

The Parasitological Society of Southern Africa

The following are abstracts of papers presented at the Annual Scientific Meeting held in the Veterinary Faculty, University of Pretoria, Onderstepoort on 7 and 8 July 1988.

Parasitologiese Vereniging van Suidelike Afrika

Die volgende is uittreksels van referate wat gedurende die Jaarlikse Wetenskaplike Vergadering op 7 en 8 Julie 1988 in die Fakulteit Veeartsenykunde, Universiteit van Pretoria, Onderstepoort gehou is.

Immunology of parasitic diseases of livestock

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Vaccines for parasitic diseases have lagged behind the development of vaccines for important viral and bacterial diseases. Among the reasons for this are: (1) the extreme antigenic complexity of parasites, (2) the adaptive ability of parasites to co-exist with their host, often through modulation of the host's immune response, and (3) a poor understanding of the immune mechanisms responsible for protective immunity. Advances in technology including *in vitro* cultivation, hybridoma, and recombinant DNA methods have provided valuable tools for the study of parasite immunology and have resulted in major strides toward vaccines for several helminth parasites.

Isolation of *Plasmodium circumflexum* from wild guinea fowl

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Blood from two live wild guinea fowl from Pienaarsrivier was injected into chicks and turkey poults, some of which developed a parasitaemia. While passaging in chicks was unsuccessful, the parasite multiplied well in turkeys and developed a marked pathogenicity with two peaks of mortality, one at the peak of parasitaemia and the other approximately 10 days later coinciding with the development of exoerythrocytic schizonts.

The parasite was identified on the morphology of its erythrocytic stages, particularly the schizonts with a single lump of pigment and 12 to 26 merozoites, and its 48-h asexual periodicity.

Host damage by *Diplozoon* species

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Paradiplozoon was found attached to the gills of the largemouth yellowfish, *Barbus kimberleyensis* (Gillchrist and Thompson, 1913). Histological and electron microscopical studies were done to show the tissue damage caused by the attachment organs of the parasite.

Damage is caused by the chitinized opisthaptor clamps capable of pinching off pieces of gill tissue. The prophaptor suckers are used for feeding in conjunction with the buccal opening. The suction causes the rupture of blood capillaries and results in the formation of a blood clot between the gill filaments. The combined effect of feeding and attachment causes hypertrophy and fusion of the gill filaments.

Aspects of the pathology caused by *Strongylus equinus* in young horses

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Strongylus equinus, a nematode which parasitizes the Equidae, is known to cause severe chronic pancreatitis in foals as the result of the migration of the fourth stage larvae in this organ. In this study, eight young horses were infected with twenty or thirty thousand third stage *Strongylus equinus* larvae. Seven months after infection they were killed and post-mortem examinations made.

The main findings were a severe disruption of omental architecture, adhesions between the liver, the stomach and the diaphragm and, in the liver, periportal eosinophilic infiltration and scarring under Glisson's capsule. Nodules were found in the ventral colon and caecal walls. In a few cases there was mild periductular infiltration of eosinophils in the pancreas but, more commonly, granulomas associated with larvae were found in the peripancreatic tissue. Larval recovery was generally very low.

Of particular significance was the lack of severe pancreatic damage. It is suggested that the presence of larvae in the pancreatic tissue may be linked to the age of the horse, with a larger degree of damage being caused to the pancreatic tissue in younger animals. Alternatively, the presence or absence of pancreatic tissue damage may be linked to previous exposure to strongyles or the presence of milder strains of *Strongylus equinus* in Southern Africa.

Trichodinid parasites of the giant African snail *Achatina* in Mauritius

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Two species of the giant African snail *Achatina* occur abundantly on the Indian Ocean island of Mauritius. These snails were accidentally introduced to the island towards the turn of the century. An examination of specimens of these snails revealed that they host a trichodinid ectoparasite which proved to be a new species. This species was described and its morphology elucidated by scanning electron microscopy. Surveys were carried out at more than twenty localities representative of the full spectrum of climatic regions on the island.

All of the more than 300 specimens of both *A. panthera* as well as *A. fulica* examined were found to be infested by trichodinid parasites, ranging from medium to extremely high levels of infestation. An investigation of the position of infestation indicated that the mantle cavity on the neck of the molluscs hosted the highest level of infestation, but with trichodinids scattered over the lateral sides of the foot. Laboratory experiments carried out to investigate the mode of transmission indicated that cross-infestation occurred when the snails made physical contact and that faeces also harboured trichodinids. In wet conditions trichodinids were found swimming freely in drops of water surrounding the snail. All these could be means by which the effective transmission takes place.

Snail-transmitted trematode parasites in the Mooi river, Transvaal

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The aquatic mollusc fauna in Bovenste Oog in the Mooi river comprises four species, which were found to shed different types of cercariae. The life cycles of these trematodes were studied.

Bulinus africanus sheds two types of cercariae, a fork-tailed as well as a single-tailed cercaria. The life cycle of the fork-tailed cercaria was completed under laboratory conditions, using *Mastomys coucha* as final host. This trematode was identified as *Schistosoma mattheei*. The single-tailed cercaria was identified as an echinostome cercaria.

Lymnaea natalensis sheds three types of cercariae, i.e. two single-tailed as well as fork-tailed cercariae. The long single-tailed cercaria was also identified as an echinostome cercaria. The short single-tailed cercaria was identified as a xiphido-cercaria, which utilizes a freshwater shrimp as second intermediate host and *Rana angolensis* as final host. The fork-

tailed cercariae proved to be larvae of *Trichobilharzia*, a parasite of aquatic birds.

Gyraulius connollyi also sheds three types of cercariae, of which two are fork-tailed and the third a single-tailed cercaria. The last is characterized by a short body and exceptionally long tail. This seems also to be a member of the echinostome group. One of the fork-tailed cercariae was shown to be responsible for a green cyst metacercaria in small tilapia. Adults were recovered after feeding infected fish to piscivorous birds. The second fork-tailed cercaria was identified as a clinostomatid trematode.

Burnupia mooiensis sheds a similar cercaria to one found in *Gyraulius*. This cercaria was identified also as a clinostomatid trematode.

Trypanorhynch cestodes infect estuarine teleost fishes in Transkei

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Estuarine fishes were found to be infected with the plerocercoids of two trypanorhynch cestode species—*Poecilancistrum caryophyllum*, which occurred in kob *Argyrosomus hololepidotus*; and *Grillotia perelica*, which infected various mullet species (Mugilidae). The mullet infected were *Mugil cephalus*, *Myxus capensis*, *Liza tricuspidens* and *Valamugil robustus*. Although fewer specimens were examined, no trypanorhynchs were found in the mullet *L. dumerili*, *L. richardsoni* or *V. buchanani* nor in another estuarine fish, *Lichia amia*.

This study concentrated on the trypanorhynch infection of flathead mullet *Mugil cephalus*. Most plerocercoids were embedded in the muscles above the spine between the pectoral and posterior dorsal fins. No plerocercoids were found in the internal organs or in the body cavity. The prevalence of infection was 21% with a mean intensity of infection of 2.7 plerocercoids per infected fish (range 1–13 worms). Both prevalence and intensity increased with the size of the fish. The size at which *M. cephalus* was first infected corresponds closely with the size at first breeding. Furthermore, undeveloped plerocercoids were found only during the months immediately following spawning. These data suggest a correlation between infection and the reproductive behaviour of the fish. Mullet are apparently uninfected when they enter the estuary as juveniles and after maturing in the estuary; they are first infected upon returning to the sea to spawn. Subsequent spawning migrations expose the animals to further infection.

Cross-immunity between various isolates of *Cowdria ruminantium* in mice

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Cross-immunity studies in laboratory mice with *Cowdria ruminantium* showed that Kwanyanga-immune mice resist challenge with Welgevonden and Nonile; that Welgevonden protects against Nonile but not Kwanyanga; and that Nonile protects against Welgevonden but not against Kwanyanga. DBA2 mice were first infected with the immunizing stock, treated with gloxazone 7 days later to prevent mortality and then rechallenged with the immunizing stock before being infected with the challenge stock.

The Kumm, Kwanyanga, Nonile and Welgevonden stocks of *C. ruminantium* have been shown to cause mortality in DBA2 laboratory mice. The Mali stock was shown to be infective but did not cause death. In contrast the multimammate mouse, *Mastomys coucha*, obtained from Nelspruit, was susceptible only to Kwanyanga, Nonile and Mali stocks. The Kumm and Welgevonden stocks were infective but did not cause mortality. Colonies of *C. ruminantium* were found in the brain capillaries of multimammate mice dying of heartwater but not in laboratory mice.

Separation of the cuticular waxes on *Anopheles arabiensis* wings by gas-liquid chromatography

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Milligan *et al.* [(1986). *Bull. ent. Res.* 76, 529–537] used gas-liquid chromatography of waxes extracted from the cuticles of whole starved

desiccated mosquitos to distinguish the sibling species of *Anopheles culicifacies*. The method might be useful in identifying individuals of the *A. gambiae* complex caught in the field. However, specimens are usually collected after knock-down with an aerosol-based insecticide, so the effects of three killing procedures on the GC traces were examined. In order to eliminate possible extraneous and variable components derived from the internal organs and gut contents, the waxes were extracted from the isolated wings only. The mosquitoes from a colony maintained at the National Institute for Tropical Diseases, Tzaneen, were either (a) starved, (b) killed by refrigeration and stored in liquid nitrogen or (c) knocked down with a pyrethrum spray. The traces obtained after injecting 1 μ l extract in hexane into the GC column were identical. Neither storage in liquid nitrogen nor killing the mosquitoes with an aerosol insecticide altered the composition of the waxes extracted from the wings. The principal hydrocarbons ranged from C₂₁ to C₃₂ compounds, with the largest peak on the trace corresponding to a C₂₅ molecule.

The epidemiology of Karoo paralysis: seasonal incidence in relation to the infestation density of female *Ixodes rubicundus*

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The epidemiology of Karoo paralysis induced by the tick *Ixodes rubicundus* was investigated in a paralysis-enzootic area of the south-western Orange Free State. Sheep became paralysed from April to July. Most paralysis was observed during the first week of May with a second, smaller peak occurring in June. Tick numbers on paralysed sheep followed this pattern closely. The seasonal pattern of tick infestation by female *I. rubicundus* was similar on previously exposed and on naive sheep. No differences in pattern of attachment weights were found over the four experimental groups used, suggesting that previous contact of sheep with *I. rubicundus* had no effect on the ability of the tick to engorge. A certain number of ticks dependent upon the mass of the host is required before symptoms of paresis or paralysis are observed. Previously exposed or paralysed sheep are less susceptible to paralysis in the following year. Differences in susceptibility between individual sheep seem likely.

Weerstandbiedendeid van veldstamme van *Haemonchus contortus* en *Trichostrongylus colubriformis* van skape teen levamisool en morantel

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In 1987 is gerapporteer oor 5 stamme haarwurm wat teen verskeie van die mees moderne wurmmiddels weerstandbiedend geraak het. Daar is ook gewys dat van die middels wat wyd in gebruik was in Suid-Afrika, slegs die levamisool/morantel groep op daardie stadium nog nie lokaal deur weerstand geaffekteer is nie. Die mening is uitgespreek dat hierdie groep heel moontlik ook met die tyd in Suid-Afrika deur weerstand geteister sou word.

Vanjaar is die vooruitskating van 1987 reeds bewaarheid, aangesien twee veldgevalle van weerstand gedurende die huidige verslagjaar teen die levamisool/morantel groep aangetoon is: 'n Stam van *Haemonchus contortus* en 'n stam van *Trichostrongylus colubriformis*, beide vanaf Natal. In die geval van die *T. colubriformis* was beide levamisool en morantel totaal ondoeltreffend, aangesien die behandelde groepe diere meer wurms gehuisves het as die onbehandelde kontrole diere. Teen die stam van *H. contortus* was levamisool nog 76,5% doeltreffend, terwyl morantel slegs 41,9% van die wurms verwyder het.

Tans is dus van die meer moderne wurmmiddels, slegs die organiese fosfaatgroep nog nie by weerstand betrokke gevind nie. Dit is moontlik dat die groep tot nog toe nie voldoende gebruik is om aanleiding te kon gee tot die ontstaan van weerstand nie. Maar dit moet ook in gedagte gehou word dat daar nog nie 'n opname gedoen is van weerstand in die land nie, en is dit nie onmoontlik nie dat weerstand wel ook teen hierdie groep bestaan, maar nog nie gevind is nie.

'n Verskynsel wat tevoorskyn getree het, is die verspreiding van weerstandige wurmstamme deur bemerking van aangetaste diere aan ander boere. 'n Stam van haarwurm wat verlede jaar weerstandig bevind is teen 3 verskillende wurmmiddelgroepe, is skielik verkoop sonder dat die

betrokke boer sy raadgeer geraadpleeg het, en is dus wyd versprei. Dit is te wagte dat sulke gevalle in die toekoms meer dikwels aangetref sal word.

An outbreak of *Fasciola hepatica* in sheep

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In a field outbreak of *Fasciola hepatica*, the common liver fluke, six sheep from a flock of approximately 200 died from suspected fascioliasis, while numerous others were seriously affected. The outbreak was unusual in that, while the clinical symptoms and post-mortem lesions indicated a chronic liver fluke infestation, histological lesions in the liver indicated an acute reinfestation, and both immature and mature flukes were recovered in large numbers. All three potential intermediate hosts of liver fluke in South Africa, *Lymnaea columella*, *L. natalensis* and *L. (Galba) truncatula* were founds, but none of those examined was infested with liver fluke intermediate stages.

Die moontlikheid om 'n weerstandige rondewurmstam te beheer deur dit op die weiding deur 'n vatbare wurmstam te vervang

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'n Proef is te Kempton Park op die Transvaalse Hoëveld uitgevoer om te toets of 'n bensimidasoel-weerstandige stam van haarwurm op die weiding vervang kon word deur 'n vatbare stam van dieselfde wurmsoort. Kikuyu weiding is besmet met 'n stam van haarwurm wat weerstandbiedend is teen die bensimidasoel wurmmiddels, waarna die weiding in 6 kampte verdeel is. Terwyl een van die kampe as 'n kontrole behou is (waar nie gepoog is om die weerstandige stam te vervang nie), is pogings in die ander kampe aangewend om 'n ommekeer in weerstandbiedendheid te bewerkstellig. Die verskillende wurmstamme is m.b.v. skenkerskape op die weiding aan die gang gehou: aanvanklik in skenkers wat met die weerstandige wurmstam besmet is, en daarna in ander skape wat met die vatbare stam besmet is.

In twee van die kampe is die vatbare wurmstam in die laat somer ingevoer, nadat die weiding vir of 8 of 10 weke onbewei gelaat is. Die doel van die tydperk van nulbeweiding was om te toets of die weerstandige stam op die weiding deur blootstelling in die afwesigheid van 'n geskikte gasheer oor hierdie tydperk voldoende uitgedun sou raak sodat die vatbare stam 'n kans sou hê om dit getalsgewys op die weiding te oorweldig. Daar is verwag dat in die kamp waar die weiding vir 10 weke gerus het, die vatbare wurmstam 'n beter kans sou hê om die ander te vervang, aangesien meer tyd gegun is vir die weerstandige wurmeiers en larwes om aan blootstelling te vrek.

In die ander drie kampe waar die vatbare stam ingevoer is, was daar egter nie 'n tydperk van nulbeweiding nie, aangesien die omskakeling tussen die stamme in die lente geskied het, wanneer die weiding op die Hoëveld nie besmetlik is vir die gasheer nie. Die vatbare stam is dus die kans gegun om op die weiding aan te samel in 'n tyd wanneer die weerstandige stam geen bron van verdere besmetting gehad het nie. Die omskakeling het plaasgevind op 10 September, 29 Oktober en 17 Desember, welke spasiëring gekies is om te toets of die tyd van omskakeling moontlik 'n effek op die resultate sou hê. In teorie is verwag dat, hoe gouer in die lente oorgeskakel kon word, hoe groter sou die kans vir sukses wees, aangesien die vatbare stam langer tyd gegun sou word om op die weiding aan te samel alvorens dit vir die gasheer besmetlik sou raak.

Die resultate was belowend, aangesien daar blykbaar 'n ommekeer voorgekom het in die weerstandigheid van die stam op die weiding in 3 van die 5 toetskampe, terwyl die stam in die kontrolekamp skynbaar onveranderd weerstandig gebly het. Soos teoreties verwag, was die beste tyd vir vervanging van 'n weerstandige wurmstam op die weiding vroeg in die lente in die geval waar daar nie 'n tydperk van nulbeweiding voorgekom het nie. In die twee kampe waar daar wel 'n tydperk van nulbeweiding was, het daar in een kamp 'n doeltreffende ommekeer in die weerstand voorgekom, en slegs gedeeltelike ommekeer in die ander. Die resultate het egter nie die teoretiese verwagtinge gevolg nie, aangesien die ommekeer in weerstand voorgekom het in die kamp wat slegs

8 weke gerus het, terwyl slegs 'n gedeeltelike ommekeer voorgekom het in die kamp wat 10 weke lank gerus het.

Terwyl daar nog baie bykomende werk gedoen moet word om hierdie resultate te bevestig, en daar ook vrae bestaan oor die aanvaarbaarheid van die beginsel dat die boer sy diere met 'n vatbare wurmstam sal moet laat besmet, word weerstandbiedendheid so belangrik, dat enige dergelike metode ten volle opgevolg moet word. In Suid-Afrika mag dit eer lank gebeur dat daar vir sekere wurmstamme geen middels oor is om die wurms mee te beheer nie, in welke geval die boere geen keuse sal hê nie, as om hul na ander metodes van beheer te wend, al is hierdie metodes nie gewild nie.

Paralysis of laboratory rabbits by *Ixodes rubicundus* (Acarina: Ixodidae) nymphae

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Seven tick species, three of which occur in South Africa, cause paralysis relevant to veterinary medicine.¹ A recent survey² has accentuated the economic importance of Karoo paralysis caused by *Ixodes rubicundus*. Sheep, goats, cattle and wild ungulates are affected and small-stock losses of approximately 36 000 head occurred during 1986. The quantitative determination of paralysis potential should be defined as the minimum infestation necessary to induce a paresis or paralysis.³ Numerous past attempts have, however, failed to produce clinical symptoms of Karoo paralysis in the laboratory. This has hampered the determination of the toxic phase of female *I. rubicundus* during engorgement as well as the isolation and characterisation of the toxin involved.

Recent infestations of laboratory rabbits with high numbers of nymphae under conditions of cold stress have elicited typical paralysis symptoms leading to death of the host animals. This laboratory inducement of Karoo paralysis, albeit in a laboratory host with the nymphal stage, is regarded as the first important step in the inducement of paralysis with adult *I. rubicundus*, its subsequent quantification and the isolation and characterisation of the toxin involved.

1. Gothe R. (1984). Tick paralysis: reasons for appearing during ixodid and argasid feeding. In *Current Topics in Vector Research*, edit. K.F. Harris, pp. 199–223. Praeger, New York.
2. Spickett A.M. and Heyne H. (1988). *Onderstepoort J. vet. Res.* 55, 89–92.
3. Hamel H.D. and Gothe R. (1978). *Vet. Parasitol.* 4, 183–191.

Transmission of bovine fascioliasis in drinking troughs

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Five cases of atypical transmission of *Fasciola gigantica* were found in the northern Transvaal. In three of the five cases clinical symptoms of chronic fascioliasis were observed and deaths of adult cattle occurred. Transmission took place via *Limnaea natalensis* in drinking troughs that were fed with borehole water. A high percentage of the *Limnaea natalensis* (20–81%) was infested with the intermediate stages of *Fasciola gigantica*. It was found that *F. gigantica* cercariae encysted on the surface of the water as well as on the shells of the intermediate hosts and on debris such as leaves and feathers. The cattle most probably became infested by ingesting the contaminated objects while drinking.

The role of large ruminants in the life cycle of the bont tick *Amblyomma hebraeum*

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Comparisons were made of the number of free-living larvae of *Amblyomma hebraeum* collected in a nature reserve containing large ruminants, a nature reserve without large ruminants, and a farm without large wild ruminants and on which dipping of domestic stock with an acaricide was practised. Three habitats at each site, namely grassland, gully with occasional water and thick bush, were sampled for free-living ticks by dragging. No differences were observed in the numbers of *A. hebraeum* larvae recovered in the nature reserve without large ruminants and on the farm. Considerably larger numbers of larvae were recovered from the nature

reserve containing large wild ruminants than from the latter sites. Seasonal variations in the numbers of larvae recovered were not found on the farm or nature reserve without large ruminants but were present in the area containing large ruminants. These differences are due to the fact that large ruminants are necessary as hosts for the adult stage of the life cycle of *A. hebraeum*. By comparison, larvae of the South African tortoise tick, *Amblyomma marmoreum*, were found in consistently low, but similar, numbers at all three localities.

Recent outbreaks of conical fluke infestation in cattle

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Four outbreaks of paramphistomosis in the 1987/1988 season are reported. These outbreaks occurred very early in the season, contrary to the general belief in South Africa that they are confined mainly to the late summer and early winter months. The source of infestation of the snail intermediate hosts in all four cases could be traced back to animals on the same farms that had previously been infested and had built up an immunity to the pathogenic immature stages of the parasite, while still excreting large numbers of eggs in their faeces. A breakdown of this immunity due to the stress of pregnancy was observed in one of the outbreaks, resulting in the death of mature cows that had high counts of paramphistomid eggs in their faeces, and should therefore have been immune to reinfection.

Very high densities of *Bulinus tropicus*, the intermediate snail host, were recorded in three of the four outbreaks. However, a very low percentage of the snails was infected. Because of the tendency of cercariae to encyst immediately below the surface of water, and the diurnal periodicity in their emergence from infested snails, the metacercariae on heavily infested herbage were concentrated in concentric rings that were visible to the trained eye. Up to 6 rings of metacercariae could be distinguished on the herbage and up to 3400 metacercariae were counted on a single 'biesie' stem. Although metacercariae are found experimentally to be sensitive to desiccation and to sunlight, some that were collected from the top levels of the herbage and had thus been exposed to these factors for at least three days were as infective to sheep as the freshly collected parasites.

In vitro chloroquine-resistant *Plasmodium falciparum* malaria in KwaZulu

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In May 1987 and January 1988, the chloroquine sensitivity of *Plasmodium falciparum* in the Ubombo and Ingwavuma districts of KwaZulu was determined by a modified *in vitro* microtest in which the patients' plasma was replaced with non-immune human AB serum; the test plates were incubated in an atmosphere of 3% oxygen, 4% carbon dioxide and 93% nitrogen. All of 23 successfully tested isolates from malaria patients reporting to clinics and a hospital in these areas were found to be resistant to chloroquine, with schizogony being inhibited at 32 pmol/well in the majority of tests. Seventy-five per cent of the isolates obtained through active surveillance in the Ubombo district were found to be resistant in varying degrees. Malarial parasites collected from clinics and a hospital in the endemic areas did not change markedly in their *in vitro* response to chloroquine during the 8-month period between May 1987 and January 1988.

The use of immuno-blotting as a possible confirmatory test for cysticercosis

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Clinical diagnosis of neurocysticercosis is hampered by the diversity and non-specificity of presenting symptoms. Immunological diagnosis is generally based on the detection of antibodies to a crude antigenic frac-

tion prepared from cysts of *Taenia solium*. This use of crude antigenic fractions can result in non-specific reactions which may be manifested as a high background in an enzyme-linked immunoassay. Diluting samples further or raising the cut-off value may result in the exclusion of seropositive samples with low levels of specific antibody. The result is that there is always a section of samples which falls close to the cut-off value and which is neither clearly positive nor negative.

A selection of these samples has been studied using the immuno-blotting technique described by Gottstein *et al.* (*Am. J. trop. med. Hyg.* 35, 308–313; 1986). Control sera were found to react with several components of *T. solium* cysts but mainly those of high molecular mass. A number of apparently specific reactions were found, using sera from cysticercosis patients. Of particular importance were two antigens with apparent molecular masses of 27–30 kD and less than 20 kD. Reactions with either one or both of these components were found in 20 of 20 positive patients and 0/20 negative controls. When samples giving equivocal results (+1% or -1% of the cut-off value) were studied, similar reactions were found in 10 to 20 cases. Because of the absence of these reactions in all cyst-free patients studied, we believe that their presence can be considered diagnostic for cysticercosis. Further, we feel that the technique of immuno-blotting can be used successfully as a confirmatory test for cysticercosis to resolve equivocal results.

The intestinal parasites of conventionally maintained laboratory rodents: comparison of two rodent species and the effects of a concomitant schistosome infection

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The experimental schistosomiasis research programme at the RIDTE relies heavily on animal model studies. The two rodent models most commonly used for this programme are non-inbred *Mastomys coucha* and inbred BALB/c mice, both of which are housed under conventional conditions. Following an incidental observation, on histological examination, of endoparasites in the gastro-intestinal tracts of schistosome-infected animals, it was decided to carry out a longitudinal study to determine the spectrum of intestinal parasites present in non-schistosome infected rodents and to establish the effects, if any, of a concomitant schistosome infection on their intestinal parasite status.

Male non-schistosome infected (control) animals of each rodent species were studied, in groups of five, at 2-weekly intervals over a period of 9 to 29 weeks of age. Age- and sex-matched animals infected with *S. mansoni* (PR strain) were examined (in groups of 5), in the case of BALB/c mice at 10, 14, 16 and 20 weeks post-infection and at 11, 15, 17 and 21 weeks in the case of *M. coucha*. Stool specimens, mucosal scrapings of the large and small intestines and a sample of caecal contents from individual animals were examined microscopically.

The parasites most frequently encountered in both rodent species (whether or not infected with schistosomes) were *Entamoeba muris*, the flagellates *Trichomonas muris* and *Spironucleus muris*, and the nematodes *Aspicularis tetraaptera* and *Syphacia obvelata*. Age-related differences in the occurrence of these parasites were noted in control animals, particularly in BALB/c mice. Although the two rodent species are maintained under the same conditions, they seem to have differing susceptibilities to intestinal infection, with *M. coucha* consistently having a heavier parasite load. Concomitant *S. mansoni* infection was found to exacerbate the intestinal parasite status in BALB/c mice, while this was not so apparent in *M. coucha*, presumably due to the fact that intestinal parasite loads in the control animals were already heavy.

Damage to host fish by *Dolops ranarum* (Stuhlmann, 1891) (Crustacea: Branchiura)

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Dolops ranarum is an ectoparasite of freshwater fish in Africa. The parasite adheres to its host by means of the maxillulae, which are reduced into powerful hooks. The mandibles are reduced to very small (120 µm); sickle-shaped appendages encircled by the proboscis. Scanning electron microscopy and histological sections revealed penetration into

the dermis and a loss of epithelium. Large numbers of red blood cells were present, indicating haemorrhaging and disruption of tissue occurred. Although Paperna¹ recorded that secondary infections are regularly encountered, no evidence of such infections or abnormal amounts of white blood cells were found. Normal wound healing was observed. It would appear, therefore, that the damage caused by this parasite is due largely to attachment.

1. Paperna I. (1980). Parasites, infections and diseases of fish in Africa. *CIFA Technical Paper 7*, pp. 216.

Specialised techniques used to elucidate specific morphological features of Diplozoons

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Owing to the unsatisfactory results obtained by studying morphological features from conventional whole mounts, certain specialised techniques were used to study specific structural features of a diplozoon species. The indoxyl acetate method for esterases, as described for *Diplozoon paradoxum* by Halton and Jennings (1964), was used to study the nervous system of *Pardiplozoon kimberleyensis*. This method illustrates the nervous system in whole mounts and indicates that the highest concentration of nerve fibres is present in the organs associated with muscular activity (i.e. prothaptor and opisthaptor). These data were added to the information obtained from transverse serial sections and graphic reconstructions of the nerve supply to the opisthaptor. Likewise, studies of whole mounts indicate that the pharynx is an integral part of the digestive tract. Reconstructions from transverse serial sections of the prothaptoral region, however, show that the so-called pharynx in diplozoons forms a type of caecum which is connected to the oesophagus only by means of a thin tube. This phenomenon suggests a different function for the so-called pharynx, which proved to be a glandular rather than a muscular organ.

Acanthocephala from freshwater fish in Southern Africa with a description of a new species from the pike *Hepsetus odoë* (Bloch, 1794)

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Research Unit for Fish Biology, Rand Afrikaans University, Johannesburg, 2001.

The phylum Acanthocephala comprises a relatively small group of spiny-headed worms, the adults of which occur exclusively in the intestines of vertebrate hosts. They are pseudocoelomates with bilateral symmetry and usually cylindrical bodies. A reduction of the muscular, nervous, circulatory and excretory systems and a complete loss of the digestive system are among the adaptations to a parasitic way of life. Although acanthocephalans parasitize all major groups of vertebrates, the majority of genera and species have thus far been described from fishes, particularly freshwater fishes. Incidentally, not a single species has so far been described from Southern African freshwater fishes. During a field trip to the eastern Caprivi in the spring of 1984 and 1985, numerous adult specimens of an unknown acanthocephalan species were collected from the intestines of the pike. Immature specimens were found also in the liver of the striped robber, *Alestes lateralalis* (Boulenger, 1900), which apparently acts as a paratenic host.

Adaptations to parasitism in the piscine parasitic Siphonostoma (Crustacea: Copepoda)

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The suborder Siphonostoma constitutes approximately 75% of the known piscine parasitic Copepoda. The major adaptation to parasitism in these organisms towards utilizing a parasitic niche is generally agreed to be the characteristic mouthtube or siphonostome, into which the functional mouthparts are incorporated. It is, however, interesting to note that specialization in this group of parasites appears to have taken place only in selected areas, whereas other aspects have become functionally redundant and morphologically reduced. Parasitic copepods face three major problems in ensuring the survival of the species: 1) finding a suitable host, 2) attachment to it, and 3) having an effective means of feeding on it.

Morphological adaptations to these ends in the Siphonostoma are discussed with reference to the ultrastructure of a number of representatives of the family as determined by means of light and scanning electron microscopy.

A preliminary report on the intestinal nematodes of nine Caprivi communities and Bushmen in Namibia

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A preliminary investigation of stools from 2235 randomly selected patients from nine communities living along the Cuando river in East Caprivi revealed a high prevalence of polyparasitism with a predominance of *Schistosoma mansoni* followed by hookworm (24–49%) and *Strongyloides* (5–39%). A negligible number of *Physaloptera* (0.27%), *Trichuris* (0.31%), *Ascaris* (0.09%) and a single case of *Fasciola* sp. were also seen. Overall, 45% of subjects were infected with at least one nematode.

Schoolchildren (103) from 5 schools in Bushmanland were infected with hookworm (85%) and *Strongyloides* (25%). A further group of adults and children (31) in the Kaudom Game Reserve were infected with hookworm (63%) and *Trichuris* (37%). Epidemiological factors that could play a part in the dissemination of infections were noted.

Changes in malaria prevalence in recent years

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During the last decade, malaria notifications in South Africa rose to 10 000 annually from previous levels of one to two thousand. The prevalence of malaria has shown considerable seasonal and geographic variation, as examples from three situations show.

Venda reported a major increase of malaria during the summer months of the past three years, to between 700 and 1400 infections. The periods of highest notification differed each year from November to April. Infections were extremely scattered, 670 being reported from 228 villages, 65 villages reporting only one or two annually. Most infections were of indigenous origin, being contracted in areas with vector control. Climatic factors, especially rainfall, were responsible for the increased malaria.

The Mhala district of Gazankulu reported 1200 infections during the four months from June 1985. Almost all of these were refugees from Mozambique. Indigenous infections increased to 100 during December but were related to similar increases in adjacent districts rather than to the imported infections. Vector control and parasite surveillance in the district probably prevented a major increase in malaria transmission.

The Ubombo and Ingwavuma districts of KwaZulu reported up to 600 infections monthly during the first seven months of 1987 and 1318 infections in December in contrast to less than 100 infections monthly in recent years. This increase was related to agricultural development, migration from Mozambique, bedbug infestations and possibly chloroquine resistance. The majority of infections were contracted locally.

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