

The Parasitological Society of Southern Africa

Selected abstracts of papers presented at the 16th Annual Congress of the Society held at Nelspruit on 16 and 17 July 1987.

Parasitologiese Vereniging van Suidelike Afrika

Uitgekose uittreksels van referate wat opgelewer is gedurende die 16de Jaarlikse Kongres van die Vereniging wat op 16 en 17 Julie 1987, in Nelspruit gehou is.

Morphological adaptations of Branchiura to a parasitic mode of life

A. Avenant and J.G. van As

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

Three genera of the order Branchiura are known in Southern Africa, i.e. *Dolops*, *Chonopeltis* and *Argulus*. *Dolops* attaches by means of hooks. In scale fish they attach on the non-scaly parts such as the mouth and branchial cavity and at the base of the fins, but on smooth-skinned fish they attach on any protected surface. In *Argulus* and *Chonopeltis* the larvae hatch with a complete hook which is gradually replaced by a sucker. Since *Argulus japonicus* larvae and adults appear on the same host, the change in mode of attachment may be a result of interspecies competition. *Chonopeltis* larvae are found on different hosts from the adults [Fryer, G. (1968). *J. Zool., (Lond.)* 156, 45–95], and the change in mode of attachment may be due to differences in microhabitat. Recently, an undescribed species of *Chonopeltis* was found on the riverfish *Synodontis*. Adult forms of these parasites have a complete hook and sucker as in stage 3 larvae. Is this animal still evolving the characteristic hookless sucker or is it a neotenic characteristic retained to exploit this specific microhabitat?

Epidemiology of amoebiasis

T.F.H.G. Jackson, V. Gathiram*, A.E. Simjee* and S. Whittaker†
*Research Institute for Diseases in a Tropical Environment (MRC), Congella 4013, *Department of Medicine, Medical School, University of Natal, Durban 4001, and †Department of Community Health, Medical School, University of Cape Town.*

Isoenzyme electrophoresis and serology have been used to make more accurate observations of the epidemiology of amoebiasis in South Africa. It has been found that it is possible to differentiate *Entamoeba histolytica* into pathogenic and non-pathogenic zymodemes (strains determined from characteristic isoenzyme patterns); pathogenic zymodemes alone were isolated from individuals with invasive disease while both pathogenic and non-pathogenic zymodemes were isolated from asymptomatic carriers. When these findings were correlated with serological data it was seen that use of two complementary serological tests resulted in subjects with invasive disease presenting with 100% seropositivity, contrary to other surveys which, illogically, are positive less frequently (85%). Furthermore, seropositivity was found to be directly related to infection with pathogenic zymodemes (both symptomatic and asymptomatic), whereas non-pathogenic zymodemes were incapable of eliciting an immune response in infected subjects.

As this work implies that seropositivity relates exclusively to infection with pathogenic zymodemes, interpretation of the results of many sero-epidemiological surveys needs reassessment. In order to obtain meaningful epidemiological results, we propose that amoebic culture be performed on stools collected from the study population to determine overall prevalence (both pathogenic and non-pathogenic zymodemes). Serology and/or isoenzyme electrophoresis of the population can then be used to determine the prevalence of infection with pathogenic *E. histolytica*. A recent outbreak of invasive amoebiasis in Phillipi in the Cape provided an excellent opportunity to assess the ability of this combination of techniques for controlling an epidemic. All the carriers were identified and successfully treated, infection pathways were established and it was possible to identify the person who had introduced the pathogen to this normally non-endemic area for invasive amoebiasis. Infection with pathogenic

zymodemes of *E. histolytica* has been found to occur in family groups and related individuals such as neighbours. It is therefore essential in terms of good clinical management, to examine and treat related individuals to prevent disease transmission.

Occurrence of *Schistosoma mattheei* in south-western Transvaal

P.H. Joubert, V.L. Hamilton-Attwell* and F.J. Kruger

*Research Institute for Diseases in a Tropical Environment (MRC) Nelspruit 1200, and *Zoology Department, PU for CHE, Potchefstroom.*

The south-western Transvaal is non-endemic for human schistosomiasis, probably because of unfavourable environmental conditions. Nevertheless, a stable population of the bovine parasite *Schistosoma mattheei* has been described from the Sterkstroom in the Ventersdorp district. This isolated population has generated taxonomic interest, as it provided an opportunity for the study of the parasite from a region where the closely related human parasite, *S. haematobium*, with which it hybridizes in nature, does not occur. As part of this study, a survey was conducted in the south-western Transvaal in order to establish the prevalence of the parasite in *Bulinus africanus*. Ten habitats harboured the snail species and at one site, the 'Bovenste Oog' of the Mooi river, they were infected with *S. mattheei*. The cercariae were passaged through the mouse, *Praomys coucha*, and the resultant adult worms, ova and miracidia were examined using morphological characters described elsewhere. Results indicated that this population is taxonomically identical to the Sterkstroom one. It is therefore suggested that the south-western Transvaal *S. mattheei* population should be regarded as the plesiotype of South African *S. mattheei*.

Decreases in schistosomiasis prevalence rates in certain areas of the Transvaal

P.S. Visser

Research Institute for Diseases in a Tropical Environment (MRC), Nelspruit 1200.

Over the past three decades, decreases have been documented in the prevalence of schistosomiasis at several localities in the Transvaal. Three examples are discussed here and explanations are offered for the reductions in each case.

1) During the late 1960s, an approximately 20% prevalence of *Schistosoma haematobium* infection was recorded among black children living along the Bamboesspruit, Wolmaransstad, in the western Transvaal. Several surveys conducted in the area between 1970 and 1985 have failed to reveal further infections and transmission has presumably ceased.

2) *S. haematobium* prevalences of up to 50% were reported among children at 10 of 11 schools sampled in the Brits/Rustenburg area [(Gear, Pitchford and Van Eeden (1980). *Atlas of Bilharzia*. SAIMR, Johannesburg]. These same schools were revisited in 1985 but infection was found at only four of them. *Schistosoma mansoni* infection was recorded at five of the schools by Gear, Pitchford and Van Eeden and the prevalence at the latter school was 50%. During the 1985 survey, no *S. mansoni* infections whatsoever were found.

3) In the former black township of Nelspruit with its inadequate water supply, the prevalence of both *S. haematobium* and *S. mansoni* among schoolchildren was nearly 100%. Following the township's relocation 15 years ago to KaNyamazane where proper water supplies were built, these infection rates have fallen to less than 10%.

Inquiries have suggested that the focus of transmission at Wolmaranstad was maintained by a team of labourers stationed temporarily in the town, but that they have since left. In addition, the climatic conditions in this area are considered marginal for *S. haematobium*. In the other two cases, the dramatic decreases in prevalence are thought to be associated with improved standards of living which incorporate proper sanitation and safe water supplies.

Plant molluscicides

S.J. Pretorius

Research Institute for Diseases in a Tropical Environment (MRC), Nelspruit 1200.

The efforts to break the schistosome life-cycle with plant molluscicides seem an attractive procedure which can involve community participation not only at village level but also in the more developed farming areas. Moreover, the advantages of using indigenous rather than imported materials are self-evident. The growing interest in plant molluscicides stems from the hope that they will be cheaper and more readily available than synthetic chemicals. The desirable characteristics of candidate plants such as their potency, availability and toxicity to man, are summarized by Kloos and McCullough [(1981). *WHO Schisto/81*, 59]. Plant molluscicides have received very little attention in South Africa since the work published by Wager on *Balanites maughamii* in 1936 (*S. Afr. med. J.* 10, 10–11). However, various plants have been tested elsewhere in Africa, some of which also occur in South Africa.

Table 1. Plant with molluscicidal properties tested against SA intermediate host snails (Kloos and McCullough, 1981).

Plant species	Part	mg/l	% Kill
<i>Agave sisalana</i>	Leaves	5000	90
<i>Canna indica</i>	Root, leaves	100	10
<i>Rauvolfia caffra</i>	Root	100	100
<i>Annona senegalensis</i>	Stem	100	85
<i>Combretum</i> spp.	Stem, root	100	100
<i>Dichrostachys cinerea</i>	Leaves	100	100
<i>Balanites maughamii</i>	Fruit	25	100

Seven of these were plant species tested against those snail intermediate hosts which also occur in South Africa (Table 1). Preliminary tests have shown that two of these, *B. maughamii* and *Dichrostachys cinerea*, are molluscicidal. The green outer fleshy parts of the fruits of *B. maughamii* and the leaves of *D. cinerea* were active and crude water extracts of 100 mg/l were sufficient to kill all the snails in 24 hours. This potency, among others, qualifies both plant species for further comprehensive studies.

David Bruce and *Trypanosoma* in Natal

C.H.J. Schutte

Research Institute for Diseases in a Tropical Environment (MRC), Congella 4013.

In this presentation, one of the most important parasitological breakthroughs to be made in South Africa was highlighted. This was the discovery in 1894 by David Bruce of the causative agent of the trypanosome disease known as 'Nagana', which had been killing cattle in Africa for centuries. It was made at Ubombo, a small village on the Lebombo mountain range in northern KwaZulu. Dr Bruce was assisted by his wife, Mary, and they worked for more than two years under the most primitive conditions. In a relatively short time, he could prove that Nagana was caused by organisms which were later identified as *Trypanosoma*, that wild animals acted as reservoir hosts for the parasite and that the latter was transmitted from infected to healthy animals by tsetse flies. The parasite was later named *Trypanosoma brucei* in his honour. With his knowledge and experience, Bruce in later years also played a major role in the identification of the causative agents, life-cycle and transmission of the trypanosomes causing sleeping sickness in man.

The discovery of the cause of Nagana did not mean the immediate end to the problem. It took more than 50 years before the cattle disease could be brought under control, since it was firmly believed that the only way to do so was to kill the reservoir hosts. As a result, tens of thousands of wild animals were culled.

Bruce is also known for the discovery of the causal agent of Malta fever, a fatal disease which was later called brucellosis in his honour. He was on active service with the Natal Field Force during the Anglo-Boer War, and was present at the battles of Elandslaagte, Laingsnek, Belfast and the siege of Ladysmith. He performed numerous operations in primitive circumstances and also took some of the first X-ray pictures of fractures under war conditions.

One of the most intriguing aspects of Bruce's discovery is the exact spot where it was made. The remains of what could have been the hut in which David and Mary Bruce lived and worked was recently discovered and it was suggested that the Parasitological Society of Southern Africa consider the possibility of erecting a memorial stone in his honour.

Studies on amoebic antigen

Wendy Armstrong and B. Breidenkamp*

Research Institute for Diseases in a Tropical Environment (MRC), Congella 4013, and *Department of Chemical Pathology, University of Natal, Congella 4013.

Axenic cultures of *Entamoeba histolytica* (Strain NIH:200) were homogenized and soluble antigens extracted with conventional phosphate-buffered saline (PBS). The resulting pellet of particulate material was further extracted with a surfactant (Triton X100) buffer (Tx100-PBS) in an attempt to extract membrane-associated antigens.

The protein profiles of the two extracts were compared using iso-electric focusing and their antigenic nature examined by means of Ouchterlony gel diffusion. Results indicated, firstly, that at least one protein is extracted with Tx100-PBS but not with PBS; secondly, and more significantly, that there is an antigen (recognized by pooled positive human sera), extracted with Tx100-PBS that is absent from the conventional PBS extract.

Prevalence of vaginal trichomoniasis in black female patients

A.A. Hoosen, A.B.M. Kharsany and J. van den Ende

Department of Medical Microbiology, Faculty of Medicine, University of Natal, Congella 4013.

This study deals with the prevalence of vaginal trichomoniasis in various groups of patients at King Edward VIII Hospital, Durban. These studies were based on the wet-mount technique for the rapid diagnosis of *Trichomonas vaginalis*. Evaluation of diagnostic techniques for the disease was also done.

The prevalence of *T. vaginalis* among different patient categories at King Edward VIII Hospital was: pelvic inflammatory disease group ($n=50$) 56%; family planning clinic group ($n=50$) 20%; diabetic clinic ($n=100$) 20%; sexually transmitted disease clinic ($n=100$) 20%. In order to evaluate diagnostic techniques, vaginal secretions obtained from 193 pregnant patients attending an ante-natal clinic were examined by the following methods: 1, wet-mount technique (performed at bedside); 2, staining methods—acridine orange and papanicolaou; 3, culture in modified Diamond's medium.

T. vaginalis was detected in 72 patients (37,3%), by means of the wet-mount method or by culture alone. However, when both these methods were used, the detection rate increased to 49,2%. Staining methods were less sensitive than wet-mount or culture diagnosis, and tested positive in only 32 (16,5%) patients.

Damage to fish skin epithelium by the ectoparasite *Argulus japonicus* Thiele, 1900

P.W. van Heerden and W.H. Oldewage

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

The primary barrier between the fish and its environment is the epithelium. When this is damaged, the underlying tissue is exposed to the environment, which inhibits the control of homeostasis and may ultimately lead to death. The attachment to the host and possible damage resulting from feeding habits were investigated by scanning electron microscopy of the ectoparasitic branchiuran, *Argulus japonicus* Thiele, 1900 infesting the skin of *Tilapia sparmanii* Smith, 1840. It was found that *A. japonicus* causes ultrastructural damage to its host mainly as a result of attachment, by means of its cup-shaped suckers, and feeding via its stylet which is used to puncture the epithelium of the fish. The preferred sites were the

tail and caudal fin of *T. sparmanii*; secondary infection by opportunistic pathogens was commonplace. Results obtained during this study suggest that the modes of attachment and feeding of *A. japonicus* cause severe damage to the host and render it susceptible to a variety of secondary pathogens, which may in turn contribute to stress and cause death.

Mebendazole (Vermox®) as a single-dose treatment for medically important nematodes

A.C. Evans and A.W. Hollmann*

Research Institute for Diseases in a Tropical Environment (MRC), Nelspruit 1200, and *University of Pretoria, Pretoria 0002.

A Mebendazole (500 mg) tablet was administered as a single-dose treatment to each of 211 schoolchildren aged 5 to 16 years old (mean 10 years) and weighing 16 to 69 kg (mean 31,5 kg) with single or mixed intestinal nematode infections. Of the 211 who complied for final assessment, 69,6% (147/211) had *Ascaris*, 54,5% (116/211) hookworm and 3,3% (7/211) *Trichuris*; 91 had only *Ascaris*, 53 *Ascaris* + hookworm, 1 *Ascaris* + hookworm + *Trichuris*; 2 *Ascaris* + *Trichuris*, 60 only hookworm, 2 hookworm + *Trichuris*, 2 only *Trichuris*; 9 were also infected with *Hymenolepis nana*. A majority had low EPG rates.

Treatment was particularly effective against *Ascaris*; 93,2% (137/147), less so against hookworm: 56,9% (66/116) and promising against *Trichuris*: 100% (7/7); *H. nana* was unaffected. Most refractory cases (45/60) had decreased EPG rates. Treatment resulted in fewer *Ascaris* (95%) and hookworm (84%) eggs reaching the environment. One case of *Strongyloides* (10 LPG) appeared after treatment. Results compare well with those from elsewhere in the world. The drug was well tolerated and there were no side effects, which together make it a safe and possible candidate for mass therapy as a control strategy.

The tapeworm *Cephalochlamys namaquensis* (Pseudophyllidea) in a population of the clawed toad, *Xenopus laevis*, in Natal

R.R. Ferguson and C.C. Appleton

Department of Zoology and Entomology, University of Natal, Pietermaritzburg 3200.

Several aspects of the population structure and transmission biology of *Cephalochlamys namaquensis* have been examined. The prevalence of infection in a population of *X. laevis* from Pietermaritzburg was 68,9% and most worms were attached in the anterior half of the toad's duodenum. The median burden was 3 per host and 76,2% of worms recovered were shown to be sexually immature. Growth appeared to be rapid with a longevity of approximately one year. Egg-output in the toads' faeces was high, reaching an estimated 242 000 g⁻¹. Coracidia had a LT₅₀ of 6 h, and the cyclopoid copepod, *Eucyclops gibsoni*, was shown to act as an intermediate host. Freshly hatched coracidia were found experimentally to accumulate at the bottom of the water-column where infection of the intermediate host is thought to take place. In the habitat sampled, this would be in darkness. This host/ parasite system is considered a useful one for studies into the dynamics of helminth transmission in an aquatic environment.

Occurrence of *Entopolooides* in South Africa

P.J. Fripp

Department of Microbiology/Parasitology, Medical University of Southern Africa, MEDUNSA 0204.

After splenectomy, six vervet monkeys (*Cercopithecus aethiops pygerythrus*) captured in the Buffelsdrift area of the northern Transvaal developed massive intra-erythrocytic infections. The organisms were highly polymorphic and resembled *Babesia* but with several major differences. The young stages consisted of small malaria-like rings each with a chromatin dot. Multiple infections and accolae forms as seen with *Plasmodium falciparum* were common. Older amoeboid forms showed characteristic protoplasmic pseudopodial extensions that often bore clubbed ends. Nuclear division produced two and four merozoites sometimes arranged in the 'Maltese cross' formation seen in *Nuttallia*, but were more irregular and not so clearly pear-shaped. Pigment was absent. The distortions to the erythrocyte caused by the organisms were clearly seen in SEM preparations.

Examination of blood smears before splenectomy revealed very low

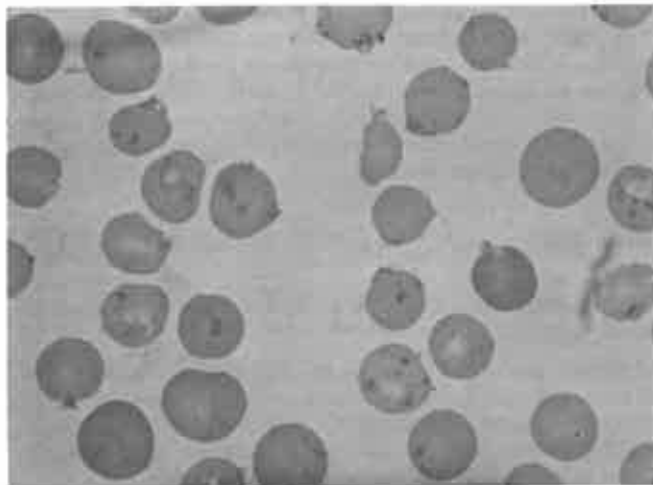


Fig. 1. Giemsa-stained thin blood smear. Multiple infections of *Entopolooides* in erythrocytes showing different stages of development.

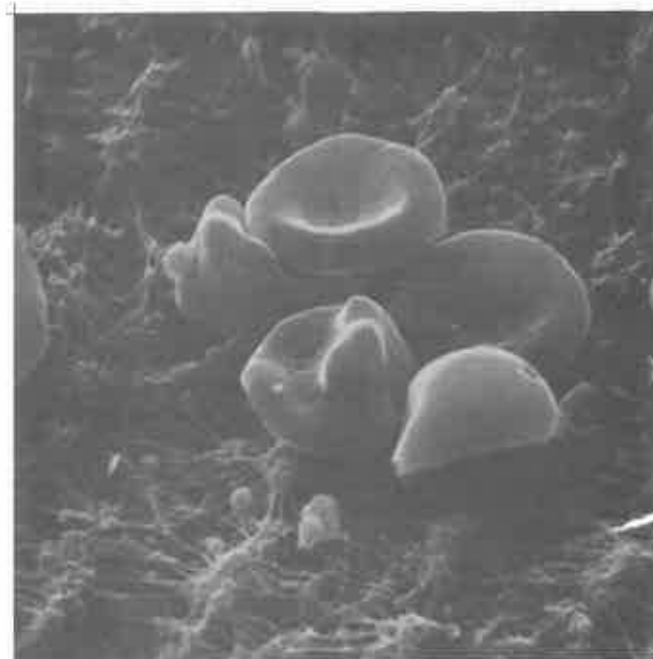


Fig. 2. SEM preparation. Two erythrocytes distorted by *Entopolooides*.

grade parasitaemia in only one monkey, but after splenectomy the parasitaemias rose to above 50% and, although the animals became severely anaemic, none died from the infection. The morphology of the organisms most closely resembled *Entopolooides*, which Levine [(1971). *Trans. Am. Microsc. Soc.* 90, 2-33], 'more from convenience than conviction', placed in the Babesiidae.

The type specimen *E. macaci* was obtained from Javanese Kra monkeys (*Macaca irus*) [Meyer (1934). *Zentralblatt für Bakteriologie, Originale*, 131, 132-6] and there are only two previous reports of the organism in Africa. Fairbairn [(1948). *Ann. trop. Med. Parasit.* 43, 118] first found it in two *C. aethiops* from near Tinde in Tanzania, and Hawking [(1972). *Parasitology* 65, 89-109] in two caged *C. pygerythrus* that probably originated from East Africa.

The life-cycle of *Entopolooides* is unknown, but it is likely to be indirect and, because of its resemblance to the babesias, involves ticks although attempts to transmit the parasite through hard and soft ticks were unsuccessful (Hawking *loc. cit.*). This well-tolerated parasite would seem to have a focal distribution, as the only other isolations have been obtained from vervets near Skukuza in the Kruger National Park (Van Dellen, personal communication).

Tango receptors embedded in the tubercle-integument of *S. mattheei* indicate that the tubercles have a tactile function

V.L. Hamilton-Attwell and F.J. Kruger*

Department of Zoology, PU for CHE, Potchefstroom 2520, and *Research Institute for Diseases in a Tropical Environment (MRC), Nelspruit 1200.

Certain tubercles of adult *S. mattheei* males are distally protuberant, creating an impression of a nipple. Scanning electron, transmission electron and light microscopy of differentially stained sections indicated that these nipples enclose a corpuscular process consisting of nervous tissue. This terminally situated process is connected to smaller corpuscles embedded in the integument of the tubercle by nerve-like fibres. It is postulated that the corpuscles are tango receptors which indicates that the tubercles have a tactile function. The results obtained suggest that the well-documented ciliated sensory receptor common to all schistosomes has a sensory function other than tactile.

Piscine parasitic Ergasilidae (Copepoda: Poecilostomatoida) from (Southern) Africa

W.H. Oldewage and J.G. van As

Department of Zoology, Rand Afrikaans University, Johannesburg 2001.

African freshwater and estuarine fish are parasitized by 16 species of *Ergasilus* von Nordmann, two species of *Parergasilus* Markewitsch and one species of *Dermaergasilus* Ho et Do. These parasites resemble free-living cyclopoids, except for the hooked antennae, which are adapted to clutch around the gill filament of the host. Although these have not previously been found south of the Zambezi and Limpopo rivers, Southern African fish are shown to be infested by three indigenous (*Ergasilus mirabilis*, *Ergasilus ilani* and *Dermaergasilus mugilis*) and one cosmopolitan (*Ergasilus nanus*) ergasilid. *E. mirabilis* parasitizes a wide range of freshwater hosts, whereas *E. ilani*, *E. nanus* and *D. mugilis* are exclusive to mullets. The present study presents numerous new records of these parasites in Southern Africa as well as a summary of the cumulative information on the fauna of the rest of the continent. The host-range of the Southern African species is provided.

Ecological studies on *Ostertagia ostertagi* third stage larvae

R.C. Kreck and K.D. Murrell*

Department of Parasitology, University of Pretoria, Pretoria 0002, South Africa and *Helminthic Disease Laboratory, Animal Parasitology Institute, Barc-East, USDA, Beltsville, Maryland, USA.

Studies on the migration of third stage larvae of *Ostertagia ostertagi* were undertaken to extend our knowledge of their ecology. These observations on their migration in soil and herbage were made from spring to autumn in the north-eastern USA.

Herbage migration was examined diurnally, at 6–3-h intervals and correlated with several meteorological factors: rainfall, relative humidity, ambient together with minimum and maximum air temperatures, mat, soil and dung temperatures. Vapour pressure deficit, annual precipitation index and soil moisture were also calculated. The largest numbers of larvae were recovered from herbage at sunrise and sunset. The factors which correlated most closely with larval counts of the lower herbage were mat and dung temperatures and for upper herbage, vapour pressure deficit and interval air temperature. Third stage *O. ostertagi* larvae have the ability to migrate to depths of 15 cm in sandy loam. This behaviour may signify a larval adaptation which provides a habitat protecting them from harsh conditions prevailing at the surface.

On the ultrastructure of the marine piscine parasite, *Caligus Africanus* (Copepoda: Caligidae)

W.H. Oldewage and J.G. van As

Research Unit for Fish Biology, Rand Afrikaans University, P.O. Box 524, Johannesburg 2000.

The morphology and fine structure of a representative of the marine piscine ectoparasitic genus *Caligus*, *C. africanus*, was studied by means of light and scanning electron microscopy. A variety of structures, such

as the rough, rugose area on the frontal plates, which are believed to be chemosensory, the sensory setae on the carapace, as well as the mouthparts and appendages were investigated. Functional aspects of the morphology of this copepod are discussed with reference to its parasitic niche. The parasite attaches to the host by means of a 'cephalothoracic sucker', which is formed by the marginal membrane of the carapace. This attachment facilitates feeding, as the mouthtube is forced onto the host surface, causing it to expose the feeding apparatus to the host tissue. Regarding the feeding mechanism itself, only the mandible and strigil, located inside the mouthtube, appear to be functional in scraping and gathering host tissue, respectively.

Influence of route of infection on the survival of *Plasmodium durae* in turkeys

F.W. Huchzermeyer

Veterinary Research Institute, Onderstepoort 0110.

During routine syringe passaging of *Plasmodium durae* in turkeys, a prolongation of the prepatent period after intramuscular (i.m.) inoculation was observed compared with the use of the intravenous (i.v.) route. This could be due either to an obligatory development of exoerythrocytic schizonts (EES) or an inability of the parasite to reach red blood cells of the new host. Histological examination of the pectoral muscle at regular intervals after i.m. inoculation did not show any evidence of EES development. Examination of brain, spleen and bone marrow smears in addition to blood smears at regular intervals after i.v. inoculation proved that erythrocytic forms occurred before the appearance of EES. Inoculation i.v. of 100 and 1000 fold dilutions demonstrated a lengthening of prepatency with increasing dilutions.

In a comparison of prepatency of an equal inoculum given i.v. and i.m. as well as i.v., i.m., subcutaneously (s.c. and intraperitoneally, i.p.) the lengthening of the prepatent period by use of the three last-named routes as compared with the i.v. route was equivalent to that expected with a dilution of the inoculum of 1:500 or to an apparent loss of 99,5% of parasites.

These results may have an implication for experiments with a small-animal model, where use of the i.v. route presents some difficulties, particularly if the inoculum contains only small numbers of parasites.

Immunological diagnosis of schistosomiasis as the cause of myelopathy

S. Epstein, M. Haribai*, B. Bredenkamp† and M.D. Pammenter
Research Institute for Diseases in a Tropical Environment (MRC), Congella 4013, *Neurology Department, Wentworth Hospital, Wentworth 4001, and †Department of Chemical Pathology, University of Natal, Durban 4001.

An enzyme-linked immunosorbent assay was established for the detection of anti-schistosome antibodies in cerebrospinal fluid (CSF). This test was performed on over 200 patients suffering from myelopathy admitted to Wentworth Hospital, Durban. CSF was also tested for the presence of oligoclonal antibodies. Of the patients admitted, 14 were clinically diagnosed as suffering from myelopathy due to schistosomiasis (to be reported elsewhere). Twelve of these 14 patients had positive anti-schistosome antibody titres in their CSF and in 13 oligoclonal antibody bands were identified.

The presence of high anti-schistosome antibody titres and oligoclonal antibodies correlates well with a clinical diagnosis of neurological schistosomiasis. Based on these criteria, we were able to detect 80% of cases of neurological schistosomiasis with 3% false positive results. It is suggested that these assays may be of value as supportive diagnostic tests for neurological schistosomiasis.

Prevalence of asymptomatic malaria infections

C.F. Hansford

National Institute for Tropical Diseases, Tzaneen 0850.

The detection of malaria infections by control staff in the field (active surveillance) is dependent on the infection causing illness which is used as a screening method for taking blood smears. Malaria infections may be mild or asymptomatic due to previous infection followed by immunity, genetic protective factors (such as sickle cell trait) or failure to acknowledge mild illness. During 1986 in the Nelspruit region, 408 probably

asymptomatic infections were found among local residents. A further 769 asymptomatic infections were found among 3425 Mozambican migrants (22,45%).

In Venda during 1986, case investigation detected 50 infections (0,19% positive) and a special survey four infections (0,04% positive). Of 841 malaria IFA tests, 26 were positive, and of these, four were from confirmed malaria infections, 19 from case investigation smears and three from active surveillance; the latter 22 were not confirmed by blood smear examination. Of these 22 positive IFA tests, 18 were aged below 20 years, suggesting that there has been considerable recent exposure to malaria.

In Gazankulu during 1986, the number of infections detected by active surveillance and positivity of blood smears correlated with the number of infections in Mozambican migrants; 660 infections were found on active surveillance out of a total of 1161, and 473 were imported, suggesting

that 80 asymptomatic infections were found among local residents.

In Natal in 1985, a total of 942 infections was found by active surveillance, 521 (55,3%) were asymptomatic and only 49 (5,2%) were definitely of local origin, suggesting that asymptomatic infections were due to previous malaria infection in Mozambique.

In KwaZulu total malaria infections increased from 1147 during 1985 to 22 366 in the first six months of 1987. Infections found by active compared with passive surveillance decreased from 75,3% to 43,4%, especially those detected by house to house visiting and mass surveys. The positivity found in a mass survey was high (2,63%), suggesting a high proportion of asymptomatic infections or greater migration from Mozambique than estimated. In all areas a considerable reservoir of asymptomatic malaria infections exists. Antibody surveys are required to estimate their true extent.

BOOK REVIEWS/RESENSIES

Seeing how we got here

The Age of Science: The Scientific World-view in the Nineteenth Century. By David Knight. (Blackwell, Oxford)

Dr D.M. Knight is senior lecturer in the History of Science at the University of Durham, and has written several books dealing with aspects of this subject over the period 1600–1900. The present work is scholarly, handsomely produced in clear, comfortably legible type and attractively though slightly sparsely illustrated. (I regretted the omission, from the body of the text, of pictures of some of the leading scientific figures of the day.)

The scope of this treatise is enormous. It attempts to cover and interconnect the principal aspects of all fields of scientific endeavour from the time of the French Revolution to the dawn of the present century, and in fact to explore beyond the domain of natural philosophy proper into the realms of theology, spiritualism and psychic phenomena, inasmuch as these experienced the impact of the scientific revolution of the nineteenth century. The author explains his purpose on p. 9:

The story told here is not simply that of the progress of a triumphal chariot rushing towards our own day; rather it is an essay towards placing science in the cultural context of the nineteenth century, in the belief that it occupied a place of paramount importance.

He warns that because of the magnitude of the task, an essay has been presented 'in an enormous sphere where a full treatise would be impossible', and that selection based upon personal preference, interest and knowledge was therefore inevitable.

The book opens with a description of the enormous impetus to scientific development provided by the French Revolution, both in French response to the missionary zeal and sense of liberation in all intellectual spheres encouraged by the new movement, and in British reaction to what was seen as a savage, hostile and atheist power, intent upon spreading social disorder and national instability. The chapter 'Rivalry with the French' contrasts the methods,

ultimate aims and style of scientific enquiry in the two countries. As particular examples of leading scientists, the endeavours of Humphry Davy and Gay-Lussac are described in some detail, in an age when French science was still pre-eminent in chemistry and mathematics, and strenuous efforts were being made across the Channel to close the gap. The next chapter, 'Wrestling with God', covers very different ground: the work of William Paley, William Buckland, Charles Lyell and others in natural history, palaeontology and geology in an age when fairly comfortable co-existence between scientists and orthodox churchmen in England was still possible. The influential and important Bridgewater Treatises, which attempted to cement a sort of coalition between contemporary science and theology on the basis of reason, observation and reasonableness, are described in some detail. Ominous precursors to T.H. Huxley and Charles Darwin were, however, already on the horizon.

'The German Challenge' describes the very different empirical and experimental background and approach to science in Germany, still to be united in one country, from that of the French academies and British societies. Deeply influenced by serious philosophers like Goethe and Kant and initially highly speculative and metaphysical, the German scientific establishment was in due course transformed by the middle of the century into a power house of university centres of experimental investigation, far more systematically organised and substantially funded than in Great Britain, and where sound training was offered in experimental chemistry and physics at a time when British universities still adhered to the ancient models of purely mathematical and theoretical degrees.

'Arguing with Sceptics' describes the systematic elimination of dubious and heretical areas of pseudo-science such as physiognomy and phrenology from the corpus of orthodox scientific opinion, the gradual tightening and formalising of valid 'entrance qualifications' required for any purported area of scientific enquiry to gain acceptance into the recognised body of

science proper. The hypothesis of the existence of atoms, and their rôle as the basic constituents of matter in all forms, was one doctrine which did succeed in gaining the status of orthodoxy, despite strong opposition by many chemists. This was due in part to the work of John Herapath, Rudolf Clausius, Clerk Maxwell and William Thomson (later Lord Kelvin). Incidentally, the discussion of elasticity and inelasticity in atomic collisions, on p. 84, although linguistically reasonable, is flawed in terms of accepted terminology in physics.

The 'Debate about Animals' breaks into the period of greatest conflict between scientific and orthodox religious opinion. Many readers will find the study of the predecessors of Darwin, namely Georges Cuvier, J.B. Lamarck, Richard Owen, William Swainson and others, highly informative in providing a new perspective on evolutionary thought. 'Discourse in Pictures' and 'Scientific Culture' provide lighter interludes on social aspects of science. The 'Battle of Symbols and Jargon' describes the vital role of symbolism in the growth of scientific theory and practice to maturity, and 'The Triumphal Chariot' the pinnacle of material achievement, success and recognition attained by science towards the end of the last century.

In their response to 'Wrestling with the Unknown', scientists remained divided, however. Some scientific popularisers like W.K. Clifford held vehemently anti-religious opinions, some eminent physicists like John Tyndall, professor at the Royal Institution, were courageously agnostic, while others like Balfour Stewart and Peter Guthrie Tait, joint authors of *The Unseen Universe*, produced thoughtful studies which aimed to show that modern science did not require the abandonment of traditional Christianity and especially the belief in eternal life. Incidentally, the brief discussion of the contributions of the great John William Colenso, Bishop of Natal, to these questions is disappointingly incomplete, and no mention is made of his excommunication from the Church on grounds of heresy.

Towards the end of the book, attention is devoted to the most interesting group of men and women who formed the Society for Psychical Research. Here again, there are disappointing omissions of important detail: the apparently random assortment from all walks of intellectual life has a

closer semblance of order when one realizes that Lord Rayleigh (J.W. Strutt) was married to Evelyn Balfour, a sister of the statesman Arthur James Balfour, (first Earl Balfour), while his other sister, Eleanor Mildred Balfour; for a number of years Lord Rayleigh's scientific assistant, was married to Henry Sidgwick, Professor of Moral Philosophy at Cambridge. There were thus close family and social ties between several prominent members of the Society.

This ambitious work literally peters out, perhaps from exhaustion, at the end of its shortest chapter, 'Science Comes of Age', with the slightly mundane concluding sentences:

The great problem which the Age of Science has bequeathed to us sorcerer's apprentices is perhaps that of specialization, which solved problems our ancestors inherited, but leaves us alienated. There is no easy solution, but seeing how we got here is a help (p. 212).

A battery of references is provided under 'Further Readings' and in the notes to each chapter. These are, however, mainly books, usually published this century, and very little mention is made of primary source material.

This is undoubtedly a worthwhile book, conveying much information and providing many insights which readers will find new and thought-provoking. Its biggest drawback, in my opinion, is the author's style of writing, never easy at the best of times, heavy and turgid in places. Sentence structures are often long and complex, containing contrasting ideas juxtaposed in an unfortunate way which compel slow and laboured reading. In each chapter, a labyrinthine jungle of facts, ideas, analysis and discussion of such density is created that many of us would be hard put to summarize the main thread of the argument on each page, on putting the book aside. The essential ingredients which distinguish a great from a competent and substantial work, have escaped detection on my part.

J.D. Hey

Department of Physics,
University of Cape Town.

History of hydraulics

Hydraulics and Hydraulic Research. A Historical Review. Edited by Günther Garbrecht. Pp. 362. (Balkema, Rotterdam)

This book is based on papers presented at a two-day symposium held in April 1985 in West Berlin to commemorate the 50th birthday of the International Association of Hydraulic Research (IAHR), preceded by a two-day workshop on Great Names in Hydraulics. It opens with editor Garbrecht's masterly review of water resources development from 5000 to 600 BC in the four main centres of early civilization—the valleys of the Nile, Indus and Yellow rivers, and Mesopotamia (Euphrates/Tigris). It was only through water management systems that these first great civilizations

could flourish. From 600 to 100 BC came the Greek contributions to hydraulics and hydrology, followed by those of Rome from the first century BC to about 500 AD, also traced in interesting fashion by Garbrecht, with a section on each of the great names—perhaps the greatest being Frontinus.

A chapter by Macagno, of Iowa Institute of Hydraulic Research, on the genius of Leonardo da Vinci is followed by one by Fasso of Milan Polytechnic with further fascinating detail of da Vinci's work. The Italian School of Hydraulics in the 16th and 17th centuries features the work of Galileo, Castelli, Torricelli and other famous scientists. A whole chapter is devoted to the amazing young Torricelli, who for a short time brought such comfort to the ailing Galileo until his death in 1642. Torricelli's well-known experiments with barometric pressure, projectiles and jets are described.

Thirriot of Toulouse Polytechnic puts into perspective the development of hydraulic research in France during the 17th and 18th centuries. The scene is of course dominated by the work of the Swiss scientists, the Bernoullis and Euler, but many other famous names appear: Pascal, Pitot, d'Alembert, Borda, Coulomb, Lagrange and Navier and much of the work is related to that of Isaac Newton. A chapter by Daniel Vischer of ETH, Zurich, is devoted to the biographies of the Bernoullis and Euler, bringing out the importance of their concepts and of course the familiar Bernoulli and Euler equations. An account of advances in hydraulics and fluid mechanics in the 19th century in each of France, Britain, Germany and the USA brings to light another string of famous names: Froude, Stokes, Reynolds, Rehbock, Prandtl, Francis, Pelton, Freeman, Manning, Joukowsky and many others.

Professor Jim Dooge, himself famous, writes about his renowned countrymen, the Malvany brothers and Manning—Malvany junior for his Rational method for estimating small-catchment flood peaks and Manning for his widely used channel flow formula. Dooge follows with an erudite outline of the development of concepts in open channel flow from the first century AD to the 1930s—which he takes to be the beginning of modern techniques.

There are chapters on Chinese river engineering and valuable advances in river hydraulics by Hungarian, Czechoslovakian, Rumanian and Austrian engineers. There is a section on great contributions to the early development of hydraulic machinery. Only towards the end of the book, however, is the impact of the famous German engineers discussed—a chapter each on Weisbach and Engels, Theodor Rehbock and Prandtl.

Hunter Rouse outlines the outstanding contributions of five famous international Americans: Freeman, Bakhmeteff, Straub, Knapp and Ippen. This is followed by Rouse's own scholarly review of the rise of fluid mechanics, written with his customary flair and full of anecdotal interest. As might be expected, his former colleagues,

Jack Kennedy and Enzo Macagno, provide an enchanting biography of the great teacher himself. It is left to engineers from one of the most famous hydraulics laboratories, Delft, to write on flow simulation, culminating in numerical simulation of wave run-up and large-eddy turbulence.

The book offers fascinating reading and provides a sound perspective of the significance of contributions associated with each of the great names. Of particular interest is the wealth of personal biographical and anecdotal material. There are gaps of course—few contributions from the USSR and China, none from India, Egypt and the southern hemisphere and, except in Kennedy's brilliant closure on trends towards the year 2000, little about the development of modern sophisticated hydrological and hydraulic modelling techniques. Particularly timely is Professor Kennedy's appeal to academics to spend less time on topics of limited practical value and to devote more time to such efforts as putting into usable form the tremendous volume of research material already published; also, his plea for professors to acquire adequate practical experience.

D.C. Midgley

Professor Midgley is the former director of the Hydrological Research Unit at the University of the Witwatersrand.

Fire in the fynbos

Disturbance and the Dynamics of Fynbos Biome Communities. Edited by R.M. Cowling, D.C. Le Maitre, B. McKenzie, R.P. Prys-Jones and B.W. van Wilgen. South African National Scientific Programmes Report No. 135. (CSIR, Pretoria).

In 1986, the researchers of the Fynbos Biome Project met to attempt to consolidate ten years of research under the heading *Disturbance and dynamics of fynbos biome communities*. Fire in fynbos usually is a stochastic event in all respects, except for some seasonal variation. By definition, stochastic events are extremely difficult to include in any form of model. Yet fire happens to be the major disturbance factor in fynbos, and has been suitably selected as the theme of this recent publication of invited papers from the 1986 meeting.

The contributions range from reviews to research papers. They cover: fire regimes; life history strategies; canopy- and soil-stored seed bank dynamics; small-mammal community dynamics; and ecosystem nutrient dynamics.

The publication has two aims, one stated and the other implied. The stated aim is to provide 'undergraduate and early post-graduate ecology students with a summary of research results and questions which may stimulate them to explore further'. Considering the duration and scope of the project, it is intriguing why such a modest approach has been taken, especially when the implied aim is considered.