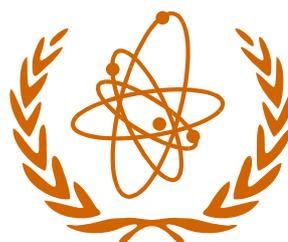


TSETSE AND TRYPANOSOMIASIS INFORMATION QUARTERLY

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SECTION A – NEWS

PROGRAMME AGAINST AFRICAN TRYPANOSOMIASIS

PAAT-L e-mail network

To accompany recent progress in the Programme against African Trypanosomiasis, FAO is pleased to announce that the new e-mail network PAAT-L is now operational. This has been created to improve communication between everyone in the trypanosomiasis community at all levels, and to act as a focus for discussion and consultation during the development stages of the PAAT Information Service.

PAAT has set itself the task of providing the means for facilitating improved coordination of the many and varied resources dedicated to the trypanosomiasis problem, and through the collection and analysis of data, coupled with information dissemination, aims to provide a forum that will serve the needs of investing and tsetse-infested countries as well as the research and technical communities engaged in this field. PAAT-L will facilitate the attaining of this objective but its success depends on the level of voluntary participation we may achieve.

To subscribe to the list, please send an e-mail to mailserv@mailserv.fao.org. Leave the subject blank and then put in the first line of the message the following:

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REGIONAL TSETSE AND TRYPANOSOMOSIS CONTROL PROGRAMME

RTTCP training activities

Capacity building in Tsetse and Trypanosomosis Control has been one of the main objectives of the RTTCP. A wide spectrum of training was conducted in 1997.

The M.Sc. Course 'Tsetse and Trypanosomosis Control' started in May 1997, involving thirteen students from six different countries in West and southern Africa. The course is part-time and is to be spread over three years. Training modules of four-weeks duration were held in May, August and November, covering a variety of general topics on the surveillance and control of the vector and the disease. All students passed the examination held in December and have now proceeded to Year Two of the course, during which they will specialise in either tsetse or trypanosomosis. In Year Three the students will perform a research project. It is not yet known whether there will be a second intake for this M.Sc. programme, in the year 2000. Therefore, the RTTCP discourages interested persons from making enquiries now, but recommends that further information be sought during the first half of 1999.

Three middle level training courses were provided: (1) Trypanosomosis surveys; (2) Use of traps, targets and odours; and (3) Tsetse identification and sampling. These one-

week courses were field based and practically orientated. The courses were attended by a total of 51 technical personnel from Zimbabwe, Zambia, Mozambique, Namibia, Botswana and Malawi. This type of technical training had to be discontinued in 1998 due to a lack of funds.

A four-day course of management training was given for senior managers during the week preceding the 24th ISCTRC Conference, held in Maputo in September/October 1997. The course was entitled 'Project Cycle Management and Logical Framework Method'. It was attended by 17 participants from 12 African countries. Management training was also offered as a sub-module to the M.Sc. students.

In order to provide the above set of courses it has been necessary to mobilise a large number of experts in a variety of fields. Information on these persons and on the trainees has been recorded in a database, for easy reference in planning other training activities.

MEETING REPORT

Second World Meeting on Salivarian Trypanosomes

This 'virtual conference', which was organised by Drs Alberto M.R. Davila and Roberto Aguilar M.S. Silva of EMBRAPA/Centro de Pesquisa Agropecuaria do Pantanal, Brazil, took place from 9 to 19 March 1998. Participants received copies of presented papers by e-mail and, in some cases, additional material from internet websites, and were able to take part in discussions on the papers by e-mail.

The following is a list of the papers presented. Abstracts of papers marked with an asterisk are available at the website <http://www.cenargen.embrapa.br/~davila/salivaria/vmeetings/abstracts.html>. Lively discussions took place throughout the conference on points raised by the papers.

Opening lecture: The OIE ad hoc group on non-tsetse transmitted animal trypanosomes (NTTAT): its origin, scope and perspective (L. Touratier, e-mail oiie@oiie.int).

Epidemiology: A possible role for Rusa deer (*Cervus timorensis russa*) and wild pigs in spread of *Trypanosoma evansi* from Indonesia to Papua New Guinea* (S.A. Reid *et al.*, simon.reid@jcu.edu.au); Bovine trypanosomiasis [*T. vivax*] in Brazilian and Bolivian lowlands: evidence for disease spreading by cattle routes* (R.A.M.S. Silva *et al.*, ramss@cpap.embrapa.br); The seroprevalence of the equine trypanosomiasis [*T. evansi*] in the Pantanal: preliminary data (A.M.R. Davila *et al.*, alrida@cpap.embrapa.br, amrdavila@hotmail.com).

Special session: Characterisation of *Trypanosoma rangeli* strains isolated in Central and South America* (E.C. Grisard, grisard@ccb.ufsc.br); The circulation of trypanosomatids [*T. cruzi*] in sylvatic environments* (A.M. Jansen *et al.*, jansen@gene.dbbm.fiocruz.br).

Biochemistry, drugs and chemotherapy: Laboratory and field evaluation of biodegradable polyesters for sustained release of isometamidium and ethidium* (S. Geerts *et al.*, sgeerts@itg.be); Innate resistance to trypanosomiasis in Cape buffalo* (S.J. Black *et al.*, sblack@vasci.umass.edu); The dynamics of calcium homeostasis in *Trypanosoma brucei** (L. Ruben *et al.*, lruben@post.cis.smu.edu); Novel approaches to antitrypanosomal chemotherapy* (S. Croft, s.croft@lshtm.ac.uk); Therapy of human African trypano-somiasis: current situation (J. Atouguia and J. Costa, j.atouguia@ip.pt).

Molecular biology and evolution: Comparative genomics and efficient gene discovery in the African trypanosomes* (P. Majiwa *et al.*, p.majiwa@cgnet.com); The evolution of Salivarian trypanosomes* (J.R. Stevens and W.C. Gibson, j.r.stevens@bristol.ac.uk); Programmed cell death in procyclic form *Trypanosoma brucei rhodesiense* (S.C. Welburn and N.B. Murphy, s.welburn@cgnet.com, n.murphy@cgnet.com); Mechanisms mediating antigenic variation in *Trypanosoma brucei** (G. Rudenko, gloriar@nki.nl); Analysis of Brazilian isolates of *Trypanosoma evansi* by RAPD and characterization of a species-specific randomly amplified DNA fragment (R. Ventura).

Molecular epidemiology, diagnosis and immunology: Bovine trypanosomosis and immunosuppression* (K.A. Taylor and B. Mertens, k.taylor@cgnet.com); Review on the molecular tools for the understanding of the epidemiology of animal trypanosomosis in West Africa* (G. Duvallet *et al.*, duvallet@cirad.fr); Outbreak of trypanosomosis in KwaZulu-Natal, South Africa* (D.T. de Waal *et al.*, Theo@moon.ovi.ac.za); Improved methods for the diagnosis of African trypanosomosis* (D.E. Rebeski *et al.*, rebeski@rial1.iaea.or.at).

Special session: The genus *Endotrypanum*: characterization of an interesting Trypanosomatidae* (A.M.R. Franco, franco@gene.dbbm.fiocruz.br); Trypanosomiasis [*T. evansi*] in domestic and reservoir host animals (R.Z. Machado *et al.*, zacarias@fcav.unesp.br).

Economy, vectors and control: Can remotely sensed NOAA and Meteosat data significantly contribute to reduce costs of tsetse surveys? (G. Hendrickx *et al.*, tryptogo@cafe.tg); The Programme against African Trypanosomiasis (PAAT): a joint FAO, WHO, OAU and IAEA initiative* (B. Hursey *et al.*, brian.hursey@fao.org); Estimated financial impact of *Trypanosoma vivax* on the Brazilian Pantanal and Bolivian Lowlands* (A. Seidl, aseidl@ceres.agsci.colostate.edu); Integrated control of African trypanosomosis* (P.H. Holmes, P.H.Holmes@vet.gla.ac.uk).

It is hoped that the proceedings of the meeting may be published if funding can be found.

JOINT FAO/IAEA DIVISION AND SEIBERSDORF LABORATORY

Technical Co-operation Project: Tsetse eradication in Ethiopia

Based on the success in Zanzibar (see news item in *TTIQ*, 21 (1)), a new model project has been started in Ethiopia where tsetse-transmitted animal trypanosomosis is one of the country's most important livestock development problems. Estimates of the tsetse-infested land mass in Ethiopia range between 100,000 and 150,000 km², and a total of about 10 million cattle are under threat. The livelihood of some 5 million people is directly or indirectly negatively affected by the presence of the tsetse fly and the disease it transmits to livestock. This 10 year programme will eventually cover an area of 25,000 km² in the Southern Rift Valley. On-going efforts on tsetse and trypanosomosis management will be supplemented by the sterile insect technique, using an area-wide eradication approach against *Glossina pallidipes*, apparently the only tsetse species in the Rift Valley. The area appears to be isolated by high altitude and dry climate from other tsetse belts in the country. Any areas at risk of possible reinfestation will be identified

and, if necessary, taken care of by adherence to basic quarantine procedures. It is envisaged to start with a pilot zone of 5,100 km² during the first 5 years and, during the second 5 year period, to cover the remaining area of the valley in two 10,000 km² blocks.

Tsetse fly and trypanosomiasis surveys covering the entire prospective eradication area will start before the initiation and expansion of fly suppression activities. The project has two main implementation components: (i) establishment of a centrally located and operated sterile insect production plant for provision and dispersal of sterile tsetse; and (ii) the actual field operation of the fly eradication process which will be implemented on a district level. A major part of the work in the field is planned to be undertaken by the target community with technical supervision and back stopping from programme staff. The total expenditure of this long-term project is estimated now at US\$ 43.8 million. The project is in the planning stages now: many changes will be made as additional data and information are obtained.

A technical contract has been awarded for the development of a decision support model on the feasibility of using the SIT as a component of integrated area-wide tsetse control/eradication in tsetse affected areas.

Co-ordinated Research Projects

Automation in tsetse fly mass-rearing for use in SIT programme

This 5 year project (1995-2000) aims to improve and up-grade tsetse mass-rearing by the development and utilisation of automation and other methods. Emphasis will be placed on automation of moving materials, such as the blood used to feed tsetse flies, the pupae produced by tsetse flies and the male tsetse flies which are introduced into cages with females and then removed when mating has been completed. In addition, the automation of separating male from female tsetse flies may be possible, provided one or more methods of determining the sex of tsetse fly pupae can be developed.

Improved attractants for enhancing the efficiency of tsetse fly suppression operations and barrier systems used in tsetse control/eradication campaigns

This 5 year project (1994-1999) aims to improve the efficiency of pre-SIT-release fly population suppression operations and entomological monitoring of the target tsetse fly species by developing better visual and odour attractants. This will reduce the time and amount of materials required to suppress a tsetse population to densities that permit the initiation of the SIT. Currently, pre-release population suppression of *G. austeni* involves more than 80 insecticide-impregnated targets per km² for more than 18 months, whereas good attractants available for other tsetse species reduce the requirement to only 4 to 8 targets per km² for a period of 3 to 6 months. Moreover, reliable entomological data can be collected with less labour and investment. Thus, it will be possible to assess the progress of vector control or eradication operations, including the SIT, more easily and more accurately.

Genetic applications to improve the SIT for tsetse control/eradication including genetic sexing

This 5 year project (1997-2002) aims to obtain information for a better understanding of the phylogenetic relationships between different tsetse species, subspecies and strains, and of heritable traits that can be subjected to selection pressure.

This knowledge is of particular importance during the planning and the operational stages of area-wide control/eradication campaigns. Data on genetic variation within a target population and information on the gene flow between neighbouring tsetse fly populations will have implications for planning and implementation of control campaigns. The possible development of resistance (physiological or behavioural), based on the selection of particular genotypes, will interact with and influence the type of control measure chosen and its mode of application. A second objective is to acquire knowledge on all factors, genetic and microbial, which modulate tsetse-trypanosome interaction. Knowledge of these factors could enable trypanosome refractoriness to be introduced into a target population or a mass-reared tsetse strain. A third objective is to develop tsetse strains that are more suitable for mass-rearing and release in tsetse control/eradication campaigns. Particular emphasis is laid on the development of an automated sexing method for immature fly stages (genetic sexing), and on other genetic or related techniques that foster an efficient large-scale application of the SIT. This also includes research directed at a trans-taxon use of laboratory-reared sterile flies for tsetse and trypanosomiasis control or eradication activities.

Developments at the Entomology Laboratory, Seibersdorf

Extensive work has been carried out on the evaluation of the tsetse production unit, which moves fly cages mechanically to the blood feeding membrane. Initial adult mortality was very high but has been reduced by limiting the amount of movement. However, pupal production is still unsatisfactory. Attention is now being focused on the improvement of cage design and size.

The present stocking of cages by hand with chilled pupae will have to be replaced in future large-scale rearing by the development of self-stocking production cages. A system based on the weight of pupae has now been developed and tested and looks very promising.

A large *in vitro* fed colony is being established with *G. pallidipes* field material from Ethiopia. The flies feed and mate satisfactorily and are producing pupae of the required quality and quantity. The *G. austeni* colony has been reduced in size since the Tanga colony it was supplying reached the required size.

DNA analysis of *G. pallidipes* field material from Ethiopia, and of *G. pallidipes* laboratory material from Uganda and Zimbabwe, showed very few differences in the DNA level between the laboratory colonies (suggesting some cross-contamination?), but the field material showed characteristic variation. This type of analysis will be used to determine the population structure of *G. pallidipes* in the target area in Ethiopia.

SECTION B – ABSTRACTS

1. GENERAL (INCLUDING LAND USE)

- 10365 **Hay, S.I., 1997.** Remote sensing and disease control: past, present and future. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **91** (2): 105-106.

Trypanosomiasis and Land-use in Africa (TALA) Research Group,
Department of Zoology, University of Oxford, South Parks Road, Oxford
OX1 3PS, UK.

This article focuses on the insight that has been gained, and might further arise, from observations of the land surface by satellite-borne sensors, and presents recent examples of the application of high and low spatial resolution satellite sensor data to the control of malaria and trypanosomiasis, respectively. Low spatial resolution data from the National Oceanic and Atmospheric Administration's (NOAA) Advanced Very High Resolution Radiometer (AVHRR) can be of use on the broad scale of national and regional planning. Temporal Fourier analysis to capture the seasonal variation in a time series of monthly vegetation (1981-1992) and temperature indices (1987-1992) derived from the AVHRR, as well as monthly rainfall indices derived from the geostationary Meteosat satellite (1988-1992), has been used in combination with an 8 × 8 km resolution Digital Elevation Model (DEM) for Africa to predict contemporary tsetse fly distributions in Côte d'Ivoire and Burkina Faso. The environmental niche of the tsetse fly was considered to have been effectively described by these variables. Some of the major advances in spatial, temporal and spectral resolution of the satellite-borne sensors to be launched into orbit by the year 2000 are also highlighted.

- 10366 **Janssens, P.G., 1996.** La trypanosomiase en Angola à l'aube du 20e siècle. Réflexions sur les épidémies des bassins du Cuanza et du Congo (notes historiques). [Sleeping sickness in Angola at the turn of the 20th century. Reflections on the epidemics in the Cuanza and the Congo Basins (historical notes).] *Bulletin des Séances, Académie Royale des Sciences d'Outre-Mer*, **42** (3): 537-569.

'Sparrenkrans', Vogelsanck 12, 2970 's Gravenwezel, Belgium.

This paper discusses the report produced by Dr A. de Souza Leitão following a survey carried out from November 1900 to February 1901 whose intention was to document the responsibility of sleeping sickness for the decline of the estates in the Cuanza Valley in the hinterland of Luanda, Angola. It provides a circumstantial and reliable account of the sleeping sickness situation in the estates in the Golungo Alto and Cazengo regions and also in municipalities such as Dongo, Massangano and Muxima. The carefully collected data show that this visit took place during the final stage of a declining epidemic. Leitão completed his report with a clinical description of the disease and underlined the many attempts carried out to unravel its aetiology. In his opinion sleeping sickness was an infectious and communicable disease of bacterial origin.

- 10367 **Kohler-Rollefson, I., 1994.** Ethnoveterinary practices of camel pastoralists in Northern Africa and India. *Journal of Camel Practice and Research*, **1** (2): 75-82.

Institut für Zoologie, Technische Hochschule, Darmstadt, Germany.

Indigenous veterinary treatments as practised by camel pastoral cultures are reviewed. Drawing on information published by colonial veterinarians, anthropologists and early travellers, the article summarises aspects of general knowledge and therapies for three important camel diseases: trypanosomiasis, mange and camel pox. It is concluded that the combination of traditional and modern medicines might provide cost-effective alternative means of camel health maintenance.

10368 **Mayor, A., 1996.** Kenia: la sabana científica. [Kenya: the scientific savanna.] *Microbiología*, **12** (4): 651-658.

ICIPE Science Press, Nairobi, Kenya.

This article discusses the nature and development of microbiological and medical research in Kenya with reference to the work of the different research organisations. References to trypanosomiasis are included.

10369 **Molyneux, D.H., 1997.** Patterns of change in vector-borne diseases. *Annals of Tropical Medicine and Parasitology*, **91** (7): 827-839.

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

This review discusses the changes in status of vector-borne diseases in recent years and the primary causes of change (urbanisation, increased conflict, changes in water-resource management, ecological and environmental change, and reduced health service resourcing). Successful vector-control programmes have been implemented against onchocerciasis and Chagas disease, and bednet programmes for the control of malaria show promise. In contrast to the success achieved in limiting *Simulium* and *Triatoma* populations through vertical programmes, the use of highly effective tsetse trapping using insecticide-impregnated traps and targets has only been applied in limited situations for sleeping sickness control despite evidence, particularly from Uganda, Congo and Côte d'Ivoire, that such approaches can reduce transmission and vector populations. Although traps and targets are relatively cheap and can be made locally, deployment generally depends on external donor support. Late-stage treatment still depends on melarsoprol because DFMO is too costly to be used in any existing health system, even if logistic and supply problems could be overcome. At present few solutions exist to the disastrous sleeping sickness situation in Central Africa, particularly in the Democratic Republic of Congo (DRC) and most patients will never have access to any health services there are. The disastrous epidemics of the 1930s and 1960s are now being repeated in the DRC.

10370 **Schillhorn van Veen, T.W., 1997.** Sense or nonsense? Traditional methods of animal parasitic disease control. *Veterinary Parasitology*, **71** (2-3): 177-194.

Department of Agriculture and Natural Resources, World Bank, 1818 H Street, Washington, DC 20433, USA.

In recent years, there has been a resurgence of interest in traditional health-care practices. In animal health, this had led to further interest in ethnoveterinary research and development, which has practical applications for animal parasite control, whether related to epidemiology, diagnostics and therapy, or to comprehensive disease control methods leading to integrated pest/disease management. Examples are provided of traditional practices in diagnostics and herd-, grazing- and pasture-management as well as of manipulation and treatment. For trypanosomiasis, traditional diagnostic observations include the distinctive smell of the urine and taste of the milk (for *Trypanosoma evansi* infections in camels), generalised swelling of the lymph nodes, and 'unthriftiness'. Naturally trypanotolerant breeds are utilised and a form of 'natural vaccination' or 'seasoning' is used, especially in West Africa, where herds with some genetic resistance are knowingly exposed to tsetse for limited periods so that they may slowly adapt to the infection: this allows them to survive under medium tsetse/trypanosomiasis challenge on the fringes between savanna and tsetse-infested forest. Management strategies used by herders include the avoidance of tsetse-infested woods, especially in the daytime, by night grazing and migration through the tsetse belt at night. Herders also move their animals north during the rainy season to reduce the risk of trypanosomiasis, and may deliberately overstock pastures to keep down the vegetation, thus destroying potential tsetse habitat. Many of these applications indicate a basic understanding of disease, especially epidemiology, by farmers and herders, and the application of traditional practices seems to make sense in areas without adequate veterinary services. Moreover, acknowledgement of the value of traditional knowledge empowers local herders/farmers to try to solve their herds' disease problems in a cost-effective way.

10371 **Toure, S.M. and Mortelmans, J., 1996.** Stratégie et planification de la lutte contre la trypanosomose animale africaine, avec implication des communautés rurales et du secteur privé. [Strategy and planning of the control of African animal trypanosomiasis with involvement of the rural communities and the private sector.] *Bulletin des Séances, Académie Royale des Sciences d'Outre-Mer*, **42** (3): 485-512.

CIRDES, B.P. 454, Bobo-Dioulasso 01, Burkina Faso.

The high agropastoral potential of several African sub-Saharan countries within the sub-humid zone are underexploited as a result of tsetse-transmitted animal trypanosomiasis. Control strategies and planning of related activities are reviewed with emphasis on tsetse control. The technical tools available include the use of screens and targets and the treatment of cattle using pour-on formulations of pyrethroids. The role of community participation in control, the environmental consequences, training requirements for technical staff and livestock breeders, and institutional aspects related to control programmes are discussed, and proposals for coordination mechanisms are put forward.

2. TSETSE BIOLOGY

(a) REARING OF TSETSE FLIES

[See **21**: no. 10373.]

(b) TAXONOMY, ANATOMY, PHYSIOLOGY, BIOCHEMISTRY

[See also **21**: nos. 10373, 10379.]

10372 **Gooding, R.H., 1997.** Genetics of hybridization of *Glossina swynnertoni* with *Glossina morsitans morsitans* and *Glossina morsitans centralis*. *Medical and Veterinary Entomology*, **11** (4): 373-382.

Department of Biological Sciences, University of Alberta, Edmonton, AB T6G 2E9, Canada.

Reciprocal crosses were performed with *G. swynnertoni* and *G. m. morsitans* and with *G. swynnertoni* and *G. m. centralis*, using strains that carried marker genes in all three linkage groups. *G. swynnertoni* males can inseminate, but not fertilise, *G. m. morsitans*; all other crosses produced some fertile females. Hybridisation did not cause sex ratio distortion among F₁ flies. Most F₁ and backcross females were fertile, but all F₁ males were sterile. Sterility among backcross males was also high (99% in Bx₁, 85% in Bx₂, and about 50% in Bx₃ to Bx₅). Chromosome transmission by hybrid females usually conformed to Mendelian expectations, but genetic recombination was lower than observed in *G. m. morsitans*. The reduction in fertility among backcross females was not associated with heterozygosity in any linkage group. Sterility among hybrid and backcross males was associated with heterozygosity of sex chromosomes and probably autosomes. The results support the systematic placement of *G. swynnertoni* closer to *G. m. centralis* than to *G. m. morsitans*.

(c) DISTRIBUTION, ECOLOGY, BEHAVIOUR, POPULATION STUDIES

[See also **21**: nos. 10365, 10381, 10383.]

10373 **Clutton-Brock, T. and Langley, P., 1997.** Persistent courtship reduces male and female longevity in captive tsetse flies *Glossina morsitans morsitans* Westwood (Diptera: Glossinidae). *Behavioural Ecology*, **8** (4): 392-395.

Large Animal Research Group, Department of Zoology, University of Cambridge, Downing Street, Cambridge CB2 3EJ, UK.

Where males can increase their mating success by harassing females until they accept copulation, harassing tactics can be expected to evolve to a point where they have costs to the longevity of both sexes. By experimentally manipulating the sex ratio in captive groups of *G. m. morsitans*, we demonstrated that the longevity of females declines where sex ratios are biased toward males, while the longevity of males declines where the

sex ratio is biased toward females. Neither irradiation of males nor prevention of copulation by blocking or damaging the external male genitalia increased the longevity of females caged with them, suggesting that female longevity was reduced by the physical aspects of male harassment rather than by components of the ejaculate.

- 10374 **Mohamed-Ahmed, M.M. and Wynholds, Y., 1997.** Effects of vegetation and weather on trap catches of *Glossina fuscipes fuscipes* near Lake Victoria, Kenya. *Entomologia experimentalis et applicata*, **85** (3): 231-236.

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

G. f. fuscipes was sampled in isolated thickets and forest patches near Lake Victoria, Kenya, using unbaited biconical traps, between March 1992 and June 1993. Traps set at 1 m from the forest edge caught 3.3 times as many males and 5 times as many females as those set inside or 10 m away. The corresponding figures at 1 m from the edge of thicket were about 1.43 and 1.64 times, respectively. Hourly catches of males and females were positively correlated with temperature, light intensity and host (monitor lizard) prevalence, and negatively correlated with relative humidity. Light intensity and temperature were the most important variables affecting the catches of each sex. The results are discussed in relation to control and monitoring of *G. f. fuscipes* using traps.

- 10375 **Odulaja, A. and Madubunyi, L.C., 1997.** A sampling bias model for odour-baited traps in relation to tsetse hunger cycle and population suppression. *Ecological Modelling*, **104** (2-3): 165-173.

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

Eight progressive stages of midgut evacuation (MES), which reflect increasing degrees of hunger, were used to define the hunger cycle in tsetse. The distribution of flies in all eight MES in thriving tsetse populations, as well as in odour-baited trap catches, was modelled using exponential and β probability density functions, respectively. These distributions enabled derivation of the proportion (p) of a tsetse population that succumbs daily to a sampling device. This parameter proved useful for evaluating the bias of cow urine-baited NG2G trap samples of *Glossina pallidipes*, and for estimating trapping mortality and the required period and trap density for tsetse control. The higher the value of p , the less biased the sample and the higher the trapping mortality; the shorter the period, the fewer the number of traps required for achievement of tsetse control. Simulations based on field data and parameter estimates in the published literature predict that ICIPE's NG2G traps baited with cow urine may achieve up to an average of 97% reduction of *G. pallidipes* populations in 1 year. Using this trapping system for tsetse suppression could achieve up to 98% population reduction within 1 year in 75% of control campaigns. It will require about 2 years to achieve a 99.9% reduction in the fly population, given these parameters.

- 10376 **Späth, J., 1997.** Natural host odours as possible attractants for *Glossina tachinoides* and *G. longipalpis* (Diptera: Glossinidae). *Acta Tropica*, **68** (2): 149-158.

Glogauer Weg 12, D-84130 Kingolfing, Germany.

As strictly haematophagous insects, tsetse flies feed on a wide variety of wild and domestic animals. Although these are mainly mammals, some tsetse species also feed on reptiles. The present study investigated whether the odours of several potential natural tsetse hosts may be used as novel attractants to improve the catch of *G. tachinoides* or *G. longipalpis* in biconical traps. The odour of a living monitor lizard (*Varanus niloticus*) had no effect on the catch of *G. tachinoides*. Hexane skin washings of monitor lizard and warthog (*Phacochoerus aethiopicus*) dispensed in small quantities improved the catch of *G. tachinoides* significantly by factors of up to 1.34 and 1.46, respectively. Skin washing of bushbuck (*Tragelaphus scriptus*) did not increase the catch of *G. tachinoides*, but the synthetic phenolic fraction of bushbuck urine enhanced it significantly by 1.81 times. The catch of *G. longipalpis* was improved significantly by the urines of warthog, domestic pig and bushbuck by factors of 1.58, 1.91 and 2.51, respectively. In relation to the quantity of evaporated odour, bushbuck and warthog urine seem to be of particular interest for further attractant studies. The effect of tested host odours on the catch of *G. tachinoides* and *G. longipalpis* is compared with data of other tsetse species and with the frequency with which these hosts are fed on by tsetse flies. Bushbuck is one of the principal natural hosts of both *Glossina* species investigated, and of all odours tested, bushbuck urine and its synthetic phenolic fraction improved the catch of both tsetse species the most.

3. TSETSE CONTROL (INCLUDING ENVIRONMENTAL SIDE-EFFECTS)

[See also 21: nos. 10369, 10371, 10374, 10375.]

10377 **Bossche, P. van den, 1996.** Laboratory bioassays of deltamethrin, topically applied, during the hunger cycle of male *Glossina tachinoides*. *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **49** (4): 329-333.

Veterinary Department, Institute of Tropical Medicine, Nationalestraat 155, 2000 Antwerp, Belgium.

Fully engorged immature male *G. tachinoides* (not more than 24 h old) and mature male *G. tachinoides* (20 days old) were starved for 0 to 5 days. Different batches of 40 mature flies were topically treated with deltamethrin (0.08 ng) once on one of the successive days of their hunger cycle. Batches of at least 54 immature flies were similarly treated. The fat levels of the flies were also determined on successive days of the hunger cycle using different batches of flies. Mortality of immature male *G. tachinoides* increased with increasing starvation, reaching 100% after 48 h when treated on day 4. Similarly, mortality of mature flies increased when treated later in the hunger cycle but was lower than in immature flies on corresponding days. There was a significant negative correlation between fat level and mature male mortality 48 h after deltamethrin application ($P < 0.01$) and between their mortality and average residual dry weight ($P < 0.01$). The apparent protective role of the blood meal is attributed to the high amount of non-target tissue diverting the insecticide to sites of 'non lethal action'. The general lower

susceptibility of mature flies is attributed to an additional non-target tissue, the body fat reserve.

- 10378 **Chikuni, O., Nhachi, C.F.B., Nyazema, N.Z., Polder, A., Nafstad, I. and Skaare, J.U., 1997.** Assessment of environmental pollution by PCBs, DDT and its metabolites using human milk of mothers in Zimbabwe. *Science of the Total Environment*, **199** (1-2): 183-190.

Department of Clinical Pharmacology, Medical School, P.O. Box A178, Avondale, Harare, Zimbabwe.

Seven sampling areas were chosen across Zimbabwe representing areas with vector control programmes (Kariba), fruit-growing areas (Nyanga), mining areas (Kwekwe), cotton-growing areas (Kadoma), industrialised suburbs (Bulawayo), suburbs (Harare) and rural areas (Esigodini). Milk samples were collected between February 1993 and April 1995 from women who had lived in the areas for at least 5 years, were healthy and breast feeding their first, second or third child. Organochlorine pesticide residues were detected in the human milk samples at the following levels: pp-DDE 100%; pp-DDT 98%; and total polychlorinated biphenyls (PCB) 53%. The Kariba area had the highest mean level of sum DDT (25,259 ng/g milk fat), and the lowest mean level of sum DDT (1607 ng/g milk fat) was found in Esigodini. The major DDT metabolite was pp-DDE. The ratio of pp-DDT:pp-DDE was highest in Kariba (0.6) suggesting recent pollution by DDT in that area. It was concluded that the vector control programmes (extensive pesticide spraying of pests such as mosquitoes and tsetse flies), agricultural activities and dietary habits were the main contributing factors towards the high levels of pesticides in most of the areas. The Kadoma area had the highest mean level of sum PCB (60 ng/g milk fat).

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

[See also **21**: nos. 10376, 10384, 10391, 10449.]

- 10379 **Grubhoffer, L.V.H. and Volf, P., 1997.** Lectins (hemagglutinins) in the gut of the important disease vectors. *Parasite*, **4** (3): 203-216.

Institute of Parasitology, Academy of Sciences of the Czech Republic, Faculty of Biological Sciences, University of South Bohemia, Branišovska 31, 37005 Ceske Budejovice, Czech Republic.

This review of the gut lectins/haemagglutinins of ticks, reduviid bugs, mosquitoes, sandflies and tsetse flies surveys the recent research on these carbohydrate binding factors with respect to their structural and functional properties, and their significance for pathogen/parasite transmission. Their production in response to the tsetse blood meal, and their role in trypanosome agglutination in the tsetse midgut, in the susceptibility/refractoriness of tsetse to trypanosome infection, and in trypanosome maturation is discussed. Recent results suggest that in most vectors the gut lectin activities are blood-

meal enhanced, might participate in blood-meal processing and digestion and could serve as antibacterial and antiparasitic agents.

- 10380 **Kazadi, J.M., Kageruka, P., Losson, B., Jochems, M. and Hees, J. van, 1996.** Influence de l'intervalle du repas d'entretien sur la compétence vectorielle de *Glossina palpalis palpalis* (Mongo-Bemba, Zaïre) vis-à-vis de *Trypanosoma brucei brucei* EATRO 1125: morphologie et cycle du parasite. [Influence of upkeep meal intervals on *G. p. palpalis* (Mongo-Bemba, Zaire) vectorial competence in relation to *T. b. brucei* EATRO 1125: morphology and parasite cycle.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **49** (3): 199-206.

Kazadi: Département de Santé Animale, Institut de Médecine Tropicale Prince Léopold, Nationalestraat 155, 2000 Antwerp, Belgium.

The vectorial competence of *G. p. palpalis* (Mongo-Bemba, Zaire) in relation to *T. b. brucei* EATRO 1125 was evaluated. After receiving a single feed on an infected rat, 1304 teneral flies were divided into three groups and given maintenance feeds every one, two or three days on uninfected rats. The infection levels of the midgut, the proventriculus and the salivary glands differed significantly in both sexes. The interval between meals had no significant effect on the infection levels in either the females or the males. However, when males and females were compared, although there was no significant difference between them when fed every one or two days, male vectorial competence was significantly higher than that of females when the flies were fed at three-day intervals. Metacyclogenesis was expressed by the successive invasion of trypomastigotes into the midgut, proventriculus and salivary glands. Parasite invasion was permanent in all colonised sites.

- 10381 **La Rocque de Severac, S. de, 1997.** *Identification des facteurs discriminants majeurs de la présence des glossines dans une zone agro-pastorale du Burkina Faso. Intérêt pour la prévision du risque trypanosomien.* [Identification of major discriminant factors for the presence of tsetse flies in an agropastoral area of Burkina Faso. Importance in predicting trypanosomiasis risk.] Thèse de doctorat en Biologie des systèmes intégrés, agronomie, environnement; Université de Montpellier II Sciences et Techniques du Languedoc, Montpellier, France.

Animal trypanosomoses represent one of the major pathological constraints to cattle breeding in sub-Saharan Africa. The present study aimed at identifying factors enabling the forecasting of the distribution and abundance of two tsetse species (*Glossina palpalis gambiensis* and *G. tachinoides*) in an area covering approximately 1000 km² in south-west Burkina Faso. The study combined field surveys and high resolution remote sensing data (SPOT images). Geographical information systems were used to combine the following different levels of information (all geo-referenced): entomology (3600 tsetse flies captured, 1 trap every 100 m along a 120 km hydrographic network); parasitology (standard methods increased by PCR analysis) on vectors and livestock (sentinel herds); natural environment (70 parameters mainly concerning vegetation types, watercourses and their frequency of use); use of valley landscape; land use and its dynamics (agricultural

fragmentation); livestock distribution (exhaustive census, type of producers); and the different pastoral practices (livestock range management, watering places). The association of all these levels of information led to a favourable classification of biotopes. The evolution of these tsetse populations is discussed in the light of environmental changes revealed through a series of aerial and satellite pictures. Spatial differences appeared in vector distribution, in types of trypanosomal infection and in host species. The relation between the risk of trypanosome transmission and the densities of these tsetse species is discussed. The risk seemed to depend mainly on the spatial and temporal contact between the vectors and the cattle. This new approach to this complex pathogenic system, viewed in its agro-ecological and socio-cultural context, helped to reveal places of epidemiological risk..

5. HUMAN TRYPANOSOMIASIS

(a) SURVEILLANCE

10382 **Arbyn, M., Bruneel, H., Molisho, S. and Ekwanzala, F., 1995.** Human trypanosomiasis in Zaire: a return to the situation at the beginning of the century? *Archives of Public Health*, **53** (7-8): 365-371.

Arbyn: Medical Department, Médecins Sans Frontières, Dupréstraat 94, B-1090 Brussels, Belgium.

This paper addresses briefly the history of sleeping sickness in Zaire (Democratic Republic of Congo), concentrating on the number of new cases detected annually between 1930 and 1995. A survey in 1992 revealed a disease prevalence of 15.2% in the Bogbamili area of the Karawa district, and surveys carried out in 1994 revealed 8169 cases in the north of the Equateur region, and a prevalence of 21% in 5613 individuals from the Bandundu region. These upsurges in several foci in the country indicate that the ongoing epidemic is evolving exponentially towards the dramatic prevalences reported at the beginning of the century.

10383 **Endeshaw, T., Kebede, A., Haddis, M., Tilahun, T. and Asfaw, T., 1997.** The human trypanosomiasis situation in Gambella, south western Ethiopia. *Ethiopian Journal of Health Development*, **11** (1): 23-28.

Ethiopian Health and Nutrition Research Institute, P.O. Box 1242, Addis Ababa, Ethiopia.

Surveillance of human trypanosomiasis was carried out in Gambella, south-western Ethiopia, during March and October 1993 and April 1994. A total of 1600 blood samples were collected from the indigenous Anuak population from the districts of Abobo and Gokna-Jor. Individuals aged over 10 years were selected using random sampling methods and the samples were screened for trypanosomiasis by the microhaematocrit buffy coat technique and Giemsa-stained blood smears. Biconical traps and moving vehicles were used to sample the tsetse population. No parasitologically confirmed cases of trypanosomiasis was detected. *Glossina pallidipes* and *G. tachinoides* in wooded savanna

and forest areas, and *G. fuscipes* in riverine vegetation, were commonly encountered. However, a decline in the prevalence of *G. morsitans* was observed. It is concluded that, although there were no proven cases of trypanosomiasis, the presence of tsetse flies, ecological rehabilitation of the area to its previous condition and the invasion of game animals (39 mammal species were recorded in the area) may lead to the reappearance of *Trypanosoma brucei rhodesiense*. Thus, regular active surveillance of the endemic region is of great importance to control, and a comprehensive study on community awareness about sleeping sickness and its vector is also recommended to support future control measures.

10384 **Khonde, N., Pépin, J., Niyonsenga, T. and Wals, P. de, 1997.** Familial aggregation of *Trypanosoma brucei gambiense* trypanosomiasis in a very high incidence community in Zaire. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **91** (5): 521-524.

Pépin: Centre Universitaire de Santé de l'Estrie, Center for International Health, 3001 12^{ème} Avenue Nord, Sherbrooke, Quebec J1H 5N4, Canada.

Familial aggregation of *T. b. gambiense* human African trypanosomiasis (HAT) was investigated in three adjacent villages of central Zaire (Democratic Republic of Congo) where 318 out of 1431 inhabitants had previously suffered from HAT. Neither spatial nor familial aggregation was detected when analysing the distribution of cases in the whole community using Poisson, negative binomial and pairwise odds ratio models. However, clustering of cases was observed when specific familial relationships were examined. The risk of HAT for a child was significantly increased if the mother had also had HAT, but it was not influenced by a past history of HAT in the father. Sisters and brothers of cases of HAT had a higher risk of HAT than siblings of individuals who had never had HAT, but no such association was documented for half-sisters and half-brothers. Among married couples, a past history of HAT in one spouse had no impact on the other spouse's risk of HAT. Indirect arguments suggested that familial clustering was a consequence of shared exposure, either sequential or simultaneous, rather than of genetic susceptibility. The existence of familial clustering should be kept in mind when implementing passive or active case-finding activities.

10385 **Nantulya, V.M., 1997.** *TrypTect* CIATT[®] – a card indirect agglutination trypanosomiasis test for diagnosis of *Trypanosoma brucei gambiense* and *T. b. rhodesiense* infections. *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **91** (5): 551-553.

Brentec Diagnostics, P.O. Box 42477, Nairobi, Kenya.

A simple and rapid test, the card indirect agglutination trypanosomiasis test (*TrypTect* CIATT) is described, for detecting circulating antigens in persons suffering from *T. b. gambiense* and *T. b. rhodesiense* infection by latex agglutination. The sensitivity of the test (95.8% for *T. b. gambiense* and 97.7% for *T. b. rhodesiense*) was significantly higher than that of lymph node puncture, microhaematocrit centrifugation and CSF examination after single and double centrifugation. The specificity of the test

was also high: 106 blood donor sera as well as sera from 37 patients with malaria, 25 with visceral leishmaniasis, 10 with schistosomiasis, 5 with filariasis and 10 with hydatid disease, from trypanosomiasis-free areas, gave negative results. Eighteen clinical suspects from active disease transmission foci, without microscopically detectable parasitaemia but with a positive test result, were further examined by lumbar puncture and inoculation of blood into mice; 11 (61%) were found to be infected, suggesting that the test had a high positive predictive value. This study showed that *TrypTect* CIATT is a useful test for rapid diagnosis of both patent and non-patent *T. b. gambiense* and *T. b. rhodesiense* infections.

(b) PATHOLOGY AND IMMUNOLOGY

10386 **Kennedy, N., Beeching, N.J., Humphrey, P.R. and Wyatt, G.B., 1997.** African trypanosomiasis complicated by transverse myelitis in a traveller returning from Zimbabwe. (Meeting abstract.) *Transactions of the Royal Society of Tropical Medicine and Hygiene*, **91** (5): 510.

Kennedy: Infectious Diseases Unit, Fazakerley Hospital, Lower Lane, Liverpool L9 7AL, UK.

The case of a 67-year-old woman, who returned from a holiday in Zimbabwe with fever, anorexia, abdominal discomfort, intermittent confusion, general malaise and a purpuric rash over the abdomen, is described. Numerous trypanosomes (*Trypanosoma brucei rhodesiense*) were seen in the blood film: these cleared rapidly with suramin and steroid treatment. Since the CSF protein and white blood cell count were both elevated, treatment with increasing doses of melarsoprol was commenced, with initial favourable response. However, after 4 weeks she developed a transverse myelitis, with urinary retention and asymmetrical numbness and weakness of the lower limbs. Treatment was discontinued and her neurology gradually improved and the CSF returned to normal. Late onset transverse myelitis is an unusual occurrence as a result of the disease and/or the treatment.

10387 **Mhlanga, J.D.M., Bentivoglio, M. and Kristensson, K., 1997.** Neurobiology of cerebral malaria and African sleeping sickness. *Brain Research Bulletin*, **44** (5): 579-589.

Kristensson: Department of Neuroscience, Karolinska Institute, Doktorsringen 17, S-17177 Stockholm, Sweden.

This review is aimed at emphasising the need for basic neuroscience research on two tropical diseases, malaria and sleeping sickness, in which severe involvement of the nervous system is frequently the direct cause of death. The life cycles of the two protozoan causative agents of malaria and sleeping sickness are briefly reviewed and the different strategies for survival in the host by the intracellular *Plasmodium* and the extracellular *Trypanosoma brucei* are summarised; such strategies include sites favourable for hiding or replication of the parasites in the host, antigenic variation, and interactions

with the cytokine network of the host. In particular, tumor necrosis factor- α and interferon- γ may play a role in these infections. The parasites may paradoxically interact with cytokines to their benefit. However, cytokine receptors are expressed on neuronal subsets sensitive to cytokine action, and stimulation of these subsets may cause neuronal dysfunctions during the infections. Finally, the clinical symptoms of the two diseases and research aiming at deciphering their pathogenetic mechanisms that could affect the nervous system at a molecular level are described. The need for neuroscientists in this endeavour is emphasised.

- 10388 **Monnet, D., Lonsdorfer, A., Pénali, K., Valéro, D., Doua, F., Bogui, P. and Yapo, A.E., 1997.** Valeurs sériques des marqueurs protéiques de l'inflammation et de la nutrition dans la phase méningo-encéphalitique de la trypanosomose humaine africaine. [Serum level of nutritional and acute phase proteins during human African trypanosomiasis in the meningo-encephalitic stage.] *Bulletin de la Société de Pathologie exotique*, **90** (2): 105-106.

Monnet: Laboratoire de Biochimie, Faculté de Pharmacie et Institut Pasteur, B.P. 490, Abidjan, Côte d'Ivoire.

Two acute phase proteins, C-reactive protein and acid α 1-glycoprotein, and three nutritional markers, prealbumin, retinol binding protein and transferrin, have been evaluated in eight patients suffering from trypanosomiasis in the meningo-encephalitic stage and compared to those obtained from 15 normal control subjects of the same age. Results showed a marked decrease of nutritional markers without change of serum acute phase proteins. This suggests that in the meningo-encephalitic stage of human African trypanosomiasis, denutrition was a major biological or clinical feature, in association with monoclonal or polyclonal lymphoid cell stimulation as revealed by an increase in β 2-microglobulin levels.

- 10389 **Rhind, S.G., Shek, P.N., Radomski, M.W., Doua, F. and Buguet, A., 1996.** Cytokine profile in human African sleeping sickness. (Meeting abstract.) *Journal of Sleep Research*, **5** (Suppl. 1): 194.

Rhind: Defence and Civil Institute of Environmental Medicine, Toronto, ON M3M 3B9, Canada.

- 10390 **Sabbah, P., Brosset, C., Imbert, P., Bonardel, G., Jeandel, P. and Briant, J.F., 1997.** Human African trypanosomiasis: MRI. *Neuroradiology*, **39** (10): 708-710.

Sabbah: SP 91479, F-00218 Armées, France.

We report a case of human African trypanosomiasis caused by *Trypanosoma brucei rhodesiense* in a 30-year-old white man visiting Rwanda. One month after feeling a painful insect bite while in the bush, he suffered headache and weight loss of 10 kg in 10 days. He was flown to France where trypanosomes were identified. After the febrile period of parasite dissemination, the patient had meningeal involvement but normal computer tomography (CT). Magnetic resonance imaging (MRI) showed the appearances

of meningitis. After two periods of arsenical treatment, a severe encephalopathy occurred, suggesting post-therapeutic reactive encephalitis (PTRE). Nevertheless, T2-weighted MRI showed no oedema, but focal bilateral high signal areas in the white matter. PTRE was excluded and a third course of treatment with melarsoprol, followed by prednisolone, was undertaken. The lesions progressively disappeared.

10391 **Smith, D.H. and Bailey, J.W., 1997.** Human African trypanosomiasis in south-eastern Uganda: clinical diversity and isoenzyme profiles. *Annals of Tropical Medicine and Parasitology*, **91** (7): 851-856.

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

The spectrum of clinical manifestations of trypanosomiasis in south-eastern Uganda is extremely wide. Isoenzyme characterisation of trypanosome strains isolated in this area during recent epidemics of sleeping sickness has shown that particular clinical features of the disease can be related to the zymodeme of the causative parasite. For example, B17, part of the 'busoga' group of isolates and a zymodeme identified from central areas of Busoga during outbreaks of sleeping sickness, is associated with severe early features and a high frequency of presentation with a chancre. Isolates belonging to the 'zambezi' group, most of which came from areas close to the lake shores or close to the River Nile, were more heterogeneous and were associated with significantly different clinical features: a more chronic, prolonged illness, more frequent presentation with meningo-encephalitis, and less frequent chancres. The clinical spectrum of infection associated with the parasites currently in circulation indicates that the previous endemicity and the early epidemics could be explained on the basis of existing zymodemes.

(c) TREATMENT

[See also **21**: nos. 10386, 10390, 10425.]

10392 **Gompel, A. van and Vervoort, T., 1997.** Chemotherapy of leishmaniasis and trypanosomiasis. *Current Opinion in Infectious Diseases*, **10** (6): 469-474.

Gompel: Medical Department, Institute of Tropical Medicine, Nationalestraat 155, B-2000 Antwerp, Belgium.

No real breakthroughs in the treatment of African trypanosomiasis have been reported in the past year. The article mentions the use of pentamidine for the treatment of *Trypanosoma brucei gambiense* infection in Côte d'Ivoire and of combination therapy for *T. b. rhodesiense* (metronidazole plus suramin, suramin plus eflornithine). Experimental therapy in murine models includes the use of topical melarsoprol and 5-nitroimidazoles.

6. ANIMAL TRYPANOSOMIASIS

(a) SURVEY AND DISTRIBUTION

[See also **21**: no. 10370.]

- 10393 **Desquesnes, M. and Tresse, L., 1996.** Evaluation de la sensibilité du test de Woo pour la détection de *Trypanosoma vivax*. [Evaluation of the sensitivity of the Woo test for the detection of *T. vivax*.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **49** (4): 315-321.

Desquesnes: CIRAD-EMVT, Campus International de Baillarguet, B.P. 5035, 34032 Montpellier Cedex 1, France.

The haematocrit centrifugation technique (HCT), or Woo test, is the technique most commonly used for the diagnosis of animal trypanosomoses, but its sensitivity is not well defined. The aim of the present study was to measure the sensitivity of the Woo test for the detection of *T. vivax* (from French Guiana) using 22 blood samples with pre-determined levels of parasitaemia, ranging from 1 to 1767 trypanosomes/ml, that had been prepared by mixing infected ovine blood with known parasitaemia with non-infected ovine blood. A simple technique is described for the enumeration of parasites in blood. The mean positivity level of the Woo test in sheep was about 200 ± 110 trypanosomes/ml. The sensitivity of the test was 100% in samples with more than 700 trypanosomes/ml, about 80% between 300 and 700, 50% between 60 and 300, and was negligible below 60 trypanosomes/ml. Parameters are provided to estimate parasitaemia based on the number of parasites observed between slide and cover slip (parasitaemia > 2000) or in the capillary tube (parasitaemia < 2000). Sensitivity of techniques for the detection of active infection could be evaluated by comparison with fixed values such as known parasitaemias, artificially created, as described here.

- 10394 **Desquesnes, M. and Tresse, L., 1996.** Evaluation de la sensibilité de la PCR pour la détection de l'ADN de *Trypanosoma vivax* selon divers modes de préparation des échantillons sanguins. [Evaluation of PCR sensitivity for the detection of *T. vivax* DNA using several different methods of blood sample preparation.] *Revue d'Elevage et de Médecine vétérinaire des Pays tropicaux*, **49** (4): 322-327.

Desquesnes: CIRAD-EMVT, Campus International de Baillarguet, B.P. 5035, 34032 Montpellier Cedex 1, France.

Twenty-two blood samples containing known numbers of *T. vivax*/ml, ranging from 1 to 1767, were prepared by diluting *T. vivax*-infected sheep blood with blood from a non-infected sheep. The sensitivity of the PCR technique was evaluated in several types of blood sample preparations: crude heparinised blood, plasma, lysed blood, buffy coat from haematocrit capillary tubes, pellet from plasma centrifugation, and DNA purified with a commercial ion exchange resin kit. Crude heparinised blood almost always inhibited PCR. Sensitivity of PCR with plasma and lysed blood was low, around 450

trypanosomes/ml. PCR on buffy coat was more sensitive, but PCR products were sometimes barely visible. The plasma centrifugation pellet was an original, fast and economic preparation, whose PCR products were highly visible and which presented a high sensitivity: 100% of the samples were positive when the parasitaemia was over 9 trypanosomes/ml. DNA purification was slightly more time-consuming and expensive, since it required several manipulations and the use of a commercial kit, but it appeared to be the most sensitive technique among those investigated: 100% of the samples were positive when the parasitaemia was over 2 trypanosomes/ml; however, PCR products were sometimes difficult to interpret. These last two techniques are recommended for a sensitive and species-specific diagnosis of active infections of livestock with *T. vivax* and should be evaluated for other pathogenic trypanosome species.

10395 **Dia, M.L., Diop, C., Aminetou, M., Jacquiet, P. and Thiam, A., 1997.** Some factors affecting the prevalence of *Trypanosoma evansi* in camels in Mauritania. *Veterinary Parasitology*, **72** (2): 111-120.

Dia: Laboratoire de Parasitologie, Centre National d'Élevage et de Recherches Vétérinaires, B.P. 167, Nouakchott, Mauritania.

A study was conducted on the epidemiology of camel trypanosomosis in Mauritania using 2073 camels of various ages in five regions (Trarza, Gorgol, Adrar, Hodh El Chargui, Nouakchott). The prevalence was determined through blood smear and serological tests: card agglutination test for trypanosomiasis (CATT) and immunofluorescence antibody test (IFAT). The prevalence of the disease was 1.3% using blood smear examinations, 16.2% with CATT and 25.2% with IFAT. The following variations were observed: (i) camels in Trarza had the highest prevalence (18.0% by CATT, 30.1% by IFAT); (ii) significant variation between regions was seen; (iii) animals that migrated to the south were more commonly infected than those that were kept in the north to avoid tsetse-infested areas; and (iv) animals in the 5- to 10-year age group had the highest prevalence. The study indicated that camel trypanosomosis was widespread in Mauritania, especially in the wooded areas near waterways in the south.

10396 **Menninger, R., 1996.** *Erfolgskontrolle eines Tsetse- und Trypanosomose-bekämpfungsprogramms in der Côte d'Ivoire: Untersuchungen ausgewählter Rinderherden mit parasitologischen und serologischen Methoden.* [Successful control of tsetse flies and trypanosomiasis in Côte d'Ivoire: a parasitological and serological survey of selected herds.] (Summaries in English and French.) Thesis, Fachbereich Veterinärmedizin, Freie Universität, Berlin, Germany. 158 pp.

A total of 2865 blood samples were tested by the haematocrit centrifugation technique for trypanosomes, and by enzyme immunoassay for antibody to, or antigen of, *Trypanosoma brucei*, *T. congolense* and *T. vivax*. Mean infection rates for herds inside tsetse fly control areas were 2-5%; 51-68% of sera were positive for antibody and 9-18% were positive for antigen. Respective percentages for cattle outside the tsetse control areas were 13-41%, 79-80% and 24-46%.

- 10397 **Olaho-Mukani, W., Nyang'ao, J.M.N. and Ouma, J.O., 1996.** Comparison of Suratex[®], parasite detection and antigen-ELISA for the evaluation of treatment efficacy and diagnosis of surra in dromedary camels. *Journal of Camel Practice and Research*, **3** (1): 1-5.

Olaho-Mukani: Livestock Health Research Institute (LIRI), P.O. Box 96, Tororo, Uganda.

An antigen detection latex agglutination test for the diagnosis of *Trypanosoma evansi* infection, Suratex, was compared with the micro-haematocrit centrifuge technique (MHCT), mouse inoculation (MI) and antigen-ELISA (Ag-ELISA) in the evaluation of chemotherapeutic response in six camels experimentally infected with *T. evansi* and for the diagnosis of surra in camels under natural conditions. After experimental infection with *T. evansi*, a positive Ag-ELISA response was observed in two camels by the first week, while for Suratex, positivity was observed by the second week. A month after infection, three camels were treated with Cymelarsan (melarsomine) and three with Trypan: the former became Suratex or Ag-ELISA negative by the third or fourth week following treatment, while the latter did not respond to treatment and remained Suratex or Ag-ELISA positive throughout the 1 month observation period. Several pre-infection sera from the six animals tested negative. In eight herds from different parts of Kenya, comprising 450 camels, 58 (13%), 133 (30.0%), 247 (54.9%) and 232 (51.5%) camels were positive by MHCT, MI, Suratex and Ag-ELISA, respectively. Suratex detected 53 (95%) out of the 58 MHCT positive camels, while Ag-ELISA detected 56 (96%) of the same camels. Of the 133 MI positive camels, Suratex detected 124 (93%) positive cases, while Ag-ELISA detected 118 (89%). Sera from a control herd of 61 parasite-negative camels tested negative for both Suratex and Ag-ELISA. Based on these results, Suratex was 100% specific and showed sensitivity ranging from 93.2 to 94.6%. Moreover, the two serological tests also diagnosed the animals with sub-patent infections which could not be detected by parasitological methods.

- 10398 **Singh, V., Gahlot, A.K. and Chhabra, M.B., 1994.** Evaluation of some sero-diagnostic tests for *Trypanosoma evansi* infection in camel. *Journal of Camel Practice and Research*, **1** (1): 30-33.

Department of Veterinary Parasitology, Haryana Agricultural University, Hisar 125004, India.

An indirect ELISA was used to detect *T. evansi* in the sera of 110 camels from different locations of northern India, symptomatically suspected of having surra. The ELISA revealed 84.54% positive for circulating antigens as well as antibodies, compared with a wet blood smear examination which detected only 34.54% positive cases. The antigen-detection ELISA was positive in all the parasitologically proven cases as well as those with no parasitaemia. This therefore appears to be a useful method for the diagnosis of latent surra in camels.

(b) PATHOLOGY AND IMMUNOLOGY

[See also 21: no. 10411.]

- 10399 **Akinbamijo, O.O., Bennison, J.J., Romney, D.L., Wassink, G.J., Jaitner, J., Clifford, D.J. and Dempfle, L., 1997.** An evaluation of food intake, digestive physiology and live-weight changes in N'dama and Gobra zebu bulls following experimental *Trypanosoma congolense* infection. *Animal Science*, **65** (2): 151-158.

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

The effects of experimental *T. congolense* infection on the digestive physiology and nutrient utilisation in Gobra zebu and N'Dama cattle were examined in a 16-week trial. A pair-feeding procedure permitted examination of the effects of both food intake and trypanosomosis infection. Twenty Gobra and 16 N'Dama bulls aged between 1 and 2 years were paired on a live-weight basis within each breed. One of each pair was chosen at random to serve as an uninfected control while the other was inoculated intradermally with 10^4 *T. congolense* in mouse blood in the 6th week of the experiment. Packed cell volume and parasitaemia data were collected weekly throughout the trial. Total dry-matter intake (TDMI) and live-weight changes were measured weekly in all animals during the 16-week trial. Rate of passage (RoP) and dry matter digestibility were evaluated before and after infection. While infection significantly depressed TDMI in both breeds ($P < 0.05$), neither infection nor breed affected the RoP and the apparent digestibility of the dry matter. Significant changes in live weight attributable solely to the infection were observed in both breeds. Loss of body weight was more severe ($P < 0.05$) in infected Gobra bulls compared with N'Dama bulls, possibly implying a superior efficiency of nutrient utilisation by the N'Dama during infection. In the course of the trial, one N'Dama and three Gobra bulls that presented severe clinical symptoms of trypanosomosis were treated and withdrawn from the experiment along with their pair-fed controls. In conclusion, the RoP and the digestive efficiency were not affected by infection and breed differences. Also, the trypanotolerance mechanism does not seem to be affected by anorexia but rather by the ability to conserve body reserves during infection.

- 10400 **Aliyu, M.M., Oladosu, L.A. and Joshua, R.A., 1997.** Changes in haematological and biochemical levels in *Trypanosoma congolense*-infected Berenil-treated donkeys. *Tropical Veterinarian*, **15** (1-2): 25-34.

Aliyu: Department of Veterinary Medicine, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria.

The effect of *T. congolense* infection on the haematological parameters, plasma proteins and transaminases in donkeys and the efficacy of diminazene aceturate as a therapeutic agent against *T. congolense* were examined. All infected donkeys had a significant ($P < 0.01$) drop in PCV, haemoglobin concentration and red blood cell count, while a significant ($P < 0.01$) increase in white blood cell count was observed. There was a significant increase ($P < 0.05$) in mean total protein levels and a significant decrease ($P < 0.05$) in mean albumin levels in the infected donkeys. There was also a significant

increase ($P < 0.05$) in mean globulin levels of the infected donkeys. The mean glutamic oxaloacetic transaminase (GOT) levels of the infected donkeys increased significantly but the increase in glutamic pyruvic transaminase (GPT) levels was not significant ($P > 0.05$). All parasites were cleared from the blood of all the infected donkeys 8 days post diminazene aceturate treatment at a dose of 3.5 mg/kg body weight. While plasma protein level returned to almost pre-infection values, the plasma GOT and GPT levels remained high 8 days post treatment. The implications of these results are discussed.

- 10401 **Buza, J., Sileghem, M., Gwakisa, P. and Naessens, J., 1997.** CD5⁺ B lymphocytes are the main source of antibodies reactive with non-parasite antigens in *Trypanosoma congolense*-infected cattle. *Immunology*, **92** (2): 226-233.

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

Mice infected with African trypanosomes produce exceptionally large amounts of serum IgM, a major part of which binds to non-trypanosome antigens such as trinitrophenol and single-strand DNA. In this paper, we show that, in Boran and N'Dama cattle infected with *T. congolense* and *T. vivax*, similar antibodies are found, although they bind mainly to protein antigens, such as β -galactosidase, ovalbumin and ferritin. The parasite non-specific IgM antibodies appear around the same time as the parasite-specific antibodies, but their origin and function are not clear. We tested the hypothesis that CD5⁺ B cells (or B-1 cells), which increase during trypanosome infections in cattle, are responsible for production of antibodies to non-trypanosome antigens. Splenic CD5⁺ and CD5⁻ B cells from infected cattle were sorted and tested in a single cell blot assay. The numbers of immunoglobulin-secreting cells were similar in both B-cell populations. However, antibodies with reactivity for non-trypanosome antigens were significantly more prevalent in the CD5⁺ B-cell fraction and were exclusively IgM. The preference for production of these antibodies by CD5⁺ B cells, and the expansion of this subpopulation during infections in cattle, strongly suggest that CD5⁺ B cells are the main source of trypanosome non-specific antibodies. We propose that these antibodies are natural, polyreactive antibodies that are predominantly secreted by CD5⁺ B cells. Since B-1 cells are up-regulated in many states of immune insufficiency, the immunosuppression associated with trypanosome infections may be responsible for the increase of this subset and the concomitant increase in trypanosome non-specific antibodies.

- 10402 **Dia, M.L., Aminetou, M., Diop, C., Thiam, A., Jacquet, P. and El Mabrouk, A., 1997.** Auto-guérison chez un chamelon (*Camelus dromedarius*) expérimentalement infecté par *Trypanosoma evansi*. [Self cure of *T. evansi* experimental infection in a young camel (*Camelus dromedarius*).] *Revue de Médecine vétérinaire*, **148** (8-9): 713-716.

Dia: Laboratoire de Parasitologie, Centre National d'Élevage et de Recherches Vétérinaires, B.P. 167, Nouakchott, Mauritania.

An 18-month-old camel calf was experimentally infected with a stock of *T. evansi*. The first parasites were detected in the animal's peripheral blood on day 6, and serological tests were positive with IFAT on day 11 and by CATT on day 15 until the animal was

slaughtered on day 581. Between days 170 and 581, all investigations carried out to detect the presence of *T. evansi* in the camel (blood inoculations into mice, immunodepressed or not, immunodepression of the camel, direct investigation of the camel's blood, CSF and organs (liver, kidneys, heart, spleen) at autopsy) were negative.

10403 **Goossens, B., Osaer, S. and Kora, S., 1997.** Long-term effects of an experimental infection with *Trypanosoma congolense* on reproductive performance of trypanotolerant Djallonké ewes and West African Dwarf does. *Research in Veterinary Science*, **63** (2): 169-173.

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

Ten West African Dwarf (WAD) does and 12 Djallonké ewes were artificially infected with a West African strain of *T. congolense* and observed over two years (1992-1994). The infected animals showed a chronic anaemia together with a persistent parasitaemia but very low mortality, and increase in body weight was not significantly different from the control. In the infected sheep significant differences were found in offspring production at 3 and 5 months due to a higher mortality among the lambs. The infected goats had more abortions and stillbirths, and period to first kidding, total number of parturitions, production at birth, 1, 3 and 5 months were significantly different from the controls. A productivity index was calculated and revealed that a chronic *T. congolense* infection significantly decreases the productivity of WAD goats during 2 years whereas in Djallonké sheep the loss in productivity is recovered after 1 year. Although both species are regarded as trypanotolerant, the Djallonké sheep thus show a better tolerance to a chronic *T. congolense* infection than the WAD goats.

10404 **Goossens, B., Osaer, S., Kora, S., Jaitner, J., Ndao, M. and Geerts, S., 1997.** The interaction of *Trypanosoma congolense* and *Haemonchus contortus* in Djallonké sheep. *International Journal for Parasitology*, **27** (12): 1579-1584.

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

The interaction between *T. congolense* and the helminth *H. contortus* was studied in five groups of eight Djallonké sheep. Two groups received a single infection with either *H. contortus* or *T. congolense*, and two groups were infected with *T. congolense* followed by *H. contortus* (TH) or vice versa (HT). One group was kept as uninfected controls. Mortality due to infection was observed only in the dual infection groups. In the TH group, the effects were more acute whereas in the HT group they were more chronic. No significant differences in weight gain could be demonstrated between infected and control groups. Djallonké sheep are able to withstand a single infection with either *T. congolense* or *H. contortus*, which confirms their trypanotolerant nature and provides preliminary indication of resistance against helminth infections. However, when exposed to successive infections with both parasites, some of the animals lose this tolerance.

10405 **Katunguka-Rwakishaya, E., 1996.** Influence of *Trypanosoma congolense* infection on some blood inorganic and protein constituents in sheep. *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **49** (4): 311-314.

Department of Veterinary Medicine, Makerere University, P.O. Box 7062, Kampala, Uganda.

Twelve 4-month-old male castrate Scottish Blackface lambs were randomly divided into two groups of six animals each. One group was infected with 1×10^5 *T. congolense* 1180 and the other group served as uninfected controls. The animals were bled three times a week for estimation of parasitaemia by the buffy coat method and PCV by the capillary tube centrifugation technique, and once a week for biochemical estimations. Monitoring continued for 10 weeks. It was observed that infection did not have a significant effect on the plasma concentrations of zinc, copper, calcium, magnesium and inorganic phosphate. The serum iron concentrations in infected animals were higher, but not significantly so, than in control animals. Infected animals developed hypoalbuminaemia and hyperglobulinaemia, while changes in total protein were not significant. The relevance of these changes to the pathogenesis of *T. congolense* infection is discussed.

- 10406 **Katunguka-Rwakishaya, E., McKechnie, D., Parkins, J.J., Murray, M. and Holmes, P.H., 1997.** The influence of dietary protein on live bodyweight, degree of anaemia and erythropoietic responses of Scottish Blackface sheep infected experimentally with *Trypanosoma congolense*. *Research in Veterinary Science*, **63** (3): 273-277.

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

The present study investigated the influence of dietary protein on the intensity of parasitaemia, degree of anaemia and erythropoietic responses, in sixteen 4-month-old male castrate lambs experimentally infected with *T. congolense* and given either a high protein diet (116 g digestible crude protein (DCP) per day) or a low protein diet (51.5 g DCP per day). It was observed that infected and control animals on the high protein diet grew at similar rates while infected animals on the low protein diet experienced marked retardation of growth compared with their uninfected controls. Dietary protein had no influence on the degree of anaemia that followed infection. Measurement of blood volumes revealed that the low protein infected group had significantly lower mean circulating red cell volumes than their controls. Ferrokinetic measurements indicated that plasma iron turnover rates and ^{59}Fe incorporation rates were higher in the high protein infected group than in the low protein infected group, although these differences were not significant. These observations indicate that infected animals on a high protein diet tended to show greater enhancement of erythropoietic activity than infected animals on a low protein diet.

- 10407 **Mertens, B., Muriuki, C., Muiya, P., Andrianarivo, A., Mwangi, S. and Logan-Henfrey, L., 1997.** Bovine stem cell factor: production of a biologically active protein and mRNA analysis in cattle infected with *Trypanosoma congolense*. *Veterinary Immunology and Immunopathology*, **59** (1-2): 65-78.

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

The cDNA coding for the soluble form of bovine stem cell factor (boSCF^{Ala165}) was cloned and recombinant protein was produced in bacteria as a histidine tagged-protein. The protein was purified from the inclusion bodies in one step by metal chelation chromatography under denaturing conditions. Recombinant bovine SCF was shown to act synergistically with interleukin 3 (IL-3) and erythropoietin (EPO) in stimulating the growth of bone marrow progenitor cells such as colony forming units-granulocyte macrophage (CFU-GM) and burst forming units-erythroid (BFU-E). Analysis of SCF mRNA expression by reverse transcription-polymerase chain reaction (RT-PCR) revealed that the transcripts were detectable in bone marrow, lymph node and spleen of cattle, and that the level of transcription was upregulated in lymph nodes of cattle infected with *T. congolense*. Two isoforms of SCF mRNA were amplified by RT-PCR. The availability of recombinant bovine SCF provides a valuable tool for studying the role of SCF in the development, growth and differentiation of bovine hematopoietic cells.

- 10408 **Mourad, M. and Magassouba, B., 1996.** Causes de mortalité des bovins de race N'Dama sur le plateau du Sankaran, Faranah, Guinée en 1993-1994. [Causes of mortality in N'Dama cattle on the Sankaran plateau, Faranah, Guinea, in 1993-1994.] *Revue d'Élevage et de Médecine vétérinaire des Pays tropicaux*, **49** (4): 289-293.

Centre de Recherche Zootechnique de Faranah (CRZF/IRAG), B.P. 1523, Conakry, Guinea.

From September 1993 to August 1994, 33 herds of N'Dama cattle on the Sankaran plateau were screened for disease and the cause of mortalities. A total of 1598 animals were involved: 129 calves aged 0-6 months, 213 animals aged 6-18 months and 1256 more than 18 months old. Diarrhoea was the commonest cause of death in the two younger age groups (20 out of 49, 40.81%, and 17 out of 29, 58.62%), while pasteurellosis was the most frequent cause in the oldest age group (125 out of 202, 61.88%). Trypanosomiasis was a cause of death only in the youngest age group (12 out of 49, 24.48%), where it was the second most frequent cause.

- 10409 **Ng'wena, A.G.M., Patel, N.B. and Wango, E.O., 1997.** Plasma luteinizing hormone levels in response to gonadotropin-releasing hormone agonist and clonidine in *Trypanosoma congolense*-infected female goats. *Brain Research Bulletin*, **44** (5): 591-595.

Patel: Department of Medical Physiology, University of Nairobi, P.O. Box 30197, Nairobi, Kenya.

In the present study, we investigated whether trypanosomiasis-induced reproductive disorders were due to pituitary or hypothalamic dysfunction by determining plasma luteinising hormone (LH) response to gonadotropin-releasing hormone (GnRH) agonist or clonidine in *T. congolense*-infected female goats. With GnRH agonist administration, the total amount of LH secreted over a 140-min sampling period on day 23 and day 60 p.i.

was consistently higher (71 and 21%, respectively) in infected goats compared to controls. In contrast, clonidine administration to infected goats on day 28 and day 69 p.i. failed to significantly alter the LH pulse frequency or the mean LH pulse amplitude over an 80-min sampling period. The results, especially the lack of response to clonidine, indicate that trypanosomiasis impairs GnRH release from the hypothalamus.

10410 **Obasi, O.L., Ogwu, D., Okon, E.D. and Mohammed, G., 1997.** Response to estrus synchronization of the Nigerian Zebu cattle infected with *Trypanosoma congolense*. *Tropical Veterinarian*, **15** (1-2): 35-38.

Obasi: Faculty of Agriculture, University of Oyo, P.M.B. 1017, Akawa Ibom State, Nigeria.

Three cycling Bunaji (White Fulani) heifers were each infected with 5×10^6 *T. congolense* organisms, strain Y58. Two heifers of the same breed served as control. At the peak of parasitaemia in the infected animals (day 13 p.i.), both the infected and the uninfected control group were given two injections of PGF_{2α} (25 mg i.m.) 11 days apart, inseminated artificially 72 h after the second PGF_{2α} injection and subsequently allowed free access to a bull. There was a 100% response to the second dose of PGF_{2α} in both groups. Behavioural oestrus was, however, less pronounced in the infected group. The infected heifers also failed to conceive to the inseminations, while 50% of the controls became pregnant. We conclude that *T. congolense* strain Y58 infection in Bunaji heifers may induce a non-fertile oestrus.

(c) TRYPANOTOLERANCE

[See also **21**: nos. 10370, 10403, 10408.]

10411 **Achukwi, M.D., Tanya, V.N., Hill, E.W., Bradley, D.G., Meghen, C., Sauveroche, B., Banser, J.T. and Ndoki, J.N., 1997.** Susceptibility of the Namchi and Kapsiki cattle of Cameroon to trypanosome infection. *Tropical Animal Health and Production*, **29** (4): 219-226.

Achukwi: Institute of Animal and Veterinary Research, Wakwa Centre, P.O. Box 65, Ngaoundéré, Cameroon.

Two indigenous Cameroonian taurine cattle breeds, Namchi ($n = 18$) and Kapsiki ($n = 23$), were evaluated for trypanosusceptibility following inoculation with *Trypanosoma congolense*. The degree of zebu ancestry in the experimental animals was assessed using six microsatellite markers which are known to have certain unique alleles which are diagnostic of *Bos indicus* genetic input. Their response to the infection was compared to that of known trypanotolerant (N'Dama, $n = 15$) and trypanosusceptible (Ngaoundéré Gudali, $n = 10$) cattle. The Namchi and the N'Dama controlled the development and severity of anaemia and parasitaemia better than the Kapsiki and the Gudali. For these parameters, there was no significant difference between the N'Dama and Namchi nor between the Kapsiki and Gudali. Similarly, weight loss showed significant breed variation. The N'Dama lost the least weight and the Kapsiki the most. Zebu introgression

in the Namchi was comparable to that in the N'Dama while that of the Kapsiki breed was higher, indicating a high level of cross breeding. From the results, the Namchi are considered trypanotolerant while the Kapsiki are trypanosusceptible. The potential exploitation of the indigenous Namchi cattle is discussed; this breed could replace the N'Dama presently imported from Guinea and Senegal.

10412 **Mattioli, R.C. and Wilson, R.T., 1996.** Trypanosomes, tsetse and trypano-tolerance: coevolution in tropical Africa. *Parassitologia*, **38** (3): 531-535.

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

Trypanotolerance reaches varying degrees of stability in wild and domestic animals according to their co-evolutionary contacts with tsetse flies (*Glossina* spp.) and trypanosomes (*Trypanosoma brucei brucei*, *T. congolense*, *T. vivax*, *T. simiae*). In this context, various mechanisms developed by wild and domestic Bovidae to cope with tsetse and trypanosome challenge are discussed. The presence of unknown trypanocidal factors in the sera of some game animals confers on them their superior resistance to trypanosomiasis infection in comparison to domestic animals, and the skin reaction to trypanosome injection is more effective in limiting the number of parasites acting at the injection point in wild animals and in African tolerant taurine than in African susceptible zebu breeds. Antibodies also play a fundamental role in trypanosome tolerance. Higher antibody titres are found in animals which have been previously primed compared with animals at their first trypanosomal contact, indicating that animals provided only with this defensive system and at first infection run a higher risk of succumbing than do animals in which innate defence mechanisms exist. In addition, in trypanotolerant N'Dama cattle the antibody defence seems to be assisted by leucocyte phagocytosis. Finally, refractoriness (impossibility to acquire trypanosome infection), which has not been considered here because it is not part of the phenomenon of tolerance, should also be studied as it might be explained by the absence, for the trypanosome, of an adequate nutritional environment in the host.

(d) TREATMENT

[See also **21**: nos. 10367, 10397.]

10413 **Anika, S.M. and Anene, B.M., 1997.** Trypanocidal resistance in *Trypanosoma brucei* isolates from dog and the chemotherapeutic efficacy of intravenous difluoromethylornithine (DFMO): combination with diminazene. *Journal of Veterinary Pharmacology and Therapeutics*, **20** (Supp. 1): 155.

Faculty of Veterinary Medicine, P.M.B. 011, University of Nigeria, Nsukka, Nigeria.

Eleven isolates of *T. brucei* were collected from clinically infected dogs in Nsukka area, Nigeria, and were tested in mice for their sensitivity to diminazene aceturate (at 7 and 14 mg/kg intraperitoneally) and isometamidium chloride (at 0.25 and 0.5 mg/kg). Six of the 11 isolates relapsed to diminazene, three at both drug levels and three at the lower

dose only. Similarly, eight isolates showed varying levels of resistance to isometamidium: three were resistant at both drug levels and five were resistant at the lower dose level only. Additionally, eleven dogs experimentally infected with *T. brucei* were used to test the efficacy of DFMO combined with diminazene. Dogs treated with a single dose of diminazene at 7 mg/kg relapsed 13 days after treatment. Those treated with DFMO alone (400 mg/kg i.v. daily in three divided doses for 7 days) relapsed 5 days after treatment. However, a combination of diminazene and DFMO was effective in treating the infection which had not relapsed by the end of the experiment.

10414 **Maina, N.W.N., Otieno, C., Wesongah, J.O., Ngatia, P.N., Auma, J.E., Nyang'ao, J.M.N., Olaho-Mukani, W. and Sutherland, D.V., 1996.** Epidemiology of drug resistant *Trypanosoma evansi* isolates from camels in Kenya. *Journal of Camel Practice and Research*, **3** (2): 125-129.

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

The sensitivity patterns of 22 *T. evansi* isolates collected from camel herds in four districts of Kenya to melarsomine (melarsen, Cymelarsan), suramin and Trypacide (quinapyramine) were assessed *in vitro*. Trypanosome metabolism was determined by the direct counting method and measurement of pyruvate levels. Eighteen isolates (85.5%) were sensitive to melarsen with IC₈₀ values in the range 3 to 35 ng/ml, while three isolates (14.5%) showed reduced sensitivity to melarsen (IC₈₀ 50 to 500 ng/ml). Resistance to quinapyramine was observed in 12 isolates (58%) at 500 ng/ml, while eight isolates (38%) were resistant to suramin at 10 µg/ml. Only six isolates (29%) were resistant to both quinapyramine and suramin. The isolates from Isiolo were all resistant to quinapyramine, while two (50%), one (25%) and one (20%) isolates from Tana River, Marsabit and Laikipia, respectively, were resistant at 500 ng/ml. All the isolates from Laikipia were sensitive to suramin (IC₈₀ 0.06 to 3 µg/ml), while five (63%), two (50%) and one (25%) isolates collected from Isiolo, Tana River and Marsabit, respectively, were resistant at 10 µg/ml. Similar sensitivity patterns were revealed by the pyruvate method and the direct counting method, although the former was more reproducible and able to screen larger numbers of samples.

10415 **Yang, Y.-S., Ou, Y.-C., Ruan, C.-M., Cheng, Y.-G., Cai, H. and Zhang, F.-Q., 1996.** [Therapeutic effect of Berenil liposomes for cattle with natural *Trypanosoma evansi* infection.] (In Chinese.) *Chinese Journal of Veterinary Science and Technology*, **26** (4): 32.

Agricultural and Animal University, P.L.A., Changchun, Jilin 130062, China.

In a clinical trial, 35 cattle infected with *T. evansi* were injected i.m. with a Berenil (diminazene aceturate) liposome at 5 mg/kg; 32 were cured by one injection with a negative-transformation rate of 91.4%.

7. EXPERIMENTAL TRYPANOSOMIASIS

(a) DIAGNOSTICS

[See also **21**: nos. 10393, 10394.]

- 10416 **Ventura, R., Silva, R.A., Nunes, V.L.B., Takeda, G.K.F. and Teixeira, M.M.G., 1997.** Evaluation of a randomly amplified polymorphic DNA fragment as a diagnostic marker for *Trypanosoma evansi*. (Meeting abstract no. 244.) *Memórias do Instituto Oswaldo Cruz*, **92** (Suppl. 1): 189.

Ventura: Departamento de Parasitologia, ICB/USP, São Paulo, S.P., Brazil.

(d) PATHOLOGY AND IMMUNOLOGY

[See also **21**: no. 10441.]

- 10417 **Buguet, A., Burlet, S., Montmayeur, A., Jouvét, M. and Cespuglio, R., 1996.** Dual aspects of NO implication in African trypanosomiasis. [*T. brucei*, *T. b. gambiense*, *T. b. rhodesiense*; rat.] (Meeting abstract.) *Journal of Sleep Research*, **5** (Suppl. 1): 24.

CRSSA, B.P. 87, 38702 La Tronche Cedex, France.

- 10418 **Haraguchi, Y. and Sasaki, A., 1997.** Evolutionary pattern of intra-host pathogen antigenic drift: effect of cross-reactivity in immune response. *Philosophical Transactions of the Royal Society of London (B)*, **352** (1349): 11-20.

Department of Biology, Faculty of Science, Kyushu University, Fukuoka 812-81, Japan.

This paper describes the use of a model to theoretically study the pattern of intra-host micro-evolution of pathogen antigen variants under the antigen specific immune response. The implication of the model to recurrent febrile episodes of equine infectious anaemia virus, antigen drift in HIV and antigenic switching in *Trypanosoma brucei* is discussed.

- 10419 **Igbokwe, I.O. and Nwosu, C.O., 1997.** Lack of correlation of anaemia with splenomegaly and hepatomegaly in *Trypanosoma brucei* and *Trypanosoma congolense* infections of rats. *Journal of Comparative Pathology*, **117** (3): 261-265.

Igbokwe: Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Maiduguri, P.M.B. 1069, Maiduguri, Nigeria.

- 10420 **Milaninezhad, M., 1996.** *Studien zur Adhäsion von Trypanosoma congolense an bovine Endothelzellen in vitro*. [Studies on the adhesion of *T. congolense* to bovine endothelial cells *in vitro*.] Thesis, Institut für Veterinär-Biochemie, Fachbereich Veterinärmedizin, Freie Universität Berlin, Germany. 219 pp.

- 10421 **Nessiem, M.G., Salem, G.H. and Yacoub, R.S., 1993.** Transmission of *Trypanosoma evansi* in rats and cats. *Egyptian Journal of Agricultural Research*, **71** (3): 817-823.

Animal Health Research Institute, Agricultural Research Centre, Dokki, Egypt.

- 10422 **Quan, N., Herkenham, M., McCoy, A.N., Whiteside, M.B., Mhlanga, J.D.M. and Kristensson, K., 1997.** Induction of mRNA for I κ B α and iNOS in the brain after *Trypanosoma brucei* infection in the rat. (Meeting abstract no. 593.29.) *Society for Neuroscience Abstracts*, **23** (2): 1513.

Section for Functional Neuroanatomy, NIMH, Bethesda, MD 20892, USA.

- 10423 **Sternberg, J.M. and Maclean, L., 1997.** Nitric oxide production by activated macrophages in trypanosomiasis: from mouse to man. [*T. brucei*; vervet monkeys.] (Meeting abstract no. 11.20.) *Immunology*, **92** (Suppl. 1): 40.

Sternberg: Department of Zoology, University of Aberdeen, Aberdeen AB24 2TZ, UK.

(c) CHEMOTHERAPEUTICS

[See also **21**: nos. 10448, 10459.]

- 10424 **Barry, J.D., 1997.** Advances in basic and applied research into African trypanosomiasis. *Current Opinion in Infectious Diseases*, **10** (5): 345-350.

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

The threat to human health and the developmental constraints imposed by African trypanosomiasis require continued efforts in epidemiology and drug development, using new approaches and exploiting discoveries in the laboratory. Recent advances in the study of trypanosome (*Trypanosoma brucei* spp.) metabolism and drug treatment (glycolysis, protein modification pathways), control of gene expression (nuclear genes, mitochondrial RNA editing), antigenic variation, and trypanosome life and death (receptors, lysis by human serum, host cytokines) are reviewed. These offer some promise for the development of new approaches to control.

- 10425 **Croft, S.L., 1997.** The current status of antiparasitic chemotherapy. *Parasitology*, **114** (Suppl.): S3-S15.

Department of Medical Parasitology, LSHTM, Keppel Street, London W1E 7HT, UK.

This review considers the current drug situation for the treatment of malaria, trypanosomiasis and leishmaniasis, coccidian and microsporidian parasites and helminthiasis. Drug design is considered with regard to molecular, biochemical and pharmacological approaches.

- 10426 **Kreimeyer, A., Magor, E. and Nickel, P., 1997.** Suramin analogues with a 2-phenylbenzimidazole moiety as partial structure. 1. Carboxylic acid analogues. *Pharmazie*, **52** (4): 268-271.

Nickel: Pharmazeutisches Institut, Universität Bonn, An der Immenburg 4, D-53121 Bonn, Germany.

- 10427 **Lemmouchi, Y. and Schacht, E., 1997.** *In vitro* evaluation of poly(ϵ -caprolactone-co-L-lactide) implants containing trypanocidal drugs. [Isometamidium, homidium.] *Journal of Bioactive and Compatible Polymers*, **12** (3): 175-185.

Schacht: Polymer Materials Research Group, Institute of Biomedical Technology, University of Ghent, Krijgslaan 281, B-9000 Ghent, Belgium.

- 10428 **Lemmouchi, Y., Schacht, E., Kageruka, P., Deken, R. de and Geerts, S., 1997.** *In-vitro* and *in-vivo* evaluation of biodegradable polyester-trypanocide devices. [Isometamidium, homidium; rabbits, cattle.] (Meeting abstract.) *Journal of Controlled Release*, **48** (2-3): 298-299.

Lemmouchi: Polymer Materials Research Group, Institute of Biomedical Technology, University of Ghent, Krijgslaan 281, B-9000 Ghent, Belgium.

- 10429 **O'Sullivan, M.C., Zhou, Q.-B., Li, Z.-L., Durham, T.B., Rattendi, D., Lane, S. and Bacchi, C.J., 1997.** Polyamine derivatives as inhibitors of trypanothione reductase and assessment of their trypanocidal activities. [Incl. *T. brucei* spp.; mice.] *Bioorganic and Medicinal Chemistry*, **5** (12): 2145-2155.

O'Sullivan: Department of Chemistry, Indiana State University, Terre Haute, IN 47809, USA.

- 10430 **Youan, B.B.C., Coulibaly, S., Miezán, T.B., Doua, F. and Bamba, M., 1997.** *In vivo* evaluation of sixteen plant extracts on mice inoculated with *Trypanosoma brucei gambiense*. *Bulletin of the World Health Organization*, **75** (4): 343-348.

Youan: Department of Pharmaceutical Sciences, School of Pharmacy, Catholic University of Louvain, Avenue E. Mounier 73.20, B-1200 Brussels, Belgium.

After examination of the drugs used by traditional practitioners in Côte d'Ivoire, nine formulae prescribed in the treatment of African human trypanosomiasis were selected for investigation. These made use of 40 plants, 16 of which were studied because of their properties, as described in the literature, and their frequent use by practitioners. The plant

extracts were administered, after maceration or decoction, either orally or intraperitoneally, to mice that had previously been inoculated with *T. b. gambiense*. Control mice were given either a saline solution (SS: negative control) or well-known drugs (melarsoprol, difluoro-methylornithine and pentamidine: positive control). None of the plant extracts revealed trypanocidal or trypanostatic activity relative to SS controls ($P > 0.05$) and the mice died on the third day after inoculation. The treated positive controls, relative to SS, showed 100% survival and no parasitaemia ($P < 0.05$). This method of testing the sensitivity of trypanosomes to plant extracts is easy and inexpensive, and could be applied to other areas of research on tropical diseases.

8. TRYPANOSOME RESEARCH

(a) CULTIVATION OF TRYPANOSOMES

- 10431 **Wang, X.-S., Sun, E.-G., Liu, X.-F., Yang, F.-Q., Xie, C., Dong, W.-Q. and Gu, W.-W., 1997.** [Establishment of an *in vitro* cultured *Trypanosoma evansi* strain and determination of its hypoxanthine-guanine phosphoribosyltransferase activity.] (In Chinese with English summary.) *Chinese Journal of Veterinary Science*, **17** (1): 39-44.

(b) TAXONOMY, CHARACTERISATION OF ISOLATES

[See also **21**: no. 10391.]

- 10432 **Komba, E.K., Kibona, S.N., Ambwene, A.K., Stevens, J.R. and Gibson, W.C., 1997.** Genetic diversity among *Trypanosoma brucei rhodesiense* isolates from Tanzania. *Parasitology*, **115** (6): 571-579.

Gibson: School of Biological Sciences, University of Bristol, Woodland Road, Bristol BS18 1UG, UK.

We compared 19 stocks of *T. b. rhodesiense* collected in 1991 and 1994 from Tanzania with representative stocks from other foci of Rhodesian sleeping sickness in Zambia, Kenya and Uganda. Stocks were characterised by isoenzyme electrophoresis, restriction fragment length polymorphisms in variant surface glycoprotein genes and random amplification of polymorphic DNA; the banding patterns obtained were coded for numerical analysis. In addition, the Tanzanian stocks were compared by pulsed field gel electrophoresis. Overall the Tanzanian stocks formed a homogeneous group and the predominant genotype isolated in 1991 was still present in the 1994 sample, although at a reduced level. The Tanzanian stocks were distinct from representative stocks from other East African foci. This observation does not support the proposal that there are northern and southern strains of *T. b. rhodesiense*, but is consistent with the view that *T. b. rhodesiense* stocks form a mosaic of different genotypes varying from focus to focus in East Africa.

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

[See also 21: no. 10431.]

- 10433 **Alfonzo, J.D., Thiemann, O. and Simpson, L., 1997.** The mechanism of U insertion/deletion RNA editing in kinetoplastid mitochondria. [Incl. *T. brucei*.] (Review.) *Nucleic Acids Research*, **25** (19): 3751-3759.

Simpson: Howard Hughes Medical Institute and Department of Molecular, Cell and Developmental Biology, University of California, Los Angeles, CA 90095-1662, USA.

- 10434 **Barcinski, M.A., 1997.** Apoptosis in trypanosomatids: facts and hypotheses. [Incl. *T. b. rhodesiense*.] (Extended meeting abstract no. C13.) *Memórias do Instituto Oswaldo Cruz*, **92** (Suppl. 1): 17-18.

Departamento de Parasitologia, ICB/USP, Av. Prof. Lineu Prestes 1374, 05508-900 São Paulo, S.P., Brazil.

- 10435 **Borst, P., 1997.** Antigenic variation in African trypanosomes and other pathogenic microorganisms. [Incl. *T. brucei*.] (Extended meeting abstract no. C1.) *Memórias do Instituto Oswaldo Cruz*, **92** (Suppl. 1): 4.

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

- 10436 **Borst, P. and Leeuwen, F. van, 1997.** β -D-glucosyl-hydroxymethyluracil, a novel base in African trypanosomes and other Kinetoplastida. [*T. brucei*, *T. equi-perdum*, *T. evansi*.] (Review.) *Molecular and Biochemical Parasitology*, **90** (1): 1-8.

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

- 10437 **Brooks, H.B. and Phillips, M.A., 1997.** Characterization of the reaction mechanism for *Trypanosoma brucei* ornithine decarboxylase by multiwavelength stopped-flow spectroscopy. *Biochemistry*, **36** (49): 15147-15155.

Phillips: Department of Pharmacology, University of Texas SW Medical Center, 5323 Harry Hines Boulevard, Dallas, TX 75235-9041, USA.

- 10438 **Carnall, N., Webb, H. and Carrington, M., 1997.** Mutagenesis study of the glycosylphosphatidylinositol phospholipase C of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **90** (2): 423-432.

Carrington: Department of Biochemistry, University of Cambridge, Tennis Court Road, Cambridge CB2 1QW, UK.

- 10439 **Connaris, S. and Greenwell, P., 1997.** Glycosidases in mucin-dwelling protozoans. [Incl. *T. brucei*.] *Glycoconjugate Journal*, **14** (7): 879-882.

School of Biological and Health Sciences, University of Westminster, 115 New Cavendish Street, London W1M 8JS, UK.

- 10440 **Cornely, K.A. and Campbell, A.G., 1997.** Functional studies of multiple domains of the replication enzyme ribonuclease H. [*T. brucei*.] (Meeting abstract.) *Molecular Biology of the Cell*, **8** (Suppl.): 22a.

Department of Chemistry, Providence College, Providence, RI 02918, USA.

- 10441 **Deitsch, K.W., Moxon, E.R. and Wellems, T.E., 1997.** Shared themes of antigenic variation and virulence in bacterial, protozoal, and fungal infections. [Incl. *T. brucei*.] *Microbiological and Molecular Biology Reviews*, **61** (3): 281-293.

Laboratory of Parasitic Diseases, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Bethesda, MD 20892-0425, USA.

- 10442 **Dormeyer, M., Schöneck, R., Dittmar, G.A.G. and Krauth-Siegel, R.L., 1997.** Cloning, sequencing and expression of ribonucleotide reductase R2 from *Trypanosoma brucei*. *FEBS Letters*, **414** (2): 449-453.

Krauth-Siegel: Biochemie-Zentrum Heidelberg, Ruprecht-Karls-Universität, Im Neuenheimer Feld 328, D-69120 Heidelberg, Germany.

- 10443 **Heise, N. and Opperdoes, F.R., 1997.** Purification, characterisation and sub-cellular localisation of glucose-6-phosphate dehydrogenase from *Trypanosoma brucei* procyclic forms. (Meeting abstract no. 151.) *Memórias do Instituto Oswaldo Cruz*, **92** (Suppl. 1): 143.

Opperdoes: Research Unit for Tropical Diseases, International Institute of Cellular and Molecular Pathology, Avenue Hippocrate 74, B-1200 Brussels, Belgium.

- 10444 **Horn, D. and Cross, G.A.M., 1997.** Position-dependent and promoter-specific regulation of gene expression in *Trypanosoma brucei*. *EMBO Journal*, **16** (24): 7422-7431.

Horn: Department of Infectious and Tropical Diseases, LSHTM, Keppel Street, London WC1E 7HT, UK.

- 10445 **Hunger-Glaser, I. and Seebeck, T., 1997.** Deletion of the genes for the paraflagellar rod protein PFR-A in *Trypanosoma brucei* is probably lethal. *Molecular and Biochemical Parasitology*, **90** (1): 347-351.

Seebeck: Institut für Allgemeine Mikrobiologie, Universität Bern, Bern, Switzerland.

- 10446 **Koslowsky, D.J. and Yahampath, G., 1997.** Mitochondrial mRNA 3' cleavage/polyadenylation and RNA editing in *Trypanosoma brucei* are independent events. *Molecular and Biochemical Parasitology*, **90** (1): 81-94.

Koslowsky: Department of Microbiology, Michigan State University, East Lansing, MI 48824, USA.

- 10447 **Leeuwen, F. van, Wijsman, E.R., Kieft, R., Marel, G.A. van der, Boom, J.H. van and Borst, P., 1997.** Localization of the modified base J in telomeric VSG gene expression sites of *Trypanosoma brucei*. *Genes & Development*, **11** (23): 3232-3241.

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

- 10448 **Li, G.-Q., Wang, Z.-K., He, X.-Z., Pan, H.-J. and Shen, Y.-L., 1996.** [Attenuation effect of physical and chemical factors on *Trypanosoma evansi*.] [Irradiation, diminazene, suramin; mice.] (In Chinese with English summary.) *Acta Veterinaria et Zootechnica Sinica*, **27** (6): 554-559.

Li: College of Veterinary Medicine, Beijing Agricultural University, Beijing 100094, China.

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Division of Molecular Genetics, Institute of Biomedical and Life Sciences, University of Glasgow, Anderson College, 56 Dumbarton Road, Glasgow G11 6NU, UK.

- 10450 **Michels, P.A.M., Chevalier, N., Opperdoes, F.R., Rider, M.H. and Rigden, D.J., 1997.** The glycosomal ATP-dependent phosphofructokinase of *Trypanosoma brucei* must have evolved from an ancestral pyrophosphate-dependent enzyme. *European Journal of Biochemistry*, **250** (3): 698-704.

Michels: ICP-TROP 74/39, Avenue Hippocrate 74, B-1200 Brussels, Belgium.

- 10451 **Morris, J.C. and Mensa-Wilmot, K., 1997.** Role of 2,6-dideoxy-2,6-diaminoglucose in activation of a eukaryotic phospholipase C by aminoglycoside antibiotics. [*T. brucei*.] *Journal of Biological Chemistry*, **272** (47): 29554-29559.

Mensa-Wilmot: Department of Cellular Biology, University of Georgia, 724 Biological Sciences, Athens, GA 30602, USA.

- 10452 **Murphy, N.B. and Welburn, S.C., 1997.** Programmed cell death in procyclic *Trypanosoma brucei rhodesiense* is associated with differential expression of mRNAs. *Cell Death and Differentiation*, **4** (5): 365-370.

Welburn: Tsetse Research Group, Division of Molecular Genetics, IBLS, University of Glasgow, 56 Dumbarton Road, Glasgow G11 6NU, UK.

- 10453 **Mutomba, M.C., To, W.-Y., Hyun, W.C. and Wang, C.C., 1997.** Inhibition of proteasome activity blocks cell cycle progression at specific phase boundaries in African trypanosomes. [*T. brucei*.] *Molecular and Biochemical Parasitology*, **90** (2): 491-504.

Mutomba: Department of Pharmaceutical Chemistry, University of California, San Francisco, CA 94143-0446, USA.

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Okenu: Division of Biochemistry, National Institute for Medical Research, P.M.B. 2013, Yaba, Lagos, Nigeria.

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Boshart: Max-Planck-Institut für Biochemie, Am Klopferspitz 18a, D-82152 Martinsried, Germany.

- 10456 **Roberts, T.G., Sturm, N.R., Yee, B., Yu, M.C., Hartshorne, T., Agabian, N. and Campbell, D.A., 1997.** Small nucleolar RNAs from the spliced leader-associated RNA locus in the kinetoplastid protozoa. [Incl. *T. brucei*.] (Meeting abstract no. 212.) *Memórias do Instituto Oswaldo Cruz*, **92** (Suppl. 1): 173.

Roberts: Department of Microbiology and Immunology, University of California, Los Angeles, CA 90095, USA.

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

- 10458 **Salmon, D., Hanocq-Quertier, J., Paturiaux-Hanocq, F., Pays, A., Tebabi, P., Nolan, D.P., Michel, A. and Pays, E., 1997.** Characterization of the ligand-binding site of the transferrin receptor in *Trypanosoma brucei* demonstrates a structural relationship with the N-terminal domain of the variant surface glycoprotein. *EMBO Journal*, **16** (24): 7272-7278.

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

- 10459 **Scory, S. and Steverding, D., 1997.** Differential toxicity of ricin and diphtheria toxin for bloodstream forms of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **90** (1): 289-295.

Steverding: Abteilung Parasitologie, Hygiene-Institut der Ruprecht-Karls-Universität, Im Neuenheimer Feld 324, D-69120 Heidelberg, Germany.

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

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

- 10462 **Vassella, E., Straesser, K. and Boshart, M., 1997.** A mitochondrion-specific dye for multicolour fluorescent imaging of *Trypanosoma brucei*. *Molecular and Biochemical Parasitology*, **90** (1): 381-385.

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Docampo: Molecular Parasitology Laboratory, Department of Pathobiology, College of Veterinary Medicine, University of Illinois, 2001 S. Lincoln Avenue, Urbana, IL 61802, USA.

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Ruben: Department of Biological Sciences, Southern Methodist University, Dallas, TX 75275, USA.