

THE PARASITOLOGICAL SOCIETY OF SOUTHERN AFRICA

The following are abstracts of papers presented at the Annual Scientific Meeting on 30 June - 1 July 1994. The congress was held at the University of Pretoria Conference Centre and the theme was "David Bruce Centenary"

DIE PARASITOLOGIESE VERENIGING VAN SUIDELIKE AFRIKA

Die volgende is uittreksels van referate wat gedurende die Jaarlikse Wetenskaplike Vergadering op 30 Junie - 1 Julie 1994 gelewer is. Die kongres was gehou by die Universiteit van Pretoria Konferensie Sentrum en die tema was "David Bruce honderdjarige herdenking"

Parasites as indicator organisms for heavy metal pollution

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A preliminary study to determine parasite prevalence and intensity at seasonal intervals was conducted in the Olifants River over a period of 30 months.

Fish were collected by means of seine and gill nets and the emphasis was on variety of species. As many fish specimens as possible were examined macro- and microscopically and all parasites were collected and identified. This parasite data were correlated with water quality data from water samples collected simultaneously at four localities in the Olifants River at Eastern Transvaal.

As parasite numbers (prevalence and intensity) vary seasonally, this presentation shows the results from two surveys during the same season of consecutive years only. Two surveys represent a period of poor and good water quality, respectively.

Parasite composition (i.e. variety of parasite species) are indicative of the water quality. Endoparasites such as trematodal cysts and larval nematodes are not influenced as severely by poor water quality as ectoparasites. Endoparasites are not in direct contact with the environment, as they are harboured within a cyst produced by the host. Ectoparasites, on the other hand, are exposed to the water environment and the limiting effect of water quality on their presence is clearly illustrated.

The present cattle trypanosome distribution in northern Zululand

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A survey was undertaken in the communal areas of northern Zululand from May 1990 to December 1992 to map areas of active trypanosomosis in cattle. The principle diagnostic method used was the examination of thick and thin blood smears taken from emaciated cattle. The Buffy Coat Method was used in areas where disease was suspected but the standard method could not detect parasites. The survey covered 132 diptank areas, 61 areas were found to have cattle infected with *Trypanosoma congolense* or *Trypanosoma vivax*. There are 40 300 cattle at risk in the 18 infected areas of Ingwavuma district, 65 100 cattle in the 21 infected areas of Ubombo district and 66 200 cattle in the 22 infected areas of Hlabisa district.

Cattle showing signs of chronic trypanosomosis in these areas were treated with homidium bromide (Ethidium, Camco). In 1990/91 52 424 cattle were treated, in 1991/92 47 464 cattle were treated and in 1992/93 20 071 cattle were treated.

Two tsetse fly species, *Glossina brevipalpis* and *Glossina austeni*, occur in northern Zululand.

Schistosomiasis and the use of indigenous plant molluscicides: a rural South African perspective

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In the last decade, plant molluscicides have received considerable attention in the search for cheaper alternatives in the control of schistosomiasis. The attraction of a locally grown molluscicidal plant is also based on the development of a philosophy of self-reliance in rural communities. If these self-help programmes are expected to succeed they must have the support of the community involved. This study aimed to assess: - the knowledge of schistosomiasis in rural communities, their attitude to control measures (particularly plant molluscicides) and the prevalence and intensity of infection in relation to perceived severity.

Study sites were located at Mtwalume (Natal). Sixty-nine community members were interviewed during 6 focus-group interviews. Urine and stool samples of 354 children (2 - 25 years old) were analyzed for infection.

Results indicate that the general understanding of schistosomiasis is poor but is a primary health concern for communities dependent on river water for all their water requirements. Oral antischistosomal drugs are inaccessible and/or prohibitively expensive. All respondents welcomed the use of medicinal molluscicidal plants which could be locally grown, extracted and applied. Preliminary results indicate a prevalence of 75% for *Schistosoma haematobium*. Results of the complete analysis will be considered.

Natural infections and population dynamics of *Polystoma marmorati* and *Polystoma umthakathi* (Polystomatidae: Monogenea)

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Polystome parasites infect their amphibian hosts at the tadpole stage and later migrate to the urinary bladder. In young tadpoles the parasite develops into a neotenic form which establishes itself on the branchial filaments. The sympatric occurrence of several species of polystomes in the Vernon Crookes Nature Reserve presented an ideal opportunity for field studies over a two year period. Intensive studies to determine the levels of *Polystoma umthakathi* infection in its natural host *Natalobatrachus bonebergi* as well as the levels of *Polystoma marmorati* infection in its natural host *Hyperolius marmoratus marmoratus* were conducted.

A high parasite prevalence was recorded in post-metamorphic *H. m. marmoratus* adults (up to 47%) while the tadpoles were poorly infected. Conversely, a very low parasite prevalence was recorded in post-metamorphic *N. bonebergi* adults, while the tadpoles were heavily infected (up to 100%). Based on these results the hypothesis presented is:

- In *P. marmorati* the neotenic parasite does not play a decisive role in determining the population, this is maintained by adult bladder parasites.
- In *P. umthakathi* the neotenic parasite is far more important than the bladder parasite and the population can probably survive without any significant contribution from adult bladder parasites.

Host-tick interrelationships: A study on the rock elephant shrew and the Karoo paralysis tick

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The rock elephant shrew (*Elephantulus myurus*) is the most important natural host for immature Karoo paralysis ticks (*Ixodes rubicundus*). Adults of this tick are frequently responsible for epidemic outbreaks of paralysis amongst domestic stock. Various aspects related to the bionomics of the tick and its interrelationships with *E. myurus* are currently being studied and will be briefly reported on. The geographic distribution of *E. myurus* largely encompasses that of *I. rubicundus*. Contact between host and tick is enhanced through similar habitat requirements as well as the territorial behaviour of the host. Peak numbers of *E. myurus* occur during periods when larvae of *I. rubicundus*, the most abundant and sensitive stage, are active. This enhances the possibility of host-tick contact. Resistance in *E. myurus* is characterized by an inefficient or non-existing anti-tick immune response which enables immature *I. rubicundus* to engorge successfully and ensures a high rate of moulting success. Detachment rhythms of *I. rubicundus* are strongly correlated with the activity patterns of its host, which not only enhance survival, but also dispersion and host contact of subsequent stages.

Plasmodium falciparum: inhibition of in vitro growth by amantadine

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Amantadine is a weak monoprotic base which inhibits intraerythrocytic growth of specifically chloroquine-resistant strains of *Plasmodium falciparum* in vitro. Amantadine in combination with chloroquine, quinine, mefloquine, halofantrine and primaquine, in the chloroquine-resistant strains is synergistic, while only the combination of chloroquine and quinine are synergistic in the susceptible parasite, the remaining drugs are additive. Work with synchronously grown cultures, monitoring morphological changes and the incorporation of ³[H]-hypoxanthine into parasite nucleic acid, indicates that susceptibility to amantadine is evident in all stages of development, and that exposure of trophozoites to the drug for 8 h, causes an irreversible arrest on parasite growth. The effect on trophozoite is dependent on amantadine's presence in the medium, however, amantadine does not block pores which are induced by the parasite in the host cell membrane. Susceptibility to amantadine is linearly dependent on inoculum size and is independent of plasma concentration. Susceptibility to amantadine sensitivity shows a linear dependence on external pH in the chloroquine-susceptible strain, but a non-linear relationship exists in the chloroquine-resistant strain. The presence of the amine group is essential for antimalarial activity. These results suggest that factors in addition to pH gradient are involved in the effect of amantadine, possibly interactions with membrane phospholipids are involved.

Tsetse in South Africa - historical aspects

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Tsetse exist in fly belts that vary in size and locality with time. At their greatest extent, the southern limits stretched from Angola in the west through Northern Botswana, to Mozambique and Northern Natal/KwaZulu in the east.

The distribution and size of individual belts were affected by climatic conditions but mostly by the presence and density of host ungulates. Thus, following the wholesale slaughter of game, the belts in the Western Transvaal and Botswana were reduced or even eliminated. For example, the site of the type specimen of *Glossina morsitans* collected in 1830 on a hill near the Limpopo in western Transvaal was freed of fly before the rinderpest epidemic.

The eastern flybelts in 1890's were, in general, restricted to the coastal plain. As white farmers moved into the area, their cattle were decimated by nagana. They pressurized the government in Pietermaritzburg to do something which resulted in Sir David and Mary Bruce being sent to Ubombo near the summit of the Lebombo mountains. They set up their laboratory in an old trader's house above the fly-infested plain and in a brilliant piece of work interrupted by a nine-month recall to Pietermaritzburg were able to show that nagana was caused by *Trypanosoma brucei* and transmitted by tsetse which in this case was *Glossina pallidipes*. Bruce concluded that the parasite was maintained in wild ungulates and that areas could be cleared of fly by game eradication, so endorsing the view of the farmers who were quick to organize a number of biggame hunts. However, the rinderpest epidemic moving south through Africa from Somalia intervened. It reached Zululand in July 1897 and killed off 80% of the domestic cattle population and probably a similar number of nagana-host game animals resulting in almost total elimination of tsetse. Small residual pockets of fly remained usually associated with surviving game, especially buffalo. The numbers of animals subsequently began to recover, followed later by reappearance of the tsetse, so that by 1907 Ubombo and the Bruces' camp were part of a new fly belt. Subsequently a series of major nagana outbreaks took place until 1947 when DDT and later BMC were used to spray the tsetse with almost complete success.

Biological diversity as seen through the scanning electron microscope

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The invention of the simple-lens microscope in the 17th century opened a whole new world for exploration. During the 19th century, explorers of microscopic phenomena had their task further aided by the development of the compound microscope. In 1932, light as a medium for the examination of specimens was replaced by the electron, and the electron microscope was born. This invention revealed an uncharted universe, undreamed of by early microscopists such as Malpighi, Hooke, Swammerdam, Grew, and Leeuwenhoek. It is the purpose of this poster to display a few of the wonders of nature as revealed by the modern scanning electron microscope.

Parasites collected from African dwarf crocodiles at markets in Brazzaville

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Wild-caught African dwarf crocodiles *Osteoleaemus tetraspis* are slaughtered routinely at several Brazzaville markets for their meat. In May 1993, 23 crocodiles were examined at these markets, blood smears taken and parasites collected from lungs, stomachs and intestines.

Pentastomes of the genera *Sebekia* and *Alofia* (identified by J. Riley, Dundee, UK) were found in the lungs of 21 crocodiles. Ascaridioids (being identified by L. Khalil, St Albans, UK) were found in the stomachs of 15 crocodiles, mainly associated with deep ulcers, and in the intestines of 7 and the cloacas of 2 crocodiles. Trematodes were found in the intestines of 21 crocodiles, sometimes in large numbers, all identified by L. Khalil, as *Pseudoneodiplostomum bifurcatum*. Hepatozoon sp. (being identified by M.A. Peirce, London, UK) was found in 21 blood smears.

Coccidial sporocysts were found in the pancreas of 1 crocodile, while intestinal stages were absent from all specimens, probably because of the long delay between capture and slaughter, estimated at an average of 30 days.

This work forms part of a project which aims at establishing a data base on *O. tetraspis* with the ultimate goal of the complete protection of this species in the Congo.

Clinical trial of a monoclonal-antibody based enzyme linked immunosorbent assay (ELISA) for detection of specific *Entamoeba histolytica* antigen in faecal specimens

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Entamoeba histolytica sensu stricto is an intestinal parasite that infects approximately half a billion people worldwide annually. Recently, this organism was proved to comprise a species complex consisting of the pathogenic *E. histolytica* and the nonpathogenic *Entamoeba dispar*. We have developed an enzyme immunoassay test based on epitope specific monoclonal antibodies to the galactose inhibitable adherence protein (GIAP) of these organisms. The test detects antigen in faeces and distinguishes *E. dispar* from the potentially invasive *E. histolytica*. It represents the first rapid and practical method for the detection of these intestinal protozoa in faecal specimens. A clinical field trial is currently being carried out to assess the value of this method in the routine laboratory. Thus far, fifty random, consecutive faecal specimens from King Edward VIII hospital have been screened. In comparison to the existing methods of culture and isoenzyme electrophoresis, this test has been found to be rapid, less involved and sensitive.

Use of recombinant surface antigens of *Entamoeba histolytica* in the differentiation of current and past infections

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Recently, we reported the development of serological tests based on two recombinantly produced major surface proteins, the serine rich *Entamoeba histolytica* protein and the 170kDa subunit of the galactose inhibitable adherence protein. The serological responses of patients with amoebic liver abscess (ALA) and control subjects were determined using conventional serology in comparison to tests employing the recombinant proteins. Although sensitivity using the recombinant antigens was lower than in a conventional serological test (65-90% versus 100%), specificity was higher (95-98% versus 53%) and, most importantly, the positive predictive value was higher (92% versus 65%). This indicated that tests using these recombinant antigens offer improved diagnosis of active invasive amoebiasis. We are currently longitudinally monitoring the serological responses of reconvalescent ALA patients using the recombinant proteins in comparison to a standard indirect haemagglutination test. The 14 subjects studied thus far have reverted to seronegativity more rapidly using the recombinant antigens.

A new species of *Parafilaria*. The cause of ulcerative dermatitis in African buffalo (*Syncerus caffer*)

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Lesions in the skin caused by *Parafilaria* sp. infection in African buffalo have been recorded for the first time. These commence as haemorrhagic perforations which show a seasonal periodicity from the beginning of November to the end of January. Beneath the perforations, migratory tracts which occur in the subcutis are characterized by a distinct bright green colour and contain whitish, gravid female filariae of 35 mm long. The prevalence of these perforations can be as high as 52,8%. Over 71% of perforations were present on the dorsal and lateral aspects of the body, of which nearly 63% occurred over the shoulder and ribs. The average number of perforations in the skins of free-living animals was 2,3 while the average number of perforations in confined buffalo was 12. Complications in a small percentage of animals led to the development of large ulcerated cutaneous lesions towards the middle of January, which healed by the end of February. The majority of ulcerative lesions occurred on the dorsal and lateral aspects of the shoulder and rib areas. The reason for the development of the ulcers appears to be multifactorial but remains unresolved. The free-living status and behavioural aspects of the buffalo and red-billed oxpeckers (*Buphagus erythrorhynchus*), are important factors in the epidemiology of this syndrome.

A novel approach to controlling worms in horses in South Africa

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Internal parasites of horses, comprised mainly of nematodes, have been implicated as one of the causes of colic which can lead to death. Little information exists concerning the extent of these parasites in horses in South Africa or how the levels compare in horses managed under different systems. Therefore, a study was designed to compare the nematode levels evidenced by egg counts of two groups of horses. Group 1 were horses on chiefly zero grazing and treated four times a year with antiparasitic remedies. In contrast, Group 2 grazed on irrigated pastures and received antiparasiticides twice a year.

The two groups were each divided into conventional and selective subgroups. Whereas the conventional subgroups were treated as previously, the selective animals received treatment if the quantitative nematode egg count was greater than or equal to 300 eggs per gram of faeces.

The egg counts and larval cultures were carried out every four weeks. It was found that strongyle eggs and cyathostome larvae predominated. Statistical analyses were performed on total mean egg counts for conventional and selective subgroups within each group of horses.

The mean egg counts were statistically different between the two subgroups ($p < 0,05$ of both groups). Fewer treatments were required for the selective subgroup of Group 1 as compared to the conventional. Group 2 showed a decrease in egg counts, suggesting that despite a wetter season, than the norm, regular monitoring of nematode levels followed by treatments does lead to reduction of helminths levels.

An experimental vaccine against South African *Babesia canis*

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A strain of *Babesia canis*, vector-specific to *Haemaphysalis leachi*, was isolated during tick transmission trials. Two hundred and seventy seven dogs

from four different regions of the country were tested for the presence of specific antibodies to this strain. Nearly 50% of the dogs had positive antibody titres to the isolated strain.

The immune responses of two beagles to live parasites of the isolated *B. canis* strain were tested. These dogs were infected with live parasites and were treated with a drug that would not sterilize the infection to allow an immune response to develop. Once recovered from the initial infections, both dogs received two separate homologous challenges with live parasites. During the second challenge, neither dog showed clinical signs of disease and examination of blood smears showed only a very low level of parasitaemia suggestive of a state of premunity.

An experimental vaccine was developed against the isolated *B. canis* strain. Parasites were grown in a microaerophilous stationary phase cell culture system to provide (a) antigen-containing supernatant material and (b) pellet material containing dead parasites. Two dogs each were inoculated with the different formulations of the vaccine three weeks apart. One month after the second inoculation, all four dogs were given a homologous challenge with live parasites. Three of the four dogs recovered from the challenge without any anti-babesial treatment.

The cysteine protease activity of *Trypanosoma brucei* is enhanced by a kininogen-like molecule

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Proteases of African trypanosomes have been implicated in the pathology of trypanosomiasis and in the degradation of antibodies directed against the parasite variable surface glycoprotein. The cysteine proteases (CPs) of trypanosomes can be measured by the hydrolysis of Z-Phe-Arg-NHMeC or by the digestion of protein within protein-containing SDS-PAGE gels. When assessed by the latter procedure, the CP from *Trypanosoma brucei* has an estimated molecular mass of 28kDa. However, if plasma or serum is added to the trypanosome extracts, additional high M_r bands of increased CP activity are observed. The activating molecule, which has been purified from rat serum, is a heat stable, cationic, glycoprotein that reacts weakly, but positively, with anti-low M_r human kininogen. Extra bands of CP activity are also observed in the presence of human low M_r kininogen and chicken egg white cystatin. Preliminary results show that in some instances low M_r human kininogen may increase the rate of hydrolysis of Z-Phe-Arg-NHMeC by live *T. brucei* at 37°C although it inhibits it at 25°C. Kininogens and cystatins are generally considered to be CP inhibitors but our observations suggest they may also have the opposite effect. This may have important repercussions in the control and pathology of trypanosomiasis.

Attempts to identify a small piroplasm from lions from the Kruger National Park

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A small piroplasm was detected in blood smears prepared from lions in the Kruger National Park. The parasite was provisionally identified as *Babesia felis*, but serum from these lions tested negative on *B. felis* antigen in the indirect immunofluorescent antibody test (IFAT).

Blood from a lion was sub-inoculated into a domestic cat in an attempt to identify this parasite. When parasites first appeared in blood smears, blood was collected and antigen slides prepared for the IFAT.

One lion was infected with *B. felis* (from a cat) and two leopards with blood stabilate from the unidentified small piroplasm. The 3 animals were immobilized at monthly intervals and blood collected for serum and blood smear preparation. All serum samples were tested against *B. felis*, the unidentified small piroplasm and *Cytauxzoon felis* antigen. The serological test results indicate the small unidentified piroplasm to be distinct. No fluorescence was observed with serum from lion on either *B. felis* or *C. felis* antigen and therefore is probably a different species to *B. felis* and *C. felis*.

The anatomy and morphology of the male reproductive system of *Chonopeltis victori* Avenant-Oldewage, 1991

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The present study intends to provide a detailed morphological description of the male reproductive system of *Chonopeltis victori* Avenant-Oldewage, 1991, using histological serial sections and scanning electron micrographs.

The general form of the male is similar to that of the female, but the former has a relatively longer abdomen and distinct copulatory structures on legs 2 to 4. In males, leg 2 differs from that of the female, in that papillated projections, covered with bristle-like scales, occur on its posterior face. A socket, with a slit-like opening on the dorsal surface, is present on leg 3. A peg, with an opening on its tip, occurs on leg 4 and serves most probably for grasping the female during copulation.

The natatory lobes, situated on the fourth leg, are round with long spines and differ between males and females, which indicates that these structures most probably have a function during reproduction. Pigment spots are present on the abdominal lobes and protect the testes against prolonged exposure to sunlight.

The testes, large and ellipsoid, extend past the cleft of the abdomen. The lateral capsular wall is undulated. Internally the reproductive system consists of paired testes, vasa efferentia, vasa deferentia, ductus ejaculatoria and accessory reproductive glands (paired prostate complex), a single vesicula seminalis and genital atrium.

Aspects of the morphology of the parasitic copepod *Lamproglena clariae* Fryer, 1956

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The genus *Lamproglena*, being cosmopolitan copepod parasites, comprises 28 species worldwide with 13 species occurring in Africa. The female of *Lamproglena clariae* Fryer 1956, found associated with the fish *Clarias gariepinus* has been recorded from Lake Nyasa and the Nile, with recent discoveries in the Olifants River in the Kruger National Park. On the gills of their hosts, their light yellow, elongated, indistinctly segmented bodies mimic gill filaments. A morphological study of the appendages in particular, using scanning electron microscopy and light microscopy, was undertaken.

The antennule with one podomere, bears a number of much reduced setae along its pre-axial margin. The short antennae consist of two podomeres, the distal one bearing five small setae. Mandible remnants were observed, situated laterally in the buccal cavity. Both, the chitinized maxillae and maxillipeds, have swollen basal joints, terminating in one and three claws, respectively. Five pairs of bigamous, reduced swimming legs were observed, with the first having a series of minute denticles along their basal margins. The furcal rami bear rudiments of three furcal setae with 2 - 3 lateral setae.

The elongated form is probably a direct parasitic adaptation to this species micro-habitat. The longer the gill filaments, the longer the parasite grows, allowing for respiratory swinging movements and aeration of the two egg sacs in the open gill cavity.

Two new species of ixodid ticks closely related to *Ixodes pilosus* (Acari: Ixodidae)

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Morphological studies of different populations of adult *Ixodes pilosus* (Koch, 1844), have revealed that it comprises three species. One of these, *Ixodes pilosus sensu stricto*, is associated with forested regions and is distributed from the Soutpansberg, south along the Transvaal Drakensberg, extending into KwaZulu/Natal and into the eastern Cape as far south as the Tsitsikamma forest. It parasitizes a wide variety of hosts, including cattle, bushbuck (*Tragelaphus scriptus*), common duiker (*Sylvicapra grimmia*), and caracal (*Felis caracal*). A second species, for the moment named "thick haired pilosus", is most common in KwaZulu/Natal, but has occasionally been recorded in the northern Transvaal and eastern Cape. It is found in areas which are either forested or covered with thick bush. This species is usually found on bushbuck (*Tragelaphus scriptus*) and common duiker (*S. grimmia*). It feeds readily on cattle in the laboratory. The third "hairless palp" species is restricted to the coastal forests and coastal fynbos of the eastern and southern Cape. It feeds on most domestic animals and has also been collected from grey rhebok (*Pelea capreolus*), bontebok (*Damaliscus d. dorcas*) and scrub hare (*Lepus saxatilis*). None of these species is known to transmit any disease.

Aspects of the fine structure of *Kroyeria carchariaglauci* Hesse, 1879

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Kroyeria carchariaglauci is a marine fish parasite and its behaviour has never been observed on a live host, due to practical constraints. This study attempts to gain an insight into the function of various appendages by means of scanning electron microscopy.

A sensory pit is present on the dorsal shield in close proximity to the base of the antennule. The antenna is smooth and stout and bears a single seta on the articulated, terminal hook. The second segment has a thin, plate-like fringe ventrally. The terminal, articulated hoof fits into a depression in its opposing, rigid hook on the second segment. It appears that the second antennae are the primary attachment organs and that the grip on a gill filament can readily be released. This implies that this parasite is a browsing feeder. The second maxilla is stout with a fringe of spines along its inner margin. The terminal segment is stout and ends in a sharp, curved claw.

The mouth tube is short and the labrum has lateral, spinose lobes. A dentiferous ridge is also present on the innerface of the labium. This ridge evidently functions in removing epithelial cells from gill filaments.

The ultrastructure and function of cuticular spines in the parasite *Holobomolochus*

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The fine structure of parasitic copepods is frequently neglected in taxonomic study, but the spectacular cuticular structures of these animals frequently play an essential part in their utilization of a specialised niche.

The prominent antenna is covered by posteriorly directed, blade-like and sharply pointed spines. Those on the interpodal plate of the first pair of swimming legs are thick, stout and blunt, although also directed posteriorly. The margin of the basidipodite of the first swimming legs bears a single row of delicate, flat spines. The flat cuticular ridges on the first segment of the maxilliped, and the spinules on the larger spines on the exopodites of the second, third and fourth legs are not directed in a particular direction.

The labrum has two rows of densely packed, long spines along its border and the labium a single row, which is shorter and broader. As feeding was observed to be typically poeciliostomatoid, i.e. by extrusion of the rasping mandible through outward movement of the labrum and labium, these spines obviously play an important role in preventing loose epithelial material from being swept away before ingestion.

Studies on the morphology of the parasitic copepod *Lernaea cyprinacea* Linnaeus, 1758

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The morphology of *Lernaea cyprinacea* was studied by means of scanning electron microscopy and light microscopy.

L. cyprinacea is an ectoparasitic copepod of freshwater fish. The female penetrates the skin and establishes permanently under the fish's scales.

The head is distinct and round, bearing four large processes behind the head, by which the parasite anchors itself to the host's body. Two antennulae, consisting of five podomeres each, are situated on the lateral sides of the labrum. The antennae consist of three podomeres, the terminal one armed with a strong mobile claw.

The oral opening is covered by the upper lip (labrum) anteriorly and by a triangular lower lip posteriorly. The mandibles have lamellar basal podomeres bearing curved, lancet-shaped spines. The maxillulae are situated ventrally to the mandibles which consist of one podomere, whereas the maxillae consists of two to three podomeres bearing two mobile hooks terminally. The enormous maxillipedes consist of two podomeres bearing terminal claws.

The six pairs of swimming legs lose their primary locomotory function and do not undergo any morphological changes. The terminal segment of the body is narrow and rectangular and terminates in furcal rami.

The permanently fixed position which is assured by the encapsulated anchors as well as the significant changes occurring in the morphology of the parasite body in length as well as in width, allows sufficient space for the developing ovaries.

Tick control in a predominantly blue tick area of South Africa

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Tick control practices of farmers in the Border region of South Africa were determined by questionnaire survey. The main livestock farming types in the region are wool sheep (55%), beef cattle (22%), Angora goats (12%) and dairy cattle (2%). The majority of wool producers preferred to use organophosphate acaricides, in contrast to producers of the other livestock types who all favoured synthetic pyrethroid acaricides. The major consideration of all producers in choosing an acaricide was its price. The majority of wool, beef and Angora producers preferred plunge dipping, while most dairy producers used pour-on application of acaricides. Treatment frequencies per annum favoured by small stock producers were, wool <6 times and Angora <6 times, while most cattle farmers treated 11-15 (beef and dairy) and 41-52 (dairy) times per annum. Twenty three percent of beef cattle producers vaccinated their cattle against gallsickness (12%), redwater (7%) and heartwater (4%), while only 9% of dairy producers vaccinated, and then only against gallsickness.

Transmission of *Ehrlichia bovis* by *Rhipicephalus* spp. in South Africa.

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Rhipicephalus appendiculatus, which is recognized as an important vector of various cattle diseases in Africa, is also generally accepted to be a vector of *Ehrlichia bovis* in southern Africa. However, two other closely related rhipicephalid species, *Rhipicephalus zambeziensis* and *Rhipicephalus nitens*, which have often been confused with *R. appendiculatus* in the past, occur in South Africa: *R. zambeziensis*, which occurs sympatrically with *R. appendiculatus* in some areas and replaces it in others at lower altitudes and/or in drier climates, and *R. nitens*, which replaces *R. appendiculatus* in the southern and south-western coastal areas of the Cape Province, west of longitude 26°E. Few or no data are available on the role of these latter two tick species in disease transmission.

Cattle were infected with a laboratory isolate of *E. bovis* and different tick instars applied when parasites became microscopically detectable in thin blood smears. Transstadial transmission (nymph to adult) of *E. bovis* by *R. appendiculatus* was confirmed. Transstadial transmission (both larva to nymph and nymph to adult) by *R. zambeziensis* was demonstrated. However, female *R. zambeziensis* ticks failed to transmit *E. bovis* transovarially. Nymph to adult transmission by *R. nitens* was also successful.

These results further indicate that *R. zambeziensis* and *R. nitens* may also be vectors of other diseases transmitted by *R. appendiculatus*, as has been demonstrated for *Theileria* spp. transmitted by *R. zambeziensis*.

The haematozoa of the laughing dove (*Streptopelia senegalensis*)

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The seasonal abundance and prevalence of haematozoa of laughing doves were studied from July 1992. Until the end of May 1994 more than 560 birds have been ringed and examined for haematozoa. There were also more than 280 retraps that were examined for changes in the parasitaemias of the birds.

The most common blood parasites were *Haemoproteus columbae*, which occurred in 44% of the birds, *Leucocytozoon marchouxi* in 20% and *Trypanosoma hanna* in 8%. The prevalence of *H. columbae* was low during December 1992 and January 1994. The prevalence of *L. marchouxi* was high during late summer and that of *T. hanna* in all summer months. When thin blood smears were examined, 8% of the birds were found to be infected with *T. hanna*, this figure increased markedly to over 20% when examining the buffy coat area of centrifuged capillary tubes.

There were seasonal variations in the prevalence of all of these parasites. After the drought of 1991-1992, the normalisation of the rainfall resulted in an increase of the prevalence of blood parasites.

Pseudolynchia canariensis, the vector of *H. columbae*, was found on 17% of the birds.

A new *Nannomonas*-type trypanosome: Isolation, in vitro cultivation and partial characterization

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Within the subgenus *Nannomonas*, *Trypanosoma congolense* and *Trypanosoma simiae* are the only recognized species. Here, the isolation and partial characterization of a new *Nannomonas*-type trypanosome from a *Glossina pallidipes* caught at the Ngulia Rhino Sanctuary, Tsavo West National Park in Kenya is described. A trypanosome culture was initiated with metacyclics derived from a single tsetse. Organisms were propagated axenically as trypomastigote forms at 35°C initially, in the presence of bovine aortic endothelial cells. Culture-derived bloodstream trypomastigotes were transformed into procyclics at 26°C which later transformed to epimastigotes and finally to pig-infective metacyclics.

On Giemsa-stained slides the organisms had a marginal kinetoplast close to the posterior end. The undulating membrane was well developed in some organisms but inconspicuous in others. The undulating membrane extended to the tip of the flagellum. A free flagellum seemed to be present only in some trypanosomes.

The parasites caused a very mild infection in domestic pigs accompanied by a low parasitaemia. Infections were either eliminated by self-cure or by treatment with the trypanocidal drug, diminazene aceturate. The trypanosomes were not infective for mice, goats and a steer.

DNA from the trypanosome isolate hybridized with DNA probes for the *Nannomonas* subgenus; it did not hybridize with DNA probes for Kilifi-type and Savannah-type *T. congolense*, *T. simiae*, or *Trypanosoma brucei*.