring has shown that although non-target organisms can be affected by anti-tsetse spraying, this appears to be transitory and with the advent of traps and targets the direct effects of control have receded as a controversial issue. Indirect effects, which relate to the consequences of controlling tsetse and trypanosomiasis, are not yet fully understood. A rapidly increasing human population is also removing tsetse habitats and hosts with the consequent disappearance of tsetse over large areas. In principle, effective tsetse control provides an opportunity for land development but plans are often not implemented and the land is exploited in a non-sustainable way. Control strategies therefore need to be developed and assessed in terms of whether they are likely to exacerbate or reduce risks of environmental degradation. The degree of ecological damage that can occur varies according to existing or potential livestock management practices, such as national parks and reserves, nomadic pastoralism, traditional agropastoralism, arable farming and intensive livestock production systems, and these in turn are related to climatic, edaphic, social and other factors. Particularly rigorous precautions are necessary when previously unoccupied land is opened up to domestic livestock by effective tsetse control.

7917 **Jordan, A.M., 1992.** Degradation of the environment: an inevitable consequence of trypanosomiasis control? *World Animal Review*, no. 70/71: 2-7.

Ekpoma, Ladymead Lane, Langford, Bristol BS18 7ED, UK.

Africa is facing two closely linked crises, human population growth and environmental degradation, which have major implications for the development of appropriate strategies for trypanosomiasis control. Growth of livestock populations resulting from a reduced incidence of trypanosomiasis must not exceed the carrying capacity of the land. African cattle are primarily kept for social reasons, with quantity more important than quality. The potential environmental risks of animal trypanosomiasis control are examined in different land use systems: wilderness without domestic livestock, national parks and reserves, pastoralism, traditional agropastoralism, arable farming and intensive livestock production systems. The environmental impact of control measures can vary from highly damaging to highly advantageous, according to livestock management practices which, in turn, are related to climatic, edaphic, social and other factors. Rigorous precautions are necessary when previously unoccupied land is opened up to domestic livestock; in theory, trypanosomiasis control should be deferred until sustainable land use can be ensured. By contrast, trypano-somiasis control in well-established farming systems is generally beneficial. Environmental degradation will continue as a result of population pressure and should not necessarily be attributed to trypanosomiasis control.

7918 **Josenando, T., 1992.** La trypanosomiase en Angola: stratégie d'action face à la dynamique épidémiologique. [Trypanosomiasis in Angola: action strategy in the face of epidemiological dynamics.] *In*: Habbema, J.D.F. and Muyenck, A. de (eds), 1992 (see **16**: no. 7912), pp. 109-113.

Programa Nacional de Controlo da THA, C.P. 2657-C, Luanda, Angola.

The war of independence and the civil war have aggravated the trypanosomiasis situation in north-west Angola. Almost half of the country is infested with tsetse flies and 2 million people are at risk. The index of infection in 1950 was 5.92%; this fell to 0.01% in 1974 but had increased to 5.22% in 1990. The history of sleeping sickness in Angola is briefly reviewed. Well-equipped, mobile surveillance units, based in provincial capitals and provided with trained personnel, are able to use modern techniques for serological and parasitological diagnosis. Treatment is carried out in health centres. Permanent surveillance is provided at fixed centres with mobile surveys every 6 months in foci and annually in the rest of the endemic area. The control strategy is aimed at early treatment, control of human migration in endemic zones and vector control in endemic foci.

7919 **Kegels, G., 1992.** Comment chiffrer l'histoire naturelle de la THA sur la base de l'expérience Kasongo: le problème de la reproductibilité. [How to assess the natural history of human African trypanosomiasis on the basis of the Kasongo experience: the problem of reproducibility.] *In*: Habbema, J.D.F. and Muyenck, A. de (eds), 1992 (see **16**: no. 7912), pp. 55-59.

Prince Leopold Institute of Tropical Medicine, Nationalestraat 115, B-2000 Antwerp, Belgium.

The natural history of sleeping sickness is considered as a dynamic epidemiological model, within which the risks of transition from one stage to another need to be quantified. A study carried out at Kasongo in Zaire, where 2500 people were surveyed four times in a period of 18 months, has provided data which can be used to calculate these risks. A simplified epidemiological model is proposed. For defining individual stages within the model, the reproducibility of tests is important. An example is developed using serological results from Kasongo to define the stages 'non-infected' and 'infected'.

7920 **Lancien, J., 1992.** Coût et rendement des différentes stratégies de lutte (isolées ou combinées). [Cost and benefit of different control strategies (individual or combined).] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 83-86.

P.O. Box 5244, Kampala, Uganda.

The importance of cost analysis in determining control strategies for sleeping sickness is stressed.

Resources and efficiency vary greatly among the 36 African countries affected and the situation is worst in those countries in a state of crisis, such as Angola, Zaire, Uganda and Sudan, where funding is extremely low. The costs and benefits of control in south-east Uganda are described. Trapping of *Glossina fuscipes* by local people over an area of 3000 km² has reduced the incidence of new cases of the disease by over 95%. Surveillance is currently carried out by 20 diagnostic centres, supplemented by visiting the sick at home. The control strategies of trapping and surveillance could be successfully combined by encouraging local people to undertake responsibility for both. The conditions necessary for the success of a community-based surveillance programme are the same as for vector control: the mobilisation and instruction of local people through a village-based organisation and the establishment of a supervisory and administrative structure at 'subcounty' level. It remains to be seen if this choice is politically acceptable in all the countries affected.

7921 **Laveissière, C. and Meda, A.H., 1992.** Lutte antivectorielle: faisabilité dans le contexte d'un programme de contrôle, coût et rendement, pérennité. [Anti-vector control: feasibility in the context of a control programme, cost and benefit, long-term effect.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 79-82.

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

The control of vectors of human African trypanosomiasis is now technically feasible. Trapping, which can often be carried out by local people, is significantly cheaper in relation to other techniques without loss in efficacy. Unfortunately, despite the current upsurge of the disease, no control project has yet been successful for several reasons: lack of political willpower and lack of funding, which are strongly correlated; and lack of qualified personnel. The control of sleeping sickness demands that the disease should be taken more seriously, that it should become

better understood and that the rural population should be more effectively screened. Ideally a multidisciplinary team of specialists, which would be able to intervene effectively and in the shortest possible time, should be available in addition to existing health care services.

7922 **Lovemore, D.F., 1992.** A regional approach to trypanosomiasis control: activities and progress of the RTTCP. *In*: FAO, 1992 (see **16**: no. 7908), pp. 147-176.

RTTCP, P.O. Box A560, Avondale, Harare, Zimbabwe.

The RTTCP has as its overall objective the eventual eradication of tsetse from the common fly belt of Malawi, Mozambique, Zambia and Zimbabwe. The scale and cost of the control operations are unique but the implications for environmental degradation have invited criticism. The preparatory phase of the RTTCP was implemented in 1986, to be followed by the eradication phase. The background, financing and organisation of the RTTCP are described, and the implementation and progress of the preparatory phase are presented.

Aspects covered include regional coordination, aerial spraying development, environmental impact studies, regional training, large-scale field trials using odour-baited insecticide-treated targets, programme evaluation, tsetse and trypanosomiasis surveys in all member countries, and control trials in Malawi (targets and deltamethrin-treated cattle), Zambia (aerial spraying and targets) and Zimbabwe (aerial spraying, targets and deltamethrin-treated cattle). The technical, administrative and economic aspects of the RTTCP have been positively evaluated; it was recommended that the preparatory phase be extended by 3 years for the development of a comprehensive strategy for the eradication phase, and that environmental and economic issues should be investigated. Detailed proposals are given for the 3-year extension period.

7923 **Makubalo, E.L., 1992.** The role of socio-economic aspects in sleeping sickness control. *In*: Habbema, J.D.F. and Mynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 97-100.

TDRC, Ndola, Zambia.

Efforts to control sleeping sickness are affected by a number of social, economic, behavioural, cultural and demographic factors, collectively referred to as socio-economic factors. These factors are listed and can be used to identify high-risk behaviour associated with the acquisition of sleeping sickness, to develop mechanisms for reducing or preventing human/vector

contact, and to identify and treat infected individuals. The role of some socio-economic factors is examined with respect to specific control strategies. Surveillance programmes are affected by time and financial considerations and community participation issues such as time affordability and sex role differentiation. Treatment is affected by time and financial affordability and the presence of competing social commitments. The reduction of human/vector contact is affected by population mobility patterns and community participation.

7924 **Mbulamberi, D.B., 1992.** The role of migration in the control of *gambiense* sleeping sickness in north western Uganda. *In: Habbema, J.D.F. and Muyenck, A. de (eds), 1992 (see 16: no. 7912), pp. 35-37.*

Uganda National Sleeping Sickness Control Programme, P.O. Box 1241, Jinja, Uganda.

Epidemics of *Trypanosoma brucei gambiense* sleeping sickness have been recurring in north-west Uganda since the beginning of the century. Partial control has been achieved by mass surveys and treatment and strategic vector control, but the effects have been short-lived. The failure of long-term control is attributed to the population movements which have characterised this part of the country. There is considerable evidence to suggest that factors such as population movement, trypanosome strain and communal susceptibility to infection play an important part in the spread, severity and epidemic potential of sleeping sickness. The past and present disease situation in north-west Uganda is briefly examined in relation to population movements which have taken place in the region since the end of the 19th century as a result of repeated episodes of political and socio-economic turmoil.

7925 **Muyenck, A. de, Beghin, I., Carpels, G., Mentens, H., Wilson, I., Coosemans, M., Elsen, P., Geerts, S., Kageruka, P., Leray, D., Stuyft, P. van der and Wéry, M., 1992.** Le rôle du modèle causal dans l'étude de l'épidémiologie et du contrôle de la maladie du sommeil. [The role of the causal model in the study of the epidemiology and control of sleeping sickness.] (Appendix 1.) *In: Habbema, J.D.F. and Muyenck, A. de (eds), 1992 (see 16: no. 7912), pp. 153-206.*

Wilson: Statistical Services Centre, University of Reading, Whiteknights, Reading RG6 2AH, UK; other authors: Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

The role of the causal model in the study of trypanosomiasis is reviewed, with reference to causal

analysis, rules of construction and advantages and disadvantages. Such a model may be used to improve understanding of the causes of sleeping sickness, to identify gaps in knowledge, to promote a multidisciplinary approach, to select relevant and adequate fields of study, to create empirical research tools for analysis and validation, to form a basis for the construction of a statistical model and to revise and evaluate a control programme. It provides a broad understanding of the complex mechanisms of the transmission, detection and control of sleeping sickness for specialists and non-specialists alike. The causal model of sleeping sickness is presented in diagrammatic form with submodels for actual incidence and duration of the disease, passive detection by health services, active detection and opportuneness of detection. The significance and interrelationships of each part of the model and submodels are discussed.

7926 **Muynck, A. de and Habbema, J.D.F., 1992.** Towards the development of 'TRYPANOSIM'. An epidemiological microsimulation model of transmission and control of *T. b. gambiense* human African trypanosomiasis. *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 151-152.

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TRYPANOSIM is a microsimulation model based on a dynamic model of *Trypanosoma brucei gambiense* sleeping sickness with the determination of adequate parameters for its effective use and identification of the main gaps in knowledge. Model predictions have been validated by observations in endemic areas and the value of control strategies recommended by the model have been tested. TRYPANOSIM will serve as a platform for the standardisation of concepts and techniques and will integrate current knowledge in different fields of trypanosomiasis research and control. It will indicate priority research fields, provide a monitoring and evaluation tool, help integrate control strategies into primary health care and contribute indirectly to the general development of endemic regions.

7927 **Muynck, A. de and the Working Group for the Modelling of Human African Trypanosomiasis at the Institute of Tropical Medicine, Antwerp, 1992.** Le modèle causal de la THA. [The causal model

of human African trypanosomiasis.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 131-134.

Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000, Antwerp, Belgium. The increase in incidence of human African trypanosomiasis and the simultaneous reduction of control activities in affected countries have called for a rationalisation of sleeping sickness control, in which modelling has an important role. As a preliminary stage in the development of a mathematical model, a causal model is proposed which is defined as a number of causal hypotheses linked in a hierarchical way to the prevalence of trypanosomiasis. The procedure and rules for constructing such a model are described and include multidisciplinary input and the introduction of factors playing a potential causal role. The model is flexible and presents a general view of the problem of endemicity. It can be used as a research tool for the analysis of data and for the construction of simulation models. It is not seen as an end in itself but as a step towards the conceptualisation and evaluation of control programmes and the elaboration of mathematical models; it forms the basis for TRYPANOSIM, a simulation model of human African trypanosomiasis.

7928 **Nigerian Institute for Trypanosomiasis Research, [1989].** *Annual scientific report 1987/1988.* Kaduna, Nigeria; NITR. 80 pp. NITR, P.M.B. 2077, Kaduna, Nigeria.

Research projects included studies on the ecology of *Glossina* spp. in derived savanna zones at Egbe, Kwara State and Ekosodin near Benin City. The apparent disappearance of the *G. morsitans* group at Egbe is attributed to increased human activity. *G. palpalis palpalis* predominated in both areas: none of the flies examined was infected. Trapping and screening of livestock was continued to assess the effectiveness of the BICOT project at Lafia, where sterile male *G. p. palpalis* had been released: there was a marked reduction in the population but trypanosomiasis transmission was being maintained by other tsetse species. Laboratory studies concentrated on rearing. Laboratory-reared *G. p. palpalis* were used to test the effect of the insecticide Cislin (deltamethrin): this was found to be highly toxic at low concentrations and about 40 times as toxic to tsetse as DDT. No association was found between the virulence of a trypanosome strain and its ability to infect tsetse. An outbreak of bovine trypanosomiasis

(probably due to *Trypanosoma vivax*) near Jos in 1987 was studied and brought under control by chemotherapy (3.5 mg/kg Berenil) and prophylaxis (Samorin) within 4 months. West African Dwarf sheep were found to be less susceptible to *T. vivax* infection than Yankassa and Balami sheep. Feeding tsetse on guinea pigs treated with 0.25-1.0 mg/kg Samorin eliminated *T. vivax* from infected flies; at 0.125 mg/kg the trypanosomes acquired some resistance. Other laboratory studies included the sensitivity of different stocks of trypanosomes to Berenil, clinical and biochemical changes in experimental *T. brucei* infections in dogs and the IgM profile of female goats infected with *T. vivax*.

7929 **Nigerian Institute for Trypanosomiasis Research, [1990].** *Annual scientific report 1989.* Kaduna, Nigeria; NITR. 74 pp. NITR, P.M.B. 2077, Kaduna, Nigeria.

The maintenance and performance of laboratory colonies of *Glossina palpalis palpalis* and *G. tachinoides* are described. The possible effect of fluorescent dye (neon red) used to mark laboratory-reared *G. p. palpalis* for SIT release was investigated: no effects on the fecundity or emergence rate were recorded. The economic effects of animal trypanosomiasis in Nigeria and attempts being made to control it are discussed: strategies include tsetse trapping, chemoprophylaxis and use of trypanotolerant breeds. Research needs and priorities are identified. A *G. tachinoides*-transmitted outbreak of animal trypanosomiasis was investigated on the Jos Plateau: 38.6% of Zebu cattle and 20.6% of Yankassa sheep were infected, mostly by *Trypanosoma vivax*. Control was achieved by chemotherapy (3.5 mg/kg Berenil) and prophylaxis (Samorin). Laboratory studies included the investigation of anaemia due to *T. brucei* and *T. congolense* infections in goats, the erythrocytic response to anaemia in experimental *T. brucei* infection in dogs, and the bone marrow response of Yankassa rams infected with *Trypanosoma* spp. The effect of the glucose uptake-inhibiting antifungal drug Nystatin on *T. b. brucei* infection in rats was investigated: Nystatin was found to have some trypanocidal activity but did not potentiate or antagonise the trypanocidal action of pentamidine when used in combination with this drug. The results of screening 134,308 people for sleeping sickness in six Nigerian states during January-December 1989 are tabulated: active cases (21 out of 14,649 people) were only observed in Benue State.

7930 **Nigerian Institute for Trypanosomiasis Research, [1991].** *Annual scientific report 1990.* Kaduna, Nigeria; NITR. 73 pp.

NITR, P.M.B. 2077, Kaduna, Nigeria.

Cattle, sheep, goats and pigs have been screened to determine the incidence rates of *Trypanosoma brucei*, *T. congolense* and *T. vivax* and to assess their role as potential reservoir hosts of human trypanosomiasis: *T. vivax* accounted for about 50% of detected cases. Five *T. brucei* isolates from Kano, Rano and Tudun Wada are within a known sleeping sickness focus. A tsetse survey in the Zango Kataf area yielded only two male *Glossina tachinoides*, both uninfected; other biting flies and ticks are thought to be responsible for livestock diseases in the region. Another survey in the Karim Lamido and Numan areas of Gongola State showed that although 34.26% of 79 *G. tachinoides* were positive for trypanosomes, Zebu cattle had a low prevalence of trypanosomiasis. This may be explained by a long period of chronic infection leading to adaptive tolerance, low tsetse challenge and/or previous treatment of cattle with trypanocidal drugs. Research is in progress on the effect of prolonged administration of Samorin on pregnancy in ewes and its concentration in their milk. The effect of single trypanosome infections on the serum protein level in rams was related to trypanosome species. With *T. b. brucei* and *T. vivax* it remained high until treatment with Berenil but with *T. congolense* it fell 2 weeks p.i. and before treatment. Continuing progress on laboratory rearing of tsetse flies is reported. Reduced fecundity was traced to the presence of antibiotic (32% oxytetracyclin) and coccidiostat (62% salinomycin) in the rabbit host feed.

7931 **Overseas Development Administration and University of Bristol, 1993.** *Tsetse Research Laboratory annual report 1992*. Bristol; ODA and University of Bristol. 52 pp.

TRL, Langford House, Langford, Bristol BS18 7DU, UK. This is the last annual report from TRL. Core funding by ODA ceased on 31 March 1993; some activities are continuing in the Department of Veterinary Medicine, University of Bristol, and others will become research projects funded by ODA through other institutions. (See news item on p. 116.) Colonies of *Glossina morsitans morsitans*, *G. palpalis palpalis* and *G. pallidipes* were maintained, together with small stocks of *G. austeni* and *G. m. centralis*. Studies on tsetse behaviour included the effect of background colour on responses of different species to coloured targets, the effects of target orientation on attraction, bioassay development for ox odour components, field responses to ox sebum odours, the

effect of trypanosome infection in cattle on the attraction and feeding success of tsetse, the effect of feeding preferences on the epidemiology of trypanosomiasis, and the nutritional state of feeding tsetse. Tsetse control studies involved field trials of pyriproxyfen and oil-formulated pyrethroids, the control (and role as vector) of *G. longipennis* at Galana Ranch, Kenya, and the potential of ecdysteroids, a compound which blocks digestion of blood in mosquitoes and a proline inhibitor for tsetse control. The tsetse-trypanosome interface was examined with respect to lectin activity in *palpalis* and *morsitans* group flies and the elimination of symbionts (Rickettsia-like organisms) from tsetse. The characterisation of trypanosomes by KIVI (kit for *in vitro* isolation), isoenzyme analysis and DNA probes in Côte d'Ivoire, Congo, Uganda and The Gambia is described.

2. tsetse biology

(a) REARING OF TSETSE FLIES

7932 **Moloo, S.K., 1992.** A comparison of colony performance of *Glossina pallidipes* originating from two allopatric populations in Kenya. *Medical and Veterinary Entomology*, **6** (4): 399-400.

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

The successful large-scale rearing of two geographically isolated populations of *G. pallidipes* is described, one from Shimba Hills close to Mwalewu Forest, Coast Province, and the other from Nguruman, Rift Valley Province, Kenya. The survival and reproductive performance of the two colonies were compared. Survival of both colonies was excellent in that more than 60% survived for 72 days. The fecundity (expressed as puparia per reproductive cycle) of both colonies was good but that of the Shimba Hills population was significantly ($P < 0.001$) better. The mean puparial weights of the Shimba Hills and Nguruman colonies were 41.8 ± 0.1 mg and 41.4 ± 0.1 mg; the mean emergence rates were $91.2 \pm 0.4\%$ and $91.8 \pm 0.3\%$; and the mean female mortalities were $0.87 \pm 0.05\%$ and $0.91 \pm 0.05\%$ per day, respectively. Both colonies have produced adequate surplus for research on their vector competence.

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

[See also **16**: no. 7939.]

7933 Goes van Naters, W.M. van der and Otter, C.J. den, 1992.

Sensitivity of smell: a diel rhythm. (Meeting abstract no. 158.) *Chemical Senses*, **17** (6): 888.

Department of Animal Physiology, University of Groningen, P.O. Box 14, 9750 AA Haren, Netherlands.

Feeding activity of *Glossina morsitans morsitans* peaks during the early morning and again in the late afternoon, with a minimum near midday. The spike activity of two types of antennal olfactory receptor cells on stimulation with 1-octen-3-ol and 3-methylphenol was recorded at different times of day and the results pooled into three periods: 07.00-10.00, 11.00-15.00 and 16.00-19.00 h. Sensitivity of the receptors was found to be higher during the first and third periods than during the second period, paralleling the daily changes in levels of feeding behaviour.

7934 Gooding, R.H., Mbise, S., Macha, P. and Rolseth, B.M., 1993.

Genetic variation in a Tanzanian population of *Glossina swynnertoni* (Diptera: Glossinidae). *Journal of Medical Entomology*, **30** (2): 489-492.

Gooding, Rolseth: Department of Entomology, University of Alberta, Edmonton, Alberta T6G 2E3, Canada; Mbise, Macha: Tropical Pesticides Research Institute, P.O. Box 3024, Arusha, Tanzania.

Adult *G. swynnertoni* that emerged from puparia collected during 1989 and 1991 near Makuyuni, Tanzania, were examined by polyacrylamide gel electrophoresis. Fourteen of 17 enzymes were monomorphic. Midgut alkaline phosphatase (ALKPH), phosphoglucosmutase (PGM), and glucose-6-phosphate isomerase (PGI) from the head and thorax were polymorphic. Banding patterns indicated that the locus for PGM was on the X chromosome and loci for ALKPH and PGI were autosomal. For the 17 loci studied, the mean heterozygosity per locus was $6.1 \pm 3.7\%$ in the 1989 sample and $5.7 \pm 3.7\%$ in the 1991 sample. The effective number of alleles per locus was 1.11 and 1.10 in these samples. This level of genetic variation was low compared with other populations of tsetse flies and indicated that the sample may have been drawn from a small inbred population or one that recently had gone through a genetic bottleneck.

7935 Otter, C.J. den and Goes van Naters, W.M. van der, 1993.

Responses of individual antennal olfactory cells of tsetse flies (*Glossina m. morsitans*) to phenols from cattle urine. *Physiological Entomology*, **18** (1): 43-49.

Department of Animal Physiology, University of Groningen, P.O. Box 14, 9750 AA Haren, Netherlands.

Action potentials from olfactory cells in antennae (funiculi) of living tsetse flies, *G. morsitans morsitans*, were recorded using a surface-contact technique. Stimuli were the vapours of the seven alkylphenols identified in cattle urine: phenol, 3-methyl-, 3-ethyl-, 3-*n*-propyl-, 4-methyl-, 4-ethyl-, and 4-*n*-propylphenol. In addition, responses to the vapours of 1-octen-3-ol, acetone and dichloromethane were recorded. The phenol-sensitive cells could be grouped into four subclasses. Subclass 1, 2 and 3 cells responded to the phenols only, cells of subclass 1 and 2 being activated by these substances, those of subclass 3 inhibited. Cells of subclass 4 were activated to a similar degree by all phenols and by one or more of the other chemicals tested. Subclass 1 cells were strongly activated by the 3-alkylphenols, whereas subclass 2 cells were most sensitive to 4-methylphenol. Subclass 3 cells were most strongly inhibited by phenol, and 3- and 4-methylphenol. The results suggest that, although individual phenols may be attractive to *G. m. morsitans*, preference for certain blends of phenols may exist; for example, blends composed of moderate doses of 4-methylphenol and 3-methyl-, 3-ethyl- or 3-*n*-propylphenol.

7936 **Zdárek, J. and Denlinger, D.L., 1992.** Neural regulation of pupariation in tsetse larvae. *Journal of Experimental Biology*, **173**: 11-24.

ICIPE, P.O. Box 30772, Nairobi, Kenya; Zdárek: also Insect Chemical Ecology Unit, Institute of Organic Chemistry and Biochemistry, Czechoslovak Academy of Sciences, U Salamounky 41, 15800 Prague 5, Czech Republic; Denlinger: also Department of Entomology, Ohio State University, 1735 Neil Avenue, Columbus, OH 43210, USA. (Reprint requests to Denlinger.)

A neural mechanism coordinates pupariation behaviour and tanning in the tsetse larva, *Glossina morsitans*. At parturition, the mature larva has already received sufficient ecdysteroid to commit the epidermal cells to metamorphosis but, before sclerotisation and tanning of the cuticle can begin, the larva must first select a pupariation site and then proceed through a stereotypic sequence of pupariation behaviour that culminates in the formation of a smooth, ovoid puparium. Both pupariation behaviour and tanning are inhibited by the CNS during the wandering phase. This central inhibition is maintained by sensory input originating in the extreme posterior region of the body. At the transition from wandering to pupariation, the posterior

signal that induces inhibition of pupariation behaviour is removed and the larva begins the contractions associated with pupariation, but the CNS inhibition of tanning persists. At this point, separation of the body into two halves by ligation or nerve transection prevents tanning of the anterior half (containing the CNS), whereas the denervated integument of the posterior half tans completely. Transection of nerves to the midline of the body produces larvae with a tanning pattern that ends abruptly along a sagittal plane, implying that the central control of this process is uncoupled between the left and right regions of the CNS. A few minutes later, when the final shape of the puparium is completed, the CNS inhibition is lifted and the tanning process begins. At this time, separation of the body into two halves by ligation or nerve transection has no inhibitory effects on either part. Exogenous ecdysteroids fail to release the CNS inhibition, and haemolymph containing the pupariation factors from *Sarcophaga bullata* have no accelerating effects on tsetse pupariation. These results imply that regulation of meta-morphosis in the insect integument is not the exclusive domain of blood-borne hormones.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **16**: no. 7933.]

7937 **Elsen, P., Amoudi, M.A. and Leclercq, M., 1991.** A propos de la découverte, en Arabie Saoudite, de deux espèces de mouches tsé-tsé vectrices de trypanosomiasés humaines et animales. [On the discovery of two species of tsetse fly, vectors of human and animal trypanosomiasés, in Saudi Arabia.] *Revue médicale de Liège*, **46** (4): 225-231.

Prince Leopold Institute of Tropical Medicine, Nationalestraat 115, B-2000 Antwerp, Belgium. Following the discovery of *Glossina fuscipes fuscipes* and *G. morsitans submorsitans* in south-western Saudi Arabia near the border with Yemen (see *TTIQ*, **14** (2): no. 6698), the vectorial capacity, life cycle and geographical distribution of tsetse flies are briefly reviewed. Various hypotheses concerning the presence of these species of *Glossina* in Saudi Arabia are discussed, and it is concluded that the south-westernmost part of the Arabian peninsula constitutes a relict habitat from times when the range of Glossinidae was greater.

7938 **Gouteux, J.-P., 1991.** La raréfaction de tsé-tsé du groupe *fusca* en Afrique Centrale (Diptera, Glossinidae). [The decline of tsetse flies of the *fusca* group in Central Africa.] *Bulletin de la Société entomologique de France*, **96** (5): 443-449.

ORSTOM, Centre de Bangui, B.P. 893, Bangui, Central African Republic.

Although numerically the most important tsetse with 13 species, *fusca* group flies have little medical or veterinary importance and their study has been neglected. Data on distribution and abundance are given for five species and subspecies as a result of observations made in the Central African Republic and the Congo between 1984 and 1990: *Glossina tabaniformis*, *G. schwetzi*, *G. nashi*, *G. fusca congolensis* and *G. fuscipleuris*. The results show that some species of the *fusca* group in this area have declined, perhaps to the point of extinction: only six specimens of *G. f. congolensis* and none of *G. fuscipleuris* were captured during this period in the Bambari region of the Central African Republic, where they were common in the 1960s. Similarly, *G. tabaniformis* has become increasingly rare in the Batéké plateaux of the Congo. Reasons for this decline are discussed and include deforestation and reduction of game as a result of increased human activity.

7939 **Hargrove, J.W. and Packer, M.J., 1993.** Nutritional states of male tsetse flies (*Glossina* spp.) (Diptera: Glossinidae) caught in odour-baited traps and artificial refuges: models for feeding and digestion. *Bulletin of Entomological Research*, **83** (1): 29-46.

c/o Tsetse and Trypanosomiasis Control Branch, P.O. Box 8283, Causeway, Harare, Zimbabwe; Papua New Guinea Institute of Medical Research, Box 378, Madang, Papua New Guinea.

Male *Glossina morsitans morsitans* and *G. pallidipes* caught in artificial refuges in Zimbabwe had *c.* six times as much haematin and up to 32% more fat than flies from odour-baited traps, but haematin-specific fat levels did not differ significantly between trapping methods. *G. pallidipes* estimated to have fed < 9 h prior to sampling contained *c.* 3.3 mg fat— only 10% less than peak levels. A differential equation model for blood-meal metabolism was developed which described well the changes in fat levels of laboratory *G. m. morsitans* and the relationship between fat and log haematin in field data. The model predicts a mean feeding interval (*T*) of 54-65 h and mean fat levels of *c.* 2.8 mg for *G. pallidipes* at feeding. When haematin frequency data were

analysed as suggested in the literature, estimates of feeding rates and intervals, and of the non-feeding phase, varied with sampling method. Published estimates of activity levels related to feeding suggest a model where feeding rates increase approximately linearly during the trophic cycle. For $T = 58$ h the model gives good predictions of mean fat levels and variances in both species, with starvation rates $< 1\%/day$. Models with long non-feeding phases predict fat levels up to 40% lower than observed and with smaller variances. For constant feeding rates, fat levels were well predicted for $T = 54$ h, but predicted death rates ($> 5\%/day$ due to starvation alone) were impossibly high. It is suggested that a proportion of tsetse flies with high fat levels feed on mobile hosts early in the trophic cycle and that this effect is more marked for *G. m. morsitans* than for *G. pallidipes*. Over-estimates of T result from the failure to consider these tsetse flies and not from errors in the assumed time scale, nor from failure to catch high-fat tsetse flies which visit stationary traps.

7940 **Jura, W.G.Z.O. and Davies-Cole, J.O.A., 1992.** Some aspects of mating behavior of *Glossina morsitans morsitans* males infected with a DNA virus. *Biological Control*, **2** (3): 188-192.

ICIPE, P.O. Box 30772, Nairobi, Kenya.
Mating behaviour of *G. m. morsitans* males, inoculated with the DNA virus during the third-instar larval stage, and sexual receptivity of females pre-mated with such males were studied in the laboratory. Like normal males, the virus-infected males readily located females and mounted them instantaneously. The mean duration of copulation was similar in both normal and infected groups, and all males in both groups experienced the final jerking phase before separating. The value for the degree of insemination (mean spermathecal value) for the females mated with normal males was significantly greater than that for the flies mated with the virus-infected males. Although spermathecae of the latter group were devoid of spermatozoa, attempts to remate them with virile, 7-day-old, normal *G. m. morsitans* males were mostly unsuccessful. By 72 h after mating, over 80% of the females previously mated with the infected, sterile males showed consistent refractoriness. These observations indicate that the virus-infected tsetse males, despite sterility, retain their normal mating efficiency and would be suitable

for use in the sterile-insect release programme for control of *Glossina* species.

7941 **Paynter, Q. and Brady, J., 1993.** Flight responses of tsetse flies (*Glossina*) to octenol and acetone vapour in a wind-tunnel. *Physiological Entomology*, **18** (1): 102-108. Brady: Imperial College, Silwood Park, Ascot, Berks SL5 7PY, UK.

Female *Glossina morsitans morsitans* were video-recorded in a wind-tunnel as they entered, in crosswind flight, a broad plume of either octenol or acetone (two components of ox odour). Both odours produced upwind turning responses (in-flight anemotaxis) to a range of concentrations, with thresholds at around 10^{-8} mg l⁻¹ for octenol and 10^{-6} mg l⁻¹ for acetone. Kinetic responses were unaffected by octenol at low concentrations, but flight speed was significantly reduced and sinuosity (m⁻¹) and angular velocity (s⁻¹) significantly increased by concentrations at or above those in ox breath; for acetone, these effects were apparent but inconsistently related to concentration. It is concluded that octenol and acetone vapour are used by tsetse flies to locate hosts by upwind anemotaxis, probably combined with kinetic responses. The behavioural basis for the 'repellency' of high octenol concentrations in the field is discussed in the context of the virtual loss of upwind anemotaxis to octenol at the highest concentration tested in the tunnel (30 \times ox breath).

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

[See also **16**: nos. 7901, 7902, 7907, 7913, 7914, 7916, 7920-7922, 7940, 7970.]

7942 **Bauer, B., 1992.** Laboratory tests and field trials against *Glossina* spp. using different formulations of various pyrethroids. (Abstract only.) *In*: FAO, 1992 (see **16**: no. 7908), pp. 143-145.

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

The efficiency of different formulations of pyrethroids applied to cattle for tsetse control was evaluated under laboratory conditions. Knock-down effects were considered more important than mortality rates and the effects of rain and solar radiation on persistence were noted. In a field trial at Satiri, 45 km north-east of Bobo-Dioulasso, 2000 cattle were treated at monthly intervals with flumethrin. After 13 successive treatments the trypanosomiasis infection rate in 200

cattle examined at monthly intervals was significantly reduced. The mean age of the tsetse population dropped from 35 to 12 days after one treatment and the population had disappeared after six treatments. The control area was extended to around 1000 km² in 1989. Five treatments of 3500-8000 cattle achieved a further reduction in infection rate; 130 insecticide-impregnated traps were deployed at possible tsetse reinvasion sites.

7943 **Chadenga, V., 1992.** Analysis of the efficacy, practicality and cost of various tsetse and trypanosomiasis control techniques as used in Zimbabwe. *In*: FAO, 1992 (see 16: no. 7908), pp. 105-128.

Tsetse and Trypanosomiasis Control Branch, Department of Veterinary Services, P.O. Box 8283, Causeway, Harare, Zimbabwe.

The history of tsetse and trypanosomiasis control in Zimbabwe is briefly reviewed. Control is currently achieved by ground spraying, aerial spraying, odour-baited and insecticide-treated targets, cattle dipping and trypanocidal drugs. The results obtained with each technique are discussed. A cost analysis of the different control techniques was carried out: costs varied according to strategies used, type of terrain and productivity of personnel. Ground spraying with deltamethrin and aerial spraying are the most expensive techniques and their use in tsetse control cannot be justified in economic terms where cheaper techniques are feasible. Targets compare favourably with ground spraying of DDT; the cheapest technique is the direct application of insecticide to cattle but this is dependent on livestock density. The technical feasibility and practicality of these different control techniques are assessed with regard to cost-effectiveness and environmental impact. A Tsetse and Trypanosomiasis Control Committee is to be reconstituted, to advise the TTCB on the requirements for control in relation to optimal land use, human health and conservation of natural resources.

7944 **Cuisance, D., 1992.** Impact sur l'environnement de la lutte contre les tsé-tsé. [Environmental impact of tsetse control.] *In*: Balança, G. and Visscher, M.-N. de (eds), *Méthodes de recherche en écologie des traitements antiacridiens en Afrique* (Compte rendu de l'Atelier CCE-CIRAD, Montpellier, France, 24-27 février 1992) [Research methods in the ecology of antilocus treatment in Africa (Proceedings of a CCE-CIRAD Workshop, Montpellier, France, 24-27 February 1992)] (Brussels;

Commission des Communautés Européennes, and Montpellier; CIRAD-GERDAT-PRIFAS), pp. 109-116. CIRAD-EMVT, Centre ORSTOM, B.P. 5045, 34032 Montpellier Cedex, France.

Short- and long-term environmental effects of organochlorine insecticides and deltamethrin used for tsetse control are reviewed. Immediate and high mortality of non-target organisms, especially insects and insectivorous birds, occurred when high rates (800-900 g/ha) of dieldrin or DDT were sprayed. High rates of endosulfan affected bird behaviour and increased fish mortality, and rates as low as 6-14 g/ha continued to affect fish and some populations of piscivorous birds. Five sequential aerial applications of endosulfan at 14-24 g/ha in north-east Zimbabwe had short-term effects on the bioecology of mammals and birds but little effect on non-target invertebrates. The use of dieldrin and DDT has now almost ceased; only low rates of endosulfan continue to be routinely sprayed. Deltamethrin application at rates varying from 0.2-30 g/ha had serious short-term effects on terrestrial and aquatic invertebrates. Organochlorine insecticides can continue to affect vertebrate populations for many years but no long-term effects are known for deltamethrin. Large-scale insecticide application now belongs to the past and its adverse environmental effects are not considered irreversible in the long term. Future control prospects are briefly discussed.

- 7945 **Douthwaite, R.J., 1992.** Non-target effects of insecticides used in tsetse control operations. *World Animal Review*, no. 70/71: 8-14.
Field Ecology Section, NRI, Central Avenue, Chatham Maritime, Chatham, Kent ME4 4TB, UK.
Indiscriminate spraying with high doses of persistent organochlorine insecticides for tsetse control has largely been replaced by selective residual treatment of resting sites or sequential low-dose drift spraying timed to kill newly-emerged flies. The use of traps and screens is also increasingly replacing spraying as the preferred means of control. The implications of these changes for non-target organisms are reviewed. Dieldrin is highly toxic to a wide range of species but appears not to have irreversible effects on animal populations. The adverse effects of DDT seem to be less widespread than was feared but remain sufficiently serious to warrant the use of alternative means of tsetse control. Deltamethrin affects invertebrates more than DDT but residues do not persist long or bioaccumulate and it is less hazardous to vertebrates. Drift spraying with deltamethrin and endosulfan appears to have transitory effects on non-target species and the effects of insecticide-impregnated traps and screens are minimal. Concern about the use of insecticides for tsetse control is seen as an irrational fear which requires environmental monitoring and careful selection of techniques to be essential components of control programmes.
- 7946 **Gouteux, J.P. and Le Gall, F., 1992.** Piège bipyramidal à tsé-tsé pour la protection de l'élevage en République centrafricaine. [Bipyramidal tsetse trap for livestock protection in the Central African Republic.] *World Animal Review*, no. 70/71: 37-43.
ORSTOM, B.P. 893, Bangui, Central African Republic;
ANDE, B.P. 1509, Bangui, Central African Republic.
Animal trypanosomiasis, transmitted by *Glossina fuscipes fuscipes*, is the principal constraint to livestock development in the Central African Republic where 2.6 million Mbororo Zebu cattle are dependent on chemotherapy. The National Agency for Livestock Development (ANDE) has launched a control strategy whereby traps, to be managed by the Mbororo cattle herders, are set at watering places to suppress the vector population. The bipyramidal traps are made of blue and black plastic to attract the flies and their construction, cost and utilisation are described. The flies are caught in an opalescent plastic bottle which

is impregnated with deltamethrin: the flies die quickly from insolation whereas the insecticide prevents predation by ants so that catches can be recorded. This trap was found to be more efficient than the biconical trap and preliminary trials have confirmed its efficacy for protecting Mbororo cattle. Its use in other situations remains to be evaluated.

7947 **Lawrence, J.A., 1990.** The ox and its parasites: some experiences and opinions on the theme of control.

Zimbabwe Veterinary Journal, **21** (4): 133-143.

Department of Paraclinical Veterinary Studies,
University of Zimbabwe, P.O. Box MP 167, Mount
Pleasant, Harare, Zimbabwe.

A personal view of ways to control cattle parasites, particularly in Zimbabwe, is given. Sections on trypanosomiasis include discussions of trypanotolerance and tsetse control in Zimbabwe. It is now recognised that N'Dama cattle, although small, give a high productivity per hectare and are an economically attractive proposition in tsetse-infested areas. They are now being exported from their home area in West Africa to other parts of Africa. The degree of trypanotolerance of other indigenous breeds is also being evaluated. In 1890 tsetse occupied half of Zimbabwe. The rinderpest epidemic in 1896 killed cattle and wildlife which resulted in the eradication of the fly from all but a few residual foci in the Zambezi valley. Tsetse populations were re-established from these foci and began invading towards their original ecological limits. The author considers that eradication in the long term is not possible to achieve. Limiting economic effects, e.g. by using resistant cattle, insecticidal traps and targets and clinical treatment, would be a biologically sounder approach but is politically difficult to justify in the face of the need for more land for settlement.

7948 **Njogu, A.R., 1992.** Recent progress in the development of bait techniques for tsetse survey and control. *In*:
FAO, 1992 (see **16**: no. 7908), pp. 129-133.

StockWatch Ltd, c/o P.O. Box 72647, Nairobi, Kenya.

Baits, either live or artificial, can be used to attract tsetse. The flies can then be caught to indicate their presence and abundance, as in surveys, or they can be trapped and killed, as in control. The development of bait techniques is briefly reviewed, with reference to the visual and olfactory responses of *palpalis*, *morsitans* and *fusca* group flies to different stimuli. New trap designs include F3 and epsilon traps

in Zimbabwe and the Ngu trap in Kenya. Studies are under way to replace insecticides with chemosterilants or synthetic juvenile hormone. Static baits are being replaced in some areas by cattle treated with pour-on formulations of deltamethrin, flumethrin or cypermethrin.

7949 **Slingenbergh, J., 1992.** Tsetse control and agricultural development in Ethiopia. *World Animal Review*, no. 70/71: 30-36.

Animal Production and Health Division, FAO, Via delle Terme di Caracalla, 00100 Rome, Italy.

Tsetse flies are increasing their range in a large area of west and south-west Ethiopia. Highlands above 2000 m are generally free of tsetse but below this altitude some 6 million cattle are now exposed to tsetse-transmitted trypano-somiasis. The flies are moving upwards out of the valleys to occur seasonally in agricultural land on the foothills of the high plateaux. Loss of cattle through trypanosomiasis, especially draught animals, has considerably reduced agricultural productivity. Tsetse control was initiated in the Didessa Valley in 1986. Low-cost techniques were used: odour-baited traps and insecticide-impregnated targets which had been adapted to local conditions so they could be used by the villagers themselves without outside assistance. These techniques have been shown to be efficient under different ecological conditions. The progressive elimination of *Glossina morsitans submorsitans* in savanna areas and *G. tachinoides* along water courses has enabled farmers to reintroduce livestock and double their agricultural output.

7950 **Smith, S.C., 1992.** Investigation of the possible vapour action of α -endosulfan on *Glossina morsitans morsitans*. *Pesticide Science*, **36** (3): 301-307.

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

An all-glass apparatus was set up whereby insects were brought into contact with α -endosulfan vaporised from a heated bulb. The attribution of the initial high mortality to vapour action was not substantiated by subsequent chemical analysis. Use of reduced amounts of α -endosulfan to provide more nearly the calculated saturated vapour concentration resulted in little kill. The α -endosulfan vaporised transiently then condensed onto the surrounding surfaces; any mortality resulted from contact action. These observations do not support

the contention that α -endosulfan acts via the vapour phase at long range in the field.

7951 **Vloedt, A. van der, 1992.** The integration of biological techniques into tsetse control programmes. *In*: FAO, 1992 (see **16**: no. 7908), pp. 135-142.

Insect and Pest Control Section, Joint FAO/IAEA Division, IAEA, Vienna, Austria. (Author deceased.) The technical effectiveness of SIT, particularly under West African conditions, has been proven and there is now justification for medium- to large-scale use of SIT against those species which can be mass-reared. Fly rearing in support of control programmes is discussed: centralised production in Africa at a few properly equipped regional centres is envisaged. The release of sexually sterile females for recapture data and information on their mating status would indirectly reflect the wild population density; such releases at intervals could be used to monitor control operations. Hybrid sterile males or 'satyrs' could be used as genetic control agents since they will mate with hetero-specific or hetero-subspecific females and produce no offspring. Biological control agents have been little studied. Release trials of the hymenopteran parasitoid *Synthomosphyrum* in East Africa had positive but not sustained results. Virus-like particles which cause hypertrophy of the salivary glands and gonadal lesions in tsetse may have control potential. The use of systemic insecticides such as ivermectin, insect growth regulators, and juvenile hormone analogues such as pyriproxyfen to inhibit female reproduction is discussed.

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

[See also **16**: nos. 7919, 7924, 7968, 8014.]

7952 **Brown, S.J., 1989.** Pathological consequences of feeding by hemato-phagous arthropods: comparison of feeding strategies. *Miscellaneous Publications of the Entomological Society of America*, no. 71: 4-14.

Department of Biology, Loyola Marymount University, Los Angeles, CA 90045, USA.

Haematophagous arthropods exhibit essentially two basic feeding styles, solenophagy (vessel feeding) and telmophagy (pool feeding). Solenophagous arthropods typically feed within minutes, causing minimal tissue destruction, but intense allergic reactions of an immunological nature may follow. Telmophagous arthropods usually have a longer feeding period ranging from minutes to days. As a result, tremendous tissue

destruction may occur, followed by allergic reactions that may persist for months or years. The tsetse fly, *Glossina morsitans*, exhibits a feeding style intermediate between solenophagy and telmophagy and induces a very strong blood and tissue basophilia and eosinophilia similar to ticks. The presence of host acquired resistance to the tsetse fly is discussed.

7953 **Hervouët, J.P. and Laveissière, C., 1992.** La trypanosomiase humaine: éléments d'épidémiologie. [Human trypanosomiasis: epidemiological factors.] *In:* Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see 16: no. 7912), pp. 29-32.

Muraz/OCCGE, B.P. 171, Bobo-Dioulasso, Burkina Faso; IPR/ OCCGE, B.P. 1500, Bouaké, Côte d'Ivoire.

The change from an endemic to an epidemic situation is seen as the result of an imbalance between environmental potential and environmental use by human societies. Aspects of the epidemiology of human trypanosomiasis are discussed. Trypanosomiasis is largely dependent on entomological conditions which themselves are affected by human impact on the environment: the principal risk zone is the gallery forest-plantation-water hole-encampment complex. The spread of the disease is seen as a social phenomenon in that conditions which maximise human/fly contact encourage the rapid circulation of the parasite, and these vary according to the way of life of the social groups concerned. Human trypanosomiasis is a dynamic ecological system which persists and changes according to the interaction of various factors. The study of the disease and the establishment of control strategies cannot be based on single factors alone.

7954 **Hilali, M. and Fahmy, M.M., 1993.** Trypanozoon-like epimastigotes in the larvae of *Cephalopina titillator* (Diptera: Oestridae) infesting camels (*Camelus dromedarius*) infected with *Trypanosoma evansi*. *Veterinary Parasitology*, **45** (3-4): 327-329.

Parasitology Department, Faculty of Veterinary Medicine, Cairo University, P.O. Box 12211, Giza, Egypt. (Correspondence to Fahmy.)

The possible transmission of *T. evansi* by the fly *C. titillator*, which infests the nasal cavity of camels, was investigated. Twenty camels highly parasitaemic with *T. evansi* were slaughtered and 100 *C. titillator*, representing first, second and third stage larvae, were collected at random from their nasal mucous membranes. Fluid was aspirated from each larva, centrifuged, and the sediment stained with Giemsa. The results showed that

all three larval stages were heavily infected with the epimastigote stage of *T. evansi*, which was always in a dividing state. Mice and guinea pigs inoculated with larval fluid showed no trypomastigotes after 2 months. It is possible that the epimastigote stage is not the infective form or that it might be exclusively parasitic in the fly. More research is necessary.

7955 **Kageruka, P., 1992.** Concepts sur l'existence du réservoir animal de *Trypanosoma brucei gambiense*. [Concepts on the existence of an animal reservoir for *T. b. gambiense*.] *In*: Habbema, J.D.F. and Muyndck, A. de (eds), 1992 (see **16**: no. 7912), pp. 39-44.

Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

The presence of an animal reservoir for *T. b. gambiense*, formerly considered to be specific to humans, may contribute to the failure of long-term control of sleeping sickness in Central and West Africa. Evidence for the existence of such a reservoir is reviewed. Several species of domestic and wild animals, including pigs, goats, dogs, monkeys and antelopes, have been infected with *T. b. gambiense* in the laboratory. It has not been possible to extrapolate these results to the field; the ecology of some good experimental hosts, such as *Cricetomys gambianus*, would preclude their role as reservoir hosts in the wild. The establishment of an animal reservoir depends on the prevalence of the disease in humans, the presence of vectors with feeding preferences including both human and animal hosts and the frequency and ecology of potential animal hosts. Diagnostic techniques with potential for isolating *T. b. gambiense* infections in animal hosts include mAEC, ELISA and KIVI (kit for *in vitro* isolation). The characterisation of *T. b. gambiense* and other *T. brucei* spp. is briefly reviewed: it is possible that mixed infections of *T. b. gambiense* and *T. b. rhodesiense* occur in wild animals.

7956 **Meda, A.H., Laveissière, C. and Soares, A., 1992.** Projet Zoukougbeu: rationalité de la récolte de l'information initiale. [The Zoukougbeu Project: rationale for collecting the initial information.] *In*: Habbema, J.D.F. and Muyndck, A. de (eds), 1992 (see **16**: no. 7912), pp. 21-27.

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

The research project on the epidemiology of human African trypanosomiasis in the subprefecture of Zoukougbeu aims to define the different parameters of transmission in one of the most active foci in Côte

d'Ivoire. The preliminary data have been collected according to a multidisciplinary approach: socio-geographical, including a population census, mapping and a socio-anthropological survey; epidemiological, including a sero-parasitological survey; and entomological, including a study of factors affecting the rate of transmission. It is hoped that the analysis of these data will identify the essential parameters for a causal model of the disease. A knowledge of these factors is fundamental for the choice of an appropriate control strategy.

7957 **Mutero, C.M. and Mutinga, M.J., 1993.** Defecation by *Anopheles arabiensis* mosquitoes of host blood infected with live *Trypanosoma congolense*. *Tropical Medicine and Parasitology*, **44** (1): 23-26.

ICIPE, P.O. Box 30772, Nairobi, Kenya. (Correspondence to Mutinga.)

Female *A. arabiensis* mosquitoes were experimentally fed on hamsters and BALB/c mice which were either clean or infected with *T. congolense*. The mosquitoes readily fed on either animal. A blood repletion rate of 82.7% was recorded for mosquitoes feeding on hamsters. Seventy-seven per cent of the replete mosquitoes continued to feed while at the same time defecating the host's blood in droplets, ejected in quick succession from the anus. Ninety-five per cent of mosquitoes defecating blood while feeding on mice infected with *T. congolense* ejected live parasites along with the blood. Clean mice inoculated intraperitoneally with tail blood or defecated blood from *T. congolense*-infected mice developed parasitaemia between the third and seventh day. This phenomenon could imply possible mechanical transmission of the parasites to the hosts being fed on by the mosquitoes.

5. human trypanosomiasis

(a) SURVEILLANCE

[See also **16**: nos. 7918, 7920, 7921.]

7958 **Ekwanzala, M., 1992.** L'accessibilité et l'acceptabilité du dépistage et de la prise en charge des trypanosomés: politique, stratégie et critères.

[The accessibility and acceptability of screening and care of trypanosomiasis patients: politics, strategy and criteria.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 103-107.

Bureau Central de la Trypanosomiase, B.P. 7782, Kinshasa 1, Zaire.

The accessibility of surveillance for trypanosomiasis depends on several factors: the location of health centres or mobile units, cost and acceptability. The situation in Zaire, where some 12.5 million people are at risk, is described. The Bureau Central de la Trypanosomiase (BCT) is organised at three levels: central, regional and operational, with 25 mobile units. Examinations are carried out by lymph node palpation and standard parasitological techniques with referral to health centres or hospitals for treatment. Only about 12% of the population at risk are covered and this proportion is further reduced by absenteeism which reaches 50% in one region. Lack of effective surveillance is attributed to insufficient units; lack of fixed health centres, personnel and equipment; overworked and demoralised staff, absence of supervision, and costs. Treatment is inefficient due to inaccessibility of treatment centres, lack of perception of the need for treatment, frequent disruption in drug supply, cost of hospitalisation, bad working conditions, adverse reaction to treatment and lack of overall control by the BCT. Zaire aims to create 306 health zones, 107 of which will cover the entire population at risk from trypanosomiasis. People will be encouraged through education to take part in surveys.

7959 **Kegels, G., Criel, B., Lerberghe, W. van, Mentens, H., Magnus, E. and Balen, H. van, 1992.** Screening for *Trypanosoma brucei gambiense* antibodies with the indirect fluorescent antibody test (IFAT): effect of age and previous treatment. *Annales de la Société belge de Médecine tropicale*, **72** (4): 271-281.

Public Health Research and Training Unit (Kegels, Criel, Lerberghe, Balen), Epidemiology Unit (Mentens) and Laboratory for Serology (Magnus), Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

Early diagnosis of *gambiense* sleeping sickness is essential to prevent its progress to the disabling stage and to reduce transmission. The IFAT screening test was found suitable for the field situation at Kasongo, Zaire, which is an endemic area with a two-tier health care service. It is the cheapest serological method available, costing 20-25% of that of the alternative CATT method. The results of IFAT tests carried out on 2252 people were related to age and previous history of trypanosomiasis. The prevalence of IFAT positivity rises with age except in previously treated cases, where IFAT positivity decreases slowly

with time elapsed since the last treatment. The age effect is explained as the result of either accumulating non-trypanosome but cross-reacting antibodies or *T. b. gambiense* antibodies to past infections that had been spontaneously controlled by the individuals' own biological defence mechanisms. 'False positives' with no parasitological confirmation probably include aspecific cross-reactions, residual antibodies from previous infections and latent infections. It is concluded that parasitological examination can be limited to patients showing a strongly positive IFAT reaction and that the distinction between screening and true case identification needs to be maintained.

7960 **Mentens, H., 1992.** Dépistage passif et actif de la trypanosomiase humaine africaine par les soins de santé primaires: opportunités et difficultés. [Passive and active detection of human African trypano-somiasis by primary health care: opportunities and difficulties.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 73-78.

Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium. The possibility of integrating human trypanosomiasis control into the structure of basic health care has been investigated and shown to be practical and economic. Both 'passive' and 'active' detection of the disease, at fixed health centres and by mobile units respectively, are feasible within this structure. The advantages and disadvantages of these methods are discussed. Active detection may exceed the resources of health care centres in terms of funding and manpower and should be limited to those groups or areas at special risk. Elsewhere detection should be carried out at health centres where it should be possible to examine the entire population within 5 years. This has been shown to be effective in reducing the rate of transmission in a region of weak endemicity and is recommended as an alternative to the deployment of mobile units. A simulation model is proposed to assess the reduction in the human reservoir needed to arrest disease transmission.

7961 **Molisho, S., 1992.** Place des techniques sérologiques et parasitologiques dans le dépistage de la trypanosomiase humaine africaine à *Trypanosoma brucei gambiense* par les équipes mobiles au Zaïre. [Place of serological and parasitological techniques in the detection of human African trypanosomiasis due to *T. b.*

gambiense by mobile teams in Zaire.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 67-72.

Bureau Central de la Trypanosomiase, B.P. 7782, Kinshasa 1, Zaire.

An average of 10,000 cases a year are reported from a population of some 12.5 million at risk, of which less than 15% are covered by sleeping sickness control services. The distribution of the disease in Zaire has changed little over the past 60 years and 6 monthly surveys are carried out only in strongly endemic zones. Serological tests introduced in Zaire in the 1970s have only been applied in sporadic fashion in certain foci; diagnosis is usually based on lymph node palpation. New survey techniques, including CATT and DEAE-cellulose mini-column filtration, in addition to classic techniques, have been used by mobile teams in the Bas-Zaire region and the results are described. The use of CATT has maximised and improved early diagnosis. It was found that lymph node hypertrophy varied according to focus, the prevalence ranging from 8.7% in active foci to 3.6% in controlled foci. It is recommended that lymph node palpation be continued in parallel with the use of CATT.

7962 **Nieuwenhove, S. van, 1992.** Trypanosomiase: efficacité et efficience des dépistages répétés.

[Trypanosomiasis: efficacy and efficiency of repeated screening.] *In*: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 45-53.

Administration Générale de la Coopération au Développement, B.P. 57, B-1050 Brussels, Belgium.

Repeated systematic serodiagnostic screening carried out by mobile public health services has been found to be the most effective and low-cost control strategy in the long term. The reduction of human reservoir hosts to a very low level, following an initial phase of treatment lasting a maximum of 3 years, allows subsequent screening and treatment to be carried out at intervals of a minimum of 5 years. Non-mobile health services should play an important complementary role and selective vector control for a limited period should contribute to the even more rapid reduction in disease.

7963 **Simarro, P.P., Ona Sima, F., Mir, M., Mateo, M., Rodriguez, J., Moreno, C., Burgos, A. and Ndong Asumu, P., 1992.** Le programme de contrôle de la maladie du sommeil en Guinée Equatoriale 1985-1990. Méthodologie et résultats. [The sleeping sickness control programme in Equatorial Guinea 1985-

1990. Methodology and results.] *In*: Habbema, J.D.F. and Muyenck, A. de (eds), 1992 (see **16**: no. 7912), pp. 115-121.

Simarro, Ona Sima, Mir, Ndong Asumu: Centro de Control de la Tripanosomiasis, B.P. 560, Bata, Equatorial Guinea; Mateo: Hôpital de Luba, Luba, Equatorial Guinea; Rodriguez: Hôpital de Kogo, Kogo, Equatorial Guinea; Moreno, Burgos: Hôpital de Mbini, Mbini, Equatorial Guinea.

The National Control Programme for Trypanosomiasis in Equatorial Guinea supervises trained personnel in each district affected by the disease. From 1985 to 1990 the Programme has carried out serological and parasitological surveys in order to control the historic foci of Kogo, Mbini and Luba and to study the areas where there may be a risk of infection.

Different approaches to serological diagnosis (indirect immunofluorescence, CATT and mAEC) and vector control (trapping) have been evaluated. The results of the surveys show that trypanosomiasis is still contained within the historic foci and that other areas are still free from the disease. In the foci a 55-74% coverage was obtained using a different approach at each focus. At Luba, where surveillance had been interrupted for more than 10 years, 6 monthly surveys were carried out in the main epicentre for 2 years, followed by annual surveys. At Mbini and Kogo, where passive surveillance had been maintained, annual and biennial surveys were carried out. The epidemiological indices were reduced by 98.7% at Luba, 97.5% at Mbini and 69.9% at Kogo. Tsetse trapping at Luba reduced the apparent fly density by 83%.

(b) PATHOLOGY AND IMMUNOLOGY

(c) TREATMENT

7964 **Doua, F., 1992.** Traitement spécifique des trypanosomés: critères et quantification du rendement thérapeutique, de la résistance des rechutes et de la létalité (résultats observés chez 378 sommeilleux traités à l'Arsobal à Daloa). [Specific treatment of trypanosomiasis patients: criteria and quantification of therapeutic benefit, resistance, relapse and lethality (results observed in 378 sleeping sickness patients treated with Arsobal at Daloa).] *In*: Habbema, J.D.F. and Muyenck, A. de (eds), 1992 (see **16**: no. 7912), pp. 87-89.

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

Relapse, resistance and lethality associated with the use of Arsobal (melarsoprol) for the treatment of human African trypanosomiasis have been assessed by a study of 378 patients at Daloa, Côte d'Ivoire. These criteria were based on clinical examination and the analysis of CSF for cell count, protein level and presence of trypanosomes. Eighty-five (22.5%) of the patients were in the lymphatic-blood phase and 293 (77.5%) were in the nervous phase of the disease, with normal and abnormal CSF respectively. Of the 378 patients, 344 (91%) left hospital free of trypanosomes and 34 (9%) died during treatment, 18 (4.7%) of them from encephalopathy and 16 (4.3%) from trypanosomiasis. Among the patients leaving hospital, 23 (6.7%) were not seen again, 33 (10.3%) relapsed, 133 (41.4%) were followed up for 24 months only and 152 (47.3%) were declared cured after periods ranging from 24-60 months. Three deaths were unaccounted for. The results show that mortality due to treatment (4.7%) was almost identical to mortality from the disease itself (4.3%). All relapses occurred between 1 and 24 months after the end of treatment; the relapse rate of 10.3% is high but compares favourably with the rate of 15.6% reported from the Congo.

7965 **Hatz, C. and Brun, R., 1992.** Zerebrale Trypanosomose: Aspekte zu Epidemiologie, Klinik, Therapie und Krankheitsverlauf. [Cerebral trypanosomiasis: epidemiology, clinical aspects, therapy and course of illness.] *Schweizerische Medizinische Wochenschrift*, **122** (23): 873-878.

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

More than 20,000 people are infected with one of the two forms of African trypanosomiasis each year. Without treatment the outcome is almost always fatal. There are, however, problems involved in drug treatment. Reactive encephalitis is recorded in up to 18% of all cases treated for cerebral trypanosomiasis. Recently a lack of response to treatment has been reported with increasing frequency from endemic areas. Relapses occur in up to 10% of cases. Reasons for relapses include insufficient treatment due to poor compliance or lack of drugs, reinfection in endemic areas, pharmacokinetic problems, the parasite's evasive mechanisms, and primary and/or secondary drug resistance.

7966 **Jannin, J., 1992.** Doit-on traiter systématiquement les séropositifs en THA? Analyse décisionnelle.

[Should human African trypanosomiasis seropositive cases be systematically treated? Decisional analysis.]

In: Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 61-66.

Ecole de Santé Publique, Rennes, France.

Treatment of advanced cases of trypanosomiasis with melarsoprol carries a 5-10% risk of mortality; treatment of early stages of the disease with pentamidine isethionate has a greatly reduced risk of mortality at one per 10,000 cases. Early stages can only be detected by serological tests. The systematic treatment of seropositive cases requires a clear definition of the stages of the disease and a quantified analysis of the risks involved. Decisional analysis is an approach which allows for different diagnostic techniques, analyses events with respect to their chronology and quantifies probabilities and risks. Its use should optimise control strategies and justify the decisions taken. An example of decisional analysis is given, using the results of a CATT survey carried out in the Congo.

7967 **Ngampo, S., 1992.** Quels sont les critères et les résultats d'efficacité et de létalité du traitement des cas résistants? L'expérience congolaise. [What are the criteria and the efficacy and lethality of treatment of resistant cases? The Congolese experience.] *In:* Habbema, J.D.F. and Muynck, A. de (eds), 1992 (see **16**: no. 7912), pp. 91-95.

Programme National de Lutte contre la Trypanosomiase, Brazza-ville, Congo.

Some 300-400 cases of sleeping sickness are treated in the Congo each year. Patients are followed up with clinical, parasitological and cytobiological (CSF) surveys for 2 years after treatment and relapsed or drug-resistant cases undergo further treatment. A preliminary study was made of 135 cases of recurrent relapse following melarsoprol treatment: 43 were eventually cured, 19 by using DFMO (15 after the first relapse, three after the second and one after the third) and 24 by using Arsobal (23 after the first relapse, one after the second and none after the third). Twenty-two patients died (three after the first relapse, 15 after the second and four after the third, all following Arsobal treatment). The remaining 70 cases did not continue to take part in the study. It is concluded that repeated treatment with the same drug is less effective than if different trypanocides are used.

6. animal trypanosomiasis

(a) SURVEY AND DISTRIBUTION

7968 **Ijagbone, I.F. and Ayanwale, F.O., 1991.** Isolation of trypanosomes from natural infection in domestic pigs. *Tropical Veterinarian*, **10** (1-2): 65-67.

Department of Veterinary Public Health and Preventive Medicine, University of Ibadan, Ibadan, Nigeria. Five trypanosome isolates were recovered from 239 domestic pigs (2.1%) slaughtered at the Ibadan Municipal Abattoir between May and July 1990. Four of the isolates, which were *Trypanosoma brucei*, were isolated from the local black pigs while the fifth, which was *T. congolense*, was isolated from an exotic gilt. The blood incubation infectivity test performed on the isolates was negative. Public health implications of the findings underscored the need for further studies on domestic pigs as reservoirs of pathogenic trypanosomes in Nigeria.

7969 **Luckins, A.G., 1992.** Methods for diagnosis of trypanosomiasis in livestock. *World Animal Review*, no. 70/71: 15-20.

CTVM, Easter Bush, Roslin, Midlothian EH25 9RG, UK. Clinical diagnosis alone is too imprecise to use as a basis for trypanosomiasis control. The type of diagnostic test used depends on the epidemiology of the disease and the control strategy. Where disease prevalence is high, tests of low diagnostic sensitivity will suffice if chemotherapy is administered on a herd basis. Where chemotherapy is given to individual animals, more sensitive tests are needed to detect active infections. The tests should show high specificity and sensitivity, easy reproducibility, simplicity, economy and ease of interpretation. Problems in the interpretation of current diagnostic tests are highlighted, including parasitological diagnosis and immunodiagnostic techniques. One particular test should be chosen to overcome problems of standardisation. ELISA tests are particularly recommended since they are easy to automate and have potential for field use. Antibody assays enable an overall assessment to be made of a population; antigen assays enable the identification of individuals with active infections, species differentiation and detection of drug resistance. These tests all have limitations and sensitive parasitological tests such as HCT or the DG (dark ground buffy coat) technique should also be employed to detect acute infections.

7970 **Mattausch, M., 1990.** *Epidemiologische Untersuchungen der Trypano-somosis von Rind und Schaf im Anschluss an eine Tsetsefliegen-Tilgung in den Weidegebieten von Sideradougou, Burkina Faso.*

[Epidemiological investigations of trypanosomiasis of cattle and sheep after eradication of tsetse flies in the pastoral zone of Sideradougou, Burkina Faso.] Inaugural Dissertation, Tierärztliche Hochschule Hannover, Germany. 134 pp. (English summary.)

Almost 2 years after eradication of tsetse flies from the pastoral zone of Sideradougou, Burkina Faso, 750 young cattle were examined for salivarian trypanosomes (between August 1986 and June 1987) using HCT. Some of the cattle studied were from trial areas in the project zone and some were from control areas outside the zone. In addition, blood of 231 of these cattle was tested by IFAT. Incidence of infection in 223 sheep and 220 adult cattle was also recorded. Low incidences of infection of 0-1.9% (HCT) and low infection rates of 0-5.9% (IFAT) were found in young cattle from the trial areas. In general, higher incidences and infection rates were detected in the trial area at the northern border of the zone compared to the other trial areas. In the trial area at the eastern part of the zone a high incidence (9 of 29) and a high infection rate (7 of 26) were found at the end of the dry season. Only 2% of sheep in the trial areas were infected with pathogenic trypanosomes. The prevalence of infection in adult cattle in the trial areas was 3%. All infections in the trial areas were caused by *Trypanosoma vivax*. In one of the two control areas incidences of infections of 4-27.3% and infection rates of 12.5% and 29% were obtained in young cattle. In the other control area, very high incidences of 19.6-77.1% and infection rates of 70.5% and 88.6% were found in young cattle. In the same area 8.8-20% of sheep were infected. In the control areas the prevalence of infections in adult cattle was 24.4%. *T. vivax*, *T. congolense* and *T. brucei* were diagnosed as causative agents. The *T. vivax*:*T. congolense* quotient in young cattle was 8.6 and 5.3, in sheep 6.9 and in adult cattle 2.3 and 0.6. In the trial area at the northern border of the pastoral zone a very low density of *Glossina tachinoides* was found using biconical traps. In the other trial areas, tsetse flies were not detected. In all trial and control areas, mechanical vectors (tabanids, stomoxiids, hippoboscids) of pathogenic trypanosomes were abundant. It was concluded that tsetse fly eradication had been successful in the southern and

eastern parts of the pastoral zone. In these parts the rare trypanosome infections were attributed to non-cyclical transmission. A specific entomological study conducted in the trial area at the northern border of the zone revealed a reinvasion of *Glossina* into this area.

7971 **Otesile, E.B., Garba, Y. and Olufemi, B.E., 1990.** Survival period of *Trypanosoma vivax* and *T. congolense* in cattle blood and of *T. brucei* in goat blood. *Tropical Veterinarian*, **8** (3-4): 213-218.

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

Investigations on the survival periods of *T. vivax* and *T. congolense* in cattle blood and of *T. brucei* in goat blood showed that the parasites survived longer at 4°C than at room temperature. The survival periods were directly related to the initial parasitaemia of blood samples. There was no significant difference between the survival periods of *T. vivax* and *T. congolense* in cattle blood both at room temperature and at 4°C. Storage of blood samples at 4°C prolonged survival of both *T. vivax* and *T. congolense* by 24 h in cattle blood and of *T. brucei* by 48-72 h in goat blood. In spite of relatively high parasitaemia, *T. brucei* parasites in goat blood at 4°C were no longer infective for mice at 48 h, indicating that infectivity of the parasites declined faster than ordinary survival.

7972 **Reynolds, L. and Opasina, B., 1987.** Trypanosomes and other blood parasites in slaughter cattle at Ibadan, Nigeria in 1984-1985. *Tropical Veterinarian*, **5** (1-4): 187-190.

ILCA, P.O. Box 5320, Ibadan, Nigeria.

Over a 12-month period 313 (8.4%) out of 3727 slaughter cattle sampled at Ibadan abattoir were found to be infected with trypanosomiasis. Infection rates were higher in the dry than in the wet season, ranging from 20.4% in November to 2.8% in May. Overall PCV levels were higher in the dry season, suggesting that trypanosomiasis might not be the primary cause of the anaemia. Trypanosomiasis is no longer a major problem in slaughter cattle at Ibadan, 98% of which come from northern areas.

(b) PATHOLOGY AND IMMUNOLOGY

7973 **Akinbamijo, O.O., Ademosun, A.A., Zwart, D., Tolkamp, B.J. and Brouwer, B.O., 1990.** Effect of *Trypanosoma brucei* infection on live weight, organic matter intake digestibility and N-balance on West African Dwarf goats. *Tropical Veterinarian*, **8** (3-4): 140-148.

Humid Zone Programme, ILCA, P.M.B. 5320, Ibadan, Nigeria; Department of Animal Science, Obafemi Awulowo University, Ile-Ife, Nigeria; Department of Tropical Animal Husbandry, Agricultural University, P.O. Box 338, 6700 AH Wageningen, Netherlands; *ibid.*; *ibid.*

In one experiment, half of a group of 10 West African Dwarf (WAD) goats fed pelleted alfalfa *ad libitum* was infected with *T. brucei* and live weights were measured 8 and 11 weeks p.i., all infected animals being treated with Berenil 8 weeks p.i. Infected animals lost 30 (s.e. 6) and 18 (s.e. 5) g day⁻¹ while control animals gained 41 (s.e. 2) and 63 (s.e. 2) g day⁻¹ respectively, the differences between groups being significant. In a second experiment, nine infected and nine matched control animals were housed in metabolism cages during part of the experimental period and organic matter (OM) intake, nitrogen balance (NB) and digestibility of OM and crude protein (CP) were determined during three 7-day periods, 1 week pre- and 1 and 10 weeks p.i. Rectal temperatures were recorded daily and blood samples for analysis of PCV and buffy coat examination for parasite count were taken twice weekly. All infected animals showed fever and parasitaemia and one infected animal died of encephalitis in week 9 p.i. During the week pre-infection there were no differences in OM intake, OM digestibility, CP digestibility or NB between the control group and the group to be infected. At 1 week p.i., the infected animals showed significantly lower (-18%) OM intake and lower (-77%) NB than the controls but no differences in OM or CP digestibility. Infected animals showed a lower NB compared to controls at equal OM intake. During the third balance trial, 10 weeks p.i., infected animals showed lower (-63%) OM intake compared to controls and infected animals had a negative but controls a positive NB. The effects of infection on OM intake and NB were highly variable but OM and CP digestibility were not affected by infection during the third trial. It is concluded that the effect of *T. brucei* infection on live weight in WAD goats is not due to a decreased digestive capacity but mainly the result of a decrease in voluntary feed intake, probably aggravated by an increased nitrogen loss in the urine compared to controls at equal intakes.

7974 **Akinbamijo, O.O., Hamminga, B.J., Wensing, T., Brouwer, B.O., Tolkamp, B.J. and Zwart, D., 1992.** The effect of *T. vivax* infection in West African Dwarf goats on energy and nitrogen metabolism. *Veterinary Quarterly*, **14** (3): 95-100.

Akinbamijo: Humid Zone Programme, ILCA, P.M.B. 5320, Ibadan, Nigeria; Hamminga, Brouwer, Tolkamp, Zwart: Department of Tropical Animal Husbandry, Agricultural University, P.O. Box 338, 6700 AH Wageningen, Netherlands; Wensing: Department of Large Animal Medicine and Nutrition, Faculty of Veterinary Medicine, University of Utrecht, Utrecht, Netherlands.

(Correspondence to Zwart.)

To investigate how *Trypanosoma vivax* affects metabolism in West African Dwarf goats, nine wethers (infection group) given alfalfa pellets *ad libitum* were infected i.v. and food intake was recorded up to 49 days p.i. in the infection group and in the control group ($n = 9$). Controls received the same diet, *ad libitum* before infection and in restricted amounts after infection, in order to obtain similar intakes in the two groups. Digestible organic matter intake (DOMI) and nitrogen balance (NB) were determined during four balance trials. All animals were bled regularly to measure parasitaemia, PCV and a number of serum metabolites. All infected animals showed symptoms typical for *T. vivax* infection as judged by parasitaemia, PCV and rectal temperature. Infection had a non-uniform negative effect on food intake. Compared with controls at equal DOMI, NB was lower in infected animals, the difference being significant 4 weeks p.i. This was caused by a gradual increase in NB at equal DOMI of the control group. The NB of the *ad libitum* fed infected animals 2 and 4 weeks after infection was comparable to values normally found in healthy *ad libitum* fed Dwarf goats with an equal DOMI. Non-esterified fatty acid (NEFA) values in serum were significantly elevated after infection. Except for two infected animals with an extremely low food intake towards the end of the experiment, no rise in serum ketone bodies was evident. After infection, serum protein increased, differences with controls being significant 4 and 7 weeks p.i. It is concluded that *T. vivax* infection results in a decrease in energy intake and a decrease in NB up to at least 4 weeks p.i. At equal DOMI, NB of infected animals was not lower than expected for *ad libitum* fed healthy animals but was lower than in healthy controls on a restricted diet, probably as a result of a decrease in maintenance requirements of the latter. The data on NB and serum NEFA concentrations suggest that non-protein energy sources are used to supply the increased energy demand as a result of infection.

7975 **Little, D.A., Dwinger, R.H., Clifford, D.J., Grieve, A.S., Kora, S. and Bojang, M., 1990.** Effect of nutritional level and body condition on susceptibility of N'Dama cattle to *Trypanosoma congolense* infection in The Gambia. (Meeting abstract.) *Proceedings of the Nutrition Society*, **49** (3): 209A. ITC, P.M.B. 14, Banjul, Gambia.

Two groups (low, 174 kg, and medium, 205 kg, body condition) of 20 3-year-old trypanotolerant N'Dama bulls were used. Half of each group was fed on a low (LP) and half on a high (HP) plane of nutrition. For 9 weeks after intradermal inoculation with 10^4 *T. congolense*, cattle were bled regularly for parasitic examination and PCV measurement, and weighed weekly. Ten similar bulls acted as uninfected controls; five were fed on LP and five on HP. Parasitaemia occurred 6-7 days p.i., and group mean PCV declined linearly to a minimum 24 days later. PCV then slightly increased to means averaging 1.2 units above their respective minima. From 27 to 56 days after initial parasitaemia, the mean PCV was higher in HP than in LP animals. Degree of parasitaemia was not affected. Nutritional treatment influenced the rate of live weight gain. The uninfected controls gained weight at a rate significantly greater than the infected groups, showing a deleterious effect of trypanosome infection on efficiency of nutrient utilisation. The most severe response to infection occurred in medium-condition LP animals. While the higher plane of nutrition clearly was beneficial in reducing the severity of infection in trypanotolerant cattle, the syndrome was more severe in animals of better body condition at the time of infection.

7976 **Ogbechie, C.A. and Oyejide, A., 1988.** Thrombocytopaenia and coagulation defects in acute and chronic *Trypanosoma brucei* infections. *Tropical Veterinarian*, **6** (1-4): 77-82.

Department of Haematology, University College Hospital, Ibadan, Nigeria; Department of Veterinary Pathology, University of Ibadan, Ibadan, Nigeria.

Acute (3 day) and chronic (5 week) *T. brucei* infections of rats and sheep respectively were studied with respect to changes in four coagulation factors. The acute infection in rats was characterised by a fulminating parasitaemia associated with a rapidly occurring thrombocytopenia and depletion of serum fibrinogen, prothrombin and factor V. The chronic infection in sheep on the other hand was characterised by a low parasitaemia and a relatively less severe thrombo-cytopenia, serum fibrinogen depletion and

prolongation of prothrombin time. Factor V levels were not significantly affected. Berenil treatment completely restored thrombocyte, prothrombin and factor V pre-infection levels in sheep within 2 weeks. The concurrent depletion of these coagulation factors in both acute and chronic diseases suggests induction by common mechanisms operating at rates apparently proportional to parasitaemic levels and probably associated with enhanced splenic activity and disseminated consumption.

7977 **O'Hara, H.B. and Gombe, S., 1987.** Preliminary studies on the fertility of the Small East African male goats following pre-pubertal infection with *Trypanosoma congolense*. *Tropical Veterinarian*, **5** (1-4): 191-196.

Reproductive Biology Unit, College of Biological and Physical Sciences, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.

Pre-pubertal male Small East African goats were chronically infected with *T. congolense* at 4-5 months of age. Changes in body weight gains and haemograms were monitored weekly, and plasma testosterone levels were monitored three times a week, until the animals reached puberty or, failing which, were 15 months old. Onset of puberty was determined by the increase in libido, start of mating and elevation of plasma testosterone. Trypanosomiasis reduced body weight gains, delayed onset of puberty and impaired the gonads. These effects were found to be reversible on treatment with isometamidium chloride in goats treated 5 weeks after infection. Thus, if infected pre-pubertal goats are treated before serious gonadal damage occurs, reproductive function can be restored and these animals usefully kept in the herd for reproductive purposes.

7978 **Otesile, E.B. and Akpavie, S.O., 1992.** Concurrent fatal *Theileria mutans* and *Trypanosoma vivax* infections in White Fulani (Zebu) cattle in Nigeria. *Tropical Veterinarian*, **10** (1-2): 5-9.

Department of Veterinary Medicine (Otesile) and Veterinary Pathology (Akpavie), University of Ibadan, Ibadan, Nigeria.

An outbreak of a disease characterised by respiratory distress, lymph gland enlargement, hydrothorax, hydropericardium, anaemia and icterus in White Fulani (Zebu) cattle is described. An intercurrent infection with *T. vivax* appeared to have aggravated the severe and fatal *T. mutans* infection.

7979 **Oyejide, A., Ijagbone, I., Reynolds, L., Adeyemo, O. and Ekwuruke, J., 1989.** The effect of two planes of nutrition on the

morbidity, pathology, humoral immune response and serum testosterone of rams infected with *Trypanosoma vivax*.

Tropical Veterinarian, **7** (3-4): 169-176.

Oyejide, Ijagbone, Adeyemo: Faculty of Veterinary Medicine, University of Ibadan, Ibadan, Nigeria; Reynolds, Ekwuruke: ILCA, IITA Office, Ibadan, Nigeria.

This study investigated the effects of undernutrition on some parameters of the susceptibility of West African Dwarf (WAD) sheep to *T. vivax* infection. Two groups of adult male sheep consisting of ten animals each were placed on a maintenance ration (MP) and a sub-maintenance diet (LP), respectively. Subsequently, five sheep from each group were challenged with *T. vivax* organisms while the remaining five served as uninfected controls. The infection caused an acute, severe disease complicated by bronchopneumonia in the LP group. However, the majority of animals in the MP group suffered a sub-acute condition with minimal pulmonary complication. Neither the progressive decrease in PCV and plasma testosterone nor the increase in IgG antibodies to crude *T. vivax* somatic antigen detected by ELISA were significantly ($P > 0.05$) influenced by the level of nutrition.

7980 **Wassink, G.J., Momoh, I.S., Zwart, D. and Wensing, T., 1993.** The relationship between decrease in feed intake and infection with *Trypanosoma congolense* and *T. vivax* in West African Dwarf goats. *Veterinary Quarterly*, **15** (1): 5-9.

Wassink, Zwart: Department of Tropical Animal Husbandry, Agricultural University, P.O. Box 338, 6700 AK Wageningen, Netherlands; Momoh: Njala University College, Freetown, Sierra Leone; Wensing: Department of Large Animal Medicine and Nutrition of Large Animals, University of Utrecht, P.O. Box 80152, 3508 TD Utrecht, Netherlands.

Twenty-three mature Dwarf goats were used to study whether there is a relationship between the decrease in feed intake for individual goats and infection with *T. congolense* and *T. vivax*. Furthermore, it was investigated how rectal temperatures and blood parameters were affected by the *T. congolense* infection and how changes in these parameters can be used to predict the effect of a *T. vivax* infection on feed intake. For individual goats a ranking correlation was found between relative dry matter intake and infection ($r = 0.59$; $P < 0.05$).

Animals with the most marked decrease in dry matter intake during the *T. congolense* infection showed a smaller increase in urea and a higher increase in non-esterified fatty acids and β -hydroxy butyrate levels in

their blood. Evidence was obtained that the relative decrease in dry matter intake for individual goats during a *T. vivax* infection can be predicted on the basis of urea and creatinine responses measured in the blood during a previous infection with *T. congolense*.

(c) TRYPANOTOLERANCE

7981 **Agyemang, K., Dwinger, R.H., Grieve, A.S. and Bah, M.L., 1991.**

Milk production characteristics and productivity of N'Dama cattle kept under village management in The Gambia. *Journal of Dairy Science*, **74** (5): 1599-1608.

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

The objective of this study was to quantify the milk production of N'Dama cattle kept under village conditions in The Gambia as part of an epidemiological study designed to identify production constraints and to develop strategies to improve livestock productivity of farmers with smallholdings. Milk and component yields were monitored monthly by measurement of milk extracted for human use (milk offtake) plus that consumed by the calf, estimated from body weight changes. Least-squares analyses of 668 lactations recorded over 4 years gave: mean lactation length, 420 days; milk offtake, 404.3 kg; fat, 5.1%; protein, 3.2%; calf weaning weight, 88.1 kg; and calving interval, 641 days. A productivity index incorporating milk offtake, calf weaning weight, calving rate and viability gave a mean annual 140.6 kg of weaner calf plus the weight equivalent of milk offtake/100 kg of cow metabolic weight. The index was higher than that recorded for larger Zebu (*Bos indicus*) cattle managed under similar production systems elsewhere in Africa. These results show that the trypanotolerant N'Dama cattle appear to be more productive than previously thought and should therefore be considered when promoting livestock development in Africa, especially in tsetse-infested areas where other breeds cannot survive.

7982 **Hoste, C.H., 1992.** Contribution du bétail trypanotolérant au développement des zones affectées par la trypanosomiase animale africaine. [Contribution of trypanotolerant livestock to development in zones affected by African animal trypanosomiasis.] *World Animal Review*, no. 70/71: 21-29.

ISNA, P.O. Box 93375, 2509 AJ The Hague, Netherlands.

Only West and Central Africa have sufficient space, natural grazing and water resources to permit a rapid growth in animal production. Trypanosomiasis is

present in both these areas, as are trypanotolerant cattle, sheep and goats. Present and potential situations are described, with reference to the productivity of trypanotolerant livestock in terms of meat, milk and use as draught animals. Research and development priorities if this potential is to be realised include cooperation between organisations and coordination of research programmes, genetic characterisation of trypanotolerant races, the mechanisms of genetic resistance, factors limiting the reproduction and productivity of trypanotolerant breeds, control of trypanosomiasis and the identification of trypanotolerance parameters which could be used as selection criteria for breeding programmes. The countries concerned should aim to create socio-economic conditions favourable for the development of trypanotolerant livestock and to establish breeding programmes and methods for recording and analysing data.

(d) TREATMENT

7983 **Connor, R.J., 1992.** The diagnosis, treatment and prevention of animal trypanosomiasis under field conditions. *In*: FAO, 1992 (see **16**: no. 7908), pp. 1-38.

RTTCP, P.O. Box A560, Avondale, Harare, Zimbabwe. To overcome food shortages, agricultural production in Africa must be increased by 4% per annum: animal trypanosomiasis is a major constraint on achieving this goal and factors affecting its control are reviewed, including current policy and the use of direct and indirect diagnostic methods. Most of the text concerns chemotherapy and chemoprophylaxis. The present range of drugs available, their toxicity, pharmacokinetics and activity are described. Attempts to improve efficacy and factors affecting drug treatment, such as underdosing, are considered. Chemoprophylaxis is a practical approach when trypanosomiasis challenge is high: the duration of prophylaxis, the interval between prophylactic treatments, strategic and tactical chemoprophylaxis, and benefits are reviewed. The problem of drug resistance is considered with reference to its identification and assessment, *in vitro* assay, the assessment of drug resistance in the field, and the epidemiology and control of resistance. Trypanosomiasis control must be integrated with improved management to have maximum impact. Improved supervision and staff training and the involvement of

livestock producers are essential. The costs of selected methods for diagnosis and surveillance in 1990 are appended.

7984 **Mohamed-Ahmed, M.M., Rahman, A.H. and Karim, E.I.A., 1992.** Multiple drug-resistant bovine trypanosomes in South Darfur Province, Sudan. *Tropical Animal Health and Production*, **24** (3): 179-181.

ICRPE, P.O. Box 30772, Nairobi, Kenya; Veterinary Research Administration, P.O. Box 8067, El-Amarat, Soba, Khartoum, Sudan; *ibid.*

Persistent infections in 5.9% of cattle treated with trypanocides suggested drug resistance. To test this, one half of a herd of 2000 nomadic cattle was regularly treated with isometamidium chloride at 0.5 mg/kg and the other half with homidium bromide at 1.0 mg/kg during the tsetse challenge period in 1986. On leaving the tsetse belt, the cattle were treated with diminazene aceturate at 3.5 mg/kg and 2 months later examined for trypanosomes by HCT. Seven strains were isolated and maintained in goats. Infected goats were then treated with 2.5% homidium bromide, 7% diminazene aceturate or 2% isometamidium chloride and examined regularly for initial clearance of parasitaemia, relapse and permanent cure. Relapse infections were noted for all trypanosome strains treated with up to three times the recommended dose of homidium bromide or diminazene aceturate. Permanent cure was achieved with 1.5 mg/kg isometamidium chloride. Similarly, 544 cattle from the original herd were treated with 1.5 mg/kg isometamidium chloride, which effected permanent cure. These results demonstrate the presence of drug-resistant trypanosomes in South Darfur Province, which can be controlled in cattle by a single high dose of isometamidium chloride.

7985 **Onyeyili, P.A., Ameh, F.A., Adam, H.K. and Paul, B.S., 1991.**

Diminazene aceturate: plasma kinetics and effects on haematological values in goats. *Tropical Veterinarian*, **9** (3-4): 187-194.

Department of Veterinary Physiology and Pharmacology, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B. 1069, Maiduguri, Borno State, Nigeria.

Plasma kinetics of diminazene aceturate and effects of the drug on haematological values were investigated in goats. Following subcutaneous drug administration, samples of blood were collected at various time intervals. Measurable blood levels of diminazene were obtained for 24 h. The drug was readily absorbed from

the route of administration with an absorption rate constant (γ) of $8.86 \pm 2.22/h$ and was slowly eliminated from the plasma. The rate constant of elimination (β) was $0.06 \pm 0.03/h$. Diminazene aceturate was observed to produce some haematological changes in goats. Following drug administration the PCV, Hb, RBC and WBC values were elevated.

7986 **Otesile, E.B., Akpokodje, J.U. and Ekwuruke, J.O., 1991.**

Performance of a herd of Ndama cattle during and after cessation of chemoprophylaxis for trypanosomiasis.

Tropical Veterinarian, **9** (1-2): 51-54.

Department of Veterinary Medicine (Otesile) and Veterinary Surgery and Reproduction (Akpokodje), University of Ibadan, Ibadan, Nigeria; Ekwuruke: ILCA, P.O. Box 5320, Ibadan, Nigeria.

Suspension of isometamidium prophylaxis in a herd of N'Dama cattle was followed by an outbreak of *Trypanosoma vivax* infection. The disease was characterised by anaemia, significantly increased herd mortality rates, decreased birthweight of calves and retarded weight gains in 0-3 month old calves. No further losses occurred after reintroduction of chemoprophylaxis. The findings indicated that N'Dama cattle under trypanosomiasis risk can benefit from chemoprophylaxis.

7987 **Sutherland, I.A., Codjia, V., Moloo, S.K., Holmes, P.H. and Peregrine, A.S., 1992.** Therapeutic activity of isometamidium chloride in Boran cattle against a tsetse-transmitted clone of *Trypanosoma congolense* with a low level of drug resistance. *Tropical Animal Health and Production*, **24** (3): 157-163.

Sutherland, Holmes: University of Glasgow Veterinary School, Bearsden Road, Glasgow G61 1QH, UK; Codjia, Moloo, Peregrine: ILRAD, P.O. Box 30709, Nairobi, Kenya.

Experiments were conducted with a clone of *T. congolense*, IL 3580, which exhibited a low level of resistance to isometamidium chloride. Five cattle were treated i.m. with isometamidium chloride at a dose rate of 0.5 mg kg^{-1} body weight (b.w.) and challenged 28 days later with five *Glossina morsitans centralis* infected with *T. congolense* IL 3580. All five cattle and 15 untreated steers challenged on the same day became parasitaemic by day 15. Thus, at a dose of 0.5 mg kg^{-1} b.w., the prophylactic action of isometamidium chloride did not extend to 28 days following treatment. Subsequently, the 20 steers were divided into four groups of five animals each and treated with isometamidium chloride at

one of the following dose rates: 0.5 or 1.0 mg kg⁻¹ b.w. i.m. and 0.5 or 1.0 mg kg⁻¹ b.w. i.v. (groups A, B, C and D respectively). Group A consisted of the five animals that had previously been treated with isometamidium chloride. Animals relapsed in all groups except those in group B, treated i.m. with isometamidium chloride at a dose of 1.0 mg kg⁻¹ b.w. Four of the five animals in group A, treated i.m. with isometamidium chloride at a dose of 0.5 mg kg⁻¹ b.w., relapsed following a mean interval of 16 days post-treatment. Similarly, infections in all animals in groups C and D, given i.v. injections of isometamidium chloride at a dose of 0.5 and 1.0 mg kg⁻¹ b.w., respectively, were not eliminated as a result of treatment. The mean intervals to first detection of parasitaemia in these two groups following treatment were 14 and 20 days respectively. The results therefore indicate that i.v. administration of isometamidium chloride does not enhance the drug's therapeutic efficacy in the treatment of a *T. congolense* clone which expresses a low, but significant, level of resistance to isometamidium.

7. experimental trypanosomiasis

(a) DIAGNOSTICS

(b) PATHOLOGY AND IMMUNOLOGY

7988 **Bakhiet, M., Olsson, T., Edlund, C., Höjeberg, B., Holmberg, K., Lorentzen, J. and Kristensson, K., 1993.** A *Trypanosoma brucei brucei*-derived factor that triggers CD8⁺ lymphocytes to interferon- γ secretion: purification, characterization and protective effects *in vivo* by treatment with a monoclonal antibody against the factor. [Rats, mice.] *Scandinavian Journal of Immunology*, **37** (2): 165-178.

Olsson: Department of Neurology, Karolinska Institute, Huddinge Hospital, S-141 86 Huddinge, Stockholm, Sweden.

- 7989 **Ekejindu, G.O.C., Ekejindu, I.M., Olatunde, D.S. and Agbi, H.H., 1987.** Adaptation of fresh isolates of *Trypanosoma brucei gambiense* from man to rodents. [Mice, rats, rabbits, giant (pouched) rats.] *Tropical Veterinarian*, **5** (1-4): 133-138.
NITR, P.M.B. 2077, Kaduna, Nigeria.
(Correspondence to G.O.C. Ekejindu at NITR, P.M.B. 3, Vom, Plateau State, Nigeria.)
- 7990 **Eneroth, A., Bakhiet, M., Olsson, T. and Kristensson, K., 1992.** Bidirectional signals between *Trypanosoma brucei brucei* and dorsal root ganglion neurons. [Rats.] *Journal of Neurocytology*, **21** (12): 846-852.
Kristensson: Clinical Research Centre, Karolinska Institute, Huddinge Hospital, S-141 86 Huddinge, Stockholm, Sweden.
- 7991 **Gillett, M.P.T. and Owen, J.S., 1991.** Cirrhotic patients are susceptible to infection with *Trypanosoma brucei brucei* because of plasma apolipoprotein A-I deficiency. [*In vitro*; mice.] (Meeting abstract no. 116.) *Journal of Hepatology*, **13** (Suppl. 2): S31.
University Department of Medicine, Royal Free Hospital School of Medicine, Rowland Hill Street, London NW3 2PF, UK.
- 7992 **Howard, C.J., Sopp, P., Parsons, K.R., McKeever, D.J., Taracha, E.L.N., Jones, B.V., MacHugh, N.D. and Morrison, W.I., 1991.** Distinction of naive and memory BoCD4 lymphocytes in calves with monoclonal antibody, CC76, to a restricted determinant of the bovine leukocyte-common antigen, CD45. [*T. brucei*.] *European Journal of Immunology*, **21** (9): 2219-2226.
Howard: AFRC, Institute for Animal Health, Compton, Newbury RG16 0NN, UK.
- 7993 **Jungnitz, S., Hiepe, F., Kiessig, S.T., Jungmann, R. and Hiepe, T., 1992.** Autoimmunphänomene bei *Trypanosoma equiperdum*-Inokulation der Labormaus. [Autoimmune phenomena during *T. equiperdum* infection of laboratory mice.] *Berliner und Münchener Tierärztliche Wochenschrift*, **105** (6): 197-201.
Institut Parasitologie, Philippstrasse 13, 0-1040 Berlin, Germany.
- 7994 **Lomo, P.O., Makawiti, D.W. and Konji, V.N., 1993.** Respiratory activity of isolated liver mitochondria following *Trypanosoma congolense* infection in rabbits: the role of thyroxine. *Comparative Biochemistry and Physiology (B)*, **104** (1): 187-191.
Makawiti: Department of Biochemistry, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.
- 7995 **Nok, A.J., Esiebo, K.A.N., Ukoha, A.I., Ikediobi, C.O., Baba, J.,**

- Tekdek, B. and Ndams, I.S., 1992.** Kidney Na^+, K^+ -ATPase: a kinetic study in rats during chronic infection with *Trypanosoma congolense*. *Journal of Clinical Biochemistry and Nutrition*, **13** (2): 73-79.
Nok: Department of Biochemistry, Ahmadu Bello University, Zaria, Nigeria.
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Nok: Department of Biochemistry, Ahmadu Bello University, Zaria, Nigeria.
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8. trypanosome research

(a) CULTIVATION OF TRYPANOSOMES

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In order to estimate the value of population genetics for both the taxonomy of trypanosomes belonging to the species *T. brucei* and a better understanding of human African trypanosomiasis, a cellulose acetate electrophoresis isoenzyme study was undertaken involving 55 stocks isolated from man and animals in Congo, Zaire and Cameroon. Out of the 24 loci surveyed, 15 exhibited variability, which made it possible to delimit 23 zymodemes, divided into two groups. The first group equated to the classic subspecies *T. b. gambiense*, while the second corresponded to the classic subspecies *T. b. brucei*. These results broadly agree with the current taxonomy, and are corroborated by RFLP analysis of kDNA. Statistical analysis indicates a basically clonal reproduction system of the trypanosomes in the area studied; the zymodemes are equivalent to natural clones (or a family of closely related clones), stable in space and time. Epidemiological hypotheses are proposed according to the geographic distribution of the clones in this area.

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