BIOLOGICAL OBSERVATIONS ON THE FREE-LIVING MITES OF SIGNY ISLAND IN THE MARITIME ANTARCTIC

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ABSTRACT. A list is given of the free-living Acari from Signy Island, South Orkney Islands, maritime Antarctic. The 18 species include: Mesostigmata (four species), Cryptostigmata (two species), Astigmata (four species) and Prostigmata (eight species). Aspects of the field biology and the geographical distribution of some of the taxa are discussed. The pedipalps and the structure of the genital area of four species of prostigmatid mites (*Eupodes minutus* (Strandtmann), *Ereynetes macquariensis* Fain, *Stereotydeus villosus* (Trouessart) and *Tydeus tilbrooki* Strandtmann) are illustrated. Details of the leg chaetotaxy of these four species are also provided.

THE information presented in this paper details the biological observations on the free-living Acari of Signy Island, South Orkney Islands, together with notes on the taxonomy of some undescribed juvenile life stages and the distribution of these species in Antarctic and sub-Antarctic localities. The observations were made during a 27 month field study of the population dynamics, ecology and respiratory physiology of the terrestrial mites occurring in two contrasting moss communities designated the Signy Island reference sites (SIRS 1 and 2).

SIRS 1, on a north-west-facing slope at *c.* 53 m a.s.l., is a relatively dry *Polytrichum alpestre–Chorisodontium aciphyllum* moss-turf community, with a patchy lichen cover and broken by areas of dead moss, melt-water runnels and lichen-encrusted stones together with small rock outcrops. SIRS 2, in a shallow drainage basin at 25 m a.s.l., is situated below McLeod Glacier, and is a permanently wet *Calliergon sarmentosum–Calliergidium austro-stramineum–Drepanocladus uncinatus* moss-carpet community broken by areas of senescent moss, growths of the liverwort *Cephaloziella varians* and in summer with some areas of standing fresh water. These sites are the subject of a long-term ecosystem study and have been described by Tilbrook (1973*a*). Three papers have been published on the Acari of these sites, two on the respiratory physiology of the Mesostigmata (Goddard, 1977*a*) and the Prostigmata (Goddard, 1977*b*). The third paper discusses the population dynamics of the Acari in the SIRS moss profiles (Goddard, 1979).

The free-living terrestrial acarine fauna of Signy Island, in common with that of many Antarctic terrestrial habitats, is dominated by the Prostigmata, and differs from more temperate areas where the Cryptostigmata tend to be the dominant group. Early reports on the biology of Antarctic Acari are papers in Gressitt (1967*a*), and Gressitt and Strandtmann (1971); more recent publications include Matsuda (1977) and Rounsevell (1977*a*, *b*, in press). Information on the Arthropoda of the maritime Antarctic has been given by Gressitt (1967*b*), Strong (1967), Tilbrook (1973*b*) and Graham (1974). Most of these refer to short-term observations and consequently little is known of the biology of the terrestrial Antarctic Acari especially the Prostigmata, where observations mostly refer to adults. The observations reported here are intended both as a contribution to the biological knowledge of the Antarctic forms and as a guide to their identification in the Signy Island fauna, especially with regard to the separation of the life stages of some of the prostigmatids.

SIGNY ISLAND ACARI

Acari were first recorded from the South Orkney Islands by the Scottish National Antarctic Expedition, 1902–04, when three species were collected from moss on Laurie Island (Trouessart, 1912); these were the three largest and most conspicuous: *Alaskozetes antarcticus* (Michael), *Gamasellus racovitzai* (Trouessart) and *Stereotydeus villosus* (Trouessart). In the first intensive survey of the terrestrial invertebrate fauna of Signy Island during 1961–64,

Tilbrook (1973*b*) recorded 16 species of Acari, four of which were represented by only one or two specimens. Two of these were identified to generic level only, *Chelytus* sp. and *Acaropsis* sp. The specimens of *Chelytus* are in poor condition and cannot be identified further, while no specimen of *Acaropsis* can be traced. Both genera are ectoparasitic on birds and are not free-living.

Table I lists free-living Acari recorded from Signy Island, compiled during the present work

TABLE I. FREE-LIVING ACARI RECORDED FROM SIGNY ISLAND, SOUTH ORKNEY ISLANDS

Taxon	*Tilbrook 1961–64*	*Goddard 1971–74*
ORDER MESOSTIGMATA		
Family Rhodacaridae Oudemans 1902		
Gamasellus racovitzai (Trouessart 1903)	+	+
Family Haemogamasidae (Oudemans 1926)		
*Haemogamasus pontiger** (Berlese 1903)	+	
Family Laelaptidae Berlese 1892		
*Proctolaelaps hypudaei** (Oudemans 1902)	+	
Family Ascidae Voigts and Oudemans 1905		
Lasioseius sp.*		+
ORDER CRYPTOSTIGMATA		
Family Podacaridae Grandjean 1955		
Alaskozetes antarcticus (Michael 1903)	+	+
Halozetes belgicae (Michael 1903)	+	+
ORDER ASTIGMATA		
Family Glycyphagidae Berlese 1887		
Glycyphagus destructor† (Schrank 1781)	+	+
Family Acaridae Ewing and Nesbitt 1942		
Tyrophagus putrescentiae† (Schrank 1781)	+	+
*Neocalvolia antarctica** (Hughes and Tilbrook 1967)		+
Family Hyadesidae Halbert 1915		
Neohyadesia signyi Hughes and Goodman 1968		+
ORDER PROSTIGMATA		
Family Bdellidae Dugès 1834		
*Spinibdella antarctica** (Trägårdh 1907)		+
Family Eupodidae Koch 1842		
Eupodes minutus (Strandtmann 1967)	+	+
Halotydeus signiensis Strandtmann 1968	+	+
Family Penthalodidae Thor 1933		
Stereotydeus villosus (Trouessart 1902)	+	+
Family Ereynetidae Oudemans 1937		
Ereynetes macquariensis Fain 1962	+	+
Family Tydeidae Kramer 1877		
Tydeus tilbrooki Strandtmann 1967	+	+
Family Pachygnathidae Kramer 1877		
Nanorchestes antarcticus Strandtmann 1963	+	+
Family Pyemotidae Oudemans 1937		
Bakerdania antarcticus (Mahunka 1967)	+	+

* Species represented by only one or two individuals.
† Species present in large numbers but for reasons given in the text are considered as introductions.

and from Tilbrook (1973*b*). The 18 species include four Mesostigmata, two Cryptostigmata, four Astigmata and eight Prostigmata. Two of the mesostigmatid mites recorded by Tilbrook (1973*b*), *Haemogamasus pontiger* (Berlese) and *Proctolaelaps hypudaei* (Oudemans), were not found in the present study, and a third species, *Lasioseius* sp., was collected by the author but not by Tilbrook. Similarly, two species of Astigmata: *Neocalvolia antarctica* (Hughes and Tilbrook) and *Neohyadesia signyi* Hughes and Goodman, together with one prostigmatid mite *Spinibdella antarctica* (Trägårdh), were found during the current work but were not recorded

TABLE II. MEAN (± S.E.) BODY LENGTHS (μm) AND LENGTH RANGES OF SOME FREE-LIVING ACARI AT SIGNY ISLAND, SOUTH ORKNEY ISLANDS

Species	*Life stage*	*Mean length of idiosoma (excluding gnathosoma)*	*Length range (μm)*	*n*
MESOSTIGMATA				
Gamasellus racovitzai	L	426±9.6	368–486	22
	PN	577±11.4	470–700	30
	DN	759±10.5	600–906	84
	M	953±3.7	800–1 038	71
	F	1 011±4.5	930–1 056	45
CRYPTOSTIGMATA				
Alaskozetes antarcticus	L	314±4.0	310–322	3
	PN	394±5.5	379–402	4
	DN	600±12.3	552–621	5
	TN	916±15.9	885–989	6
	M	1 030±7.8	1 012–1 058	5
	F	1 098±19.1	1 069–1 150	4
Halozetes belgicae	M	612±11.1	563–655	10
	F	676±12.4	632–724	6
ASTIGMATA				
Neocalvolia antarctica	PN	293±12.6	250–321	5
	TN*	387.5	–	–
	M*	385	–	–
	F	440	–	1
Neohyadesia signyi	L	205	–	1
	PN	230	–	1
	DN	318±17.0	287–345	3
	TN	402	–	1
	M	462±8.0	437–471	5
	F	487±13.0	460–529	5
PROSTIGMATA				
Spinibdella antarctica	TN	610	–	1
	F†	1 230	–	–
Eupodes minutus	L	120	–	1
	PN	163±7.0	143–175	4
	DN	204±4.3	191–220	6
	TN	231±1.4	228–235	4
	M	354±6.2	327–377	9
	F	324±16.2	285–347	4
Halotydeus signiensis	F	515±27.2	471–565	3
Stereotydeus villosus	L‡	244	–	–
	PN	276	–	1
	DN	325±10.2	294–372	8
	TN	502±20.9	468–540	3
	M	540±2.7	504–576	67
	F	563±3.2	528–600	33
Ereynetes macquariensis	PN	192±3.4	180–196	11
	DN	233±7.0	219–228	6
	TN	270±12.0	254–324	5
	M	318±6.5	286–360	11
	F	346±5.8	287–408	24
Tydeus tilbrooki	L	137	–	1
	PN	169	–	1
	DN	187±8.0	177–203	3
	TN	246	234–257	2
	AD	322±4.5	279–355	17
Nanorchestes antarcticus	L	100	–	1
	PN	127	–	1
	DN	174±5.6	144–210	20
	TN	256±2.3	181–334	208
	AD	295±7.2	240–340	23
Bakerdania antarctica	AD	359±7.2	344–373	4

* From Hughes and Tilbrook (1966).
† From Wallace (1970).
‡ From Graham (1974).
L larva; PN protonymph; DN deutonymph; TN tritonymph; AD adult; M male; F female; *n* number of determinations.

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earlier. The other two astigmatid mites listed in Table I, *Glycyphagus destructor* (Schrank) and *Tyrophagus putrescentiae* (Schrank) were found in large numbers on Signy Island on several occasions both in the present study and by Tilbrook (1973*b*). Both species are worldwide in distribution and are commonly associated with stored foods, etc.; they are not regarded as part of the natural fauna of Signy Island. The astigmatid species *Neohyadesia signyi* is the only fresh-water mite recorded from the South Orkney Islands. It is included in this discussion because it is the only non-terrestrial mite found outside the marine ecosystem, and is sometimes collected with fresh-water tolerant terrestrial mites in samples from shallow pools.

From the 18 species listed in Table I, five are almost certainly introduced. This leaves 13 indigenous species, eight of which are common in terrestrial habitats, while the remaining five are either rare or restricted in distribution.

Table II gives the mean body lengths for most life stages of the 13 indigenous species. Most species are small with only two, the mesostigmatid *G. racovitzai* and the cryptostigmatid *A. antarcticus* just exceeding 1 000 μm mean adult length; five others are medium-sized, ranging from 450 to 650 μm mean adult length. The remainder are all Prostigmata of less than 400 μm mean adult length, the smallest being *Nanorchestes antarcticus* Strandtmann at 295 μm. For most species there is a 250–300% increase in length between the larval stage and the mature adult, the greatest increase being 350% for *A. antarcticus*. Data for live weights of Acari from Signy Island have been given by Block (1976, 1977) and Goddard (1977*b*, 1979). As may be expected, body lengths and weights between species are not correlated; for example, *A. antarcticus* is similar in size to *G. racovitzai* but it is almost twice the weight, and *N. antarcticus*, the smallest species, is heavier than another prostigmatid *Tydeus tilbrooki* Strandtmann.

The structure of the genital region of each life stage of four species of Prostigmata, *Eupodes minutus* Strandtmann, *Stereotydeus villosus* (Trouessart), *Ereynetes macquariensis* Fain and *Tydeus tilbrooki* Strandtmann, is illustrated in Figs 1, 3–5 and 7, whilst Figs 2 and 6 show their pedipalp morphology. A summary of the chaetotaxy of the genital region of these species is given in Table III. The immatures of these species have not been described previously except for brief unillustrated references to *E. macquariensis* by Strandtmann and Tilbrook (1968), and to *S. villosus* by Graham (1974). The terminology of the genital structure follows that of Strandtmann (1967): setae on the genital plates are external genital setae, setae in the genital area but not on the plates are paragenital setae, and setae situated under the genital plates in mature adults are internal genital setae (nymphs bear no such internal setae and larvae lack genital structures). Genital setation increases in complexity with succeeding life stages within a species and is sufficiently different between species to be diagnostic. Variability of the genital setation within life stages is sometimes evident. There is little variation in *E. macquariensis* and *E. minutus*, where additional setae within a life stage are rarely found. There is a small degree of variation in setal numbers and structure in *T. tilbrooki*, in which the tritonymph and adult may have an additional paragenital seta or a pair of setae. Similarly, one or occasionally two setae may be absent from the genital plate (not to be confused with setae being broken off during mounting procedures, etc.). Sometimes one or more of the nude genital setae of the male may be plumed and more rarely one of the plumed setae of the female may be nude. Strandtmann (1967) reported atypical forms of *T. tilbrooki* from the South Orkney Islands.

In *S. villosus* there is rarely any variation in the genital setae, different numbers of paragenital setae occur, but not so often as to make life-stage separation difficult. In the tritonymph the number of paragenital setae varies from five to nine and in the adult from 12 to 20 within the same population. The genus *Stereotydeus* has been found in most Antarctic terrestrial habitats where arthropods occur and it is represented by more species (seven) than any other Antarctic terrestrial arthropod genus (Greene and others, 1967). Intraspecific variation in the genus *Stereotydeus* has been reported previously (Pittard and others, 1971) for *S. mollis* Womersley and Strandtmann, and by Gless (1972) for *S. belli* (Trouessart). In *S. belli* the number of paragenital setae ranges from eight to ten (Gless, 1972), while for *S. villosus*

TABLE III. SETATION OF THE GENITAL AREA OF EACH LIFE STAGE FOR FOUR SPECIES OF PROSTIGMATA OCCURRING AT SIGNY ISLAND, SOUTH ORKNEY ISLANDS

Species and life stage	*Number of setae*			*Number of genital discs*
	Paragenital	*External genital*	*Internal genital*	
Eupodes minutus				
L	0	0	0	0
PN	0	1	0	1
DN	2	2	0	2
TN	3	3	0	2
M	4	6	6 (+sperm sac)	2
F	4	6	6	2
Stereotydeus villosus				
L	0	0	0	0
PN	0	1	0	1
DN	2	2	0	2
TN	5–9	3	0	2
M	12–20	6	6 (+sperm sac)	2
F	12–20	6	6	2
Ereynetes macquariensis				
L	0	0	0	0
PN	1	1	0	2 sets of 4 small pores
DN	2	2	0	2 sets of 4 small pores
TN	3	3	0	2 sets of 4 small pores
M	5	6	3 (+testis)	2
F	5	6	0	2 (+1)
Tydeus tilbrooki				
L	0	0	0	0
PN	0	1	0	0
DN	2	2	0	1 set of 2 small pores
TN	3–4	3	0	2 sets of 2 small pores
M	4	5 nude+1 plumed	6 (+sperm sac)	2 very small stalked structures
F	4	6 plumed	2	2 very small stalked structures

L larva; PN protonymph; DN deutonymph; TN tritonymph; M male; F female.

Womersley and Strandtmann (1963) stated that the paragenital setae number between ten and 12, although they did not examine material from the South Orkney Islands. Morphological variation within a species may be expected when populations are isolated by major geographical barriers (*c.* 640 km of ocean separate the South Orkney Islands from the nearest land at the north end of the Antarctic Peninsula). Morphological variation between the South Orkney Islands and the Antarctic Peninsula populations of *S. villosus* are discussed below. The genus *Tydeus* is also represented by more species (five) in the Antarctic than most other arthropod genera. Morphological variation in different populations of *Tydeus erebus* Strandtmann has been reported by Rounsevell (1977*b*). The genus *Eupodes* has the same number of Antarctic representatives as *Tydeus* but no morphological variation in *Eupodes* has been noted. No variation was observed in the South Orkney Islands populations of *E. minutus* when compared with specimens from the Antarctic Peninsula. The Antarctic Peninsula populations of *N. antarcticus* vary slightly in pedipalpal setation from those in the South Orkney Islands (Strandtmann, 1967) and there are only two species of this genus in the Antarctic (*N. antarcticus* and *Nanorchestes bifurcatus* Strandtmann). The number of mite species of a genus in a defined area is not necessarily correlated with the degree of intraspecific variation. It seems that geographically isolated populations of most Antarctic arthropods exhibit morphological variation to a greater or lesser degree. The ability of a species to change morphologically and physiologically in such harsh and variable environments may be ecologically advantageous.

Figs 2 and 6 show the pedipalp structure of the four above-mentioned species of Prostigmata and Table IV details their leg chaetotaxy. The leg chaetotaxy increases in complexity with succeeding life stages and for the Signy Island species it shows little intraspecific variation. It is a useful secondary parameter for life-stage separation when the genitalia are distorted or obscured. The pedipalp structure is sufficiently different between species to enable them to be separated when other parameters are unusable. Fig. 8 shows the pedipalp and genital structure of the fifth species of Prostigmata (*Spinibdella antarctica* (Trägårdh 1907)).

With the aid of these data and illustrations it should be possible reliably to separate the life stages both within and between these four species of Prostigmata in the Signy Island acarine fauna.

Biological Observations

The following systematic treatment provides descriptions of each species listed in Table I together with relevant biological observations.

Order Mesostigmata

Family Rhodacaridae Oudemans 1902

Gamasellus racovitzai (Trouessart 1903)

Adults of this species are well-sclerotized mites, dark orange-brown in colour and about 1 mm in length, while the immature stages are progressively less sclerotized and lighter in colour with the pale orange-white larva being virtually unsclerotized. This species is fairly active in the field and may be observed moving rapidly about under stones when disturbed. The taxonomy of this mite is unclear with the generic name alternating between *Cyrtolaelaps* (Ryke, 1962) and *Gamasellus* (Trägårdh, 1908), both being used freely in the literature. At present the latter name is used. The adult and immature stages of this species have been re-described by Hunter (1967*a*). The body-length measurements in Table II differ slightly from those given by Hunter, with the larva and protonymph from Signy Island being slightly smaller and the deutonymph slightly larger than his specimens from the Antarctic Peninsula.

G. racovitzai is the only common predatory mite recorded from the South Orkney Islands. It is found either as isolated individuals or in loose active aggregations of varying size (*c.* 10–400+ individuals) mainly under stones on or near moss and algal communities but tending to avoid wet, waterlogged and dry barren areas. The number of individuals found is minimal in mid-summer and maximal in early spring (October–November) and late summer (late February–March). Usually the larger aggregations consist mostly of deutonymphs in early spring and late summer, the proportion of other life stages increasing towards mid-summer and decreasing in autumn. Larvae are always scattered and are rarely aggregated in the field. The reasons for deutonymphal aggregations are unknown but in mid-summer when prey populations are maximal a greater dispersal of the predator will be advantageous in ensuring that more prey is caught by the predator population as a whole, thus increasing its reproductive potential. Although the deutonymph is the main overwintering stage, all life stages except the larva are recorded in every month of the year. However, adults are scarce in winter and may be represented by the hardier survivors from the preceding summer. Activity is minimal in winter and when field temperatures fall below 0° C individuals observed under stones are inactive. It is not known whether overwintering adults breed in spring but adults are not recorded in the early spring aggregations. In winter (April–October) only occasional individuals of *G. racovitzai* are found under stones and it is thought that the deutonymphal aggregations of autumn disperse in the surface layers of the substrate to overwinter, re-forming in the spring, possibly for mating as deutonymphs moult to adults. Once an adult female has mated, it leaves the

TABLE IV. LEG CHAETOTAXY OF THE IMMATURE STAGES OF FOUR SPECIES OF PROSTIGMATA FROM SIGNY ISLAND, SOUTH ORKNEY ISLANDS

Species	*Life stage*	*Limb number*	*Limb section*					
			Tarsus	*Tibia*	*Genu*	*Femur*	*Trochanter*	*Coxa*
Eupodes minutus	L	I	12	4	4	6	0	0
		II	7	3	4	3	1	0
		III	6	4	3	4	1	1
	PN	I	14	5	4	4	0	2
		II	7	4	4	7	0	1
		III	8	4	3	5	1	2
		IV	6	0	0	0	0	0
	DN	I	14	5	4	7	0	1
		II	10	5	4	7	0	1
		III	8	4	4	3	1	2
		IV	8	4	3	3	1	0
	TN	I	15	5	6	11	0	2
		II	12	5	4	9	1	1
		III	9	4	3	7	1	2
		IV	12	4	3	4	0	2
Stereotydeus villosus	PN	I	14	6	5	6	0	1
		II	11	6	4	6	1	1
		III	8	5	5	5	1	2
		IV	6	0	0	0	0	0
	DN	I	15	6	4	6	0	2
		II	10	5	5	6	0	1
		III	10	5	4	4	1	2
		IV	9	5	2	3	0	1
	TN	I	16	6	4	6	1	2
		II	11	6	4	6	1	1
		III	10	5	4	6	2	2
		IV	9	4	2	3	1	1
*Ereynetes macquariensis**	PN	I	8	4	4	6	1	2
		II	6	2	4	5	0	1
		III	6	2	4	3	1	1
		IV	6	2	4	(2+0)*	0	0
	DN	I	8	4	4	6	1	1
		II	6	4	4	4	1 nu	1
		III	6	4	3	3	1	2
		IV	6	3	3	(2+2)*	0	2
	TN	I	6	6	4	6	1	3
		II	6	3	4	4	1 nu	1
		III	6	3	3	3	1	2
		IV	6	3	3	(2+2)	0	3
			pl nu	pl nu	pl nu	pl nu	pl nu	pl nu
Tydeus tilbrooki†	L	I	4 2	0 3	0 3	0 4	0 0	0 0
		II	4 2	0 2	0 2	0 4	0 0	0 0
		III	4 2	0 2	0 2	0 3	0 0	0 0
	PN	I	8 2	0 4	0 3	0 4	0 0	0 2
		II	(4–6) 1	0 2	0 2	0 4	0 0	1 0
		III	(4–5) 1	1 1	0 3	0 4	0 2	1 0
		IV	5 1	0 0	0 0	0 0	0 0	0 0
	DN	I	8 2	0 (3–4)	0 3	0 4	0 0	0 2
		II	6 1	0 2	0 2	0 4	0 0	(1–2) 0
		III	4 1	1 1	0 2	0 4	0 1	1 1
		IV	5 0	0 2	0 2	0 2	0 0	1 0
	TN	I	9 1	0 4	0 3	0 4	0 1	0 2
		II	6 1	0 3	0 2	0 4	0 0	2 0
		III	5 1	1 1	0 2	0 (3–4)	0 1	1 1
		IV	5 1	1 1	0 3	0 2	0 0	1 1

* Femur IV is partially divided with setae on each half.

† In this species setation is variable within life stages; the numbers in brackets show the range of variation observed in this study.

L larva; PN protonymph; DN deutonymph; TN tritonymph; I–IV leg number from anterior to posterior; pl plumose setae; nu nude setae. Unless otherwise indicated all setae are plumose.

aggregation to lay eggs elsewhere in the habitat, possibly in the moss turf where the larvae can feed on the small Prostigmata. Females are scarce in collections of adults from aggregations, the ratio of males to females in several hundred observations being 9.7:1. There are many more non-gravid than gravid females present in aggregations at all seasons.

G. racovitzai was first recorded from the Gerlache Strait area of the Antarctic Peninsula (Trouessart, 1903) and has since been recorded from many localities in the Antarctic Peninsula–Scotia arc region (Trägårdh, 1907, 1908; Trouessart, 1907; Berlese, 1917; Gressitt and Weber, 1960; Hunter, 1967*a*, *b;* Tilbrook, 1967) and also at South Georgia (Hunter, 1970). On Signy Island the mite is widely distributed from sea-level to isolated nunataks on the permanent ice cap.

Family Laelaptidae Berlese 1892

Proctolaelaps hypudaei (Oudemans 1902)

Several specimens of this species were recorded from Signy Island by Tilbrook (1973*b*), two in a sample from a shallow fresh-water pool and a third from an unrecorded source. No specimens were recorded in the present study. Evans and others (1961) listed this species as a predator in underground mammalian nests in the British Isles and Hughes (1961) recorded it from stored food. In view of these observations, it is unlikely that this species is native to Signy Island especially as it has never been recorded in the field and no records exist for it elsewhere in the Antarctic. This mite is assumed to be an introduced species.

Family Haemogamasidae Oudemans 1926

Haemogamasus pontiger (Berlese 1903)

One specimen of this species was recorded by Tilbrook (1973*b*) from an un-named source on Signy Island. It was not found during the present study. *H. pontiger* has been recorded from sub-Antarctic Macquarie Island in the vicinity of the Australian research station (Watson, 1967) and from debris on the floor of living quarters at Davis Station on the east coast of Antarctica (Rounsevell, in press). *H. pontiger* has been recorded from many areas of the world in warehouse debris, stored foods, etc. and in the underground nests of small mammals (Hughes, 1961). It is doubtful if this mite is indigenous to Signy Island.

Family Ascidae Voigts and Oudemans 1905

Lasioseius sp.

Three specimens of a species of *Lasioseius* were found during the present study in a laboratory culture of the foliose alga *Prasiola crispa* taken from an elephant seal wallow. According to Evans (1957), members of this genus are predatory upon mites in stored foodstuffs. *Lasioseius* was not recorded by Tilbrook (1973*b*) and, as with the previous two species, it is probably an introduction.

Order Cryptostigmata

Family Podacaridae Grandjean 1955

Alaskozetes antarcticus (Michael 1903)

A dull brownish black species, heavily sclerotized and almost globular in shape, it is the largest mite recorded from Signy Island. The mean adult length is fractionally longer than that

of *G. racovitzai* (Table III), while its mean live weight (*c.* 170 μg) is greater than that of the mesostigmatid mite (*c.* 105 μg).

A. antarcticus, described in detail by Wallwork (1962), has been the subject of a number of studies. Various workers, including Gressitt (1967*b*), Strong (1967) and Tilbrook (1967, 1973*b*), have made ecological observations on this species, while Peckham (1967), Marsh (1973) and Block (1977) have undertaken physiological studies.

Sluggish in activity, *A. antarcticus* is widely distributed on Signy Island below 200 m altitude, and it can occur in dense aggregations varying from tens to thousands of individuals. Dense aggregations are usually found in areas rich in organic debris, especially of animal origin such as dead birds and guano in penguin and other sea-bird colonies, on old whale bones and around well-rotted seal carcasses. Large numbers are often associated with *Prasiola crispa* and various species of crustose lichen, especially on lower ground near the sea, but it generally avoids the littoral and splash zones where it is often replaced by *Halozetes belgicae* (Michael). All life stages of *A. antarcticus* including ova occur in aggregations throughout the year, which supports the findings of Strong (1967) and Tilbrook (1973*b*), although Strong's observation at Palmer Station on the Antarctic Peninsula that the aggregations disperse in summer was not confirmed by the present study. At Signy Island, the aggregations remained relatively stable in numbers and position throughout the year with a slight tendency to dispersion in winter. When the habitat temperature falls below 0° C for more than a few days, *A. antarcticus* gradually becomes less active, and in prolonged periods of low temperatures it becomes motionless. In general, the species is least active between April and October; however, even in mid-winter, summer-activity levels were observed in aggregations on crustose lichen on rocks exposed to direct solar radiation. No aggregations were observed in the moss-turf communities (SIRS 1) or in the damper moss carpets (SIRS 2) where only isolated individuals, mostly adults, were found. However, Tilbrook (1973*b*) recorded concentrations of *A. antarcticus* in *Andreaea–Grimmia* moss communities.

In most aggregations, live mites were mixed with exuviae and corpses, the exuviae generally being fused into a crust. Strong (1967) suggested that the cementing material may be the integumental secretions of moulting nymphs. *A. antarcticus* survives immersion in water for prolonged periods, many specimens of adults and nymphs being found clinging to fresh-water filamentous algae in shallow pools and in some fresh-water lakes to a depth of *c.* 4–5 m. In the laboratory these mites remained alive after being sealed in jars full of algae and water for over 9 months (personal communication from J. J. Light). Sex ratios in *A. antarcticus* aggregations were *c.* 1:1, similar to the findings of Strong (1967), Covarrubias (1968) and Tilbrook (1973*b*). The first author found adult to immature ratios of 5:1 but present observations confirm the findings of Tilbrook (1973*b*) with a ratio of 1:1.

A. antarcticus is the most frequently recorded mite in collections of Antarctic and sub-Antarctic Acari (Greene and others, 1967) and it occurs in many localities in the maritime Antarctic as well as the sub-Antarctic islands (Michael, 1903; Trägårdh, 1908; Wallwork, 1965, 1967; Gressitt, 1967*b*, 1970).

Halozetes belgicae (Michael 1903)

This mite is essentially similar to *A. antarcticus* in activity and shape, and is equally well sclerotized. However, it is smaller, adults rarely exceeding 700 μm in length, and lighter in colour, being a light to medium chestnut- or chocolate-brown and much more glabrous. *H. belgicae* is the only other terrestrial cryptostigmatid mite recorded from Signy Island and it has been re-described by Wallwork (1965).

This species is similar in habits to *A. antarcticus* with which it is often associated. Tilbrook (1973*b*) rarely found *H. belgicae* in the absence of *A. antarcticus* but in the present study it was frequently found alone especially in crustose lichens on rocks near the sea, often in the littoral

and splash zones. These habitats included small offshore rocks where, with the exception of the prostigmatid *Tydeus tilbrooki*, it was the only terrestrial mite found, suggesting a greater salinity tolerance than in *A. antarcticus*. This salinity tolerance may be expected as the genus *Halozetes* has a number of marine representatives. The tendency to aggregate in this species is less marked than in *A. antarcticus*, aggregations being looser with fewer individuals and without the cemented mass of exuviae. More often than not, *H. belgicae* was found as isolated individuals. It was less common in areas rich in organic debris than *A. antarcticus*, possibly because it does not have the same affinity for nitrogen-rich areas as the latter species. *H. belgicae* was rarely found in fresh-water pools and lakes, and when confined underwater for several weeks it did not survive. On SIRS 1 and 2 only scattered individuals were found with slightly greater numbers in the wet moss-carpet communities. Few specimens were recorded on *Prasiola crispa* in contrast to the observations of Covarrubias (1968), who found highest populations on this alga; Gressitt (1967*b*) recorded few individuals from pure *Prasiola* but large numbers from lichenized *Prasiola*. At Signy Island the common habitats for *H. belgicae* were crustose lichens and some birds nests (not penguins), and occasionally old lichenized whale and seal bones.

H. belgicae is distributed throughout the Antarctic Peninsula–Scotia arc region and South Georgia (Wallwork, 1965, 1967, 1973), and several localities on sub-Antarctic islands (Spain and Luxton, 1971).

A second species, *Halozetes marinus* (Lohmann 1907) has been recorded in collections from Signy Island by Wallwork (1967). It appears to be restricted to the marine ecosystem, specimens being found in the present study on marine algae in intertidal pools.

Order Astigmata

Family Glycyphagidae Berlese 1917

Glycyphagus destructor (Schrank 1781)

This small pale white mite is easily recognized by the many long setae on the opisthosoma. Sheals (1956) reported this mite from arable soils in Scotland, while Solomon (1945) found it as an inhabitant of most stored food products. It is a cosmopolitan species (Evans and others, 1961). Tilbrook (1973*b*) recorded *G. destructor* in heat extractions of moss at Signy Island and large numbers were recorded in one sample from SIRS 1 in the present study. Investigation of dirt and debris in the station buildings, especially in the indoor food store, revealed many more specimens of this species. The occurrence of this mite in the extraction was probably due to the failure to cover the sample immediately after its removal from the extractor. When care was taken to prevent contamination of extracted samples, no further *G. destructor* were recorded. There was no evidence that this species occurred anywhere but in the station complex at Signy Island. It is virtually certain that this mite was introduced to Signy Island by Man.

Family Acaridae Ewing and Nesbitt 1942

Tyrophagus putrescentiae (Schrank 1781)

This species was recorded by Tilbrook (1973*b*) at Signy Island and on one occasion in the present study in old dry agar plates in the laboratory. It has never been recorded outside the station. *T. putrescentiae* is similar in appearance to *G. destructor* but it is slightly larger, *c.* 450 μm in length, and is undoubtedly introduced. Both *G. destructor* and *T. putrescentiae* were illustrated by Evans and others (1961).

Neocalvolia antarctica (Hughes and Tilbrook 1966)

This is an almost colourless pale translucent white species, ovoid in shape and with a transverse line on the opisthosoma, one-third of the body length from the gnathosoma. Two pairs of long setae on the posterior of the body and two lateral pairs anteriorly distinguish this species from any other mite on Signy Island. Adults range in size from 380 to 450 μm. A full description of *N. antarctica* has been given by Hughes and Tilbrook (1966), who referred to it as *Calvolia antarctica*. This species is rare on Signy Island, one female having been recorded in a moss core from *Polytrichum alpestre* encrusted with lichen, and several nymphs having been collected from the foliose alga *Prasiola crispa*. Hughes and Tilbrook (1966) recorded it from lichen-covered rocks. Nothing is known of the biology of *N. antarctica*. The genus is endemic to the sub-Antarctic and maritime Antarctic zones, and other species have been recorded from a variety of habitats including decaying vegetation, moss, lichen, algae, bird nests and guano (Fain, 1976). A key to the known species of *Neocalvolia* has been given by Fain (1976). To date, *N. antarctica* has only been recorded from the South Sandwich Islands (Hughes and Tilbrook, 1966) and Signy Island.

Family Hyadesidae Halbert 1915

Neohyadesia signyi Hughes and Goodman 1969

N. signyi is an oval, milky white species with orange-brown chelicerae and claws. The adult size is *c.* 500 μm with a pair of long posterior dorsal setae and the opisthosoma surrounded by a sparse fringe of slightly shorter setae. A full taxonomic description has been given by Hughes and Goodman (1969).

N. signyi is a fresh-water mite and the only known locality is a series of shallow (depth *c.* 0.01–0.5 m) brackish pools *c.* 10 m from the sea in Paal Harbour, Signy Island. The pools contain various nematodes, crustaceans and algae with much organic detritus. Little is known of its biology.

Recently, specimens of a mite fitting the description of *N. signyi* have been recorded from halophilic vegetation on the sub-Antarctic Macquarie Island over 7 000 km from Signy Island, off the coast of East Antarctica (Fain, 1975). Because of slight morphological differences, Fain (1975) has given the Macquarie Island specimens subspecies status, viz. *Neohydesia signyi punctulata* Fain 1975. Other species in the family Hyadesidae have been recorded in fresh-water, littoral and supra-littoral habitats in the sub-Antarctic (Fain, 1975).

Order Prostigmata
Family Eupodidae Koch 1842

Eupodes minutus (Strandtmann 1967)

Some authors refer to *Eupodes* as *Protereunetes* but Strandtmann (1970) has stated that the names are synonymous, the former taking precedence.

E. minutus is a small, green-brown pear-shaped mite often with a dorsal longitudinal red or white stripe and with translucent reddish or whitish legs. Adults range in length from 260 to 370 μm and are *c.* 2 μg live weight with the males tending to be slightly larger (Table II). It is, in common with many Prostigmata, a poorly sclerotized and extremely fragile mite, being easily damaged by handling and very susceptible to desiccation. Consequently, it is a very difficult animal to work with in the laboratory. It is an extremely active mite and can run very fast; Gressitt (1967*b*) commented on this high activity rate. Strong (1967) reported large numbers of *E. minutus*, including its pale salmon-pink eggs, associated with *A. antarcticus*

aggregations in amongst the cemented mass of exuviae. *E. minutus* was occasionally found with *A. antarcticus* on Signy Island but never in large numbers. Gressitt (1967*b*) recorded concentrations of *E. minutus* under stones near penguin rookeries and in *Pholia–Bartramia* moss associations. In the present study this mite was observed in large numbers on fruticose lichens (*Usnea* spp.) growing in well-shaded situations, on lichens encrusting moss banks (e.g. SIRS 1), and it was often abundant on *Prasiola crispa*. W. L. Graham (personal communication) observed *E. minutus* depositing eggs in a culture of *Prasiola crispa* at Palmer Station, Antarctic Peninsula. No oviposition was observed in the present study, although successful laboratory cultures were kept for several weeks. *E. minutus* was regularly found in small numbers under stones on moist silty ground rich in algae and also under stones in moist but not waterlogged areas on moss banks. It avoided dry situations and areas subject to prolonged direct solar radiation. It would rapidly run around the underside of a stone when it was overturned in daylight; this photonegative behaviour was also observed in the laboratory but this may have been an avoidance of low humidity. In the field it is very difficult to distinguish *E. minutus* from *Ereynetes macquariensis*. The structure of the genital area and pedipalps for all life stages of *E. minutus* is shown in Figs 1 and 2a, while Table IV gives the leg chaetotaxy of the immatures.

The adult of *E. minutus* was first described by Strandtmann (1967), who recorded it from the northern part of the Antarctic Peninsula; it has been recorded also from the South Orkney and South Sandwich Islands in the Scotia arc (Tilbrook, 1967), South Georgia (Gressitt, 1970; Strandtmann, 1970), and more recently I identified it in material collected by R. B. Heywood at Ablation Point, Alexander Island (lat. 71°31′S), off the southern part of the Antarctic Peninsula.

Halotydeus signiensis Strandtmann and Tilbrook 1968

H. signiensis is a medium-sized (adult length *c.* 500 μm), dark olive-green ovoid mite. It is relatively inactive, sluggish and rather rare, preferring damp moss habitats such as *Drepanocladus uncinatus*, *Calliergidium austro-stramineum* and *Calliergon sarmentosum*. It was occasionally found on SIRS 2 but was more regularly observed on clumps of *Drepanocladus* spp. growing in shady melt runnels in damp crevices on rock faces and sometimes on rock outcrops on high ground on the ice cap. It was never found in areas affected by salt spray. Two ova in a female were observed to contain possible pre-larvae. This species is endemic to Signy Island, where it was first recorded in Tilbrook's survey (Strandtmann and Tilbrook, 1968), and adjacent Coronation Island, where it was collected in the present study.

Family Penthalodidae Thor 1933

Stereotydeus villosus (Trouessart 1902)

S. villosus is the largest and most noticeable terrestrial prostigmatid species on Signy Island, the adult ranging from 500 to 750 μm in length and being 20–34 μg live weight. This moderately active mite is dark olive-green in colour with a bright red fringe bordering the dorsal surface of the opisthosoma. The bright scarlet legs are long and slender; adults and tritonymphs are ovoid in shape and similar in coloration, whilst the larva, protonymph and deutonymph are lighter in colour and are pear-shaped resembling adult *E. minutus*, *E. macquariensis* and *T. tilbrooki*. They can be distinguished by the slightly longer legs, slower locomotory rates and the absence of the dorsal longitudinal stripe.

The adult of *S. villosus* was re-described by Womersley and Strandtmann (1963). The immature stages have yet to be described but Graham (1974) has given the body-length measurements of all life stages at Palmer Station on the Antarctic Peninsula. These differ from

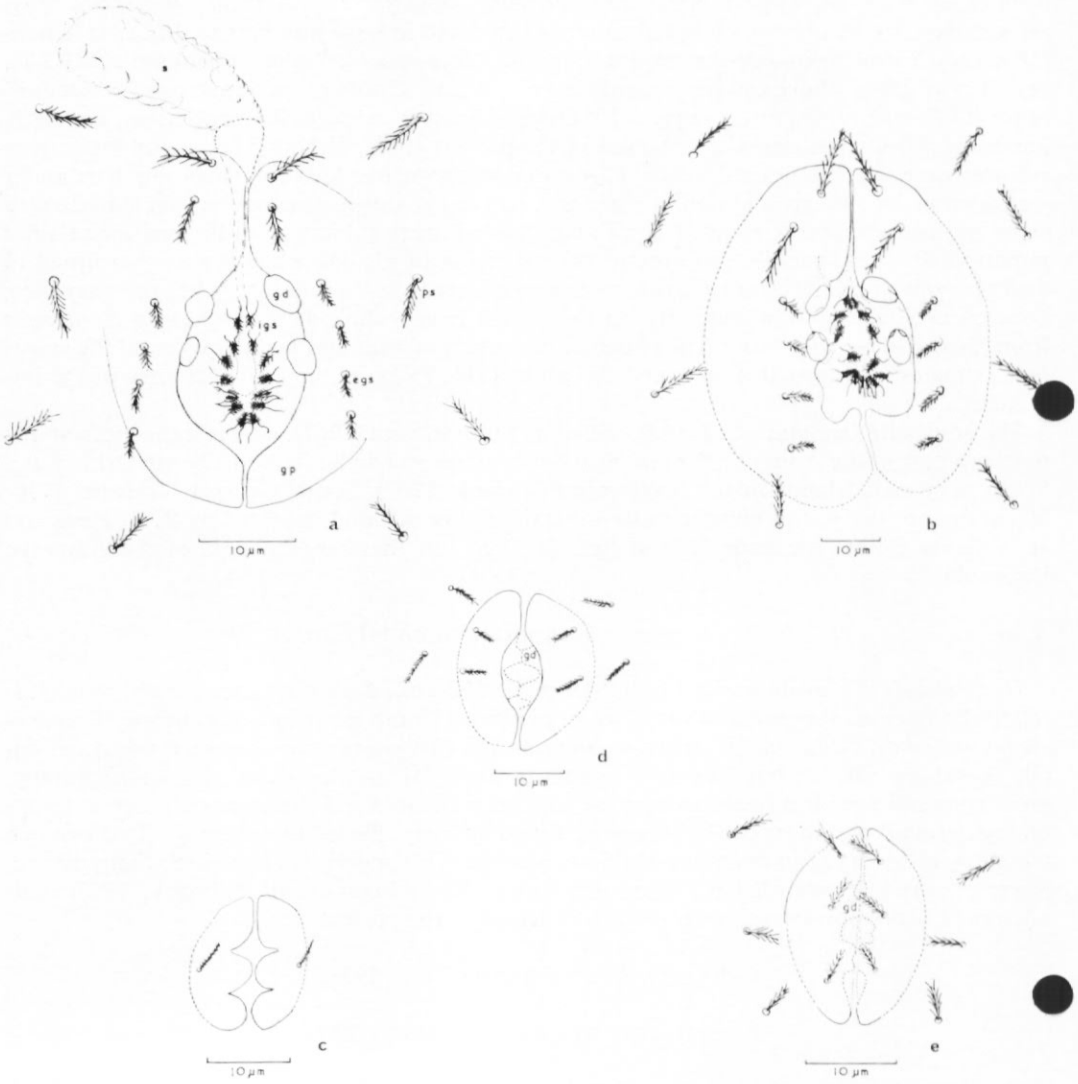

Fig. 1. *Eupodes minutus* Strandtmann; genital structure of adult and nymphal stages.
a. ♂; b. ♀; c. Protonymph; d. Deutonymph; e. Tritonymph.
s, sperm sac; gd, genital disc; igs, internal genital setae; egs, external genital setae; ps, paragenital setae; gp, genital plate. Top of the figure is anterior and bottom is posterior.

those of the material measured at Signy Island, with the Antarctic Peninsula specimens, except the tritonymph, being 10–20% longer than the Signy Island animals. The tritonymphs were similar. *S. villosus* is sexually dimorphic with the mean female live weight being significantly ($P < 0.05$), greater than the male by 2.35 ± 0.07 μg, i.e. *c.* 8% (Goddard, 1977*c*). The mean genital plate length of the female is 107.2 ± 1.3 μm (range 84–120 μm) and of the male $84.8 \pm$

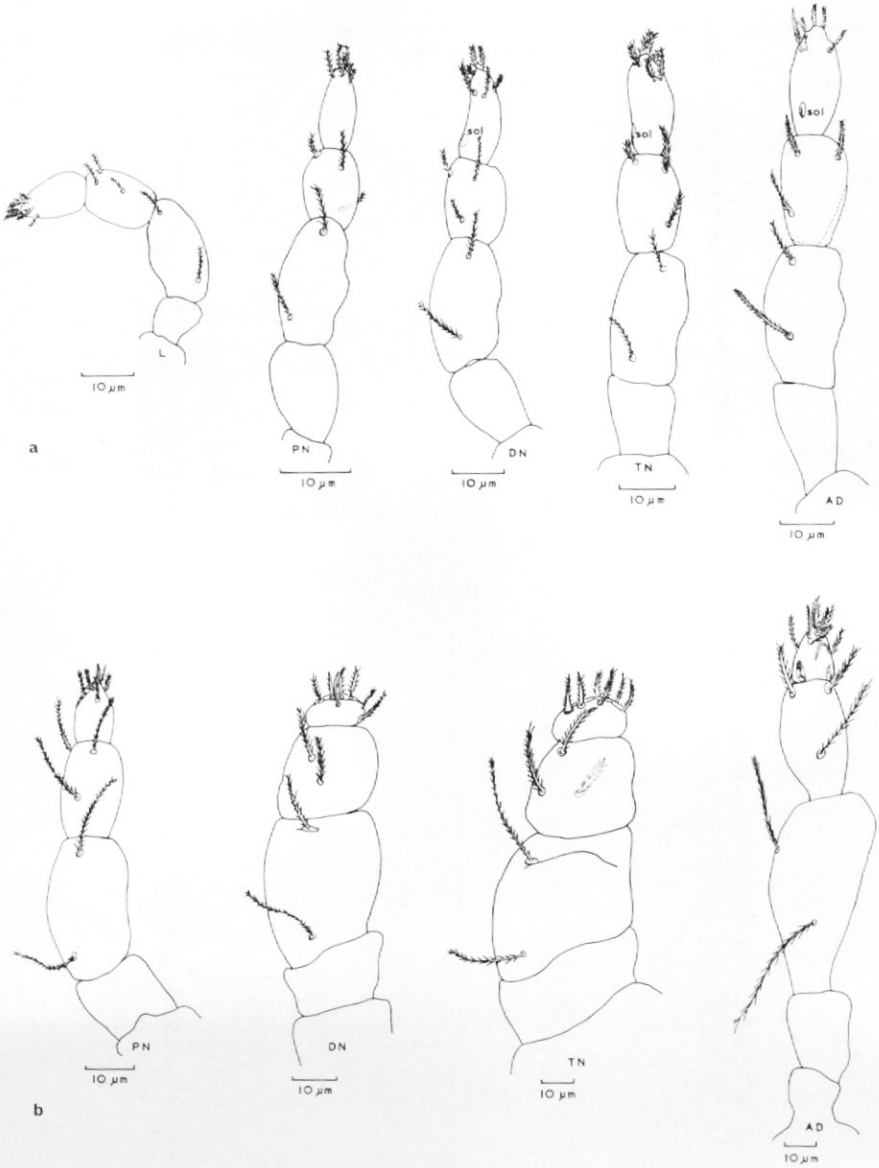

Fig. 2. a. Pedipalp structure of all life stages of *Eupodes minutus* Strandtmann.
b. Pedipalp structure of the nymphal and adult stages of *Stereotydeus villosus* (Trouessart).
sol, solenidion.
L, larva; PN, protonymph; DN, deutonymph; TN, tritonymph; AD, adult.

1.9 μm (range 78–100 μm), a difference of 21%, which is significant at $P < 0.05$. Similar measurements were given by Graham (1974) for *S. villosus* from Palmer Station, the only difference being the smaller males, which ranged from 68 to 87 μm with a mean of 78 μm. Fig. 2b gives details of the pedipalps, whilst Figs 3 and 4 illustrate the genital structure of adult and immature stages of *S. villosus* and Table IV gives the chaetotaxy of the legs. Accord-

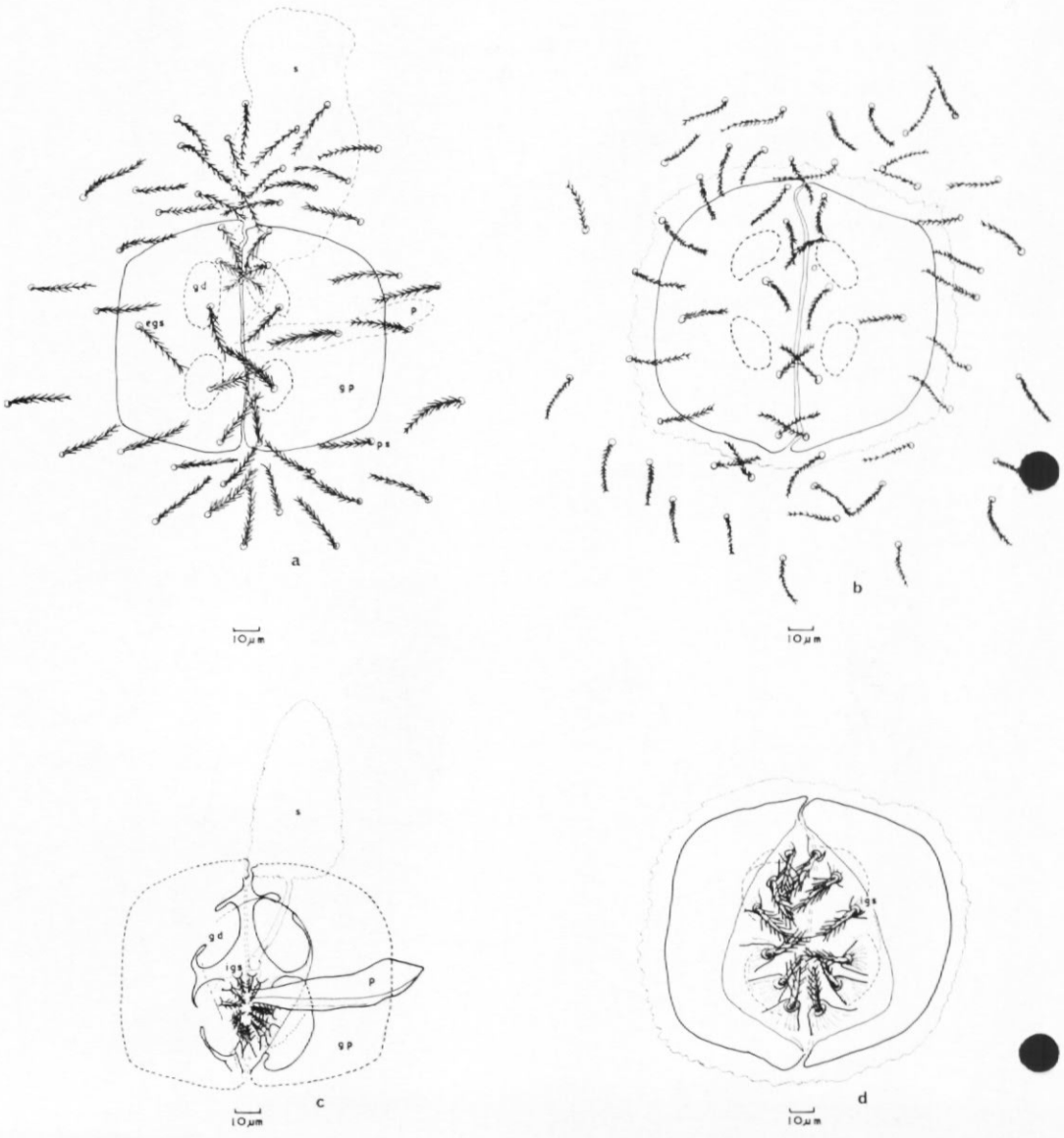

Fig. 3. *Stereotydeus villosus* (Trouessart); adult genital structure.
a and b. External features; c and d. Internal features.
a. ♂; b. ♀; c. ♂; d. ♀.
s, sperm sac; gd, genital disc; gp, genital plate; egs, external genital setae; ps, paragenital setae; p, penis igs, internal genital setae. Top of the figure is anterior and bottom is posterior.

ing to Gressitt (1967*b*), *S. villosus* is replaced in the South Orkney Islands by *S. intermedius* and Wallwork (1973) found both species in collections from these islands. Strandtmann (1967) gave the locality of *S. intermedius* as moss on Laurie Island with a brief taxonomic description, but he stated that he had yet to see a specimen. Since no specimen of this species exists in the collections of the British Antarctic Survey, and as no other record can be traced, the authen-

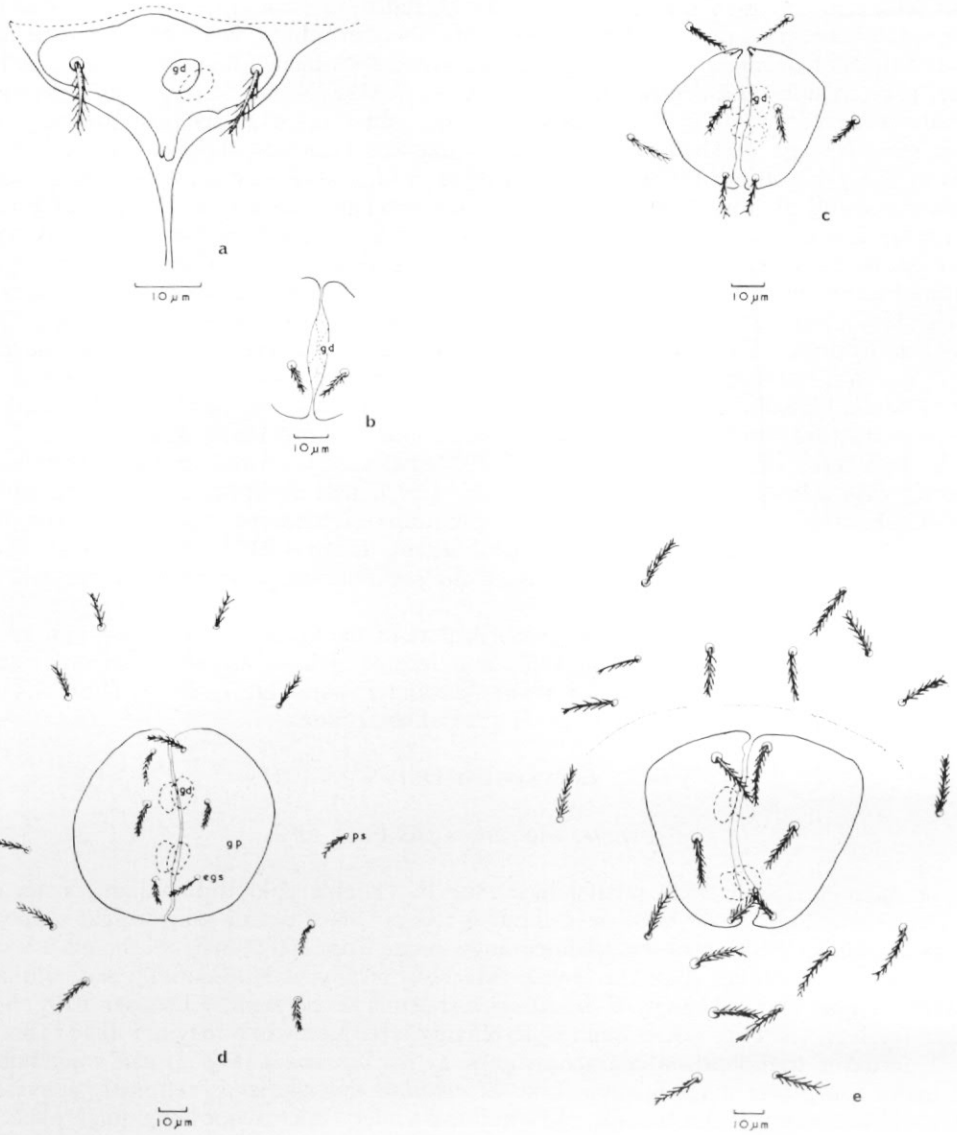

Fig. 4. *Stereotydeus villosus* (Trouessart); genital structure of nymphs; note variation in external genital setation of tritonymph.
a. Protonymph; b. Protonymph; c. Deutonymph; d. Tritonymph; e. Tritonymph.
gd, genital disc; gp, genital plate; egs, external genital setae; ps, paragenital setae. Top of the figure is anterior and bottom is posterior.

ticity of the existence of *S. intermedius* must remain in doubt. All specimens from Signy Island in the present study and the Antarctic Peninsula fit the description of *S. villosus* as given by Womersley and Strandtmann (1963).

S. villosus is common in loose aggregations under stones on moss banks, under stones in moist algal-rich silty ground and under stones overlying drier stands of the moss *Drepano-*

cladus uncinatus, often in the company of the predatory mesostigmatid *G. racovitzai*. It is infrequent in the moss profile, although large numbers of adults have been recorded in the surface fronds of *Grimmia antarctici* and *D. uncinatus*. Specimens found in mosses tend to be larvae, protonymphs and deutonymphs. Both Gressitt (1967*b*) and Strong (1967) observed a diurnal rhythm of activity in *S. villosus* with groups wandering over the moss surface at dusk and in very overcast weather, dispersing in daytime and bright conditions. This activity was noted at Signy Island but the individuals in these groups were very scattered. An avoidance response, possibly photonegative, was observed in individuals subjected to the light of a microscope lamp in the laboratory. *S. villosus* avoids conditions of low humidity and very waterlogged areas in the field. Aggregations under stones tend to disperse when the substrate temperature falls below 0° C, although individuals were observed active at −5° C. This supports Strong (1967), who observed activity below 0° C amongst ice crystals under stones. Such activity in the present study was much reduced compared to the level above 0° C. In the laboratory, *S. villosus* showed signs of torpidity at temperatures above +15° C, even at high relative humidity, and died in a few minutes at +25° C. These comments must be treated with caution as they are based on only ten adults, which had been previously maintained at +2° to +3° C. In a series of experiments, Graham (1974) recorded a greater degree of temperature tolerance with a lower lethal temperature of *c.* −16° C and an upper lethal temperature of +34° C. Fitzsimons (1971) studied the temperature tolerance of several Antarctic mites including *Stereotydeus mollis* and recorded heat distress above +23° C; he noted that survival time at a particular temperature depended on the previous temperature which the mite had experienced.

S. villosus has been recorded from the north part of the Antarctic Peninsula (Trouessart, 1902; Trägårdh, 1908; Strandtmann, 1967) and recently I have identified it from material collected by R. B. Heywood at Ablation Point, Alexander Island (lat. 71°31′S). Tilbrook (1967) recorded it from the South Shetland and South Orkney Islands.

Family Ereynetidae Oudemans 1937

Ereynetes macquariensis Fain 1962

E. macquariensis is a small pear-shaped mite of variable coloration ranging from dark green-brown to light fawn, with or without a red or white dorsal longitudinal stripe and reddish or whitish translucent legs. Adults range in size from 250 to 380 μm, the male tending to be smaller and darker than the female. Macroscopically, it is essentially very similar to *Eupodes minutus* and, although *E. macquariensis* tends to be slightly broader with shorter thicker forelegs, the two species cannot be reliably separated while they are alive. The long dorsal posterior trichobothria characteristic of *E. macquariensis* (Fig. 5) can sometimes be seen under low-power magnification. Like *E. minutus*, this species is extremely active, very fragile and susceptible to desiccation, and specimens under a microscope lamp quickly succumb and die. Fain (1962) reported that some specimens of *E. macquariensis* contained small bluish granules and similar granules were observed in many individuals in the present study, although nearly always in adults, rarely in tritonymphs and never in other life stages. The pigmentation is similar to the dark slate-blue colour characteristic of the collembole *Cryptopygus antarcticus*, the most numerous terrestrial arthropod on Signy Island, but there is no evidence of *E. macquariensis* predating Collembola and it may be that similar feeding habits or other factors account for the similarity of pigmentation. The presence or absence of this granular blue material affects the colour of specimens and more often than not the darker-coloured green-brown individuals were filled with these granules, specimens without granules tending, but not exclusively, to be fawn in colour.

The previously undescribed nymphal genital structures are shown in Fig. 5 together with

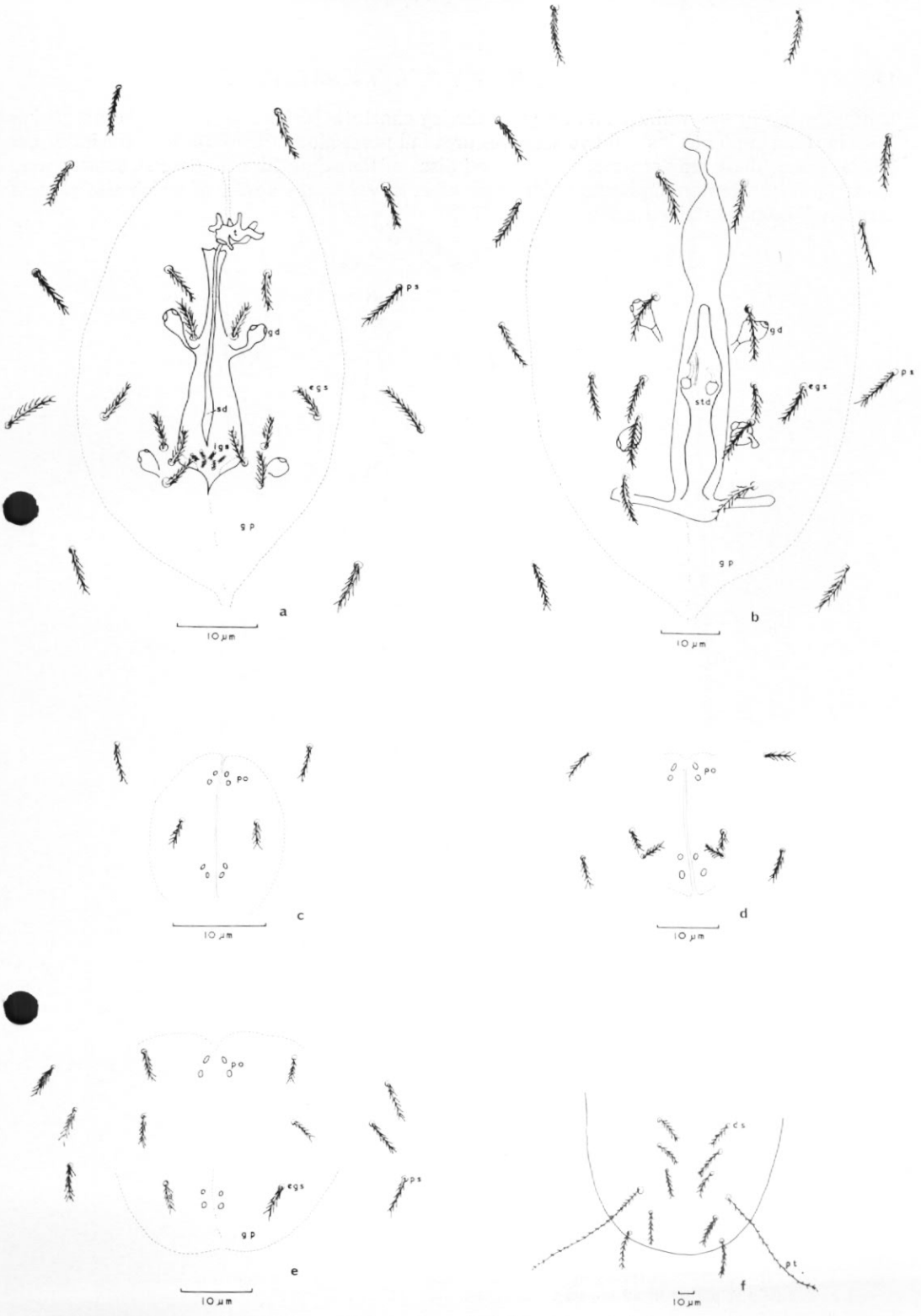

Fig. 5. *Ereynetes macquariensis* Fain; genital structure of adult and nymphal stages.
a. ♂; b. ♀; c. Protonymph; d. Deutonymph; e. Tritonymph; f. Tritonymph, dorsum.
t, testis; gd, genital disc; gp, genital plate; igs, internal genital setae; egs, external genital setae; ps, paragenital setae; sd, sperm duct; po, genital pore; std, stalked discs; ds, dorsal setae; pt, posterior trichobothria. Top of the figure is anterior and bottom is posterior.

pedipalps in Fig. 6a, while Table IV gives the leg chaetotaxy. There appear to be no genital discs in the nymph but instead two sets of four small pores along the mid-line of the indistinct genital plate; these may represent the stalked discs of the adult. Similar pore structures were observed in the deutonymph and tritonymph of *T. tilbrooki*, the adults of which also possess very small internal stalked genital structures.

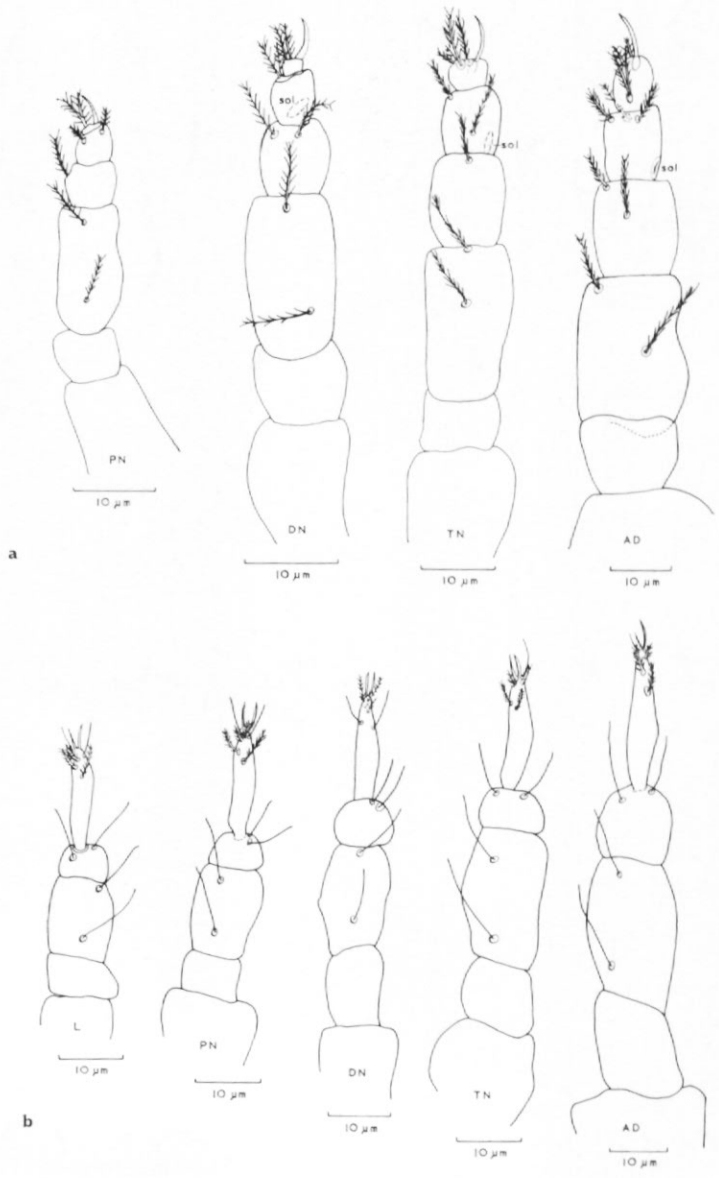

Fig. 6. a. Pedipalp structure of the nymphal and adult stages of *Ereynetes macquariensis* Fain.
b. Pedipalp structure of all life stages of *Tydeus tilbrooki* Strandtmann.
sol, solenidion.
L, larva; PN, protonymph; DN, deutonymph; TN, tritonymph; AD, adult.

On Signy Island, *E. macquariensis* occurs in much the same situations as *E. minutus*, being common under stones on damp algal-rich soil, in *Prasiola crispa* and in the drier moss banks such as SIRS 1. Fain (1962) gave a varied list of habitats in which this mite had been collected, the most preferred being green algae on rocks, in litter and in a grass (*Poa* sp.). Tilbrook (1973*b*) recorded bryophyte habitats as the most preferred. Both these authors thought that *E. macquariensis* tended to occur deep in the soil profile, the former recording individuals at a depth of 1.5 m. These observations are supported in the present study as it was found at similar depths in a moss profile as well as in silty soil much more frequently than other mites at Signy Island.

First described from sub-Antarctic Macquarie Island (Fain, 1962), *E. macquariensis* was re-described by Strandtmann and Tilbrook (1968), who recorded it from localities in the northern part of the Antarctic Peninsula (South Shetland Islands and Deception Island) as well as from the South Orkney Islands. Strandtmann (1970) reported this species from many localities in South Georgia, while Fain (1976) identified it from Iles Kerguelen material. It may well be that this species is circum-polar in the sub-Antarctic (Wallwork, 1973).

Family Tydeidae Kramer 1877

Tydeus tilbrooki Strandtmann 1967

T. tilbrooki is a small pear-shaped mite, dark reddish green in colour with a red longitudinal dorsal stripe and bright scarlet legs and gnathosoma. It is similar in appearance to *E. minutus* and *E. macquariensis* but it is not so variable in colour and, although highly active, it does not exhibit the high level of activity of the eupodid or ereynetid mites. Adults range from 250 to 320 μm in length and are approximately 1.9 μg live weight. Both Tilbrook (1973*b*) and Gressitt (1967*b*) mentioned that this is one of the smallest Antarctic mites. From the many observations made in the present study, the size of this mite is little different from the other small Prostigmata at Signy Island with many specimens being larger, albeit slightly, than *E. minutus*. *T. tilbrooki* is less fragile and much easier to handle than either *E. minutus* or *E. macquariensis* and it is less prone to desiccation. Prolonged observation in the laboratory under a microscope lamp did not appear to damage or distress this species, whereas all other Prostigmata died in *c.* 10 min. There was no indication of photonegative behaviour in *T. tilbrooki*. It is slightly more sclerotized than the other Prostigmata and this may explain its greater hardiness.

The adult mite was described by Strandtmann (1967) but the immature stages have not been described; the genital structures are shown in Fig. 7, the pedipalps in Fig. 6b, and the leg chaetotaxy is given in Table IV. The nymphal coloration is similar to that of the adult, the larva and protonymph being slightly lighter in colour.

T. tilbrooki is most commonly found in large aggregations associated with mats of *Prasiola crispa* and lichen encrustations, especially *Xanthoria candilaria*, on rock faces and the various species growing on drier moss banks (e.g. SIRS 1) but few specimens were found in the moss profile itself. Gressitt (1967*b*) recorded large numbers of this mite in *Prasiola* mats, especially lichenized *Prasiola*, *Polytrichum* moss and various lichens including species of *Ramalina*, *Caloplaca* and *Usnea*. Tilbrook (1973*b*) found *T. tilbrooki* virtually confined to lichens and suggested that it showed a wide temperature tolerance. This is supported by the present observations, where *T. tilbrooki* was recorded active in the field in winter on *Prasiola* at an air temperature of *c.* -15° C, and on lichens on a sunny rock face in summer at $+27^{\circ}$ C (the latter temperature was recorded on the surface of a *X. candilaria* encrustation with a portable thermistor probe). This species was reared through all life stages in the laboratory on *Prasiola crispa* contaminated with a mass of fungal hyphae and it thrived equally well in conditions of both high and low humidity. Ova observed in female mites appeared to contain pre-larvae,

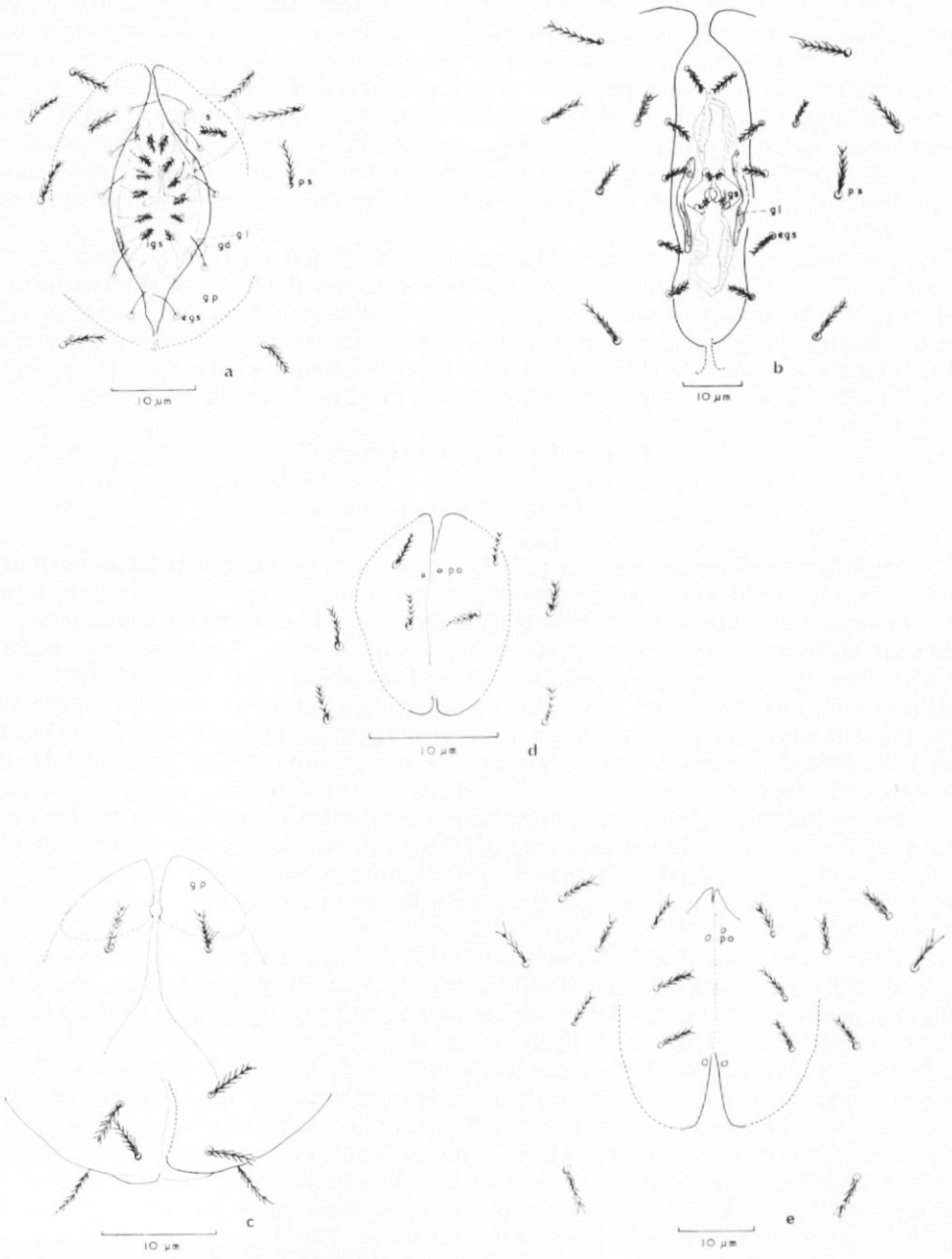

Fig. 7. *Tydeus tilbrooki* Strandtmann; genital structure of all life stages.
a. ♂; b. ♀; c. Protonymph; d. Deutonymph; e. Tritonymph.
s, sperm sac; gd, genital disc; igs, internal genital setae; egs, external genital setae; ps, paragenital setae; gp, genital plate; po, genital pore; gl, genital papillae. Top of the figure is anterior and bottom is posterior.

although in the laboratory eggs did not hatch for 3–4 weeks after oviposition. Its life cycle in the laboratory has been discussed by Goddard (1979).

T. tilbrooki has been recorded from the north of the Antarctic Peninsula and the South Orkney Islands (Tilbrook, 1967; personal communication from W. L. Graham) and from South Georgia where it is rare (Strandtmann, 1970).

Family Pachygnathidae Kramer 1877

Nanorchestes antarcticus Strandtmann 1967

This is a small deep red, almost spherical, mite with short, thick, bright red legs and gnathosoma. It cannot be confused with any other prostigmatid mite occurring at Signy Island, as when examined microscopically it is immediately distinguished by its spheroid shape and characteristic branched setae. It is a moderately active species but when disturbed it can jump many times its own length (maximum recorded distance in the present study was *c.* 80 mm); this phenomenon had been noted previously by Gressitt (1967*b*) and Strong (1967). Other Antarctic Prostigmata are able to jump and have thickened posterior femora, e.g. *Eupodes wisei* Womersley and Strandtmann (Gless, 1972). The femora of *N. antarcticus* are normal and, as there is no furcula-like structure as in Collembola, the mechanism of jumping is unknown. This species is fairly robust for its size and withstood laboratory handling better than any other prostigmatid mite at Signy Island but it was less tolerant of low humidities than *T. tilbrooki*. Adults range from 240 to 320 μm in length and from 8 to 12 μg live weight. Specimens from Signy Island appear to be larger than those from other Antarctic localities with tritonymphs frequently exceeding the mean adult length of 240 μm given by Strandtmann (1967). Larger than normal specimens have also been reported from Palmer Station, Anvers Island, with deutonymphs as large as adults (personal communication from A. Crooker and W. L. Graham). Variation in this species is not unusual as Strandtmann (1967) reported minor morphological differences in specimens from different localities.

N. antarcticus was originally described by Womersley and Strandtmann (1963) and has recently been re-described for all life stages by Lindsay (1972).

At Signy Island, *N. antarcticus* is found in a wide variety of habitats and is common in the surface layers (0–3 cm) of both dry and wet moss communities, in lichens, rich organic soils, damp algal-rich silt, dry barren rocky areas and on isolated rocky outcrops on the ice cap. It was recorded from the splash zone at sea-level to the rocks on the summit of Tioga Hill at 279 m, although the number found in areas affected by salt spray were few. The greatest concentrations of *N. antarcticus* occurred under small flat stones in silty ground at the edges of melt runnels, rivulets and damp patches on glacial moraines, and at the edges of snow and ice fields. Aggregations in excess of 50 cm^{-2} were observed in these areas but they tended to be restricted to the damper niches and only occasional specimens were found at distances greater than *c.* 0.5 m away from melt runnels, damp patches and snow areas. The aggregations remained under stones close to snow patches following the retreating edge of the snow and ice as it melted during summer. In damp areas, *N. antarcticus* was nearly always associated with either a gelatinous red alga (*Chlamydomonas* sp.) or with green algal felts under the stones and these algae may have been their food source in these areas. Large numbers were found in drier clumps of the moss *Drepanocladus uncinatus* and Gressitt (1967*b*) also recorded high concentrations of *N. antarcticus* in both *Drepanocladus* and *Polytrichum mosses*. *N. antarcticus* is the commonest and virtually the only mite to thrive in the barren chalikosystem habitat that covers much of the ice-free terrestrial continental Antarctic (Janetschek, 1967). Rounsevell (1977*a*) carried out a detailed autecological study of this species in the chalikosystem habitats near Davis Station on the east side of the Antarctic continent. He found the mite in similar situations as the present study and noted a diurnal and seasonal vertical migration in the

barren silty ground, especially when the soil surface temperature fell below 0° C. This confirms observations in the present study that aggregations under stones on barren ground disappeared when the soil temperature fell below 0° C for more than a few days, and in winter no mites were found in these situations.

Tilbrook (1973*b*) suggested that *N. antarcticus* is tolerant of a wide range of environmental conditions, and Fitzsimons (1971) conducted temperature-tolerance experiments on this species and concluded that it had the widest tolerance of all the Antarctic arthropods tested. He recorded activity in *N. antarcticus* from −23° to +31° C. It was observed that the activity of *N. antarcticus* was normal at −20° C in a deep freeze at Signy Island but the mites appeared distressed in the laboratory in humid conditions at *c.* +25° C.

In the present study most of the specimens of *N. antarcticus* recorded under stones on barren ground were tritonymphs, this being so from when the aggregations first appeared in October to when they disappeared in mid-April. The reasons for this are not clear but it may be that the tritonymph has a greater tendency to aggregate than other stages for similar reasons to the final deutonymphal stage of the mesostigmatid mite *G. racovitzai*. Here the aggregations enable adults of both sexes to be in close proximity as soon as the nymphs have moulted. However, very few adults were found in the *N. antarcticus* aggregations and, unlike *G. racovitzai*, the proportion of adults in these groups did not alter during summer.

Block (1976) and Goddard (1977*b*) have given respiration data for *N. antarcticus*.

N. antarcticus is the southernmost occurring arthropod in the world having been recorded from the Horlick Mountains on the Antarctic continent at lat. 85°32′S. It also has the greatest altitude range of any Antarctic arthropod at over 2 245 m (Wise and Gressitt, 1965). It is distributed over the whole of the Antarctic region and much of the sub-Antarctic, and appears to have a circum-polar distribution. It has been recorded from the Antarctic continent (Womersley and Strandtmann, 1963; Strandtmann, 1967; Rounsevell, 1977*a*), the Antarctic Peninsula and maritime Antarctic islands (Gressitt, 1967*b*; Tilbrook, 1967), and from South Georgia and other sub-Antarctic islands (Gressitt, 1970; Spain and Luxton, 1971; Wallwork, 1973). There is an interesting single record from sub-alpine habitats in Japan (Shiba, 1969).

Family Pyemotidae Oudemans 1931

Bakerdania antarcticus (Mahunka 1967)

These glabrous chestnut-brown ovoid mites are from 300 to 400 μm in length and have a segmented appearance. Tilbrook (1973*b*) referred to *B. antarcticus* as *Pygmephorus* sp. and recorded it only from the nest burrows of birds such as the dove prion, *Pachyptila desolata*, and other petrels. In the present study *B. antarcticus* was found only in occupied dove prion burrows, although Tilbrook recorded it from the soil at the sides of unoccupied burrows as well as in nest material. The mites were never found on the birds themselves. As this species is exclusively associated with bird-nest burrows, it cannot be strictly regarded as free-living. Nothing is known of its biology, the only literature being taxonomic. Other species of *Bakerdania* have been recorded from islands in the sub-Antarctic zone (Cross, 1970) and also from the South Sandwich Islands as well as the South Orkney Islands (Tilbrook, 1973*b*).

Family Bdellidae Dugès 1834

Spinibdella antarctica (Trägårdh 1907)

According to Evans and others (1961), the Bdellidae include many carnivorous forms but nothing is known of the habits of the Antarctic species. As only a single specimen (tritonymph) of this species has been found at Signy Island, its status remains in doubt. *S. antarctica* has

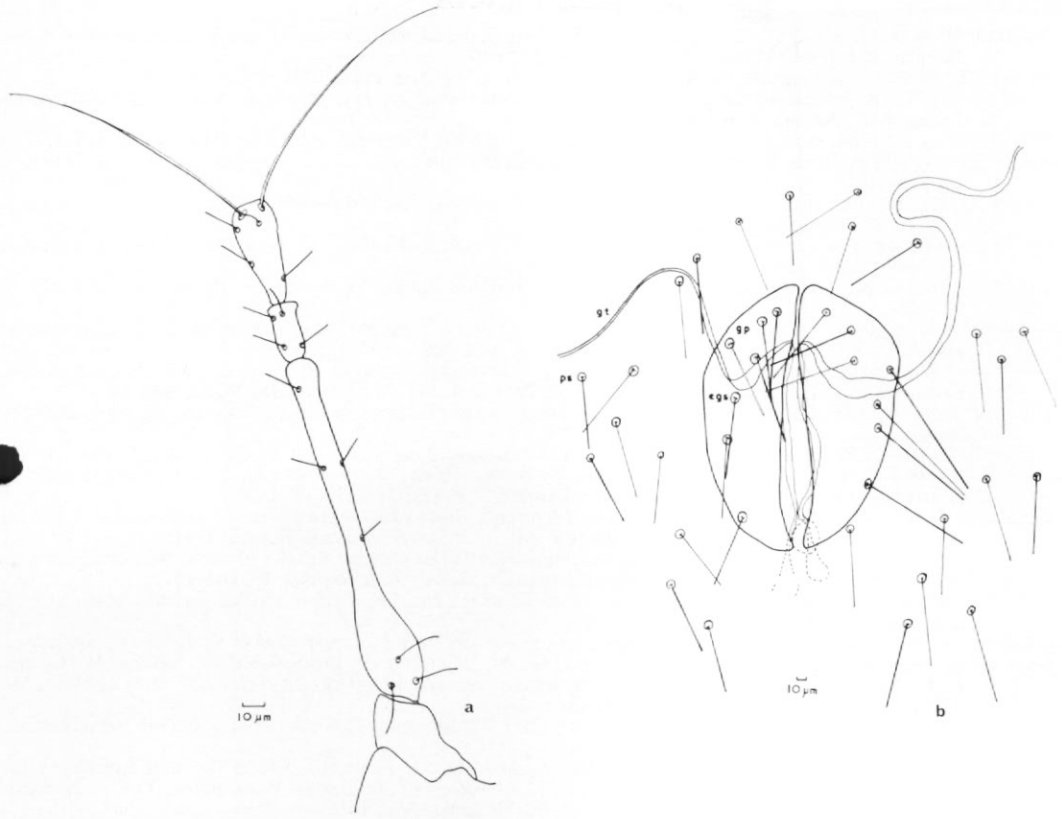

Fig. 8. *Spinibdella antarctica* (Trägårdh).
a. Pedipalp structure of the tritonymph; b. Genital structure of the tritonymph.
gp, genital plate; gt, genital trachea; egs, external genital setae; ps, paragenital setae. Top of the figure is anterior and bottom is posterior.

been recorded previously from a number of localities in the sub-Antarctic by Wallace (1970), who gave a key for the separation of all the bdellid mites of the Antarctic region. *S. antarctica* is distinct in being the only species with a pair of long setae on the venter of the hypostome. It is a fairly large mite with an adult size of *c.* 1 200 µm and, if it does prove to be resident at Signy Island, it will be the largest mite in the island's fauna. Fig. 8 illustrates the genital and pedipalp structure of the tritonymph, and there is little possibility of this mite being confused with any other Acari at Signy Island.

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