

Parasitological Society of Southern Africa

The following are abstracts of papers presented at the Annual Scientific Meeting of the Society held at the Veterinary Research Institute, Onderstepoort, on 5 and 6 July, 1983.

Parasitologiese Vereniging van Suidelike Afrika

Die uittreksels van referate wat tydens 'n Jaarlikse Wetenskaplike Vergadering van die Vereniging, op 5 en 6 Julie 1983, by the Navorsingsinstituut vir Veeartsenykunde, Onderstepoort, aangebied was, word hieronder aangegee.

Pathology Caused by the Migration of the Larvae of *Taenia multiceps*

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The pathology caused by the migration and development of the larvae of *Taenia multiceps* in sheep was studied. Lambs 4–6 months old were dosed with different numbers of viable ova to precipitate infestations of acute, subacute and chronic natures. Lesions were found in the skeletal muscles, heart, kidneys, liver, pancreas and central nervous system.

Early lesions were characterized by tortuous necrotic migratory tracts often situated in close association with blood vessels. In extraneural localities the lesions gradually progressed to granulomas containing necrotic debris in the centre. Resolution of these extraneural lesions resulted in either calcification or focal accumulation of lymphocytes. Metacestodes associated with extraneural lesions did not develop into coenuri.

Acute lesions in the central nervous system were characterized by trauma to the brain tissue and necrosis of blood vessel walls. The vascular lesions led to hypoxic polioencephalomalacia. Mature coenuri caused atrophy, leukoencephalomalacia and fibrosis of adjacent brain tissue.

First Record of *Stilesia globipunctata* in the Republic of South Africa

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Stilesia globipunctata was recovered from a full-mouthed ewe on a farm in Heidelberg, Cape Province. The scolices of the cestodes were imbedded in nodules situated in the duodenum and tapeworm strobila up to 20 mm long protruded from them. Preliminary identification (including scanning electron microscopy) as *S. globipunctata* was confirmed after further specimens from the same farm were examined in detail.

Vergelyking van Gelatien Kapsules en 'n Water Suspensie vir Toediening van Vriesbewaarde Besmetlike *Trichostrongylus* spp.

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Gelatien kapsules word algemeen vir per os dosering van verskeie soorte nematood besmetlike larwes (L_3) aan herkouers, gebruik [Reinecke R. K. (1973). The larval anthelmintic test in ruminants. *Tech. Commun., Dept. Agri. Tech. Serv., Rep. S. Afr.*, No. 106].

Ontskede bevrore L_3 van *Trichostrongylus colubriformis* en *T. falculatus* wat na ontdooring op filtreerpapier gekonsentreer en per os in gelatien kapsules aan skape toegedien word, is egter voorheen bevind baie swak lewensvatbaar te wees.

By mondelinge dosering het vriesbewaarde L_3 van *T. falculatus* in water suspensie egter betekenisvol beter ontwikkel as die wat in gelatien kapsules toegedien is. Daarteenoor het vooraf stimulering van die slukderm groefrefleks met CuSO_4 by nog die kapsules nog suspensie betekenisvolle verskille in ontwikkeling van *T. falculatus* tot gevolg gehad.

Verdere vergelykings van ontwikkeling van onbevrore, beskede L_3 behoort ook gedoen te word.

Efficacy of Ivermectin against the Migrating Stages of *Strongylus vulgaris* in Ponies

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The efficacy of ivermectin paste formulation was evaluated against the migrating larvae of *Strongylus vulgaris*. Twelve crossbred Shetland ponies, naturally infested with parasites, were restrictively allocated to six replicates of two animals each according to live mass and sex. Within each replicate, animals were randomly allocated to one of the following treatment groups: (a) ivermectin paste at 200 mcg/kg in a paste formulation, orally once; (b) vehicle-treated controls.

Ponies were slaughtered either 27 or 35 days after treatment. The complete mesenteric arterial system of the colon and caecum and the aorta, including portions of its other major abdominal branches, were dissected and examined for the presence of larvae. All larvae were removed, counted and identified. Vascular lesions were sectioned for histopathological examination.

Relative to the vehicle treated controls, ivermectin paste was 100% effective ($P < 0.05$) in reducing the number of 4th stage *S. vulgaris* in the blood vessels of treated ponies. Fifth stage *S. vulgaris* was reduced by 88% but the numbers present were too few for meaningful statistical evaluation.

Arterial lesions caused by migrating *S. vulgaris* were found in all ponies. The lesions, which were detected mainly in the vicinity of the ileocolic artery, consisted of a macroscopically marked thickening of the wall and irregular appearance of the intima. There were no significant difference ($P > 0.10$) between treatment groups for arterial lesion size. Microscopically, the vascular changes were characterized by marked fibroplasia, especially of the intima, but also the *tunica media* and serosa. Granulomas, some of which contained larvae, were seen in the vascular walls of both treated and control animals. All these larvae were dead and showed evidence of disintegration. Acute focal necrosis of the intima was present in the vascular walls of the vehicle-treated control ponies; with one exception, similar lesions were absent in the ivermectin-treated ponies. An increased cellular infiltration (eosinophils, neutrophils, lymphocytes, plasma cells and macrophages) of the intima and *tunica media*, was also observed in the controls relative to the treated ponies.

It was concluded that treatment with ivermectin was highly effective against arterial stages of *S. vulgaris* larvae in ponies, and resulted in the recovery of the acute vascular lesions.

Seasonal Incidence of Lice and Other Arthropods in Springbok (*Antidorcas marsupialis*) at Benfontein, Kimberley

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In a preliminary trial six springbok were shot in July 1979 at the farm Benfontein, Kimberley, and from November 1979 to December 1980 3 to 5 animals were shot every 6 weeks. The hide and feet were placed in separate plastic bags containing a solution of 20 ml Triatix (Coopers) in 10 litres of water, and 24 hours later they were scraped with steel brushes, the scrapings sieved (150 μm apertures) and the residues placed in jars and preserved in 2% formalin. The skull was sawn down its length and searched for larvae of *Rhinoestrus* spp.

Table 1. Arthropods recovered from 42 springbok at Benfontein, Kimberley.

Arthropod	No. of animals infested
Lice	
<i>Damalinea</i> sp.	41
<i>Linognathus antidorciis</i>	42
<i>L. armatus</i>	24
<i>L. bedfordi</i>	12
<i>L. digitalis</i>	7
<i>L. euchore</i>	27
Ticks	
<i>Amblyomma hebraeum</i>	2
<i>Rhipicephalus evertsi evertsi</i>	22
Nasal botflies, 2nd and 3rd instars	
<i>Rhinoestrus antidorciis</i>	9
<i>R. vanzyli</i>	10
Louse flies	
<i>Hippobosca rufipes</i>	2
<i>Lipoptina sepiacea</i>	16

The arthropods recovered are listed in Table 1. The mean number of lice at each slaughter ranged from 52 to 990 and the total per animal from 1 to 1 672. Lice burdens fluctuated, reaching a minor peak in February 1980 to fall in autumn and thereafter rose steadily, reaching a peak in September to fall markedly thereafter. Both adults and nymphs were responsible for these fluctuations. The dominant species were *Linognathus antidorciis* and *Damalinea* spp.

Nasal botflies had a minor peak in January, disappearing from February to May, rising in June to a peak in August, followed by a marked fall in September. They were absent from October to December.

The other arthropods were present in such small numbers that no seasonal trends could be established.

Comparison of Parasites in Burchell's and Mountain Zebra

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The nematode burdens and diversity of species in Burchell's zebra (*Equus burchelli*), Mountain zebra (*Equus zebra hartmannae*) and horses from different locations in Southern Africa were compared. In South Africa, the Burchell's zebra were collected in the Kruger National Park and locations in Namibia, including the Etosha National Park, the Pro-Namib Naukluft reserve area and a farm outside Windhoek. Both Burchell's and Mountain zebra were collected from the same habitat in the Etosha Game Reserve. The nematode families recovered included Strongylidae (Strongylinae and Cyathostominae), Atractidae and Spiruridae.

The highest moisture conditions occurred in the Kruger National Park and the greatest diversity of species and highest burdens were found there. The equids in Namibia were collected during a period of drought and these animals showed less diversity and smaller worm burdens. Parasite families with life-cycles dependent on conditions outside the host (Strongylidae, Spiruridae) predominated in the wetter environment, while those with life cycles completed inside the host and therefore less dependent on external conditions (Atractidae) were predominant in the arid environment. In times of severe drought the numbers of all parasites were greatly reduced.

The specimens of *Habronema muscae* examined agree with previous descriptions of this species isolated from the horse except that the spicules are shorter. Investigations are in progress to determine if this discrepancy is a result of host differences.

Effects of Drugs on Experimental Hepatic Capillariasis in Mice

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Capillaria hepatica is a nematode parasite with a unique life-cycle. The adult worms inhabit the liver of the host animal, where the females lay their

eggs. These ova are released into the environment only if the host dies and its body disintegrates. Eggs may also be released by cannibalism or carnivorousness, the non-infective eggs being passed out in the faeces of the animal that ingests them. After a period of embryonation, the eggs are able to infect a new host.

Rodents are important reservoirs of *C. hepatica*. Markus and Yeo [unpublished data] examined the livers of 235 black rats (*Rattus rattus*) on the Witwatersrand and found the prevalence of infestation to be 58%. In some places, almost all rats were infected, while in other localities, few rats harboured the parasite. The bigger the rat population in a confined area, the greater appeared to be the prevalence of *C. hepatica* infestation. Where infected rodents live in close proximity to man there is, therefore, the possibility that the latter may ingest *C. hepatica* ova.

Three South African cases of human liver infestation with *C. hepatica* have been published [Cochrane and Skinstad (1960). *S. Afr. med. J.* 34, 21; Kallichurum and Elsdon-Dew (1961). *Ibid.* 35, 860; Silverman, Katz and Levin (1973). *Ibid.* 47, 219]. Virtually nothing is known about the treatment of hepatic capillariasis in man, a disease which is often fatal. In the work reported here, fourteen compounds which have already been marketed as successful anthelmintics, were tested in experimental white mice of the Swiss-Webster strain for their action against *C. hepatica*. The effects of most of these drugs on *C. hepatica* had not previously been determined. The compounds were: albendazole, amosanate, febantel, mebendazole, niclosamide, oxamniquine, oxfendazole, oxclozanide, piperazine adipate, piperazine citrate, piperazine dihydrochloride, praziquantel, pyrantel pamoate and rafoxanide. Four of these anthelmintics prevented the deposition of eggs of *C. hepatica* in mouse liver. The levels at which the four drugs were effective in preventing more than 99% of egg deposition were: albendazole, 30.0 mg/kg; febantel, 30.0 mg/kg; mebendazole, 3.13 mg/kg; and oxfendazole, 12.5 mg/kg. Of these compounds, mebendazole is at present the only one which is marketed locally as a preparation for human use, and our application of five daily doses at 3.13 mg/kg is within the recommended dose range. The effectiveness of mebendazole in our experiments confirms the findings of Lämmle and Grüner [(1976). *Berl. Münch. Tierärztl. Wschr.* 89, 222], who used the multimammate mouse *Mastomys natalensis* as a host animal.

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Sarcocystis Infection in Wild Southern African Birds

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The present survey was carried out because nothing is known about the prevalence of *Sarcocystis* in wild African birds. Skeletal muscle from 1511 individuals of 279 species (representing 64 families) was examined histologically. Muscle samples were obtained mainly from road casualties, fixed specimens, birds which had died at the SPCA bird hospital in Johannesburg, or deep-frozen birds at the Transvaal Museum, Pretoria.

39 individuals of 24 species (representing 19 avian families) proved to be infected with *Sarcocystis*. The species concerned were (the number of individuals infected, followed by the number examined, is given in brackets for each host species): northern giant petrel *Macronectes halli* (1/1), little egret *Egretta garzetta* (1/2), yellowbilled egret *Egretta intermedia* (1/2), cattle egret *Bubulcus ibis* (4/22), blackcrowned night heron *Nycticorax nycticorax* (1/1), hadeda ibis *Bostrychia hagedash* (1/6), Swainson's francolin *Francolinus swainsonii* (3/8), purple gallinule *Porphyrio porphyrio* (1/3), spotted dikopp *Burhinus capensis* (4/10), subantarctic skua *Catharacta antarctica* (1/2), laughing dove *Streptopelia senegalensis* (3/70), diederik cuckoo *Chrysococcyx caprius* (1/4), barn owl *Tyto alba* (1/13), spotted eagle owl *Bubo africanus* (1/14), whiterumped swift *Apus caffer* (2/31), brownhooded kingfisher *Halcyon albiventris* (1/8), lilac-breasted roller *Coracias caudata* (2/4), redbilled hornbill *Tockus erythrorhynchus* (3/14), yellowbilled hornbill *Tockus flavirostris* (2/4), Natal robin *Cossypha natalensis* (1/1), longtailed shrike *Corvinella melanoleuca* (1/9), bokmakierie *Telophorus zeylonus* (1/5), Burchell's starling *Lamprolornis australis* (1/10) and Cape glossy starling *Lamprolornis nitens* (1/9). Cardiac muscle from a number of birds found to have sarcocysts in skeletal muscle was subsequently examined, but in no case was the organism detected in the heart as well.

Approximately six different species of *Sarcocystis* could be distinguished on the basis of the fine structure of the cyst wall. Morphologically similar

cysts of a particular type occurred in unrelated hosts — for instance, that first seen in the spotted dikkop [Kaiser and Markus (1981). *Proc. Electron Microscop. Soc. sth. Afr.* 11, 115] was also present in the laughing dove, lilac-breasted roller, redbilled hornbill and yellowbilled hornbill (and possibly in one or two of the other host species as well). The ultrastructural findings, which will be discussed in more detail elsewhere, provide further evidence that species of avian *Sarcocystis* can have a loose host specificity [Box and Smith (1982). *J. Parasit.* 68, 668].

This work was supported by the CSIR. We thank various colleagues and institutions for donating material — in particular, the bird department of the Transvaal Museum, Pretoria and the SPCA bird hospital, Johannesburg.

Domestic Dog as a Final Host of *Sarcocystis* of the Mountain Zebra *Equus zebra hartmannae*

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We have recently found that the electron microscopic structure of the cyst wall of *Sarcocystis* microcysts of both Burchell's zebra (*Equus burchelli*) and the Mountain zebra (*Equus zebra hartmannae*) resembles that of domestic horse *Sarcocystis*. Whether more than one species of *Sarcocystis* occurs in the horse is not at present clear [Hinaidy and Loupal (1982). *Zbl. VetMed.* B29, 681; Matuschka (1983). *Z. Parasitenk.* 69, 299]. Since the domestic dog is known to be a final host of horse *Sarcocystis* in Europe and the USA, it was decided to attempt transmission of zebra *Sarcocystis* to the dog.

Sarcocystis-infected Mountain zebra meat collected in the vicinity of Windhoek, Namibia, was fed to four coccidia-free puppies which had never eaten raw meat, namely two from each of two litters. A litter-mate puppy from each litter was used as a control animal. The faeces of the control puppies were examined daily for seven weeks after commencement of the experiment. They remained coccidia-free throughout this time. Sporulated oocysts of *Sarcocystis* were present in the intestinal villi of two experimental puppies examined after 9.5 days, although stages of the parasite had not yet appeared in their faeces. The prepatent period in the other two experimental puppies was more than 9.5 but less than 10.5 days. Fifteen sporocysts measured $12.3 \times 9.2 \mu\text{m}$ (range $10.9 - 13.1 \times 8.9 - 9.5 \mu\text{m}$).

Oocysts and sporocysts were harvested from the intestinal mucosa of the experimental puppies by a modification of the technique used by Heydorn, Haralambidis and Matuschka [(1981). *Berl. Münch. Tierärztl. Wschr.* 94, 229]. These sporocysts will be used for attempted transmission of zebra *Sarcocystis* to the domestic horse.

This is the first time that the question has arisen of whether *Sarcocystis* of a domestic animal may in some areas have a wild animal reservoir host. The black-backed jackal *Canis mesomelas*, a scavenger, may prove to be a final host of zebra *Sarcocystis* under natural conditions.

This work was supported by the Department of Agriculture and Fisheries and by the CSIR.

Anopheles merus Donitz: Its Distribution in South Africa and Factors Affecting its Distribution

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Anopheles merus is a salt-water breeding mosquito of the *A. gambiae* complex. In East Africa, field work has shown this species to be a low-rate malaria vector and an efficient vector of bancroftian filariasis. However, very little is known in regard to this species in South Africa.

Twenty-three distributional records exist for this species in this country. This distribution is contained by the 16°C Effective Temperature isoline, an area that by definition experiences an excess of 254 days a year when the mean temperature is > 16°C. A further factor that is considered to be of major importance in their distribution is their salt-water breeding habit. *A. merus* has never been found breeding in fresh water in the wild. Laboratory experiments have shown that first instar larvae have the lowest salinity tolerance of the larval stages, and can only survive in water up to 75‰ of sea-water (100‰ sea-water = 31.7 g NaCl per litre). This requirement limits the species from exploiting true salt-water habitats such as estuaries.

These data have further enabled the derivation of a salinity tolerance test

whereby larvae irrespective of instar can be specifically identified in respect to those of freshwater breeding *A. gambiae* s.l. Twenty-one of the distributional records for *A. merus* in this country are from Natal and two from the Transvaal. The Natal records occur within the area bounded by the sea in the east and the 16°C Effective Temperature isoline in the west. It is considered that this area favours *A. merus* distribution, due to the presence of Cretaceous marine deposits, which, where exposed, cause standing water to become saline. The two records from the Transvaal are both from saline waters associated with geothermal activity.

Aspects of the Ecology of the Fish Louse *Dolops ranarum* in the Transvaal

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The fish louse *Dolops ranarum* (Branchiura: Crustacea) is found widely distributed in various water bodies. The geographical distribution in the Transvaal, host preference and site specificity were studied and a seasonal investigation of its population dynamics in selected water bodies carried out.

It was found that *D. ranarum* parasitized mainly *Clarias gariepinus* and *Oreochromis mossambicus*. On the latter the parasites were restricted to the mouth and branchial cavity, whilst on *C. gariepinus* they were found mainly on the body surface. Although surveys were carried out at a variety of water bodies, this parasite was found only in dams in the Limpopo and Olifants river drainage systems.

A seasonal investigation showed that the infection rate was higher during autumn.

Trichodinid Ectoparasites of Fish in South Africa and Israel

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South Africa and Israel are located at the extreme limits of the Afro-tropical region and show great similarities in fish fauna and climatic conditions. A study of ectoparasitic Protozoa of these two countries was carried out in which the trichodinid ectoparasites (Peritricha: Ciliophora) were specifically identified, host-parasite relations examined and general biology of these parasites studied.

Eight species of the genus *Trichodina*, one *Tripartiella* sp. and one *Trichodinella* sp. were identified, including three new species. Two species were found exclusively in Israel, two in South Africa, while ten species were found in both countries.

Experimental Evaluation of Formalin Treatment for Ectoparasitic Protozoans of Fish

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Mortalities amongst *Oreochromis mossambicus* (Peters) and *Cyprinus carpio* L. fry from the Lowveld Fisheries Station occurred during October 1982 and were found to be due to severe infestations by various species of *Trichodina* Ehrenberg, 1938, *Chilodonella hexatracha* Kiermik, 1909, *Ichthyophthirius multifiliis* Fouquet, 1876 and sessile ciliates. Laboratory experiments were carried out to determine the lowest effective concentration of formalin as indefinite treatment. It was found that *C. carpio* responded to a treatment of 25 mg/l of formalin, whereas *O. mossambicus* required 40 mg/l to eradicate trichodiniasis. A concentration of formalin as high as 100 mg/l, however, proved ineffective for the treatment of encysted *I. multifiliis*.

Substrate Preference of Ectoparasitic Sessile Ciliates

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Sessile ciliates (Ciliophora: Peritricha) have been found to cause lesions on fish which can result in mortalities. It is well known that sessile ciliates representative of many genera are found widely distributed in fresh water. A study of the sessile ciliates of a small impoundment was carried out to

determine which species were associated with fish and to establish the substrate specificity of sessile peritrichians under natural conditions.

A total of 15 species were identified including four new species. They were found attached to plant material, snails, insect larvae, crabs, fish and inanimate substrates placed in the impoundment. Representatives of the following genera were found on fish: *Ambiphrya*, *Apiosoma*, *Epistylis* and *Scyphidia*. They are specific to fish and differ significantly from the other species in their morphology.

Clinostomatid (Trematoda: Digenea) Infections of Fish in the Transvaal

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During a harvesting programme of fish in impoundments in Venda and Lebowa, northern Transvaal, surveys were carried out to determine the extent and prevalence of clinostomatid metacercarial infections. The water bodies were found to be extremely favourable habitats for various snail species, some of which act as the intermediate host for larval trematodes. Specimens of *Oreochromis mossambicus* (Peters) in the impoundments investigated were infected by *Clinostomum tilapiae* Ukoli, 1966 and *Euclinostomum heterostomum* (Rudolphi, 1809), which were found encysted respectively in the gills and muscles of the fish.

The presence of these parasites has numerous implications in that they can cause mortalities amongst fish and are undesirable in food, thus leading to a market resistance. Reports have shown that humans have, in exceptional cases, harboured clinostomatid trematodes.

Antigens to *Cysticercus cellulosae* and Their Use in a Serological Test

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Immunoglobulins were isolated from the serum of humans and pigs infected with *Cysticercus cellulosae*. These antibodies were coupled to Sepharose 4B and used in the immuno-affinity chromatographic preparation of antigens of these cysts. Antigens isolated in this manner were characterized by sodium dodecyl sulphate electrophoresis.

In human sera there were antibodies to at least 11 components, and 9 peptides were isolated using porcine immunoglobulins. The most prominent immunogen in both pig and human preparations had a molecular weight of the order of 170 000. The majority of peptides from the two preparations coincided, suggesting similarity, although in the case of the human preparations, antigens with estimated molecular weights of 40 000 and 160 000 were also found.

These preparations have been used in an ELISA test to assess their relative usefulness in the serological detection of cysticercosis. The pure antigens gave a higher detection rate than a crude antigen preparation but also displayed a higher incidence of apparent false positives. This aspect is being investigated further.

Methodology for Testing Cestocides in Sheep

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In South Africa, cestocides are tested in naturally infested lambs but the critical trial design which is usually followed presents a number of problems. Thus for instance lambs are often infested with more than one of the genera *Moniezia*, *Avitellina* and *Thysaniezia*, but only *Moniezia* and to a lesser extent *Thysaniezia* can readily be diagnosed in the live animal.

It is important to determine which cestodes are present in the trial animals because, in a critical trial, excreted strobilae may be digested to the extent where they are unidentifiable so that the spectrum of activity of the test compound cannot be determined with certainty.

A critical double control trial procedure is more appropriate than a critical trial because untreated animals are slaughtered on the day of treatment as well as on the day of slaughter of the treated group. This design also allows for the detection of immatures and these can be identified by scanning electron microscopy and staining techniques.

The phenomenon of self-cure readily takes place when weaners infested with *Moniezia* are removed from grazing and transported to the laboratory. Self-cure takes place spontaneously and may resemble the effect of cestocidal treatment. In order to differentiate between this and a true drug effect, a staggered critical control trial design was tested.

On day one, seven untreated lambs were slaughtered, five were treated with a cestocide and the remaining six were left untreated as controls. On day two, three of the six controls were treated and on day three, the last three controls were treated. Faecal examinations were carried out on all lambs from day one to the day of slaughter and data on volume and lengths of strobilae, number of scolices and number of immature and adult cestodes were collected. This design ensured that controls were present parallel to any of the treated groups and therefore the time between treatment and excretion of strobilae in the faeces of all groups could be compared for all groups, thus indicating self-cure or drug effect.

Lungworms in Cats in South Africa

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A number of helminths may occur in the lungs of cats. *Toxocara cati*, other ascarids, *Ancylostoma* spp. and *Strongyloides* spp. migrate through the lungs as part of their life cycle, but it is the normal habitat of *Capillaria aerophila* and the genera *Paragonimus*, *Bronchostrongylus*, *Aelurostrongylus*, *Vogeloides* and *Anafilaroides*.

Paragonimus spp. have been recorded in domestic cats from Zululand, and *Bronchostrongylus subcrenatus* from a lion in the Kruger National Park. Recently we have found *Aelurostrongylus abstrusus* in cats in Pretoria and Durban and *Vogeloides* spp. was an incidental finding from the lung of a cat killed at the Pretoria S.P.C.A. *Anafilaroides* spp. and *Capillaria aerophila* have not yet been found in South Africa.

Some Aspects of Giardiasis in Zimbabwe

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Infection of children in two rural primary schools with intestinal parasites was considered with particular reference to water supply and nutritional status. The prevalence of *Giardia lamblia* was twice as high (20%) in the school where water was obtained mainly from boreholes and wells than in the school where water was obtained direct from rivers. The possibility of contamination of, and dissemination through, the communal water supply was discussed.

There was an association between giardiasis and under-nutrition in both schools. This was most marked in cases where the under-nutrition was severe, but was also noted in children showing evidence of chronic under-nutrition. The low prevalence of other intestinal pathogens in these children suggested a causal relationship. In a further study 10% of children admitted to hospital with severe diarrhoea harboured *Giardia lamblia*, compared with 2% of children admitted for other reasons.

The need for prompt diagnosis and treatment, and for more research into the epidemiology of giardiasis, was emphasized.

Efficacy of Oxfendazole against *Trichuris vulpis* in Naturally Infested Dogs

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Fourteen dogs naturally infested with *Trichuris vulpis* were used to compare the efficacy of oxfendazole with that of mebendazole. Six dogs were treated with 10 mg/kg oxfendazole daily for 5 days and another 6 with 20 mg/kg mebendazole for 5 days; two animals acted as untreated controls. Faecal examinations were carried out at intervals from 7 to 59 days after treatment. Three of the six dogs in each treated group were negative for 5 weeks after treatment. However, neither mebendazole nor oxfendazole was fully effective against the immature worms, since eggs occurred in the faeces within three weeks of treatment.

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Spurious Human Infection with a Trypanorhynchid Tapeworm

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A nine-year-old boy passed a 'worm' in his faeces. The organism, which measured 29 mm long after preservation in 5% glycerine-alcohol, was divisible into two regions. The posterior part, which consisted of a body or strobila 29 mm long, was annulated and ovoid in section with a diameter of approximately 1.4 mm. The first-formed segment (pygidium) was retained. An unsegmented anterior holdfast or scolex which, with a maximum width of 4.3 mm was wider than the general width of the segments, constituted approximately one quarter the total length of the cestode. Four short globular tentacles bearing rows of similar hollow hooks projected anterior to two pairs of tumescent swellings on the holdfast. These fleshy margins (bourrelets) partially obliterated a pair of longitudinal grooves (bothridia) in which the tentacles lay, and continued to the anterior tip of the holdfast to join the corresponding margins of the opposite side.

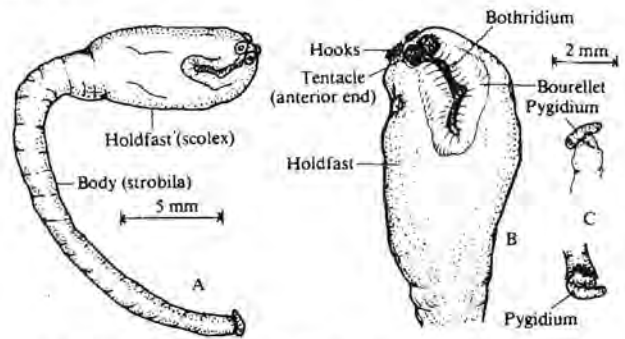


Fig. 1. *Hepatoxylon trichiuri*. A, Post-larva; B, holdfast; C, distal end of strobila.

The morphology corresponded to that of the post-larva of *Hepatoxylon trichiuri* (Holten, 1802), a common parasite in the viscera of teleosts and selachians, although the adults are seemingly restricted to selachian hosts [Wardle and McLeod (1952). *The Zoology of Tapeworms*. University of Minnesota Press, p. 302]. The child gave a history of eating fish whilst on holiday in Maputo. No further specimens were obtained.

Book Reviews

Measuring the Earth

Geodesy: The Concepts. By P. Vanicek and E. J. Krakiwsky. Pp. 691. (North Holland, Amsterdam; 1982) Approx. R140.

Occasionally there appears a publication which stands out from those of a similar kind in a particular discipline. The work under review is such a case and it represents a significant contribution to the better understanding of the principles and extent of modern geodesy. The numerous clear diagrams I encountered in an initial paging through the book give force to the old adage that a picture is worth a thousand words. Without reference to the text, the illustrations alone provide a useful visual summary of the contents. In their Foreword, the authors state their reasons for writing the book as being to provide conceptual cover of the entire subject of geodesy, including most recent developments, to 'demystify' the subject by clarifying the terminology, make it more uniform and remove those implicit ideas, currently extant, of separate physical and geometrical geodesies, marine geodesy, satellite geodesy and other, sometimes misleading, artificial subdivisions of the subject.

The subject matter is treated in six parts and there are good author and subject indexes. Comprehensive lists of references follow each part. Part I is introductory, comprising a brief history of geodesy, the relationship of geodesy to some of the other sciences, the mathematics of geodesy and the structure of the discipline. The reader who might look in the authors' treatment of the history of geodesy for some reference to the great geodetic arcs of India and Africa, will, however, be disappointed. Nor will he find any references to the names of men like de la Caille, Gill, Maclear and Struve, for in-

stance. I also noted a few statements in the historical introduction which appear to be at variance with those quoted by a number of other authorities. For example, in the text the originator of the hypothesis of continental drift, Wegener, is said to have been a geophysicist. According to Wilson *et al.* (1976), he is described as having been a successful astronomer and practising meteorologist. Later, in the same section the French physicist Foucault is credited with having invented the gyroscope. This is not strictly correct. While Foucault is normally credited with having invented the word 'gyroscope' in 1852, the instrument known today by that name was first constructed by Professor von Bohnenberger of Tübingen some time before 1813 (cf. von Bohnenberger, 1819; Strasser, 1969). In clarification of the relationship between geodesy and surveying, the authors have written, 'Surveying is the practice of positioning and geodesy is the theoretical foundation of surveying. For centuries, the role of geodesy was to serve mainly mapping — an end many people still regard as the major purpose of geodesy. This reduction of geodesy to control surveying . . . is not correct.' These remarks are entirely consonant with my own views on the matter.

In the text, geodesy is divided into three fundamental parts, namely, positioning, the earth's gravity field, and temporal variations, components which are in keeping with the modern understanding of the nineteenth-century geodesist Helmert's original definition of the subject. Two other parts are also included, one devoted to the earth and the other to methodology. The part about methodology gives an overview of the methods of adjustment theory and statistics used in geodesy. There are five sections in this part, the first dealing with numerical analysis procedures usually followed when

performing a geodetic task. This is followed by a treatment of mathematical modelling and then by two further sections on the characteristics of observations as isolated observables and vectors of observables. There is also a chapter on the assessment of results, which includes four tables of useful statistical tests. Any practitioner who might feel inclined to consult this work for procedural detail will be disappointed, instrumentation and measuring/observing techniques are not treated. This is a book about concepts.

Anyone wanting a clear and concise description of the earth and its motions will find it in Chapter 5. Chapter 6 provides a fine introduction to the gravity field of the earth, the geoid and deflections of the vertical. *En passant* it is remarked that the authors have contented themselves with quoting the 1967 International Gravity Formula in the face of more recently available information at the time the work went to press. The reader will also notice in Chapter 7 that the maps summarizing the state of world geodetic height and horizontal control networks is derived from 1971 U.S. Army Topographic Command information relating to 1970. No height networks, for example, are shown for Namibia. I wonder whether more up-to-date figures could not have been secured by the authors to illustrate this part of their text. Chapter 7 deals with the size and shape of the earth. Conventional attitude is adhered to here concerning the figure of the earth — it is assumed to be rigid and then temporal variations are treated separately. A clear explanation is provided of the concept of sea topography in relation to the geoid and its 'approximate coincidence' with sea level. Very little is given of the geometry of biaxial and triaxial ellipsoidal surfaces, which coincide very closely with the geoid. The har-