

TSETSE AND TRYPANOSOMIASIS INFORMATION QUARTERLY

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SECTION B - ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

5688 **Cavalli-Sforza, L.T., 1987.** Nutritional implications of animal trypanosomiasis in Africa. *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 94-97.

Consiglio Nazionale delle Ricerche, c/o Istituto Nazionale della Nutrizione, via Ardeatina 546, Rome, Italy.

As the risk of contracting trypanosomiasis is much greater for a domestic animal than for a man, animal trypanosomiasis can have much greater consequences on human populations than human trypanosomiasis itself. Such consequences can be described in terms of losses and costs for man. Losses derive mainly from the decreased efficiency of production of domestic livestock due to disease and death of animals. Besides losses of meat, milk and milk products, animal trypanosomiasis greatly limits land utilisation and causes livestock to be concentrated in limited grazing areas, which results in their overuse and deterioration. The lack of livestock decreases dramatically the efficiency of agriculture, by subtracting the traction power necessary to expand the area cultivated, manure and cash income to buy essential inputs for production (seeds, pesticides, fertilisers, etc.). Another important contribution of livestock to agriculture lies in the encouragement to introduce forage legumes, which stabilise the soil, improve crop yields, reduce artificial nitrogen requirements and provide high-protein animal feed. The costs of animal trypanosomiasis for man include those of detection and treatment of infected animals, of preventive operations and of research on animal trypanosomiasis control. All these expenditures subtract a very substantial amount from the already limited existing resources, which could be used differently to improve human nutrition. Given the multiple effects of animal trypanosomiasis on the environment and on human development, tsetse control strategies need to be planned carefully in the context of the general development process.

Author's abstract

5689 **Ferguson, W., 1988.** Factors influencing the production potential of trypanotolerant livestock. *In: ILCA/ILRAD, 1988* (see **12**: no. 5692), pp. 187-209.

Via F. Domenico Guerrazzi, no. 12, int. 2, Monteverde Vecchio, Rome, Italy.

The paper briefly reviews the agricultural potentials of the areas infested by tsetse fly and the factors which have been influencing the trends in trypanosomiasis and other animal disease risk over recent decades. It also reviews the impact of demographic trends on agricultural practice and the influence this will probably have on breed selection, with particular reference to the subhumid zone of West Africa where trypanotolerant livestock are relatively widely distributed and scope for agricultural and livestock development is high by African standards. The conclusion is drawn that one of the main factors which will influence the potential role of trypanotolerant livestock generally will be the rate of progress achieved in control of trypanosomiasis and streptothricosis. In more area-specific terms, the rate of increase in population density and adoption of more intensive land use practices will greatly influence the scale of adoption of trypanotolerant breeds.

Breed selection is more likely to be determined by farmers than by governments or technical advisory agencies. In situations where trypanosomiasis and streptothricosis can be economically controlled and population density is high, non-trypanotolerant breeds may be preferred for traction and/or milk production. Proposals are made for closer study of socio-economic factors likely to influence the economic role of trypanotolerant breeds.

From author's abstract

5690 **Finelle, P., 1987.** The African animal trypanosomiasis: economic implications. The FAO Programme of Action. *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 91-93.

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

After a short introduction on the world-wide distribution of animal trypanosomiasis, the report considers the economic consequences of African animal trypanosomiasis, transmitted by the tsetse fly, and the control techniques currently used. Then it describes the Programme for the Control of African Animal Trypanosomiasis and Related Development, launched by FAO in response to a recommendation of the World Food Conference (Rome, 1974). In 1984, the strategy of the Programme was modified to take into account the current economic situation. It now concentrates on priority areas selected according to needs for new land, increased food production, technical and economic feasibility and prospects for funding. It promotes the use of simple control techniques and gives emphasis to the integration of control activities in rural development programmes.

Author's abstract

5691 **Haan, C. de, 1988.** Research requirements for livestock development in tsetse-affected areas. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 459-465.* World Bank, 1818 H Street, N.W. Washington, DC 20433, USA.

The tsetse-infested savannas are Africa's only remaining land resource with good physical potential. However, the ecology of the zone is extremely fragile and sustainable mixed-farming systems, supported by more appropriate land tenure systems, need to be urgently developed. With a decreasing tsetse challenge in many areas, livestock production in these areas is increasingly being based on trypanosensitive Zebus kept under chemoprophylaxis, supported by other control methods like traps and screens. The increased use of trypanocidal drugs by non-professionals, linked with this development, requires careful producer training and monitoring to avoid chemoresistance. For the trypanotolerant breeds, emphasis should be on a more rational use of the existing population, not only in meat production but especially in milk and traction and on a concerted effort to find ways of enhancing their reproductive efficiency.

Author's abstract

5692 **International Livestock Centre for Africa/International Laboratory for Research on Animal Diseases, 1988.** *Livestock production in tsetse affected areas of Africa.* Proceedings of a meeting of the African Trypanotolerant Livestock Network held in Nairobi, Kenya, 23-27 November 1987, organised by ILCA and ILRAD. Nairobi; ILCA/ILRAD. 473 pp. Abstracts available, in English and French, in a separate book, 75 pp.

ILCA, P.O. Box 46847, Nairobi, Kenya; ILRAD, P.O. Box 30709, Nairobi, Kenya.

Abstracts of most of the papers presented at this meeting are in section 6a-d of this issue of *TTIQ*. The remainder will be found in sections 1 (nos. 5689, 5691, 5693, 5694, 5695, 5696, 5698, 5699, 5701, 5702), 2c (no. 5716), 3 (no. 5718) and 4 (nos. 5719, 5721, 5722, 5723, 5727). Because of the collaborative nature of the research reported in these proceedings, papers sometimes have up to 35 authors. In such cases, an exception has been made to *TTIQ*'s usual practice of including the names of all authors, and '*et al.*' has been used instead.

5693 **Itty, P., 1988.** Modelling possible effects of strategic nutritional interventions on national N'Dama cattle production in The Gambia. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 404-410.

ILCA, P.O. Box 46847, Nairobi, Kenya.

The Gambian cattle population totals approximately 300,000 head and while its current level of production is considered satisfactory, increased productivity is required as maximum stocking rates are thought to have been reached, and demand for beef and milk is rising due to an annual 3% increase in human population. A simulation model of the national cattle herd production is used to observe the responses to strategic nutritional interventions. The assumed resulting improvements in reproductive performance and viability would allow a mean annual increase of 3% in cattle production to be achieved during a 10 year period, matching the growing human requirements, with the herd size remaining constant.

From author's abstract

5694 **Jahnke, H.E., Tacher, G., Keil, P. and Rojat, D., 1988.** Livestock production in tropical Africa, with special reference to the tsetse-affected zone. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 3-21.

Jahnke, Keil: International Agricultural Development Technical University, Im Dol 27-29, D-1000 Berlin 33, Federal Republic of Germany; Tacher, Rojat: IEMVT, 10 rue Pierre-Curie, 94700 Maisons-Alfort, France.

Tropical Africa, of which 40% is tsetse-infested, supports 161 million cattle and 264 million small ruminants (sheep and goats), as well as 12 million camels, 12 million equines, 10 million pigs and some 460 million chickens. Although the cattle per caput ratio is almost as high in Africa as in the developed world and the small ruminant per caput ratio is considerably higher, productivity is much lower in Africa: 14 kg meat per head of cattle and 3.7 kg per head of small ruminant compared with 79 kg and 6.5 kg respectively in the developed world, and 90 l milk per head of cattle versus 900 l. Furthermore 66% of the population is agricultural in Africa versus 10% in developed countries. Cattle are most numerous in the semi-arid regions, sheep and goats in the arid regions. Ruminant densities are highest in the highlands because of their good bio-climatic conditions. The function of livestock is multiple, their economic and social importance depending on the production system: meat and milk in pastoral systems, labour and manure in agropastoral systems, as well as saving and social considerations, monetary income in modernised production systems.

Improvement of livestock production and productivity has to cope with constraints of capital and scarcity of energy. The major environmental constraints are aridity and diseases, mainly trypanosomiasis in semi-humid areas.

Eliminating trypanosomiasis is estimated to result in an additional 1 million tons of meat-equivalents per year. Currently Africa is confronted by a deficit in both meat and dairy products and the gap between supply and demand seems likely to worsen, making improvement of livestock production imperative. Development initiatives should be based mainly in the traditional sector, with incentive price policies. Trypanosomiasis control is justified only if the benefits exceed the costs, and the choice between different methods (tsetse control, trypanocidal drugs, use of trypanotolerant breeds) depends on local conditions.

5695 **McIntire, J., 1988.** Introduction to economic analysis in the African Trypanotolerant Livestock Network. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 350-359.*

ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

The Network has a comprehensive and comparative set of animal production data on which to estimate rates of return to interventions - breed introduction, substitution and improvement, disease control and improved nutrition - aimed at increasing livestock productivity in areas with different levels of trypanosomiasis risk. The economic studies will utilise a microcomputer herd model developed at ILCA which carries out two types of analyses: one static and one dynamic. The static approach utilises mean productivity values for a single year. The economic rate of return per breeding cow in that year is the indicator of profitability. The dynamic analytical approach calculates herd structure and output projections over many years and produces frequency distributions of the latter. This is particularly appropriate in livestock production, where reproductive performance and cumulative effects can only be fully taken into account over a number of years.

From author's abstract

5696 **Plucknett, D.L. and Smith, N.J.H., 1988.** The potential of collaborative research networks in developing countries. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 22-30.*

CGIAR Secretariat, World Bank, 1818 Street, N.W. Washington, DC 20433, USA.

Agricultural research networks are increasing in number and scope, particularly in developing countries. Four main types of networks are used to support research or research-related activities: information exchange, material exchange, scientific consultation, and collaborative research. Although collaborative research networks are highly desirable because scientists in jointly-planned research ventures pool their resources and talents and participate in planning and policy formulation, in reality there are few such networks operating. The African Trypanotolerant Livestock Network exemplifies true collaborative research and has many lessons to offer. The benefits, planning and pitfalls of networks are discussed.

Based on authors' abstract

5697 **Poli, G. and Rognoni, G., 1987.** Tripanosomiasi animale. [Animal trypanosomiasis.] *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 79-84.

Istituto di Microbiologia e Immunologia Veterinaria, Università di Milano, Milan, Italy; Istituto di Zootecnica, Facoltà Medicina Veterinaria, Università di Milano, Milan, Italy; C.N.R.-Istituto per la Difesa e Valorizzazione del Germoplasma Animale, Milan, Italy.

African animal trypanosomiasis causes the death of more than 3 million cattle each year and renders uninhabitable for these animals 10 million km² of the most fertile land. This review, after some general considerations, considers the up-to-date knowledge of the trypanosome life-cycle and the pathogenesis of the disease. Particular emphasis is given to antigenic variation, a phenomenon that allows the parasite to escape the immune response of the host. Classic and new diagnostic techniques are reported, and also prophylactic and therapeutic treatments both in use and under study for possible future application. The review concludes with the description of particular cattle populations which possess some degree of resistance to trypanosomiasis (trypanotolerant breeds) and the proposed coordinated programmes for their selection and diffusion, including the use of the embryo transfer technique.

Authors' abstract

5698 **Schuetterle, A. and Coulibaly, M., 1988.** The socio-economic aspects of livestock production in villages in northern Côte d'Ivoire. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 389-398.*

SODEPRA/GTZ/CIPEA, B.P. 143, Boundiali, Côte d'Ivoire.

Planners often give primary attention to the technical aspects of production.

However, it is the socio-economic aspects that play a key role in farmers' decision making, and these are discussed with particular reference to data from the Boundiali region of northern Côte d'Ivoire.

5699 **Tacher, G., Jahnke, H.E., Rojat, D. and Keil, P., 1988.** Livestock development and economic productivity in tsetse-infested Africa. *In: ILCA/ILRAD, 1988. (see 12: no. 5692), pp. 329-349.*

Tacher, Rojat: IEMVT, 10 rue Pierre-Curie, 94700 Maisons-Alfort, France;

Jahnke, Keil: International Agricultural Development Technical University, Im Dol 27-29, D-1000 Berlin 33, Federal Republic of Germany.

Trypanosomiasis is not only a constraint for livestock development but for rural development in general. Because its importance depends greatly on local conditions, the fight against trypanosomiasis must be related to the overall agricultural planning policy. The main economic technique to evaluate trypanosomiasis control programmes is the cost-benefit analysis. Unfortunately full comparisons between the rare economic studies are difficult since calculations are not sufficiently standardised. Three main types of control programmes are currently available. 1. Tsetse eradication or control by insecticide spraying, use of traps and screens and the sterile insect technique (SIT). The costs of insecticide spraying or SIT appear to be in general higher than those of traps and screens but this may vary with the area and the time period considered. Cost-benefit analysis shows that eradication may be economically feasible. 2. The use of drugs to protect or treat non-tolerant cattle has shown some good results in ranching situations when tsetse challenge is not too high, but it is difficult to manage in traditional production systems. Prophylaxis appears to be better than treatment as trypanosomiasis challenge increases, but it must face the risk of resistance. The use of drugs is superior to tsetse eradication or control only in low trypanosomiasis challenge. 3. The use of trypanotolerant livestock is the only economical solution if the level of permanent trypanosomiasis challenge is high, when their productivity is greater than that of zebu cattle. The conclusions and recommendations are: to introduce an economic component at

each stage of trypanosomiasis control or research; to try and standardise the methodology for economic appraisals; to classify in the economic analyses costs to be paid in local or foreign currencies; to define more precisely the trypanosomiasis challenge, perhaps through a continuing epidemiological index, in order to improve the precision and comparability of economic calculations; to maintain advantages gained through eradication campaigns by improved training and information campaigns.

From authors' abstract

5700 **Thompson, G.A., 1988.** *African trypanosomiasis research, 1900-1985: growth and bibliometric characteristics.* Master in Library Science thesis, Ahmadu Bello University, Zaria, Nigeria. 163 pp.

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

This study was designed to elucidate the growth and bibliometric characteristics of a typical biomedical discipline, namely African trypanosomiasis. A number of questions instigated the project. Some aspects of the pattern of growth are still enigmatic because no studies have focused on the multidisciplinary nature in terms of the growth of the components. Does each component grow exponentially, linearly or otherwise? How does the growth of each component relate to the overall? Does the author productivity pattern fit Lotka's law? Also, does literature dispersion corroborate Bradford's law? Based on the journal productivity pattern, which journals can be acquired for cost-effective and cost-benefit information services? Besides, what effect has FABIT (Far-Back-In-Time) analysis of the literature on the rank of journals? How do the authors collaborate in producing the papers? What is the pattern of multiple authorship in relation to single authorship? A total of 5139 articles, 1900-1985, were analysed from *Tropical Diseases Bulletin* and *Tsetse and Trypanosomiasis Information Quarterly (TTIQ)* using the counting method. African trypanosomiasis literature, earlier characterised by a fluctuating growth, is now one of steady infective exponential growth with a 53-year doubling rate. The decennial average growth rate was about 73% while the average cumulative growth rate was about 48%.

All the literature components grow exponentially. The most active are Entomology (70-year doubling) and Parasitology (60-year doubling). The overall exponential growth seemed derived by superimposing each component on and above each other, implying a compounding of exponential growth. Lotka's law does not apply in its original form. However, it does apply in the generalised form with exponent of 2.03 when tested with K-S statistical test. The maximum difference in the observed and estimated values of the proportion of the authors was highly insignificant at 0.01 level. The core journals were determined, based on the Bradford-Zipf bibliograph. Twelve titles contributed 50% of the articles, 72 published 75% while 240 titles published 90%. The degree of overlap, C, between the FABIT list and the 1965-85 list is 0.90. The coefficient of correlation, R, is 0.93, showing a high degree of relatedness. Single author papers were 38.51% while 61.49% (3160) were multiple author. The degree of collaboration as indicated by the weighted average is 2.19. The average number of authors per paper is between 2 and 3, though there is an indication of a tilt beyond this.

Author's abstract

5701 **Trail, J.C.M., 1988.** Network research: future developments. *In:* ILCA/ILRAD, 1988 (see **12:** no. 5692), pp. 466-473.

ILCA, P.O. Box 46847, Nairobi, Kenya.

To help in visualising the overall research area, a problem tree was drawn up, indicating researchable areas. The present situation within the African Trypanotolerant Livestock Network is summarised in a matrix which shows the 14 sites in the Network whose activities make up the projects which fall within four major themes: trypanosomiasis epidemiology, trypanotolerance, genetics of trypanotolerance, and biological and economic evaluation of productivity responses to interventions. The implications of the overall research aims are discussed, particularly with regard to the likely time scales.

5702 **Wissocq, N.M., Bell, R., Durkin, J., Gettinby, G., Light, D.E. and Trail, J.C.M., 1988.** IDEAS: a tool for improved evaluation and utilization of animal genetic resources. *In:* ILCA/ILRAD, 1988 (see **12:** no. 5692), pp. 449-455.

Wissocq, Trail: ILCA, P.O. Box 46847, Nairobi, Kenya; Bell: 187 Adventure Drive East, Whitby, Wellington, New Zealand; Durkin, Light: ILCA, P.O. Box 5689, Addis Ababa, Ethiopia; Gettinby: Department of Mathematics, University of Strathclyde, 26 Richmond Street, Glasgow G1 1XQ, UK.

IDEAS (ILCA's Data Entry and Analysis System) is a micro-computer-based animal performance recording package that has been designed for use in livestock production research and development situations in Africa. It has been produced because no data entry system has previously offered an integrated approach to recording and analysing all biological facets of animal production operations. IDEAS, with its interconnected database approach, meets this requirement. It has been designed for maximum ease of usage and to run on an individual farm to the point where all logical herd-level decisions can be made without having access to large computer facilities.

From authors' abstract

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

5703 **Agatsuma, T. and Otieno, L.H., 1988.** Isoenzyme studies on two field populations of *Glossina pallidipes* Austen (Diptera, Glossinidae) in Kenya. *Insect Science and its Application*, **9** (4): 527-530.

Department of Parasitology, Kochi Medical School, Oko, Nankoku, Kochi 781-51, Japan; ICIPE, P.O. Box 30772, Nairobi, Kenya.

Electrophoretic studies were carried out on isozymes of *G. pallidipes* to determine whether there are any genetic differences between natural populations from an area free of sleeping sickness (Nguruman) and an area where sleeping sickness is endemic (Lambwe Valley) in Kenya. Out of 12 enzymes examined, two

enzymes, GPI and PGM, showed high polymorphism in the two populations, while the other 10 enzymes were all monomorphic. At the GPI locus, at least five alleles were detected, and two alleles were found at the PGM locus. There was a difference in the frequency of isozyme patterns between males and females, indicating that the PGM locus is on the sex-linked chromosome (X-chromosome). Nei's genetic distance (D) was 0.00154 between the two populations, which is the value within the range for local populations in different organisms examined so far. Some difference between the two populations was found in the level of average heterozygosity (H) and in allelic composition of the GPI locus, that is, the Lambwe Valley population is more heterogeneous than the Nguruman population. Authors' abstract

5704 **Carlson, D.A., 1988.** Hydrocarbons for identification and phenetic comparisons: cockroaches, honey bees and tsetse flies. *Florida Entomologist*, **71** (3): 333-345.

Insects Affecting Man and Animals Research Laboratory, USDA, ARS, Gainesville FL 32604, USA.

Distinctive patterns and quantities of cuticular alkanes were seen in gas chromatography data of 26 species and subspecies of tsetse flies using dried museum and fresh specimens. A phenogram for *morsitans* and *palpalis* group *Glossina* based on these data showed phenetic separations which agreed quite well with recognised group classifications based on traditional morphological and genetic information.

5705 **Endege, W.O., Lonsdale-Eccles, J.D., Olembo N.K., Moloo, S.K. and ole-MoiYoi, O.K., 1989.** Purification and characterization of two fibrinolysins from the midgut of adult female *Glossina morsitans centralis*. *Comparative Biochemistry and Physiology (B)*, **92** (1): 25-34.

Endege, Lonsdale-Eccles, Moloo, ole-MoiYoi: ILRAD, P.O. Box 30709, Nairobi, Kenya; Endege, Olembo: Department of Biochemistry, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.

Adult female tsetse flies, *G. m. centralis*, have at least five midgut fibrinolytic proteases, the two most active of which we have purified using DE-52 cellulose. The purified proteases appeared as single bands in sodium dodecylsulphate polyacrylamide gels and had molecular weights of 24,000 and 23,500 and pI values of 6.0 and 5.3, respectively. Both proteases hydrolyse Tosyl-Gly-Pro-Arg-pNA optimally at pH 8.0 (with K_m of 20 and 30 μ M) and were inhibited by diisopropylfluorophosphate, α - p^m rotease inhibitor, aprotinin, soybean trypsin inhibitor, benzamidine and tosyllysine chloromethylketone. Compared to bovine plasmin, these enzymes digest fibrinogen or fibrin at a slower rate but give similar products. Thus these enzymes are serine proteases similar to the trypsin-like enzymes detected in *G. m. morsitans*.

Authors' abstract

5706 **Gooding, R.H., 1989.** Genetics of two populations of *Glossina morsitans centralis* (Diptera: Glossinidae) from Zambia. *Acta Tropica*, **46** (1): 17-22.

Department of Entomology, University of Alberta, Edmonton, Alberta, Canada T6G 2E3.

G. m. centralis was collected from the main fly belt west of Mumbwa, Zambia, and from the apparently isolated 'Keembe pocket' and 11 gene-enzyme systems were examined by polyacrylamide gel electrophoresis. There were no significant differences in allele frequencies among flies collected entering a vehicle, from fly-rounds, or from F3 traps in the main fly belt. Mean heterozygosity per locus is slightly higher in flies from the main fly belt than it is in flies from the 'Keembe pocket'. Allele frequencies at loci for xanthine oxidase (*Xo*), aldehyde oxidase (*Ao*) and a thoracic esterase (*Est-2*) were significantly different in the two populations and it is concluded that there is little gene flow between them.

Author's abstract

5707 **Gooding, R.H., Rolseth, B.M. and Tarimo, S.A., 1988.** Genetics of *Glossina morsitans morsitans* (Diptera: Glossinidae). XIII. Mapping the locus for tetrazolium oxidase in linkage group I and refinement of the linkage group II map. *Genome*, **30** (6): 885-887.

Department of Entomology, University of Alberta, Edmonton, Alberta, Canada T6G 2E3; *ibid.*; ICIPE, P.O. Box 30772, Nairobi, Kenya.

The locus for tetrazolium oxidase, *To*, is mapped at 4.3 \pm 1.3 recombination units from the locus for arginine phosphokinase, *Apk*, in linkage group I, and the distance between the eye colour locus, *sal*, and *Apk* is confirmed to be about 39.5 \pm 3.2 recombination units. In linkage group II the loci for aldehyde oxidase, *Ao*, and for two esterases are arranged in the order *Ao Est-1 Est-2* with 3.5 \pm 1.2 recombination units separating *Ao* and *Est-1* and 8.3 \pm 1.8 recombination units separating *Est-1* and *Est-2*.

Authors' abstract

5708 **Hardie, R., Vogt, K. and Rudolph, A., 1989.** The compound eye of the tsetse fly (*Glossina morsitans morsitans* and *Glossina palpalis palpalis*). *Journal of Insect Physiology*, **35** (5): 423-431.

Max-Planck-Institut für Biologische Kybernetik, Spemannstrasse 38, D-7400 Tübingen, Federal Republic of Germany; Hardie, Rudolph also: Department of Zoology, Cambridge University, Cambridge, UK; Vogt also: Department of Biology, Freiburg University, Freiburg, Federal Republic of Germany.

(Correspondence to Hardie at Cambridge address.)

We have examined the retina of the tsetse fly *G. morsitans* and *G. palpalis* using anatomical, optical, biochemical and electrophysiological techniques. The eye is basically very similar to those of other higher Diptera such as *Musca* and *Calliphora*. The ommatidial organisation has an open rhabdom arrangement typical of a neural superposition eye. The central rhabdomeres R7 and R8 are smaller in diameter than peripheral rhabdomeres (R1-6) except at the dorsal margin of the eye, where they are greatly enlarged. The number of secondary pigment cells is unusually large with 16-18 surrounding each ommatidium. The facet lenses are also unusually thick with a weakly curved outer surface and a strongly convex inner surface. It is shown how this gives rise to the characteristic striped reflections from the tsetse eye by total internal reflection, and possible functions for this are considered. As in most other dipterans, the visual pigment chromophore is 3-hydroxy retinal, and an ultraviolet sensitising pigment, 3-hydroxy retinol, is present also. Photoreceptor cells R1-6 have a similar spectral sensitivity to those in *Musca*, although the position of the green peak (500 nm) is some 10 nm longer. Two spectral classes of R7 correspond to the so-called 7y and 7p cells in *Musca*, with predominantly ultraviolet sensitivity, and the spectral

sensitivity of the R8 cells encountered resembles that of so-called 8y cells (λ max 520 nm). Due to a dietary deficiency, the eyes of flies raised on porcine blood contain no traces of C₄₀ carotenoids. This is correlated with the observation that the spectral sensitivity⁴⁰ of both 7y and 8y cells are systematically higher in the blue (400-500 nm) than their counterparts in *Musca* or *Calliphora*.

Authors' abstract

5709 **Kokwaro, E.D. and Murithi, J.K., 1988.** Ultrastructural characteristics of the ejaculatory duct of the male tsetse, *Glossina morsitans morsitans* Westwood. *Insect Science and its Application*, **9** (4): 475-482.

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

The ultrastructural changes in the ejaculatory duct epithelium in *G. m. morsitans* were examined for special features related to spermatophore formation; special attention was paid to the cytoplasmic organelles and the plasma membrane specialisations (apical infoldings and space formation). Internally, the transportation system is characterised by a cuticle-lined lumen bordered by cuboidal cells. The endoplasmic reticulum is scarce, while mitochondria are distributed throughout the cytoplasm. At the cuticular surface of the cells, extensive apical infoldings are associated with numerous mitochondria.

Glycogen granules are found only in the cytoplasm of teneral flies. Apically, adjacent cells are tightly apposed; however, prominent intercellular spaces develop (1-7 days), permeate most of the epithelium and connect to the basal surface of the cells. These are features characteristic of transporting cells believed to have an absorptive function. As the adult fly ages, the ultrastructural characteristics of the epithelium change and are typified by the disappearance of glycogen granules and the formation of intercellular spaces. The features of the ejaculatory duct are discussed briefly in terms of their role in spermatophore formation.

Authors' abstract

5710 **Kongoro, J.A. and Odhiambo, T.R., 1988.** Functional ultrastructure of Malpighian tubules of tsetse, *Glossina morsitans morsitans* Westwood (Diptera: Glossinidae). *Insect Science and its Application*, **9** (4): 563-571.

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

The tsetse, *G. m. morsitans*, has two pairs of Malpighian tubules. Ultrastructurally, the tubules consist of three recognisable functional zones: the distal, intermediate and proximal regions, which are characterised by three distinct cell types: I, II and III respectively. The three cell types had numerous microvilli and basal infoldings: the microvilli of type I and II cells were associated with long mitochondria, while those of type III were devoid of mitochondria. Autoradiographic observations using (³H) glucose indicated that there was synthetic activity in the tubules, and that there was greater incorporation of the radiochemical in the distal and intermediate tubule regions than in the proximal region. The distal and intermediate regions have some functional similarities. With regard to primary urine formation in the tubules,

it is suggested that the cell types I and II (and hence the distal and intermediate regions) are secretory, and the cell type III (that is, the proximal region) is absorptive. 'Canaliculi' in the proximal region increase the surface area for absorption.

Authors' abstract

5711 **Mwangi, R.W. and Awiti, L.R.S., 1989.** Hypertrehalosaemic activity in corpus cardiacum-corpora allatum-aorta complex and adipokinetic response of *Glossina morsitans*. *Physiological Entomology*, **14** (1): 61-66.

Department of Zoology, University of Nairobi, P.O. Box 30197, Nairobi, Kenya; ICIPE, P.O. Box 30772, Nairobi, Kenya.

Extracts from the corpus cardiacum-corpora allatum-aorta (CC-CA-A) complex of *G. m. morsitans* contain a hypertrehalosaemic factor when assayed in *Periplaneta americana* and in *G. morsitans*. A slight though significant decrease, followed by an increase, in haemolymph total carbohydrate occurs when tsetse are flown for 1 h. When assayed in *Locusta migratoria*, the extracts have no adipokinetic activity, but *L. migratoria* corpus cardiacum extract produces an adipokinetic response in the female tsetse. It is suggested that the neurosecretions contained in the tsetse CC-CA-A complex contain a hypertrehalosaemic factor whose role is to mobilise glycogen.

Authors' abstract

5712 **Saini, R.K., Hassanali, A. and Dransfield, R.D., 1989.** Antennal responses of tsetse to analogues of the attractant 1-octen-3-ol. *Physiological Entomology*, **14** (1): 85-90.

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

Antennal movement responses of male *Glossina morsitans morsitans* to twelve analogues of the tsetse olfactory attractant 1-octen-3-ol were investigated to determine their structure-activity relationships. The results indicate that the chemoreceptors which perceive this set of kairomones may not be highly specific. Activity is dependent on the length of the alkyl chain; also homologues with odd alkyl chains such as 3-buten-2-ol, 1-hexen-3-ol and 1-octen-3-ol evoked higher antennal responses than homologues with even alkyl chains such as 1-nonen-3-ol, 1-hepten-3-ol and 1-penten-3-ol. Comparison of the activities of eight carbon structural variants of 1-octen-3-ol showed that the structural requirements for activity of the functional end of the molecule may not be rigid; thus, 1-octyn-3-ol elicited relatively high responses. However, low responses to 1-octene and 3-octanol showed that both the π electron system as well as the oxygen function are important for activity. Laboratory bioassay findings indicate that compounds such as 1-octyn-3-ol, 3-buten-2-ol, allyl alcohol and 1-octen-3-one which evoke

antennal responses 2-3 times greater than the control have attractive properties and preliminary field investigations show that 3-buten-2-ol and allyl alcohol significantly increase trap catches.

Authors' abstract

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

5713 **Colvin, J., Brady, J. and Gibson, G., 1989.** Visually-guided, upwind turning behaviour of free-flying tsetse flies in odour-laden wind: a wind-tunnel study. *Physiological Entomology*, **14** (1): 31-39.

School of Animal Biology, University College of North Wales, Bangor, Gwynedd, LL57 2UW, UK; Imperial College, Silwood Park, Ascot, Berks, SL5 7PY, UK; Department of Entomology, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK. (Correspondence to Brady.) To test the hypothesis that tsetse flies use visual input from the apparent movement of the ground to assess wind direction while in flight, *Glossina morsitans morsitans* females were video-recorded in a wind-tunnel as they entered, in cross-wind flight, a broad plume of simulated host odour (CO₂ at c. 0.05%). The tunnel (2.3 × 1.2 m wide) generated winds up to 0.25 m s⁻¹ and had a strongly patterned floor that could be moved upwind or downwind to increase or decrease the visual input due to wind drift. Flight tracks were analysed for speed, direction relative to the wind, and angle of turn. Mean groundspeeds were c. 1.8 m s⁻¹. In control measurements in still air (with or without odour) flies turned 50:50 'upwind': 'downwind'. With a 0.25 m s⁻¹ odour-permeated wind, 79% turned upwind, and c. 70% left view flying upwind. When the floor was moved at 0.25 m s⁻¹ upwind (to mimic the visual input from the ground due to a 0.5 m s⁻¹ wind), the strength of this response increased. If instead the floor was moved downwind, faster than the wind speed (to mimic the visual input due to a wind from the opposite direction), 59% turned downwind and c. 70% left view flying downwind, and thus away from the source (though progressing 'upwind' in terms of the visual input from apparent ground pattern movement). Upwind turns were on average significantly larger than downwind turns. It is concluded that tsetse navigate up host odour plumes in flight by responding to the visual flow fields due to their movement over the ground (optomotor anemotaxis), even in weak winds blowing at a fraction of their groundspeed.

Authors' abstract

5714 **Dransfield, R.D., Brightwell, R., Kiilu, J., Chaudhury, M.F. and Adabie, D.A., 1989.** Size and mortality rates of *Glossina pallidipes* in the semi-arid zone of southwestern Kenya. *Medical and Veterinary Entomology*, **3** (1): 83-95.

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

Seasonal changes in the mean size of tsetse, *G. pallidipes*, as indicated by wing vein length, were monitored during 1983-86 at Nguruman, southwestern Kenya. Changes in size of nulliparous females and wing fray category 1 males were shown to be correlated with the relative humidity 2 months before they were captured. Soil temperature when flies were in the pupal stage had much less effect. Size-dependent mortality was demonstrated, with the mean size of flies

emerging from pupae significantly less than that of field-caught flies. This mortality must occur at emergence, since there was no evidence of size-dependent mortality once the flies became available to the trap. Size was correlated with density-independent mortality acting on the parent population 2 months previously. It might therefore be possible to use size as an index of the intensity of such mortality. This could be useful when assessing the level of additional mortality required to suppress tsetse populations.

Authors' abstract

5715 **Green, C.H., 1989.** The use of two-coloured screens for catching *Glossina palpalis palpalis* (Robineau-Desvoidy) (Diptera: Glossinidae). *Bulletin of Entomological Research*, **79** (1): 81-93.

TRL, University of Bristol, School of Veterinary Science, Langford, Bristol BS18 7DU, UK.

Designs for insecticide-impregnated screens based on combinations of two different colours were evaluated for their attractiveness to *G. p. palpalis* in Côte d'Ivoire. Screens were tested with flanking panels of mosquito netting (flanked screens) and without such panels (simple screens), using electric nets to catch flies contacting cloth of various colours or mosquito netting. No flanked screen caught more flies than an all-blue single-coloured screen; flanked screens without blue portions generally had lower catches than those with blue portions. The majority of flies was always caught over the netting panels rather than over the cloth screens, although the proportions varied for different colours. Among simple screens, one half phthalogen blue and half ultraviolet-reflecting white caught 2.4 times as many female flies as an all-blue screen and 3.6 times as many as an all-white (ultraviolet-reflecting) screen. The basis for this synergistic effect is that blue attracts flies strongly to a position near the target (e.g. circling), while the white induces landing responses; in the blue-and-white simple screens, 77% of all tsetse landed on the white surface. Several other colour combinations in simple screens gave similar results to the blue-and-white screen for female flies, for example black-and-white, and one of the blue-and-light-blue combinations. For males, the best combination for simple screens was blue and black. In tests of different configurations of blue and ultraviolet-white on simple screens, most flies were caught using a diagonally-divided screen, the lower triangular portion being white and the upper one blue.

Author's abstract

5716 **Tikubet, G. et al., 1988.** Odour attractants for *Glossina pallidipes* in south-western Ethiopia. In: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 125-129. ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

Latin square trials were carried out in the Ghibe valley in south-western Ethiopia to compare the effectiveness of different odour attractants and the Ngu and biconical traps for *G. pallidipes*. The Ngu trap baited with acetone and cow urine showed significant increases (4.8-fold for male flies, 7.5-fold for females) over the unbaited biconical trap. Biconical traps baited with acetone and either cow or pig urine give significant increases over unbaited biconical traps (cow urine, 2.6-fold increase for male flies, 4.6-fold for females; pig urine, 2.6-fold for males and females). Biconical traps baited with acetone and either hippo dung or octenol yielded higher catches than unbaited biconical traps but the increases were not significant.

5717 **Torr, S.J., Parker, A.G. and Leigh-Browne, G., 1989.** The responses of *Glossina pallidipes* Austen (Diptera: Glossinidae) to odour-baited traps and targets in Somalia. *Bulletin of Entomological Research*, **79** (1): 99-108.

ODNRI, Central Avenue, Chatham Maritime, Chatham, Kent, ME4 4TB, UK;
ODA Tsetse Transition Phase, c/o British Embassy, P.O. Box 1036, Mogadishu, Somalia; *ibid*.

Studies were carried out at Jilaal Moogi, south-eastern Somalia, of the responses of *G. pallidipes* to traps and targets. F3 traps caught three times as many tsetse as a biconical trap. Baiting F3 traps with acetone (released at 5-50,000 mg/h), butanone (10-50 mg/h) or octenol (0.05-5 mg/h) either alone or as mixtures did not affect the catch significantly. The catch was increased by 1.6 times ($P < 0.05$) by releasing a mixture of 4-methylphenol (at 0.2 mg/h) and 3-*n*-propylphenol (0.04 mg/h), and by four times by releasing a mixture of acetone (500 mg/h), octenol (0.5 mg/h) and the two phenols. Baiting a target enclosed in an electric net with the combination of acetone, octenol and phenols increased the catch only 1.3 times, ($P > 0.05$). Baiting an electric net plus target with natural ox odour increased the catch 1.8 times ($P < 0.05$). A pthalogen blue (peak reflectivity = 40% at 450 nm) target caught 1.7 times as many tsetse as a black target ($P < 0.01$) and a standard blue (reflectivity = 29%) target caught 7.4 times the catch of a yellow one ($P < 0.001$). The results are compared with published data from Zimbabwe, Kenya and Mozambique, and it is noted that the level of response of *G. pallidipes* in Somalia to host odours is lower than elsewhere.

Authors' abstract

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE EFFECTS)

5718 **Küpper, W., 1988.** Tsetse control by means of insecticide impregnated biconical traps: results of five consecutive campaigns in Côte d'Ivoire. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 63-69.

Projet Ivoirien-allemand de Lutte contre le Trypanosomiase et les Tsetse, B.P. 45, Korhogo, Côte d'Ivoire.

During five consecutive campaigns using biconical traps, populations of *Glossina palpalis* and *G. tachinoides* were controlled in an area of 13,000 km². The degree of control varied according to the species and the number of campaigns which had already taken place, but was high from the start, 96-98% fly reductions within 2 months and 99% towards the end of a campaign. Due to climatic and environmental conditions all traps have to be withdrawn during the rainy season of 3-4 months which results in a population recovery of about 3%. Observations on sex composition and age structure of target populations, prior to and during a campaign, showed that the female portion of the population declined faster than the male and older females disappeared faster than younger. Trypanosomiasis monitoring in sentinel herds proved the technique's ability to control the disease: 25% mean herd infection rate at the beginning of the campaign, 3.5% after one campaign, 2.9% after the second campaign. That trypanosomiasis control through tsetse control is economically feasible, is proved by the fact that the overall costs of the campaign per head equals one Berenil treatment or in monetary terms 0.25 US \$ per ha per year. While this technique allows a rapid and economical control

of animal trypanosomiasis, it must be kept in mind that it has to be applied every year, otherwise the tsetse population grows back within a short time to its pre-campaign level.

Author's abstract

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

[See also **12**: nos. 5732, 5738, 5787.]

5719 **Clair, M., 1988.** The epidemiology of African animal trypanosomiasis. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 77-86.

IEMVT, 10 rue Pierre-Curie, 94700 Maisons-Alfort, France.

The epizootiology of African animal trypanosomiasis is based on knowledge of three elements: the trypanosome, the tsetse fly and the animal itself. Much research has been carried out in recent years and is continuing. As the virulence of trypanosome strains varies, research tends to characterise them through studies on serodemes, zymodemes and nucleodemes. The estimation of livestock infection rate and the appearance of species resistant to trypanocidal drugs are still two major problems. The ILCA/ILRAD network is trying to quantify the tsetse challenge and the disease risk and to relate them to trypanosome prevalence in livestock. Within the same fly population the power of transmission varies and seems to depend on several factors which are presently under study. Promising results have been obtained in ecology (visual and olfactory attractants) and in physiology (haemolymph and pheromones). Much research is being carried out on the reactions of the infected animal to trypanosomes (in both susceptible and more resistant breeds). However trypanotolerance is still an inexplicable phenomenon even though a number of markers associated with resistance have now been identified. Little is known about interaction with other infections. Man's knowledge of epidemiology has enabled him to master numerous efficient control measures. Everything is possible, but lack of funds, or the secondary effects of these control measures, are major constraints to their success. Besides these three elements, environmental factors such as drought, which causes malnutrition, have a great influence on the dynamics of the disease. But it is man who today is contributing the most to the change in the African animal trypanosomiasis scene simply through population growth and socio-economic activities.

Author's abstract

5720 **Hervouet, J.P. and Laveissière, C., 1987.** Facteurs humains de la transmission de la maladie du sommeil. [Human factors in the transmission of sleeping sickness.] *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 72-78.

ORSTOM, 3191 Route de Mende, 34060 Montpellier Cedex, France;

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

In the forest zone of Côte d'Ivoire, replacement of the forest by coffee and cocoa plantations has created botanical and entomological conditions favouring

transmission of sleeping sickness. However, large variations in the prevalence of the disease in the population can be explained only by human factors which determine the very variable rates of transmission not only between ethnic groups but also according to the social organisation of individuals within a group. These disparities proceed mainly from the spatial behaviour of individuals and societies. Thus, an open social organisation like that of the Mossi favours the transmission and diffusion of the parasite, whereas the closed social organisation of the Baoulé assures a prophylactic function by restricting man/fly contact to a limited number of men and insects. This observation has important implications regarding the control of this disease.

Authors' abstract

5721 **Jordan, A.M., 1988.** The role of tsetse in African animal trypanosomiasis. *In: ILCA/ILRAD, 1988 (see 12: 5692), pp. 37-42.* ODA/University of Bristol, School of Veterinary Science, Langford, Bristol, BS18 7DU, UK.

Although mechanical transmission of African animal trypanosomiasis may be important in some localities at some seasons of the year, there is no evidence that the disease can persist in the absence of tsetse flies. Advances and recessions of the flies in the past have been associated respectively with outbreaks and declines of the disease. This dynamic nature of trypanosomiasis, in both space and time, is apparent from the literature on the disease but is becoming an increasingly important element of the epizootiology of the disease. The most potent factor operating today is the effect of rapidly increasing human populations on the habitats and hosts of *Glossina*. These effects can be either favourable or unfavourable to the flies, with corresponding effects on the distribution and importance of the disease. Although human populations are expanding at high rates throughout sub-Saharan Africa, the base line from which this expansion is taking place is very variable. In densely populated countries, many *Glossina* populations, particularly species of the *morsitans* and *fusca* groups, have been markedly reduced. Elsewhere man has not, as yet, had any significant effect on populations of *Glossina* and the impact of trypanosomiasis on rural economies has been unaffected. Future approaches to control of animal trypanosomiasis by vector control or chemotherapy, if they are to be effective, must take the changing epizootiology of the disease into account. The phenomenon of trypanotolerance exhibited by certain breeds of cattle permits such breeds to live together with *Glossina* spp. and may have particular value in the humid zones of West and Central Africa where tsetse populations, particularly of the *palpalis* group, are likely to persist for the foreseeable future even in the presence of increasing numbers of man.

Author's abstract

5722 **Leak, S.G.A et al., 1988.** Determination of tsetse challenge and its relationship with trypanosome prevalence in trypanotolerant livestock at sites of the African Trypanotolerant Livestock Network. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 43-54.*

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

In the African Trypanotolerant Livestock Network, tsetse challenge is estimated using three components: tsetse relative density, trypanosome infection rate and the proportion of feeds taken by these tsetse from livestock in the study areas.

The relationship between tsetse challenge and trypanosome prevalence in trypanotolerant livestock across eight Network sites for trypanotolerant cattle and four sites for trypanotolerant sheep is reported for the period 1984-1986. Low tsetse relative densities at several network sites prevent across-site analysis between monthly estimates of tsetse challenge and trypanosome prevalence, but annual mean estimates can be used. Annual trypanosome prevalence estimates, following arcsin transformation to stabilise variance, were regressed on $\log_{10} + 1$ tsetse challenge. Significant relationships between tsetse challenge and trypanosome prevalence in trypanotolerant cattle have been observed across years ($P < 0.001$), and in 1984 ($P < 0.05$) and 1986 ($P < 0.001$), showing that a linear relationship exists between the two parameters. In trypanotolerant sheep, a significant relationship between the two parameters was also observed across years ($P < 0.05$), but the small number of sites with trypanotolerant sheep did not allow meaningful yearly analyses. The implications of using this relationship, for predicting trypanosome prevalence and for determining or evaluating trypanosomiasis control strategies, are discussed.

Authors' abstract

5723 **Nankodaba, G., Coulibaly, L., Hecker, P., Leak, S.G.A. and Schuetterle, A., 1988.** Trypanosome prevalence in cattle herds exposed to a range of tsetse challenge levels in northern Côte d'Ivoire. *In: ILCA/ILRAD, 1988* (see 12: no. 5692), pp. 55-62.

Nankodaba: SODEPRA/GTZ/NORD, B.P. 143, Boundiali, Côte d'Ivoire;
Coulibaly, Hecker, Schuetterle: SODEPRA/GTZ/CIPEA, B.P. 143, Boundiali,
Côte d'Ivoire; Leak: ILRAD, P.O. Box 30709, Nairobi, Kenya.

Tsetse challenge and trypanosome prevalence in cattle have been estimated between March 1984 and December 1986 at villages in Tengrela and Boundiali districts of northern Côte d'Ivoire, following the protocol of the African Trypanotolerant Livestock Network. The relationships between those two parameters in sixteen village cattle herds are reported here. *Glossina palpalis gambiensis* and *G. tachinoides* have been detected at villages throughout the area and a small number of *G. morsitans submorsitans* in the south. There was a trend for tsetse challenge to decrease northwards, corresponding to a decrease in annual rainfall. A $\log_{10} + 1$ transformation of tsetse challenge and an arcsin transformation of trypanosome prevalence estimates have been used in regression analyses to determine relationships between the two parameters. A highly significant relationship has been observed between the transformed data across years ($P < 0.001$), and in 1984 ($P < 0.01$), 1985 ($P < 0.05$) and 1986 ($P < 0.05$). Differences observed between estimates of tsetse challenge at villages within a few km of each other, and between trypanosome prevalence estimates for cattle herds from the same village or from villages in close proximity, highlight the need for cattle grazing and watering areas to be accurately determined. Tsetse challenge should then be measured as close as possible to the areas at which cattle are actually exposed in order to detect within-site relationships between the two parameters. These baseline tsetse challenge and trypanosome prevalence estimates at the village level in Côte d'Ivoire will enable a forthcoming tsetse control trial in Boundiali district to be more fully evaluated than has been previously possible.

Authors' abstract

5724 **Richner, D., Brun, R. and Jenni, L., 1988.** Production of metacyclic forms by cyclical transmission of West African *Trypanosoma (T.) brucei* isolates from man and animals. *Acta Tropica*, **45** (4): 309-319.

Swiss Tropical Institute, Socinstrasse 57, CH-4051 Basel, Switzerland.

(Correspondence to Jenni.)

Fifteen West African *T. brucei* isolates from man and animals were cyclically transmitted. Five stocks belonging to the non-*gambiense* group could easily be transmitted through *Glossina morsitans morsitans* or *G. m. centralis* infected on mice, whereas successful transmission of the 10 isolates identified as *T. b. gambiense* was performed using *G. palpalis gambiensis* as vector. *G. p. gambiensis* was infected with culture-derived procyclic trypanosomes by repeated membrane feeding. In both cases, metacyclic forms could normally be detected in saliva samples of positive flies 3-4 weeks after first infection. These forms of major interest were subsequently characterised relative to their resistance/sensitivity against normal human serum *in vitro* and their antigenic properties using indirect immunofluorescence. Metacyclic forms of all the *T. b. gambiense* isolates were determined by a stable human serum resistance and a restricted metacyclic variable antigen type (mVat) repertoire, whereas representatives of the non-*gambiense* group (including TH162/78E 021) were sensitive against the trypanolytic factors of normal human serum and expressed a heterogeneous metacyclic antigen profile.

Authors' abstract

5725 **Schweizer, J., Tait, A. and Jenni, L., 1988.** The timing and frequency of hybrid formation in African trypanosomes during cyclical transmission.

Parasitology Research, **75** (2): 98-101.

Schweizer, Jenni: Swiss Tropical Institute, Socinstrasse 57, CH-4051 Basel, Switzerland; Tait: Department of Veterinary Parasitology, University of Glasgow, Bearsden Road, Glasgow G61 1QH, UK.

The frequency of hybrid formation between two *Trypanosoma brucei* clones during cyclical transmission through *Glossina morsitans centralis* was analysed. In two independent experiments, teneral *G. m. centralis* were infected with an equal mixture of two *T. brucei* clones showing different homozygous isoenzyme patterns for isocitrate dehydrogenase (ICD; E.C. 1.1.1.42) and alkaline phosphatase (AP; E.C. 3.1.3.1). Trypanosomes were cyclically transmitted to mice from 23 infective flies and the subsequent bloodstream-form populations were characterised by isoenzyme electrophoresis. Heterozygous patterns for ICD and AP indicated that hybrid formation occurred in at least 9 of the 23 vectors. There was further evidence that extrusion of hybrid parasites with saliva from a single fly was not necessarily continuous but could alter over time with the occurrence of either or both of the homozygous parental clones.

Authors' abstract

5726 **Snow, W.F., Tarimo, S.A., Staak, C. and Butler, L., 1988.** The feeding habits of the tsetse, *Glossina pallidipes* Austen on the south Kenya coast, in the context of its host range and trypanosome infection rates in other parts of East Africa. *Acta Tropica*, **45** (4): 339-349.

ITC, P.M.B. 14, Banjul, Gambia; ICIPE, P.O. Box 30772, Nairobi, Kenya; *ibid.*; *ibid.*

The results of blood-meal identifications for 651 *G. pallidipes* from five subpopulations near the Kenya coast south of Mombasa, and one 70 km inland, are presented. Bushpigs and/or warthogs were important hosts for *G. pallidipes* at all sites. Other major hosts included elephant, buffalo and bushbuck where they were present, and on a dairy ranch nearly 30% of feeds were taken from cattle. There was a general relationship between the numbers and diversity of wild herbivores and the abundance of *G. pallidipes*. These results are discussed in relation to published data on feeding patterns and trypanosome infection rates for *G. pallidipes* from other parts of East Africa. Overall, there are significant correlations between the proportions of bovid feeds and *T. vivax* infections. Bovid-feeding *G. pallidipes* populations with high *T. vivax* infection rates in south-east Uganda and western Kenya contrast with the coastal, suid-feeding populations with low *T. vivax* rates. These characteristics are presented as clines extending across East Africa.

Authors' abstract

5727 **Wacher, T., Rawlings, P. and Jeannin, P., 1988.** Tsetse and trypanosomiasis in cattle: the interface of grazing patterns and its importance. *In*: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 70-73.

ITC, P.O. Box 14, Banjul, Gambia.

Studies of tsetse distribution and of herd movements are being carried out at three village sites in The Gambia to obtain more information on how cattle/fly contact can vary within a particular village. The ranges of three village herds of N'Dama cattle have so far been established for the late dry season (May-June) and the wet season (July-August) at Keneba. In the dry season, when cattle are free to move at will, the herds show partial but significant range separation. In the wet season, herdsman take the cattle away from growing crops to woodland areas to the north of the village. Fly trap data, not yet available, are expected to show differing rates of challenge in the different areas visited by the herds.

5728 **Welburn, S.C., Maudlin, I. and Ellis, D.S., 1989.** Rate of trypanosome killing by lectins in midguts of different species and strains of *Glossina*. *Medical and Veterinary Entomology*, 3 (1): 77-82.

TRL, University of Bristol, Langford, Bristol BS18 7DU, UK; *ibid.*; London School Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK. (Correspondence to Maudlin.)

The activity of lectins in different species of tsetse was compared *in vivo* by the time taken to remove all trypanosomes from the midgut following an infective feed and *in vitro* by agglutination tests. Teneral male *G. pallidipes*, *G. austeni* and *G. p. palpalis* removed 50% of all *Trypanosoma brucei rhodesiense* infections within 60 h. A 'refractory' line of *G. m. morsitans* took 170 h to kill 50% infections while a 'susceptible' line of the same species failed to kill 50%. Agglutination tests with midgut homogenates showed differences between fly stocks which accorded with differences in rate of trypanosome killing *in vivo*. Flies fed before an infective feed were able to remove trypanosomes from their midguts more quickly than flies infected as tenerals. Increasing the period of starvation before infection increased the susceptibility to trypanosome infection of non-teneral flies. Teneral flies showed little agglutinating activity *in vitro*, suggesting that lectin is produced in response to the bloodmeal. Feeding flies before infection also abolished the differences in rate of trypanosome killing

found between teneral 'susceptible' and 'refractory' *G. m. morsitans*, suggesting that maternally inherited susceptibility to trypanosome infection is a phenomenon limited to teneral flies. Electron micrographs of midguts of *G. m. morsitans* suggest that procyclic trypanosomes are killed by cell lysis, presumably the result of membrane damage caused by lectin action.

Authors' abstract

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

[See also **12**: no. 5771.]

5729 **Cattand, P., 1987.** Advances in the field diagnosis of human African trypanosomiasis. *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 105-108.

Parasitic Disease Programme, WHO, 1211 Geneva 27, Switzerland.

The author reviews the diagnostic techniques available today for the detection of sleeping sickness in the field and discusses the pros and cons of these techniques. The evasiveness of the trypanosome in human African trypanosomiasis is a major problem in diagnosis. The use of serology as a means to identify suspects may prove highly useful in mass screening, particularly for the *gambiense* disease. The secondary reactions of current treatment schemes and the margin of error of the serological tests make it undesirable to rely exclusively on indirect methods for diagnosis. Demonstration of the parasite remains a prerequisite to treatment, but newly developed, more sensitive parasitological techniques have brought new hope for improving the efficacy of mass surveillance as well as individual diagnosis.

Author's abstract

5730 **Josseran, R., Hengy, C., Calvez, T. and Kouka Bemba, D., 1987.**

Evolution de la trypanosomiase humaine dans les pays de l'OCEAC. [Evolution of human trypanosomiasis in the OCEAC countries.] *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 62-66.

OCEAC, B.P. 288, Yaoundé, Cameroon.

Human trypanosomiasis due to *Trypanosoma brucei gambiense* is still rife in the six OCEAC Member States (Cameroon, Congo, Gabon, Central African Republic, Chad and Equatorial Guinea). In 1985 around 2000 new cases were declared in various known foci. These last 10 years have been marked by progressive abandonment of chemoprophylaxis with Lomidine (pentamidine), confirmation of efficiency of anti-vectorial control by trapping, and more particularly the development of new serological techniques (Celognost, Testryp CATT) and the direct demonstration of the parasite by methods which are more sensitive and applicable in the field (e.g. filtration on DEAE cellulose column). Despite these advances, the incidence of the disease has continued to increase, except in Gabon. A decrease in the resources devoted to systematic screening

campaigns could explain this deterioration and make us fear an under-estimation of the latter.

Authors' abstract

5731 **Stanghellini, A., 1987.** Méthodologies et stratégies de lutte contre la trypanosomiase humaine à *T. b. gambiense*. [Methodologies and strategies of control against human trypanosomiasis due to *Trypanosoma brucei gambiense*.] *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 67-71.

Service National de Lutte contre la Trypanosomiase, Hôpital N'Kembo, B.P. 998, Libreville, Gabon.

Before any trypanosomiasis control programme can be initiated, certain indispensable data on the disease situation, population movements, agricultural or pastoral projects and financial and other resources should be gathered from various government departments, and these supplemented by field investigations. The information collected will determine the best choice of methods and strategies to be applied. Two strategies of screening the population for trypanosomiasis are possible: active and passive. Active surveillance is necessary in epidemic or hyperendemic regions; passive surveillance may be all that is required in areas where cases are sporadic, though patients should be carefully questioned to assess whether active screening should be undertaken. The immunological and parasitological techniques available are discussed. Action to control trypanosomiasis may be undertaken at three levels: village (detection of suspects, vector control by trapping), dispensary (diagnosis) and specialised regional medical centre (laboratory confirmation of cases, hospitalisation, mobile surveillance teams, etc.). Strategies of control vary in different countries: there may be a centrally based trypanosomiasis control service or, at the opposite extreme, autonomous regional organisation of services, with other intermediate situations.

(b) PATHOLOGY AND IMMUNOLOGY

(c) TREATMENT

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

5732 **d'Ieteren, G.D.M. et al., 1988.** Genetic and environmental factors affecting trypanosome prevalence and parasitaemia in livestock. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 87-99.

ILCA, P.O. Box 46847, Nairobi, Kenya.

The prevalence, species and intensity of trypanosome parasitaemias in livestock were estimated, generally during a three year period, January 1984 to December 1986, at ten sites in West, Central and East Africa. The sites studied were OGAPROV (Gabon), Avetonou and Sokode (Togo), Boundiali and Tengrela

(Côte d'Ivoire), Mushie, Kolo and Idiofa (Zaire), Ghibe (Ethiopia) and Muhaka (Kenya). The influence of location, season, livestock species, breed, animal age and female physiological status on the prevalence, species and intensity of trypanosome parasitaemia is reported. There were marked differences in trypanosome prevalence between locations and livestock species, while season and age class effects were inconsistent. Female physiological status did not affect prevalence. Differences were found between locations, livestock species, breeds and age classes, but not seasons or female physiological status classes, for the proportions of infections due to *Trypanosoma congolense* and *T. vivax*. Species of trypanosome appeared to be the major influence on the intensity of infection, measured by parasitaemia score. Results showing the duration of trypanosome infections and demonstrating the pattern of parasitaemia are presented for two sample sites and the effects of trypanosome species, animal age and breed on the duration of infection are considered.

Authors' abstract

5733 **Ngamuna, S. et al., 1988.** Trypanosomiasis in N'Dama cattle under village management in Zaire. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 119-124.*

DPP Idiofa, B.P. 8251, Kinshasa, Zaire.

Trypanosomiasis prevalence and duration was studied over an 18 month period in N'Dama cattle managed in village herds in forest and plateau areas of Idiofa, Zaire. Mean monthly trypanosome prevalence was 4.6% for the forest population, 1.4% for the plateau. No seasonal or age effects were seen. Over 90% of trypanosome parasitaemic months were *Trypanosoma congolense* infections; 70% of infections were parasitaemias lasting a single month and 21% lasted 2-3 months. Trypanosome infection consistently depressed PCV and reduced post-weaner growth by some 35%. Other parasites had little effect on either PCV or growth. Mortality rates were low.

(b) PATHOLOGY AND IMMUNOLOGY

[See also 12: no. 5733.]

5734 **Coulibaly, L. et al., 1988.** Disease interactions in cattle and sheep in northern Côte d'Ivoire. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 110-118.* SODEPRA/GTZ/CIPEA, B.P. 143, Boundiali, Côte d'Ivoire.

Six cattle herds (N'Dama, Baoulé and crosses between N'Dama, Baoulé and Zebu) and five sheep flocks (mainly Djallonké, some Djallonké \exists Sahelian) were monitored for 36 months for the presence of trypanosomes and other blood and internal parasites and their effects on PCV and on the major production traits. Strongyles and coccidia were the most frequently occurring internal parasites, *Theileria* spp. the only common blood parasites other than trypanosomes. PCV was significantly depressed, in both cattle and sheep, by trypanosome parasitaemia but not by other parasite infection. Neither trypanosomes nor other parasites had any effect on growth in cattle, although trypanosomes in the lamb resulted in lighter weaning weight and other parasites also occasionally affected weight in sheep. Interactions between the parasites were not significant.

5735 **d'Ieteren, G.D.M. et al., 1988.** Trypanosome infections and other factors influencing PCV in livestock. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 161-167.

ILCA, P.O. Box 46847, Nairobi, Kenya.

The effect of number, species and intensity of trypanosome parasitaemias on the PCV of cattle and sheep was estimated for various characters: average PCV during gestation, PCV at parturition, average PCV pre-weaning, PCV at weaning and average PCV during defined periods post-weaning. Cattle and sheep were studied at Avetonou (Togo) and Boundiali and Tengrela (Côte d'Ivoire) and cattle at OGAPROV (Gabon), and Kolo and Mushie (Zaire). Trypanosome parasitaemia depressed PCV in cattle and in sheep. Generally 2 or more parasitaemic months during the period defined by the character depressed PCV significantly, but the effect of 1 parasitaemic month was variable. Estimates of the effects of species and intensity of trypanosome parasitaemia on PCV are reported for N'Dama cattle at Mushi. There was a large variation in PCV between year-season and between herds but interactions between trypanosome infection and these effects were not significant.

Based on authors' abstract

5736 **Duvallet, G., Ouedraogo, A., Pinder, M. and Melick, A. van, 1988.**

Observations following the cyclical infection with *Trypanosoma congolense* of previously uninfected Baoulé and zebu cattle. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 318-325.

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

Five zebu and 12 Baoulé cattle were cyclically infected with one fly bite infected with *Trypanosoma congolense* strain Karankasso/83/CRTA/57 stabilate 12/240186. Five zebu cattle were used as controls. All animals within the experiment had been raised in a tsetse-free building since birth. The objective was to compare the immune response following the primary parasitaemia peak. Weights, body temperature, parasitaemia and PCV were also measured.

Preliminary indications are: one fly bite or tentative fly bite without blood sucking can infect cattle; there were no significant breed differences for skin reactions, prepatent period, weight changes and body temperature; PCV drops were significantly higher in zebus. Both Baoulé and zebu cattle started to control their PCV from the 55th day after infection. Baoulé cattle controlled their parasitaemia faster than zebu, although peak parasitaemias were not significantly different. Immune responses were evaluated by the complement lysis test. Zebu cattle produced a higher titre but reacted later (after 80 days versus 60 days). The animals have now been exposed in the field, to allow comparison under high natural challenge.

Authors' abstract

5737 **Dwinger, R.H., 1988.** De sjanker: een ouderwets begrip of een moderne oplossing voor slaapziekte? [Chancre: an old-fashioned term or a modern solution for trypanosomiasis?] *Tijdschrift voor Diergeneeskunde*, **113** (19): 1049-1058.

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

A brief introduction to trypanosomiasis in ruminants and an explanation of the term chancre are followed by a discussion of a number of findings on the early pathogenesis of the disease.

Author's abstract

5738 **Dwinger, R.H., Grieve, A.S., Jeannin, P., Agyemang, K. and Faye, J., 1988.** Anti-trypanosomal antibodies in sequentially collected sera of N'Dama cattle under natural trypanosomiasis risk in The Gambia. *In: ILCA/ILRAD, 1988* (see **12**: no. 5692), pp. 100-109.

ITC, P.O. Box 14, Banjul, Gambia.

One thousand N'Dama cattle kept under village management conditions and natural trypanosomiasis risk in The Gambia were examined twice a year for 2 years for anti-trypanosomal antibodies using IFAT. At the start, most of the older animals had high antibody levels whereas only a few animals younger than 5 years of age showed any evidence of antibodies. As time progressed, antibody titres decreased and more animals were found to be serologically negative. Over the same period, the tsetse challenge decreased and fewer animals were positive for parasites. Antibody levels to *Trypanosoma congolense* and *T. vivax* also differed according to the time of year and place of sampling. Maternal antibodies were detected in calves only up to 3 months of age. This study suggests that antibody levels are maintained, in the absence of trypanosome challenge, for only a short time, perhaps less than 6 months. In a controlled experiment, antibodies were detected only as long as parasites were detectable in the blood.

5739 **Mulatu, W. et al., 1988.** Health and performance of Zebu cattle exposed to trypanosomiasis risk in S.W. Ethiopia. *In: ILCA/ILRAD, 1988* (see **12**: no. 5692), pp. 257-261.

ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

The prevalence, species and intensity of trypanosome parasitaemias over an 18 month period are reported for East African Zebu cattle managed in 10 village herds in four areas around Ghibe, S.W. Ethiopia. Mean monthly trypanosome prevalences in the three areas with trypanosomiasis risk were 18.8, 19.9 and 22.0%. Pre-weaners had the lowest and adult males the highest mean prevalence. About 99% of parasitaemic months were single species infections, with 79% caused by *Trypanosoma congolense*. Pre-weaners had a higher proportion of *T. vivax* parasitaemias than older age classes. A higher proportion of *T. congolense* infections in adult compared to young cattle lasted for more than 1 month (0.30 and 0.20 respectively). Parasitaemias were treated with Berenil at each monthly sampling. Most (95% or more) *T. vivax* and *T. brucei* infections lasted only one month. Trypanosome parasitaemia consistently depressed PCV which averaged 26.5% for the cattle at trypanosomiasis risk. Pre-weaners had higher PCV than other age classes. Mean liveweights were 62 and 86 kg for calves at 8 and 12 months respectively and 204 kg for cows post-partum.

Authors' abstract

5740 **Singh, V., Sharma K.N. and Raisinghani, P.M., 1988.** Absolute leukocytes, lymphocytes and 'E'-rosette- and 'EAC'-rosette-forming lymphocytes of buffalo calves infected with *Trypanosoma evansi*. *Indian Journal of Animal Sciences*, **58** (11): 1288-1291.

Department of Parasitology, Veterinary College, Gujarat Agricultural University, S.K. Nagar, Dantiwada 385 506, India; Sukhadia University, Bikaner, Rajasthan 334 001, India; *ibid*.

(c) TRYPANOTOLERANCE

[See also **12**: nos. 5689, 5692, 5693, 5695, 5701, 5702, 5732, 5736.]

5741 **Agyemang, K., Jeannin, P., Grieve, A.S., Bah, M.L. and Dwinger, R.H., 1988.** Milk extraction for human consumption from N'Dama cattle under village management conditions in The Gambia. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 231-245.

ITC, P.O. Box 14, Banjul, Gambia.

A milk recording scheme was initiated in November 1985, in four Gambian villages, to determine the amount of milk offtake from N'Dama cattle for human consumption. Analyses of data collected on 500 cows showed that milk offtake was strongly influenced by stage of lactation, climatic season and village and herd management effects. Initial observations suggest that milk yield could be increased by exploiting seasonal influence on the lactation curve and that overall productivity of N'Dama cattle is enhanced by some extraction of milk for human consumption.

From authors' abstract

5742 **Cundiff, L.V., 1988.** Quantitative genetic approaches to breeding for genetic resistance to disease in cattle. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 413-424.

USDA, US Meat Animal Research Center, P.O. Box 166, Clay Center, NB 68933, USA.

Procedures for experimental assessment and utilisation of additive and non-additive genetic variation between and within breeds are discussed. Significant additive genetic variation is seen among cattle breeds for resistance to certain pathogens and parasites (e.g. trypanosomiasis). Although heritability of survival is low, specific components of survival and longevity are moderately to highly heritable (e.g. PCV/trypanotolerance). Selection for increased resistance to certain infections may result in increased susceptibility to others.

5743 **Defly, A. et al., 1988.** Effect of trypanosome infection on livestock health and production in Togo. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 251-256.

CREAT-Avetonou, B.P. 27, Agou-Gare, Togo.

The prevalence, species and intensity of trypanosome parasitaemias in different livestock species, breeds, age groups and management systems are reported for cattle and sheep in the Avetonou area and for sheep and goats in the Sokode area. Trypanosome prevalence varied between years and location but there was no marked seasonal variation. Prevalence in cattle was about three times that in sheep kept in the same area and there was no difference between sheep and goats.

N'Dama and Race Locale (West African Shorthorn with some Borgou genes) had similar prevalence levels within ranch and village management systems. In cattle prevalence was twice as high in pre-weaners as in adult females, but in sheep prevalence was several times higher in adult females than in pre-weaners. *Trypanosoma vivax* parasitaemias accounted for 89% of all parasitaemias in cattle, 98% in sheep and 94% in goats. There were no differences between cattle breeds or management systems for species of infection. Adult female cattle had a higher proportion of *T. congolense* parasitaemias (18%) than calves. Age did not affect species of parasitaemia in sheep. Intensity of *T. vivax* parasitaemias was lower in ranch cattle (mean score 1.9) than in village cattle (3.2) and village sheep (3.5). N'Dama and Race Locale cattle had similar parasitaemia scores. Trypanosome infection of the individual depressed its own PCV but infection of the dam did not depress progeny PCV. Trypanosome infection during gestation and lactation or pre- and post-weaning appeared to depress PCV cumulatively. A parasitaemia with a high score depressed PCV more than a parasitaemia with a low score. Trypanosome infection post-partum did not affect parturition interval, but there was a tendency for dams with higher PCV to have shorter intervals. Liveweights were not affected by trypanosome infection, but animals within the lowest PCV class tended to have the poorest performance. Results were consistent for trypanotolerant cattle and sheep.

Authors' abstract

5744 **d'Ieteren, G.D.M and Trail, J.C.M., 1988.** An overview of the African Trypanotolerant Livestock Network. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 31-34.*

ILCA, P.O. Box 46847, Nairobi, Kenya.

An ILCA/FAO/UNEP study on 'Trypanotolerant Livestock in West and Central Africa' (1979) emphasised their importance and potential and the need for more precise research to achieve a better understanding of genetic resistance, acquired resistance, environmental factors that affect susceptibility and the efficacy of control measures available, and to ensure optimal application of research findings. The network of research sites has been established through tropical Africa in order to study the complex interactions that affect trypanotolerance. A very large body of data is now being built up on various breeds and their crosses under different levels of trypanosomiasis risk in different management and institutional situations. Selection of sites for the network was based on their complementarity in terms of disease level, tsetse challenge and livestock breed, the desire of the institutions concerned to cooperate, the availability of basic research infrastructure and the willingness of donor agencies to provide supplementary funds. The scientists associated with the network meet regularly to discuss progress and plan the future direction of research. Areas of specific research and studies of intervention possibilities already started are tsetse control, trypanocidal drug usage, improvement of reproductive performance, improvements in the diagnosis of trypanosomiasis, nutritional interventions, definition of selection criteria for trypanotolerance, and maximising the rate of genetic progress through selection.

From authors' abstract

5745 **Feron, A. et al., 1988.** Productivity of ranch N'Dama cattle under trypanosomiasis risk. *In: ILRAD/ILRAD, 1988 (see 12: no. 5692), pp. 246-250.*

c/o Cie J. van Lancker, B.P. 199, Kinshasa, Zaire.

Performance characters estimating the viability, reproductive, growth and milk yield components of livestock production can be combined in productivity indices expressing total output and its efficiency in a single figure. Example indices are weight of weaner (and milk equivalent) produced per dam per year, or per unit weight of dam per year, or per unit metabolic weight of dam per year. Cow and calf viabilities, parturition intervals, cow parturition and weaning weights and calf weaning weights were recorded during a three-year period, January 1984 to December 1986, for N'Dama cattle under the same ranch management at Mushie and Kolo (Zaire) where trypanosomiasis risk was high and zero respectively. Estimates for the performance characters from each site were combined in three productivity indices. Viability and reproductive performances were similar at both sites, but calf weaning weights were slightly heavier and cow weights substantially heavier at Kolo, giving equivalent productivities per cow per year, but superior productivity per unit weight of cow and per unit metabolic weight of cow per year in Mushie. These N'Dama productivities are compared with the productivities of other major breeds under different trypanosomiasis risk, management and environmental conditions in West and East Africa.

Authors' abstract

5746 **Ghirotti, M., 1987.** Trypanotolerance in livestock. *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 85-90.

WHO/ISS Collaborating Centre for Research and Training in Veterinary Public Health, Istituto Superiore di Sanità, Rome, Italy.

Trypanotolerant livestock are a very important resource for farmers living within the tsetse belt. However, only recently have they gained the attention of research organisations and most of the nature of this resistance to trypanosomiasis is still debated. In this paper the work carried out so far on the identification of the mechanism and on productivity of trypanotolerant livestock is reviewed.

Attention is drawn to the need for multidisciplinary research, correct integration of these livestock with current trypanosomiasis control measures, and the identification of genetic markers for trypanotolerance, given the heterogeneity within trypanotolerant breeds.

Author's abstract

5747 **Jeannin, P., Grieve, A.S., Agyemang, K., Clifford, D.J., Munro, C.D. and Dwinger, R.H., 1988.** Reproductive performance of N'Dama cattle kept under village management in The Gambia. *In: ILCA/ILRAD, 1988* (see **12**: no. 5692), pp. 174-183.

ITC, P.O. Box 14, Banjul, Gambia; Munro: 7 Percy Street, Alnwick, Northumberland, UK.

The reproductive performance of N'Dama breeding females was estimated from herd structure data collected in four villages during a 2-year survey on health and productivity. Results indicated a poor reproductive efficiency of N'Dama cattle under village management. Poor nutrition appeared to be the main cause.

Prevalence of trypanosomiasis and other parasitic diseases was low but the N'Dama cows suffered from chronic anaemia. Preliminary results from 24 supplementary fed N'Dama cows at ITC demonstrate that the interval between calving and the resumption of ovarian cyclicity can be shortened by improved feeding.

5748 **Logan, L.L., Paling, R.W., Moloo, S.K. and Scott, J.R., 1988.**

Comparative studies on the responses of N'Dama and Boran cattle to experimental challenge with tsetse-transmitted *Trypanosoma congolense*. In: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 152-160.

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

Eight N'Dama of Gambian origin and eight age- and sex-matched Boran of Kenyan origin were on five occasions challenged by *T. congolense*-infected *Glossina morsitans centralis*. The first four challenges were with clones (IL 1180, IL 2642, IL 1587 and IL 2079) belonging to different serodemes and the fifth challenge (IL 1180) was the clone to which the cattle had been first exposed two years previously. During the five infection periods parasitaemia and anaemia were monitored. When PCV dropped to 15% or lower, cattle were treated with Berenil. None of the 8 N'Dama required drug treatment during the course of 5 challenges while the 8 Boran receiving 5 challenges required 30 treatments (75%). N'Dama and Boran were treated to terminate each challenge with *T. congolense* at 164, 127, 149, 133 and 105 days respectively. The N'Dama demonstrated an ability to control anaemia, which improved following each of the subsequent challenges, and which was not related to an improved ability to control parasites nor to a difference in virulence of the *T. congolense* clones. This phenomenon was not observed in the Boran cattle. The trypanotolerance of the N'Dama was further expressed by significantly lower blood parasitaemias than those of the Boran. It is concluded that, under controlled experimental conditions, the mean PCV of animals within a group of age-matched N'Dama, measured during primary infection with *T. congolense*, might serve as a selection criterion for trypanotolerance.

Authors' abstract

5749 **Lorenzini, E., Scott, J.R., Paling, R.W. and Jordt, T., 1988.** The effects of *Trypanosoma congolense* infection on the reproductive cycle of N'Dama and Boran heifers. In: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 168-173.

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

Five N'Dama and nine Boran heifers were infected with *T. congolense* serodeme IL 1587 transmitted by *Glossina morsitans centralis*. The infections were terminated by treatment with Berenil after 149 days or when PCV levels reached 15%. The N'Dama heifers continued cycling throughout the infection period, with trypanosomes detectable in the blood, and completed at least six oestrous cycles (average length 20.3 days). None showed impaired luteal function, and progesterone profiles before and after infection were similar. Three previously cycling Boran heifers ceased cycling by day 28 post-infection, while the others remained inactive. Seven of the nine Boran required treatment, after which the previously cycling animals showed renewed ovarian activity.

5750 **Maehl, J.H.H. et al., 1988.** Factors influencing liveweight in a range of Network situations. In: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 219-230.

ILCA, P.O. Box 46847, Nairobi, Kenya.

Factors, including number, species and intensity of trypanosome parasitaemias, affecting liveweight and liveweight change of cattle and sheep were analysed for populations from various sites in West, Central and East Africa, generally covering a three-year period, January 1984 to December 1986. Dam liveweights at parturition and weaning, the weight change between them, progeny birth

weights, weaning weight and pre-weaning daily gain, and post-weaning weights and weight changes were considered, when appropriate and possible, for mainly trypanotolerant sheep in Avetonou (Togo) and Boundiali and Tengrela (Côte d'Ivoire) and for trypanotolerant cattle breeds in Avetonou, Boundiali, Tengrela, Mushie and Kolo (Zaire) and OGAPROV (Gabon). At the latter site a susceptible breed and its crosses were also included. In general, trypanosome infections, whether caused by *T. congolense* or *T. vivax*, did not have an important effect on liveweight or liveweight change. The estimation of possible cumulative effects of trypanosome infections, the importance of intensity of infection and of interactions between trypanosome infections and other factors, require studies at sites with high trypanosomiasis risk and/or longer periods of recording. Breeds and some environmental effects showed large variation for liveweight characters. The relationship between blood PCV and liveweight, for livestock at trypanosomiasis risk or in its absence, is discussed.

Authors' abstract

5751 **Morkramer, G. et al., 1988.** Economic aspects of recently introduced trypanotolerant livestock production under trypanosomiasis risk in southern Togo. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 377-388.

CREAT-Avetonou, B.P. 27, Agou-Gare, Togo.

Trypanotolerant breeds of cattle and sheep have recently been introduced into the Avetonou area, situated in the subhumid southern part of Togo, an area of low-to-medium trypanosomiasis risk. An economic evaluation of livestock production is being carried out comparing two cattle management systems (station and villages) and two livestock species of trypanotolerant breeds (Djallonké sheep and N'Dama and Race Locale cattle). Productivity results estimated from data collected from January 1984 to December 1986 and the production inputs involved (health care and services, fencing and kraal construction, pasture improvements, working facilities and herding labour) are considered for this analysis. The village Djallonké sheep gave very positive economic returns due to the very low level of inputs required. All except one of the village cattle herds also gave positive returns, though the profitability of village cattle production seems questionable. Cattle production in the station yielded negative returns as a consequence of the very high costs of fodder production.

Based on authors' abstract

5752 **Murray, M., 1988.** Trypanotolerance, its criteria and genetic and environmental influences. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 133-151.

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

Trypanotolerance appears to be associated with at least three possibly related but genetically independent characteristics, namely the ability to control parasitaemia, the ability to develop an effective immune response, and the ability to resist anaemia. An understanding of these key factors could lead to novel strategies for the control of animal African trypanosomiasis, e.g. the identification of markers for genetic resistance for selection in conventional breeding programmes, or the production by therapeutic or immunological means, or by molecular genetics, of animals that are more resistant to the effects of infection, and hence more productive. Such research should be strongly encouraged in view of the poor

prospects for the development of a vaccine or new trypanocidal drugs. It must also be emphasised that trypanotolerant breeds can suffer from trypanosomiasis and may even die under certain circumstances. Factors responsible would appear to include severity of tsetse-trypanosomiasis risk, stress of overwork, pregnancy, parturition, lactation, suckling, and intercurrent disease. More recently, nutritional status has been shown to be of major importance in determining the capacity of cattle to resist the effects of a trypanosome infection.

From author's abstract

5753 **Njogu, A.R., Ismael, A.A., Dolan, R.B., Okech, G., Sayer, P.D., Opiyo, E.A. and Alushula, H., 1988.** Trypanotolerance in East Africa: a summary of studies in the Orma Boran cattle. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 447-448.*

KETRI, P.O. Box 30148, Nairobi, Kenya.

Orma Boran cattle have evolved in the tsetse-infested Tana River area of Kenya, and KETRI has carried out a series of laboratory and field measurements of their resistance to trypanosomiasis since 1980. Boran cattle that had been selected over the last 100 years for growth in the tsetse-free Kenya Highlands and had been moved to Galana Ranch in 1964 (Galana Borans) were used in comparative studies. Under needle and laboratory fly challenge, Orma Borans showed lower mortality and higher PCV levels, body weight gains and level of self-cure than Galana Borans. Under natural tsetse challenge the Orma Borans had fewer infections, gained more weight and required less drug treatment than the Galana Borans. Breeding herds of Orma and Galana Borans have been maintained since 1983 and studies indicate the Orma Boran can be productive under tsetse challenge with minimum use of trypanocidal drugs.

Authors' abstract

5754 **Ordner, G. et al., 1988.** Health and productivity of trypanotolerant and susceptible cattle exposed to trypanosomiasis in Gabon and the impact of strategic chemoprophylaxis. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 310-317.*

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

The influences of breed, chemoprophylactic regime, animal age and female physiological status on the prevalence, species and intensity of trypanosome parasitaemia of N'Dama, Nguni and crossbred cattle are reported for up to a four-year period, December 1982 to November 1986. The effect of number, species and intensity of trypanosome parasitaemias on dam reproductive performance, liveweights and blood PCV and on calf birth and weaning weights and PCV were estimated for N'Dama cows receiving no, partial (breeding season only) and continuous chemoprophylaxis and for N'Dama, Nguni and crossbred cows receiving no chemoprophylaxis. The viabilities of cows and calves in the breed/chemoprophylactic regime groups are reported. There were major differences in viability and susceptibility to trypanosome infection between breeds, with the Nguni having higher mortality and greater susceptibility than N'Dama, with crossbreds having intermediate values. The effect of trypanosome parasitaemia on the cow and calf performance and PCV traits are discussed for the breed/chemoprophylactic groups, and the design of a breed \times chemoprophylactic regime study which began in August 1986 is presented and preliminary results reported.

Authors' abstract

5755 **Riley, J.A., Agyemang, K., Dwinger, R.H., Jeannin, P., Grieve, A.S. and Little, D.A., 1988.** N'Dama cattle production in relation to nutritional interventions in villages in The Gambia. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 399-403.

ITC, P.O. Box 14, Banjul, Gambia; Little: ILCA, P.O. Box 5689, Addis Ababa, Ethiopia.

Supplementary feeding trials using groundnut meal were carried out on 1-5 months post-partum cows and on 1-5 months old calves in three Gambian villages during the dry season. Calves receiving supplementary feed were on average 40% heavier than controls in one village. Provision of the supplement to cows significantly increased milk extracted for human consumption. Monitoring is continuing to establish any effects on reproductive performance. The overall results suggest that marked improvements in cattle productivity can be achieved from small inputs of high quality supplement in this system. Further study will reveal the influence this also might have on the effects of trypanosome infection.

From authors' abstract

5756 **Teale, A.J. and Kemp, S.J., 1988.** The bovine MHC and trypanotolerance. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 440-446.

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

The major histocompatibility complex (MHC) comprises a series of genes encoding glycoproteins which are expressed on the surface of cells, and functions to direct and control the immune response. Certain MHC alleles are known to be associated with susceptibility to certain diseases. Studies are now under way to compare the MHC profiles of trypanotolerant N'Dama cattle with those of unrelated susceptible breeds. A high frequency of the KN18 gene has been found in N'Dama whereas high frequencies of KN8 and KN12 are more typical of the East African Zebu. However, KN104 occurs in both N'Dama and Zebu but not in European breeds, and a particular w10 subtype is present in N'Dama and European cattle but not in Zebus. These studies should facilitate the selection of haplotypes in breeding experiments to study the involvement of MHC in trypanotolerance.

5757 **Thorpe, W. et al., 1988.** Factors influencing reproductive performance in a range of Network situations. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 210-218.

ILCA, P.O. Box 46847, Nairobi, Kenya.

Factors, including number, species and intensity of trypanosome parasitaemias, influencing the reproductive performance of cattle and sheep were evaluated at various sites in West, Central and East Africa, generally during a three-year period, January 1984 to December 1986. Reproductive performance, estimated by parturition interval, was studied for mainly trypanotolerant sheep in Avetonou (Togo) and Boundiali and Tengrela (Côte d'Ivoire) and for trypanotolerant cattle breeds in Avetonou, Boundiali, Tengrela, Mushie and Kolo (Zaire). Calving percentage was analysed for trypanotolerant and susceptible breeds in OGAPROV (Gabon). Trypanosome infection was not an important factor affecting the reproductive performance of trypanotolerant breeds at the levels of trypanosomiasis risk prevailing during these studies. Several systematic environmental effects were significant sources of variation, but results relating

blood PCV characters to reproductive performance were inconsistent. Longer periods of study and/or higher trypanosomiasis risk levels are required to confirm the lack of an effect, of the number and intensity of infections by the major trypanosome species, on the trypanotolerant breeds and to estimate the importance of interactions between trypanosome infection and other factors, including genotype and nutrition level, affecting reproductive performance.

Authors' abstract

5758 **Thorpe, W. et al., 1988.** Practical possibilities of blood grouping for parentage information: a pilot study in Zaire. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 430-432.

ILCA, P.O. Box 46847, Nairobi, Kenya.

Blood samples were taken from 389 N'Dama cattle and their crosses for red-cell antigen typing against 53 blood group antigens. The technique was found to be effective for parentage identification in a situation typical of many African livestock systems. The method will allow the estimation of the genetic parameters associated with criteria of trypanotolerance and may open the way to the development of effective selection programmes for trypanotolerant livestock.

5759 **Trail, J.C.M. et al., 1988.** Evaluation of criteria of trypanotolerance. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 425-429.

ILCA, P.O. Box 46847, Nairobi, Kenya.

Trypanotolerance involves at least two major components: trypanotolerant livestock under natural challenge become infected less often, and once infected are more able to control anaemia. In terms of the optimal usage and management of trypanotolerant livestock, criteria need to be defined that are easily and cheaply measured and are positively correlated with performance. (If genetic improvement is to be attempted, these criteria must also have a sufficiently high heritability for operation of a practical selection programme.) At OGAPROV, Gabon, 179 one-year-old N'Dama heifers were exposed to a high natural challenge over a 7 month period. The effects of trypanosome infection, trypanosome species and parasitaemia score on PCV and growth were evaluated monthly. The effect on growth of ability to maintain PCV levels (anaemia control) was additionally evaluated. Results indicated that phenotypic variance in growth associated with parasitaemia aspects could be at least as large as that associated with anaemia control aspects. As in artificial challenge, either by syringe or by infection with captured flies, virtually all animals become parasitised, it follows that, in research using artificial challenge, it is possible that half of the phenotypic variance in growth potential is being ignored.

Authors' abstract

5760 **Trail, J.C.M. et al., 1988.** Genetic aspects of criteria of trypanotolerance. *In*: ILCA/ILRAD, 1988 (see **12**: no. 5692), pp. 433-439.

ILCA, P.O. Box 46847, Nairobi, Kenya.

Two field experiments were undertaken, at Mushie ranch, Bandundu region, Zaire, on N'Dama cattle, and at Kilifi Plantation, south-east coast of Kenya, on Sahiwal/Ayrshire cows, to provide indications of heritability levels for aspects of parasitaemia, anaemia control, immune response and animal performance. First results suggest that the parasitaemia aspects are unlikely to have sufficiently high heritabilities for practical selection approaches; that ability to maintain PCV levels under high natural challenge could well be the basis of a practical selection

approach for anaemia control; and that in certain circumstances it might be possible to select for ability to acquire resistance to trypanosomiasis.

(d) TREATMENT

[See also **12**: no. 5754.]

5761 **Dolan, R.B., Sayer, P.D., Alushula, H. and Heath, B.R., 1988.**

Pyrethroid impregnated ear tags in trypanosomiasis control. *Tropical Animal Health and Production*, **20** (4): 267-268.

KETRI, P.O. Box 362, Kikuyu, Kenya; *ibid.*; *ibid.*; Galana Game and Ranching Ltd, P.O. Box 76, Malindi, Kenya.

Three groups of 33 Boran steers were fitted (i) with a single ear tag impregnated with the synthetic pyrethroid fenfluthrin, (ii) with two ear tags, or (iii) with no ear tag (control group), and exposed to natural challenge for 4 months between December 1984 and April 1985. There was a marked reduction in the number of infections with *Trypanosoma congolense* and *T. vivax*: 15% with one tag and 39% with two tags. There were no significant differences observed in PCV changes or weight gains between the groups. The results suggest that fenfluthrin has a repellent effect against tsetse and possibly also biting flies.

5762 **Hendy, C.R.C., 1988.** The effects of trypanosomiasis prophylaxis and anthelmintic treatment in goats under traditional management in southern Tanzania. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 289-309.* ODNRI, Central Avenue, Chatham Maritime, Chatham, Kent ME4 4TB, UK. Anthelmintic treatment and trypanosomiasis prophylaxis trials were conducted over 4 years on 3000 goats (including over 700 breeding females) in 64 flocks under traditional management distributed throughout different tsetse infestation and farming system zones of Mtwara and Newala Districts of southern Tanzania. Increased tsetse challenge (from low to medium; <0.5 and >0.5-1.5 flies/trap/day respectively) was associated with only small (-13 to -18%) reductions in overall productivity (measured by an index of total weight of offspring weaned per breeding female per year). Responses to anthelmintic treatment were small (<10%), though indicated trends for increased litter sizes, reduced parturition intervals, greater pre-weaning offspring growth and survival rates, and higher overall productivity with treatment. A significant interaction of treatment with season showed large positive responses in the period November to February (early rains) but small or negative responses in other seasons. Trypanosomiasis prophylaxis gave a 23-27% increase in overall productivity. Responses varied, though, between traits. For breeding females, there was evidence of a negative effect of prophylaxis on dam liveweights (-4%) and litter sizes (-8%) mainly due to significantly greater losses of liveweight post-partum under prophylaxis. This was nevertheless associated with greater offspring liveweights and growth from birth to weaning, and greater offspring survival to weaning. That trypanosomiasis was the disease problem, despite apparently low trypanosome prevalence (1-4%), was evidenced by the significant interaction of prophylaxis and tsetse challenge, with large (+62 to +77%) responses in overall productivity to prophylaxis under medium challenge compared to almost no response under low challenge. The results suggest that the principal response to trypanosomiasis prophylaxis in breeding goats was through increased milk yields of suckled dams, and that trypanosomiasis prophylaxis may be economically justifiable at apparently low levels of disease prevalence.

Author's abstract

5763 **Ilemobade, A.A., 1988.** Chemotherapy against African animal trypanosomiasis: its strengths and limitations. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 265-273.* Federal University of Technology, P.M.B. 704, Akure, Nigeria. Drug control of animal trypanosomiasis relies essentially on three drugs: homidium (Novidium, Ethidium), diminazene aceturate (Berenil) and isometamidium chloride (Samorin, Trypamidium). When properly used, chemotherapy allows temporary or permanent maintenance of livestock under moderate trypanosomiasis risk where the tsetse are riverine species, reduces stock losses especially during seasonal migrations through tsetse belts to areas of pasture and water, and is effective in the control of sporadic trypanosomiasis due to mechanical transmission, seasonal fly dispersal and scattered tsetse foci. Chemotherapy also allows the introduction of livestock into tsetse reclamation schemes, leading to better land utilisation, but is not sufficient alone to allow susceptible livestock to be raised on a permanent basis in *morsitans* fly belts except when it is combined with vector control. Some problems associated with

drug resistance in trypanosomes and measures aimed at combating such resistance in the field are discussed.

From author's abstract

5764 **Itty, P. et al., 1988.** Economic aspects of cattle production and of chemoprophylaxis for control of trypanosomiasis in village East African Zebu cattle in Kenya. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 360-376.* ILCA, P.O. Box 46847, Nairobi, Kenya.

The economics of chemoprophylaxis were studied for East African Zebu cattle exposed to a medium tsetse challenge and monitored in village herds at Muhaka, Coast Province of Kenya. Cattle production was more profitable when cattle were treated prophylactically than when they merely received therapeutic treatments. Doubling the use of Samorin was still economical. The economic superiority of prophylaxis was directly related to an increase in lactation yield. A cost-benefit analysis considered the economics of different levels of veterinary inputs, and the effect of foreign exchange costs.

5765 **Jibbo, J.M.C., Durkin, J., Light, D.E., Murray, M., Sones, K. and Trail, J.C.M., 1988.** Chemoprophylaxis: its successful use in the control of trypanosomiasis in Boran cattle, at Mkwaja Ranch, Tanzania. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 274-282.*

Amboni Ltd, Mkwaja Ranch, P.O. Box 117, Tanga, Tanzania; ILCA, P.O. Box 5689, Addis Ababa, Ethiopia; *ibid.*; Glasgow University Veterinary School, Bearsden Road, Bearsden, Glasgow G61 1QH, UK; ILCA, P.O. Box 46847, Nairobi, Kenya.

Reproductive performance, mortality, growth and culling and replacement rates based on 20,000 calving records were evaluated for grade Boran beef cattle maintained with trypanocidal drugs in an area of high trypanosomiasis risk in Tanzania. Under ranching conditions, over a 10-year period in this area of high *Glossina morsitans morsitans*, *G. pallidipes* and *G. brevipalpis* challenge, a calving interval of 15.9 months, pre-weaning mortality of 8%, annual cow mortality of 5.8% and 8-month weaning weight of 133.5 kg resulted in a herd productivity of 96 kg of weaner calf per cow per year. The proportion of heifers required as replacements (45%) and the generation interval (6.9 years) indicated scope for implementation of selection programmes on growth traits. The level of productivity achieved compared favourably with that of pure Boran cattle under trypanosomiasis-free ranching conditions in Kenya. An average of 4.4 treatments with Samorin, a prophylactic, and 0.6 treatments with Berenil, a therapeutic, were required per year. The number of treatments varied from year to year and by area, being greater in the south of the ranch where the tsetse challenge was considered higher. Despite such extensive use of trypanocidal drugs, there was no indication that drug resistance had developed or evidence that repeated inoculation of Samorin had affected productivity. These results indicate the possibility of improving livestock production in tsetse-infested areas by the rational use of chemoprophylaxis as an integral part of management.

Authors' abstract

5766 **Maloo, S.H. et al., 1988.** The use of chemoprophylaxis in East African Zebu village cattle exposed to trypanosomiasis in Muhaka, Kenya. *In: ILCA/ILRAD, 1988 (see 12: no. 5692), pp. 283-288.*

Veterinary Investigation Laboratories, P.O. Box 204, Mariakani, Kenya.

The efficacy of chemoprophylaxis for the control of trypanosomiasis was studied on some 700 head of East African Zebu cattle maintained in 10 village herd groups in a tsetse-infested area at Muhaka, Coast Province of Kenya. In April 1984, approximately 2/3 of adults and 2/3 of youngstock within each herd were identified to join the prophylaxis programme, with 1/3 of each remaining as controls. Samorin was given by deep intramuscular injection at 0.5 mg/kg. The strategy was designed to treat animals just before the periods of maximum disease risk, three times a year, in April, July and October. In addition, Berenil was given by intramuscular injection at 3.5 mg/kg in January, the lowest risk period. Its use was to eliminate any possible trypanosome infections that existed in the cattle population. The control groups were treated for trypanosomiasis on an *ad hoc* basis, the study lasting for 33 months. In the case of breeding cows, the use of trypanocidal drugs reduced detectable parasitaemias by 39%, reduced the number of therapeutic treatments required by 64%, and increased cow productivity (weight of 12 month old calf and liveweight equivalent of milk extracted for human consumption per unit metabolic weight of cow maintained) by 20%. Similarly, youngstock performance between the ages of 12 and 30 months (viability and growth) was increased by 19%, detectable parasitaemias were reduced by 54% and therapeutic treatments required were reduced by 61%.

Authors' abstract

5767 **Njau, B.C., Mkonyi, P.A. and Lekaki, K., 1988.** Susceptibility of a *Trypanosoma congolense* isolate of water-buffalo origin to diminazene aceturate and isometamidium chloride. *Insect Science and its Application*, **9** (4): 461-463. ILCA, P.O. Box 5689, Addis Ababa, Ethiopia; Animal Diseases Research Institute, P.O. Box 9254, Dar-es-Salaam, Tanzania; *ibid.*

Laboratory mice infected with a *T. congolense* isolate of water-buffalo origin did not respond when treated with diminazene aceturate at 3.5 mg/kg and 7 mg/kg body weight and also isometamidium chloride at doses less than 3 mg/kg. Effective cure was achieved with isometamidium and diminazene at 3 mg/kg and 14 mg/kg respectively; doses in excess of those recommended for use in the field to treat animal trypanosomiasis by the manufacturers. Irregular use of the two drugs on infected water-buffaloes while improperly restrained may be one of the factors responsible for the dual drug-resistant *T. congolense* isolate emerging.

Authors' abstract

5768 **Takken, W., Taylor-Lewis, E.G. and Woodford, M.H., 1988.** Field studies on animal trypanosomiasis in Mozambique. I. Effectiveness of the prophylactic drugs isometamidium chloride and pyrimethidium bromide. *Tropical Animal Health and Production*, **20** (4): 243-255.

Ten Katelaan 29, 3723 DR Bilthoven, Netherlands; African Development Bank, Abidjan, Côte d'Ivoire; c/o National Westminster Bank, Hendford, Yeovil, Somerset, UK.

The efficacy of the trypanocides Samorin (isometamidium chloride) and Prothidium (pyrimethidium bromide) to protect beef cattle in areas of different trypanosome challenge was studied in Muabsa, Mozambique, during an 18 month period. The performance of two groups of 1.5- to 3-year-old bulls was observed, the first group in an area of high tsetse density, the second in an area of low to medium tsetse density. *Glossina morsitans* and *G. pallidipes* were present and their respective densities were determined using standard fly rounds, a mobile

electric screen and biconical traps. The trypanosome challenge was determined using parameters of tsetse density and infection rates; the trypanosome risk was determined by Berenil Indices in both groups of animals. The Berenil Indices in the two study areas were not significantly different despite a great difference in apparent densities of the tsetse flies. The period of protection afforded by Samorin and Prothidium was similar in both areas which would appear to indicate that the tsetse density had no apparent effect on the degree of challenge. Samorin gave a slightly better protection than Prothidium as shown by a lower frequency of infections as well as higher packed cell volumes. There was no difference in growth rates between the treatment groups and study areas during the entire study period. It was concluded that in the study area Samorin usage is preferable to that of Prothidium. Tsetse densities obtained from standard fly rounds were found unsatisfactory in assessing the challenge, possibly because this method does not sample all components of the population. The Berenil Index, however, was found to be a useful indicator of trypanosome risk and thus frequency of treatment required.

Authors' abstract

7. EXPERIMENTAL TRYPANOSOMIASIS

(a) DIAGNOSTICS

5769 **Levine, R.A., Wardlaw, S.C. and Patton, C.L., 1989.** Detection of haematoparasites using quantitative buffy coat analysis tubes. *Parasitology Today*, **5** (4): 132-134.

Department of Laboratory Medicine, Yale University School of Medicine, New Haven, CT 06511, USA.

5770 **Liu, M.K., Pearson, T.W., Sayer, P.D., Gould, S.S., Waitumbi, J.N. and Njogu, A.R., 1988.** Serodiagnosis of African sleeping sickness in vervet monkeys by detection of parasite antigens. [*T. b. rhodesiense*.] *Acta Tropica*, **45** (4): 321-330.

Department of Biochemistry and Microbiology, University of Victoria, Victoria, British Columbia, Canada V8W 2Y2; *ibid.*; KETRI, P.O. Box 362, Muguga, Kenya; *ibid.*; *ibid.*; *ibid.* (Correspondence to Pearson.)

Sera of vervet monkeys experimentally infected with *Trypanosoma brucei rhodesiense* were examined using a double antibody sandwich ELISA and Procyclic Agglutination Trypanosomiasis Test (PATT) for the presence of circulating trypanosomal antigens and anti-procyclic surface antibodies respectively. The sandwich ELISA gave a better indication of the disease progression than the PATT, especially during trypanocidal drug therapy, and could be useful for the diagnosis of African sleeping sickness.

From authors' abstract

5771 **Nantulya, V.M., 1989.** An antigen detection enzyme immunoassay for the diagnosis of *rhodesiense* sleeping sickness. *Parasite Immunology*, **11** (1): 69-75.

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

A monoclonal antibody raised against a non-variable surface antigen of *Trypanosoma brucei rhodesiense* procyclic trypomastigotes was used to develop an antigen detection enzyme immunoassay for the diagnosis of *rhodesiense* sleeping sickness. The assay was evaluated using 211 sera from clinically suspected cases: 142 from parasitologically proven cases and 69 from patients who were negative on parasitological examination. The test was positive in 128 out of 142 parasitologically proven cases. The negative cases may have been in the early stages of the disease, or may represent patients with antibody levels sufficient to prevent detection of antigen. Of particular significance, however, was the finding that eight of the 69 patients with undiagnosed disease were antigen positive despite the negative parasitological findings. Since false-positive reactions were not observed with blood donor sera, or with sera from malaria, schistosomiasis and leishmaniasis patients, it is reasonable to conclude that the eight antigen-positive patients were actual cases of sleeping sickness. The remaining 61 cases who were negative for both parasitaemia and antigenaemia may conceivably represent the variety of diseases whose clinical manifestations resemble those of *rhodesiense* sleeping sickness. The antigen detection method would thus not only be complementary to parasitological diagnosis, but essential for correct diagnosis in certain stages of the disease.

Author's abstract

(b) PATHOLOGY AND IMMUNOLOGY

5772 **Anthoons, J.A.M.S., Marck, E.A.E. van, Gigase, P.L.J. and Stevens, W.J., 1989.** Immunohistochemical characterization of the mononuclear cells in the brain of the rat with an experimental chronic *Trypanosoma brucei gambiense* infection. *Parasitology Research*, **75** (4): 251-256.

Department of Pathology, Institute of Tropical Medicine, Nationalstraat 155, B-2000 Antwerp, Belgium; *ibid.*; *ibid.*; Department of Immunology, University of Antwerp, Universiteitsplein 1, B-2610 Antwerp-Wilrijk, Belgium. (Reprint requests to Marck.)

5773 **Frevert, U., Herzberg, F. and Reinwald, E., 1988.** The role of the surface coat on phagocytosis of *Trypanosoma congolense* *in vitro*. *Endocytobiosis and Cell Research*, **5** (2): 245-257.

Institut für Veterinär-Biochemie, Freie Universität Berlin, D-1000 Berlin, Federal Republic of Germany.

5774 **Frommel, T.O., Seed, J.R. and Sechelski, J., 1988.** Changes in albumin levels in blood and urine of *Microtus montanus* chronically infected with *Trypanosoma brucei gambiense*. *Journal of Parasitology*, **74** (6): 957-962.

Department of Medical Genetics, University of British Columbia, Vancouver, British Columbia, Canada V6T 1W5; Department of Parasitology and Laboratory Practice, School of Public Health, University of North Carolina, Chapel Hill, NC 27599-7400, USA; *ibid.*

5775 **Oka, M., Yabu, Y., Ito, Y. and Takayanagi, T., 1988.** Polyclonal B-cell stimulative and immunosuppressive activities at different developmental stages of *Trypanosoma gambiense*. [Mice.] *Microbiology and Immunology*, **32** (11): 1175-1177.

Oka, Ito: Department of Parasitology, School of Medicine, University of Tokushima, Tokushima 770, Japan; Yabu, Takayanagi: Department of Medical Zoology, Nagoya City University Medical School, Nagoya, Aichi 467, Japan.

5776 **Schultzberg, M., Ambatsis, M., Samuelsson, E.-B., Kristensson, K. and Meirvenne, N. van, 1988.** Spread of *Trypanosoma brucei* to the nervous system: early attack on circumventricular organs and sensory ganglia. [Rats, mice, deer mice.] *Journal of Neuroscience Research*, **21** (1): 56-61.

Neuropathological Laboratory, Department of Pathology, Huddinge Hospital, Karolinska Institutet, S-141 86 Huddinge, Sweden; *ibid.*; *ibid.*; *ibid.*; Laboratory of Serology, Prince Leopold Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

5777 **Sippel, H., 1988.** Nebenwirkungen trypanozider Diamidine. II.

Hepatotoxische Effekte. [Side effects of trypanocidal diamidines. II.

Hepatotoxic effects.] (Meeting abstract.) [Mice.] *Archiv der Pharmazie*, **321** (9): 640.

Lehrstuhl für Toxikologie und Pharmakologie der Universität Erlangen-Nürnberg, Universitätsstrasse 22, D-8520 Erlangen, Federal Republic of Germany.

5778 **Steinmann, U., 1988.** Nebenwirkungen trypanozider Diamidine. I.

Nebenwirkungen auf das Kreislaufsystem. [Side effects of trypanocidal diamidines. I. Side effects on the circulatory system.] (Meeting abstract.)

[Rats.] *Archiv der Pharmazie*, **321** (9): 639.

Lehrstuhl für Toxikologie und Pharmakologie der Universität Erlangen-Nürnberg, Universitätsstrasse 22, D-8520 Erlangen, Federal Republic of Germany.

5779 **Wakelin, D.M. and Blackwell, J.M. (eds), 1988.** *Genetics of resistance to bacterial and parasitic infection*. London; Taylor & Francis. 287 pp. (Section on trypanosomiasis, pp. 121-135.)

Department of Zoology, University of Nottingham, University Park, Nottingham NG7 2RD, UK; Department of Tropical Hygiene, London School of Hygiene and Tropical Medicine, Keppel Street, London WC1E 7HT, UK.

(c) CHEMOTHERAPEUTICS

5780 **Gogh, H. van, Watson, A.D.J., Nouws, J.F.M., Nieuwenhuijs, J. and Miert, A.S.J.P.A.M. van, 1989.** Effect of tick-borne fever (*Ehrlichia phagocytophila*) and trypanosomiasis (*Trypanosoma brucei* 1066) on the pharmacokinetics of sulfadimidine and its metabolites in goats. *Drug Metabolism and Disposition*, **17** (1): 1-6.

Gogh, Miert: Department of Veterinary Pharmacology, Pharmacy and Toxicology, University of Utrecht, P.O. Box 80176, 3508 TD Utrecht, Netherlands; Watson: Department of Veterinary Clinical

- Studies, University of Sydney, Australia; Nieuwenhuijs: Department of Tropical Veterinary Medicine, University of Utrecht, Netherlands; Nouws: RVV-District 6. (Reprint requests to Miert.)
- 5781 **Hart, D., Langridge, A., Barlow, D. and Sutton, B., 1989.** Antiparasitic drug design. *Parasitology Today*, **5** (4): 117-120.
Drug Design Group, King's College London, Campden Hill Road, London W8 7AH, UK.
- 5782 **Steinmann, U., Estler C.-J. and Dann, O., 1988.** Plasma histamine levels in rats treated with trypanocidal diamidines. *Pharmacology (Basel)*, **36** (3): 204-209.
Institut für Pharmakologie und Toxikologie (Steinmann, Estler) und Pharmazie (Dann), Universität Erlangen-Nürnberg, Universitätsstrasse 22, D-8520 Erlangen, Federal Republic of Germany.
- 5783 **Steinmann, U., Estler, C.J. and Dann, O., 1989.** Hemodynamic side effects of trypanocidal diamidines in rats: studies on possible antagonisms. *Arzneimittel Forschung*, **39** (I) (2): 254-256.
Institut für Pharmakologie und Toxikologie, Lehrstuhl für Toxikologie und Pharmakologie (Steinmann, Estler) and Institut für Pharmazie (Dann), Universität Erlangen-Nürnberg, D-8520 Erlangen, Federal Republic of Germany.
- 5784 **Steinmann, U. and Fritsch, C., 1988.** Amelioration of the hypotensive effect of trypanocidal diamidines by use of heavy soluble salts. [Rats.] *Journal of Pharmacy and Pharmacology*, **40** (12): 896.
Institutes of Pharmacology and Toxicology (Steinmann) and Pharmacy (Fritsch), University of Erlangen-Nürnberg, Universitätsstrasse 22, D-8520 Erlangen, Federal Republic of Germany.
- 5785 **Witmans, C.J., Grol, C.J., Horn, A.S., Wierenga, R.K., Hol, W.G.J. and Opperdoes, F.R., 1988.** An approach to the rational design of new inhibitors for *T. brucei brucei* triosephosphate isomerase (T.I.M.). (Meeting abstract.) *Pharmaceutisch Weekblad: Scientific Edition*, **10** (6): 308.
University Centre for Pharmacy, University of Groningen, Ant. Deusinglaan 2, 9713 AW Groningen, Netherlands; *ibid.*; *ibid.*; Laboratory of Chemical Physics, University of Groningen, Nijenborgh 16, 9747 AG Groningen, Netherlands; *ibid.*; International Institute of Cellular and Molecular Pathology, Research Unit for Tropical Diseases, 1200 Brussels, Belgium.
- 5786 **Zweygarth, E. and Röttcher, D., 1989.** Efficacy of experimental trypanocidal compounds against a multiple drug-resistant *Trypanosoma brucei brucei* stock in mice. *Parasitology Research*, **75** (3): 178-182.
Chemotherapy of Trypanosomiasis Research Project (GTZ), Veterinary Research Laboratory, P.O. Box 29231, Kabete, Kenya.

8. TRYPANOSOME RESEARCH

(a) CULTIVATION OF TRYPANOSOMES

(b) TAXONOMY, CHARACTERISATION OF ISOLATES

[See also **12**: nos. 5724, 5805.]

5787 **Godfrey, D.G., 1987.** The identification of African trypanosomes.

Medicina Tropicale nella Cooperazione allo Sviluppo, **3** (2): 100-104.

TRL, Department of Veterinary Medicine, University of Bristol, Langford House, Langford, Bristol BS18 7DU, UK.

The value is described of identifying African trypanosomes, pathogenic to man and livestock, by biochemical methods. Isoenzymes and DNA sequences have already proved useful in finding animal reservoirs of human disease, and for demonstrating genetically different populations of the same species among both human and animal infections. Numerical methods of analysis demonstrate a correlation between different populations and their distribution throughout Africa, although the stability of such distribution will depend on the frequency of the recently demonstrated exchange of genetic material between trypanosome populations.

Author's abstract

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

5788 **Aline, R.F., Scholler, J.K. and Stuart, K., 1989.** Transcripts from the co-transposed segment of variant surface glycoprotein genes are in *Trypanosoma brucei* polyribosomes. *Molecular and Biochemical Parasitology*, **32** (2-3): 169-178.

Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109, USA. (Correspondence to Stuart.)

5789 **Barbet, A.F., Myler, P.J., Williams, R.O. and McGuire, T.C., 1989.**

Shared surface epitopes among trypanosomes of the same serodeme expressing different variable surface glycoprotein genes. [*T. brucei*.] *Molecular and Biochemical Parasitology*, **32** (2-3): 191-199.

Department of Infectious Diseases, College of Veterinary Medicine, University of Florida, Box J-137 JHMHC, Gainesville, FL 32610, USA; Seattle Biomedical Research Institute, 4 Nickerson Street, Seattle, WA 98109, USA; Institut für Genetik und Toxikologie, Kernforschungszentrum, Karlsruhe, Federal Republic of Germany; Department of Veterinary Microbiology and Pathology, Washington State University, Pullman, WA 99163-7040, USA.

5790 **Battaglia, P.A., Costanzo, G. and Birago, C., 1987.** Spatial genetic information in the kinetoplast DNA of trypanosomes. *Medicina Tropicale nella Cooperazione allo Sviluppo*, **3** (2): 109-111.

Laboratorio di Biologia Cellulare, Istituto Superiore di Sanità, Rome, Italy.

5791 **Benne, R., 1989.** RNA-editing in trypanosome mitochondria. (Review.) [*T. brucei*.] *Biochimica et Biophysica Acta*, **1007** (2): 131-139.

c/o Ms G.E.E. Van Noppen, Publications Secretary, Laboratory of Biochemistry, University of Amsterdam, Meibergdreef 15, 1105 AZ Amsterdam, Netherlands.

- 5792 **Boothroyd, J.C., Campbell, D.A. and Sutton, R.E., 1985.** Expression of surface antigen genes in *Trypanosoma brucei* involves a novel system of discontinuous transcription. In: Lerner, R.A., Chanock, R.M. and Brown, F. (eds), *Vaccines 85: Molecular and chemical basis of resistance to parasitic, bacterial, and viral diseases* (Cold Spring Harbor, New York; Cold Spring Harbor Laboratory), pp. 61-66.

Department of Medical Microbiology, Stanford University School of Medicine, Stanford, CA 94305, USA.

- 5793 **Bülow, R., Nonnengässer, C. and Overath, P., 1989.** Release of the variant surface glycoprotein during differentiation of bloodstream to procyclic forms of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **32** (1): 85-92.

Department of Medical Microbiology, Sherman Fairchild Science Building, Stanford, CA, USA; Max-Planck-Institut für Biologie, Corrensstrasse 38, D-7400 Tübingen, Federal Republic of Germany; *ibid.* (Correspondence to Overath.)

- 5794 **Carruthers, V.B. and Clarke, M.W., 1988.** Mapping of segmental antigenic determinants on structurally related variant surface glycoproteins of *Trypanosoma brucei*. *Biochemistry and Cell Biology*, **66** (11): 1231-1237.

Department of Microbiology and Immunology, University of Western Ontario, London, Ontario, Canada N6G 5C1.

- 5795 **Clayton, C.E. and Fox, J.A., 1989.** Phosphorylation of fructose biphosphate aldolase in *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **33** (1): 73-80.

Rockefeller University, 1230 York Avenue, New York, NY 10021, USA.

- 5796 **Cross, G.A.M. and Ferguson, M.A.J., 1985.** Variant surface antigens of *Trypanosoma brucei*. In: Lerner, R.A., Chanock, R.M. and Brown, F. (eds), *Vaccines 85: Molecular and chemical basis of resistance to parasitic, bacterial, and viral diseases* (Cold Spring Harbor, New York; Cold Spring Harbor Laboratory), pp. 57-60.

Rockefeller University, New York, NY 10021, USA.

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