

The Parasitological Society of Southern Africa

The following are abstracts of papers presented at the Annual Scientific Meeting held at the Rand Afrikaans University, Johannesburg, on 29 and 30 June 1989.

Parasitologiese Vereniging van Suidelike Afrika

Die volgende is uittreksels van referate wat gedurende die Jaarlikse Wetenskaplike Vergadering op 29 en 30 Junie 1989 by die Randse Afrikaanse Universiteit, Johannesburg gehou is.

On the reproduction of *Dolops ranarum* (Crustacea: Branchiura)

Annemarie Avenant

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

In *Dolops ranarum*, two three-lobed testes are present in the male abdomen and are connected to the vesicula seminalis by means of two short vasa efferentia. Two vasa deferentia proceed from the vesicula seminalis to the gonopore and unite with the openings of the spermatophoric ducts. A spermatophore is formed when wall material from the spermatophoric gland is extruded through the gonopore. The secretions from both glands unite externally to form a spermatophore.

During copulation, the male grasps the female with the hooks on his maxillulae. Her fourth pair of legs are caught between his second and third pairs of legs and secured by the papilla on the third leg. The male folds his abdomen towards his thorax and removes the spermatophore. With the fourth pair of legs he manoeuvres the spermatophore onto the spermatophoric spines of the female.

Sperm move from the spermatophore to the spermathecae in the female's abdomen. She then undergoes ecdysis to rid herself of the spermatophore. During oviposition, each egg is pierced by both spermathecal spines and sperm are injected. Eggs are deposited in untidy rows and hatch after about 56 days.

The morphology of the digestive tube of *Argulus japonicus*, Thiele 1900 (Crustacea: Branchiura) in relation to the damage done to its host

Chantelle Baker, Annemarie Avenant and J.H. Swanepoel

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

Argulus, an ectoparasite of freshwater fish, inflicts mechanical injury on its host by means of the attachment organs and feeding activity. Attachment in branchiurans of the genus *Chonopeltis* is effected chiefly by means of the two sucking discs. In *Argulus* these are assisted by hooks borne on the antennules, antennae, maxillae and the minute spinules on the ventral parts of the body. Damage observed on the integument of the host is directly related to the feeding and attachment of *Argulus*. The penetration of the praecoral spine, as well as the lesions caused by the vacuum action of the sucking discs, are clearly visible.

The mouthparts consist of two separate organs, i.e. the praecoral spine and the proboscis, united at their bases. The inner portion of the praecoral spine is soft and flexible, and is folded upon itself when withdrawn. Wilson (1902) states that the spine is dropped down from its groove when intended for use, and pushed into the fish's skin by means of eversion. The chief use of the spine appears to be that of puncturing the skin and securing a strong flow of blood from the wound.

Strong striated muscles surrounding the oesophagus suggests that nutrients are ingested through the proboscis by means of suction and then passed to the crop. The oesophagus emerges into the crop as a funnel, and is regularly lobed. A continuous cuticle stretching from the oesophagus to the crop and enteral diverticles has not previously been observed in any *Argulus* species. The occurrence of vacuoles in the epithelium of the enteral diverticles suggests that absorption or secretion of some kind should occur. It therefore seems that the cuticle might be permeable as noted in other internal parasites.

Description of a distinctive type of *Sarcocystis* (Protozoa: Coccidia) in wild ungulates, and its significance

T.J.M. Daly* and M.B. Markus†

*Department of General Anatomy and †Department of Zoology, University of the Witwatersrand, P.O. Wits, Johannesburg, 2050.

Muscle sarcocysts of a distinctive ultrastructural type have been recovered from blue wildebeest *Connochaetes taurinus* from Natal, impala *Aepyceros melampus* from the eastern Transvaal and Zimbabwe, and a lechwe *Kobus leche* from Namibia. These cysts are ultrastructurally similar to one found in the diaphragm of a chamois *Rupicapra rupicapra* in Europe.¹ It has been generally assumed, on the basis of some early transmission experiments, that *Sarcocystis* is strictly specific for the intermediate host. However, the presence of the mushroom-shaped, morphologically similar cysts in different mammalian species suggests a loose host specificity for at least some species of *Sarcocystis*.

Muscle from ungulates was placed in formal-saline fixative and some of it was screened histologically for *Sarcocystis* infection. Pieces of infected muscle were subsequently processed for electron microscopy and viewed in a transmission electron microscope. Ultrastructurally, the protrusions are filled with fibrils that originate in the ground substance beneath the cyst membrane. In longitudinal section, the fibrils are seen to extend from the ground substance along the body of the protrusions. The protrusions are long and spatula-like in shape when viewed longitudinally. This explains why the fibrils are never seen to penetrate the stems of the protrusions, which are mushroom-shaped when cut in cross section.

In all specimens examined, small cilia-like structures extend from the cyst membrane surrounding the protrusions, imparting a 'brush border' appearance to the outer cyst membrane.

In the cyst from the lechwe, small club-shaped structures were found at intervals, interspersed between the cilia-like structures along the outer cyst membrane surrounding the protrusions. The function of these structures is not known.

Since each species of *Sarcocystis* has a characteristic morphology at the ultrastructural level,² it is concluded from the results reported here that the specificity for the intermediate host of at least some species of mammalian *Sarcocystis* is probably not as strict as has been thought.

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

1. Cornaglia E., Guarda Franco, Guarda Francesco and Misciattelli M.E. (1980). *Annali della Facolta di Medicina Veterinaria di Torino* 27, 279.

2. Mehlhorn H., Hartley W.J. and Heydorn A.O. (1976). *Protistologica* 12, 451.

Opalinidae in Southern African anura: preliminary results

B.L.J. Delvinquier, M.B. Markus and N.I. Passmore

Department of Zoology, University of the Witwatersrand, P.O. Wits, Johannesburg, 2050.

A total of 383 specimens of Anura from all provinces in South Africa and from Swaziland, representing 46 species belonging to eight families, were checked for opalinids in the cloaca. The genus *Opalina* was found in one species of *Phrynobatrachus* (Ranidae) and one of *Chiromantis* (Rhacophoridae). The genus *Zelleriella* was recovered in one species of

Bufo (Bufonidae); one of *Leptopelis*, two of *Kassina* (Hyperoliidae); one of *Phrynomerus* (Microhylidae); one of *Phrynobatrachus* and four of *Tomopterna* (Ranidae). The genus *Cepedea* was detected in three species of *Bufo*; one of *Afraxalus*, five of *Hyperolius*, two of *Kassina*, one of *Semnodactylus* (Hyperoliidae); one of *Phrynomerus*; one of *Phrynobatrachus*, four of *Tomopterna*; one of *Chiromantis*. The genus *Protoopalina* was present in five species of *Bufo*, one of *Schismaderma* (Bufonidae); one of *Heleophryne* (Heleophrynidae); two of *Xenopus* (Pipidae); one of *Cacosternum*, four of *Ptychadena*, one of *Pyxicephalus*, two of *Rana* and one of *Strongylopus* (Ranidae).

Opalina seems to be restricted to the Rhacophoridae and the Ranidae. It is suggested that *Kassina* and *Tomopterna* are major carriers of *Zelleriella* in Africa, as is *Limnodynastes* (Myobatrachidae) in Australia.¹ The genera *Hyperolius* and *Tomopterna* are major carriers of *Cepedea* in Africa. The genus *Bufo* and the Raninae (*Ptychadena*, *Pyxicephalus*, *Rana* and *Strongylopus*) are major carriers of *Protoopalina*.

1. Delvignier B.L.J. (1987). Opalinidae in Australian Anura. *Proc. R. Soc. Queensland* 98, 93–122.

Paralysis ticks of domestic hosts in the south-western Orange Free State

L.M. Barkhuizen, L.J. Fourie and O.B. Kok
Department of Zoology and Entomology, University of the Orange Free State, Bloemfontein, 9301.

Studies on the interrelationships between *Ixodes rubicundus*, *Rhipicephalus* sp. (near *R. punctatus*) and sheep and goats were undertaken. Merino sheep and Angora goats were confined to the same camp on a farm in the south-western Orange Free State. The camp was characterized by a heterogeneous vegetation consisting of flats and hilly areas. Observations on the behaviour of the hosts (activity patterns and habitat utilization) were made on a monthly basis (March 1988 to April 1989) and were correlated with the infestation levels of paralysis ticks on the hosts. Both intra- and interspecific differences with regard to the infestation levels with the *Rhipicephalus* sp. (near *R. punctatus*) was evident. These differences were the result of differential habitat utilization by the hosts as well as intraspecific age-related behavioural differences. Minor interspecific differences in the seasonal occurrence of *I. rubicundus* on the hosts were evident, which was related to the more pronounced use of the flats by the sheep.

The identity of hookworm in failed treatment cases

A.C. Evans, J. Daly* and M. Markus†
Research Institute for Diseases in a Tropical Environment of the South African Medical Research Council, Box 634, Nelspruit 1200, *Department of General Anatomy and †Department of Zoology, University of the Witwatersrand, P.O. Wits, Johannesburg, 2050.

Filariform larvae of hookworm cultured from stools from single-dose treatment (Vermox®, 500 mg single dose) failure cases, were fed to 2–6-month-old hamsters. About 60 days later, the rodents were sacrificed and adult worms were removed from the small intestines. Identification was carried out using scanning electron microscopy.

Micrographs of adult male and female worms showed that treatment failures were morphologically all of the *Necator americanus* species, being identified by their dorsal and ventral cutting plates, the presence of a dorsal tooth and the fused terminus of spicules.

On host specificity of trichodinid (Ciliophora: Peritrichida) ectoparasites

L. Basson and J.G. van As
Department of Zoology and Entomology, University of the Orange Free State, P.O. Box 339, Bloemfontein, 9300.

Host specificity of trichodinid fish ectoparasites has long been a topic of discussion, as many contradictory opinions were held by various authors. The lack of specific taxonomic information did not provide sufficient data for comparative evaluation. Since 1958, reliable taxonomic information became available, when a system of uniform characteristics was introduced.

Based on extensive surveys in Southern Africa, Israel and Taiwan, Van As and Basson¹ divided fish-associated trichodinids into four categories

of specificity. This hypothesis can now be tested for species occurring on hosts other than fish. In a recent survey, trichodinids from tadpoles collected in Taiwan were used in cross-infestation experiments. This parasite initially settled on fish hosts, but disappeared after a few days, whereas those on the tadpoles eventually caused high mortalities of their hosts. Similarly, laboratory experiments on a trichodinid species associated with a paradiatomid copepod initially settled on clariid larvae, but also disappeared after a few days. This substantiated our view that trichodinids from non-piscean hosts show a high degree of specificity.

1. Van As J.G. and Basson L. (1987). Host specificity of trichodinid ectoparasites of freshwater fish. *Parasitology Today* 3, 88–90.

Cryptosporidium at Ga-Rankuwa Hospital

P.J. Fripp and M.T. Bothma
Division of Parasitology, Microbiology Department, Medical University of Southern Africa, P.O. Medunsa, 0204.

Cryptosporidium oocysts were first seen in the stools of patients in Ga-Rankuwa Hospital in October 1985. Since then, all specimens submitted to the routine microbiology stool laboratory have been examined for *Cryptosporidium*. Seasonal peaks were seen in late summer (February, March) and minimum numbers were recorded during late winter (August, September). The differences remained whether the data reflected absolute numbers or percentage of parasitic pathogens isolated. The disease is one of early childhood. The majority of cases were under 3 years of age, and in an analysis of enteropathogens from November 1987 to April 1988, out of 5191 stools, 232 *Cryptosporidium* infections were detected, of which only 6 patients were older than 12 years.

Cryptosporidiosis has replaced giardiasis as the commonest stool parasite infection in the hospital.

The transovarial transmission of *Babesia caballi* by *Hyalomma truncatum*

D.T. de Waal
Protozoology Division, Veterinary Research Institute, Onderstepoort, 0110.

Studies on the vectors of *Babesia caballi* were undertaken to extend our knowledge of the epidemiology and role that this parasite plays in equine babesiosis. *Babesia caballi* isolated from a horse in Namibia was transmitted transovarially by *Hyalomma truncatum* (a two-host tick). *B. caballi* proved to be highly infective for adult *H. truncatum*. Forty-five per cent of the ticks feeding on a reacting animal become infected. Ticks were severely affected by the parasite; 70% of the infected ticks either died during oviposition or after laying only a few eggs.

The features of the infection were a prepatent period of 10 days, characteristically low parasitaemias which persisted at a patent level for 13 days, a transient febrile reaction and recovery without treatment.

Blood parasites and argasid ticks from guineafowls (*Numida maleagris*) from the Skukuza area of the Kruger National Park, with a note on the suitability of the guineafowl as an experimental host for *Aegyptianella pullorum*.

F.W. Huchzermeyer, I.G. Horak* and L.E.O. Braak†
Veterinary Research Institute, Onderstepoort, 0110, *Department of Parasitology, Faculty of Veterinary Science, University of Pretoria and †National Parks Boards, Skukuza.

Blood smears were taken and ticks collected from guineafowls shot at Skukuza at monthly intervals throughout the summer of 1988/89. Among the ticks were larvae of *Argas* sp. The blood parasites encountered were: *Leucocytozoon naevei*, a *Haemoproteus* sp., a smaller and a larger *Plasmodium* sp. and an *Aegyptianella* sp.

Heparinized blood samples were obtained from three guineafowls. One of these samples was injected into a turkey and a guineafowl and the two others into one guineafowl each. The injected turkey remained uninfected. The first guineafowl developed a parasitaemia with *P. circumflexum* and *Aegyptianella* sp., the two other guineafowls both only with *Aegyptianella* sp.

The present isolate of *P. circumflexum* was less pathogenic for turkeys

than the one previously reported. In guineafowls it produced large numbers of gametocytes, which, if occurring exclusively as reported for *P. fallax*, could be mistaken for *Haemoproteus*.

The isolates of *Aegyptianella* sp. differed morphologically from *A. pullorum*, and attempts to transmit them to young domestic fowl (*Gallus gallus*) failed. Transmission of a laboratory strain of *A. pullorum* to guineafowl produced only a very low and transient parasitaemia with sometimes abnormal forms, but still morphologically different from the guineafowl isolate. It is presumed that the guineafowl isolates of *Aegyptianella* represent a new species.

Morphology of *Acanthosentis tilapiae* Baylis, 1948 (Acanthocephala: Quadrigyridae) with special reference to the reproductive systems

Madeleine Gründlingh and J.H. Swanepoel

R.U.F.B., Department of Zoology, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000.

The phylum Acanthocephala comprises a relatively small group of spiny-headed worms, the adults of which occur exclusively as endoparasites in the intestine of vertebrate hosts. The majority of genera and species have thus far been described from fishes, particularly freshwater fishes. Morphological adaptations to a parasitic way of life include a reduction of the nervous, muscular, circulation and excretory systems as well as a complete loss of the digestive system.

During a field trip to the Eastern Caprivi, Namibia, in the spring of 1984 and 1985, adult specimens of the class Eoacanthocephala were collected from the intestines of three different host species of freshwater fish from Lake Liambezi and Lake Lesikele, bordering on the Zambezi river. The morphology of these specimens, identified as *Acanthosentis tilapiae* Baylis, 1948, are discussed with special reference to the reproductive system.

Susceptibility of *Bulinus africanus* populations to infection with *Schistosoma haematobium*

P.H. Joubert, F.J. Kruger and S.J. Pretorius

RIDTE of the SAMRC, Box 634, Nelspruit, 1200.

The use of intermediate host snails of *Schistosoma* spp. which are not susceptible to infection has been proposed as a possible method of controlling schistosomiasis. The objective of this approach is to change the susceptibility of natural snail populations from being predominantly susceptible to a non-susceptible state, through the release of refractory snails into natural habitats. In an attempt to determine whether or not such refractory *Bulinus africanus* populations occur in eastern South Africa, F1 generation snails of populations from 8 different areas were exposed to miracidia hatched from eggs excreted in the urine of *Schistosoma haematobium*-infected school children in the Nelspruit district. The proportion of snails successfully infected ranged from 27–100% and therefore displayed considerable genetic heterogeneity among populations of the same snail species. One population from Natal could be regarded as partially refractory, while a laboratory population from Durban proved to be 100% susceptible. A completely refractory strain of *B. africanus* has not yet been identified.

Some observations of an *Arthromitus*-like organism in a microbial community associated with zebra cyathostomes

R.C. Krecek, R.M. Sayre*, H.J. Els†, J.P. van Niekerk and F.S. Malan‡
Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110, *Nematology Laboratory, Agricultural Research Service, USDA, Beltsville, Maryland 20705, USA, †Electron Microscope Unit, Medical University of Southern Africa, Medunsa 0204 and ‡Hoechst Research Farm, P.O. Box 124, Malelane, 1320.

Microorganisms that attached to the posterior and anterior extremities of zebra cyathostomes were studied by scanning electron and transmission electron microscopy. The predominant constituent of the microbial community was a filamentous prokaryotic organism which resembles *Arthromitus* Leidy, 1849. The organism was associated with the vulvar and anal openings of the females of 2 of the 6 cyathostome genera. The other organisms in the community included some with a filamentous cross-

wall, a distinct double-cell wall, a blunt-end and spiral in shape. Though these microbes were not observed to invade tissues of the cyathostome hosts, they may partially block the reproductive tract of female nematodes, thereby limiting their reproductive capacity. The prokaryotic organisms appeared to be commensals living in the effluent of the nematodes.

Bulinus tropicus as intermediate 'rescuer' of various parasites in the Orange Free State

P.H. King and J.G. Van As

Department of Zoology, University of the Orange Free State, P.O. Box 339, Bloemfontein, 9300.

Bulinus tropicus (Krauss, 1848) is the most common and widespread freshwater mollusc in the Orange Free State. During several surveys in and around Bloemfontein, various parasitic life cycles were discovered, having this snail as first intermediate host. Most of these parasites have only a short period of time available to complete their cycles or to find a suitable host in which they can survive as a resting phase. This is because most pans and farm dams are of only a temporary nature and are therefore dry for long periods of the year. The second intermediate host has to be in a position to survive these conditions.

The ability of *B. tropicus* to survive desiccation in a state of anhydrobiosis also ensures the survival of the parasite, as the cercaria reinfects the snail, which then acts as second intermediate host. Thus, here we have a situation where both cercarial and metacercarial stages are within the same snail.

Attempts to establish *Strongylus equinus* in immunosuppressed laboratory animals

R.C. Krecek, D.B. Petty*, A. Verster, and A.L. Lange†

Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110, *Department of General Physiology, Faculty of Dentistry, University of the Witwatersrand, Johannesburg, 2050, and †Department of Pathology, Faculty of Veterinary Science, University of Pretoria.

Alternative hosts provide important models for the study of host-parasite interactions and also a source of regular parasitic material. This pilot study was designed to find an alternative host for *Strongylus equinus*, a pathogenic nematode in horses.

Twenty nude mice and the same number of guinea pigs were infected with 200 *S. equinus* third stage larvae (L₃) with a stomach tube and divided into 5 groups. Group 1 received cyclosporine (10 mg/kg) every second day. Group 2 received cyclophosphamide (50 mg/kg) every fourth day. Group 3 received dexamethasone (6 mg/kg) and azothioprine (25 mg/kg) on alternate days. Group 4 received methylprednisolone acetate (40 mg/kg) every three days. Group 5 were untreated controls. The animals were killed on days 9 and 21 post-infection. The viscera were opened and placed in Baermann filters to facilitate larval recovery but no *S. equinus* were recovered. There were subacute parasitic granulomas in one guinea pig from group 1. The immunosuppressive drugs and the doses at which they were used did not reduce guinea pigs' innate resistance to *S. equinus*.

First report of organophosphate resistance in a strain of *Haemonchus contortus* in South Africa

F.S. Malan, J.A. van Wyk*, H.M. Gerber* and Regina M.R. Alves*
Hoechst Research Farm, P.O. Box 124, Malelane, 1320, and *Veterinary Research Institute, Onderstepoort, 0110.

Previously, anthelmintic resistance has been shown in South Africa to all but the organophosphates among the five modern groups of drugs.¹ This report describes a strain of *Haemonchus contortus* showing resistance to this particular group of anthelmintics, among others.

During 1988, a strain of *H. contortus* that was initially a contaminant of *Ostertagia* spp. isolated from sheep on a farm in the Malmesbury district of the south-western Cape, came to our notice after having overgrown the *Ostertagia* culture during passage in the laboratory.

In two trials conducted to gauge the susceptibility of the strain to all the anthelmintic groups, the following results were obtained against the adult *H. contortus*: trichlorphon (organophosphate) had a geometric mean efficacy of 61.1% at 62.4 mg kg⁻¹ and 59.3% at 60.0 mg kg⁻¹; and levamisole (7.5 mg kg⁻¹), morantel (14.5 mg kg⁻¹), fenbendazole

(5.0 mg kg⁻¹) and rafoxanide (7.5 mg kg⁻¹) removed 59.0%, 4.9%, 46.8% and 31.2% of the worms, respectively. In contrast, both ivermectin (0.2 mg kg⁻¹) and closantel (5 mg kg⁻¹) removed a geometric mean of more than 97% of the worms. In the second of the two trials, trichlorophon (60 mg kg⁻¹) was more than 99.5% effective against a susceptible reference strain of *H. contortus*, as well as against a strain known to be resistant to ivermectin, the benzimidazoles and the salicylanilides.

It is noteworthy that, not only is this the first report of resistance to the organophosphates in South Africa, but also it appears to be the first report of resistance simultaneously to four of the five anthelmintic groups.

1. Van Wyk J.A., Gerber H.M., Bath G.F., Alves R.M.R. and Visser E.L. (1989). Weerstandbiedendheid van veldstamme van *Haemonchus contortus* en *Trichostrongylus colubriformis* van skape teen levamisool en morantel. *S. Afr. J. Sci.* **85**, 130–131.

Grooming ability and external parasite abundance in impala *Aepyceros melampus*

A.A. McKenzie

Mammal Research Institute, University of Pretoria, Pretoria, 0002.

Adult impala *Aepyceros melampus* from several conservation areas in Southern Africa have been noted to exhibit extreme wear of the anterior dentition. Fourteen impala were shot in Mashatu Game Reserve (22°10'S, 29°00'E), Botswana, in order to test an hypothesis relating dental attrition to grooming activity in browsing antelope.

Impala possessing worn incisor teeth were found invariably to exhibit pronounced alopecia of body areas other than the head and neck. Individuals with the worn incisors also carry a significantly higher burden of ectoparasites than control animals from the same area. Furthermore, animals collected in the reserve within 15 km of each other at the same time were also found to carry significantly different ectoparasite burdens. The high ectoparasite burdens and alopecia can be ascribed to the absence of an effective dental grooming apparatus in the old impala. Spatial differences in ectoparasite burdens are correlated to differences in predation patterns, and indicate the need for caution when determining 'natural' parasite levels for a particular area.

A new species of the fish parasitic genus *Lernaeenicus* from Southern Africa

W.H. Oldewage

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

The pennellid genus *Lernaeenicus* Le Sueur, 1824 has a cosmopolitan distribution, although no single species has thus far been found to occur in more than one ocean (Kabata, 1979). The number of species has grown steadily from a comprehensive checklist of 12 compiled by Wilson (1917), to an estimated number of 26 valid species recognised by Kabata (1979), although Yamaguti (1963) listed no fewer than 31 representatives of this genus. Only one species, *Lernaeenicus gonostomae* Kensley & Grindley, 1973, has been reported from the south-western Indian Ocean off the coast of Africa. The species described here was taken even further south from the southern shore of the continent.

This species can be identified by its unique overall morphology and the relative lengths of the various body parts. It belongs to the group having three antlers—as opposed to two—and embeds the head into the superficial muscle layers of the body of its host.

Two species of *Nesippus/Nogagus* from sharks off the Namibian coast

W.H. Oldewage

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

During a recent visit to the South African Museum, we acquired a number of parasitic copepods which proved rather difficult to identify. Generally, the choice lies between the well-established genus *Nesippus* Heller, 1868 and another, described as 'Pandaridae incertae sedis' by Kabata (1979), that is, the genus *Nogagus* Leach, 1816. The name of this genus has, however, frequently been misquoted as *Nogagus* by, for instance, Brian (1905), Wilson (1907), Heegaard (1955) and Kabata (1979) and others, to the extent that the latter name is accepted as the valid one.

Deciding on the validity of the genus *Nogagus* is, however, difficult. Although accepted by many authors (quoted above), Yamaguti (1963) regards it as invalid, and Cressey (1967) does not include it in a revision of the Pandaridae. Some species have been placed in the genus *Nesippus*. For instance, *Nogagus orientalis* Heller, 1868, was renamed *Nesippus orientalis* by Wilson (1907) and accepted as such (Brian, 1924; Nunes-Ruivo, 1956 and Capart, 1959). In other cases, confusion exists. *Nogagus borealis* Steenstrup & Lütken, 1861 was transferred to *Nesippus* by Wilson (1907) and recognised as such by Hewitt (1967), only to be questioned by Cressey (1967) and once again listed as *Nogagus borealis* by Kabata (1979). Another species, *Nogagus tenax* Steenstrup & Lütken, 1861, has been synonymised with *Pandarus affinis* van Beneden, 1892 (Yamaguti, 1936).

In the light of this confusion and our lack of knowledge regarding females of the genus *Nogagus* (Kabata, 1979), and the sometimes very flexible generic diagnosis given for the genus *Nesippus*, the two species collected from unidentified sharks off the Namibian coast are described and discussed. As specific identification might add to the existing confusion, new species are not created for the purpose of this discussion.

Rhabdomys pumilio as a host of the *Amblyomma* vectors of heartwater in South Africa

T.N. Petney, D.J. Howell* and I.G. Horak†

Veterinary Research Institute, Onderstepoort, 0110, *Department of Agriculture and Water Supply, P.O. Box 11, Uitenhage, 6230 and †Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110.

Infection with *Cowdria ruminantium*, the rickettsia causing heartwater, is known to occur in rodents. It is therefore possible that rodents play a role in the epidemiology of the disease. *Rhabdomys pumilio*, the striped mouse, was selected as a possible carrier of heartwater as it is common, occurs in areas where the *Amblyomma* vectors of heartwater are common, and has been implicated as a possible host of the disease.

Mice were trapped over a 17-month period in the Thomas Baines Nature Reserve in the eastern Cape Province. This reserve is known to harbour high densities of *Amblyomma hebraeum* and *Amblyomma marmoreum*, the two most common heartwater vectors in South Africa. Only 5 larvae and 1 nymphal *A. hebraeum* were recovered from over 160 infested mice. These represent less than 0.01% of the total ticks recovered. No *A. marmoreum* were recovered. It therefore seems unlikely that *R. pumilio* has a role in the natural cycle of heartwater and opens the question of whether rodents in general have such a role.

Human parasitic infections in the Cuando river area of Eastern Caprivi

C.H.J. Schutte

Research Institute for Diseases in a Tropical Environment of the S.A. Medical Research Council, P.O. Box 17120, Congella, 4013.

The most severe form of intestinal schistosomiasis in Southern Africa occurs in the Cuando river area of Eastern Caprivi (Namibia). Hepatomegaly and splenomegaly, referred to by the locals as the "swollen belly" condition, are extremely common. This district is also known as an endemic malaria area and there are high prevalences of *Strongyloides*, hookworm and hepatitis B viral infections. The RIDTE has been investigating the epidemiology of these infections for several years. Some of the interesting features of the area are the total absence of *S. haematobium* transmission, *Ascaris* and *Trichuris* infections. A schistosomiasis control project was launched in October 1987. The integrated approach of chemotherapy combined with focal mollusciciding is used and from the results obtained it would appear that we are dealing with a more virulent strain of *S. mansoni* than the one occurring in South Africa. A significant cure rate was obtained only after a second chemotherapeutic intervention, one year after the first.

DNA probes for the detection of equine babesiosis

E.S. Posnett, M.M. Oosthuizen, T. de Waal and R.E. Ambrosio
Molecular Biology Section, Veterinary Research Institute, Onderstepoort, 0110.

Babesia equi and *Babesia caballi* are two intraerythrocytic protozoan parasites and the causative agents of equine babesiosis. Because of the increase in the international trade in horses and the risk that the disease

might spread to disease-free areas, more and more countries are imposing strict import regulations. Available diagnostic tests for equine babesiosis are unreliable and unsatisfactory and may fail to detect infections in carrier animals where the number of parasites is very low. There is therefore a need for a more sensitive and specific diagnostic test.

Recombinant DNA technology has resulted in a new generation of diagnostic tests based on DNA probes. Using this technology, we have developed a *B. equi*-specific DNA probe (named pSB20) and a *B. caballi*-specific DNA probe (named pBC191). These probes are sensitive enough to detect low numbers of parasites and are therefore suitable for development into a routine diagnostic test. Furthermore, field application has shown that the *B. equi* probe can detect the presence of parasites in carrier animals.

Pathology of a nematode infection in *Cordylus polyzonus*

W.H. Oldewage

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

A heavy nematode infection was found in a representative of *Cordylus polyzonus* from the Saldanha area in the Cape Province. Although no signs of stress were evident at first, dissection showed atrophy and malfunction of the gonads. The penetration and histological effect of the parasite were studied. It was found that the mucus-secreting component of the mucosa is progressively rendered inactive by penetration of the worm. A concentration of lymphocytes and macrophages was evident in the vicinity of the parasite, and the presence of fibroblasts and collagen around the cuticula of the nematode points to an attempt by the host to encapsulate the parasite. As the deposition of collagen never encapsulates it, however, it is suspected that the parasite secretes a proteolytic enzyme to keep encapsulation at bay. Infection of the submucosa is characterized by the presence of areolar connective tissue and inflammatory fibrosis in the area around the mouth of the parasite. No hyperplasia was evident, which suggests that the nematode does not feed on cellular components of the intestine of this reptile. No haemorrhage occurs, but the presence of blood cells in the buccal cavity suggests that blood and interstitial fluid is utilized as food by the nematode. Infection is limited to the mucosal layers of the intestine and does not occur in the outer muscular component.

Interlit literature computer program

J.H. Smit and J.A. van Wyk

Veterinary Research Institute, Onderstepoort, 0110.

We describe a PC computer program developed in South Africa for computerising references to the scientific literature.

In addition to the usual options offered by such programs, the following novelties greatly facilitate the ordination of large numbers of references:

- 1) A system of key words, that can be linked in nested searches for speeding up literature searches. During a search, the numbers of references that contain a given key word, or combination of key words, are displayed. In this way various combinations of key words can be made until a manageable number of references is obtained.
- 2) An unlimited number of key words, as well as a summary per reference.
- 3) The ability to move selected references to separate files electronically, and then to print them in the style of the journal in which they are to be published.
- 4) The advantage that the program does not require a fixed computer capacity for each reference. This has the effect that the system is very economical in its requirements for computer storage capacity.
- 5) In common with other such programs the data file can be searched quickly on key words only, or else word for word in the entire file.

The adhesive disc of *Trichodina dampanula*: ultrastructure and mode of function

Michelle van der Bank

Zoology Department, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000.

The fine structure of the adhesive disc of *Trichodina dampanula* (van der Bank, Basson & Van As, 1989) is described along with a hypothesis regarding its function. The disc is a structure used for attachment to

substratum, usually the surface of another organism. In *T. dampanula* the disc consists of three different subunits: denticles, radial pins and peripheral pins. Twenty-eight to 35 interlocking denticles form a ring. Associated with each denticle are 7 or 8 radial pins. Both the radial and the peripheral pins show a highly complex ultrastructure. Several types of filaments are associated with the disc. It seems that some of these filaments are involved in sealing off the adhesive disc during its action as a sucker.

Tick vectors of *Theileria parva lawrencei* in South Africa: the identity, distribution and vector efficiency of *Rhipicephalus appendiculatus* and *Rhipicephalus zambeziensis*

W.H. Stoltz and E.F. Blouin

Protozoology Division, Veterinary Research Institute, Onderstepoort, 0110.

Corridor disease, caused by *T. p. lawrencei*, is the most important theilerial infection affecting cattle in this country, and is transmitted from buffalo (*Syncerus caffer*) to cattle by the brown ear-ticks, *R. appendiculatus* and *R. zambeziensis*. These two rhipicephaline species morphologically resemble each other very closely and have often been confused in the past. *R. zambeziensis* has only fairly recently been recognized as a distinct species¹ and, although its distribution in South Africa has not been extensively surveyed, it is believed to be more widely distributed than present data indicate. In the Kruger National Park (a Corridor disease endemic area), *R. zambeziensis* has been collected from a variety of game species² and is potentially an important vector of Corridor disease in adjacent cattle farming areas.

In an attempt to determine their respective vector abilities, nymphae of both tick species were fed concurrently on the same experimentally infected *T. p. lawrencei*-carrier cattle. After moulting, the ensuing adult ticks were fed on rabbits for four days, their salivary glands dissected out, the glands stained with methyl green/pyronin and examined with a light microscope for infective stages of the parasite. Significantly higher infection rates were found in *R. zambeziensis* than in *R. appendiculatus*, which may indicate a greater vector efficiency for *T. p. lawrencei* in the former species.

Subsequently, *R. zambeziensis* has been used repeatedly to transmit *T. p. lawrencei* trans-stadially (nymph to adult) between non-splenectomized cattle. Infections were successfully transmitted from reacting cattle with lethal infections of *T. p. lawrencei* and without chemotherapeutic intervention. These findings confirm that Corridor disease is not self-limiting in cattle. Although some of the infected cattle died within 20 days of tick infestation, they were nevertheless infective for *R. zambeziensis* nymphae, thus indicating that *T. p. lawrencei* may well be maintained in a cattle population in the absence of buffalo. Serial tick-passage of *T. p. lawrencei* with *R. zambeziensis* is being continued to investigate further the possibility of this parasite changing its behaviour to resemble that of *Theileria parva parva* (the cause of East Coast fever), as reported by Barnett and Brocklesby.³

1. Walker J.B., Norval R.A.I. and Corwin M.D. (1981). *Rhipicephalus zambeziensis* sp. nov., a new tick from eastern and southern Africa, together with a redescription of *Rhipicephalus appendiculatus* Neumann, 1901 (Acarina, Ixodidae). *Onderstepoort J. vet. Res.* **48**, 87–104.
2. Horak I.G., Potgieter F.T., Walker J.B., De Vos V. and Boomker J. (1983). Ixodid tick burdens of various large ruminant species in South African nature reserves. *Onderstepoort J. vet. Res.* **50**, 221–228.
3. Barnett S.F. and Brocklesby D.W. (1966). The passage of *Theileria lawrencei* (Kenya) through cattle. *Br. vet. J.* **122**, 396–409.

Changes in serum enzyme levels associated with *Strongylus equinus* infection

D. Petty, A. Verster†, J. Hattingh and R.C. Krecek‡

Department of General Physiology, University of Witwatersrand, P.O. Wits, Johannesburg, 2050, and †Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110.

Eight young horses were infected with 20 000 or 30 000 third-stage *S. equinus* larvae. Serum aspartate transaminase (AST), gamma glutamyl transferase (GGT), lactate dehydrogenase (LDH), amylase and lipase were monitored regularly for 28 weeks post-infection and compared with values obtained from four control horses. From 30 weeks post-infection the

horses were killed and examined at post mortem. The pathology findings have been reported elsewhere.

Damage to the liver may be reflected in increases of GGT, AST and LDH serum levels. In this study, despite the presence of mild liver damage, these enzyme levels fell or remained low in comparison to those of the control group. High amylase and lipase levels have been found to be associated with acute pancreatitis. Despite the fact that there were approximately 200 fifth-stage larvae present in the pancreas of one of the horses, changes in the amylase and lipase levels were minimal.

These findings suggest that serum enzyme levels are not suitable for monitoring the course of an infection caused by *S. equinus*.

Avian dispersal of freshwater snails

L.J. van Rensburg and K.N. de Kock*

Veterinary Research Institute, Onderstepoort, 0110, and Department of Zoology, Potchefstroom University for CHE, Potchefstroom, 2520.

The introduction of certain species of freshwater snails to new environments inaccessible by active snail migration is of veterinary and medical importance, because they may serve as intermediate hosts for trematode parasites. Various winged insects and birds in flight have been reported to transport snails, with birds probably being the more important aerial dispersers. The snails or their egg packages can be transported by birds directly on their legs or feathers, or indirectly on objects such as plant material.

A case of aerial dispersal of *Succinea striata* by carrier pigeons in South Africa was encountered recently, with up to 30 snails being recovered from individual pigeons after a flight from Matjiesfontein to Hoopstad. Although this snail species is not of veterinary or medical importance, the incident serves as an example of how snails can be transported to otherwise inaccessible localities.

The majority of freshwater snail species are bisexual, so that a single snail is sufficient to propagate the species and thus populate a new habitat.

Bovine measles: a heavily infected carcass

Lynne M. Velcich and L.C.F. Taljaard

Veterinary Research Institute, Onderstepoort, 0110.

Taenia saginata, the so-called beef tapeworm of humans, is prevalent wherever people eat underdone beef infected with viable 'measles' (cysticerci) and human sanitation is lax, leading to contamination of cattle pastures with infected human excreta. Cattle become infected when they ingest the tapeworm eggs with the herbage while grazing.

Serious financial losses are sustained by the cattle industry, either as a result of condemnation of carcasses that are heavily infected with one or more cysticerci on the majority of the cut surfaces of incisions made during meat inspection, or from special processing of more lightly infected carcasses. In South Africa, 0.04% of about 900 000 carcasses are condemned annually in the controlled abattoirs, and 3.3% are detained for freezing (P. Blom, personal communication, 1989).

Although cysticerci can occur in almost any organ of the animal, they are found most commonly in those muscular groups that have a rich blood supply, such as the masticatory muscles, the heart and the tongue.

T. saginata segments are motile, and migrate away from the human excreta in which they are deposited, widely dispersing eggs on the pasture. Thus cattle are seldom exposed to heavy infections. However, a case is depicted in which up to 13 cysticerci were recovered per gram of muscle in the masticatory muscles of a bovine, as well as numerous cysts in the heart and a few in the liver.

Weerstandbiedendheid van maagdermrondeurms teen wurmmiddels: probleme by prestasietoetsing van stoetramme in 'n sogenaamde veldramklub

J.A. van Wyk, P.C. van Schalkwyk*, G.F. Bath†, H.M. Gerber and Regina M.R. Alves

Navorsingsinstituut vir Veeartsenykunde, Onderstepoort, 0110, *SmithKline Diergesondheid, Posbus 38, Isando, 1600, en †Fakulteit vir Veeartsenykunde, Universiteit van Pretoria, Pretoria, 0002.

Veldramklubs word gestig om ramme van klublede onder veldtoestand op gesamentlike weiding vir prestasie te toets. Na afloop van die toetsing word die beste presteerders op 'n vendusie verkoop.

Nadat voorlopige wurmeiertellings by 'n veldramklub in Natal op die

moontlikheid van weerstandbiedendheid van 'n stam van *Haemonchus contortus* (haarwurm) gedui het, is die volgende resultate in 'n slagproef verkry: ivermektien (0.2 mg/kg per os)—45.5% doeltreffend (geometriese gemiddelde doeltreffendheid); oksfendasool (5 mg/kg)—31.3%; rafoksanied (7.5 mg/kg)—62.3%; klosantel (5 mg/kg)—99.8%; levamisool (7.5 mg/kg)—99.8%; en disofenol (10 mg/kg i.m.)—99.8%.

Dis is dus duidelik dat die betrokke stam van haarwurm bestand is teen 3 van die getoetste middels, al 3 waarvan aan verskillende wurmmiddelgroepe behoort.

Die implikasies is dat weerstand wyd versprei kan word tensy besonder streng voorsorgmaatreëls getref word (bv. deur die diere by bestemming te kwarantyn). Die beheer van die weerstandbiedendheid by so 'n klub sal moeilik wees, maar daar word aanbeveel dat weerstand by klublede gemonitor word.

Verder kan gepoog word om die weerstandige wurmstam op die gesamentlike weiding met 'n vatbare te vervang, of die weiding kan vir minstens twee jaar vry van skape of bokke gehou word, waarna dit vry van haarwurm behoort te wees.

Leishmaniasis: the first clinical case in a dog in South Africa

Shirley V. Yeates

Department of Medicine, Faculty of Veterinary Science, University of Pretoria, Private Bag X04, Onderstepoort, 0110.

A dog showing signs of chronic weight loss, anorexia, epistaxis, anaemia and proteinuria was referred to our department. A diagnosis of concomitant ehrlichiosis and leishmaniasis was made, based on the demonstration of the parasites in a blood smear. *Leishmania* parasites were also found in superficial lymphnode and bone marrow aspirates.

This paper deals with the clinical and clinical pathology findings observed in this case as well as the major post-mortem and histopathology findings. A short discussion with regard to the epidemiology of leishmaniasis follows and suggestions are made with regard to the possible epidemiological implications of leishmaniasis in South Africa and Namibia.

Aspects of the morphology of the digestive tract of *Gloiopotes watsoni* Kirtisinghe, 1934 (Copepoda: Siphonostomatoidea)

E. Malherbe

Department of Zoology, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000.

Although the external morphology of the genus *Gloiopotes* has been exhaustively studied, very little is known concerning its anatomy and physiology. The present study, of the digestive system of *G. watsoni*, illustrated that the mouthtube extends into the body cavity, where the oesophagus is followed by a distinctive crop. A muscular constriction regulates the flow of food from the crop to the midgut. Although it appears to function as a sphincter, the constriction is caused by substantial musculature surrounding this section of the tract, which is not incorporated in the intestine wall. The rectal cavity is distinguishable from the midgut by thick cuticle covering the epithelium centrally, indicating that this part of the digestive tract is of ectodermal origin. The anus opens posteriorly between the furcal rami as a dorso-ventral slit.

Electron microscope study of an *Echinostoma* species from the sacred ibis

Erika van Wyk

Department of Zoology, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000.

During an analysis for heavy metals in vertebrates from Vlakplaats, four organisms were found in the first third of the digestive tract of a sacred ibis (*Threskiornis aethiopicus*). Because of the characteristic structures of the anterior region, it was concluded that these organisms were parasitic, digenetic trematodes, belonging to the family Echinostomatidae. The structure of the acetabulum and circumoral collar coincides with that of the genus *Echinostoma*. The literature lacked scanning electron microscope studies of this genus so a project was launched to examine the external morphology by this means.

The integument, which was formerly described as smooth and uninter-

rupted, was found to be perforated. The spines on the circumoral collar, which were previously described as being solid structures, were found to be hollow, with round structures within the anterior aperture. The perforations may serve to enlarge the absorption areas or to enable respiration and excretion over the cuticle. The spines may permit more than just attachment; they may have sensory functions as well.

Histopathology of *Lernaea cyprinacea* on *Salmo gairdneri*

A. Venter, Marinda Kruger and Annemarie Avenant-Oldewage
Department of Zoology, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000.

Adult *Lernaea cyprinacea* females attach to their hosts by growing anchor hooks into the musculature of the host. This causes haemorrhaging lesions 10–15 mm in diameter. Histological sections revealed that the haemorrhage is limited to the area surrounding the connective tissue encapsulating the parasite. The encapsulation is formed by the host, while the nature of the capsule on the inside indicates that the parasite secretes an unidentified substance—probably an enzyme—to break down the capsule. Furthermore, evidence was found of hooks growing into the bone tissue of the host.

Ultrastructure of filamentous microbes on zebra cyathostomes

R.C. Krecek, J.P. van Niekerk* and H.J. Els*
Department of Parasitology, Faculty of Veterinary Science, University of Pretoria, Onderstepoort, 0110 and *Electron Microscope Unit, Medical University of Southern Africa, P.O. Medunsa, 0204.

Bacterial filaments were observed attached to the anal and vulvar pores of female cyathostomes recovered from zebras. These filaments were differentiated with the aid of scanning and transmission electron microscopy.

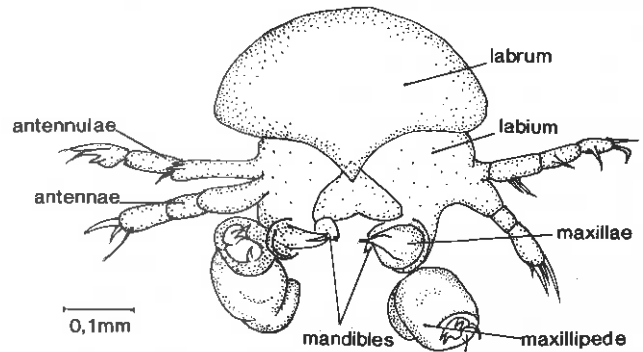
Based on both external and internal morphology, three types of the filaments could be distinguished and which were designated segmented,

multicellular continuous, and helical. That all three filamentous types were observed near the females' anal and vulvar pores suggests that substances required by the organisms are present at these sites. This study also demonstrates that the microbial community associated with these cyathostomes is more complex than previously reported.

Morphology of the appendage of *Lernaea cyprinacea*

Elsa Oosthuizen and Annemarie Avenant-Oldewage
Department of Zoology, Rand Afrikaans University, P.O. Box 524, Johannesburg, 2000.

Scanning electron microscopy and reconstructions made from histological sections revealed that the cephalic appendages consist of the antennulae, antennae, maxillae and mandibles. The labrum is the result of the coalescence of the maxillulae, hence no maxillulae are present (see figure).



A single pair of maxillipedes is present on the thorax and functions as a mouthpart. The first four pairs of natatory legs are typical biramous crustacean appendages, and the endo- and exopodites consist of three podomeres each. The fifth pair of legs is reduced to a single podomere present on the last thoracic segment, just in front of the egg sacs.

BOOK REVIEWS/RESENSIES

In pursuit of San settlements

John Parkington

Stylistic Boundaries Among Mobile Hunter-foragers. By C. Garth Sampson. Smithsonian Institution Press, Washington, D.C.

One of the interesting problems that confront Stone Age archaeologists is how to link sites together into settlement systems. This book is a defence of one approach. Garth Sampson has led a team of archaeologists in locating some 16 000 sites in 5000 km² of the central and upper Seacow Valley, a tributary of the Orange. The particular aspect of research dealt with here is the collection of all surface potsherds from sites in 2000 km² of the upper valley and the mapping of the distributions of ceramic decorative motifs in the expectation of discovering hunter-gatherer band territories. The sites are reasonably assigned to the time period between AD 1300 and 1800 and thought to have been occupied by those people known from historic documents as 'Bushmen'. The source of the model used, and the tests of the distributions obtained, are drawn imaginatively from recent ethnographic studies of San ('Bushmen') in the Kalahari. The field and

laboratory work has been pursued with considerable enthusiasm and persuasive optimism, but the construction of territories and boundaries is ultimately unconvincing.

The Introduction is the first of several chapters crucial to the argument, in that it generates a model of what the profile of a band's territory should look like archaeologically. Using 'style theory', Sampson argues that the products of an individual potter will appear on the landscape as a series of concentric circles marking a dense core area, a less dense lifetime range and a sparse outer recycling zone. The 'assertive styles' of individuals can then be accumulated to form a pattern of group or 'emblemic style' which should mark the territory of a particular band. These are Wiessner's terms.¹ Sampson's proposal is that by mapping such emblemic styles we can hope to detect band territories in the pre-colonial Seacow river valley.

Style theory seems merely to be an invitation to plot any empirically derived motif in the hope of a coherent, that is contiguous, distribution. There is no discussion as to how the—presumably competitive—

assertive styles of individuals can operate cumulatively to define the group. The choice of the band is also problematic, as this unit of study is the most abstract of ethnographic concepts, particularly in view of the flexibility of band membership. Thus members of one band are also potential (and at times actual) members of other bands. It is not clear why hunter-gatherers should want to assert their group identity in contrast to close family and kin in an adjacent territory with whom they need to cooperate.

A point not dealt with is that of generalising from the ethnographic snapshot of perhaps one generation to the archaeological moving picture of at least twenty generations. We might expect not only that many people would change bands but that many may change motifs in their lifetime and that motifs would be picked up by later generations, not necessarily within the band. We have no evidence to suggest that Lee's² bands would last 500 years.

After two readable chapters describing the environment of the upper Seacow Valley and the archaeology of its most recent pre-colonial (Smithfield = Bushman) occupants, Sampson introduces two more

Professor John Parkington is Director of the Spatial Archaeology Research Unit, University of Cape Town, Rondebosch, 7700 South Africa.