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COMPILED BY KEN N. BELL

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Authors

Birds

Book Reviews

PLANTS

REPTILES

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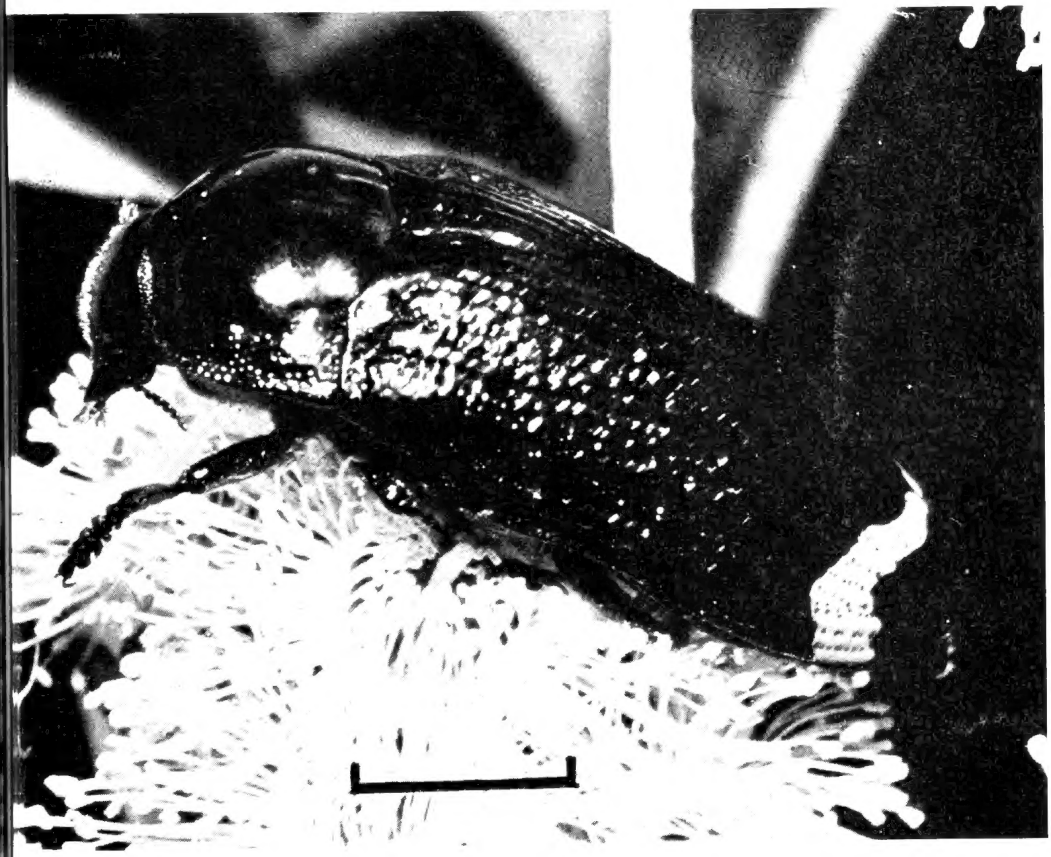

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FNCV DIARY OF COMING EVENTS

GENERAL MEETINGS

At the National Herbarium, the Domain, South Yarra.

Monday, 15 March, 8.00 p.m.
Margaret Blakers. R.A.O.U. Atlas of Australian birds.

Monday, 19 April, 8.00 p.m.
Dr Elizabeth Turner. Blacksand and Pahoehoe (volcanoes of Hawaii).

Monday, 10 May, 8.00 p.m.
Dr Bill Birch, Curator of Mineralogy, National Museum of Victoria. Minerals of Victoria.

New Members — January/February General Meetings.

Ordinary
J. L. Alston, 1/36 Margot St., Ferntree Gully.
R. Clark, 19 Waratah St., South Oakleigh.
L. Hemsley, P.O. Box 123, Bayswater.
D. Staples, 86 Surrey Rd., Blackburn.

Country
C. J. Goudey, Lot 8, Cozens Rd., Lara.
R. Loyn, 202 Monbulk Rd., Emerald.

Joint
Mr & Mrs D. C. Rogers, 57 Ardoyne St., Black Rock.

FNCV EXCURSIONS

Saturday, 6 — Monday, 8 March. Combined weekend at Morwell. This year the annual combined V.F.N.C.A. weekend gathering will be hosted by the Latrobe Valley F.N.C. Excursions on Saturday afternoon, Sunday and Monday will depart from the A.P.I. Hall in Hazelwood Rd opposite the Library where evening meetings will be held. Cost for coach and DBB accommodation will be $80.00. Deposit of $20.00 should be paid to the excursion secretary when booking. Coach departs from outside the Gas and Fuel at 8.00 a.m. on Saturday. Bring a picnic lunch.

Sunday, 4 April. Volcanoes. Leader: Graham Love. Coach will leave Batman Avenue at 9.30 a.m.

Preliminary notices:

Will members interested in an excursion to Western Australia in September/October 1982 please advise the excursion secretary as soon as possible. Programme: Friday, 24 September Perth to Jurien Bay; 25th Pinnacles National Park, overnight at Moora; 26th Moora to Merriden; 27th Merriden to Kalgoorlie; 28th Kalgoorlie area; 29th Kalgoorlie to Esperence; 1st Esperence; 2nd Esperence to Albury for 4 nights with day trips including Stirling Ranges; 6th Albany to Pemberton; 7th Pemberton to Augusta; 8th Augusta to Bussleton; 9th Bussleton to Perth. The night prior to the tour and the night we return to Perth would not be included but not transport between Perth and Melbourne. This will enable members to choose mode of transport and extend their time in Western Australia if they desired. Cost will depend on numbers going but are likely to be about $900 based on a party of 30. Accommodation will be DBB with a few lunches. A deposit of $100 should be paid when booking.

GROUP MEETINGS

FNCV members are invited to attend any Group meeting, no extra charge

Day Group — Third Thursday.

Thursday, 18 March. Port Authority harbour cruise. Booking necessary through the leader, D. Gillespie (578 1879).

Thursday, 15 April. Williamstown. 578 1879.

At the National Herbarium, the Domain, at 8.00 p.m.

First Tuesday — Mammal Survey Group.

Third Wednesday — Microscopy Group.

Wednesday, 17 February. Memories of the Microscopical Society of Victoria. Speaker: Mr Des Wentworth.

Second Thursday — Botany Group.

Thursday, 11 March. Mistletoes and mistletoe mythology. Speaker: Dr Malcolm Calder, University of Melbourne.

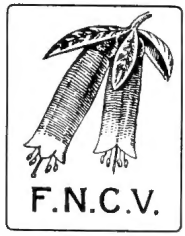
Thursday, 8 April. Ms Vivien Turner, Monash University. The strange case of the banksia and the pygmy possum.

GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

Mammal Survey Group.

Saturday, 6 — Monday, 8 March. Mt Alexander.
Easter. Friday, 9 — Monday, 12 April. East Gippsland.
Saturday, 8 — Sunday, 9 May. Strathbogies.



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Cover illustration: Stigmodera (Themognatha) mniszechi Saunders on flowers of *Eucalyptus*. Bar indicates 20 mm. (Photo by M. Peterson).

Stigmodera (Themognatha) coronata, A New Jewel Beetle (Coleoptera: Buprestidae) From South-western Australia

BY MAGNUS PETERSON*

Abstract

Stigmodera (Themognatha) coronata sp. nov. is described from Yellowdine, Western Australia. Notes are provided on the habitat and adult food plant in the area. Relationships are discussed and species groups designated for *S. coronata* and some closely related taxa. Male genitalia of five species are illustrated.

Introduction

In late January 1979 Messrs M. Powell, M. Golding and T. M. S. Hanlon visited an area 34 km E of Southern Cross, in the immediate vicinity of Yellowdine, Western Australia (31°18′S, 119°39′E), to observe buprestid beetles for distributional data.

The dominant vegetation in the area consists of cream flowered mallees (*Eucalyptus redunca* Schau.) with an understorey of porcupine grass (*Triodia scariosa* Burbidge), growing in a pink-white clay soil.

Adults of 26 buprestid species were recorded on *E. redunca* flowers, from 1600-1930 hrs on the 27 Jan. 1979 and from 0645-1000 hrs and 1545-1830 hrs on the 28 Jan. 1979 (Western Standard Time). A small sample of each taxon was retained for identification and reference purposes; the remainder were released in situ.

Six specimens of an undescribed species were amongst material retained. For these and 3 other specimens, the following nomenclature is proposed:

Stigmodera (Themognatha) coronata sp. nov. (Figs 1-6A, 11)

Types

Holotype: ♂, Yellowdine, W. Aust., on *Eucalyptus redunca*, 28.i.1979, *M. Powell*, Western Australian Museum collection, 79/1617.

Allotype: ♀, Yellowdine, W. Aust., on *Eucalyptus redunca*, 28.i.1979, *M. Golding*, WAM 79/1618.

Paratypes: 3 ♂ & 1 ♀, Yellowdine, W. Aust., on *Eucalyptus redunca*, 28.i.1979, *T. M. S. Hanlon* (Collection T. M. S. Hanlon).

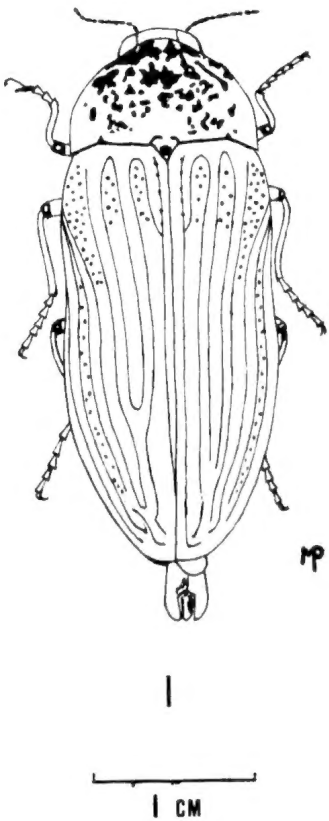


Fig. 1. Dorsal view of male *S. coronata*.

* 69 Alvah Street, St James, W.A. 6102.

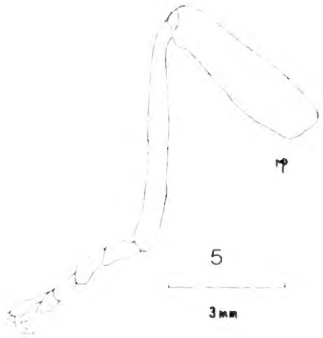
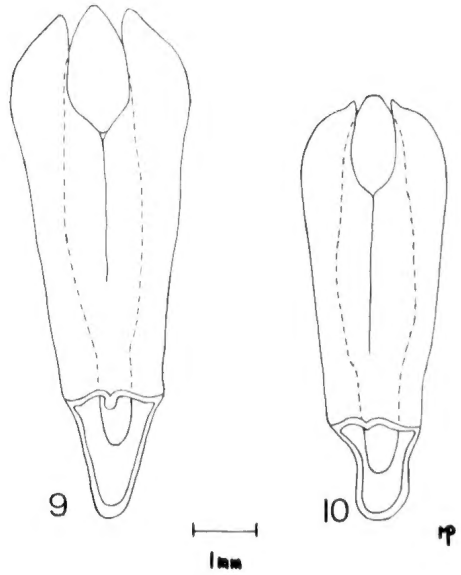
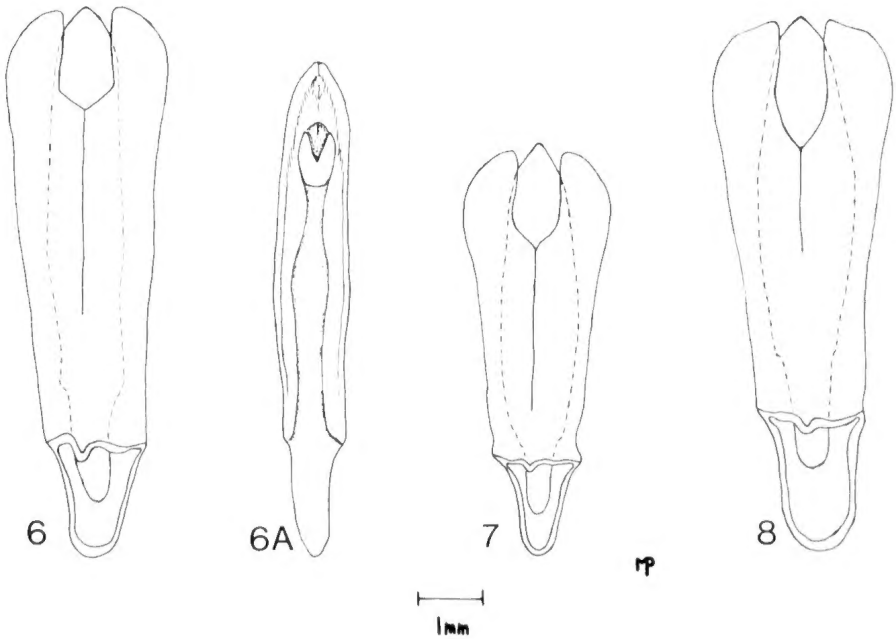


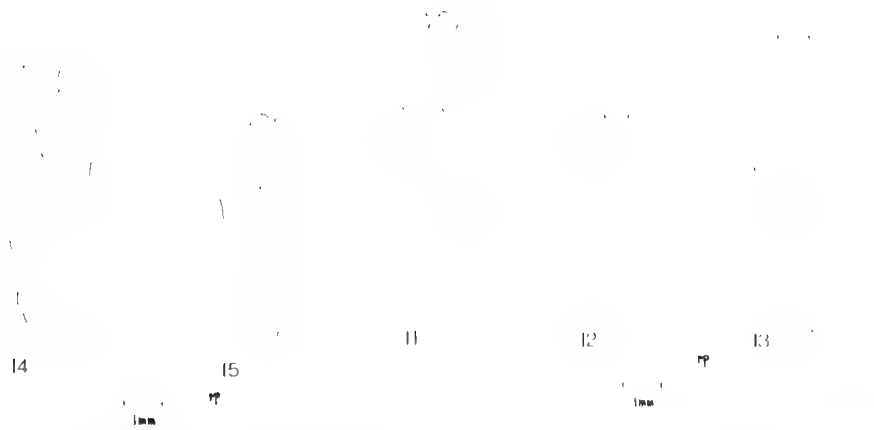
Fig. 5. Hind leg of *S. coronata*.



Figs 6-10. Outline diagram of male genitalia (dorsal view) of the following *Stigmodera (Themognatha)* species (Dotted line represents hidden outline of penis): 6 — *coronata;* 6A — *coronata* penis (ventral view); 7 — *conspicillata;* 8 — *gloriosa;* 9 — *spencei;* 10 — *duboulayi*.



same width as prothorax at base, sinuate pre-medially, then gradually rounded to each apex. *Elytral disc* punctate-striate; intervals mainly flat, becoming slightly rounded towards apex, and convex laterally; all intervals impunctate except for the following: the second and fourth intervals punctate at base; the sixth interval expanded at base, finely and closely punctate for basal third; the eighth interval with a single row of punctures for its entire length; first striae bifurcate at basal extremity; basal margin flat (not costate). *Humeral epipleuron* (Fig. 4) moderately expanded and inflexed. *Elytral apices* rounded. *Undersurface* with extremely close, fine and shallow punctures and a few, fine, short hairs



Figs. 11-15. Outline diagram of male genitalia (ventral view) of the following *Stigmodera (Themognatha)* species:
11 — *coronata;* 12 — *conspicillata;* 13 — *gloriosa;* 14 — *spencei;* 15 — *duboulayi.*

on the prosternum and metasternum. *Legs* (Fig. 5) with extremely close, fine and shallow punctures and a few, fine, short hairs at the base (proximal extremity) of the femora. First tarsal segment of hind leg not elongate, same length as remainder. *Tarsal claws* (Fig. 3) strongly lobed at base. *Apical sternite* arcuately excised (concave). *Aedeagus* (Fig. 6, 6A) elongate; inner margin of parameres angulate in dorsal view; penis slender and attenuate.

Females

Females differ in the following characters: larger size, less hirsute, apical sternite rounded (convex), larger and more strongly defined bifurcate marking on prosternum and less punctate elytral intervals.

Measurements

Males 31.65 ± 2.95 x 12.75 0.75 mm (6).
Females 36.7 ± 2.5 x 15.35 ± 0.65 mm (3).

Distribution

Only known from two localities near Yellowdine, Western Australia.

Etymology

The specific epithet *coronata* alludes to the 'crown' of iridescent flecks on the pronotum, which contrast strongly with the uniform, matt colour of the remaining dorsal surface.

Discussion

The subgenus *Themognatha* Solier, last revised by Carter (1916, 1929, 1931a, b), was recently redefined by Barker (1979) on the following characters:

A. Elytra striate or punctate-striate, sometimes with costae.

B. Tarsal claws usually lobed and toothed at base (Fig. 3).

C. Hair on dorsal surface of head.

D. Scutellum oval or round.

E. Medium to large size.

On the basis of these characters, *S. coronata* is a member of this subgenus.

Within *Themognatha*, a number of discrete species assemblages can be recognized. *S. spencei* L. & G., *S. conspicillata* White, *S. duboulayi* Saunders, *S. macfarlani* Waterhouse and *S. gloriosa* Carter are here grouped on the basis of the following characters:

A. Three elytral fasciae (including apical) in females (*S. spencei* mostly has three, occasionally two, fasciae in both sexes).

B. Sexual dichromatism, with reduced number of elytral fasciae in males of most taxa.

C. Morphology of male genitalia (Fig. 7-10, 12-15): shape of penis and outline of parameres.

They are considered to form the *S. spencei* species group. *S. coronata* is most similar to this group, in body

shape in transverse section and outline of male genitalia (Fig. 6, 11), but may be differentiated on the following suite of characters:

A. Absence of elytral pattern.

B. Absence of sexual dichromatism.

C. Angulate inner margin of parameres in dorsal view (Fig. 6).

D. Attenuate slender penis (Fig. 6, 6A).

E. Pronotal iridescence reduced to a series of flecks (Fig. 1).

For these reasons I consider *S. coronata* to constitute a monotypic species group, most closely related to the *S. spencei* species group. The *S. coronata* species group differs from all other *Themognatha* taxa, in possessing characters C and D.

S. conspicillata and *S. gloriosa*, of *S. spencei* species group members, are the most closely related to *S. coronata* on the basis of the following characters:

A. Nature of reduction of pronotal iridescence.

B. Rounded elytral apices.

C. Non-explanate pronotal margins.

D. Moderately expanded and inflexed humeral epipleuron.

I consider *S. coronata* is closest to, and possibly derived from, *S. gloriosa* because of similarities in ground colour, pronotal shape, and length and proportions of male genitalia.

In the field, *S. coronata* may be confused with four sympatric *Themognatha* taxa which are superficially similar but not closely related. These are *S. chevrolati* Gehin, *S. brucki* Thomson, *S. lessoni* L. & G. and *S. yarrelli flavipennis* Gehin. They differ as follows: *S. chevrolati* has explanate pronotal margins, bispinose elytral apices, blue elytral suture, margins and fasciae, slender elongate body and narrowly expanded humeral epipleuron; *S. brucki* has explanate pronotal margins, wide flat green pronotum with cream lateral margins, no prosternal bifurcate marking and narrowly expanded humeral epipleuron; *S. lessoni* has a green pronotum with cream lateral margins, slightly bidentate elytral apices and green elytral suture and margins; *S. yarrelli flavipennis* exhibits sexual dichromatism (elytral fasciae present in females, absent in males), blue pronotum with cream lateral margins and narrowly expanded humeral epipleuron. All these taxa differ markedly from *S. coronata* in male genitalic structure.

The colour pattern of *S. coronata* is possibly an adaptation for procrypsis on the cream flowered mallees, with the iridescent pronotal flecks approximating the sunlight reflecting on the nectar in the hypanthium and the cream ground colour blending in with the cream stamens of the mallee flowers. This is an unusual occurrence in *Themognatha* with most species being obvious even to the casual observer.

Acknowledgements

I would like to thank Mr T. J. Hawkeswood, Department of Botany, James Cook University, Townsville, Qld. and Mr D. Knowles (Perth, W.A.) for providing constructive comments on the manuscript, Messrs M. Powell and M. Golding for providing specimens, field data and other information given in this paper. The following kindly provided access to collections in their care: Dr E. Matthews, South Australian Museum, Adelaide; Dr J. Lawrence, Division of Entomology, C.S.I.R.O., Canberra; Dr G. Monteith and Mr E. C. Dahms, Queensland Museum, Brisbane; Mr M. de Baar, Queensland Forestry Dept., Brisbane; Ms M. Schneider, Queensland University, Brisbane; Queensland Dept. of Primary Industry, Indooroopilly, Brisbane; Dr A. A. Calder and Dr A. Neboiss, National Museum of Victoria, Melbourne; Dr T. F. Houston, Western Australian Museum, Perth; Dr C. N. Smithers and Mr G. Holloway, Australian Museum, Sydney; Mr A. Sundholm, Sydney; Mr T. M. S. Hanlon, Perth. I am grateful to Dr A. E. Greer (Australian Museum) for the use of equipment and Mr D. Metcalfe, Ms M. Brady and Mr P. de Boer for typing the manuscript.

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Tertiary Planktonic Foraminifera from Muddy Creek, Victoria

BY K. N. BELL* AND J. V. NEIL**

In this paper we present data on the planktonic foraminiferal fauna of the Muddy Creek Marl from Clifton Bank, Muddy Ck., Hamilton, Vict.

The foraminiferal fauna was first described by Howchin (1889). Since then further notes have been made by Chapman (1923) and Parr (1926). More recently, in an unpublished thesis, Mallett (1977) made a brief comment on the fauna listing eight species of planktonic foraminifera.

The samples studied here came from the Clifton Bank where the exposure was closely sampled (Fig. 1). The collecting party considered that the samples came from Prof. Ralph Tate's original collection site (A. R. Hutchinson *in litt* to R. Burn, 17 Aug. 1968). Of the samples, only three (9, 7b, and 5) had not been previously washed and so were suitable for foraminiferal determinations. From these a more detailed planktonic fauna was obtained than had previously been found. Each sample available was halved and independently prepared, with the faunas identified and cross-checked to overcome any bias in techniques.

Fauna and Age

A total of 20 species of planktonic forams was found (Table 1). Species marked * were rare occurring as less than 2% of the fauna (based on a count of at least 300 planktonic forams in each sample.)

Samples 9 and 7b were dominated by *Globigerinoides sicanus* (25% and 17% respectively) with *Globigerina woodi woodi* also dominant (19% and 11%). The other main species each constitute from 6-10% of the faunas.

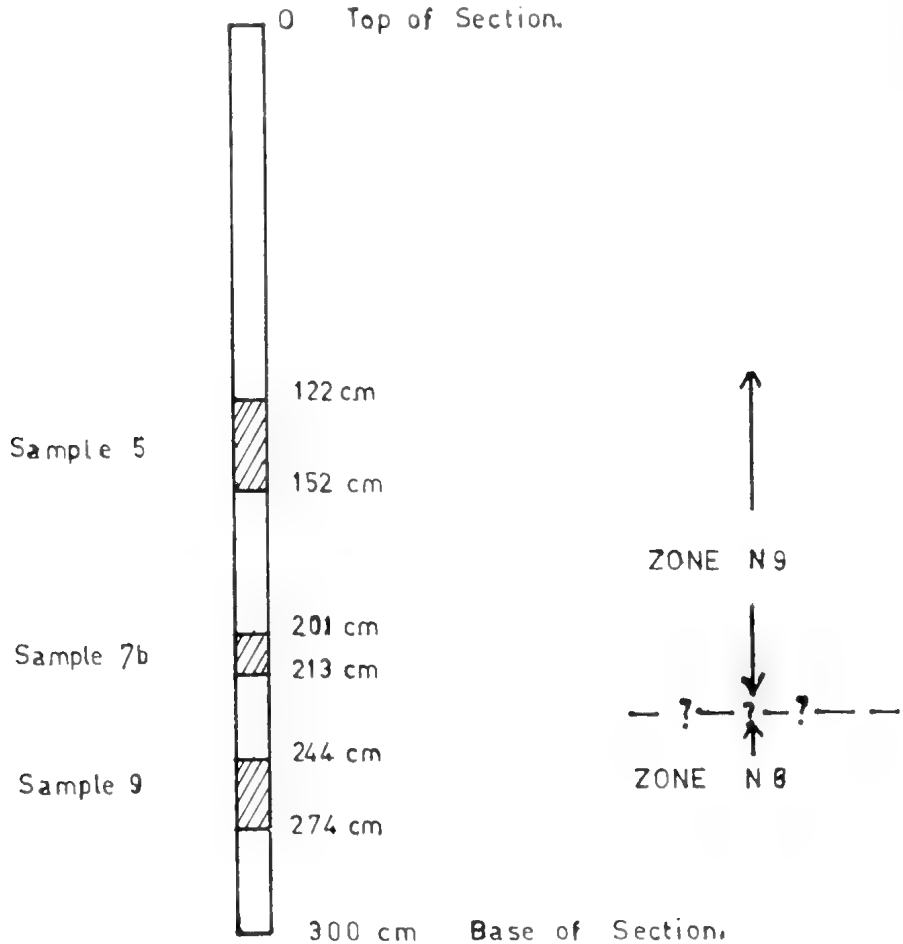
Over the past decade or so there has been a great advance in the worldwide zonation of the Tertiary based upon the planktonic forams (e.g. see Berggren and Van Couvering, 1974). Fig. 2 shows that part of the zonation scheme which concerns us here, using ages adapted from Chaproniere (1980).

The presence, in sample 9, of both *G. sicanus* and *Praeorbulina glomerosa* indicates an N8 age for this sample. With the entry of *Orbulina suturalis* in sample 7b, both this and sample 5 belong to zone N9. *P. glomerosa* extends just into the base of zone N9 (Stainforth et al 1975).

The planktonic forams also enable us to make an estimate of the depth of deposition of the sediments at Clifton Bank. It is well known that the planktonic percentage of the total foram fauna increases with increasing depth of deposition. In the present samples the planktonic percentages range from 20% (sample 9) to 11% (7b) and 9% (5). These figures indicate a depth of deposition of about 60 metre for sample 9 with a shallowing to 40 metre or less for the other two samples. The benthonic forams indicate a similar depth range and will be discussed in a further note.

* Honorary Assoc., Invertebrate Dept., National Museum of Victoria.
** 23 Michael St., Bendigo, Victoria.

Fig. 1. Columnar section at Clifton Bank showing sample sites and ages.



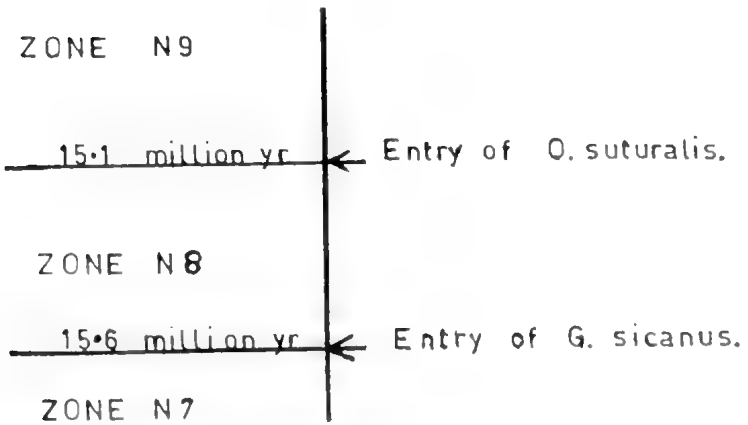


Fig. 2. International Tertiary Biostratigraphic Zones with time scale.

Table 1.

	Sample 9	*Sample 7b*	*Sample 5*
Globigerinoides			
triloba triloba	x	x	x
triloba immatura	x	x	x
sicanus	x	x	
apertasuturalis	x	x	
ruber *	x		*cf.*
Praeorbulina			
transitoria	x		
glomerosa	x	x	
Orbulina			
suturalis		x	x
Biorbulina			
bilobata		x	x
Globoquadrina			
dehiscens *	x	x	x
larmeui *			*cf.*
Globigerina			
woodi woodi	x	x	x
woodi connecta	x		
praebulloides	x	x	x
eamesi *		x	x
foliata *		x	
Globorotalia			
peripheroronda *	x		
praescitula *		x	
Globigerinella			
siphonifera *		x	x

Acknowledgement

We would like to thank Mr Robert Burn, Geelong, for allowing us to examine the material in his keeping.

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F.N.C.V. Calendar

The programme of events for the first six months of 1982 is available on request from the Subscription Secretary, FNCV, National Herbarium, The Domain, South Yarra, 3141.

Victorian Field Studies on the Broad-toothed Rat (*Mastacomys fuscus* Thomas)

By Robert L. Wallis*, Hans Brunner# and Peter W. Menkhorst †

The Broad-toothed Rat *Mastacomys fuscus* is one of the "Old Endemic" species of rodents (Ride, 1970) which belong to the subfamily Hydromyinae (Lee *et al.*, 1981). Although *Mastacomys* is genetically close to certain *Pseudomys* species, Baverstock *et al.* (1981) believe the Broad-toothed Rat is sufficiently distinctive, both structurally and behaviourally, to warrant its maintenance as a separate genus.

Mastacomys is stoutly built, thickly furred and compact, and characteristically has very broad molar teeth. Although fossil records show the species once had a wide distribution in south-eastern Australia (Wakefield, 1960, 1963a, 1963b, 1967, 1972; Calaby and Wimbush, 1964), *M. fuscus* now occurs in southern and eastern Victoria, eastern New South Wales and the western half of Tasmania (Watts and Aslin, 1980). For this reason the present distribution had been described as relict (Calaby and Wimbush, 1964), and Calaby (1963) noted that its survival in Australia was threatened. Recent work, however, has extended its known range in mainland Australia (Watts and Aslin, 1980; this paper) to the extent that it is not now considered threatened in Victoria (Ahern, in press) or New South Wales (Hermes, 1980).

Distribution

Mastacomys fuscus is restricted to the high rainfall areas of south-eastern Australia and Tasmania (Watts and Aslin, 1980). In Victoria it is confined to areas where the mean annual rainfall is greater than 1000 mm (Fig. 1). It is widespread in the Otway Ranges, South Gippsland Highlands, Central Highlands, Mt. Hotham-Bogong High Plains area and the Mt Kosciusko area, and has recently been found near Naringal in western Victoria, on Wilson's Promontory and near Cann River, East Gippsland. However, Seebeck's (1971) prediction that *M. fuscus* may occur in heaths in south-western Victoria or in The Grampians has not yet eventuated despite extensive trapping surveys (Emison *et al.*, 1978; FWD unpublished data). The mean annual rainfall in the highest parts of The Grampians exceeds 1000 mm, but in south-western Victorian heathlands it is less than 800 mm.

Detection

In most field studies reported to date, *M. fuscus* has proved difficult to live-trap. This may be related to the low population density of the rat in sub-optimal habitat; trap-shyness and competition for traps with other small mammals; or to the selective feeding habits of the species and its consequent disinterest in baits usually offered in traps. Higher population densities have recently been found above the winter snowline near Mt Kosciusko (Watts and Aslin, 1980) and below the snowline near Lake Mountain (Seebeck, pers. comm.).

Predator scat analysis is a valuable survey tool which can reveal the presence of mammal species not detected by conventional techniques such as trapping and spotlighting (Brunner, Amor and Stevens, 1976; Friend, 1978). It has been particularly useful in locating populations of *M. fuscus* as the teeth and hair of this species are characteristic and easily distinguished

* Department of Environmental Studies, Rusden CAE, 662 Blackburn Road, Clayton, Vic. 3168.
# Department of Crown Lands and Survey, Keith Turnbull Research Institute, Vermin and Noxious Weeds Destruction Board, Frankston, Vic. 3199.
† Arthur Rylah Institute for Environmental Research, Fisheries and Wildlife Division, Ministry for Conservation, Brown Street, Heidelberg, Vic. 3084.

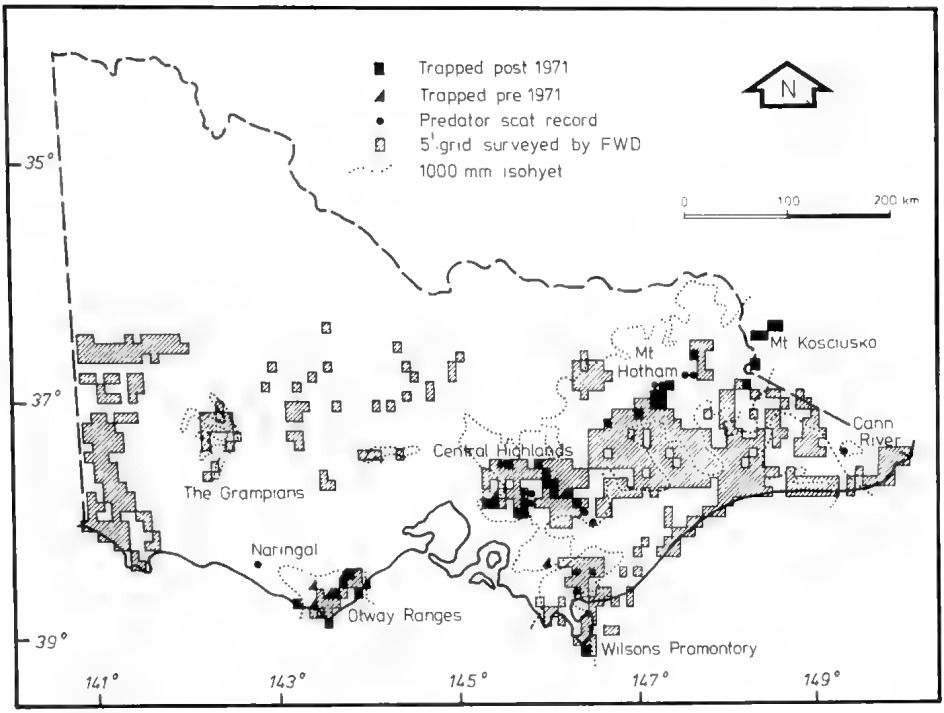

Figure 1. Distribution of *Mastacomys fuscus* in Victoria.

from those of other rodents. At Naringal, Cann River and in the South Gippsland Highlands, extensive trapping failed to locate the species but its remains have been found in predator scats (Seebeck, 1978; M. MacFarlane, pers. comm.; Norris *et al.*, 1979). The occurrences of *M. fuscus* in predator scats collected over the last decade are listed in Table 1.

Figure 2. *Mastacomys fuscus*. Photograph by E. R. Rotherham.

Figure 1 shows all latitude/longitude grid squares of 5′ resolution in which *M. fuscus* has been trapped or found in predator scats. It also indicates those grid squares surveyed to date by the Fisheries and Wildlife Division. Since 1971, 42% of the 52 new locality records of *M. fuscus* have been made by predator scat analysis (FWD unpublished data).

Habitat

Mastacomys fuscus has been found in a range of environments from alpine herbfield to coastal tussock grassland. At altitudes greater than 1200 m it inhabits tall alpine herbfield, fen, valley bog, raised bog, heath and woodland (sensu Costin *et al.*, 1979). Captures are usually along drainage lines where shrubs are absent or sparse and a dense cover of sedges, grasses, herbs and mosses is present. Common plant species in such situations include *Poa*

Table 1

Occurrences of *Mastacomys fuscus* remains in predator scats

Year	Collectors	Location	Number of Scats with *M. fuscus* remains
1971	J.M. Dixon	Falls Creek	2
1972	Students/J.M. Dixon	Otway Ranges	2
1973	M. McCallum	Mt. Howitt	1
1973	J. Backholer	Mt. Feathertop	1
1973	G. Suckling	Erica	1
1973-81	J. Lloyd, H. Brunner, I. Bertuch, A. Wallis, R. Wallis	Sherbrooke Forest Park	61
1974	J. Seebeck	Naringal East	1
1975	G. Friend	Mt. Feathertop	1
1976	P. Stevens, H. Brunner	Dartmouth Dam Site	20
1976	G. Friend	Boola Boola	3
1976	H. Brunner	Olsens Bridge	1
1976	H. Brunner	English Corner	1
1976	H. Brunner	Savins Road, near Powelltown	3
1976	H. Brunner	Mt. Square Top	2
1977	C. Anderson	Britannia Road, near Powelltown	1
1977	H. Brunner, P. Voutier	Sumner Spur, near Powelltown	75
1978	M. MacFarlane	Toolangi	1
1979	M. MacFarlane	Cann River	1
1981	J. Seebeck	Camberville	2

australis, Carex breviculmis, Sphagnum cristatum, Stellaria pungens, Empodisma minus and *Helichrysum scorpioides*. Mean annual precipitation is greater than 1400 mm.

At lower altitudes (1300 m) in the Otway Ranges, South Gippsland Highlands and Great Dividing Range, *M. fuscus* inhabits areas with a dense, wet understorey within tall open-forest and open-forest communities. The understorey may be patches of sedgeland and fernland on creek flats where there is a gap in the forest canopy or thickets of *Tetrarrhena juncea, Rubus* spp. and ferns beneath the canopy. It has also been trapped in young *Pinus radiata* plantations where a similar dense ground-cover occurs (Warneke, 1960; P. Du Guesclin pers. comm.).

Near the coast *M. fuscus* has been found in heath communities at Carlisle River (Seebeck, 1971), Moonlight Head (FWD unpublished data) and South Peak on Wilsons Promontory (Norris *et al.*, 1979). Annual precipitation at these sites (1000-1200 mm) is lower than in the alpine areas but sedges such as *Empodisma minus, Lepidosperma* spp. and *Calorophus* spp. form dense ground cover on water-logged sites. At Parker Cove near Cape Otway the species occurs in dense tussock grassland of *Poa* spp. beside the Parker River and on dunes within 100 m of the sea (FWD unpublished data).

The diversity of environments in which the species occurs makes the definition of habitat requirements difficult (Seebeck, 1971); however, two features are common to most sites:

(i) the mean annual rainfall is greater than 1000 mm and is often greater than 1400 mm;

(ii) the vegetation always includes a dense ground layer of grasses (Gramineae), sedges (Cyperaceae and Restionaceae) and herbs. As *M. fuscus* is herbivorous and feeds mainly on the stems and leaves of grasses and sedges (Watts and Aslin, 1980) this feature is probably critical.

Victorian Field Studies

(a) Sherbrooke Forest Park

In 1970 a population of *M. fuscus* was located at Sherbrooke Forest Park and subsequently studied by students at Rusden College of Advanced Education (then Monash Teachers College) under the direction of the late N. A. Wakefield. The following information has been taken from some unpublished project reports submitted by A. Brugman and P. Gallagher to that College's Biology Department.

The study site was about one hectare and consisted of dense *Tetrarrhena juncea* and other understorey vegetation in wet sclerophyll forest dominated by *Eucalyptus regnans*. Floristics of the area have been more fully described by Gullan and Robinson (1980).

Wire mesh cages were set in lines about 20 m apart and baited with rolled oats, peanut butter and honey for ten days in late July, 1970. Few Broad-toothed Rats were trapped so *Rattus fuscipes, Antechinus stuartii* and *A. swainsonii* were trapped and released elsewhere thus reducing competition for traps. Traps were checked three times daily (1730 hrs, 2200 hrs and 0800 hrs) and home ranges of individual *M. fuscus* recorded. Eleven males and nine females were originally marked, but recapture data were only obtained from eleven animals (three males, eight females). Mean body weight of male *M. fuscus* was 128 g (n = 11), and of females 111 g (8). Mean head-body lengths were 289 mm (9) and 279 mm (4) for males and females respectively, and mean head-body lengths were 172 mm (9) for males and 154 mm (4) for females. The average rate of recapture for both male and female *(M. fuscus)* was 1.5 recaptures per animal per day. One female was trapped 27

times over the ten days and its observed range length (Stickel, 1954) was about 75 m. The range lengths of the other females were smaller, but this may have been related to the fewer captures of these seven animals. Home ranges of females varied in shape and had little overlap; of the 33 trap sites where female *M. fuscus* were taken, at only eight sites were more than one individual trapped. Most male *M. fuscus* were found throughout the study site, sometimes entering traps at opposite ends of the area on successive days. Some males were trapped at "peripheral" sites at which no female *M. fuscus* were trapped. The home ranges of the three males trapped most frequently showed considerable overlap, had no distinct shape and observed range lengths were about 100 m.

Trapping recommenced in early October, 1970 for two days. Three of the four females trapped were pregnant and one gave birth between 2200 hrs (10/ix/70) and 1000 hrs (11/ix/70). Three males were also trapped, two of which had not been previously found.

The site was again trapped from 29/iii/71 to 6/iv/71. The female which had been trapped 27 times in the initial phase of the experiment was taken this time at sites also frequented by three juveniles, thought to be her offspring. Another adult female had extended its range into that previously occupied by another female killed in a trapping accident. Five other females found previously were not trapped in the 1971 program although three "new" juvenile females were found. Only two of the "original" males were trapped in the week's study, although five juvenile and two unmarked adult males were obtained. Over the eight months (August 1970 to April 1971) two females had increased their weight by 13 and 14 g and two males had increased in weight by 10 and 14 g.

Mean body weight of adult males was 131 g (range 144-122 g) and of adult females was 118 g (130-110 g).

The study resumed in April 1972. Again, *M. fuscus* were only trapped after other mammals *(Rattus fuscipes, R. rattus, Antechinus stuartii, A. swainsonii* and *Mus musculus)* had been removed. Ten Broad-toothed Rats were trapped (six males, four females). There was considerable variation in weight of each male on successive captures. Thus M6 was taken six times over the 16 days and its weight varied from 141 to 150 g. The weight variation for M34 (weighed nine times) was 86 to 96 g and for M36 (three times) was 105 to 117 g. Two juvenile males without obvious scrota were also trapped. As in 1970, males' home ranges showed considerable overlap. The largest observed range length for a male *M. fuscus* (M34) was about 105 m.

Weights of individual females also showed considerable variation, being minimal in late afternoon. F20 (trapped six times) weighed between 108 and 120 g and F24 (four times) weighed between 121 and 138 g. The mean weight of all females in the 1972 study was 107 g compared with that for male *M. fuscus* of 110 g. The four females had distinct home ranges with only one case of overlap. Maximum observed range length for a female (F21) was 45 m.

In May 1972 the four females and six males were trapped and held in the laboratory while the area was sprayed for blackberry eradication. Two weeks later the rats were released (less one male that had died) back at the original site. Fifteen months later trapping on the same grid yielded only one *M. fuscus* (a female) (Reed and Wallis, 1975), but other species of small mammal were not removed after trapping to increase the likelihood of catching Broad-toothed Rats. This difficulty in trapping *M. fuscus* was probably best highlighted when Gullan and Robinson (1980) failed to capture any Broad-toothed Rats in 13,600 trap-nights from April 1971 to January 1974 in a nearby location at Sherbrooke Forest Park.

Table 2

Percentage occurrences* of specific mammals in predator scats collected from all over Sherbrooke Forest Park and which contained bones or hair of mammalian prey in three studies:

A. Brunner, Lloyd and Coman, 1975. 1265 scats
B. Bertuch, 1975. 263 scats
C. This study, 1981. 94scats

* The sum of each column may exceed 100 as some scats contained more than one prey species.

Prey Species	Study A	Study B	Study C
Oryctolagus cuniculus	27	14	1
Rattus fuscipes	13	10	21
Antechinus stuartii	13	19	23
Pseudocheirus peregrinus	11	14	17
Trichosurus vulpecula	10	11	12
Antechinus swainsonii	6	8	4
Rattus spp.	6	3	1
Mus musculus	5	3	-
Antechinus spp.	4	4	2
Mastacomys fuscus	4	3	4
Rattus rattus	3	4	4
Possums	2	2	1
Rattus lutreolus	2	-	-
Perameles nasuta	2	< 1	-
Petaurus breviceps	< 1	< 1	-
Vulpes vulpes	< 1	2	3
Wallabia bicolor	< 1	-	4
Homo sapiens	< 1	-	2
Others	6	8	1

During 1973 and 1974, 1888 predator scats were collected from all parts of the Park and analysed. One thousand two hundred and sixty five scats contained the remains of mammals, and of these, 46 (4%) had *M. fuscus*. Some of the scats had been collected from the site of the original population studied from 1970-72 by Wakefield and his students (Brunner, Lloyd and Coman, 1975). In 1975, a further 71 predator scats containing hair were collected from the original study site and four (6%) contained hair of *M. fuscus* (Bertuch, 1975). As well, a carcas of *M. fuscus* was found on the original grid site (Brunner and Bertuch, 1976).

R.W. and H.B. are continuing to monitor the presence of *M. fuscus* in Sherbrooke Forest Park. In 1981 a further 94 predator scats containing mammal remains were collected and of these, four (4%) contained hair and/or teeth of *M. fuscus*. The percentage occurrences of specific mammals in predator scats collected from Sherbrooke Forest Park in the three studies (Brunner, Lloyd and Coman, 1975; Bertuch, 1975; our 1981 collection) are listed in Table 2. It should be noted that the percentage occurrences are only partial indications of the relative abundance of prey species in an area. Factors such as size of prey, its ease of capture and dietary preference of the predators are complicating factors. Despite recent attempts to do so (e.g., Green and Osborne, 1981), it is difficult to establish a relationship between the apparent density of *M. fuscus* as indicated by trapping data and its percentage occurrence in carnivore scats.

(b) Powelltown

Trapping of small mammals was carried out over three years (1976-1978) around Sumner Spur, near Powelltown, 76 km east of Melbourne. The spur is flanked by steep gullies and mountain ranges at an altitude of 600-700 m and has a mean annual rainfall of 1400 mm. The area is used mainly for *Eucalyptus regnans* regeneration. Elliott aluminium traps baited with a mixture of peanut butter, rolled oats and honey, were set at dusk and cleared at dawn. Some were kept open and checked during the day. Four thousand and twenty five traps were set over the three years, and 479 *Rattus fuscipes*, 15 *Mastacomys fuscus* and 281 other mammals (mainly *Antechinus* spp.) were caught. This represents a trapping ratio of 0.03:1 for *M. fuscus: R. fuscipes* (Brunner *et al.*, 1977; Brunner, unpublished data; Lloyd, unpublished data; Warden, unpublished data; Warden and Wallis, 1979).

Of 359 carnivore scats collected in 1976/77 around Sumner Spur, 21% contained the remains of *M. fuscus* and 18% had *R. fuscipes* (a ratio of1:0.86 *M. fuscus: R. fuscipes)* (Brunner, *et al.*, 1977).

Subsequently, a technique was designed to increase the trapping rate of the Broad-toothed Rat. The area was prebaited with free-feed pellets of pollard and bran, traps were then baited with these pellets as well as the conventional peanut butter, oat and honey mixture and all *R. fuscipes* trapped were held for several days to reduce competition for traps. Trapping success for *M. fuscus* improved from 0.7 to 4% using this technique. In 303 trap nights, 13 *M. fuscus* and 29 *R. fuscipes* were trapped (ratio 0.5:1) (Brunner *et al.*, 1977; Warden, unpublished data).

At Kosciusko National Park in New South Wales, low trapping ratios of *M. fuscus* to *R. fuscipes* have also been reported — 0.15:1 (Green and Osborne, 1981); 0.08:1 (Green and Osborne, 1979) and 0.06:1 (Happold, 1978). However, of 1159 fox scats collected in the Park, 9.3% contained remains of *M. fuscus* and 7.5% those of *R. fuscipes* (Green and Osborne, 1981). These authors, in comparing the ratio of occurrence in fox scats of *M. fuscus: R. fuscipes* (1:0.82) with the ratio of trapping (0.15:1) claim-

ed their data were evidence for the selective predation of foxes on *Mastacomys*. In admitting that trapping data are unlikely to accurately reflect actual relative population densities of *Mastacomys* and *Rattus* their inference regarding selective predation remains highly speculative.

Laboratory Studies

In the laboratory *M. fuscus*, when offered different foods, has shown strong preference for carrot followed by bran pellets and finally rolled oats. We have also found they readily eat wire-grass, leafy greens and mealworms. In the field Broad-toothed Rats feed on the stems and leaves of grasses and sedges (Watts and Aslin, 1980). Braithwaite *et al.*, (1978) have classified the species as a specialist herbivore, although a cockroach leg was found in a scat of a *M. fuscus* trapped at Sumner Spur (Lloyd, unpublished data).

Laboratory studies have confirmed Green's (1967) finding that *M. fuscus* is active both day and night. Two Broad-toothed Rats were kept in separate glass tanks (60 x 30 cm) with wire grass and cardboard tubes for nests or refuges. Food and water were provided *ad. lib.* and observations were made by a team of people during day and night for three months (April to June). The tanks were kept in a quiet room under natural photoperiod. Maximum activity occurred in the early evening (1900-2300 hrs) and least activity during the afternoon (1400-1700 hrs).

Braithwaite (1977) found a number of herbivorous Australian rodents had an even diel rhythm whereas the omnivorous *R. fuscipes* was nocturnally active. Seebeck (pers. comm.) has trapped *M. fuscus* during the daytime as well as at night, although no daytime captures were reported for *M. fuscus* by Warden and Wallis (1979) during trapping at Sumner Spur.

Ectoparasites collected from *M. fuscus* near Powelltown include the mites *Laelaps assimilis*, Womersley, 1956, and *L. cybiala*, Domrow, 1963, and the louse *Hoplopeura mastacomydis*, Kuhn and Ludwig, 1966. All have been previously reported as ectoparasites of *M. fuscus* (Green, 1968; Domrow, 1973).

Conclusions

Although the distribution of *M. fuscus* is more restricted today than in Pleistocene to Recent times (Calaby and Wimbush, 1964), it is not as discontinuous as was once commonly believed, and Dixon's (1971) prediction that gaps in distribution will be filled by further work has been confirmed. Predator scat analysis has proved a most useful technique in the detection of *M. fuscus* which has often proved difficult to live trap. There is difficulty, however, in determining population densities of *M. fuscus* and *Rattus* spp. by consideration of both live trapping data and the relative occurrence of the mammals' remains in predator scats.

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Discovery of Leadbeater's Possum in Gembrook State Forest

BY RICHARD H. LOYN[1] AND E. G. MCNABB[2]

Introduction

The observations were made on the northern edge of Gembrook State Forest, in mountain ash *(Eucalyptus regnans)* on the southern slopes of Mt Beenak (37° 53'S, 145° 41'E), at an altitude of 600 m above sea level. The site is in the headwaters of the Bunyip River, which flows into Westernport Bay.

Gembrook State Forest covers about 19 000 ha, 65 km east of Melbourne. It contains a wide variety of forest types, with mountain ash confined to the higher slopes in the north. It was recognised that some of the mountain ash forest was similar to known habitat for Leadbeater's possum *(Gymnobelideus leadbeateri),* elsewhere in the Central Highlands, with scattered dead trees (stags) and abundant silver wattle *(Acacia dealbata).* We examined one such area at dusk in April 1981, in the course of other studies on fauna and in co-operation with Miss D. Andrew and Miss L. Lumsden from the National Museum of Victoria, who were working on fauna of the Westernport Bay catchment. To our surprise, we were successful.

1. Forests Commission, Victoria; Mountain Research Station, Sherbrooke, 3789.
2. Marville Court, Boronia, 3155.

Observations

On 8 April 1981 we each waited near a stag (400m apart) at dusk. Three Sugar gliders *(Petaurus breviceps)* emerged from one and nothing was seen to emerge from the other where visibility was more restricted. Forty minutes after sunset, EGM played recorded calls of Sugar glider (growling) and Leadbeater's possum (chittering) at the second tree for three minutes. Five minutes later, soft noises were heard and movement was noticed in a live mountain ash; a Leadbeater's possum ran down and jumped into a silver wattle tree. A spotlight was used and the possum was identified immediately by its distinctive shape and behaviour. The possum jumped onto the trunk of the silver wattle and froze with its head downwards and its tail held stiffly upwards, looking like a stick. This gave time for EGM to set up a camera and photograph it there and as it moved away (Fig. 1).

On 12 April 1981 RHL returned with D. Andrew, and again the Leadbeater's possum appeared about an hour after sunset. They did not see it emerge from a hollow but it ran to the trunk of the same mountain ash tree where it began biting at hanging ash bark. A red spotlight was used and the possum

Fig 1. *Gymnobelideus leadbeateri* at Gembrook State Forest. Photo E. McNabb.

showed no concern. It was watched biting at bark for three short periods (½ to 2 minutes) in two adjacent trees.

Return visits were made on 30 April 1981 (with D. Hackett) and 14 September 1981 but we found no sign of the possum. Conditions were fine and calm on all four nights.

Habitat

The area contains lightly stocked mountain ash forest with a dense understorey of forest wire-grass *(Tetrarrhena juncea)* and tall shrubs such as *Olearia lirata, Polyscias sambucifolius* and *Pomaderris aspera,* and a middle storey of silver wattle and an occasional blackwood *(Acacia melanoxylon).* Many of the eucalypts regenerated from a wildfire in 1932, though some younger trees are also present. The basal area of eucalypts was estimated at 17-25 m^2/ha. The two mountain ash trees in which the possum was seen feeding were 35-40 m tall, probably of 1932 origin, with diameters at breast height of 68 cm and 48 cm. The old dead stag was about 33 m tall with a diameter at breast height of about 1.6 m. A large log on the ground was the only other conceivable source of nest hollows within 30 m of the observation. The ground sloped at 24° with a southerly aspect.

The area lies on a small private block (170 ha) currently owned by APM Forests Pty. Ltd., below a road which marks the boundary of the Powelltown Forest District and Gembrook State Forest. Part was selectively logged in the mid 1960s but there are no plans for further logging. Adjacent forest above the road was planted with mountain ash in 1961 and the trees have reached a height of 23 m with diameters at breast height of 15-40 cm.

Other animals observed nearby were Bobuck *(Trichosurus caninus),* Common ringtail possum *(Pseudocheirus peregrinus),* Sugar glider and many of the common birds of mountain ash forest, notably Australian owlet-nightjar *(Aegotheles cristatus),* Pink robin *(Petroica rodinogaster),* Rose robin *(P. rosea)* and Lewin's honeyeater *(Meliphaga lewinii).*

Significance

Since their rediscovery near Marysville in 1961 (Wilkinson 1961), Leadbeater's possums have been found solely in the Central Highlands of Victoria (Smith 1978, Rawlinson & Brown 1977, Wilkinson 1963, Owen 1963, King 1963). Recently their ecology has been studied by Smith (1978 and unpublished) and their known range has been extended with records from Toolangi (Macfarlane pers. comm.) and Pioneer Creek near Powelltown (Hackett pers. comm.). The present observation is only 10 km from Pioneer Creek, but it is the first report this century from the Westernport Bay catchment, and is also the most southerly and one of the closest to Melbourne. As only one animal was seen and Leadbeater's possums usually live in family groups (Smith 1978), we have not yet established that the species is resident there. However, it is highly probable that more would be found with further searching in nearby suitable habitat.

Four of the five early specimens of Leadbeater's possum were collected in

the catchment of Westernport Bay, and one of these was on the edge of the Kooweerup Swamp, three miles south of Tynong Railway Station (Wilkinson 1961). The latter is a perplexing record as it comes from lowland forest (now cleared) very different from habitats known to be used by the possum at present. Our observation is only 30 km north of the Tynong one; it is the closest geographically and should encourage further searching in a range of habitats between the two sites. So far mammal surveys in this area have revealed many species but not Leadbeater's possum. Perhaps the Tynong animal could have moved into lowland forest in response to population pressures, or temporary habitat changes in the mountain ash forest.

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Naturalist Review

"The Rodents of Australia"

BY C. H. S. WATTS AND H. J. ASLIN

Angus and Robertson, Sydney, 1981. 321 pp. Rrp $35.00 ISBN 0 207 14235 1.

Rodents comprise just under one quarter of Australia's mammals, yet there are few specialist books devoted to them. This book not only rectifies this deficiency, but does so very well.

The book comprises several sections. The first deals with the origins of Australia's rodents and their relationships to those overseas. General aspects on former and current distributions and general rodent biology are then presented, as well as the characteristics used in identifying and naming rodents. Illustrated keys are provided in the next section to help in this identification process. Each species (61 are covered) is then fully described and accounts of distribution, habitat and biology provided. Distribution maps and skull drawings accompany each description.

A third section deals with conserving, collecting, handling and keeping rodents.

The book is scholarly, well-referenced (316 references used), and very up to date. There are 16 colour plates and many sketches. There are one or two minor mistakes (such as the old address being given for QNPWS and stating the National Parks Service is Victoria's fauna authority) but the book, overall, is excellent value for money and will doubtless serve as an authoritative and highly regarded reference work for years to come.

R. L. Wallis

The Humpback Whale, *Megaptera novaeangliae* (Borowski, 1781), a First Stranding For Port Phillip Bay, Victoria.

BY JOAN M. DIXON*

On 14 December, 1980 an immature female Humpback whale, *Megaptera novaeangliae* stranded at Bonbeach, Port Phillip Bay, Victoria (38° 04′ S, 145° 07′ E). A bayside resident Mr R. Shipley reported to the National Museum of Victoria after the stranding that he had observed a single whale rubbing itself under his boat in the Sandringham area 6 December. It is likely that this was the same animal.

I visited the site 15 December with a team to assist in general observation and collection of biological material. The animal was badly decomposed, and obviously had been dead for some time. The skin was sloughing badly, altering the colour pattern considerably. It was readily identifiable as *Megaptera novaeangliae* by its elongated irregularly-bordered flippers, black above and white below (Plate 1). It is usual for animals frequenting the east coast of Australia to exhibit less pigmentation than those from other areas (Chittleborough, 1965).

The specimen was photographed by the research team, and by the media, measurements made (Table 1) and ectoparasites collected from the body. These were subsequently identified as whale lice *Cyamus? balaenopterae.* The skull and baleen were salvaged and the rest of the carcass removed and buried by local Council authorities. The fragmented skull and baleen are now lodged in the National Museum of Victoria, registered number C 24956.

The Scientific Event Alert Network, Smithsonian Institution was notified and the event reported in SEAN (1981).

*Curator, Department of Mammalogy
National Museum of Victoria

Humpback whale records on Australian coasts

Brazenor (1950) commented that there were several records of the species being stranded on the Victorian coast. The only known material to support his statement is a piece of baleen from Cape Woolamai, Phillip Island collected about 1940 (NMV registered number C24961).

Wakefield (1967) commented that two "humpers" were caught in Portland Bay 30 June 1843 and 25 July 1844 and reported in the Portland Guardian. There is a report that a humpback was harpooned but escaped in Portland Bay 20 June 1859.

Victorian sightings in recent years by R. M. Warneke include a specimen off Cape Conran in 1979, five specimens on the east coast in 1980, and a single specimen off Cape Conran in 1981. All sightings were reported between June and November, and all located east of Port Phillip Bay.

Wood Jones (1925) reported that a specimen was stranded at Corny Point, Yorke Peninsula and that its skeleton was preserved in the "State Museum". This refers to the South Australian Museum, but Aitken (1971) mentioned that the species was represented by scapula and humerus only in that museum, registered M5120, and that it was collected prior to November 1943 on the west coast of South Australia.

Strandings of the species in the Great Australian Bight were considered rare by Dawbin (1966), explained by the fact that the annual migratory route of these whales takes them from the Antarctic to Australia in autumn, and their return to the south in spring does not take them through the Bight. This is dealt with in detail by Chittleborough (1965). He

Plate 1. — Stranded *Megaptera novaeangliae* C 24956 at Bonbeach 15 December, 1981. Photo: D. Parsons.

Plate 2. — Baleen plates from *Megaptera novaeangliae* C 24956. Photo: D. Parsons.

Table 1

Measurements of *Megaptera novaeangliae* (modified from Baker, 1972).

1. Length, total	6.37m
2. Length, tip of upper jaw to centre of eye	1.38m
3. Length of gape (tip of upper jaw to corner of mouth)	1.22m
4. Length, tip of upper jaw to blowhole	1.96m
5. Length, tip of upper jaw to anterior insertion of flipper	1.95m
6. Length, tip of upper jaw to centre of anus	4.48m
7. Girth, maximum (2.4m from tip of snout)	4.10m
8. Length, flipper (anterior insertion to tip)	2.05m
9. Width, flipper (maximum)	0.05m
10. Width of tail flukes (tip to tip)	2.1m
11. Depth of notch between flukes	0.11m

Other measurements given by Baker, the length from the tip of the upper jaw to the tip of the dorsal fin and the height of the dorsal fin were not made because of the position of the stranded animal.

At the level of the dorsal fin, 21 ventral grooves were evident, and at the eye 26.

recorded two sightings along the South Australian coast, one at the head of the Great Australian Bight in 1952 and a female with a newly born calf off St. Vincent Gulf in winter 1961.

Guiler (1978) reported a number of Tasmanian records from Bass Strait by Lord and Scott (1924), Circular Head (Scott, 1942), sightings at Marion Bay October, 1953, Fortescue Bay January, 1958, and Darlington, Maria island 25-26 April 1969, when a cow and calf were seen at sea. None of these records are substantiated by museum reference material.

Bryden (1978) reported that humpback whales are seen regularly off the coast of Queensland in winter, and once supported a commercial industry there. He observed four humpbacks including one calf at Point Danger in October 1976 and had notification of a group of fifteen animals from the air made by Mr R. Latham. There is a report that a humpback became entangled in a shark net in Southport Bay about 1972, and when released it slowly swam away.

Bannister has reported (pers. comm.) that there have been two humpback strandings on the coast of Western Australia in the past fifteen years. Both occurred in 1977, one a male stranded at Cottesloe on 9 November, from which baleen was washed up and identified, the other about 11.9 m long was located five miles east of Augusta on the south coast about 8 December. This specimen was stranded alive, but the location was inaccessible. No reference material other than baleen was obtained from either animal and this is now located in the Western Australian Museum.

In the southern hemisphere, humpbacks assemble in warm waters for breeding during winter, and then move south to form summer feeding groups (Dawbin, 1966). Their tendency to travel along shore lines was exploited on the east coast when the Tangalooma and other whaling stations were established. Chittleborough (1965) reported that a total of 18,180 humpback whales were collected at Australian shore stations and Antarctic areas between 1949-62. He noted that despite the fact that most humpback whales have left the Australian coast by the end of October, some animals have been sighted in these waters during November and December. Three separate females which were migrating southwards along the coast in December had probably been late in making the northward migration. Each was accompanied by a calf. The Bonbeach specimen, obviously juvenile, may have been separated from its mother in their attempts to reach summer feeding grounds in the Antarctic.

There is a wealth of statistical information available on the species, but

regrettably little biological material has been collected and lodged in museum reference collections.

Acknowledgements

Thanks are extended to the following persons who made collection of the specimen possible: Henrietta Kaye, who notified me of the event, Linda Huxley, Technical Officer, Department of Mammalogy, National Museum of Victoria, Ian Gibbins, Ian Cooke, Peter Mosse and David Parsons University of Melbourne, and a Friend of the N.M.V. volunteer, Renata Officer. Mrs D. Peters kindly provided us with a film of the stranding. Gary Poure, Curator of Crustacea at the National Museum of Victoria identified the ectoparasites. Lawrie Conole, a voluntary assistant in the Dept. of Mammalogy assisted me with collation of data and records. Bob Warneke of the Arthur Rylah Institute for Environmental Research kindly provided recent Victorian records for the species.

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A Note to Prospective Authors

Contributions to *The Victorian Naturalist* are sought which deal with any aspect of natural history, field biology or earth science, but which preferably have a Victorian emphasis. Intending authors are requested to forward two copies of their manuscript, if possible typed and double spaced, to the editor. Acceptance is subject to approval by the referees and editor. Authors will receive galley proofs for checking; these should be returned promptly to ensure there are no delays in publication. Diagrams (in black ink on white card) and photographs (black and white) may also be included and the details should be of sufficient size and clarity to enable suitable reduction. Authors will receive 25 reprints *gratis*. If more are required, then orders should be made directly with the printer when proofs are forwarded for correction.

Authors are also requested to forward nature notes describing interesting observations, experiences or results of experiments which might not warrant inclusion in the journal as a full scientific paper because of their nature or size. Notes are usually refereed, but free reprints are not supplied. Reviews of books may also be sent to the editor.

Another form of contribution sought from authors is that of the general or review natural history article. Unlike scientific articles, these need not present data from "new" observations or experiments; rather, such general articles could review current knowledge, discuss the historical bases or highlight some significant aspects of our natural history.

Style of all contributions should follow that in current issues.

Notes on Insect Pollination of Two Species of *Eucalyptus* (Myrtaceae) From South-west Western Australia

BY T. J. HAWKESWOOD*

Abstract

Jewel beetles (Buprestidae) and flower chafers (Scarabaeidae) are recorded as pollinators of *Eucalyptus foecunda* Schau. and *E. cylindriflora* Maiden et Blakely (Myrtaceae) in the south-west mallee region of south-west Western Australia. Observations were undertaken in February, 1980.

Introduction

The following field observations on insects (mainly beetles) visiting the flowers of *Eucalyptus foecunda* Schau. and *E. cylindriflora* Maiden et Blakely, between Lake King (33°05'S, 119°40'E) and Peak Charles (32°23'S, 121°10'E) (Figs. 1 and 2) were made on 3 February, 1980. Flowering of both species was sporadic between these two localities. Apart from a few plants of *Melaleuca pauperiflora* F. Muell. (Myrtaceae) (which were poorly flowering) and the twiner, *Billardiera bicolor* (Putterl.) Bennett var. *bicolor* (Pittosporaceae) (which was profusely flowering), no other species of plant were in flower in the areas investigated. The weather conditions during the day were clear with little or no cloud and temperatures varied between 27°C to 30°C.

Eucalyptus foecunda Schau. (Narrow-leaved Red Mallee)

This species is usually a many-stemmed mallee growing from 2.0-4.5 m high or occasionally may be a tree to 8m high (Chippendale, 1973). The bark is smooth, grey and deciduous. The lower part of the trunks often possesses an accumulation of bark which is decorticated into ribbons. The glossy, light green, mature leaves are alternate, linear-lanceolate with a short, acuminate point, glandular, usually 4-7 cm long, 0.4-1.0 cm wide. The flowers (i.e. stamens) are cream, and there are up to 11 flowers/umbellate inflorescence. Chippendale (1973) states that the species flowers during December to March and is found in most of southern Western Australia and in the mallee dune areas of northern South Australia, north-western Victoria and the southern part of western New South Wales. According to Chippendale (1973) this eucalypt occurs in sand (which may be derived from lateritic parent material), or in sandy loam, and is sometimes found in areas near salt lakes.

Eucalyptus cylindriflora Maiden et Blakely (White Mallee)

This species is usually a slender, spreading mallee growing from 2.4-4.5 m high with usually smooth, white or grey bark shedding in ribbons. The shining, dark green, mature leaves are alternate, linear-lanceolate to narrowly oblanceolate or sometimes falcate and measure 5-7 cm long and 5-9 mm wide. The flowers (i.e. stamens) are creamy-yellow to white and there are up to 7 flowers/umbellate inflorescence. Chippendale (1973) states the species flowers during January to March. Chippendale (1973) also records the species from Bendering, southward to the Lake Grace and Lake King area, eastward to Balladonia (east of Peak Charles) and notes that it occurs on sandy loam in mallee scrub, sometimes in association with *Melaleuca uncinata* and *Eucalyptus oleosa* (both Myrtaceae).

Observations

1. 32 km E of Lake King (33°00'S, 120°02'E) (Fig. 1). 930 hrs (WST). Several flowering plants of *E. foecunda* were examined by the roadside. The only insect visitors to the flowers were numerous individuals of the large brown cetonid *Diaphonia* (*Hemichnoodes*) *mniszechii* (Janson) (Scarabaeidae) (Table 1). These beetles were actively

* Department of Botany, James Cook University, Townsville, 4810.

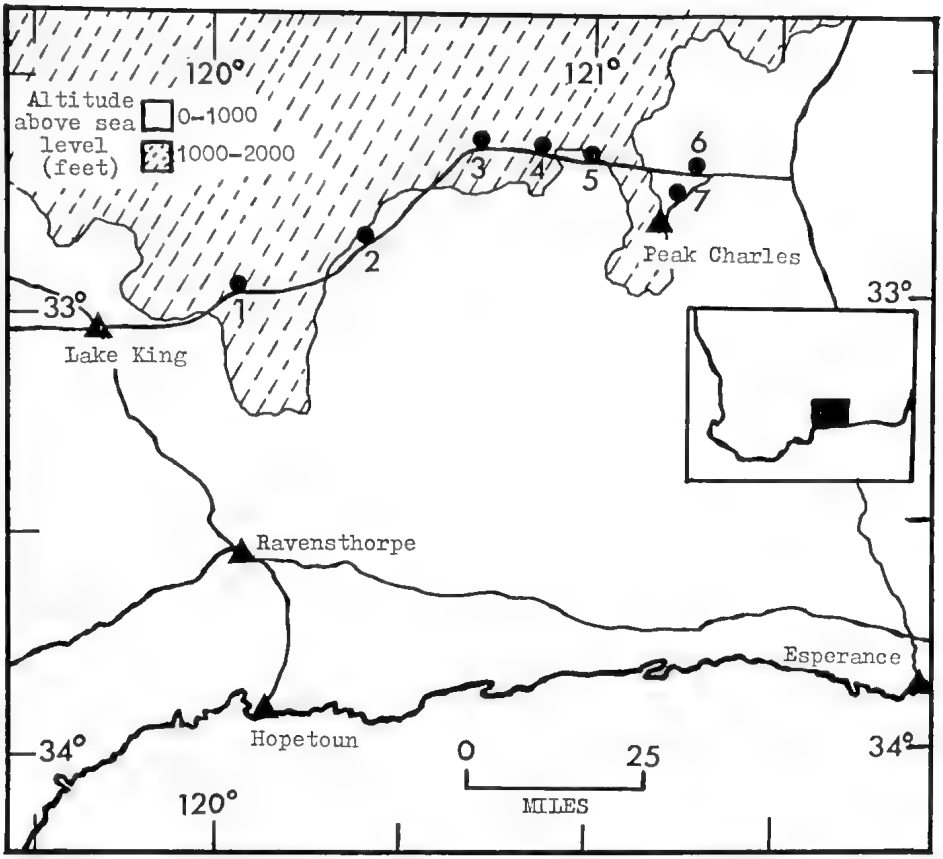

Fig. 1. Map showing the route taken on 3 February 1980, between Lake King and Peak Charles, Western Australia. (Numbered dots indicate stops at which observations were undertaken. Inset shows the area in relation to the remaining portion of south-west Western Australia).

feeding on nectar and pollen and flying around the eucalypts. Examination of several individuals revealed large amounts of yellow pollen attached to the head, pronotum and on the hairy, posterior undersurface of the abdomen. (*Diaphonia mniszechii* measures 2-3 cm long and the whole undersurface of the body is covered in long, brown to buff hairs. It is most likely that pollen is largely transported by these hairs from flower to flower during feeding and as the beetles move over the flowers).

2. 72 km E of Lake King (32°52'S,

Fig. 2. Peak Charles, showing surrounding low vegetation consisting mainly of *Eucalyptus, Acacia* and *Casuarina*. (Photograph by T. Helder).

Table 1. List and occurrence of the insect visitors to Eucalyptus foecunda Schau. and E. cylindriflora [illegible] on Lake King and Peak Charles (Feb. 1980). (Numbers refer to sites shown in Fig. 1. See text.)

Species	Sites	1	2	3	4	5	6	7
Coleoptera								
Scarabaeidae								
Diaphonia (Hemichnoodes) mniszechii (Janson)		•	•		•	•	•	•
Metallesthes metallescens White			•	•	•	•	•	•
Buprestidae								
Stigmodera (Themognatha) tibialis Waterhouse					•			
Stigmodera (Themognatha) mniszechi Saunders					•			•
Stigmodera (Themognatha) chevrolati Gehin.					•			•
Stigmodera (Themognatha) murrayi Gem. & Har.								•
Stigmodera (Themognatha) brucki Thomson								•
Stigmodera (Themognatha) chalcodera Thomson								•
Stigmodera (Castiarina) mastelamajor Thomson							•	
Cleridae								
Eleale sulicordes Gorh.							•	
Hymenoptera								
Scoliidae								
Campsomeris anthracina Burm.							•	

120°25'E) (Fig. 1). 1025 hrs. Fifteen plants of *E. cylindriflora* were examined adjacent to the road and into nearby vegetation. Large numbers of *D. mniszechii* were present as was the black cetonid beetle *Metallesthes metallescens* White (Scarabaeidae). No other insects were observed on the flowers (Table 1). Individuals of both species carried a dusting of pollen on the head, pronotum and on the posterior undersurface of the body including the legs.

3. About 98 km E of Lake King (32°40'S, 120°40'E) (Fig. 1). c. 1100 hrs. One small flowering plant (2m high, the only one flowering in the immediate area) of *E. foecunda* was examined. Large numbers (c. 40-60) of *M. metallescens* were observed actively feeding on nectar and flying around the mallee bush. No *H. mniszechii* were seen (Table 1).

4. About 16 km E of 90 mile water tanks, towards Peak Charles (32°42'S, 120°50'E) (Fig. 1). 1120 hrs. Five plants of *E. cylindriflora* growing by the roadside were examined for insect visitors. Both the scarabs *D. mniszechii* and *M. metallescens* were present, as well as a small number of the jewel beetles *Stigmodera* (*Themognatha*) *tibialis* Waterhouse (Fig. 3), *S. (T.) mniszechi* Saunders (Fig. 4) and *S. (T.) chevrolati* Gehin (Buprestidae) (Table 1). Of the three buprestid species observed, *S. chevrolati* was the most common. (Examination of randomly sampled beetles of all species revealed that *S. chevrolati* carried the largest pollen loads of the three, mostly on the head, pronotum and undersurface of the body).

5. 32 km E of 90 mile water tanks, towards Peak Charles (32°43'S, 121°00'E) (Fig. 1). 1230 hrs. Three plants of *E. foecunda* were flowering which attracted only the two species of Scarabaeidae in large numbers (i.e. c. 50-100 beetles/plant). No buprestids were observed (Table 1).

6. 51.2 km E of 90 mile water tanks, north

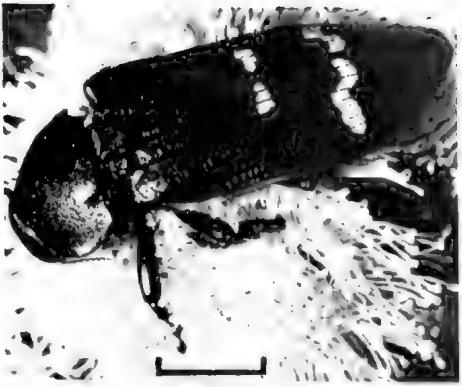

Fig. 3. *Stigmodera (Themognatha) tibialis* Waterhouse on flowers of *Eucalyptus*. Bar indicates 20 mm. (Photograph by T. Helder).

Fig. 4. *Stigmodera (Themognatha) mniszechi* Saunders on flowers of *Eucalyptus*. Bar indicates 20 mm. (Photograph by M. Peterson).

Fig. 5. *Stigmodera (Themognatha) murrayi* Gem. & Har. on flowers of *Eucalyptus*. Bar indicates 15 mm. (Photograph by D. Knowles).

Fig. 6. *Stigmodera (Themognatha) heros* Gehin on leaves of *Eucalyptus*. Bar indicates 20 mm. (Photograph by M. Peterson).

of Peak Charles (32°44'S, 121°15'E) (c. 2 km W of t/off to Peak Charles) (Fig. 1). 1255 hrs. One plant of *E. cylindriflora* was examined. *Diaphonia mniszechii* and *M. metallescens* were present on the flowers, the former species being more common. About 20 specimens of the small green clerid beetle *Eleale aulicordes* Gorh. (Cleridae) were active on the flowers (Table 1). Two specimens of the black wasp *Campsomeris anthracina* Burn. (Scoliidae) were additional visitors (Table 1). One jewel beetle *Stigmodera* (*Castiarina*) *mustelamajor* Thomson was resting on one of the flowers as well, but was not very active (Table 1).

7. 5 km NE of Peak Charles (32°50'S, 121°11'E) (Fig. 1). 1550 hrs. Thirty-five plants (2-3 m high) of *E. foecunda* were examined. On almost every plant, the following beetles were common: *D. mniszechii*, *M. metallescens*, *S. mniszechi*, *S. murrayi* Gem & Har. (Fig. 5), *S. brucki* Thomson, *S. chalcodera* Thomson (Table 1). Of these *S. mniszechi* and *S. chalcodera* were the least common.

Discussion

(a) General comments on the pollination of the two *Eucalyptus* species.

It appears from my observations, that the large scarab and buprestid beetles (body length 2.5-5.0 cm) are the main pollinators of *E. foecunda* and *E. cylindriflora* in the areas and at the times investigated. Of the two beetle

groups, it is probable that the scarabs, as a whole, are more effective pollinators since they were present in greater numbers than the buprestids, spent more time feeding on nectar and moving over individual flowers than in flight, and carried larger amounts of pollen. The hairy undersurface of their bodies (in contrast to the ± glabrous body surfaces of the buprestids), facilitates better attachment and transport of pollen which may be deposited on stigmas of flowers during feeding. In addition, pollen from the head would be deposited efficiently on the eucalypt stigma during feeding when a beetle places its head down into a flower to feed on the nectar. A high level of cross-pollination is probably effected in many areas (where more than one tree is flowering), by the scarabs, since they are strong fliers and individuals were observed actively flying from tree to tree, especially at the last observation site (7) near Peak Charles (Fig. 1).

It is doubtful whether the small clerid beetle *Eleale aulicordes* effects pollination of the eucalypts. Due to their small size (7-8 mm long) and their nervous activity, they are unlikely to contact the stigma of the eucalypt flower in order to facilitate pollen transfer from their bodies. Observations indicated that they were mainly pollen feeders.

The large, black wasp *Campsomeris anthracina* (body length 2.5-3.0 cm), spent up to thirty seconds feeding from a single flower and in so doing, collected pollen grains onto the body. Wasps are efficient pollinators but probably play a small part in *Eucalyptus* pollination in this portion of south-west Western Australia, in comparison to the role played by scarabs and buprestids.

(b) Flower-chafers (or cock-chafers or scarabs) (Scarabaeidae) as pollinators.

Little has been recorded on pollination by Australian Scarabaeidae (especially of the anthophilous subfamilies Cetoniinae and Melolonthinae). General text-books on Australian insects (e.g. Froggatt, 1907; Carter, 1933; McKeown, 1945; Britton, 1970) state that many insect species (including scarabs) visit flowers for food in the adult stage, but they do not usually mention the role of these insects in pollination. Australia has probably 300-500 species of anthophilous Scarabaeidae, but most of them have been little studied, both taxonomically and ecologically. In a recent review on pollination of Australia plants, Armstrong (1979) notes that some members of the Melolonthinae are "specifically adapted to feed on nectar and pollen", while the Cetoniinae and Valginae are diurnal and "exclusively anthophilous".

Alderson (1976) noted that *Eupoecila australasiae* (Donovan) and *Diaphonia dorsalis* (Donovan) (both Cetoniinae) were anthophilous; the former species was noted as a visitor to flowers of *Xanthorrhoea australis* (Xanthorrhoeaceae), *Bursaria spinosa* (Pittosporaceae), *Leptospermum juniperinum*, *Angophora* and *Eucalyptus* species (Myrtaceae), while the latter was recorded on *Eucalyptus* species only. Hawkeswood (1981a) first examined pollen loads of four species of Scarabaeidae *Eupoecila australasiae* (Donovan), *Polystigma punctata* (Donovan), *Glycyphana stolata* (Fabricius) (Cetoniinae) and *Phyllotocus macleayi* (Fischer) (Melolonthinae) on *Angophora woodsiana* Bail. (Myrtaceae) in south-east Queensland and on the basis of behaviour and pollen loads, came to the conclusion that they were important pollinators of their food plant.

Likewise, *Metallesthes metallescens* and *Diaphonia mniszechii* appear to be important in pollination. However, further observations on their general biology, distribution and food plant preferences are needed.

(c) Jewel beetles (Buprestidae) as pollinators.

It is well known amongst many amateur and professional entomologists interested in the Buprestidae, that many species frequent flowers in the adult stage. However, little has been documented on their food plants, both in Australia and overseas. H. J. Carter (1933, and other papers), the first resident Australian authority on the family, recorded many buprestids from flowers of *Leptospermum* species (Myrtaceae) and other plants, but he did not undertake any systematic study of the food plants since he was preoccupied with the alpha taxonomy of the group, both at the specific and generic levels. Almost nothing was recorded on adult food plants of Australian buprestids until McMillan (1952) listed adult food plants of four species of *Stigmodera* (subgenus *Stigmodera*) from Western Australia. In a report on the flora and fauna of an arid area of Western Australia (at Queen Victoria Spring, c. 40 miles north of Zanthus, 30°25'S, 123°34'E), Slater and Lindgren (1955) listed 14 sympatric species of Buprestidae feeding on flowers of *Eucalyptus uncinata*.* Hawkeswood (1981b) recorded various species of Buprestidae from flowers of the Western Australian Christmas tree, *Nuytsia floribunda* (Loranthaceae). Also recently, Williams (1977) and Hawkeswood (1978, 1981c, 1981d) have listed numerous food plants of adult beetles in eastern Australia. Despite the data available on adult food plants, no studies have as yet been undertaken in Australia (or elsewhere) in order to examine pollen loads using microscopic techniques.

* It would appear that from my examination of specimens of *E. uncinata* in the Western Australian Herbarium during 1980, and the distribution and notes provided by Chippendale (1973) that this eucalypt does not occur in the Queen Victoria Spring area, and thus the species from there was misidentified. The most likely *Eucalyptus* in the area is the Black Marlock (*E. redunca* Schau.), a common species in south-west Western Australia (Chippendale, 1973).

The author of this paper was unable to microscopically examine pollen from the beetles observed in the field and to compare it with pollen from anthers of the food plants, during the field trip from Lake King to Peak Charles. However, all available evidence (e.g. (a) the observation that the jewel beetles were not visiting any other plants for food at the time and (b) jewel beetles were on the open flowers of the eucalypts frequently contacting the anthers and stigmas) does suggest that the fine dustings of yellow pollen on many of the beetles examined, were that of the *Eucalyptus* species. Since further observations and microscopic examination of pollen loads of anthophilous beetles in south-west Western Australia (and elsewhere) are clearly needed, these notes are provided here in the hope they are a basis for further research on insect/plant relationships.

(d) Notes on diversity of jewel beetles (Buprestidae) on *Eucalyptus* flowers.

Perhaps the most interesting observation recorded on the trip was the diversity of buprestid species and their abundance. Of the 10 species of beetles recorded, 7 species belonged to Buprestidae, while only 2 belonged to Scarabaeidae and a single species to Cleridae (Table 1).

Hawkeswood (1980) recorded the large jewel beetle, *Stigmodera (Themognatha) heros* Gehin (Fig. 6) as a pollinator of *Melaleuca pauperiflora* F. Muell. (Myrtaceae) and suggested that jewel beetles dominate the feeding niche (i.e. both in species and individuals) on many flowering myrtaceous plants through the low rainfall (≤ 20 inches (≤ 50cm)) areas of southern Australia. In contrast, this niche appears to be shared more equally with insects such as lycid beetles (Lycidae), click beetles (Elateridae), longicorn beetles (Cerambycidae), flies (e.g. Tachinidae), and native bees, wasps and butterflies in the montane areas of eastern Australia (see

Hawkeswood, 1978, p. 271, for a list of species belonging to many of the insect groups noted above, on *Leptospermum flavescens* Sm.). The suggestion that buprestids can be dominant members of the feeding niche on Myrtaceae in south Western Australia is supported by the observations of Slater and Lindgren (1955) and Hawkeswood (this paper).

(e) *Eucalyptus* and pollination.

Pryor (1976) has provided a brief but concise account of our present understanding of the breeding system of *Eucalyptus*. He notes (1976, p. 25) that the *Eucalyptus* flower is highly constant in morphology throughout the genus. (The typical *Eucalyptus* flower is characterized by (a) the presence of an operculum (formed from the fusion of perianth segments), a cap covering the reproductive structures, which falls away at anthesis, exposing the numerous, free stamens arranged in two or more whorls, and (b) a thick style with a large, prominent stigma). At anthesis, the operculum falls from the flower, the stamens expand, and the anthers dehisce (usually within 24 hours; Pryor, 1951), exposing pollen (in most species) in "irregular granular aggregates on the surface of the anther" (Pryor, 1976). Pryor (1976, p. 25) also notes that the stigma at this stage is neither expanded nor receptive to pollen, although the pollen is mature and is able to germinate if placed on a receptive stigma. Pryor (1951) noted that the stigma was usually not receptive until several days after operculum fall and then remained receptive for up to four or five days and sometimes up to 10 days in the species he examined. Thus it has been concluded that *Eucalyptus* flowers are usually protandrous (Pryor, Chattaway and Kloot, 1956; Pryor, 1951, 1976) and that "The stigma usually becomes receptive on one or more days after the stamens are fully expanded, by which time much of the pollen is already removed from the anthers by visiting insects". (Pryor, 1976, p. 25). Pryor (1976, p. 25) also stated that pollination of almost all the species is effected by animal vectors, usually insects, although such a statement is surprising in the light of the fact that there have been no detailed and meaningful published studies on natural *Eucalyptus* pollination by insects. Ashton (1975) noted a wide array of insect visitors to *E. regnans* blossoms, including beetles, flies, bees and butterflies, but did not examine pollen loads, insect behaviour etc. Birds such as honeyeaters and brush-tongued parrots are also known to pollinate *Eucalyptus* flowers (e.g. Paton and Ford, 1977), although with most eucalypts, bird pollination is generally regarded as a secondary occurrence with insects as the primary pollinators (Pryor, 1951, 1976). Pryor (1976) notes that results of a study by Cooling and Endean (1966) which found that wind pollination was indeed effective, leads to the suggestion that the *Eucalyptus* flower structure permits insect pollination as well as wind pollination.

Sargent (1928), an earlier worker on Australian Pollination biology, believed that the genus *Eucalyptus* was *exclusively* pollinated by birds Sargent, 1928, p. 186; Parker, 1977. Sargent (1928) and even went to the extreme by stating "The author (Sargent) has found no trace of pollen on the body of any insect visitor of 'gum' blossoms so far examined. As time rolls on evidence is steadily accumulating that birds are the chief, if not the only, efficient pollinators throughout the genus. If this be proved as a fact, it places Honeyeaters in the front rank of economic importance, for the continuance of our natural forests would be dependant upon them. If the eucalypt forests were to perish utterly the birds would merely turn for sustenance to flowers of other plants; but if honeyeating birds became extinct the eucalypts would probably speedily follow them"!

It is most surprising that in the light of the observations presented in this paper on insects on flowers of *Eucalyptus foecunda* and *E. cylindriflora*, that Sargent did not observe insects pollinating any *Eucalyptus* species (especially *E. foecunda*) in Western Australia. In addition, it is surprising that Sargent did not observe any native insects on *Nuytsia floribunda* (Loranthaceae) either (see Hawkeswood, 1981b, for comments). It is highly probable that Sargent did not venture into the arid regions of south-west Western Australia to witness the large populations of Buprestidae and Scarabaeidae on flowering *Eucalyptus* species, but concentrated his observations in the Perth area where the beetle species listed in Table 1, do not occur or have been wiped out as a result of habitat destruction by man.

(f) *Eucalyptus* and the syndrome of cantharophily.

Hawkeswood (1981a) reviewed most of the information on insect pollination vectors of *Eucalyptus* species and noted that *Eucalyptus* (and *Angophora)* flowers possessed all the features of cantharophily. Hawkeswood (1981a) found that beetles (Coleoptera) were the dominant diurnal pollinators of *A. woodsiana* Bail. during December, in the Burbank area of south-east Queensland, which led support to Faegri and Van der Pijl's (1976) criteria for cantharophily.

According to Faegri and Van der Pijl (1976), plants which possess the syndrome of cantharophily (i.e. beetle pollination), have all (or most) of the following floral features — (a) flowers with no special or definite shape and few visual attractions; they are generally flat, cylindric or shallow, bowl-shaped and easy of access, (b) flowers which are dull, greenish or cream, and have open, easily accessible attractants such as nectar and pollen, (c) flowers with a strong, fruity or aminoid odour, (d) flowers with exposed anthers and stigmas (i.e. above the level of the corolla or perianth) and (e) flowers with an epigynous ovary (i.e. the ovary is situated below the attachment of the stamens, sepals and petals). Such flowers possess a structure considered to be adapted for protection against the biting jaws of beetles while the strong odour appears to be an adaptation for luring the beetles to the flowers (a beetle's eyesight is usually poor for an insect but its olfactory senses are usually well developed).

The flowers of *E. foecunda* and *E. cylindriflora* possess all the features of cantharophily as proposed by Faegri and Van der Pijl (1976). However, this does not necessarily suggest that these species are obligate cantharophiles since other vectors (viz. wind, birds and/or mammals) may also play a role at other times; e.g. at night or early morning, when perhaps beetles are not active. The observations made between Lake King and Peak Charles, do suggest that beetles are the dominant pollination vectors of these eucalypts in the areas and at the times investigated.

(g) Biological notes on the insect species mentioned in this paper

(A) Scarabaeidae

(a) *Diaphonia (Hemichnoodes) mniszechii* (Janson)

Lea (1914, p. 184) noted that this species occurred from the mallee district of north-western Victoria, through southern South Australia "to the coast of Western Australia as far north as Geraldton". Nothing more appears to have been written on the species since Lea, despite it being a common species, especially in south-west Western Australia. As far as the author is aware, this is the first time that the species has been recorded as a pollination vector.

(b) *Metallesthes metallescens* White

Lea (1914, p. 188) noted that "This species is fairly common in many parts of South and Western Australia". Slater and Lindgren (1955, p. 18) record the species from Queen Victoria Spring in the southern desert area of Western Australia. Since then, nothing appears to have been written on its biology.

(B) Buprestidae

(a) *Stigmodera (Themognatha) tibialis* Waterhouse

Carter (1929, p. 291) listed the distribution of this species as South Australia and Western Australia. Slater and Lindgren (1955, p. 18) list it from *Eucalyptus* flowers. Barker and Inns (1976) record an individual of this species as prey for a large robber fly (Asilidae). Little has been recorded on the biology of *S. tibialis* despite it being one of the most common species in south Western Australia.

(b) *S. (T.) mniszechi* Saunders

Carter (1929, p. 290) listed the species but did not state its distribution. It is presently known to occur in the arid mallee regions of south-west Western Australia across to South Australia (Hawkeswood and Peterson, 1979, unpub. data). It is not known whether the species extends into the mallee area of north-west Victoria. Slater and Lindgren (1955) also record it from *Eucalyptus* flowers.

(c) *S. (T). chevrolati* Gehin

Carter (1929, p. 290) listed the species but did not state its distribution. It is known to occur from the arid areas of south-west Western Australia into South Australia (Hawkeswood and Peterson, 1979, unpub. data). Slater and Lindgren (1955) record it on *Eucalyptus* flowers.

(d) *S. (T.) murrayi* Gem. & Har., *S. (T.) brucki* Thomson and *S. (T.) chalcodera* Thomson

Carter (1929, pp. 289-290) listed these three species from Western Australia only. Slater and Lindgren (1955) have recorded them on *Eucalyptus* flowers.

(e) *Stigmodera (Castiarina) mustelamajor* Thomson

Carter (1929, p. 296) records this species from New South Wales, Victoria and South Australia, while Barker (1979, p. 19) extends the distribution to Queensland and Western Australia. Hawkeswood (1980) recorded the species on flowers of *Melaleuca pauperiflora* F. Muell. (Myrtaceae).

(C) Cleridae

(a) *Eleale aulicordes* Gorh.

Western Australian Museum specimens indicate that this species has a widespread distribution in south-west Western Australia, although nothing appears to have been written on its biology.

(D) Scoliidae

(a) *Campsomeris anthracina* Burn.

The author has been unable to find any biological or taxonomic notes on the species.

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Field Naturalists Club of Victoria

Reports of recent Club activities

General Meeting
Monday 14 December

New FNCV Secretary. President Miss Clark announced the appointment of Mr Dave Lee as Club Secretary. Dave brings with him great know-how and experience for he was secretary some 10-15 years ago but had to retire due to health reasons. We welcome him back to his old job.

Group in recess. At the meeting on Monday 7 December, members of the Entomology and Marine Biology Group decided that the Group should go into recess. Only about seven or eight attend each meeting and there are other specialist societies which members could join if they wish.

Hawthorn Juniors. The programme was provided by members of Hawthorn Junior FNC; their chairman, Mr Malcolm Turner, introduced each speaker and subject in turn.

Axolotl. Andrew Pilskans (age about 13) told us about the axolotyl, the larva of a salamander from the lakes of Mexico, that breeds when still in the larval form.

Orchids. With the aid of a large white exotic orchid, Tom Long (age about 10) showed the parts of an orchid. He spoke of the specialist adaptation for pollination by insects and said that Australia has more than 400 species.

Blue-tongue Lizards. Brian Glassenbury (age about 15) said that Bluetongues can grow to more than 50cm

(20″) and one of his two specimens was very near that size. Sight and hearing are poor in Blue-tongues, knowledge of surroundings being gained mainly via the flickering tongue and by ground vibrations. They have up to 12 live young in a brood (not laying eggs as some lizards do) and the smaller specimen produced five young last year. The other one was sloughing its skin.

Tasmanian National Parks. Malcolm Turner showed colour slides of National Parks in Tasmania. He said that the St Clair park was recommended for the World Heritage List, also much of the SW area.

FNCV President thanked the Hawthorn Juniors for their varied, interesting and well-presented items.

Exhibits. The living creatures and charts of the speakers formed a large part of the exhibits. Some plants of the Common Liverwort *Lunularia cruciata* were bearing "fruiting heads" — not often seen in this so-abundant species. There were the distinctive male and female flowers of Coast Spinifex *Spinifex hirsutus*.

The most unusual exhibits pertained to the **Gippsland Giant Earth-worm** *Megascolides australis* — a model about 3 metres long (10′) and preserved specimens about 1.20m long (4′) and about 10cm long (4″). We hoped to find one during the Mt Worth excursion on 6 December for Mt Worth is on the western fringe of its range, but luck was not with us. The Museum is making a survey and seeking information on distribution, etc. Our FNCV library has an excellent study by Baldwin Spencer on this creature.

General Meeting
Monday 11 January

This was a Members' Night and there were five speakers.

Fungi. Superb shots of fungi were shown by Mr Alan Morrison, fungi of various colours and various sizes.

Spiders and Insects. More superb shots were shown by Mr Ian Morrison (Dick) of spiders in all sorts of curious forms and colours, and some minute insects.

Mammals. Miss Wendy Clark showed photos of some of the creatures taken in traps during the Christmas Camp of the Mammal Survey Group in the Big Desert. And the Group obtained the third and fourth Victorian sightings of a Ninaugi, an animal only recently discovered in Victoria although known in other States.

Whale model. Dr Brian Smith showed slides of the construction of a 25ft whale for display at the Museum. To save weight it was made of polyurethene foam and finished with a fibre glass surface.

Galls on Cootamundra. Miss Madge Lester showed shots of the larvae, pupae and mature insect found in the globular galls so common on Cootamundra Wattles in Melbourne suburbs. She asked what happened after the 5mm (1/16″) insects (wasps) escaped from the galls but no satisfactory answer was available.

Predator Wasps. Mr Urwin Bates spoke of wasps including those that lay eggs in the pupae of White Fly and those that lay eggs in the caterpillars of Snout Moth. The full-grown wasp larvae break out from the host caterpillar before pupating. A jar contained several hundred of these 2mm white pupae, from some of which the mature insects had emerged.

Exhibits. As well as the wasp exhibits, under microscopes were neat rows of moth eggs; an aquatic caterpillar about 8mm long (¼″), semi-transparent but with some short dark bristles; and white hydra on pond weed. A black beetle about 15mm long with an intriguing white pattern was probably a Fiddler Beetle.

Calendar of Events Jan-June 1982 was available.

The Centenary Expedition of the F.N.C.V. 1-8 Nov, 1980

1980 was the centenary year of the F.N.C.V. and a special expedition was planned as part of the centenary activities. It was decided to make Wilsons Promontory the venue as the F.N.C.V. had played a considerable part in establishing this area as Victoria's first National Park. In this we were greatly assisted by the Director of the National Parks Service and his staff who permitted us to reserve all the pleasant modern cabins for our members, and made available the Information Centre for our evening meetings.

So on Saturday November 1st about 160 people converged on the camp site at Tidal River on Wilsons Promontory. There were representatives of the F.N.C.V. Melbourne, and almost all the affiliated country clubs. They came with cars, caravans, tents and a bus and by mid-afternoon were busy exploring the immediate area.

The following is a record of some of the outstanding features of the weeks' activities.

Flora list

355 native plant species were seen at Wilsons Promontory together with 50 alien species. The following plants have not previously been recorded there:

Carex breviculmis
Wahlenbergia quadrifida
Levenhookia dubia

Introduced:

Euphorbia paralias
Gnaphalium spicatum
Rubus procerus
Sisyrinchium iridifolium
Trifolium striatum

Lilly Pilly Gully

It rained all Sunday morning, so the ranger Peter Thomas and F.N.C.V. member Ian Morrison showed us slides in the information centre; in the afternoon the weather cleared and Dr Willis led a walk into Lilly Pilly Gully.

We went past shining peppermints, brown stringybarks and many heathland shrubs. We searched the cones of the silver banksias and were delighted to find the little trumpet-shaped fruiting bodies of the fungus *Encoelia toomansis*. This fungus grows only on *Banksia* cones and the slaty-blue fruiting bodies can be found on all species of *Banksia* but had not been recorded previously on Wilsons Promontory.

There were the golden flowers of four species of Guinea-flower along the track; the Prickly, Erect, and Silky Guinea — flowers which are all small shrubs, and the tangled mass of the taller shrub, Rough Guinea-flower.

A few of us sat down to watch a pair of Spotted Pardalotes feeding their young in a hole in a low bank at the side of the track; others walked on and saw the Beautiful Firetail and in the Lilly Pilly area Rufus Fantails. Golden and Olive Whistlers were also seen.

Dr Willis pushed through the thick scrub to see if any specimens of the Austral Cabbage Palm still existed. He was delighted to find one, the last relic of some planted by Sir Baldwin Spencer in 1912; they do not occur naturally here.

Dr Willis and some of the party went on to Mt Bishop where they found a giant form of the Pink Finger orchid growing amongst Veined Spider-orchids, while on the upper track near the car park we found a patch of the little cream flowers of Hairy Mitrewort.

Species in the order they occur in the text:

Shining Peppermint	*Eucalyptus nitida*
Brown Stringybark	*E. baxteri*
Silver Banksia	*Banksia marginata*
Prickly Guinea flower	*Hibbertia acicularis*
Erect Guinea flower	*H. stricta*
Silky Guinea flower	*H. sericea*
Rough Guinea flower	*H. aspera*
Austral Cabbage Palm	*Livistona australis*
Pink finger Orchid (giant form)	*Caladenia carnea* var. *gigantea*
Veined Spider Orchid	*C. reticulata*
Hairy Mitrewort	*Mitrasacme pilosa*

That Fabulous Fern Foray

The trip to Chinaman's Creek which Mrs Ellen Lyndon described as "That Fabulous Fern Foray". (Reprinted from the December

1980 issue of the Latrobe Valley Naturalist by the kind permission of the author and the editor.)

For me the highlight of the week at "The Prom" was relocating the very rare Oval Wedge-fern, *Lindsaea trichomanoides*, on Chinaman's Creek. We were very fortunate in being allowed access to this marvellous gully some 9.6 kilometres in from the Vereker gate. The road was, on the whole, good, save for a few patches of rough gravel and some steep pinches. It seems a shame that it cuts a gap through this sub-tropical forest and that camping is allowed there.

The Lilly-pillys and Blackwoods tower into the sky on straight limbless trunks. One has to gaze directly upwards to work out the identity of the canopy far above the leaf strewn floor. Masses of Weeping spleenwort cascade from the high forks, reminiscent of the fern-hung jungles of the North. Most of the common ferns are present as well as two of the much rarer Fork-ferns. *Fieldia* is plentiful. Lilly-pilly Gully must have looked like this before the great fires of 1951.

I had never seen the Oval Wedge-fern but I knew what it should look like from pictures. Besides, I am familiar with all the others and knew what it was *not* by a simple process of elimination. It was a matter of cold search, as the birdoes say, keeping on the move to foil the bloodthirsty leeches.

Two botanists were ahead, looking for Slender Treefern. The Brooks' as usual were not far away. All other followers had tailed off. Cries of joy came down the gully and I felt very downcast, for my prize still eluded me and time was running out. The men found a glorious specimen of Slender Treefern, fully nine metres high, and lovely against the sunlight. Nancy and I began to retrace our steps.

The difficulty was that we didn't know exactly where the little fern grew, whether at the stream side or up on the drier slopes. But working back, one gets a different slant on the vegetation, a different light shall we say. All of a sudden there it was at the foot of a treefern in a rather dry situation, not a running fern as the text books describe it, but a distinctly tufted habit, like a small clump of Maidenhair. I must be forgiven those whoops of delight. When I could tear my eyes away there was another tuft on the neighbouring treefern, a few centimetres above the ground. A close search, however, revealed no more. Are they the last survivors?

L. trichomanoides is uncommon to rare up the east coast through N.S.W. to Queensland. It occurs on the Gordon River in Tasmania and is common on the North Island of New Zealand. Occurring as it does, in this one spot in Victoria, every effort should be made to safeguard this small gem in our wonderful Wilsons Promontory National Park.

Other naturalists were also finding items of interest at Chinaman's Creek. Dr Brian Smith showed us a native snail *Helicarion niger* and we found growing on fallen logs, several fungi; one was the small red toadstool *Mycena viscido-cruenta* and another the little blue *Mycena interrupta*. There were two bracket fungi *Trametes lilacinogilva* and a group of *Dictyopanus repidium* which look like little table tennis bats about 1 cm across.

Chinaman's Creek fern list:

Osmundaceae	
Todea barbara	King fern
Gleicheniaceae	
Gleichenia microphylla	Scrambling Coral-fern
Sticherus tener	Silky Fan-fern.
Hymenophyllaceae	
Hymenophyllum australe	Austral Filmy-fern (Mecodium austral)
Hymenophyllum cupressiforme	Common Filmy fern
Macroglena caudata	Jungle Bristle-fern
Polyphlebium venosum	Veined Bristle-fern.
Cyatheaceae	
Cyathea australis	Rough Tree-fern
Cyathea cunninghamii	Slender Tree-fern (very rare 40 ft high).
Dicksoniaceae	
Dicksonia antarctica	Soft Tree-fern
Culcita dubia	Common Ground-fern
Dennstaeditaceae	
Histiopsis incisa	Batswing fern
Hypolepis rugosula	Ruddy ground fern
Pteridium esculentum	Austral bracken
Lindsayaceae	
Lindsaea trichomanoides	Oval wedge fern (extremely rare)

Pteridaceae
Pteris tremula Teadia brake
Sinopteridaceae
Pellaea falcata Sickle fern
Grammitidaceae
Ctenopteris heterophylla Gipsy fern
Grammitis billardieri Finger fern
Polypodiaceae
Microsoruim diversifolium Kangaroo fern
Microsorium scandens Fragrant fern
Aspleniaceae
Asplenium bulbiferum Mother spleenwort
Asplenium flabellifolium Necklace fern
Asplenium flaccidium Weeping spleenwort
Aspidiaceae
Polystichum profiferum Common Shield fern
Davalliaceae
Rumohra adiantiformis Shield Hare-foot fern
Blechnaceae
Blechnum cartilagineum Gristle Fern
Blechnum nudum Fishbone Water-fern
Blechnum wattsii (procerum) Hard Water-fern
Tmesipteridaceae
Tmesipteris billardieri Long Fork-fern
Tmesipteris parva Small Fork-fern

Tongue Point

On Monday the sun shone and the whole Promontory was sparkling. We set off for Darby Saddle by bus and car, and as we drove along we could smell the honey scent of the White Kunzea that was in full bloom.

We walked up a shady track through Messmate and Shining Peppermint and here we found many orchid species, Pink Fairies, Pink Fingers, Veined Spider-orchid, Plain Spider-orchid, Thick-lip Spider orchid and Green-comb Spider-orchid. This gave us a good opportunity to compare the different species of Caladenia. Here we also found the Dwarf, Tall and Slender Greenhoods the little brown flowers of the Common Bird-orchid and leaves of the Autumn Bird-orchid. We climbed into sparser forest where we could see glimpses of the sea and islands as far as Rodondo Island.

We lunched by Lookout rocks where we found lovely specimens of the Bearded Greenhood and the Luminous Fungus growing on a dead tree. That night Dr Willis held up a piece of the fungus in the darkened hall and we could see it glowing dimly.

We followed the track on into more open heathland and found the little Forked Comb-fern and the yellow flowers of the Twisted Sun-orchid beside the path. The heathland was full of flowers, Silky Tea-tree with pale pink flowers, the yellow flowers of Karalla, Smooth Parrot Pea and Guinea-flowers. There were large mauve daisies on the Fringed Daisy-bush, a heathland shrublet. We found Prickly Geebung but without fruit or flowers.

Dr Willis and some other energetic members of the party climbed down the rocks and across onto the high tip of Tongue Point, which is an island barely separated from the point. There they found the Crimson Berry, a rare localised shrub occuring at only two other places in Victoria. It was growing almost to the water's edge and one or two shrubs of it were found in the heathland.

Some of us did not climb into this island but sat and watched a Peregrine Falcon and an immature White-breasted Sea Eagle soaring above us.

We followed the track towards Darby River through silent glades of Drooping She-oak. We heard the call of Whip-birds in the creeks below the track and saw a Blue-tongue Lizard sunning itself. As we descended we found plants of the brilliant Purple Swainson-pea, the Coast Ballart and pink-tipped flowers of the Satin Everlasting.

Tongue Point scientific names in the order they appear in the text:

White Kunzea	*Kunzea ambigua*
Messmate	*Eucalyptus obligua*
Shining Peppermint	*Eucalyptus nitida*
Pink Fairies	*Caladenia latifolia*
Pink Fingers	*Caladenia carnea*
Veined Spider-orchid	*Caladenia reticulata*
Plain-lip Spider-orchid	*Caladenia clavigera*
Thick-lip Spider-orchid	*Caladenia tesselata*
Green-comb	*Caladenia dilatata*

Spider-orchid	
Dwarf Greenhood	*Pterostylis nana*
Tall Greenhood	*Pterostylis longifolia*
Slender Greenhood	*Pterostylis foliata*
Common Bird-orchid	*Chiloglottis gunnii*
Autumn Bird-orchid	*Chiloglottis reflexa*
Bearded Greenhood	*Pterostylis plumosa (barbata)*
Luminous Fungus	Pleurotus nidiformis
Forked Comb-fern	*Schizaea bifida*
Twisted Sun-orchid	*Thelymitra flexuosa*
Silky Tea-tree	*Leptospermum myrsinoides*
Karalla	*Compholobium heugelii*
Smooth Parrot-pea	*Dillwynia glaberrima*
Fringed Daisy-bush	*Olearia ciliata*
Prickly Geebung	*Persoonia juniperina*
Crimson Berry	*Cyathodes juniperina*
Drooping She-oak	*Casuarina stricta*
Purple Swainson-pea	*Swainsonia lessertifolia*
Coast Ballart	*Exocarpus syrticola*
Satin Everlasting	*Helichrysum leucopsidium*

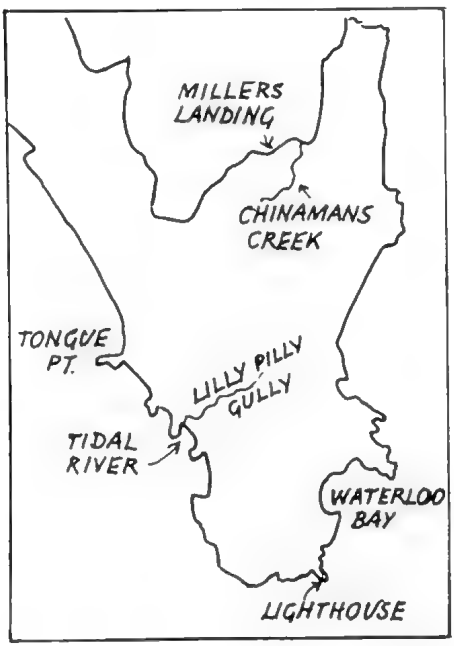

Fig. 1. Map of parts of Wilson's Promontory.

Millers Landing

We followed the morning visit to Chinaman's Creek with a walk from the Five Mile Road car park to Millers landing. The track was sandy and undulating and we saw large specimens of both Saw Banksia and Silver Banksia and an occasional bright clump of the Hairy Pink-bells. As we approached the beach a few wallabies were seen in the dappled sunlight under a stand of messmate.

The tide was receding and we were able to cross to a small island about 100 yards from the stunted white mangroves which grew along the shore. This is the most southerly occurance of mangroves in the world.

In the shallow water were many of the bivalve Pipi (one of the family Donacidae) and lumps of sausage-shaped jelly with many minute yellow specks inside; this is the egg case of a small sand snail (one of the family Naticidae).

We watched with amusement as the Soldier Crabs disappeared into holes in the sand as a shadow approached them.

The small island was only a few feet above high tide line, but it had been colonised by a beautiful collection of plants. There were very large specimens of Bulbine Lily and the bright leaves and pale purple-veined flowers of Austral Storks-bill. Tussocks of a grass and a small crassula were also growing on the island; many of the rocks were encrusted with an orange lichen.

We returned to the car park where we had a look at the delicate flowers of Slender Yellow-eye.

Saw Banksia	*Banksia serrata*
Silver Banksia	*B. marginata*
Hairy Pink-bells	*Tetratheca pilosa*
Messmate	*Eucalyptus obliqua*
White Mangrove	*Avicenna marina*
Bulbine Lily	*Bulbine bulbosa*
Austral Stork's bill	*Pelargonium australe*
Slender Yellow-eye	*Xyris gracilis.*

(To be continued)

Field Naturalists Club of Victoria

Established 1880

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Members include beginners as well as experienced naturalists.

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March/April
1982

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GENERAL MEETINGS

Monday, 19 April, 8.00 p.m.
Dr Elizabeth Turner. Balcksand and Pahoehoe (volcanoes of Hawaii).
Monday, 10 May, 8.00 p.m.
Dr Bill Birch, Curator of Mineralogy, National Museum of Victoria. Minerals of Victoria.

New Members — March/April General Meetings.

Ordinary
R. Brown, 224 Wonga Rd, Warranwood.
Lorna Grover, 7 Crown Rd, Ivanhoe.
M. P. Havir, 45 Stanley Gve, Blackburn.
Ros Kilgour, Lot 8, Haley's Gully Rd, Hurstbridge.
Stephen Platt, 6 Morshead Ave, Mt Waverley.
Stephen Tate, P.O. Box 361, Geelong.

Country
C. M. Bunn, c/o Dept. of Agriculture, Box 125, Bendigo.
Peter Dingle, RMB 5100, Alexandra.
Donald Franklin, Post Office, Mandurang South.
Sandra Leighton, P.O. Box 277, Broken Hill.
Geoff Williams, "Lorien", Newby's Lane, Lansdowne via Taree.

Joint
Cecil McQueen, 36 Swinden Ave, Cheltenham.

FNCV EXCURSIONS

Sunday, 2 May. "Tolcarne", Warburton. Mr G. Stringer has invited members to his property which is one of the former showplaces of Warburton and contains many fine old trees as well as new plantations of natives and bush. The coach will leave Batman Ave at 9.30 a.m. Fare $8.00. Bring a picnic lunch.

Sunday, 6 June. Dr J. H. Willis will lead a fungi excursion probably to the Dandeongs, but the destination will be decided nearer the time depending on the weather conditions. The coach will leave Batman Ave at 9.30 a.m. Bring a picnic lunch.

Preliminary notices:

Saturday, 28 — Sunday, 29 August. Bendigo. This will be a combined weekend with the VFNCA hosted by the Bendigo FNC. The weekend will include an excursion to the Whipstick and a meeting on Saturday evening. A coach has been chartered and motel accommodation, DBB, booked. Cost will be about $55.00 or members may camp if they prefer.

Thursday evening, 23 September — Sunday morning, 10 October. Western Australia. Accommodation, bed and breakfast has been booked at the Airways Hotel Apartments, 195 Adelaide Tec, Perth for Thursday night and the tour starts on Friday morning, travelling to Jurien Bay for the night. Saturday visit the Pinnacles National Park (lunch included), O/N Moora. Sunday O/N Merriden. Monday to Kalgoorlie via Southern Cross and Coolgardie visiting the Goldfields Historical Exhibition at Fly Flat. Tuesday and Wednesday will be based on Kalgoorlie, and include a ghost town tour and a visit to the Hainault Tourist Mine, Boulder, etc. Thursday through Norseman to O/N Esperance. Friday Esperance district including a launch trip on the bay (weather permitting). Saturday to Albany via Ravensthorpe, Hassell National Park, Many Peaks and Kalgan. Four nights in Albany with trips to the Stirling Range National Park, Porongurups, Bluff Knoll; to the south coast including The Gap, Natural Bridge, Jimmy Newhills Harbour and Frenchman's Bay; to the east coast visiting Lower King, Lower Kalgan, Nanarup, Two People Bay, Boulder Hill and Norma Beach. Wednesday O/N Pemberton. Thursday leave the coast at Alexandra Bay for a cruise downriver to Augusta, visit the lighthouse and waterwheel, O/N Augusta. Friday visit Jewel Cave and on to Busselton O/N via Margaret River, Canal Rocks, etc. Saturday to Perth with O/N accommodation, trip ending after breakfast on Sunday. Members arrange their own transport to Perth so may extend the time. Those going by air can save by purchasing Apex fares at $329 compared with $506 normal economy return. Bookings for the tour should be made as soon as possible with the Excursion Secretary, accompanied by a $100 deposit. Accommodation is DBB, mostly in motels.

GROUP MEETINGS

FNCV members are invited to attend any Group meeting, no extra charge.

Day Group — Third Thursday.
Thursday, 15 April. Williamstown. 578 1879. For details of other excursions telephone 578 1879.

At the National Herbarium, the Domain, at 8.00 p.m.

First Tuesday — Mammal Survey Group.

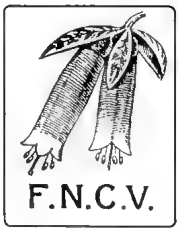
Third Wednesday — Microscopy Group.
Wednesday, 21 April. Aquatic insects. Speaker: Mr Paul Genery.

Wednesday, 19 May. Some microscopists of the past. Speaker: Mr Bob Graham.

Wednesday, 16 June. Pond life. Exhibits and comments by members.

Second Thursday — Botany Group.
Thursday, 8 April. Ms Vivien Turner, Monash University. The strange case of the banksia and the pygmy possum.

(Continued on page 80)



The Victorian Naturalist

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Insert: The Victorian Naturalist. Index for January-December, 1981.

Cover illustration: Kellam's Rocks — Reflections. A series of articles on the Permian Derrinal Glacial Valley by F. Robbins, H. E. Wilkinson and J. Kellam will be published soon in *The Victorian Naturalist* (editor).

Some Bird Records for Rum Island, Tasmania

BY J. S. WHINRAY*

The Furneaux Group is in south-eastern Bass Strait and is the most numerous group of Tasmanian islands. Rum Island, which is about eight hectares in area, is one of its south-western islets. It is at the western end of Armstrongs Channel and is about 100 metres south of Preservation Island (see Fig. 1).

Rum Island is a granite islet and the coast is rocky except for five small sand beaches. The largest beach is the north-east one and it has a small sand spit. The granite outcrops of the north end, which include the summit of about eighteen metres in height, are separated from the southern outcrops by a low-lying flat. This flat has some shallow central depressions which contain water during the wetter months.

The islet is part of the Sydney Cove Historic Site which was proclaimed on 29 March 1977 in order to protect the remains of the ship *Sydney Cove* which was run aground between Rum and Preservation Islands in 1797.

My first visit, on 4 June 1976, was so hurried that I saw only about a quarter of the islet. I stayed for four hours on the second visit, on 20 April 1978, and walked over most of the islet. The third visit, on 15 December 1979, lasted for about two hours and allowed me to see two-thirds of the islet.

Vegetation

The main vegetation was shrubby Coast Saltbush *Atriplex cinerea* which grew to 0.9 of a metre high and covered about half of the islet (see Fig. 2). Variable Groundsel *Senecio lautus* ssp. *dissectifolius* was the next most abundant species. It grew in much of the flat but, as it is not a perennial, those areas have little live vegetation at times (see Fig. 3). A succulent mat formed by Rounded Noonflower *Disphyma blackii* grew on parts of the southern rise and on a small area of the flat.

There were two small patches of sand dune shrubs. The species in the patch behind the north-eastern beach included Coast Daisybush *Olearia axillaris*, Coast Beardheath *Leucopogon parviflorus*, and Thyme Riceflower *Pimelea serpyllifolia*. Unfortunately this patch is being cleared by visitors for campsites.

The other vegetation types included a small area, towards the eastern end of the flat, where the dominant species was shrubby Australian Hollyhock *Lavatera plebeia* var. *tomentosa*.

Bird List

Tasmanian Muttonbird *Puffinus tenuirostris*

Muttonbirds were first mentioned in 1828 as a breeding species for the islet (Scott, 1828), and were mentioned again as such in 1908 (Lord, 1908). Recently the islet has been listed as a breeding area (Serventy, et al., 1971). I know neither when nor by whom any of those records were made.

The birds were absent from the breeding islands at the time of my 1976 visit.

In 1978 I found nineteen nestlings in burrows in the north-eastern quarter of the islet but most of the burrows there were empty. About three-quarters of the islet is muttonbird rookery but, despite being a reserve, it had been birded very heavily. Signs of this activity were very obvious throughout the rookery. Many burrows had been broken in completely. In some saltbush areas, bushes had been broken and pulled out. Patches of oil and gurry* were seen in much of the rookery.

* Flinders Island, Tasmania, 7255.

* Gurry is a birding term for the partly-digested stomach contents, exclusive of the oil, of muttonbird nestlings. The killed nestlings are squeezed to empty their stomach contents through their bills.

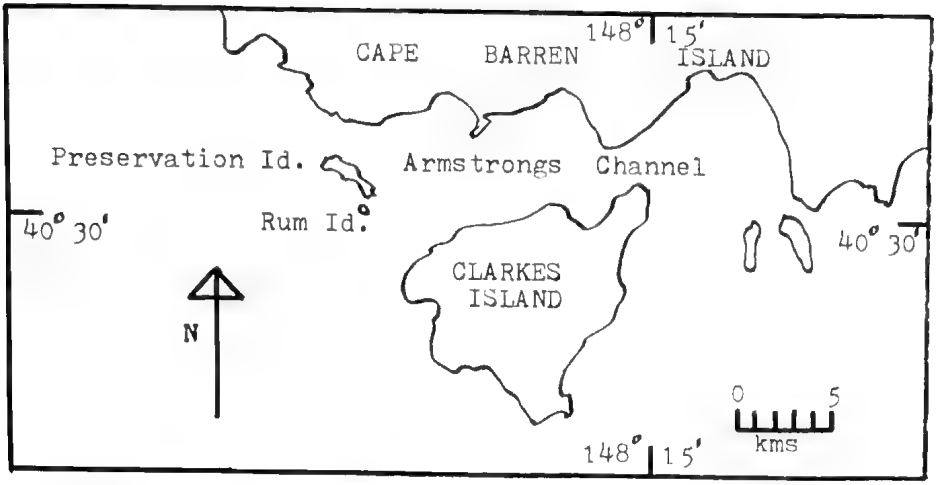

Fig. 1. Southern part of the Furneaux Group.

In 1979 there was no time to check more than one burrow. It contained an adult. Throughout the north-eastern rookery and the Groundsel sections of the flat could be seen dirt scratched freshly out of many burrows by the nesting birds.

It seems likely that the species has nested annually on the islet since long before the European occupation of Tasmania.

Australian Pelican *Pelecanus conspicillatus*

In 1976 there were fifteen on the north-eastern beach when I came in to land there.

Two flew off from the same beach when I approached it in 1978, and three in 1979.

Blackfaced Cormorant *Phalacrocorax fuscescens*

There were twelve on two small rocks just off the south-eastern point in 1978.

No signs of rookeries of this species were noticed during any of the visits.

Whitefaced Heron *Ardea novaehollandiae*

In 1978 one flew off from the flat.

Cape Barren Goose *Cereopsis novaehollandiae*

In 1828 this species was said to "abound at times" on the islet (Scott,

Fig. 2. The western end of the flat, Rum Island, April, 1978. Except for the *Poa* hassocks in the foreground, all the lighter coloured vegetation is Coast Saltbush. Photograph by J. S. Whinray.

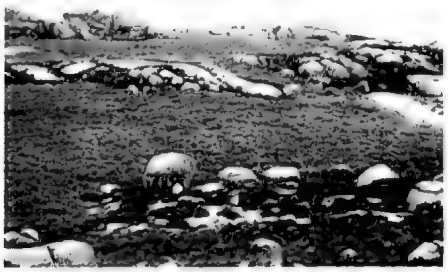

Fig. 3. The central and south-eastern part of the flat, Rum Island, April, 1978. The Variable Groundsel has died and bared the white sandy areas. The latter are partly separated by the narrow, damp central section. Photograph by J. S. Whinray.

1828). I do not know to what date, or period of years, that comment refers.

Maclaine (1908) recorded the species as laying "about three clutches" on the islet. This appears to have been the usual annual number and not just a record for one season.

Nineteen adults flew off from amongst the low vegetation of the flat in 1976.

In 1978 there were two on the north-west point, two on the north-east beach, and one on the flat. All of them were adults. This was a high number of birds for so dry a time of year, unless they were driven off Preservation Island by the shooters who were there that morning.

Five adults and four large goslings were seen on the islet in 1979.

White-breasted Sea-eagle *Haliaeetus leucogaster*

There was one on an outcrop by the summit when I reached the islet in 1978.

Sooty Oystercatcher *Haematopus fuliginosus*

In 1978 there was a pair resting on rocks just off the eastern point and, at the same time, a pair resting on a rock just west of the north-western point.

Masked Plover *Vanellus miles novaehollandiae*

Two flew off from amongst the low vegetation of the flat in 1976.

Towards the end of my 1978 visit a pair flew briefly over the flat and went south.

Silver Gull *Larus novaehollandiae*

In November 1907 Armstrong (1908) noted that, although this species had nests "in plenty" on the islet, there were no eggs and most of the nests had been robbed recently.*

In 1976 a flock of twenty-five was seen above the main rocks off the south-eastern point and then it settled there.

Fifteen, including some immature birds, rose from the main rocks off the south-eastern point in 1978. Elsewhere on the islet the largest number recorded was eight birds (four adults and four flying immature birds). These could have included part of the first flock.

One adult flew up from the north-western point in 1979.

Pacific Gull *Larus pacificus*

In November 1907 Armstrong (1908) noted that, although this species had nests "in plenty" on the islet, there were no eggs and most of the nests had been robbed recently.

Three mature and two immature birds were flying above the islet about half-way through the 1976 visit.

In 1978 there were two sightings. The first was of three mature and two immature birds; the second was of two immature birds. All of the immature birds could fly.

Only one mature bird was seen on the islet in 1979. It soon joined the four mature birds flying above the islet. Just before I left, there were six mature birds above it. One healthy, adult-sized, brown flightless chick was found on the southern rise.

Caspian Tern *Hydroprogne caspia*

There were two adults at the south end of the islet in 1979.

Crested Tern *Sterna bergii*

As I landed in 1976 there were at least thirty on the rocks off the eastern point.

Richard's Pipit *Anthus novaeseelandiae*

There were two sightings in 1978. The first was of a single bird; the second was two birds.

In 1979 two were seen in the low scrub on the southern slope of the summit.

Grey Fantail *Rhipidura fuliginosa*

There was one briefly in the sand dune shrubs behind the north-eastern beach in 1976.

Little Grassbird *Megalurus gramineus*

In 1976 a bird of this species was heard calling once in the main Coast Saltbush patch at the western end of the flat.

* Armstrong called the islet "Drum" but, because of the details he gave, it appears to have been Rum Island. The non-existent Drum Island is even listed — without comment — in a recent bibliography (see Murray-Smith & Thompson, 1981).

The species was seen or heard in every Coast Saltbush patch in 1978. Five was the largest number seen at any one time. I estimated the islet's population as at least twenty birds.

Two birds were heard during the 1979 visit. One was in the north-eastern beach dune scrub; the other was in the main Coast Saltbush patch at the western end of the flat.

Whitefronted Chat *Ephthianura albifrons*

One flew off from amongst the low vegetation of the flat in 1976.

There were four sightings in 1978. One was of two birds; each of the others was of one bird.

In 1979 there were four amongst the southern outcrops.

Silvereye *Zosterops lateralis*

There were three sightings in 1978. The first was of two birds in the Coast Saltbush behind the eastern beach. Next a party of small birds was seen in the north-eastern dune scrub and the one I could determine was a Silvereye. Finally one was seen feeding in a bush of the exotic African Boxthorn *Lycium ferocissimum*.

Two were seen briefly in the north-eastern dune scrub in 1979.

Common Starling *Sturnus vulgaris*

In 1978 a flock of seven birds was seen flying north over the middle of the islet, probably heading for Preservation Island.

Forest Raven *Corvus tasmanicus*

One was heard calling near the southern end of the islet in 1976.

In 1978 the highest number seen was eleven. Three of those were feeding on a dead Tasmanian Muttonbird nestling; the others were resting.

Comments

This list of nineteen species is the first published for Rum Island, and it includes all the earlier records known to me. My records are not the result of periodic visits because, due to the state of the sea, it is often impossible to reach the islet in the small borrowed boat that I use for island trips.

From my limited information, it can be said that the Tasmanian Muttonbird is the most common breeding species of the islet. Pacific Gulls and Cape Barren Geese also breed there but their numbers are not known.

The apparent absence of Little Penguins is unexpected, but some may yet be found there. Other species such as Sooty Oystercatchers and Silver Gulls may be found breeding on the islet if anyone can visit it at the right season. More frequent visits should result in further records of the species that I recorded only once. As well, extra birds could be added to the list.

The presence of so many Little Grassbirds in the shrubby areas is yet another local record of this species in an atypical habitat for Tasmania. Many of the prior Furneaux Group islet records of this species were made in similar habitat (Whinray, 1976).

The Sydney Cove Historic Site is being checked occasionally to protect the vessel's remains from robbers. However this work is hampered by the lack of a good sea-boat for the use of the National Parks and Wildlife Service ranger. In eleven years of visiting birding islands, I have not seen such a badly damaged rookery as that on Rum in 1978. A good boat would also allow the ranger to check the islet adequately during the birding season.

Acknowledgements

The first visit was made while I was stranded for fifteen days at Preservation Island by bad weather. Messrs R. & E. Ritchie kindly kept an eye on me and fetched me supplies on the several occasions when I ran out of food. The generous loan of Mr G. W. G. Goode's boat made the visits possible. Mr R. B. Filson made helpful comments on a late draft of this note.

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The Cape Gannet *(Sula capensis)*, A New Record For Australia

BY D. R. VENN*

In response to a request from Dr C. J. R. Robertson of the Wildlife Service of New Zealand to participate in a survey of known breeding colonies of the Australian Gannet *(Sula serrator)*, Divisional officers visited the two known breeding locations in Victoria — Lawrence Rocks off Portland and Wedge Light in Port Phillip Bay. On 4 November 1980 I examined the breeding colony on Wedge Light, a small platform located south-west of Mud Island State Faunal Reserve (38° 16′ 30″ S, 144° 42′ 10″ E).

The platform is about 4 metres above sea level, and a large craft was required to provide adequate viewing elevation so that nests on the platform could be observed, counted and photographed without disturbing nesting birds unduly. A series of photographs was taken from the bow of Fisheries Patrol Vessel *Delphinus*. From these photographs a plan of nest sites was prepared. The plan, interpreted information and photographs were forwarded to Dr Robertson.

On New Year's Eve a telegram requesting urgent checks of the birds at Wedge Light was received from Dr Robertson. While examining the photographs Dr Robertson had noticed that one bird displayed a longer gular stripe than any of the others. A long gular stripe is peculiar to the Cape Gannet which had not been recorded within Australia or New Zealand at that time. I carefully examined all the photographs I had taken and could then see the distinct difference in the gular stripe on one particular bird (Fig. 1).

Within two days I was able to arrange a visit to Wedge Light. Unfortunately, at such short notice the only boat available was a 5.0 m runabout which meant I could not take photographs or observe from above. However, the site previously identified as the nest of that particular bird was near the edge of the platform and hopefully the bird would be visible from a small craft.

I stopped the boat about 50 metres from the nest site and using binoculars saw the distinct gular stripe on one bird. I approached cautionsly and noticed that in addition to the long gular stripe there was a fine line of black plumage above the periophthalmic ring which was not apparent on the other birds. This line shows up clearly in the close-up photograph. (Fig. 2).

When I was about 10 metres away some birds, including the one under observation, took flight. All the tail feathers on the bird with the long gular stripe were black whereas the other gannets had black central tail feathers and white lateral tail feathers. I was now confident that the bird was in fact a Cape Gannet. I attempted to photograph these differences but unfortunately was unsuccessful.

During the next few weeks I revisited

* Senior Field Management Officer
North-West District
Fisheries and Wildlife Division.

Fig. 1 The Cape Gannet, *Sula capensis* (left).

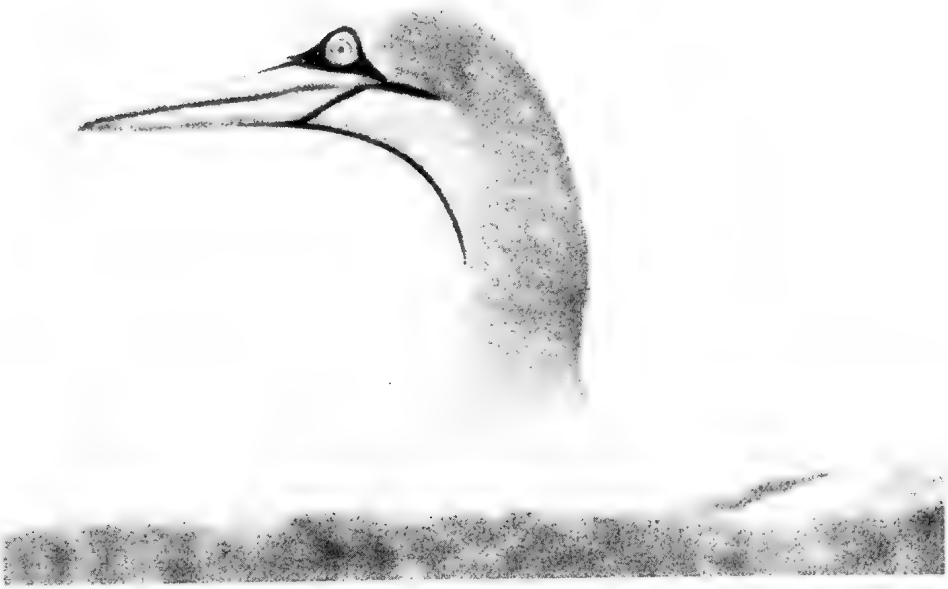

Fig. 2 Closeup of Cape Gannet, showing fine line of black plumage above periophthalmic ring.

the platform to check breeding progress. The Cape Gannet had paired off with an Australian Gannet and there was a young bird on the nest. The young bird appeared the same as the Young Australian Gannets. I had hoped to observe development of this young bird but adverse weather conditions prevented regular visits and on my return some weeks later I could not locate the Cape Gannet. The young bird, now free-flying, could not be distinguished from other young birds. The young birds on the platform were not banded, as banding under these circumstances causes too much disturbance and young birds that leave the platform end up in the water and are unable to return.

I hope that Divisional staff will visit the platform regularly during the coming months in an attempt to relocate the Cape Gannet and possibly the progeny from the last breeding.

Cup-Day Outing to Chambers Park and Mt. Cannibal

David and Ilma Dunn led an F.N.V.C. picnic-excursion to the nearer Gippsland bush on Tuesday, 3rd November (Melbourne Cup Day), participators assembling at the Emerald Hall by 11.45 a.m. Several members of our Society joined forces, as did three from the Latrobe Valley F.N.C. The first stop-over (and for lunch) was at R. J. Chambers Flora & Fauna Reserve near Upper Pakenham where the principal eucalyptus are brown stringybark, mealy stringybark, scentbark and broad-leaf peppermint, the last being white with massed honey-scented blossom. Most conspicuous native shrub was rusty bush-pea, billowing with small yellow flowers in pendant sprays. We walked around the short 'Acacia Trail', noting tall sun-orchid, red beard-orchid, long purple-flag, milkmaids and an abundance of the wiry spear-grass (*Stipa muelleri*) in flower; this tall-scrambling, almost leafless plant of poor hungry soils is locally known as "bayonet grass" and has only one to three large florets in each inflorescence (*cf.* other spear-grasses).

Then it was down to the Prince's Highway via Toomuc Creek Valley, eastward to North Garfield and north to Mt. Cannibal — a delightful knoll of granite, heavily forested with white stringybark (*Eucalyptus globoidea*). Orchids were there a-plenty, a dozen kinds being in bloom and five others identifiable from their foliage or withered flowers. Three sun-orchids were noted (*Thelymitra ixioides*, *media* and *pauciflora*), and there were many examples of cinnamon bells or potato orchid (*Gastrodia*) — one clump had 18 separate flowering heads! Two unusual finds came our way — scented colonies of the little ivy-leaf violet (normally with odourless flowers), and a form of creamy stackhousia ("candles") having distinctly *mauve* flowers.

We ascended via the northern track and came down by the south-west route, both being steep enough in their upper sections and with excellent panoramas from the two look-out points above great open slabs of granitic rock; the southern outlook is particularly impressive, with fine views to Western Port. A striking feature over much of this hill is the dense shrubbery of berry-flower heath (*Erica baccans*), an introduction from South Africa. It is a toughly twiggy bush to 3m tall, displaying masses of tiny globular rose-pink bells earlier in springtime. Despite, its attractiveness, the prevention of a complete "take-over" on this important reserve for native flora becomes an urgent desideratum — one recalls boneseed (another African) on the now damaged You Yangs.

— J. Willis

F.N.C.V. Calendar

The programme of events for the first six months of 1982 is available on request from the Subscription Secretary, FNCV, National Herbarium, The Domain, South Yarra, 3141.

Darwin: Naturalist, Scientist and Visionary

BY E. A. J. DUYKER*

19 April, 1982 marks the one hundredth anniversary of the death of Charles Darwin — one of the greatest naturalists of all time. In this article, I wish to address myself to Charles Darwin's commitment to the naturalist's discipline and to the enormous impact this commitment had on his work as a theoretical scientist. In 1831 Darwin accepted a British Admiralty offer of a position as a naturalist, to accompany Capt. Robert Fitzroy on a voyage in H.M.S. Beagle, to survey the coasts of Patagonia, Tierra del Fuego, Chile and Peru and to visit a number of Pacific islands. In order to uncover the formative significance of this voyage on Darwin, I have chosen to contrast his account of it with the text of his most important theoretical work — *The Origin of Species*.

The Origin of Species and the *Voyage of the Beagle* were published some twenty years apart and provoked totally different reactions from the public. While Darwin introduced the *Voyage of the Beagle* as a "journal, a history of our voyage" and a sketch of "observations in natural history and geology", in the *Origin of Species* he is far from frank in his introduction (although he does state a conviction that species are not "immutable" and that "natural selection has been the main but not the exclusive means of modification").

While the *Voyage of the Beagle* remains a naturalist's travel book (upon the pages of which are splashed detailed descriptions, observations, impressions and manifold questions), the *Origin of Species* remains essentially a scientific argument which attempts to answer the questions which confronted the author during his travels. Despite their different qualities and characteristics — one an argument, the other a narrative — they exhibit a multitude of similarities.

Both works are outstanding classics among the major contributions to the development of modern thought. Their value, however, is not isolated to a contributory capacity, for both are extremely rich works of literature. The first remains one of the finest works of travel ever written; the second is easily one of the most comprehensible works among the gallery of the great revolutionary products of the scientific mind. Neither work is infested with forbidding technical terms. In each work there is a huge scope and panorama of zoology, botany, geology and palaeontology.

Although the *Origin of Species* elicits a sensitive realization of the natural equilibrium, the *Voyage of the Beagle* is fraught with questions. The turmoil in Darwin's mind is revealed when we read, for example, of his demand to understand the differences between flora and fauna on the eastern and western sides of the Andes:

". . . unless we suppose the same species to have been created in two different countries, we ought not to expect any closer similarity between the organic beings on opposite sides of the Andes, than on shores separated by a broad strait of sea",

to which he added the footnote:

"The whole reasoning of course, is founded on the assumption of immutability of species. Otherwise the changes might be considered as superinduced by different circumstances in the two regions during a length of time".

This was a cryptic but obvious admission that species might possibly be mutable.

This same passage also reveals something of the author which is obvious throughout the *Origin of Species*. From both works we become aware of Darwin as a man of science — impervious to undisciplined lines of thought. We constantly encounter him insistent on objective evidence in so far as he could get it, for every step in induction and deduction by which he built up his

* Environment Section,
Department of Defence,
Canberra, A.C.T.

theories. In his efforts to remain within the bounds of this form of thought, both books reveal Darwin as a perfectionist at work. In the *Voyage of the Beagle* and the *Origin of Species* we also encounter descriptions of meticulous experiments and observations. There is an acute consciousness of each possible argumentative weakness and a desire to seal every hole.

These logical patterns also accentuate the carefully planned and premeditated form of each book. The *Voyage of the Beagle*, as a narration of the experiences of a young naturalist, was written to fulfil the desires of a public hungry to learn details of far away places. Thus, in a sense, it was following in the footsteps of Alexander von Humboldt's personal narrative and the works of Sir Joseph Banks; and its accomplishments were indeed similar. Like the *Origin of Species* it has a noticeable absence of trivia and places visited more than once have their descriptions consolidated. Unlike the *Origin of Species*, the *Voyage of the Beagle* manifests a range of moral judgements basically in relation to human behaviour and the antiquity of man together with scattered references to a creator. Sensing the storm ahead of him, it is not surprising that Darwin avoided mention of human evolution when writing the *Origin of Species!*

While Darwin's early naturalist experiences may have led him to pose questions for which he would not provide answers for another twenty years, he did, in a number of individual publications, provide answers to a number of questions in the fields of geology and zoology.

As has already been mentioned, the *Origin of Species* is an argument (of arresting proportions); Darwin starts with what he believes to be fact, then spins a hypothesis from it by induction. This is done in the first four chapters by explaining the operation of artificial selection by man, and of natural selection as a consequence of the struggle for existence. The fifth chapter deals with the laws of variation and causes of modification other than natural selection. Darwin then employs deduction in considering the consequences that could be tested for refutation or confirmation. In fact, the chapter devoted to "Difficulties on Theory" is so carefully thought out that practically no objection to the theory could be raised without him forseeing them, and providing an explanation. One such difficulty is to understand how initial and transitional stages might account for the production of electrical organs in certain fishes. Darwin's defence was that "we must own that we are far too ignorant to argue that no transition of any kind is possible".

The theory which suggests the cause of evolution, therefore, is given the foremost place in the work, and the evidence for the fact of evolution is considered in the last three chapters (excluding the re-capitulation) which provide palaeontological, geographical, anatomical and embryological evidence. Natural selection is employed in relation to these facts in a two-way process; previously inexplicable facts are explained by it, and they are used to prove its reality. The argumentative impact of this work is thus constantly developing rather than immediate.

Although both the *Voyage of the Beagle* and the *Origin of Species* display consistency with the notions of uniformitarian geology and many of the ideas of Lyell, in his earlier work Darwin states "the Geology of La Plata and Patagonia leads to the belief that all features of the land result from slow and gradual change" there is not a dogmatic adherence to these ideas. For example, quite contrary to the then prevailing and long accepted view of authorities such as Sedgewick and Lyell, Darwin concluded and expounded within the *Voyage of the Beagle* the notion that cleavage and foliation were not original phenomena dependent on the deposition of the strata, but that they had been subsequently superimposed by pressure. When experiencing the Conception earthquake of 1835, he also made an original observation of the connection between earthquakes and volcanic activity. His argument that coral islands could only have been formed as a result of subsidence of the sea floor and subsequent upward coral growth, was equally

original and has stood the test of time to be incorporated in standard teaching.

Darwin's notion of the gradual nature of change on the physical surface of the globe — that is obvious in the *Voyage of the Beagle* — is reflected in the *Origin of Species* with the author's belief in the gradual change of the animal and plant world. All such change, however, is regarded within an ecological framework. Although more acutely obvious in the *Origin of Species*, the influence of the Galapagos islands (with their distinctive tortoises, iguanas and finches adapted to live in harmony with each separate island environment) is evident in both works. Again and again the reader is reminded of the flexibility of nature, introduced by the occurrence of variation in offspring. Thus, there is constant reference within the *Origin of Species* to those incidents of animal and plant observation which the author made on his voyage in H.M.S. Beagle.

We must read Darwin, therefore, as a naturalist. Despite his logical stringency in the *Origin of Species*, he is a man writing to convince not to prove. He is a man attempting to convey an experience of the natural world and his own complex vision of how this world operates. Thus the reader is confronted with any metaphor and any analogy available which facilitates the articulate expression of his vision — the vision of an inspired naturalist. His perceptions of the mechanisms of change within nature have in most cases been substantiated by modern scientific research, but this research has in turn further illuminated the immensity of Darwin's perception, such that it would have been impossible to accommodate it within the logical categories of his time. If such argumentative forms had, in fact, been employed, his vision (the imaginative whole that it was) would have been rendered prosaic in our eyes.

Naturalist Review

BY FRANK W. ORME

"Cyclopaedia of Coldwater Fish and Pond Life"

Saiga Publishing Co. Ltd., 1981. 136pp. $22.95.

A successful compromise between inadequate coverage and an overly large and expensive publication is often elusive, and may be impossible for single volume encyclopaedias. At under 140 pages, this volume sets out to cover a wide range: from European native and exotic aquatic plants and animals to the construction and management of garden ponds.

This book does not succeed as an encylopaedia — indeed it hardly could. Perhaps it will be welcomed by affluent aspiring aquarists unfamiliar with many of the terms and names used in the European literature, but it is hard to see any other market.

More stringent editorial control over entries would have improved the book. Many of the basic biological entries seem superfluous (for example 'cell' and Fig. 98 — 'leaf types'); others are confused (e.g. 'Gasterosteidae'). Generic entries do not seem appropriate to a book of this nature — where important they could have been cross-indexed. This has led to considerable duplication (for example the Japanese Rush is entered under *'Acorus'* and 'plants'). Some illustrations are also duplicated (Smooth Newts on page 3, and colour plate 7; Arrowhead on p100 and Plate 1).

Many of the illustrations are poor, and waste space. The colour plates are clear, if rather simple, but many of the authors own black and white pictures are very weak. Some good ones are unacknowledged.

R. Gaymer.

Rare and Endangered Victorian Plants
3. Acacia glandulicarpa

BY J. STUWE*

The present paper is the third of a series outlining results of recent research into the distribution and conservation status of plants thought to be rare or endangered within Victoria. The aim of the series is outlined by Stuwe (1980). The species dealt with here is *Acacia glandulicarpa*, Hairy-pod Wattle (Fig. 1); a species of relatively fertile soils in areas now largely cleared for agriculture.

Range and abundance

The species is restricted to an area of the Wimmera in Victoria (Fig. 2), and one small population in the Northern Lofty region of South Australia (Whibley, 1980). The largest populations are in the Gerang Gerung/Kiata area. All Victorian records are within Major Grid C.

A rough estimate of the total number of plants of this species in Victoria is between 4000 and 5000, including about 1000 in biological reserves (Little Desert National Park; John Smith Memorial Sanctuary). Two large populations are from blocks of Crown Land near Gerang Gerung. The land tenure of other stands is Crown Land (3 stands); roadside (8 remnant populations); unused road easement (1 stand); and private (2 stands). Populations recorded from the railway line between Noradjuha and Jallumba, and from Nurrabiel Cemetery are presumed extinct.

Acacia glandulicarpa has been classed as 'Vulnerable', both on an Australia-wide basis by Leigh *et al.* (1981) and on a Victoria-wide basis in the present work (see Appendix 1).

Habitat and species' ecology

A. glandulicarpa occurs under a variety of dominant tree species — *Eucalyptus dumosa, E. viridis/odorata, E. behriana, E. largiflorens, E. microcarpa, E. leucoxylon, E. incrassata* and *Casuarina leuhmannii;* usually with a relatively open canopy. Lower strata, which are shrubby and/or herbaceous are also usually open in structure, often with a large proportion of bare ground. One population, however, extended a short distance into a mallee-broombush community.

Topsoil textures range from sandy clay to sandy clay-loam, with ironstone gravel present at some sites. Several stands were on areas transitional between the better farming country and the non-arable land of the Little Desert. The species probably once extended throughout much of the intensively-utilized *Eucalyptus microcarpa* and *Casuarina leuhmannii* grassy woodlands and other plant associations from the heavier Wimmera soils, although sufficient examples of such vegetation are not now available to confirm this.

Young plants occur in the absence of obvious soil disturbances or fire although more data are needed to determine whether such factors are necessary for germination.

Threats and recommended conservation measures

Stock grazing and the associated ingress of weeds are the major threats to the regeneration of this species on Crown Land. Frequent control burning potentially threatens populations on Crown Land adjoining farmland. Clearing of private land and roadworks are potential threats to other populations.

It can often be extremely difficult to obtain adequate protection for species which exist as remnant populations in areas which are utilized for agricultural, or other, purposes. *Acacia enterocarpa* (see Stuwe, 1980), for example, has been further reduced in numbers in Victoria following roadside works and rail duplication, even though a proposed conservation strategy for the species was

*Department of Botany
La Trobe University
Bundoora, Victoria 3083, Australia

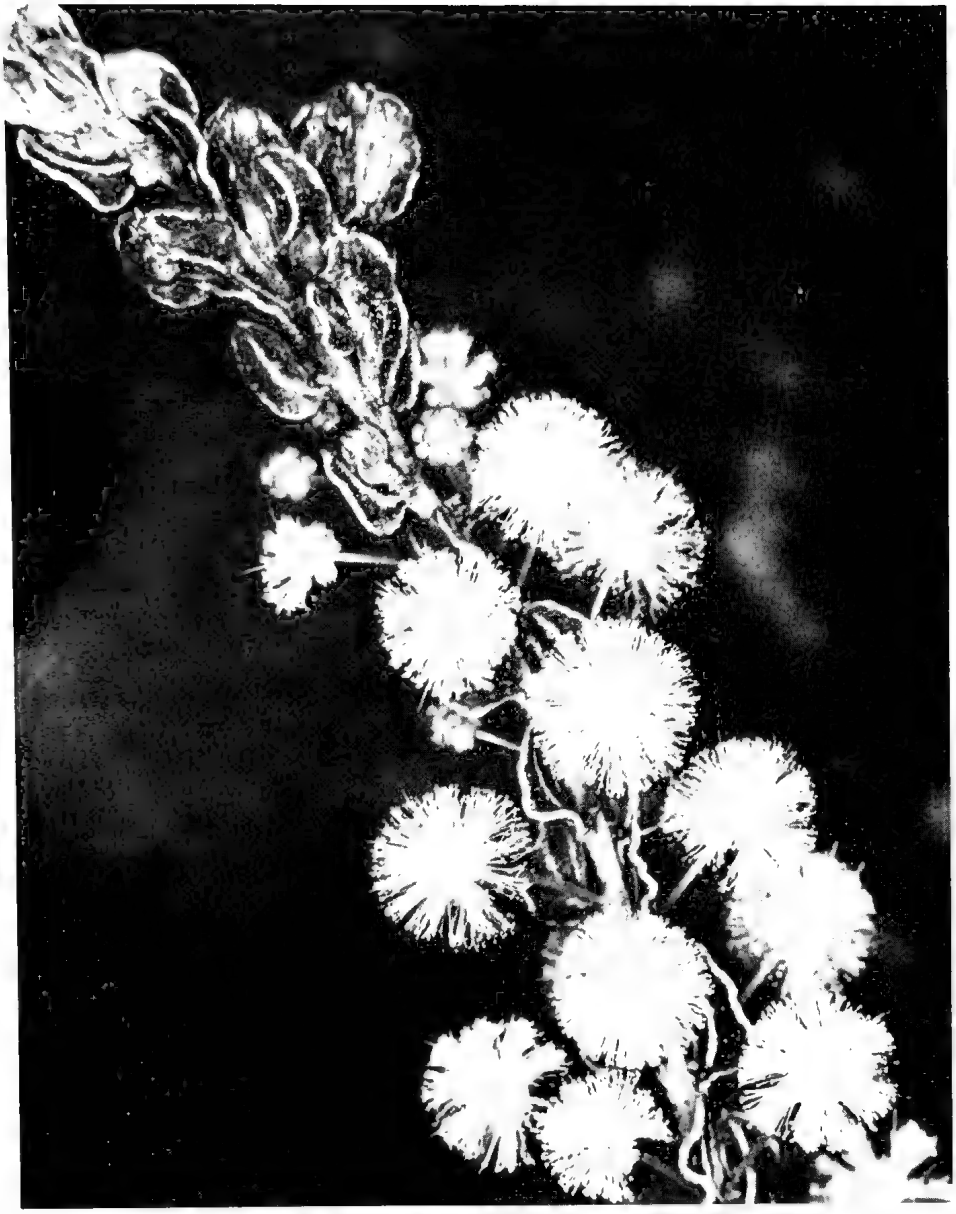

Fig 1. *Acacia glandulicarpa.* Photo by A. Gibb.

sent to relevant bodies. Lack of funding and/or interest has frustrated attempts to conserve other rare plant species. It is rather pleasing, therefore, to investigate a species such as *A. glandulicarpa* which, whilst inadequately reserved at present, occurs on a number of potentially reservable areas of Crown Land.

The conservation strategy proposed for this species depends upon (a) its continued protection within the Little Desert National Park and the John

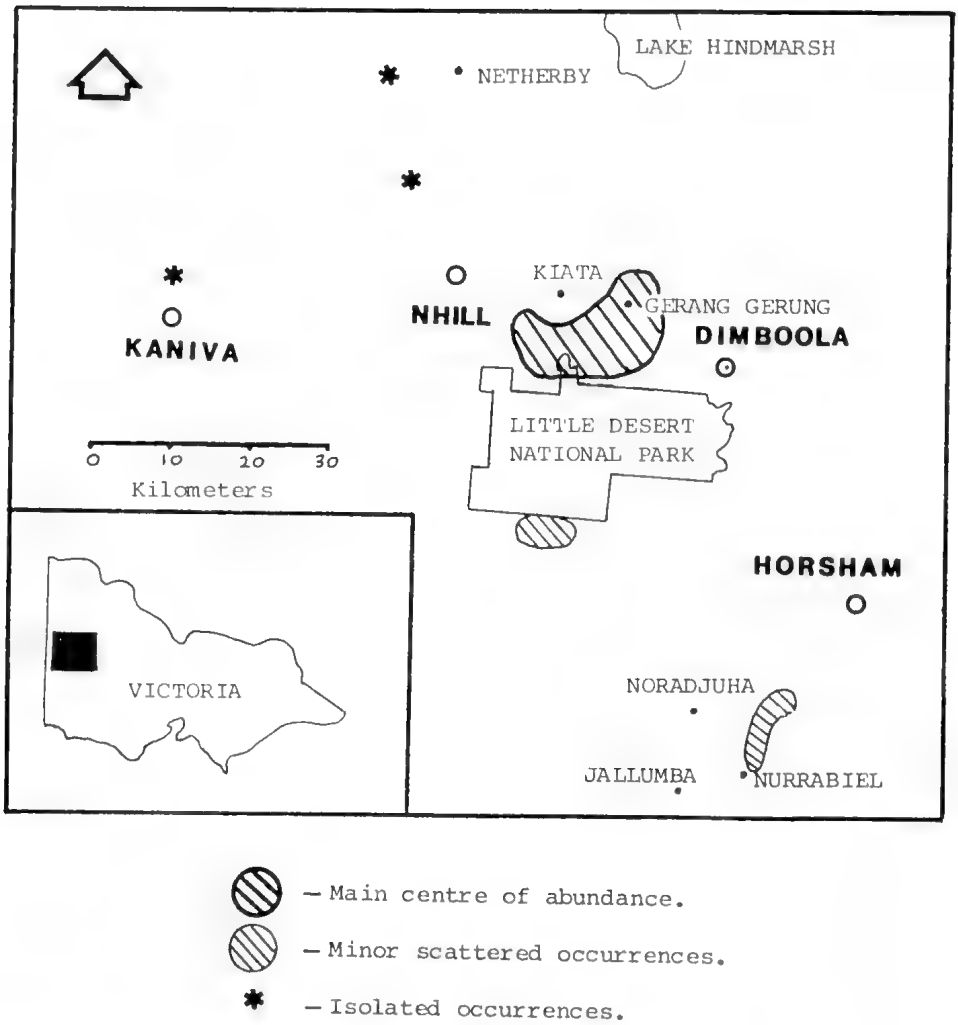

Figure 2. The distribution of *Acacia glandulicarpa* in Victoria.

Smith Memorial Sanctuary; (b) reservation of blocks of Crown Land at Gerang Gerung and Winiam East and (c) addition to the Little Desert National Park of Crown Land adjoining it to the north and south. Such reservation, with appropriate management, should afford adequate long-term protection for this species and attempts to conserve populations on private land and small roadside remnants are considered unwarranted.

The reservation of areas carrying populations of *A. glandulicarpa* will also act to conserve remnant plant communities which have been depleted through intensive utilization for agricultural purposes.

Recommendations sent to:

Department of Crown Lands and Survey; Land Conservation Council; National Parks Service, Kiata.

Acknowledgements

I wish to thank Mr F.J.C. Rogers, Mr A. Gibb, Mr A.J. Hicks and Mr A.E. Lindner for supplying information on the distribution of this species. Special thanks are extended to Mr C. Brownsea, N.P.S., Kiata, and Mr A. McMahon for locating and mapping populations in and around the Little Desert National Park. The work is funded in part by a grant from the National Estate Programme of the Australian Department of Home Affairs.

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Appendix 1: Risk categories used in the present work. These score each taxon according to the degree of endangerment. The numbers 0-3 follow the system adopted in Lucas, G.L. and Synge, A.H.M. (1977). The IUCN threatened plants committee and its work throughout the world. *Environmental Conservation, 4*(3), 179-87. Categories are defined as:

0 = EXTINCT. Taxa no longer known to exist in the wild after repeated searches of the type localities and other known or likely places.

1 = ENDANGERED. Taxa in danger of extinction, and whose survival is unlikely if the causal factors continue operating. Included are taxa whose numbers have been reduced to a critical level, or whose habitats have been so drastically reduced that they are deemed to be in immediate danger of extinction.

2 = VULNERABLE. Taxa believed to be likely to move into the Endangered category in the near future if the causal factors continue operating. Included are taxa of which most or all the populations are *decreasing* because of overexploitation, extensive destruction of habitat, or other environmental disturbance; also taxa with populations that have been seriously *depleted* and whose ultimate security is not yet assured, and taxa with populations that are still abundant but *under threat* from serious adverse factors throughout their range.

3 = RARE. Taxa with small world populations that are not at present Endangered or Vulnerable, but are at risk. These taxa are usually localized, with restricted geographical areas or habitats, or are thinly scattered over a more extensive range.

4 = LOCAL. Plants are not widely distributed although occurring over wide areas or in greater abundance than those of the categories above. Plants are not threatened although their local occurrence demands at least occasional monitoring. In practice, for a species to be regarded as rare than local, its range should include very few discrete localities — generally five or less.

Australian Natural History Medallion Fund

Amount on hand October 1981	$1643.50
The Western Australian Naturalists Club (2nd Donation)	10.00
Queensland Naturalists Club	20.00
Peninsula Field Naturalists Club (3rd Donation)	10.00
Total amount February 1982	$1683.50

Pitfall Trapping of Reptiles in the Big Desert, Victoria.

BY P. W. MENKHORST*

Introduction

Little information is available on the reptilian fauna of the Big Desert in north-western Victoria. Rawlinson's (1966) review of existing data emphasised the need for further surveys and Gilmore and McVicar's (1973) collation of literature and specimen records from the Victorian Mallee exposed many gaps. Recently, areas in the south and east of the Big Desert have been surveyed for reptiles (Mather 1979, A. J. Coventry, National Museum of Victoria *pers. comm.*) and incidental observations have been made by workers primarily interested in other fauna (e.g. Cockburn *et al.* 1979).

In this report, the results of drift fence pitfall trapping over eight days at White Spring and Ross Spring in the northern Big Desert are presented and compared with the results obtained in Wyperfeld National Park, 50 km to the SE (Mather 1979, Cheal *et al.* 1979). A reptile survey was not the primary aim of the visit and most time was spent observing birds. However, once installed, pitfall traps take little time to check and are an efficient method of sampling the reptilian fauna. The results indicate a range of habitats and diverse reptilian fauna exist in the area and emphasize the need for extensive fauna surveys before sound land use planning can be achieved.

Methods

Trapping took place between 4 and 12 November 1980 when seven lines of pitfalls and drift fences were set at the localities shown in Fig. 1. Drift fences consisted of strips of PVC Damp Course or fly screen 0.25m high held up by wire stakes. Six fences were 40m long and one (Line 3) was 20m. Pits consisted of metal tins (20cm diameter x 28cm deep) or cylinders (15-25 diameter x 45cm deep) sunk into the soil so that the rim was flush with the soil surface. Ten to twelve pits were spaced evenly along each fence and were straddled by it (Line 3, being only 20m long, had five pits). Pits were not baited and were checked morning and evening. Lines 1-3 were set for eight days and nights, Lines 4 and 5 for seven days and nights and Lines 6 and 7 for six days and five nights. Voucher specimens were collected and lodged in the National Museum of Victoria (Nos. D52740-D52779).

Trapping sites were selected to cover a range of substrates and vegetation communities. These are described below using the structural classification of Specht (1970) to describe each layer of vegetation rather than only the tallest.

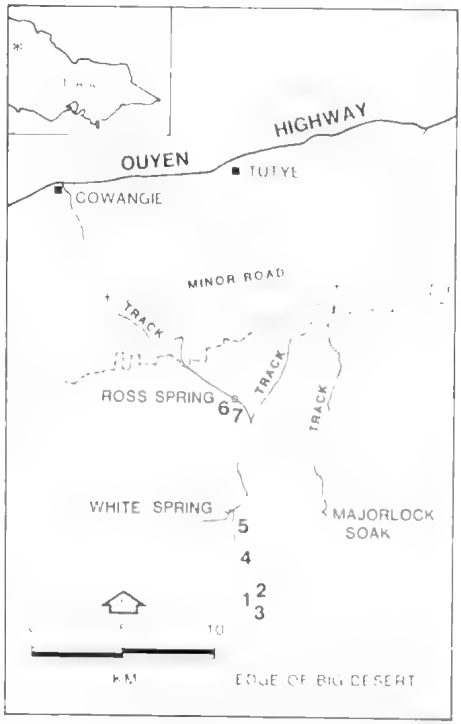

Fig. 1. Location of traplines.

* Fisheries and Wildlife Division, Arthur Rylah Institute for Environmental Research, 123 Brown Street, Heidelberg, Victoria. 3084.

Line 1. Mallee eucalypt open-scrub to 4m over a low open-shrubland of *Halgania cyanea* and *Lasiopetalum behrii* over bare compacted calcareous red sand.

Line 2. Sand dune carrying *Eucalyptus incrassata* open-scrub to 3m over open-heath dominated by *Acacia brachybotrya, A. montana, Callitris verrucosa, Leptospermum coriaceum* and *Hibbertia stricta* over sparse hummock grassland of *Triodia* sp.

Line 3. Sandy flat with *Eucalyptus oleosa* open-scrub to 4m over open-heath dominated by *Acacia brachybotrya, A. montana, Hakea muellerana* and *Callitris verrucosa* over sparse hummock grassland of *Triodia* sp.

Line 4. Limestone plain with shallow (20cm) sandy topsoil carrying *Eucalyptus porosa* open-scrub to 4m over a tall shrubland of *Melaleuca lanceolata* and *Acacia montana* over bare soil.

Line 5. Sand dune carrying tall shrubland of *Eucalyptus viridis* to 3m over open-heath dominated by *Callitris verrucosa, Leptospermum coriaceum, Hakea muellerana* and *Hibbertia* spp.

Line 6. Sandy flat carrying a low shrubland of *Callitris verrucosa* and *Leucopogon* sp. over hummock grassland of *Triodia* sp.

Line 7. Sandy flat carrying *Eucalyptus dumosa/E. foecunda* open-scrub to 4m over low shrubland of *Leptospermum coriaceum, Callitris verrucosa, Acacia rigens* and *Hibbertia stricta* over open-herbland of *Lomandra* sp. Patches of *Triodia* hummock grassland occurred nearby.

Results

Trapping results are shown in Table 1; a total of 126 reptiles was captured comprising 21 species from five families. Two other species, *Varanus gouldii* and *Trachydosaurus rugosus*, were observed in the general area. The most commonly captured family was Agamidae (55% of captures) followed by Scincidae (28%), Gekkonidae (9%), Pygopodidae (6%) and Typhlopidae (< 1%). Three species made up 60% of all captures; *Amphibolurus fordi* (39%), *Morethia obscura* (12%) and *A. nobbi* (9%). The remaining 19 species were captured in low numbers.

Twenty percent of captures occurred during the night or early in the morning; these comprised the *Typhlina*, all gekkoes except one *Diplodactylus intermedius*, 16% of agamids, one *Menetia greyi* and two *Morethia obscura*. The first two taxa are generally considered to be nocturnal while the agamids and skinks are diurnal and were probably captured in the morning before the traps were cleared.

Table 2 compares captures of diurnal and nocturnal species with daily maximum and minimum temperatures from Murrayville, 30km NNW of Ross Spring. Capture rates increased with increasing maximum temperature up to 31°C but fell at higher temperatures. The few captures of nocturnal species did not correlate closely with minimum or maximum temperatures.

The Ross Spring area contains a particularly wide range of vegetation associations and a diverse vertebrate fauna. The *Triodia* hummock grassland to the south-east of the spring is an important habitat for reptiles (Lines 6 and 7) and the small dasyurid marsupial *Ningaui* sp. was captured on Line 7. There is also evidence that the Night Parrot *Geopsittacus occidentalis* occurred there during the 1950's (Menkhorst and Isles 1981). The area deserves reservation and management for fauna.

Table 1. Reptiles captured at each trapline. Nomenclature follows Cogger (1979) except that *Ctenotus schomburgkii* becomes *C. brooksi* (Storr 1981).

Species	Trapline							Totals (%)
	1	2	3	4	5	6	7	
Gekkonidae								12(9)
Diplodactylus intermedius		1	1		2		1	5(4)
D. vittatus	1						1	2(2)
Lucaseum damaeum					1			1(1)
Phyllodactylus marmoratus		2	1					3(2)
Underwoodisaurus millii	1							1(1)
Pygopodidae								8(6)
Aprasia inaurita		1						1(1)
Delma inornata						6		6(5)
Lialis burtonis							1	1(1)
Agamidae								70(55)
Amphibolurus fordi		3		1	13	11	21	49(39)
A. muricatus				2				2(2)
A. nobbi	6	1		2	1		1	11(9)
A. pictus					2		2	4(3)
A. vitticeps				2		1	1	4(3)
Varanidae								
Varanus gouldii					1	obs.		
Scincidae								35(28)
Ctenotus brachyonyx						1	2	3(2)
C. robustus		1				3		4(3)
C. brooksi			1			1	3	5(4)
Egernia inornata			1				1	2(2)
Lerista bougainvillii		2			1			3(2)
Menetia greyi	2				1			3(2)
Morethia obscura	6	3		6				15(12)
Trachydosaurus rugosus		obs.						
Typhlopidae								1(1)
Typhlina bituberculata	1							1(1)
Total captures	18	14	4	13	21	23	34	126
% of total	(14)	(11)	(3)	(10)	(17)	(18)	(27)	(100)

Table 2. Comparison of daily maximum and minimum temperatures at Murrayville (Bureau of Meteorology figures) with captures of (a) diurnal species and (b) nocturnal species.

Date		4	5	6	7	8	9	10	11	12	13
Max. Temp. °C		22	21	23	21	21	23	26	31	35	37	41
Min. Temp. °C		4	12	13	10	7	7	9	13	14	21	18
Total Nos. Trapped	(a)		1	1	13	11	28	32	15	11		
	(b)		1	5	0	0	1	1	1	3		

Discussion

Except for the abundance of *A. fordi* on lines 5,6 and 7, total captures were spread fairly evenly across the seven traplines. However, some habitat preferences were apparent. Traplines through *Triodia* hummock grassland (Lines 2,3,6 and 7) captured almost all pygopodids and *Ctenotus* and 71% of *A. fordi*. Mather (1979) also had high captures of these taxa in areas with *Triodia* and Pianka (1972) has noted the importance of *Triodia* hummocks as shelter for many species of Australian lizards. *Triodia* grows on sand, and traplines in loose sand (Lines 2,3,5,6 and 7) tended to produce more captures and greater species diversity than those on hard calcareous substrates (Lines 1 and 4), reflecting both the importance of *Triodia* as well as the fossorial habits of many species. Lines 1 and 4, which were characterised by a calcareous substrate and open-scrub with little ground cover, produced 50% of captures of *A. nobbi* and 80% of *M. obscura*. *A. nobbi* is usually associated with mallee or broombush vegetation (Cheal *et al.* 1979) and our results suggest a preference for open-scrub with bare ground and sparse low shrub cover. *M. obscura* was found in a range of heath and mallee formations at Wyperfeld National Park (Cheal *et al.* 1979) and reasons for its preponderance on Lines 1 and 4 are not clear.

The two most commonly captured species were also abundant in Wyperfeld National Park (Mather 1979); *A. fordi* comprised 40% of captures in both areas and *M. obscura* comprised 12% in this survey and 9% at Wyperfeld. Two other species, *Ctenotus brooksi* and *Lucaseum damaeum*, were commonly captured at Wyperfeld but formed only a small percentage of captures in this survey.

The two broad reptilian "communities" recognised by Mather (1979) were not apparent from results obtained in this survey although there was clearly a difference between the reptilian faunas of areas with *Triodia* and those without. This may be partly due to the brevity and incomplete coverage of this survey which precludes a detailed analysis of habitat selection. Mather (1979) also found a greater species diversity; this is probably related to the longer sampling time and greater habitat coverage achieved in his study. Using similar techniques, he captured all species found in this survey except three (*Underwoodisaurus millii, Delma inornata* and *Typhlina bituberculata)* as well as seven extra species (*Delma australis, Ctenotus uber, Tiliqua occipitalis, Typhlina australis, Drysdalia mastersi, Pseudonaja textilis* and *Unechis brevicaudus).*

The lack of elapids captured is surprising as *Unechis brevicaudus* and *Echiopsis curta* have since been collected by hand from Ross Spring (J. Haywood, Mid Murray Field Naturalists Trust *pers. comm.).*

The survey area is uncommitted Crown Land but is available for mobile military training (LCC 1977). The effects of tracked vehicles being driven across country were evident around Ross and White Springs. Such activities can only exacerbate the already severe wind erosion hazard (LCC 1977) and may threaten populations of burrowing agamids, skinks and small mammals.

Acknowledgements

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Mr Jack Wheeler Wins "The Advance Australia Award"

The Geelong newspaper The Courier reports that Mr Jack Wheeler of The Geelong Field Naturalists Club was presented with the award by the Mayor of South Barwon, Cr Fred Rossack, in Belmont, Geelong on Tuesday 10th November.

The Advance Australia awards were introduced as part of the National Advance Australia Campaign to recognise the contributions made by Australians — either as individuals, groups or companies — to the Australian way of life.

Jack Wheeler 72, who devoted his life to the preservation of Australian flora and fauna has written more than 1000 "Nature Notes" columns in The Courier on Saturdays over the past 24 years.

Jack Wheeler was awarded The Australian Natural History Medallion for 1977 and a splendid tribute detailing the contribution that Jack has made for conservation and natural history was written by the Late J. A. Baines in *The Victorian Naturalist* Vol. 95, pages 33-34.

D. McInnes

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A Note on the Warm Ponds, Lakes Entrance, Victoria.

BY B. V. TIMMS*

Abstract

The Warm Ponds have formed since 1889 by the natural segmentation of the Cunninghame Arm of the Gippsland Lakes. The distal pond (No 1) is now almost fresh and contains a restricted freshwater fauna and a few species of estuarine affinities. The other ponds harbour a marine-estuarine fauna appropriate to their almost full strength sea water.

Introduction

Although almost all waterbodies in the sandy coastal lowlands of eastern and southern Australia have never had any contact with the sea, some apparently have evolved from marine inlets, as indicated by their physiography and the continued presence of some estuarine species. Lake Barracoota in East Gippsland is an example. Its environs indicate it has been cut-off from Mallacoota Inlet (Williams, 1980) and at least four estuarine species survive in it (Timms, 1973). Other examples are known at Bridgewater Bay, western Victoria (Timms, 1977) and along the New South Wales coast (Timms 1982 and unpublished). In each case the lake has been isolated from the sea for a few thousand years, but Blue Lagoon, northern N.S.W. is still connected intermittently.

A survey of the literature and a study of aerial photographs suggest that at least one of the Warm Ponds (*alias* Warm Holes, Bird, 1978) at the eastern end of the Cunninghame Arm at Lakes Entrance in Gippsland could be in the processing of developing from a marine to a freshwater pond. If so, then it is a further example of such a waterbody in Victoria, and more significantly, a site presently evolving from a marine to a freshwater ecosystem. It is the aim of the present note to document the major limnological features of the Warm Ponds in this context.

* Sciences Dept., Avondale College, Cooranbong, N.S.W. 2265

Physiography of the Ponds

The Warm Ponds lie in the former channel of the Reeves R. which used to be the natural outlet of the Gippsland Lakes (Bird, 1978). After the artificial entrance was cut at Lakes Entrance in 1889, the old mouth soon sealed naturally so that the channel became a backwater connected to the sea at its other end. It was renamed the Cunninghame Arm and soon began to segment by the growth of triangular shaped spits along its length. By 1929 (or earlier) Warm Pond No 1 had been cut off and by 1977 (or earlier) Ponds No 2, 3 and 4 had been formed (Miles, 1977). These latter ponds are still connected by narrow channels to the Cunninghame Arm but Pond No 1 is now typically unconnected (Fig 1), except during abnormally stormy weather when diluted sea water is backed up beyond Pond No 2, perhaps reaching it. Alternatively, during very wet weather the overflow of Pond No 1 may reach Pond No 2.

Pond No 1 is about 20m wide and 50m long and up to 3m deep. Ponds 2 and 3 are 2-3 times larger and about 2m deep. Pond No 4 was not visited but is much larger than the others.

Methods

A few physicochemical parameters were measured, mainly in Ponds No 1 and 2. Total dissolved solids (TDS) was determined gravimetrically by evaporation at 105°C (accuracy±5%), temperature was measured with a thermistor thermometer (accuracy±0.1°C), pH with a Lovibond Comparator (accuracy±0.2 units) and light penetration with a 20cm Secchi disc.

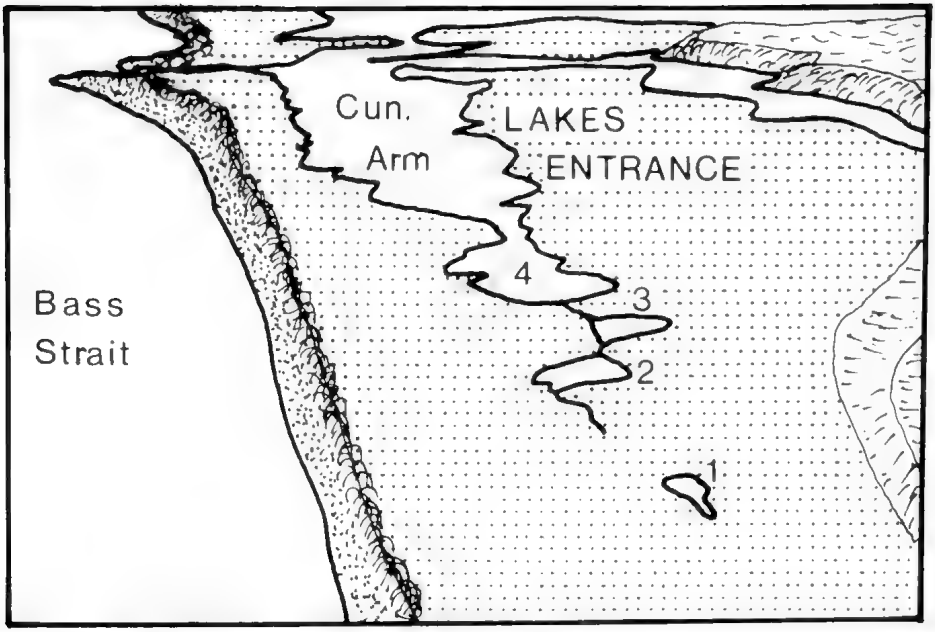

Figure 1: Sketch of the Warm Ponds taken from an oblique aerial photograph looking west over Lakes Entrance.

Zooplankton was collected at night with a conical net 30cm in diameter and a mesh size of 159 μm. and littoral invertebrates (and a few fish) were captured with a pond net of mesh size 1mm. A birge Ekman grab of 225 cm^2 gape was used to collect benthos in Pond No 1. All samples were preserved in 5% formalin.

Results

(a) *Physiochemical Features.* Although each pond had similar warm alkaline surface waters, which transmitted light roughly similarly, their TDS's were quite different — Pond No 1 was almost fresh while Ponds 2 and 3 contained only slightly diluted sea water. (Table 1). Pond No 1 was also markedly thermal stratified whereas Pond No 2 was not stratified except perhaps transitorily during warm afternoons. Bottom water of Pond No 1 smelt strongly of H_2S, indicating a lack of oxygen. The

TABLE 1
Some physicochemical features of the Warm Ponds

Parameter	Pond No 1	Pond No 2	Pond No 3
TDS (gl^{-1})	3.1	32.5	32.0
pH	8.2	8.6	8.6
Secchi disc depth (cm)	105	170	—
Surface Temperature °C	26.2•	28.3+	28.4ϕ
Bottom Temperature °C	18.5	26.9	—

• at 11 am, + at 1 pm, ϕ at 2 pm.

bottom mud of this pond was black and also had a distinct H_2S odour.

(b) *Plants.* Pond No 1 was surrounded by a thick sward of *Scirpus validus* Vahl. and *Cladium procerum* S. T. Blake in which there were patches of *Phragmites australis* (Car.) Littoral vegetation was much sparser in Ponds No 2 & 3 where *Juncus kraussi* Hockst. was the dominant emergent and *Ruppia maritima* L the dominant submergent species.

(c) *Littoral Animals.* The littoral invertebrate fauna of Ponds No 1 and 2 was quite different (*cf* Table 2 and 3). The inhabitants of Pond No 1, except for the amphipod, are freshwater species while the inhabitants of Pond No 2 are marine or estuarine species. The zooplankton of the two ponds, although somewhat different, shared a dominant species, *Brachionus plicalitis rotundiformis* and one or perhaps two other species. No benthic animals were found in the bottom of Pond No 1. Two species of fish, *Philypnodon grandiceps* Krefft and *Philypnodon* sp nov, were captured in Pond No 1; fish were seen in pond No 2 but could not be caught with a pond net.

Discussion

It might be expected that a series of ponds formed by segmentation of an arm of an estuary would show a salinity gradient. Those formed in the Cunninghame Arm in the Gippsland Lakes hardly do so, since there is little freshwater inflow at the distal end and

TABLE 2
Fauna of Warm Pond No 1

Littoral Invertebrates	
Crustacea:	
Amphipoda	*Melita* sp.
Insecta:Odonata	unident Aeschnidae sp 1 unident Aeschnidae sp 2 unident Coenagrionidae
Insecta:Hemiptera	*Naucoris congrex* Stal.
Insecta:Trichoptera	*Oecetis* sp.
Insecta:Diptera	*Chironomus* sp.
Insecta:Coleoptera	*Antiporus femoralis* (Boheman)
Mollusca:	
Gastropoda	*Physastra gibbosa* (Gould) *Potamopyrgus niger* (Quoy & Gaimard)
Zooplankton	
Rotifera	*Brachionus plicalitis rotundiformis* Tschugnoff *Hexarthra oxyuris* (Zernov) *Keratella cochlearis* (Gosse) *Keratella procurva* (Thorpe) *Lecane bulla* (Gosse)
Copepoda	*Gladioferens spinosus* Henry (night only)

TABLE 3
Fauna of Warm Pond No 2

Littoral Invertebrates	
Crustacea:	
Amphipoda	*Melita* sp.
Crustacea:Decapoda	*Amarinus laevis* (Targioni Tozzetti) *Macrobrachium intermedium* (Stimpson)
Mollusca:	
Gastropoda	*Hydrobia buccinoides* (Quoy and Gaimard) *Parcanassa burchardi* Phillippi *Pyrazus ebeninus* Bruguiere *Salinator fragilis* (Lamarck)
Mollusca:Bivalva	*Gari donacioides* (Reeve) *Xenostrobus securis* (Lamark)
Zooplankton	
Rotifera	*Brachionus plicatilis rotundiformis* Tschugunoff *Keratella procurva* (Thorpe)
Copepoda	*Acartia "clausii"* Giesbrecht *Gippslandia estuarina* Bayly & Arnott *Gladioferens* sp. juveniles *Oithona brevicornis* Gresbrecht

most of the segments are still well connected. Ponds No 2 and 3 contain only slightly diluted sea water and it is only Pond No 1, which is normally unconnected with the series, where salinity is markedly reduced. In January 1981 it was almost fresh; probably during winter it is fresh (salinity < 3 gl^{-1} *cf* Williams, 1964) since rainfall is often more abundant and evaporation always less then.

The biota of Ponds No 1 and 2 are distinctly different. The organisms in Pond 2 are almost all of marine or estuarine affinities while most of the organisms in Pond No 1 are of freshwater origin with just a few with estuarine affinities. Both ponds contain some cosmopolitan euryhaline rotifers eg. *Brachionus plicalitis* is a well-known inhabitant of coastal brackish waters and inland saline lakes (Walker, 1981).

The affinities of organisms in Pond No 1 warrant closer examination. The most prominent group in the pond is of widely distributed and tolerant freshwater species eg. *Scirpus validus, Naucoris congrex, Antiporus femoralis, Physastra gibbosa, Potamopyrgus niger, Hexarthra oxyuris,* Keratella cochlearis, Lecane bulla, Philypnodon grandiceps* and *Philypnodon* sp. and probably also, if the species were known, the odonatans, *Oecetis* sp and *Chironomus* sp. The two plants, *Cladium procerum* and *Phragmites communis*, which can both tolerate mildly brackish water (Willis, 1970) are best placed in this group. The estuarine group consists of two species, the copepod *Gladioferens spinosus* and the amphipod *Melita* sp. *G. spinosus* is typically an estuarine species, but it is also known from some freshwaters (Bayly, 1963, Shiel, 1978; Timms, 1973), while *Melita* sp. is common in estuaries such as the Gippsland Lakes (A. Poore, personal communication).

The presence of these two estuarine species is significant in a pond recently (~ 90 years ago) derived from an estuary. It strengthens previous conclusions on the marine ancestry of some coastal freshwater lakes such as L. Barracoota, L. Bong Bong and the Bridgewater Lakes which contain estuarine species (Timms, 1973, 1977). Warm Pond No 1 is still evolving from a marine to a freshwater ecosystem, for its shores are fringed with plants tolerant of brackish water and its fauna is depauperate (see earlier). The fauna is probably restricted by the high salinity which conceivably could be even higher during a rare connection to Pond No 2. However, habitat homogeneity (there is no macrobenthos and the littoral is clothed with a monotonous sward of emergent macrophytes) and insufficient time for colonization may be restricting the fauna.

It is of note that estuarine animals found in freshwater ponds/lakes of marine ancestry are usually crustaceans. This could well be due to the general osmoregulatory abilities of the group vis-a-vis other marine taxa, though none of the species involved have yet been proved to osmoregulate. Estuarine crustaceans known to intrude into such freshwaters include anthurid (*Cyathura* sp.) and sphaeromatid isopods (Atkinson *et al* 1981; Timms 1973), Amphipods (*Melita* sp. in Warm Pond No 1 and an unidentified species at Myall Lakes (Timms, 1982) and the copepods *Sulcanus conflictus* Nicholls and particularly *Gladioferens spinosus* (Bayly 1963; Timms, 1970, 1973, 1977; present data). Other taxa known so far from such freshwaters include the spionid polychaete *Boccardiella limnicola* (Blake and Woodward) and the mytilid bivalve *Fluviolanatus amarus* (Laserow) (Timms 1973, 1982). All of these species are common inhabitants at the freshwater end of salinity gradients eg. as in the Myall Lakes (Atkinson *et al*, 1981), so their occasional intrusion into freshwaters is not surprising.

* This is the first Australian record for this species — see Shiel & Koste, 1979.

Acknowledgements

The Lakes Entrance Golf Club is thanked for allowing access to the ponds, and Sue Boyer ably assisted in the field. The following taxonomists are thanked for their identifications: Dr M. Gamon (fish) Mr D. McKinnon (Copepoda in Pond No 2), Dr J. Martin (Chironomidae), The Director, National Herbarium, Melbourne (plants), Dr A. Nebois (Trichoptera), Dr G. Poore (Decapoda), Dr B. Smith (Mollusca), Dr M. Sudzuki (Rotifera) and Dr C. H. S. Watts (Coleoptera).

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Appendix: The Odonatans have since been identified by Dr J. A. L. Watson as *Aeshna brevistyla* Ramb. and *Ischnura heterostricta* (Burm). The latter is known to breed in brackish water while the presence of the former in such waters is unusual.

The Centenary Expedition of the F.N.C.V. 1-8 Nov, 1980

(Continued from page 42 in previous issue)

The Walk to Waterloo Bay

On the Thursday a group of us walked to Waterloo Bay. This is Miss Jean Galbraith's account of it. Miss Galbraith is the author of *"Wildflowers of Victoria"* and *"Collin's Field Guide to the Flowers of South-east Australia"*.

Thanks to the rangers who drove us to where the walking track leaves the lighthouse road (and took those going to the lighthouse almost to their destination) the trip to Waterloo Bay and back was an easy walk of 5 kilometres, or it was easy except for the last "black mud waterfalls" as someone aptly described them. They were negotiated by most of the party, though a few of us, doubtful whether we could keep our footing in the steep mud were content with a view of the bay from a carpet of heathland flowers at the top of the first "waterfall".

Apart from that last part, the track was easy and well-graded. It traversed two distinct plant communities, first woodlands of either Drooping Sheoak or Coast Teatree, the first especially with no undergrowth, but a carpet of brown needles on which footsteps were silent. The gnarled branches of Coast Teatree with their blue-green roof of leaves allowed more light to filter through than the dense growth of Sheoak, so there was usually more undergrowth under the teatree.

The woodland paths crossed several small creeks and their surrounding bogs by long wooden bridges. Ferns and mosses grew there; the small Fairies Aprons and tall forked Sundew, and on some banks Bushy Clubmoss grew, 30 cm high or more, like miniature pine trees with vivid green mossy foliage, and erect green "tails" of fruiting bodies.

A minor excitement was the sight of a small snake in the shallow water — a White-lipped Snake we thought, but no one was sure.

Next came the higher ground of the wind pruned heaths, and we were reminded of the heathlands on the way to Miller's Landing, though the composition of the two differs a little. Bright flowers grew amongst a 30-40 cm scrub of Silky Teatree (taller in hollows) with delicate white or pink flowers. There was some late Common Heath; primrose flowers of Karralla, and big red or apricot pea-flowers of Downy Wedge-pea; several species of bright yellow guinea flower and brown and yellow parrot-pea; magenta pink Hairy Pink-bell and Heath Milkwort, with occasional Blue-spike Milkwort, which someone described aptly (anyway when in bud) as "grape-hyacinth like". The dwarf Fringed Daisy-bush with its bright mauve flowers, and red Correa, so abundant toward Miller's Landing, were rare in the Waterloo Bay heaths but added an occasional new colour to the rainbow of heathland flowers.

There were few orchids — 4 species that I remember, but none abundant.

Some of us negotiated the "mud falls" and pressed on towards the beach, across what was in many places a wet heathland with thickets of scented paperbark. In one place water was seeping across the track and we saw a large group of the yellow onion orchid growing in the shallow water. (HW).

Scientific names in the order they appear in the text.

Drooping Sheoak	*Casuarina stricta*
Coast Teatree	*Leptospermum juniperinum*
Small Fairies Aprons	*Uticularia lateriflora*
Forked Sundew	*Drosera binata*
Bushy Clubmoss	*Lycopodium deuterodensum*
Silky Teatree	*Leptospermum myrsinoides*
Common Heath	*Epacris impressa*
Karalla	*Gompholobium heugelii*
Downy Wedge-pea	*G. ecoststum*
Fringed Daisy-bush	*Olearia ciliata*
Correa	*C. reflexa*
Guinea Flowers	*(Hibbertia) H. stricta, H. acicularis, H. sericea, H. fasciculata, H. procumbens.*
Parrot-peas	*(Dillwynia) D. sericea, D. glaberrima*
Hairy Pink-bell	*Tetratheca pilosa*
Heath milkwort	*Comesperma ericinum*
Blue-spike milkwort	*C. calymega*
Scented Paperbark	*Melaleuca squarrosa*
Yellow Onion Orchid	*Microlis atrata*

Fig. 2. Encoelia tumerensis fungi on cone of Banksia.

Sealer's Cove

A small group walked from Oberon Saddle to Sealer's Cove on Friday 7th. This is Margaret Corrick's (Senior Botanist, National Herbarium of Vic.) account of it.

The nine hours taken for the return trip enabled frequent stops to be made along the way, and over an hour was spent on the beach. Apart from one or two places along the last part leading to the camping ground the track was found to be well drained and well maintained.

Cyathea cunninghamii (Slender Tree-fern) was seen in the gully at Ferny Glade on one of the headwaters of Sealer's Creek. *Nothofagus cunninghamii* (Myrtle Beech) and *Atherospermum moschatum* (Southern Sassafras) were also found in this gully, as well as *Lycopodium varium* (Long Clubmoss). The latter is uncommon in Victoria, occurring in only five very disjunct localities.

Dr Willis reported seeing the unusual eucalypt *Eucalyptus obliqua* var. *disocarpa*, sometimes known as "Howitt's Puzzle". This has the appearance of a gum-topped stringy bark and is thought to be of hybrid origin.

A few of the party made a detour up the hillside near the camping area to look at an unusual *Banksia* which is similar to *B. integrifolia* but may prove to be a distinct species. The track between the old bridge over Sealer's Creek and the camping area passes through a dense stand of very tall *Gahnia clarkei* (Tall Saw-sedge), and at the water's edge here patches of *Callitriche* (Water Starwort) were flourishing.

Mammals

The mammal survey team concentrated their trapping areas in regions that had had little survey work done, viz Mt Oberon and the foothills behind Mt Oberon. There were three traps nights, with good success rates.

The Dusty and the Brown Antechinus were found as well as the Bush Rat, Ringtail Possum, Wombat, Echidna, Eastern Grey Kangaroo, Black Wallaby, and Koala.

The highlight of the trip was the capture of three Potoroos, one of which had a pouched young.

All those present at the camp were thrilled to have the opportunity to see at first hand, the animals that were caught. These animals were afterwards returned to the capture points.

Brown Antechinus	*Antechinus stuartii*
Dusty Antechinus	*Antechinus swainsonii*
Bush Rat	*Rattus fuscipes*
Potoroo	*Potorous tridactylus*
Ringtail Possum	*Pseudocheirus peregrinus*
Wombat	*Vombatus ursinus*
Echidna	*Tachyglossus aculeatus*
Black Wallaby	Wallabia bicolor
Koala	*Phascolarctus cinereus*

Non-marine molluscs

The following account of non-marine molluscs found on the Promontory was provided by Dr. Brian J. Smith, then President of FNCV, and Senior Curator (Zoology) at the National Museum of Victoria.

Fig. 3. Caladenia gigantea carnea var.

Fig. 4. Setting traps on Mt. Oberon.

During the week 16 species of non-marine molluscs were taken from a wide variety of habitats including 5 introduced species (see below). The saltmarsh and estuarine creek area contained members of the Ellobiidae, Amphibolidae, Hydrococcidae and Hydrobiidae, while freshwater habitats yielded a planorbid, *Physastra gibbosa* and the hydrobiid *Angrobia angasi*.

Around the Tidal River settlement area and in adjacent areas of high human use, two species of introduced slugs belonging to the families Limacidae and Milacidae and three species of helicid snails were found. Five species of native snails were found in the forest and bush areas. The punctid, *Magilaoma* was found in dry woodland and coastal heath, the remainder being in the wetter forest areas. Of particular interest

were the specimens of the large charopid, *Mulathena fordei*. The seemingly large and more fragile form found on the Promontory was described as a separate species by Gabriel (1934), *Thalassohelix translucens*.

Gabriel, C. J., 1934. *Thalassohelix translucens*, a new Victorian land shell. *Mem. natn. Mus. Vict.*, 8:157.

Species list

Family Hydrobiidae
- *Angrobia angasi* — freshwater.
- *Hydrobia buccinoides* — estuarine.

Family Hydrococcidae
- *Hydrococcus tasmanicus* — saltmarsh.

Family Ellobiidae
- *Ophicardelus ornatus* — saltmarsh.

Family Amphibolidae
- *Salinator solida* — saltmarsh.

Family Planorbidae
- *Physastra gibbosa* — freshwater.

Family Punctidae
- *Magilaoma penolensis* — coastal scrub.

Family Charopidae
- *Pillomena dandenongensis* — wet forest.
- *Mulathena fordei* — wet forest.

Family Limacidae
- *Deroceras reticulatum* — introduced slug.

Family Milacidae
- *Milax gagates* — introduced slug

Family Helicarionidae
- *Helicarion niger* — forest.

Family Camaenidae
- *Chloritobadistes victoria* — forest.

Family Helicidae
- *Theba pisana* — introduced snail.
- *Cochlicella ventrosa* — introduced snail.
- *Helix (Cryptomphalus) aspersa* — introduced snail.

Flora List

List of Mosses

Compiled by A. W. Thies, 25 Davies St., E. Malvern. 3145

Atrichum androgynum (syn. Ligulatum)
Breutelia affinis
- *Bryum argenteum* (junction Lighthouse & Waterloo Bay tracks)

B. billardieri
Camptochaete arbuscula (syn. ramulosa)
Campylopus introflexus
C. pallidus (syn. torquatus)
Dicnemolome pallidum (syn. sieberianum)
Dicranoloma billardierc
Ditrichum difficile (syn flexifolium)
Fissidens pallidus
Hedwigia integrifolia
Hypnum cupressiforme
Leucobryum candidum
Mittenia plumula
- *Orthodontium lineare* (Miller's Landing)
- *Pogonatum subulatum* (Road to Mt. Oberon Summit)

Polytrichadelphus magellanicus
Poly trichum juniperinum
Ptychomnion aciculare
Rhacocarpus purpurescens (syn. humboldtii)
Sematophyllum homomallum
Tayloria octoblepharis
Thuidium furfurosum
- *Tortula muralis* (Tidal River settlement)

T. princeps
Zygodon menziesii
- Not in checklist in "Wildflowers of Wilson's Promontory" by R. Garnet.

List of Fungi

Compiled by Hilary Weatherhead.

Gilled Fungi
- *Hypholoma fasciculare*
- *Mycena interrupta*
- *Mycena viscido-cruenta*
- *Pleurotus nidiformis*
- *Rhodophyllus virescens* (previously *Leptonia)*
- *Russula cyanothantha*

Others
- *Cymatodeoma lamellatum*
- *Daldina concentrica*
- *Dictyopanus repidium*
- *Encoelia toomansis*
- *Polyporus arcularius*
- *Pycnoporus coccineus*
- *Stereum fasciatum*
- *Trametes lactinea*
- *Trametes lilacinogilva*
- *Tremella mesenterica*

Birds

Key to locations: M = Millers Landing; D = Darby River Swamp; Y = Yanakie; T = Tongue Point; L = Lilly Pilly Gully; LT = Lighthouse Track; N = Norman Point; S = Squeaky Bay.

Emu
Common Bronze-wing M
Brush Bronze-wing
Eastern Swamphen

Short-tailed Shearwater T
Black Cormorant
Little Black Cormorant
Pied Cormorant
Little Pied Cormorant
Australian Gannet M
Pelican M
Crested Tern
Caspian Tern
Fairy Tern D
Silver Gull
Pacific Gull
Sooty Oyster-catcher
Spur-winged Plover D
Hooded Dotterel
White-faced Heron
Black Swan M
Black Duck
Chestnut Teal D
Swamp Harrier D
Wedge-tailed Eagle
White-breasted Sea Eagle T
Black-shouldered Kite
Peregrine Falcon T
Nankeen Kestrel S
Boobook Owl
Yellow-tailed Black Cockatoo
Gang-gang Cockatoo
White Cockatoo
Crimson Rosella
Eastern Rosella M
Laughing Kookaburra
Fan-tailed Cuckoo
Brush Cuckoo M
Horsefield Bronze Cuckoo
Golden Bronze Cuckoo
Welcome Swallow
Fairy Martin
Grey Fantail
Rufous Fantail L
Satin Flycatcher
Leadern Flycatcher
Scarlet Robin
Flame Robin T
Southern Yellow Robin
Golden Whistler
Rufous Whistler
Olive Whistler
Grey Shrike-thrush
Magpie-lark
Black-faced Cuckoo-shrike
Spotted Quail-thrust
Striated Thornbill
Brown Thornbill
White-browed Scrub-wren
Striated Field-Wren
Pilot Bird
Little Grassbird D
Southern Emu-wren
Superb Blue wren
Ducky Wood Swallow
White-throated tree creeper
Spotted Pardalote
Eastern Striated Pardalote
Grey-backed Silvereye
Brown-headed Honeyeater
Eastern Spinebill
Tawny-crowned Honeyeater
Yellow-faced Honeyeater
White-eared Honeyeater
Crescent Honeyeater
Yellow-winged Honeyeater
Little Wattle-bird
Red Wattle-bird
Australian Pipit
Beautiful Firetail L
Red-browed Finch
Forest Raven
Pied Currawong
Grey Currawong
Grey Butcher-bird
White-backed Magpie
Blackbird
Starling
Skylark
Greenfinch D

General notes

Other walks were also arranged; a few members walked to the lighthouse after having been driven most of the way by National Parks Services staff. There was a walk to Norman Point where we saw the Dwarf Wedge-pea *(Gompholobium ecostatum)* with lovely apricot coloured flowers and a few tall spikes of the Scented Sun-orchid *(Thelymitra aristata).* We then walked on to Little Oberon Bay. Peter Thomas took a small party to look for birds on the Pillar Point walk where they watched two Olive Whistlers fly to and fro with nesting material.

Each evening we met in the Information Centre where we reported to the group interesting items of natural history and listened to some most enjoyable talks given by guest speakers. These speakers were: Mr Peter Thomas (District Ranger) on "Early Visits to Wilson's Promontory". Dr J. H. Willis the noted botanist on "Plants of Wilson's Promontory". Mr R. A. Jones (District Superintendant National Parks Service) on "Park Management". Mr J. Ros Garnet (author of "The Wildflowers of Wilson's Promontory National Park) on the History of the FNCV and Mr Malcolm Turner (Interpretations Officer, National Parks Service) who made wonderful use of three screens to show panoramic views of the Promontory.

Some unusual items reported in the evenings included an *Octopus pallidus* two feet across found on a beach. A Copper-head snake *(Austrelaps superba)* seen curled round a stick in Freshwater Creek and a white form

of the Golden Everlasting *(Helichrysum bracteatum)* seen near the lighthouse.

Our thanks go to the Ranger Peter Thomas and to all those working for the National Parks Service who helped to make our Centenary Expedition such a success. We should not have been able to explore such places as Chinaman's Creek and Waterloo Bay without the assistance of park personnel, who helped plan our trips and opened padlocked gates to enable us to get to some less frequented parts of the promontory. They were also most helpful to the mammal survey group and drove them with their traps to the trapping sites.

I would like to thank the editor of the Latrobe Valley Naturalist for permission to reprint two articles, and to their authors Miss Jean Galbraith (author of "Wildflowers of Victoria" and "Collins Field Guide to the Wild Flowers of South-East Australia") and Mrs Ellen Lyndon.

H. Weatherhead

Forthcoming Conferences
Mountain Ecology in the Australian Region

The Ecological Society of Australia symposuim for 1982 will be held on Saturday 8 and Sunday 9 May at the Australian Academy of Science, adjacent to the Australian National University. The timing of the symposium will allow delegates to attend the 52nd ANZAAS Congress beginning on May 10 in Sydney. Alternatively they may join the field excursion to the Snowy Mountains, which will take place on Monday 10 and Tuesday 11.

The theme for the ESA symposium is directed towards ecological aspects of past and present upland environments, together with resource aspects such as inventory, conservation and management. The topics will be of interest to academics and researchers as well as those concerned with the management of natural areas.

Registrations close soon. For information, please contact:
Dr Rosemary Purdie,
ESA Symposium,
CSIRO Division of Land Use Research,
P.O. Box 1666,
CANBERRA CITY. A.C.T. 2601

The Australian Mammal Society

The AMS will hold its 26th Scientific meeting at the Australian National University, Canberra, from 12-14 May, 1982. A number of interesting papers and poster displays will be presented covering a wide range of topics dealing with Australian mammals.

Registration officer:
W. E. Poole
CSIRO Division of Wildlife Research
P.O. Box 84
Lyneham. A.C.T. 2602.

(Continued from page 50)

GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

Mammal Survey Group.
Easter. Friday, 9 — Monday, 12 April. East Gippsland.
Saturday, 8 — Sunday, 9 May. Strathbogies.
Saturday, 12 — Monday, 14 June. Lake Tyers and Nowa Nowa.

FIELD NATURALISTS CLUB OF VICTORIA

Report by Executive Council

The members of the Executive Council submit herewith balance sheet as at 31 December 1981 and income and expenditure account for the year ended on that date, and report as follows:—

1. The Net Surplus of the Club for the year ended 31 December 1981 was $3 which, added to the Surplus brought forward at 1 January 1981 of $11,133, together with a transfer of $661 from Club Improvement Account, resulted in an Accumulated Surplus to be carried forward to next year of $11,797.
2. The members of the Executive Council took reasonable steps to ascertain, before the income and expenditure account and balance sheet were made out, that all known bad debts were written off and adequate provision was made for doubtful debts.
3. The members of the Executive Council took reasonable steps, before the income and expenditure account and balance sheet were made out, to ascertain that the current assets, other than debtors, were shown in the accounting records of the company at a value equal to or below the value that would be expected to be realised in the ordinary course of business.
4. At the date of this report, the members of the Executive Council are not aware of any circumstances which would render the values attributable to the current assets in the accounts misleading.
5. No charge on the assets has arisen, since the end of the financial year to the date of this report, to secure the liabilities of another person. No contingent liability has arisen since the end of the financial year to the date of this report.
6. No contingent or other liability has become enforceable or is likely to become enforceable within the period of twelve months after the end of the financial year which in the opinion of the members of the Executive Council will or may affect the ability of the Club to meet its obligations as and when they fall due.
7. At the date of this report the members of the Executive Council are not aware of any circumstances not otherwise dealt with in the report or accounts which would render any amount stated in the accounts misleading.
8. The results of the Club's operations during the financial year, in the opinion of the members of the Executive Council, were not affected by any item transaction or event of a material and unusual nature.
9. Since 31 December 1981, and to the date of this report, in the opinion of the members of the Executive Council, no item transaction or event of a material and unusual nature has occurred, which would affect substantially the results of the Club's operations for the next succeeding financial year.
10. No member of the Executive Council, since the end of the previous financial year, has received or become entitled to receive a benefit by reason of a contract made by the Club with the member or with a firm of which he is a member or with a company in which he has a substantial financial interest.
11. The principal activities and objects of the Club are to stimulate interest in natural history and to preserve and protect Australian Fauna and Flora. No significant change in the nature of those activities occurred during that period.
12. The name of the members of the Executive Council in office at the date of this report are as follows:—

    Miss W. Clark
    Miss M. Allender
    Mr D. Dunn
    Mrs S. Houghton
    Mr D. Lee
    Miss M. Lester
    Miss L. Lumsden
    Mr J. Martindale
    Dr B. Smith
    Dr E. Turner
    Mrs H. Weatherhead
    Miss C. Zerbe

This Report is made in accordance with a resolution of the Executive Council dated 30th day of March 1982.

W. Clark President
D. Dunn Treasurer

FIELD NATURALISTS CLUB OF VICTORIA
BALANCE SHEET AT 31 DECEMBER, 1981

LIABILITIES

1980			
	Current Liabilities		
$1,169	Subscriptions paid in advance	$1,369	
2,013	Sundry Creditors	2,216	
12	M. A. Ingram Trust Grant in hand	120	
6,000	Treasury Grants in hand (Note 3)	4,000	
9,194			
	Special Funds & Accounts		
$6,000	Building Fund	$6,576	
31,800	Publication Fund	36,620	
3,152	Excursion Fund	4,827	
2,000	Centenary Excursion Fund	—	
4,000	Marie Allender Excursion Fund	6,000	
100	Library Fund	100	
5,404	Club Improvement Account	6,991	
5,217	Estate M. Wright Legacy	5,217	
1,466	Estate C. M. Walker Legacy	1,466	
20	Estate R. S. Chisholm	20	
200	Estate I. F. Knox Legacy	200	
200	Estate Ivy Dixon	200	
204	Estate I. Hanks	204	
680	Wilfred C. Woollard Fund	730	
603	D. E. McInnes Fund	638	
300	V. H. & B. E. Miller Fund	324	
90	N. A. Wakefield Memorial Fund	90	
300	P. F. Morris Gift Account	300	
250	Cedric Ralph Gift Account	250	
54	Kinglake Project Fund	54	
1,543	Natural History Medallion Fund	1,644	
520	Life Membership Fund	520	
311	Microscope Project Account	311	
$64,414			

ASSETS

1980			
	Current Assets		
$4,663	Cash at Bank	$2,855	
2,000	Commonwealth Bonds at cost	10,000	
301	Sundry Debtors	406	
	Stocks on Hand at cost—		
6	Badges	3	
$7,705	129	Microscope Project	123
1,372	Books for Sale	1,330	
61	Tee Shirts	55	
1,736	Victorian Naturalist Subject Index	1,624	
$10,268			$16,396
	Fixed Assets at cost		
$7,780	Library Furniture & Equipment	$8,442	
	Land—		
141	Cosstick Reserve, Maryborough	141	
—	Harold C. Frahm, Kinglake	—	
$7,921			$8,583
	Investment of Funds at cost		
$100	Australian Government Bonds	$100	
6,200	Australian Gov't Savings Bonds	8,200	
500	MMBW Debentures	—	
6,800	Esanda Ltd Debentures	7,500	
	National Mutual Permanent		
10,000	Building Society — Deposits	3,982	
$23,600			$19,782
	Building Fund		
$3,000	Aust Gov't Savings Bonds at cost	$3,000	
3,000	Esanda Ltd — Debentures at cost	3,400	
—	Cash at Bank	176	
$6,000	$73,282		$6,576

	Surplus Account				**Publications Fund**		
$10,240	Balance at 1/1/1981	11,133		$27,100		$31,200	
833	Transfer from Club Improvement Fund	661			National Mutural Permanent		
60	Surplus (Loss) for year	3		2,900	Building Society — Deposit	3,249	
$11,133			$11,797		Book Stocks at cost—		
				1,145	Ferns of Victoria & Tasmania	226	
				7	Wildflowers Wilson's Promontory	7	
				198	Birds of the Dandenongs	191	
				225	Sundry Debtors	762	
				350	Cash at Bank	1,113	
				(125)	*Less* Sundry Creditors	(128)	
				$31,800			$36,620
					Excursion Fund		
				$1,000	Aust Gov't Savings Bonds at cost	$1,000	
				2,000	Nat'l Mutual Perm Bldg Soc — Deposit	2,184	
				2,000	Aust Gov't — Centenary Excur'n Fund	—	
				9,395	Cash at Bank	7,343	
				340	Deposit Castlemaine Tour	—	
				(9,583)	*Less* Sundry Creditors	(5,700)	
				$5,152			$4,827
$84,741			92,784	$84,741			$92,784

1. Auditors' Remuneration of $140 relates to auditing services only. No other benefits were received by the Auditors in respect of their services to the Club.
2. No Emoluments were paid by the Club to any member of the Executive Council.
3. State Treasury Grants for 1979/80, 1980/81 and 1981/82 have been received, but grants totalling $4,000 had not been applied against expenditure at 31/12/1981.

FIELD NATURALISTS CLUB OF VICTORIA
GENERAL ACCOUNT
STATEMENT OF INCOME & EXPENDITURE FOR YEAR ENDED 31 DECEMBER, 1981

INCOME

1980					1980
	Subscriptions Received—				
$1,242	Arrears	$290			$11,071
11,132	Current	11,685			833
88	Supporting	324			1,342
$12,462			$12,299		46
					$13,292
357	Sales of "Victorian Naturalist"		438		
	Interest Received—				($1,660)
$5	Library Fund	$5			(1,000)
108	Bank Account	$122			
190	Commonwealth Bonds	564			$10,632
494	Bonds — M. Wright Legacy	421			
95	Bonds — C. M. Walker Legacy	81			$385
1,242	National Mutual Deposit	795			222
69	Life Membership Fund	67			1,044
127	Natural History Medallion Fund	186			670
$2,330			$2,241		40
	Profit — Victorian Naturalist				359
$75	Subject Index		—		130
68	Profit — Tee Shirt Sales		—		206
15	Sundry Income		204		41
956	Profit on Book Sales		2,248		384
					120
					$3,601
					$260
					453
					301
					—
					—
					956
					60
$16,263			$17,430		$16,263

EXPENDITURE

Victorian Naturalist—			
Printing		$11,549	
Illustrating		599	
Despatching		1,357	
Editorial		—	
		$13,505	
Less — Grants			
Ingram Trust — 19 Grant	$74		
Treasury (Note 3)	3,500	3,574	
			$9,931
Working Expenses —			
Postage & Telephone		$368	
Printing & Stationery		1,100	
Bookkeeping & Typing		1,126	
Rent — Herbarium & Museum		893	
Rent for storage		40	
Affiliation Fees, Subscriptions & Donations		179	
Auditors' Remuneration (Note 1)		140	
Insurance		201	
General Expenses		114	
Natural History Medallion Expenses		882	
Kinglake Expenses — Rates		150	
			$5,193
Centenary Expenses			—
Tee Shirt A/c — Loss written off			6
Nature Show — Loss			—
Badges — Loss			1
Subject Index — Loss			48
Club Improvement Account — Transfer of Profit on Book Sales			2,248
Surplus for year			3
			$17,430

FIELD NATURALIST CLUB OF VICTORIA
BUILDING FUND

Amount of Fund at 31 December 1980		$6,000
Interest on Investments and Bank Account		576
Amount of Fund at 31 December 1981		$6,576

PUBLICATION FUND

Amount of Fund at 31 December 1981		$31,800
Interest on Investments and Bank Account		2,954
Surplus (Loss) for the year from —		
Ferns of Victoria and Tasmania	$1,851	
Wild Flowers of Wilson's Promontory National Park	8	
Birds of the Dandenongs	7	1,866
Amount of Fund at 31 December 1981		$36,620

CLUB IMPROVEMENT ACCOUNT

Amount of Account at 31 December 1980	$5,404
Book Sales Account Profit	2,248
	$7,652
Less —	
Purchase Library Books & Equipment transferred to Surplus Account	661
Amount of Account at 31 December 1981	$6,991

EXCURSION FUND

Amount of Fund at 31 December 1980		$5,152
Interest received on Investments and Bank Account	$1,021	
Surplus on Tours	654	1,675
		$6,827
Less —		
Transfer of Centenary Excursion Fund to Marie Allender Fund		$2,000
Amount of Fund at 31 December 1981		$4,827

Field Naturalists Club of Victoria
Statement by the Members of the Executive Council

In the opinion of the members of the Executive Council of the FIELD NATURALISTS CLUB OF VICTORIA, the accompanying Balance Sheet is drawn up so as to give a true and fair view of the state of affairs of the Club as at 31 December 1981, and the accompanying Statement of Income and Expenditure is drawn up so as to give a true and fair view of the financial results of the Club for the year ended 31 December 1981.

Signed in accordance with a resolution of the Executive Council on 30th March 1982.

Wendy Clark President
David G. Dunn Treasurer

Statement by the Principal Accounting Officer

I, David Dunn, being the officer in charge of the preparation of the accompanying accounts of the FIELD NATURALISTS CLUB OF VICTORIA for the year ended 31 December 1981 state that, to the best of my knowledge and belief, such accounts give a true and fair view of the matters required by Section 162 of the Companies Act 1961, to be dealt with in the accounts.

Signed at Melbourne on the 30th day of March 1981.

David G. Dunn

Auditors' Report to the Members of
Field Naturalists Club of Victoria

In our opinion —

(a) The attached balance sheet and income and expenditure account are properly drawn up in accordance with the provisions of the Companies Act, 1961 of Victoria as amended and so as to give a true and fair view of:—
  (i) the state of affairs of the Club at 31 December 1981 and of the results of the Club for the year ended on that date;
  and
  (ii) the other matters required by Section 162 of that Act to be dealt with in the accounts.

(b) The accounting records and other records, and the registers required by that Act to be kept by the Club have been properly kept in accordance with the provision of that Act.

DANBY BLAND PROVAN & CO.
Chartered Accountants
R. M. Bland
Partner

Richmond
31st March 1982

Week at Portland January 16-22.

29 members, including four from country clubs, spent a rewarding week exploring the environs of Portland with the leadership of Mr and Mrs Woolcock of Portland FNC. This trip will be fully reported in a later issue.

Merricks to Pt Leo Excursion. Sunday 7 February.

The bus dropped most of us at Merricks beach in the Mornington Peninsula opposite Phillip Island. Remaining passengers returned in the bus to Pt Leo, and the first party walked the 2km or so to join them for lunch.

We walked mostly along the beach and collected an astonishing variety of creatures (no longer alive) that had been stranded by the tides. Some diversions were made inland. We went up a small estuary to see some decomposing basalt columns, and in other small valleys we came on Rough Tree-ferns *Cyathea australis,* the large Clematis *Clematis aristata* (not flowering) and mosses as well as expected coastal plants.

After lunch we went to a member's nearby home where all findings were displayed on the verandah. One of the leaders told us what the objects were and gave us some idea of how they functioned when alive.

The findings included numerous shells, both bivalves and gastropods, an intriguing leafy sea-horse *Phyllopteryx,* swim bladders of puffer-fish, "Mermaids Purses" — egg cases of skates and the black cork-screw one about 15cm long (6") of the Port Jackson shark, horny skeletons of colonial *Shertularia* polyps, sea tulips *Pyura,* a cluster of dried up sea squirts or cunjevoi, the exoskeltons of sea urchins, etc.

The bead-like seaweed Neptunes Necklace *Hormisira banksii* had unusually small beads, and the marine flowering plants Sea Nympth *Amphibolis antarctica* were fascinating: some had female flowers, some had fruit, and in a few cases the fruit had produced a seedling while still attached to the parent plant.

All unwanted specimens were returned to the beach.

The other leader told us about the geological formation of the area and of the aborigines who were living here when the white man arrived. The house bears the tribe's name Bobanarring.

We had hoped to go out on the reef to see some of our dead collection in the living state, but the tide moved out too slowly for our limited time.

We thank our leaders, Mary Doery and Elizabeth Turner, for giving us such a stimulating and informative day.

General Meeting

Monday 8 February

It is now requested that each person sign the attendance book on entering.

Speaker for the evening was President Miss Wendy Clark who gave an introductory talk on Spiders. Miss Clark stated that all spiders have eight legs and usually eight eyes, the body has only two divisions (in contrast to the insect's three divisions), that adult males have bulb-like palps, are usually slimmer with longer legs than females and are sometimes much smaller than females. Spiders are carnivorous and suck the body juices of prey as they have no chewing parts. All spiders produce silk, some only as life-lines, others for nests or for traps up to the orderly complexity of orb-webs. Colour slides were shown of several orb spinners and other spider species.

Exhibitis. Under a microscope were three eggs of the Emperor Gum Moth (each 2-3mm long) and from them had emerged 40 tiny predatory wasps.

Victorian Field Naturalists Clubs Association Annual General Meeting and get-together Saturday-Monday 6,7,8 March 1982

About 50 people gathered outside the Australian Postal Institute hall in Morwell on Saturday afternoon and members of the host club, Latrobe Valley FNC, led us to Morwell National Park. The picnic clearing had a few superb old Mountain Grey Gums (complete with a sleeping koala) but the rest was regrowth. We followed the marked nature trail and saw plants (no flowers) of the Butterfly Orchid *Sarcochilus australis* perched on branches of shrubs with the root easily visible winding along the branch.

At the Annual General Meeting on Saturday evening at the API hall, there were representatives from nine clubs and apologies from two. The Association's financial position is satisfactory with $146.19 in hand. Member clubs which have not yet paid their annual subscription were urged to do so — $2.00. There was a resolution that the Executive should investigate the logging situation in the Otways and, if considered necessary, write to ministers and public bodies as named. Slides were shown, followed by supper, but most people were able to leave by 10.15pm.

On Sunday morning we set out for the Tarra Valley and Bulga National Parks. Empty seats in the FNCV bus were filled and several cars followed. The short walk to Cyathes Falls in Tarra Valley whetted the appetite for more, which was only partly satisfied by Bulga. From the latter's suspension bridge, the unusual view of tree ferns and beeches of Macks Creek will always be remembered. One can't help wondering if any other country can offer so much lush loveliness and delicacy so easily accessible to ordinary people. It is sad that the area between the Parks has not been reserved to enable these two remarkable valleys to be more viable.

The Association's executive body had a brief meeting that afternoon. The Executive consists of two representatives from the five divisions — NW, NE, SW, central, SE. The two officers were re-elected: Mr Alan Monger of NE division as president, and Dr Elizabeth Turner of Central as secretary/treasurer.

There was another general gathering at the API hall on Sunday evening. Clubs reported on their activities, several conservation issues were raised, and a few successes reported. This airing of problems, opinions and achievements is one of the helpful aspects of the Association. Again the meeting closed at a reasonable time.

On Monday morning there was a tour of the SEC open cut and power station at Hazelwood. We were told that, to date, only 1% of the brown coal beds has been exploited!

Some members stayed with friends in the area, some camped in the arboretum at Hazelwood pondage, some stayed at motels, but all agreed that the weekend was very enjoyable and worth while. The weather was kind to us — fine and very warm until it changed on Monday Morning.

(Continued from page 86)

Spider books and two live huntsman spiders were shown. A large grey moth with body 10cm long (4") and wings of similar length was probably a wood-boring species.

Numerous exhibits from the previous day's excursion to Pt Leo enabled those who missed the trip to share some of its stimulation and, relevant to that trip, four colour slides were projected: the inflorescences and above-ground rhisomes of Coast Spinifex *Spinifex hirsutus,* a red sweaweed with vesicles, the black corkscrew egg-case of Port Jackson shark cut lengthwise to reveal the embryo inside, and the beautiful Argonaut egg-case with the grey leggy mass of the female alongside.

Slides were shown from three angles of what looked like a gnarled bud or brown skull-like object on a stalk, but the fourth slide revealed it to be a spider with red legs! Miss Clark thought it was probably a species of *Dolophones.*

The European Paper Wasp is establishing itself in Melbourne suburbs and methods of getting rid of it were described. We were told the sting is not as severe as a bull-ant bite.

Field Naturalists Club of Victoria

Established 1880

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron:
His Excellency the Honorable SIR HENRY WINNEKE, KCMG, KCVO, OBE, KStJ, QC.

Key Office-Bearers 1981-1982

President:
Miss WENDY CLARK, 27 Rangeview Grove, North Balwyn, 3104 (859 8091 A.H.)
Secretary: Mr D. LEE, 1 Rylands Road, Dandenong West, 3175 (793 3954)
Correspondence to: FNCV, National Herbarium, The Domain, South Yarra, 3141
Treasurer: Mr. D. DUNN, 3 Allfrey Street, East Brighton, 3187 (578 5753)
Subscription-Secretary: Miss H. MALCOLM C/- National Herbarium, The Domain, South Yarra, 3141
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FNCV DIARY OF COMING EVENTS

GENERAL MEETINGS

Monday, 24 May, 8.00 p.m.
Michelle Barton. Plant communities in wetlands.
Monday, 12 June, 8.00 p.m.
Julie Raines and Alan Burbidge. Establishment of the Rotamah Island Bird Observatory.

New Members — May/June General Meetings.

Metropolitan
Peter Cabena, 4/94 Lewisham Rd, North, Prahran.
G. W. Carr, 31 Caroline St, Clifton Hill.
Ian Faithful, 67 Athelston Rd, Camberwell.
Yvonne Gray, 46 Albany Cres., Surrey Hills.
Suzanne Jones, 267 Douglas Pde, Newport.
Jenny Lilburn, 2 Woodland Ave, Croydon.
Mrs S. Lindsay, 5 Laverton St, Williamstown.
A. Wegener, P.O. Box 105, The Basin.

Country
Phil. Broadway, 7 Wheeler St, Castlemaine.

Joint
John & Paddy Percival, 68 Cummins Rd, Moorabbin.

FNCV EXCURSIONS

Sunday, 4 July. National Museum of Victoria. Meet at 2.00 p.m. in Kershaw Hall, through main entrance in Russell St. Arrangements have been made for us to see the casting room as well as the general exhibits.

Sunday, 1 August. M.M.B.W. farm at Werribee. Birds and general. The coach will leave Batman Ave at 9.30 a.m. Fare $6.00.
Bring a picnic lunch. Private cars should meet at the road leading to the new complex.

Preliminary notices:
Saturday, 28 — Sunday, 29 August. Combined weekend at Bendigo. See last Naturalist for details. The coach will leave Flinders St from outside the Gas and Fuel at 8.30 a.m. Cost of weekend $55.00 of which $10.00 deposit should be paid when booking, and the balance by the August General Meeting. Bring picnic lunches for 2 days.

Thursday evening, 23 September — Sunday morning, 10 October. Western Australia. Details in the last Naturalist except that Alexander Bay should read Alexander Bridge. Bookings should be made as soon as possible with the Excursion Secretary accompanied by a $100.00 deposit.

Sunday, 5 September. Cheltenham Park. Meet at Cheltenham Station at 11.30 a.m. Bring a picnic lunch.

GROUP MEETINGS

FNCV members are invited to attend any Group meeting, no extra charge.

Day Group — Third Thursday.
Thursday, 17 June. Melbourne University grounds. Main gate, Grattan St, 11.30 a.m. 578 1879.
Thursday, 15 July. Como House, South Yarra. At gate, 11.30 a.m. 89 2850.
Thursday, 19 August. Darebin Parklands Details — A. Blackburn. 379 8960 or 578 1879.

At the National Herbarium, the Domain, South Yarra, at 8.00 p.m.

First Tuesday — Mammal Survey Group.

Third Wednesday — Microscopy Group.
Wednesday, 16 June. Pond life. Speaker: D. McInnes.
Wednesday, 21 July. Cells of the human body. Speaker: Dr E. S. Peters.
Wednesday, 18 August. Basic use of optics in microscopy. Speaker: Dr E. Hammond.

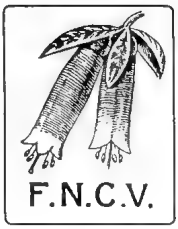
Second Thursday — Botany Group.
Thursday, 10 June. Ms Vivien Turner. The strange case of the banksia and the pygmy possum.
Thursday, 8 July. Ranger from the A. Wilkie Nature Reserve at Springvale.

GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

Mammal Survey Group.
Saturday, 12 — Monday, 14 June. Lake Tyers and Nowa Nowa.

Botany Group — Last Saturday.
Saturday, 26 June. Warrandyte — fungi. Leader: Gary Cheers.



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Cover illustration: Mycena subgalericulata (photograph by B. A. Fuhrer).

Notes on the life history of *Aspidomorpha maculatissima* Boheman (Coleoptera: Chrysomelidae: Cassidinae) at Townsville, North Queensland.

BY T. J. HAWKESWOOD*

Abstract

The life history and general biology of *Aspidomorpha maculatissima* Boheman (Chrysomelidae) was examined at Townsville (and to a lesser extent, at Herveys Range), north Queensland, during January to May, 1981. All life stages are described, a discussion on food plants is given, and the distribution of the species (based mainly on museum specimens) is provided.

Introduction

The Cassidinae, a sub-group of the large Coleopteran family Chrysomelidae, to which the genus *Aspidomorpha* belongs, are commonly known as "tortoise beetles" (Froggatt, 1907; McKeown, 1945; Britton, 1970; Richards and Davies, 1977). These beetles are so-named because they have the lateral margins of the body (i.e. elytra and pronotum) greatly expanded which consequently gives them a flattened shield-like appearance somewhat analogous to the broad carapace of tortoises and turtles. Many species are noted for their extremely brilliant coloration, which usually fades, unfortunately, very quickly after death.

Muir and Sharp (1904) first recorded the remarkable nature of the metamorphoses of some South African species of *Aspidomorpha, Basipta, Cassida* and *Laccopterus*. They found that in certain species, the eggs are enclosed in an ootheca, often of complex structure. The ootheca is of various degrees of complexity in accordance with the species that forms it. For instance, Muir and Sharp (1904) found in *Aspidomorpha puncticosta* that the structure of the ootheca was more elaborate than the comb formed by bees and wasps. However, in other species, the oothecae were found to be very small and imperfect, with a layer of excrement placed over them (Muir and Sharp, 1904).

The larvae of Cassidinae are usually short and oval, somewhat flattened and spiny, often assuming bizarre forms (Muir and Sharp, 1904; Richards and Davies, 1977). They usually cover the apical (posterior) area of their bodies with black or brown excrement which is supported by and attached to, a forked caudal process (Muir and Sharp, 1904). The cast skins also form part of this augmentative covering and the excrement may form a solid pad, attached to the exuviae, or assume the condition of long filaments.

No life history studies have been undertaken previously on Australian *Aspidomorpha* species.

During a survey of the beetle fauna of the Townsville area (by the author) during the summer of 1980-81, adults and first, second and third instar larvae of *Aspidomorpha maculatissima* Boheman were observed feeding on the leaves of *Ipomoea abrupta* R. Br. on the James Cook University campus, Townsville, on 8 January, 1981. Field observations and collections of eggs, larvae, pupae and adults were made from 8 January to 5 May 1981.

Descriptions of the life stages of *A. maculatissima* Boheman

A. Eggs and ootheca (Fig. 1, A-C).

The eggs are laid in an ootheca (Fig. 1A) in two or three distinct rows. Each row is separated by one or two thin, oothecal membranes. There are 6-9 eggs in each ootheca (i.e. 2 or 3 eggs in each row, Fig. 1B). The ootheca measures 2.8-3.2 mm wide (Mean=

* Department of Botany, James Cook University, Townsville, 4810. Queensland.

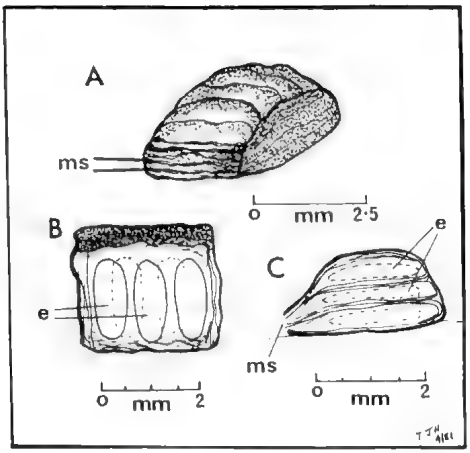

Fig. 1A. Ootheca of *Aspidomorpha maculatissima* Boheman (ms = marginal spaces).
B. Plan of ootheca showing arrangement of eggs. (Note — oothecal membranes over top row of eggs have been removed).
C. Side view of ootheca showing position of eggs (e) and marginal spaces (ms).

3.0 mm, N=5), 2.6-3.1 mm long (Mean= 2.85 mm, N=5), 1.5-2.5 mm high (Mean= 1.9 mm, N=5) (Fig. 1A-C), is orange-brown or reddish-brown when young and becomes grey to grey-brown in colour by the time the eggs have reached (or almost reached) maturity.

The ootheca is usually attached at both extremities to a leaf of the food plant, by one or two eggless membranes and has bilateral symmetry (Fig. 1A. All 5 oothecae examined on 4 April 1981, on the James Cook University campus, Townsville, were attached singly to the lower (abaxial) surface of large, healthy leaves at the tops of plants. Similarly, on 18 April 1981, at Herveys Range, about 38 km W of Townsville, 8 oothecae were examined on *Ipomoea velutina* R. Br.

The eggs are flat, with rounded apices and parallel sides (Fig. 1B), yellowish in colour and possess a thin, transparent membrane. They take 6-10 days to hatch. The eggs measure 1.5-1.7 mm long (Mean= 1.6, N= 4) and 0.8-1.2 mm wide (Mean = 0.9, N =4).

The oothecal membranes project at one of the sides (Fig. 1A) and exhibit an irregular set of marginal spaces (Fig. 1C) through which the larvae emerge.

B. Larvae (Figs. 2, A: 3, A).

(i) First instar

Dimensions: (Body length, not including length of lateral processes) 1.2-1.6 mm long (Mean= 1.4 mm, N=4), 0.8-1.0 mm wide (Mean= 0.9 mm, N=4), when newly hatched; 1.8-2.0 mm long (Mean= 1.9 mm, N=3) and 1.2-1.4 mm wide (Mean= 1.3 mm, N=3), after 1-2 days, finally reaching 2.5-2.8 mm long (Mean= 2.7 mm, N=3) and 1.5-1.8 mm wide (Mean= 1.7 mm, N=3) after 4-5 days before undergoing ecdysis. Morphology: Body elongate, depressed, narrowly oval in shape, broader in thoracic region. Eyes 10, simple, 5 on each side of the head capsule, aggregated into a small cluster. Head capsule smooth, without punctures, glabrous. All segments bear long, spiny, lateral processes (and anteriorly also on the pronotum) (these are shown in the fourth instar larvae, Figs. 2A, 3A); two long caudal processes arise from the eighth tergite upon which the exuviae of previous instars and faeces are borne

Table 1. Co-ordinates for localities from where *Aspidomorpha maculatissima* has been collected.

State and Locality	Co- Ordinates	State and Locality	Co- Ordinates
Western Australia		Queensland (cont'd)	
Kings Sound	c. 17°00'S, 123°30'E	Cooktown	15°28'S, 145°07'E
Northern Territory		Gordonvale	17°05'S, 145°48'E
Melville Island	11°30'S, 131°00'E	Innisfail	17°32'S, 146°01'E
Darwin	12°28'S, 130°50'E	Mt. Garnet	17°42'S, 145°07'E
Koolpinyah	12°23'S, 131°10'E	Palm Island	18°45'S, 146°36'E
Adelaide River	13°15'S, 131°05'E	Magnetic Island	19°09'S, 146°50'E
Queensland		Townsville	19°15'S, 146°48'E
Stewart River	c. 14°05'S, 143°35'E	Herveys Range	19°22'S, 146°30'E
		Bowen	20°01'S, 148°14'E
		Whitsunday Island	20°15'S, 149°00'E

Note: Collections from all these localities are listed in the text.

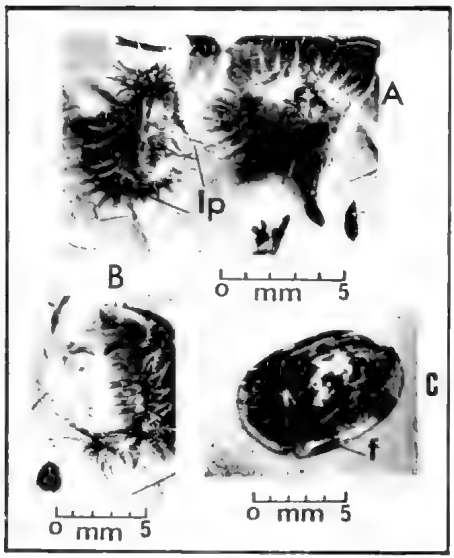

Fig. 2. A. — Two fourth instar larvae resting on an *Ipomoea* leaf. Most of their faecal shields have been removed. Note lateral processes (lp) and the long, black faeces which one of the larva (right) has extruded.
B. — Dorsal view of a pupa about 1-2 days before hatching into the adult beetle.
C. — Adult beetle resting on the underside (abaxial surface) of an *Ipomoea* leaf. Note elytral flange (f).

in a mass; lateral processes (16 pairs) acute, spinose, of varying length and thickness (Fig. 3A). Body ± glabrous, sparsely covered in very short, white, glistening hairs; hairs on undersurface of body slightly longer than the dorsal ones. Colour: (When alive). Head capsule buff-brown. Eyes black. Body usually entirely yellow (or brownish-yellow with yellow lateral margins); lateral spinose processes yellow, tipped in black (or entirely yellow when larva first hatches). Legs short, stumpy, yellow with short, brown claws.

(ii) Second instar

Similar in morphology and colour to the first instar larva.

Dimensions: Attains a size of 3.3-3.5 mm long (Mean = 3.4 mm, N=4), 2.2-2.5 mm wide (Mean =2.4, N=4), before undergoing the next ecdysis.

(iii) Third instar

Similar in morphology and colour to previous instars, although live specimens often darker yellow with broad grey or grey-brown central markings on dorsal body surface; two ± triangular-shaped grey or grey-brown marks on the dorsal thoracic region. Black portion of spinose, lateral processes more extensive than in previous instars. Dimensions: Attains a size of 3.6-4.2 mm long (Mean =3.8 mm, N=5), 2.8-3.5 mm wide (Mean= 3.2 mm, N=5), before undergoing the next ecdysis.

(iv) Fourth instar (Figs. 2, A; 3, A).

Similar in colour and morphology to previous instars but slightly more pubescent with more extensive grey or grey-brown, longitudinal markings on the dorsal body surface (Fig. 3A). A dark grey postmedial to apical, longitudinal lateral stripe towards the margin on both sides of the body, usually present. Two, irregular, central, grey, longitudinal marks usually extend from the apex of the body and each ends in a grey-brown, ± triangular blotch on the dorsal thoracic region towards the head. Occasionally, darker grey marks extend to the lateral margins of the body (Fig. 3A). The grey marks are variable and may be absent in some larvae, but the two grey-brown marks near the head are always present. Dimensions: Attains a size of 6.5-8.5 mm long (Mean= 7.8, N=4), 4.5-5.5 mm wide (Mean= 5.2, N=4) before undergoing pupation.

C. Pupa (Fig. 2, B).

Pupa dorso — ventrally flattened, ± glabrous, orange or red-brown to grey-brown in general coloration. First 5 pairs of lateral processes dorso-ventrally flattened, pale yellow-brown, pale orange-yellow, or pale buff in colour, translucent, bearing short, pale, buff-coloured spines on the margins; remaining lateral processes spinose, ± cylindrical to slightly flattened dorso-ventrally, buff brown to cream with white, ± spirally arranged spines. Pronotum broad, flat, margins with short spines of varying lengths towards base of elytra; usually with a pair of longer spines at each side of median line; pronotum pale brown usually with basal region dark brown. Thoracic region reddish to orange-brown with irregular buff horizontal marks. Remaining dorsal surface (tergites) orange to reddish-brown, usually lighter in colour on margins; spiracles small, cream. Under surface glabrous, pale-yellow to buff-brown. Length (tip of pronotum to apex of last tergite) 7.5-9.7 mm (Mean= 8.5mm, N=7) and 4.8-6.0 mm wide (Mean= 5.3mm, N=7).

D. Adult (Figs. 2, C; 3, B-D)

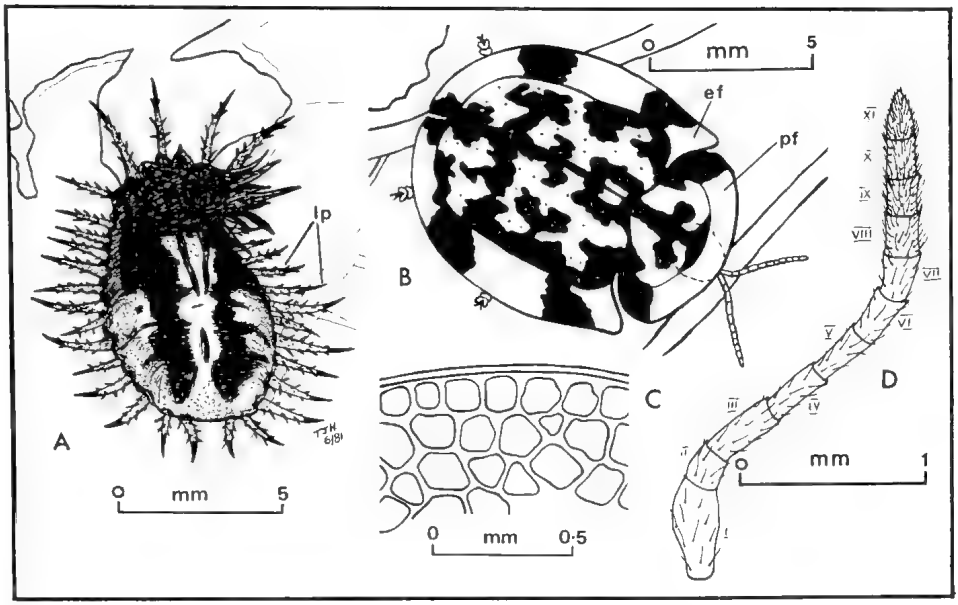

Fig. 3. A. — Dorsal view of a fourth instar larva showing the lateral processes (lp). Note that the head capsule is hidden by the thoracic tissue.
B. — Dorsal view of an adult beetle showing the typical markings on the pronotum and elytra. (Note: (a) Head (dashed line) hidden by the pronotum and the pronotal flange (pf) and (b) Elytral flange (ef)).
C. — High power diagrammatic representation of an outer portion of the elytral flange showing the reticulate pattern.
D. — Antenna showing the distribution of hairs. (Antennal segments are numbered in Roman numerals and these correspond to segment numbers used in the text).

Form convex, in elevation (Length/height ratio=3.20 (Mean) 2.74-3.57 (Range), N=8), broadly oval to almost circular in plan, (Length/width ratio=1.21 (Mean), 1.11-1.33 (Range), N=8). Head small, frons smooth, without punctures, buried in thorax. Eyes large, black. Antennae (Fig. 3D) 3.0-3.2 mm long (Mean= 3.1 mm, N=6), subincrassate; segments I-VI yellow to yellow-brown, smooth, sub-glabrous, with a few, sparse, white hairs; segments VII-VIII dark yellow smooth, with denser covering of yellow-brown hairs; segments IX-XI black, densely covered with yellow-brown hairs. Pronotum smooth, glabrous, about twice as wide as long, without punctures; yellow or orange-yellow with a median broad, shallow Y-shaped, black mark narrowly extending towards apex into another black, usually blob-shaped, smaller mark; pronotal flange broader at sides of pronotum than at apex, yellow with a prominent reticulate pattern (Fig. 3C) and with a broad black mark on both sides of pronotum extending and narrowing to the scutellum. Scutellum smooth, black, triangular in shape. Elytra irregularly punctate-striate; intervals broad, smooth, glabrous; punctures circular, deep, black, mainly occurring in short, dense series (longitudinal bands) on black regions of elytra, (sparsely distributed in loose bands on yellow portion of elytra); elytra laterally angled from base, rounded at shoulder, slightly concave towards middle, then rounded to apex; elytral ground colour pale yellow or pale orange-yellow to metallic, irridescent aquamarine-yellow, with irregular and variable black markings (Fig. 3B), usually comprised of a series of small, irregular marks along suture and extending outwards; larger black markings arising from sides of elytra extending towards suture, occasionally anastomosing with sutural markings; elytral flanges broad, yellow, translucent, each with a large humeral and post-medial black patch and a small, apical black mark; reticulate pattern similar to that of pronotal flanges. Undersurface of body mostly black or dark

brown, sub-glabrous, sparsely covered in microtrichiae; coxa, trochanter, femur, tibia and tarsus orange-yellow to yellow-brown, regularly but sparsely covered in short, appressed, yellow hairs, distal end of tibia with tuft of longer, orange-yellow hairs; claws dark brown. Sternites predominantly black or dark brown in the centre, orange-yellow to yellow-brown on the margins for about ¼ the width of the sternites, sparsely covered in microtrichiae; terminal and sub-terminal sternites with 2 or 3 rows of hairs on the apical margins. Body length (from apex of pronotum to elytral apices) 8.85-10.0 mm long (Range), 9.50 (Mean, N=8, 2♂♂, 6♀♀) and 7.5-9.0 mm wide (Range), 7.84 (Mean, N=8) (Males similar in dimensions to females).

General biology

(a) Notes on the life stages

Oothecae are usually placed on the undersurface of mature, healthy leaves of the food plants. The larvae when first hatched, feed together near the discarded ootheca and begin to radiate outwards after 1-1.5 days, feeding on epidermal and mesophyll tissue (immediately below the epidermis). As they grow older, larvae either disperse and feed on different leaves or may form small groups of up to five larvae together on the one large leaf. Feeding results in small holes being formed between the major veins (Fig. 4). Despite such destructive feeding, no leaves were killed by the larvae (or adults). Defoliation of *Ipomoea abrupta* did not occur. The amount of leaf material consumed was usually 5-10% of the total leaf area (Fig. 4) by the time individual larvae had pupated (no adults were found on leaves occupied by larvae).

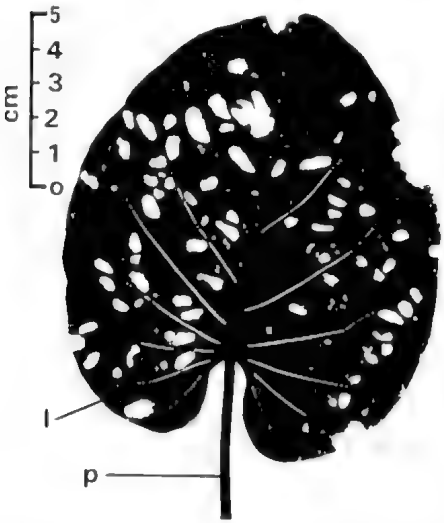

Fig. 4. Silhouette of the underside of an *Ipomoea abrupta* leaf, showing the shot-holes resulting from the feeding by larvae and adults of *A. maculatissima*. (l = lamina of leaf, p = petiole).

The duration of the life-stages is as follows:- (a) Eggs — 6-10 days to hatch after being laid, (b) First instar larva — 4-5 days, (c) Second instar — 3-5 days, (d) Third instar — 3-5 days, (e) Fourth instar — 2-4 days, (f) Pupae — 3-7 days, (g) Adults — >5 days (adults in the laboratory have lived up to 3 weeks before dying of unknown causes).

(b) Notes on the larval faecal shield and predators

The larvae of various members of the sub-family Cassidinae (Chrysomelidae) (especially *Cassida*, a predominantly North American genus), have long been known to naturalists for their odd habit of carrying their faeces in various ways by the use of a forked caudal process (e.g. Muir and Sharp, 1904; Eisner, Tassell and Carrel, 1967). The function of the faecal shield (or pad) (Eisner, Tassell and Carrel, 1967) has been a matter for dispute. It has been suggested (e.g. Weise, 1893 (cited in Eisner, Tassell and Carrel, 1967)), that the shield serves for camouflage, for protection against desiccation or rain and for defense.

The faecal shield possessed by *Cassida rubiginosa* for instance, appears to act *mainly* for defense (Eisner, Tassell and Carrell, 1967). These authors observed that the faecal shield of this cassidine species is a highly manoeuvrable device which is capable of being orientated by the larva in virtually any direction through flexion and rotation of the abdomen. The manoeuvrability of the

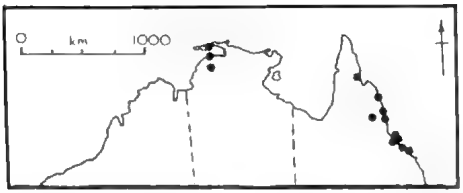

Fig. 5. Distribution of *Aspidomorpha maculatissima* Boheman in Australia. (Based on museum collections).

shield and its adaptation for defense was made apparent when these authors subjected the larval body to localized stimulation by prodding with a small, blunt probe or by pinching with fine forceps. They found that no matter where the stimulus was applied, the particular larva responded by pressing the shield against the offending instrument. Stimulation at or near the head caused the larva to uplift its rear and to bring the shield forward and downwards over the head region. Stimuli applied to the lateral margins of the body induced a sharp tilting of the shield toward the affected side while disturbance to the posterior end, caused erection and partial backward deflection of the shield. Stimuli that were applied consecutively at different sites caused the shield to be shifted equally from one appropriate defensive posture to the next. After cessation of stimulation, the shield was always returned promptly to its resting position above the body (Eisner, Tassell and Carrel, 1967, p. 1472). Stimuli applied to the bodies of various instars of *Aspidomorpha maculatissima* resulted in similar responses to those noted in *Cassida rubiginosa* by Eisner, Tassell and Carrel (1967). The first and second instar larvae of *A. maculatissima* appear to be more adept and sensitive to body contact (stimulation) than the third and fourth instar larvae. The first instar larvae often congregate on one side of an *Ipomoea* leaf in groups of 4-9 and usually lift their faecal shields simultaneously at the approach of danger, an intruder (e.g. the author lifting a leaf upon which the larvae are feeding or resting) or some other disturbance. Although some observations on responses by fourth instar larvae to body stimulation were made between 22-25 April, 1981, it is hoped that further observations will be undertaken in the near future.

If probed with a blunt pointer on one side of the dorsal region of the body, the fourth instar larva does move the shield towards the offending instrument, but not as vigorously as in *Cassida rubiginosa* (see Eisner, Tassell and Carrel, 1967). However, if both sides of the body are probed simultaneously, the shield is merely tilted over the body in a central position parallel to the mid-dorsal line. If the offending instruments are removed, the shield usually remains parallel to the body for some time before being moved into the usual upright position (i.e. perpendicular to the body). This usually occurs as soon as the larva commences feeding again or begins to move to another position on a leaf. It appears then that, although the faecal shield movements of *A. maculatissima* in response to stimuli to the dorsal body surface, are generally similar to that of *C. rubiginosa*, there are some differing behavioural traits between the two species.

Projecting outwards from the flattened body of the typical cassidine larva, is a marginal fringe of branched spines (see illustrations in, for example, Muir and Sharp, 1904 and Eisner, Tassell and Carrel, 1967) or lateral processes (Hawkeswood, this paper). These spinose processes appear to be particularly sensitive to contact stimulation and are evidently well adapted to alert the larva to the initial probings of an insect predator (e.g. ants; Eisner, Tassell and Carrel, 1967). These authors found that stimulation of a single spine and sometimes a mere prodding of one of its branches (was sufficient to ellicit an immediate defensive positioning of the faecal shield. This was also generally

noticed in the larvae of *A. maculatissima*. Contact with the spines gave better responses than body stimulation.

Eisner, Tassell and Carrel (1967) exposed individual larvae to attack by ants in order to determine how effectively the shield was employed in defense against actual predators. No ants were observed on *Ipomoea abrupta* at James Cook University, nor on *I. velutina* at Herveys Range. The possibility of ants as predators of *A. maculatissima* larvae cannot be disregarded. The green tree ant, *Oecophylla smaragdina* Linnaeaus, is common on the James Cook University grounds and is widely distributed in the Townsville area and would be the most likely predator of larvae. Experiments on ant and other predator interactions with larvae will be undertaken in the future.

Despite being a deterrent to some predators, the faecal shield of cassidine larvae appears not to protect against all arthropod predators. Vulnerability to spiders has been reported for the larvae of *C. rubiginosa* (Eisner, Tassell and Carrel, 1967). It has been suggested that the faecal shield protects against entomophagus parasites. However, Muir and Sharp (1904) noted that parasitism of *Aspidomorpha puncticosta* was very severe. Muir had bred a species of *Chalcis* and other unidentified Chalcididae from the larvae and noted that broods which were produced at certain seasons, were more affected by the parasites than those produced at other seasons. Eisner, Tassell and Carrel (1967) noted that larvae of *Cassida rubiginosa* were heavily parasitized by a chalcidoid wasp of the genus *Tetrastichus*.

On 28 April 1981, during a brief examination of *Ipomoea abrupta* growing on the James Cook University grounds, two small, black wasps were observed resting on one side of a fourth instar larva (i.e. on the dorsal body region). The larva was feeding on the upper surface of an *Ipomoea* leaf. The two wasps were presumably seeking a suitable site on the larva for laying eggs. The wasps took flight when disturbed and did not return during the ensuing period of observation totalling fifteen minutes. Four pupae and the fourth instar larva were collected and placed in glass petri-dishes in the laboratory at 23°-25°C. Three days later (1 May 1981) two adult beetles hatched and another beetle hatched after 4 days (on 2 May). On 5 May, the fourth instar larva pupated. Nine days later (14 May), sixteen small, black wasps (apparently identical to those seen on the larva on 28 April) hatched from this pupa. On 19 May, ten wasps of the same species hatched from eggs which had been deposited in another pupa (i.e. one of those collected on 28 April). The first group of wasps (16) were sent to Dr I. Naumann, Division of Entomology, C.S.I.R.O., Canberra, who identified them as *Pediobius* sp. (Eulophidae; Hymenoptera).

(The second batch of wasps are in the author's private collection of insects).

These small, parasitic wasps are probably effective in reducing the numbers of pupae (and hence the number of adults produced) in this population of *A. maculatissima*. However, it is also likely that environmental conditions, such as the high diurnal temperatures experienced in Townsville during January to April (i.e. 28°-35°C) (and hence strong sunlight on clear days) and heavy monsoonal rains, probably also have a detrimental effect.

(b) Food plants

The genus *Aspidomorpha* appears to have strong preferences for *Ipomoea* species (Convolvulaceae) as food or host plants (e.g. Muir and Sharp, 1904). Indeed, the whole sub-family Cassidinae appears to be strongly (but not exclusively) associated with members of the Convolvulaceae, and in particular *Ipomoea*. However, much more in-

formation on beetle/plant relationships is yet to be gathered. Carroll (1978) undertook a study of an undescribed cassidine, *Stolas* sp., a common leaf-eating insect on *Ipomoea asarifolia* Roem et Schult in South America (Brazil). He noted (p. 80) that the cassidine beetles which infested *I. asarifolia* appeared restricted in their feeding on the vine although, less commonly, could be found on other members of the Convolvulaceae such as *Merremia*. Carroll (1978) notes that the Convolvulaceae are well represented in the Amazon region and of these, ten species belong to the genus *Ipomoea*. Carroll (1978) also notes (as is the case in Australia) that knowledge of the foliage-feeding fauna of Brazil is meagre, despite the fact that the sweet potato (*Ipomoea batatas* Poir.) is an important crop in the region and is attacked by numerous species of foliage-feeding Coleoptera. Carroll (1978) further notes that cassidine beetles are not limited in their feeding on Convolvulaceae but herbaceous species of the family form the largest number of host records.

Six species of *Ipomoea* occur on the James Cook University grounds and adjacent areas, but none of them appear common. These are *Ipomoea dissecta* Willd., *I. angustifolia* Jacq., *I. hederacea* Jacq., *I. reptans* Poir (=*I. aquatica* Forsk.), *I. abrupta* R. Br. and *Ipomoea* species (unknown). Another species, *I. quamoclit* Linn., is not known at present from the University grounds but occurs elsewhere in the Townsville area. It is a slender, glabrous twiner with sessile, deeply pinnatifid leaves with linear-subulate segments. The species is distinctive in having slender, scarlet, tubular flowers. *Ipomoea quamoclit* is believed to have been introduced from India and has long been extensively cultivated in many of the tropical and sub-tropical regions of the world and appears to be common in Queensland (Bailey, 1901, p. 1067). *Ipomoea reptans* Poir. (=*I. aquatica* Forsk.) occurs in swampy habitats on the Townsville common and in a small creek on the University grounds. This species is a glabrous perennial with long, prostrate, trailing or floating hollow stems which are adaptations for living in marshy or wet sandy places. It is also found in tropical Asia and Africa (Bailey, 1901, p. 1062). Another species, *I. pes-caprae* Roth. (= *I. brasiliensis* (L.) Mey) is restricted to sand dunes along the north Queensland coast and is common on beaches at Townsville.

A further species, *I. velutina* R.Br. grows uncommonly at Herveys Range. It is a pubescent twining plant, woody at the base and is usually covered in reflexed hairs on the branches and the leaves. The broadly ovate-cordate leaves measure 5-10 cm long and are covered in short hairs. *I. velutina* grows over rocks and was early recorded from the Gulf of Carpentaria (Bailey, 1901, p. 1062).

Ipomoea dissecta is an annual, glabrous twiner with slender, trailing stems and small, digitate leaves with usually 3 or 5 narrow, linear segments. Early records are from the Burdekin and Einasleigh Rivers (north Queensland) (Bailey, 1901, p. 1058). *I. hederacea* is a tall, pubescent twiner with broadly cordate, 3-or-5- lobed leaves, 3-10 cm long. The species appears to have a widespread distribution in north Queensland and is common in most tropical and sub-tropical regions of the world (Bailey, 1901, p. 1058). *I. angustifolia* is also a twining creeper with sessile, linear or lanceolate leaves 2-6 cm long. The species appears to be widely distributed in Queensland (Bailey, 1901, p. 1065). *I. abrupta* is a tall, more or less glabrous,woody plant, with cordate-ovate leaves 5-12 cm long. The flowers are large and dark pink to mauve in colour. The species is known from the Burdekin River and Rockingham Bay (Bailey, 1901, P. 1062).

Ipomoea dissecta, I. angustifolia, I. hederacea and *I. quamoclit* are all

slender twiners with small leaves. It is unlikely that *Aspidomorpha maculatissima* utilizes these four species as food plants, since they possess leaves too small to sustain populations of the beetle. *Aspidomorpha maculatissima* has only been collected from *I. abrupta* and *I. velutina* in the Townsville area by the author. Although *I. pes-caprae, I. reptans* and *Ipomea* sp. possess relatively large broadly cordate-ovate leaves, which could be a suitable food source for *A. maculatissima*, there does not appear to be any utilization of these plants by this cassidine. Observations indicate that *Aspidomorpha deusta* (Fabricius) utilizes (and is restricted to) *I. pes-caprae* on the sand dunes, while an unidentified species of *Metriona* (another cassidine) appears confined to *Ipomoea* sp. No chrysomelid beetles are known to feed on *I. reptans*.

Three other species of Convolvulaceae are known from the Townsville area. These are *Bonamia (Breweria) deitrichiana, Evolvulus alsinoides* Linn. and *Merremia tridentata* Roth. ssp. *hastata* Forsk. Again, these species have small leaves and do not appear to be utilized by *A. maculatissima*.

Evidence at hand suggests that *A. maculatissima* is restricted to the indigenous species *Ipomoea abrupta* (Townsville) and *I. velutina* (Herveys Range) but may utilize the introduced *I. batatas* Poir.

(c) Distribution

The Cassidinae appear to be predominantly tropical and sub-tropical in their distribution. Froggatt (1907) inferred that most of the Australian species of the sub-family were found in tropical areas of northern Queensland, but noted that one species, *Aspidomorpha deusta* (Fabricius) came into the rainforests of northern New South Wales. (Recent research by the author suggests that the species referred to by Froggatt was not *A. deusta*, but an unidentified species of *Metriona* (another cassidine); *Aspidomorpha deusta* appears to be host-specific on *Ipomoea pes-caprae* Roth. on north Queensland sand dunes, Hawkeswood, 1981, pers. obs.).

The collections of *A. maculatissima* in the various Australian museums are somewhat small. In most cases, specimens are old, discoloured and worn, while the collection data accompanying them are usually meagre. However, the data that is available, does suggest that the species has a northern distribution in tropical Australia. The distribution is shown in Fig. 5 and the co-ordinates (i.e. long./lat. data) for each locality known are provided in Table 1. (Abbreviations for institutions and collections are as follows:— ANIC — Australian National Insect Collection, CSIRO, Canberra; QM — Queensland Museum, Brisbane; DPIQ — Department of Primary Industries Insect Collection, Indooroopilly, Brisbane; SAM — South Australian Museum, Adelaide). (No specimens of *A. maculatissima* are lodged at UQIC (University of Queensland Insect Collection, Brisbane) except for the author's collection (see below) or the DPIM (Department of Primary Industries Insect Collection, Mareeba). (In the specimens listed below, in addition to the locality, the collector, dates and number of specimens are provided wherever known).

Specimens:— **Western Australia** — Kings Sound (1)(ANIC). **Northern Territory** — Darwin, G. F. Hill (4)(SAM); Darwin, W. K. Hunt (7) (SAM); Port Darwin, 1884 (1)(ANIC); Adelaide River, H. W. Brown (2)(SAM); Melville Island, G. F. Hill (3)(SAM); Koolpinyah, G. F. Hill (1)(SAM). **Queensland** — Stewart River, W. D. Dodd (2)(SAM); Cooktown, C. French (DPIQ); Mt. Garnet, 18. ii. 1959, "in grass", G. E. (DPIQ); Gordonvale, 22. xii. 1930, (on sweet potato, *Ipomoea*

batatas) (DPIQ); Innisfail, Mission Beach, 12. v. 1948, W.A.S(aunders) (DPIQ); Palm Island, T. Bancroft (2)(QM); Palm Island, G. F. Hill (2)(SAM); Palm Island, A. M. Lea (1)(SAM); Palm Island, 23/30. v. 1925, W.A.T.S.(aunders) (DPIQ); Whitsunday Island, 1934, N. Geary (3) (QM); Townsville, 1. vi. 1900 (DPIQ); Townsville, 9. xi. 1901 (3)(SAM) and (1)(ANIC); Magnetic Island, A. M. Lea (14)(SAM); Magnetic Island, 14. iii. 1926 (1)(QM); Magnetic Island, 16. xi. 1947, S. R. Brock (3)(ANIC); Bowen, A. Simson (2)(SAM). Author's collections — James Cook University campus, Townsville, 8. ii. 81 (1)(UQIC); Same locality, 10. ii. 81 (2)(ANIC); Same locality, 22. iv. 81 (1)(SAM); Same locality, 5. v. 81, (3)(TJH); Herveys Range, 35 km W of Townsville, 18. iv. 81 (2)(TJH).

Concluding remarks

Little is known about the biology and taxonomy of Australian Cassidinae or their food plants. Masters (1887) lists 22 species of "Cassidides" (Cassidinae) from Australia; 13 of these from the genus *Aspidomorpha*, 4 from *Cassida*, 4 from *Coptocycla*, and 1 from *Hoplionota*. Since the original descriptions of these beetles were published in the scientific literature, nothing has been written on their general biology in Australia. Further basic field work should reveal a great deal more about these interesting insects and their food plants.

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A Field Identification Key of some Victorian Species of the Genus *Mycena*.

BY C. A. GRGURINOVIC* AND A. A. HOLLAND*

The Genus *Mycena* is one of the most common fungal genera to be seen in mountain gullies during autumn and winter. Its members are generally small and fragile plants which often exhibit bright colours. This key is an attempt to characterize using only macroscopic features, some of the more common species of the genus as well as some rare and as yet undescribed species.

Differentiation between species in a true botanical key is based on microscopic characteristics, such as the size and shape of spores, cystidia** and the nature of the hyphae making up the cap's cuticle. Since a microscope is needed to see these structures, they are of little use in the field. This has led to the construction of this field key, which uses characteristics easily seen by the naked eye or a handlens. The reliability of such a key can only be tested by use in the field. It is hoped that specimens which do not fit those characteristics listed will be preserved †, preferably with spore prints and growth habit notes and sent to the senior author for further study. An idea of the distribution of species listed in the key would also be appreciated, as some of those listed here as rare may prove to be more common than at first believed. This information would also need to be accompanied by specimens, preferably with some substrate material, for positive identification.

As yet, the key pertains only to Victorian members of the genus, although it is certain that a number of the species extend into other states and are of world-wide distribution. Some groups, such as the numerous small, white species have been excluded, as they have not yet been studied in detail.

In general, mycenas are often easily recognizable by their appearance and habit, or manner in which numbers of fruiting bodies grow in an area. The genus is characterized by its fruiting bodies being small, slender and delicate. Caps (fig. 1A) are usually conic or campanulate (bell-shaped) and furnished with an umbo, or bump at the apex. A translucent-striate condition is common, a situation where the gill outlines show through the moist, somewhat translucent flesh of the cap as radially arranged lines. The hollow stipe (fig. 1B) is centrally attached to the cap and has a cartilaginous consistency, meaning the stipe is thin and breaks with a firm split when bent in two. Gill attachment (fig. 1C) is generally adnate, that is the gills are more or less squarely attached to the stipe. Members of the genus always have white spores which can easily be seen "en masse" in a spore print.

Pl.1: *M. austrororida* (photograph by B. A. Fuhrer)

** Refer to glossary

† Fruiting bodies can be preserved by drying in a warm draught.

* Department of Botany
Monash University
Clayton, Vic. 3168

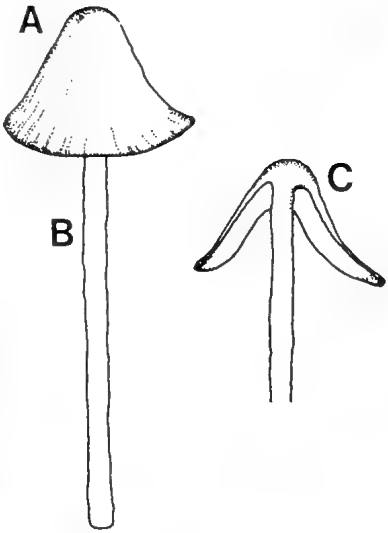

Fig. 1: A. Cap; B. Stipe; C. Adnate gill attachment.

P1.2: *M. epipterygia* (photograph by B. A. Fuhrer)

P1.3: *M. viscido-cruenta* (photograph by B. A. Fuhrer)

P1.4: *M. sanguinolenta* (Photograph by B. A. Fuhrer)

1. Cap or stipe or both viscid* or glutinous* when fresh 2
   Cap and stipe not viscid or glutinous 4

2. Cap and stipe viscid 3
   Cap dry, convex; light hazel at apex. Stipe white with a thick, glutinous layer. Gills white, broadly adnate to subdecurrent*. Fruiting bodies up to 3.5 cm in height. Common . . . . . *M. austrororida* p1.1

3. Stipe yellow. Cap pale. Cucumber-like odour. Fruiting bodies up to 7 cm in height. Widespread . . . . . *M. epipterygia* p1.2
   Fruiting bodies bright red in colour and up to 4 cm in height. Widespread . . . . . *M. viscido-cruenta* p1.3

4. Stipe with latex* when fresh 5
Stipe without latex 6

5. Stipe and cap exude a prune-coloured latex when broken. Gills with red edge. Widespread. ..... *M. sanguinolenta* p1.4
Stipe exudes a white-coloured latex when broken. Rare: Neerim East ..... *M. galopus*

6. Fruiting bodies with brown tones 7
Fruiting bodies without brown tones 16

7. Fruiting bodies tall, up to 14 cm in height. Cap up to 2 cm in diameter. Generally found on litter 8
Fruiting bodies less than 6 cm in height 9

8. On litter, gregarious* habit. Cap apex blackish, rest dark hazel to hazel. Gills white, spacing* subdistant to distant. Edges smooth*, sides pubescent*. Stipe concolorous with cap. Widespread ..... *M. hispida* (new species) p1.5
On litter, occasionally on wood, gregarious habit. Cap and stipe with greyish-brown tones. Gills pallid, spacing close to subdistant. Edges smooth, sides pruinose*. Widespread ..... *M. austrofilopes* (new species)

9. Gill attachment subdecurrent 10
Gill attachment adnate 11

10. Fruiting bodies up to 3.5 cm in height. Cap shallowly convex to convex. Colour hazel, margin pallid. Gills subdecurrent to decurrent, spacing distant. Stipe concolorous with cap, surface lubricous*. Rare: Black Spur. ..... *M. sublucida* (new species)
Fruiting bodies up to 4.5 cm in height. Cap convex, obtusely umbonate. Colour honey, rest pallid. Gills broadly adnate ± decurrent tooth or subdecurrent, spacing distant to subdistant. Stipe concolorous with cap. Rare: Granya Gap, Tallangatta. ..... *M. isabellina* (new species)

11. Gill edge not marginate* 12
Gill edge marginate; blackish-brown in colour. Cap and stipe blackish-brown. Fruiting bodies up to 6 cm in height. Cap up to 2.5 cm in diameter. Gill attachment adnate + small decurrent tooth. Habit closely gregarious to caespitose*. Rare: Narbethong and Neerim East ..... *M. atrata* (new species)

12. Gill sides pruinose 13
Gill sides pubescent. On wood, gregarious or caespitose habit. Height up to 4.5 cm. Cap

up to 1.5 cm in diameter. Cap and stipe dark hazel to hazel. Gill attachment narrowly adnate. Often with numerous anastomoses. Rare: Upper Thompson..... *M. atroavellanea* (new species)

13. Gill edge minutely denticulate*..... 14
Gill edge smooth. Gills often with numerous anastomoses. Height up to 6.5 cm. Cap up to 3 cm in diameter. Cap and stipe blackish-brown to brown. On wood, in burnt areas may be found on charcoal. Widespread ..... *M. subgalericulata* p1.6

14. Gill attachment adnate to stipe..... 15
Gill attachment adnate or free to circular descent of tissue from cap. Cap convex, depressed at apex. Blackish-brown at button stage, with age honey or hazel at apex, margin pallid. Height up to 2.5 cm. Attachment to substrate via white pruinose disc. Rare: Tonimbuk; Fernshaw Reserve..... *M. interrupta* var. *fumosa* (new variety)

15. On wood, gregarious or caespitose habit. Height up to 3 cm. Cap up to 4 mm in diameter. Cap and stipe blackish-brown to brown. Rare: Otway Ranges ..... *M. lageniformis* (new species)
On wood, gregarious or caespitose habit. Height up to 3 cm. Cap up to 4 cm in diameter. Cap and stipe concolorous. Honey to isabelline. Rare: Black Spur ..... *M. melcula* (new species)

16. Fruiting body with vinaceous* tones 17
Fruiting body without vinaceous tones 18

17. Cap and stipe pink-vinaceous. Lamellae subdecurrent, edge red. On wood, gregarious or caespitose habit. Height up to 7.5 cm. Cap up to 2.5 cm in diameter ..... *M. erythromyces* (new species) p1.7
Cap and stipe vinaceous. Lamellae adnate to broadly adnate, edge smooth, occasionally minutely denticulate, face pruinose. Height up to 7.5 cm. Cap up to 2.6 cm in diameter. On wood or tree fern litter, caespitose or gregarious in habit ..... *M. vinacea*

18. Cap dark blue at apex, lighter towards margin. Stipe white, attached to substrate via white pruinose disc borne in flattened dark blue base. Gills white, edge blue. On wood, gregarious in habit. Height up to 2.5 cm. Cap up to 1.2 cm in diameter. Common ..... *M. interrupta* p1.8
Cap and stipe white, buff or honey tinge with age. Lamellae subdecurrent to decurrent, colour white; edge minutely denticulate, face pruinose. On litter, caespitose or gregarious habit. Height up to 4.5 cm. Cap up to 1.1 cm in diameter. Rare: Victoria Valley Rd, near Moora Track, the Grampians..... *M. candidissima* p1.9 (new species)

Pl.5: *M. hispida* (photograph by B. A. Fuhrer)

Pl.8: *M. interrupta* (photograph by B. A. Fuhrer) (Printed with permission of Inkata Press)

Pl.6: *M. subgalericulata* (photograph by B. A. Fuhrer)

Pl.9: *M. candidissima* (photograph by B. A. Fuhrer)

Pl.7: *M. erythromyces* (photograph by B. A. Fuhrer)

Glossary

caespitose: where the fruiting bodies grow extremely close together, apparently out of the same mass.

cystidia: differentiated terminal cells of the hyphae in the hymenium (fertile layer) which do not produce basidiospores i.e. sterile cells; or differentiated terminal cells of the hyphae which compose the surfaces of the fruiting body.

decurrent: where the gills run down the stipe.

glutinous: where the surface of the cap or stipe is like liquid glue.

gregarious: a growth habit where the fruiting bodies are grouped close together.

growth habit: the manner in which numbers of fruiting bodies grow in an area.

latex: a milk-like juice.
lubricous: where the surface feels slippery, as if covered with a layer of oil.
marginate: where the gill edge is coloured differently to the side.
minutely denticulate: where the gill edge is minutely fringed.
pruinose: where the gill sides are powdery in appearance.
pubescent: where the gill sides have a minutely hairy appearance.
smooth: where the gill edge is uninterrupted.
spacing: measured by counting the number of gills that extend from the margin to the stipe in a quarter turn of the cap.
close: if there are more than eight gills per quarter turn of the cap.
subdistant: if there are between five and eight gills per quarter turn of the cap.
distant: if there are up to five gills per quarter turn of the cap.
subdecurrent: where the gills run down the stipe for a relatively short distance.
vinaceous: wine-coloured.
viscid: where the surface of the cap or stipe feels sticky to the touch.

A Drop Of Water

BY D. WENTWORTH*

When one hears the words "Microscope" and "Drop of Water" mentioned together, one tends to think of some sinister germs lurking around to upset our stomachs or worse.

The truth of course is that our drinking water generally is very pure and free from such contamination. It would be most unlikely that any such harmful organism would be found in fresh tap water when examined with even a high powered microscope.

The case is quite different when one is "looking" for living animals in water and when the conditions are favourable for their growth. The creatures we will refer to are broadly termed "Pond Life".

This term can of course include a very wide range of animal (and plant) life which inhabit ponds, pools, and in some instances slow running streams. To narrow the field down to the microscopic world, we would like to discuss those creatures which are normally invisible to the naked eye. We will not, however, consider bacteria or similar microorganisms as these constitute an entirely different field of study. That is to say the creatures we will be looking at can be seen with a medium powered microscope, coupled with a certain amount of "know-how" as to where to look for these specimens.

A useful item for the observation of what we collect is what is known as a "trough". It consists basically of a microscope slide to which is cemented a small piece of glass separated from the slide by a spacer-piece of material in the shape of a half ring. This forms a miniature aquarium to contain our specimens.

If a pond is found that looks to be a likely source, then one should look for small pond weeds growing close to the water's edge. With a bit of luck some of our specimens will be found growing on and living around these weeds. Small pieces of this weed can then be placed in the trough and examined under a medium power and using a suitable light with the microscope.

An important piece of equipment is a collecting-net. This consists essentially of a piece of fine gauze material attached to a metal ring with a handle attached. The small end of the net should be secured to a small glass jar or bottle. This is then used to sweep through the water to obtain free swimming specimens.

Assuming we have been successful in our collection of material, we can expect to find a variety of creatures including single celled as well as multi-celled types. These can range in the first instance from the simple *Amoeba* and other protozoans, to rather complex animals, which in some respects are almost sophisticated in their way of life.

The amoeba is essentially a minute blob of

* 218 Melville Rd., Pascoe Vale South, Vic. 3044.

jelly-like protoplasm and is regarded as a very primitive form of life. It simply engulfs its food, which generally consists of minute organisms, and digests it while slowly moving around searching for more. The other single-celled animalculea or protozoans can be found in a very wide range of shapes and sizes, and are mostly all free swimming, using small vibrating hairs or "cilia" as a means of locomotion. The cilia are also used to direct food into the mouth or food vacuole. Protozoans are often referred to as *"Infusoria"* as they are frequently found in water into which an infusion of hay has been placed and allowed to stand for several days.

A common member of the protozoan group is a trumpet-like shaped animal known as a *Stentor* which may be found attached to a piece of weed or debris. A row of cilia surrounds its outer edge and the motion of these cilia creates a flow of water directing food particles towards its mouth.

Another protozoan which is generally found attached to weeds etc., is known collectively as *Vorticella*, although similar species of other genera are often included in this group.

The body section of Vorticella is generally bell-shaped and has a ring of cilia on its outer edge, the "hairs" of which vibrate at high speed, creating a strong current flow towards the animal. At the rear end of the "bell" is a fine thread which anchors it to weeds etc. this thread has the ability to contract to such an extent that the animal, when disturbed can retract at high speed from its extended position to go right back to its anchor point.

Some protozoans are known as "Flagellates" as they possess a very flexible whip-like appendage on the front end of their body. This serves as a means of locomotion and also as a way of obtaining food. One well known example is the *Euglena* which is generally of a green colour, due to the presence of chlorophyll, and has a red "eye". These features make it easy to identify.

One of the most beautiful of the protozoans to observe is one called *Volvox* and is generally regarded as a colony of individual animals grouped together to form a perfect sphere. This "ball" has a vast number of flagella protruding through the surface and the movement of these allow the colony to "roll" through the water. The presence of chlorophyll within the sphere produces a beautiful green appearance and when conditions are favourable *Volvox* may be seen in great numbers, even to the extent of producing of green tint to the water. Both *Volvox* and *Euglena* have been claimed by some authorities as plants, though this claim has never been finally resolved.

There are of course many hundreds of species of protozoans and we have only just mentioned a few representative types as a guide as to what may be seen if the observer is keen and reasonably equipped with collecting gear.

So far we have only spoken of single-celled animals, but these of course constitute but a small sample of what one may come across in the observation of pond life.

Among the many other groups of pond creatures, perhaps the most interesting is that group known as the Rotatoria and the individuals simply as Rotifers. They could almost be regarded as the Microscopist's pets, as they have been studied and observed by both scientists and amateurs over the last two hundred years. These multi-celled animals come in a wide range of shapes and sizes, but generally have one feature in common. This is the possession of a pair of jaw-like organs called the trophi which are used to break-up or pulverise the food prior to it entering the stomach. the outstanding feature of many species is a formation of cilia at the head part of the body, which when working normally gives the appearance of a rotating wheel, or in some cases two or four wheels. It was this feature which gave the group its original name of "Rotatoria" or "wheel Animalculae" although in some species this characteristic is not present. We could divide the Rotifer class into roughly two groups — firstly the free-swimming and secondly the non-swimming or sedentary group.

The free swimming rotifers use their cilia as a means of locomotion and also for obtaining food. In most of these species the cilia is in the form of a crown which is generally referred to as the "Corona". By a rhythmic beating action of the cilia a rotary effect is produced which in turn creates a strong current when the animal is stationary, or a very effective swimming action when on the move. Most have an appendage or foot terminating in two or more "toes" which enable it to remain stationary when feeding. Some species have what is known as a cement gland incorporated in the foot and exuding a small amount of this enables the animal to attach to weed or debris whilst feeding.

The second group include some very interesting species, nearly all of which build a tube around themselves into which they can retract when disturbed. These tubes are generally of a gelatinous nature, and may be reinforced with debris etc. There is one species which is distinctive from the others in the manner in which the tube is made. This has the appearance of a brick chimney and is constructed of pellets which the rotifer forms and "lays" as required to build the tube up to the desired height. The result is a perfect example of the skill of this miniature "bricklayer". The corona of this rotifer consists of four lobes of cilia and when in full operation give the appearance of four wheels, all rotating in perfect unison. Another species which also builds a tube is one in which the cilia is absent, but this is replaced by four or five lobes bearing very fine hairs or "floscules" which extend quite a distance out from each lobe. These floscules act in trapping small protozons and other food particles.

A third but rarer species is one similar to that just mentioned except that the lobes are extended to form long petal-like structures extending above the head of the animal, giving the appearance of an exotic flower.

There are of course variations of these different forms and each species have characteristics of their own, and it is the possibility of finding something new in this field which makes the study of pond life so absorbing.

Another large group of pond dwellers is the "Crustacea", which embraces such creatures as Water Fleas and copepods. These are relatively large animals but require low to medium magnification to observe them properly. Most types in this group have a common feature, that is a protective outer covering similar to shrimps.

The water flea gets its name from its appearance and its manner of movement through the water. They often appear in vast numbers and make excellent food for fish. Two main points of interest to the observer are the structure of the eye and also the beating of the heart, which can be seen quite clearly.

The copepod, like the water flea, is often found in most ponds in large numbers. Many Northern hemisphere copepods belong to the genus *Cyclops*, a name supposedly given due to the fact that it appears to have only one eye in the centre of its head. It also bears two large antennae stretching out on each side of the head. The general shape of this animal is that of a minute shrimp. It is often seen with two egg sacs, one attached to each side of the body.

A further group of animals well worth observing are known as "Hydras", some species of which are relatively large, some being up to 3 to 4 mm length (fully extended) and are members of the jelly-fish family, but are found only in fresh water. The body is in the form of a central trunk with several (from 5 to 8) tentacles extending outwards from the top end, the lower end of which is generally anchored to a piece of weed, etc. Each of the tentacles is equipped with a large number of "buds" each containing an elaborate "firing" device, enabling a barbed projectile, containing poison, to be fired into a potential prey which comes close enough to trigger off one of these buds. The action is similar to an under-water spear gun, the "spear" being attached to the tentacle by a fine thread. Once the prey is paralysed the other tentacles come round to direct it to the hydra's mouth. It is fascinating to watch a water flea falling prey to a hydra after fighting a losing battle.

A final mention should be made of a class of minute plants, which are divided into two groups, namely "Diatoms" and "Desmids". Diatoms are found in both salt and fresh water and their fossil deposits exist in nearly every part of the world. All have a skeleton of pure silica and it is mainly in this form that they are used as a specimen for microscopic examination. They may be found in fresh water collection samples, but the best ones are generally found in fossil deposits or prepared slides. Most diatoms have very intricate and fine markings, and display beautiful patterns.

Desmids are almost exclusively fresh water dwellers and are more likely to be present in a collecting sample than diatoms. They exist in a very wide range of shapes and designs, some of which are remarkable in their symmetry and colour patterns, being mainly green due to the presence of chlorophyll.

We have only very briefly touched on some of the wonders of nature in the world of its microscopic dwellers. We hope to have aroused a little interest in some of our readers who may appreciate what may be found in "A Drop of Water".

The Southeastern Highlands: a Geological and Environmental History From 100 Million Years ago to the Present

BY PETER WELLMAN*

Introduction

There is good evidence that during the past 100 million years (m.y.) the southeastern highlands differed from the present highlands in altitude, latitude, temperature, and rainfall. A knowledge of the changes and their causes leads to a greater understanding of physiography, soils, and sediments on the floors of river valleys and lakes. In addition, changes in the physical environment with time would have affected biological evolution in the area.

Until twenty years ago our understanding of the geological and climatic history of southeastern Australia was based on visual observations of the landscape and exposed rocks, and the use of macrofossils to date sedimentary rocks and estimate past climate. The results of this early work were summarised by Hills (1960) and Browne (1969) for Victorian and NSW landscape history respectively, and Gill (1961a) for climate.

More recently there have been major advances in the understanding of this region. A more detailed evolutionary history of the highlands has been determined using the distribution of precisely dated volcanic rocks to determine the uplift and erosional history, the magnetisation of the rocks to measure past latitude, and palaeontology and stable isotope geochemistry to infer past climate.

The present structure of the Earth under the highlands has been determined using seismic waves to establish the distribution of rock layers, and variations in gravity to determine the strength of the outer part of the Earth. The chemical and mineral composition of the rocks below the surface has been determined using the chemistry and mineral composition of outcropping volcanic lava flows, and of blocks of other rocks within the lava flows.

This paper describes southeast Australia's present geological structure and its history during the last 100 m.y. The description applies strictly only to eastern Victoria and southeastern NSW, but much of it is valid also for Tasmania, western Victoria, New England, and to a lesser extent the Flinders Ranges and eastern Queensland.

History of the area surrounding the highlands

Continents are not fixed relative to one another, but move by continental drift. Before 80 m.y. ago (mid-Cretaceous) Australia was in the interior of a larger continent called Gondwanaland. To the east of southeast Australia was a wide continental shelf containing the present New Zealand and New Caledonia, and to the south was the Antarctic landmass (Fig. 1a). The present southeast highlands were a low-altitude drainage divide. To the northwest in the Murray Basin the older rocks had been eroded flat and were near sea level. To the south and east, at the edge of the present Australian landmass, Gondwanaland had begun to fracture. The rocks over this fracture were subsiding rapidly because they were poorly supported from below. this subsidence formed a depression which was quickly filled with sediments.

Between 80 and 60 m.y. ago (during the late Cretaceous and earliest Cainozoic) that part of the continent to

* Bureau of Mineral Resources, Geology and Geophysics, P.O. Box 378, Canberra City, A.C.T. 2601.

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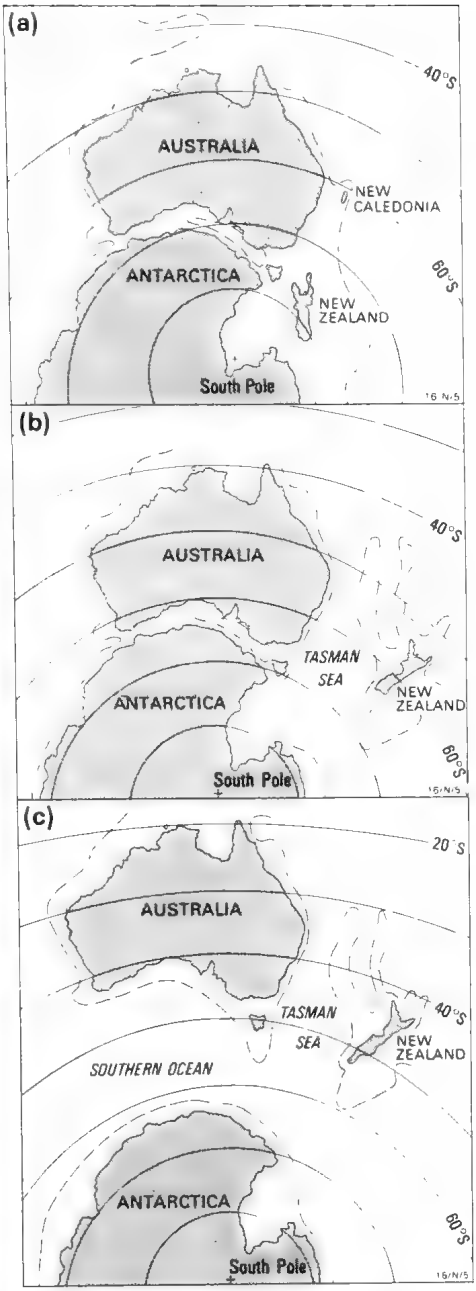

Fig. 1 Geography. (a) 80 m.y. ago before formation of the Tasman Sea; (b) 60 m.y. ago when the Tasman Sea was its present width, but before the southern Ocean began to form; (c) 20 m.y. ago. The dashed line shows the continental shelf. (b & c after Kemp, 1978).

the east of present Australia moved away (Weissel & Hayes, 1977) by continental drift. A new ocean floor was created, the Tasman Sea basin. The break between the two continental masses was on the Australian side of the subsiding zone (Jongsma & Mutter, 1978), so that today the eastern side of the Australian continent has only a narrow continental shelf (Fig. 1b).

The next major event to affect the highlands took place about 55 m.y. ago (late Paleocene), when Australia began to move northward away from Antarctica (Weissel & Hayes, 1972). This movement continues today. The new oceanic sea-floor created between the two continents forms the Southern Ocean (Fig. 1c). The early subsiding zones are on the Australian side of the initial fracture; in part they form the Gippsland and Otway sedimentary basins in the southern Victoria lowlands. The central Murray Basin and southern Victorian lowlands were covered by shallow seas during part of this period. These seas had their greatest extent about 20 m.y. ago.

Igneous rocks

Igneous activity is the upward movement of molten rock from deep in the Earth. The molten rock may crystallize and cool below the surface to form an intrusion, or it may rise to the Earth's surface, and then crystallize and cool as a lava flow. In the southern highlands there was a major period of igneous activity extending from 80 m.y. ago to the present day (Wellman & McDougall, 1974). This is thought to have been triggered by the formation of the Tasman sea starting about this time. The volume of intrusions within 20 km of the Earth's surface was probably about equal to about twice the volume of flows according to studies of acceleration due to gravity (Wellman & McDougall, 1974); however, the flows have now been partly removed by erosion. The total volume of flows before erosion is such that they

would have had an average thickness over the highland of approximately 70 m, but their distribution is irregular.

Ages have been determined for most lava flows in eastern Australia using the natural radioactive decay of an isotope of potassium (K-40). These ages show that the overall rate of igneous activity has been approximately constant for the last 80 m.y. The older igneous activity is generally near the coast, and the younger activity inland. Lava flows can be grouped into provinces from 50 to 200 km across. Within each province the range in age of the lava generally is less than 5 m.y.; adjacent provinces have a different age.

The molten rock comes originally from depths of 50 to 130 km below the surface (Green, 1972; Frey *et al.*, 1978). At these depths the temperature of the rock is high enough to melt those minerals with the lowest melting points and give a fluid component comprising 4-25% of the total rock. Igneous activity occurs when the molten fraction of this rock rises towards the Earth's surface along a fissure to form intrusions and lava flows. The composition of such igneous rocks depends mainly on the proportion and depth of melting and the amount of crystallization on the way towards the Earth's surface. Most of the igneous rocks formed during this period of activity were of basaltic composition.

Dissection and uplits of the highlands

When basaltic lava reaches the surface of the Earth it has a low viscosity, so on plains it spreads out as an extensive, flat sheet filling shallow river valleys, and then crystallizes. Where there is considerable topographic relief (Fig. 2a) it flows downhill to the riverbed, and then flows down this riverbed (Fig. 2b) before crystallizing.

Subsequent erosion changes the volcanic landscape. Basalts formerly covering plains are generally preserved as wide flat surfaces standing slightly above the surrounding countryside.

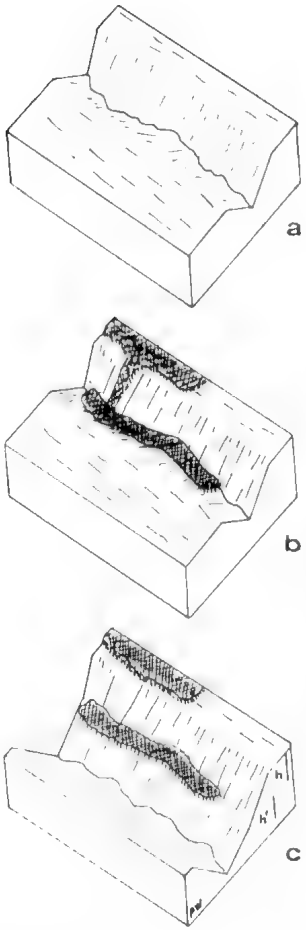

Fig. 2: Relationship of basaltic flows to landscape. Landscapes are — (a) pre-basalt; (b) immediately post-basalt, and (c) present-day. h gives the pre-basalt relief, and h + h' gives the present relief.

Basalts originally covering valley floors in areas of considerable topographic relief are generally preserved as disconnected ribbons of basalt overlying coarse river gravels. The present-day gravelly stream bed is commonly at a lower level on one side of the lava flow, with the original higher ground on the other side (Fig. 2c).

The topographic relief at the time of the basalt flow can be estimated from the height difference between the base of the basalt where it rests on gravels and the highest land in the local area (h of

Fig. 2c). The amount of river downcutting since the basalt flow filled the stream is given by the height difference between the base of the basalt and the present lowest stream bed in the area (h'). The present local relief is the sum of these two heights (h + h'). By combining the results for basalts of different ages it can be shown that local relief in the highlands has increased to the present (Fig. 3). Local relief 45 m.y. ago was one half the present local relief, and by extrapolating back in time, it can be inferred that local relief was very low about 90 m.y. ago.

Near the margins of the highlands the major rivers can cut down rapidly if the gradients of the rivers steepen. Many of the localities used in Figure 3 are close to the margin of the highland, and therefore the increase in local relief with time measures indirectly the highland uplift with time.

From this argument it follows that the eastern highlands had a low altitude and a low relief 90 m.y. ago, and were probably similar to the western 'highlands' of Victoria today. During the last 90 m.y. the eastern highlands have been uplifted at an approximately constant rate at any one place. This gives a mean uplift rate for the axis of the highlands of about 1 km in 90 m.y., or about 0.01 mm per year.

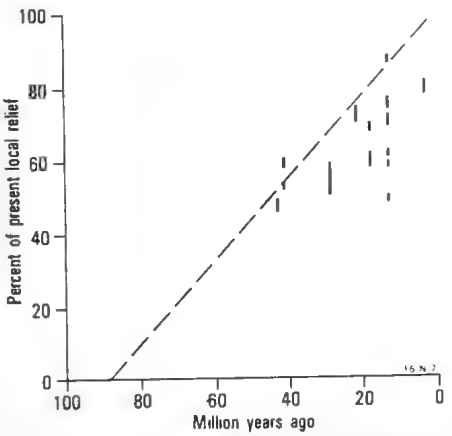

Fig. 3: Increase of local relief in the highland to the present. Local relief 45 m.y. ago was about one-half that of today (after Wellman, 1979a).

As an example, consider the Gelantipy area of eastern Victoria. In this area the Snowy River is at about 200 m altitude in a gorge, and there is an extensive area of 40 m.y. old basalt forming an extensive plateau at about 900 m altitude. The present local relief is therefore 700 m. Some basalts of the same age are preserved on the side of the Snowy River Gorge at about 600 m altitude. They overlie river gravels that were the bed of the Snowy river at the time the basalts flowed. The bed of the Snowy River was probably then at about its present level of 200 m altitude, so at that time, the plateau would be at about 500 m altitude, and local relief 300 m. At 40 m.y. ago at this location the percent of the present local relief would therefore be about 57% (Fig. 3). This location provides good evidence for about 400 m of uplift during the last 40 m.y.

Uplift is not necessarily matched by immediate dissection of the highlands. Where there are major rivers, or soft rock, the highlands have been deeply dissected. However, in some areas of hard rock with no rivers (e.g. Victorian High Plains), the present surface is of low relief, and is little changed since 90 m.y. ago except for the considerable uplift.

In the upper parts of present-day river valleys there are often steps in the river profile, or the valley sides have areas of flat ground above the valley bottom and below the summits. These steps are thought to be due to harder rock having locally restricted the downcutting of the river or valley side, and not to periods of rapid uplift equal to the amount of the step (King, 1959).

Adjacent parts of the highland may not be uplifted by the same amount. Places of relatively low uplift within the highland often have swamps, lakes, and thick sediments (e.g. Lake George and Omeo areas); places of relatively high

uplift are often areas of river gorges. The present-day relative movement of adjacent parts of the highland can be measured by geodetic survey techniques (Wellman, 1981), and by means of earthquake records (Gibson, 1981).

Structure of the highland and the cause of uplift

The Earth can be considered to be composed of concentric shells (like an onion), the shells having different chemical compositions and density. The outermost shell is the Earth's crust. It varies in thickness from 5 to 60 km and is relatively strong, but brittle. This crust is underlain by weaker shells that are collectively called the mantle. In eastern Australia the upper surface of the crust ranges from 2 km above sea level in the highlands down to 6 km below sea level in the adjacent deep oceans. The Earth's surface tends to remain reasonably flat because the mantle is not sufficiently strong to support greater topographic relief. The situation is like that of logs of wood of similar density floating in water; their top surface is only slightly above water level, and variations in this top level depend mainly on variations in log thickness.

Some idea of the crustal structure under the eastern highlands of Australia can be found by explosion seismic studies. In this method seismic waves are generated by explosions. The time these waves take to travel through rock is determined for a range of distances. These measurements can be used to determine the variation of seismic wave velocity with increasing depth in the Earth. The results (Fig. 4) show the expected pattern of increasing crustal thickness with increasing surface altitude. Under the Tasman Sea where the surface of the Earth is 5 km below sea level the crust is only about 5 km thick, in the Murray Basin where the surface is near sea level it is about 35 km thick, and in the eastern Highlands where the surface averages 1 km above sea level the crust is over 50 km thick in some places.

The chemical composition and mineralogy of the Earth's crust and upper mantle have been determined from study of igneous rocks. Many lava flows contain blocks of crust and mantle

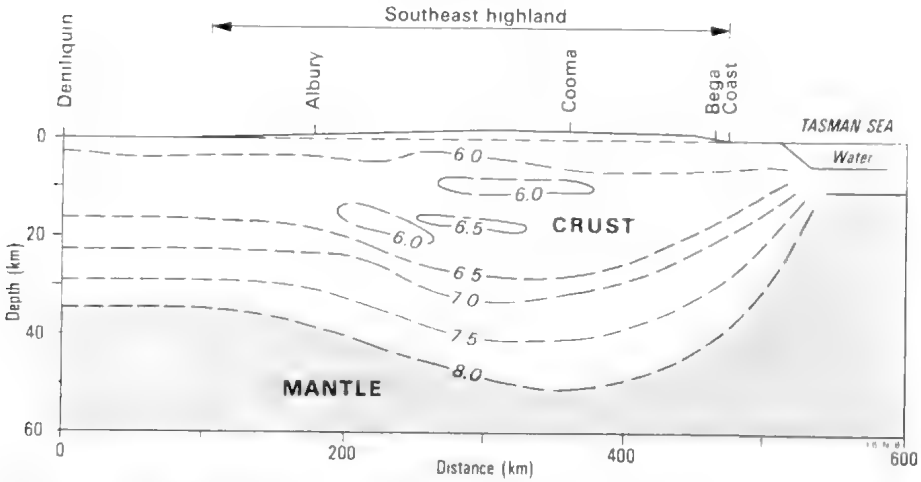

Fig. 4: Section of the Earth's crust under the southeastern highlands. The numbers give the seismic velocity in rock (kilometres per second); this is roughly proportional to rock density (data from Finlayson *et al.*, 1979).

(xenoliths) that have been ripped off the walls of the deep fissure as the lava rushed upward from the mantle to the surface. The depth of origin of these xenoliths can be determined by chemically analysing the xenolith as a whole, and the minerals that they contain, and comparing these compositions with those of minerals crystallized in the laboratory at known temperatures and pressures. It has been found that with increasing depth there is a change in the composition of rocks and a change in the type and composition of minerals found. For continental land masses the mean rock composition near the surface is close to that of granite or quartz-rich sediments, while in the bottom half of the crust the rocks are somewhat denser and are similar to basalt in composition and mineral assemblage (Ferguson *et al.*, 1979). The mantle beneath the crust is denser still and consists mainly of olivine and pyroxene crystals, plus a little basalt-like material. The minerals garnet and spinel replace the plagioclase found in basalt.

Studies by Ewart *et al.*, (1980) of the chemistry of the more common eastern Australian igneous rocks suggest that the molten rock from which they crystallized did not rise quickly from the source region in the mantle. The molten fraction of the mantle rose to the crust/mantle interface region and partly crystallized to form a basaltic intrusion, adding to the base of the crust ('underplating'). The fluid that did not crystallize later rose quickly to the surface to form a lava flow.

The uplift of the eastern highlands is thought to be due to an increase in crustal thickness by underplating with subsequent buoyant upward movement (isostatic movement). The uplift is unlikely to have been caused by upward bending of the crust without underplating, because there is good seismic evidence that the crust under the highland is thick (45-50 km). Also crustal thickening by such decreasing of the horizontal extent of the crust is also unlikely to have caused the uplift, because this would require a shortening of about 25 percent and there is no evidence for this on the surface.

Shape of the eastern highlands

The location of the highlands suggests that they were formed adjacent to, and caused by, the major continental breaks that caused the eastern and southern margins of the Australian continent. The highlands along the eastern coast of Australia are just west of the Tasman Sea basin, and the highlands in southern Victoria are just north of areas of subsidence in the Gippsland and Otway Ranges that were associated with the formation of the Southern Ocean basin.

The present highlands are generally steepest on their eastern and southern margins. This is probably due mainly to the uplift mechanism having been stronger in the vicinity of the break in the crust. It could also be that the highland in this vicinity was already somewhat steeper 90 m.y. ago before uplift began.

The width of the highland depends on the extent of the uplift forces, and also whether or not the crust has sufficient strength to spread the uplift forces and produce a wider and lower highland with the same mass above sea level. The evidence from gravity anomalies suggests that the crust in this area is relatively weak (Wellman, 1979b). Because the crust is weak the extent of the uplift is likely to have been almost solely controlled by, and therefore coincides with, the extent of the excess crustal thickness (Fig. 4).

The amount of uplift in the last 80 m.y. varies both along the length of the highland, and across a section of the highland. Before uplift, it is likely that local relief was low and the streams had a low gradient, so the higher parts of the highlands would have had an altitude of only about 300 m, like the present western Victorian highlands. Many of

the higher parts of the present-day highlands are relatively flat (New England plateau, Blue Mountains, central Kosciusko National Park, Dargo High Plains), and where lava flows 40 m.y. old are at present associated with this relatively flat surface, they are only slightly above the present average topographic height, hence it is inferred that there has not been much erosion of the higher parts of the highland during the last 80 m.y. Assuming negligible erosion, the amount of uplift along the axis of the highlands would be between zero in the Hunter Valley and 1.5 km in the Snowy Mountains, and be generally between 0.7 and 1.0 km.

Latitude: an indicator of yearly variation in temperature

The latitude of a landmass in the past can be determined from the magnetisation of rocks. As a basalt flow cools, or sediments are deposited, tiny magnetic particles in the rock are preferentially aligned in the direction of the Earth's magnetic field at that time. This original direction of magnetisation is often still preserved and can be measured. After correcting for later tilting of the rock, this direction can be used to calculate the distance and direction from the Earth's magnetic pole at the time the rocks were formed. The average position of this pole is the same as that of the spin axis of the Earth (the geographic pole), so the magnetisation of rocks can be used to determine the latitude in the past.

By measuring rocks with a range of ages the change in the position of the pole relative to Australia has been determined. Figure 5 shows that the south pole has been moving southward relative to eastern Australia since about 100 m.y. ago. The latitude of Victoria has changed from about 70°S 100 m.y. ago to its present latitude of 38°S. We can account for most of the movement by the known drift of Australia north from Antarctica at a rate of 67 mm per year starting 55 m.y. ago.

The spin axis of the Earth is at present tilted at 23° relative to the axis of rotation around the sun. This angle was probably the same 100 m.y. ago, so at that time Victoria (which was about 20° from the pole) had very short days in the winter, and very long days in the summer. However, this may not have resulted in a large annual temperature range at places with high latitudes because heat was transferred between the low and high latitudes more rapidly in the past than at present (Truswell, 1981).

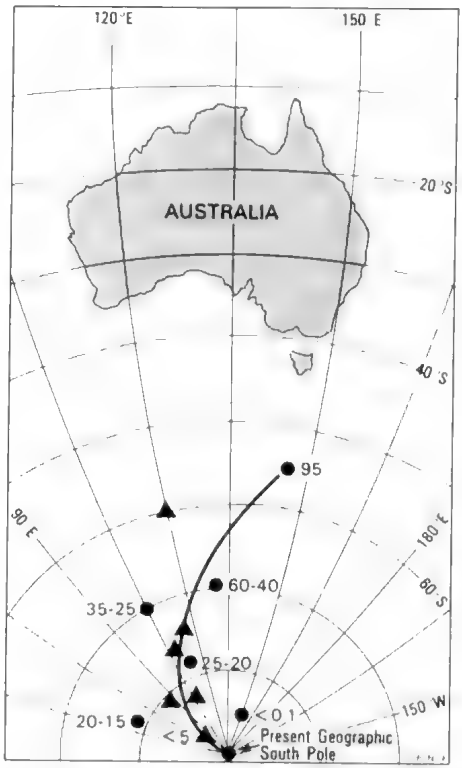

Fig. 5: Movement of the south pole during the last 95 m.y. relative to Australia and the present latitude and longitude lines. The dots and triangles give estimated pole positions; dots give pole positions of known age but with a lower positional accuracy (after Idnurm and Senior, 1978).

Mean annual temperatures

Estimates of the mean annual temperature during the Cainozoic (since 65 m.y. ago) have been made by comparing the distribution of fossil plants and animals with their present distribution, and also, independently, by measuring the ratios of the two isotopes of oxygen (0-16 and 0-18) in the calcium carbonate from marine animals. This ratio is directly related to the temperature of the water in which the animals lived. Inferred New Zealand temperatures are extremely important because New Zealand had a latitude similar to that of Australia during the Cainozoic and its fossil flora and fauna are better known. The shallow marine fossils and oxygen isotope measurements for both southeast Australia and New Zealand (Fig. 6; Gill, 1961a & b) show a warming during the period 65 to 55 m.y. ago (Paleocene), and then high temperatures from 55 to 15 m.y. ago (late Paleocene to middle Miocene) broken by lower temperatures during the early Oligocene (38 to 30 m.y. ago). These high temperatures were followed by a rapid cooling that started about 15 m.y. ago. Southern Ocean temperatures measured by Shackleton & Kennett (1975) indicate that the cooling of oceanic water started in the early Eocene (about 54 m.y. ago), but this pattern may not have applied to, and is not consistent with, the shallow marine inferred temperatures.

The floral history of southeast Australia (Kemp, 1978) is similar to that of New Zealand (McQueen *et al.*, 1968;

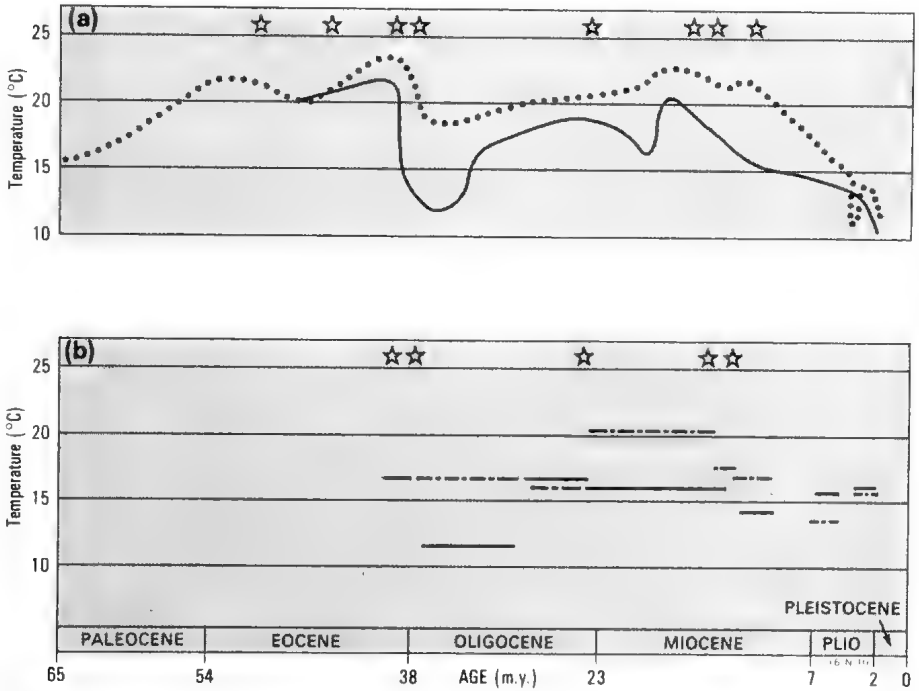

Fig. 6: Cainozoic temperature changes in shallow marine seas (a) for New Zealand and (b) for southeastern Australia. Continuous and almost continuous lines are oxygen isotope results, for New Zealand from Devereux (1967), and for Australia from Dorman (1966) using Deveraux's method of calculating mean temperatures. The dotted line is inferred from palaeontology (Hornibrook, 1971). The stars show the times of short invasions of 'tropical' larger foraminifera (McGowran, 1979).

Mildenhall, 1980). Podocarps were dominant 65 to 54 m.y. ago, and plants with tropical affinities became important about 50 m.y. ago, but many species had disappeared by 40 m.y. ago. The *Nothofagus brassi* group pollens (today forming high-altitude tropical forests) were important from 38 to 15 m.y. ago. There is strong floral evidence for rapid cooling starting about 15 m.y. ago. This floral history was interpreted by Kemp (1978) as indicating a warming, followed by high temperatures in the Eocene (54 to 38 m.y. ago) and lower temperatures in the Oligocene (38 to 23 m.y. ago). In New Zealand the very similar floral history was interpreted by McQueen *et al.* (1968) and Mildenhall (1980) as indicating relatively high temperatures during the whole middle Cainozoic (54 to 10 m.y. ago) in agreement with the temperatures inferred from, and measured on, shallow marine fossils.

Southeastern Australia was almost surrounded by water during part of the middle Cainozoic, and it had a lower altitude than at present. Consequently land temperatures are likely to have been similar to shallow marine temperatures, and to have had only a small annual temperature range. It is therefore likely that in southeast Australia the land temperatures were relatively high during the whole of the middle Cainozoic. The middle Cainozoic floras suggest closed rainforest — forests with leaves intercepting most of the sunlight. Closed rainforests are thought to be restricted to humid climates.

These inferred Cainozoic temperature changes are likely to have been due to a combination of the following two factors. (1) Southeast Australia drifted north from high to middle latitudes starting 55 m.y. ago. This had a tendency to increase temperatures. (2) Polar temperatures decreased slightly during the early and middle Cainozoic, and then rapidly during the late Cainozoic after the Antarctic ice cap started to form 20 m.y. ago. This greatly decreased polar temperatures, but only slightly decreased equatorial temperatures. The fairly constant mean annual temperatures inferred for southeast Australia during the middle Cainozoic could result from the above two factors cancelling each other. The decreasing temperatures for southeast Australia in the late Cainozoic were due to the very rapid decrease in polar temperatures at this time, only slightly offset by warming due to northward drift.

Soils

The soils of the Cainozoic would have differed from those of today, mainly because rainfall, temperature, and humidity would have been higher, and because the main vegetation was of closed rainforest type. On the granites and old sediments there is scattered evidence for considerable chemical weathering of the soils to form leached, iron-rich and silica-rich deposits. This suggests that the soils were more weathered in the past than at present. However the closed rainforest would have been very efficient in recycling nutrients, so leached soils may not have limited plant growth.

In the past, topographic relief would have been lower in the highlands, so there would have been few steepland soils of relatively high natural fertility, and less variation in microclimate. River flows would have been more regular, with a lower sediment load and higher amounts of organic matter in solution.

In the mid-Cainozoic, basalts were much more extensive than today, but not continuous (cf. Galloway, 1967). Basalts are higher in plant nutrients than granites and old sediments. Consequently with high rainfall, and therefore high watertables, basalts would probably have supported a high-mass, diverse rainforest.

Conclusion

This paper shows that studies of the geology, geophysics and geochemistry in

the southeastern highlands have made important advances during the last twenty years, and that some conclusions can be reached on the area's present-day structure and its environmental history during the last 100 m.y.

Topics that are at present being studied, but so far without conclusion, include the following: (1) The climatic and weathering history is being determined by studying Cainozoic lake and river sediments and their spores and pollens, and by studying weathered soil profiles that have been dated by their magnetisation; (2) The mean heat flow through the upper layers of the highlands is being measured to determine any regional heating of the crust by volcanic activity; (3) The lower crust under southeast Australia is being studied to determine whether Precambrian (older than 600 m.y.) sediments underlie the area, and if so at what depth. Sediments of this age are thought to have melted at depth to provide the source of some of the granites in the area (Wyborn & Chappell, 1979).

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Will the Construction of A New Harbour at Lorne Destory the Beach?

BY EDMUND D. GILL* AND N. H. MCNEILL**

Lorne, on Loutit Bay, Otway coast of Victoria, is famous as a holiday resort because it combines a beautiful beach with forested hills. Small fishing boats operate from Lorne, but after use they have to be lifted on to the pier for protection against the strong swell waves. The fishermen wish to use larger vessels, but this would necessitate a more protected harbour. A very important question is what environmental changes would result. Will the beach, a basic resource for this holiday resort, be modified or lost? This is a relevant question because unexpected and undesirable changes to the coast have accompanied the construction of Victorian outer ports. For example, at Apollo Bay, S.W. of Lorne, the harbour has sanded up considerably, an unwanted dune has grown between the main street and the beach, and erosion has occurred further round the bay.

Anatomy of Loutit Bay

The only way to forecast what effect a new harbour will have on Lorne beach is to define the present shoreline processes, then calculate how the new structure will affect them. No amount of computing and modelling will provide the answer until it is known what factors need computing and modelling.

Although Loutit Bay is open, the high hills on the south side shelter the beach from the strong cool south and southwest winds. Both shores are rocky with varying amounts of backshore sand. The west shore follows the strike of the strata, while the strike on the south shore is oblique. On both shores the strata dip gently seawards. This geological structure accounts in part for the presence of the bay (Medwell 1971).

Where the two shores meet, the Erskine River debouches. Lorne's excellent beach is the shore face of a sand spit that deflects the river to the north, hard against the rocky limits of the bay. When sea level was low during the Ice Age, the Erskine River cut a valley across what is now Loutit Bay. This also contributed to the forming of the bay.

Fig. 1. The beach at Lorne at low tide. Note the groyne in the distance (which see in Figure 2). A current flowing towards the groyne maintains the sand supply higher on the viewer's side. Photo by N. H. McNeill.

Fig. 2. Telephoto of the north end of Lorne beach, showing the groyne and the mouth of the Erskine river deflected against the rocky limit of the bay. The purpose of the groyne is to increase the amount of sand on Lorne beach. It shows that the longshore current is moving north away from the viewer. In the background is North Lorne. Photo by N. H. McNeill.

* 1/47 Wattle Valley Road, Canterbury, Victoria 3126.
** 23 Dorman Street, Lorne, Victoria 3232.

As the sea rose, this valley was filled with sand brought down the river, and sand brought in by longshore currents. Sand still moves along the coast, and the question of the effect of a new harbour is to what extent it will interrupt this natural sand movement that nourishes the beach.

River of Sand

Most beaches are rivers of sand, ever on the move. This year's Lorne beach has different sand from last year's. Sand has drifted away and new sand has taken its place. A beach is a dynamic structure, with a budget of sand arriving and sand departing. There are two processes whereby sand is propelled alongshore. Firstly, waves *oblique* to the shore push the sand along. This is normal in England, for example, where short period waves generated by local storms push the sand along. By contrast, the waves on open beaches in southern Australia are long period ones generated in the very energetic Southern Ocean. They "feel" the seafloor far out on the continental shelf and align themselves so as to arrive *parallel* to the shore. They do not propel sand alongshore.

A professor from the United Kingdom skilled in shoreline studies was asked what impressed him most about the Victorian coast. "That the waves arrive parallel to the shore," he said. On most Victorian beaches sand is lifted from the seafloor by the waves, but wind-generated currents keep the river of sand moving alongshore. At Warrnambool this type of sand movement has been studied in detail and quantified (Gill 1978), because it is important for coastal engineering and conservation (Gill 1979, 1980). Wind-generated currents move at about 2% of the wind speed. Tidal currents also occur, but as the tidal range is small the currents are weak.

Where the sand moving longshore is of a unique color or grade, its movement is easy to follow, but this does not happen often. Where clayey river waters enter the ocean then move parallel to the shore, they show the presence of a longshore current and its direction. A sand spit does the same. Thus the spit at Lorne that deflects the Erskine River to the north tells us there is a northerly current there. The piling of sand on the south side of the groyne (Fig. 2) tells us the same thing. Thus a degree of sand starvation on the north side of the groyne has led to some erosion there, countered by the emplacement of some large rock masses.

Sand Movement in Loutit Bay

The south shore of Loutit Bay is too protected for wind-generated currents to be effective, but surprisingly (for Victoria) there are oblique waves to propel the sand. Point Grey (see air photo in Gill 1977) juts into the sea and the waves coming round it do not have time to align themselves to the south shore, so pass at an angle to it. These waves provide the energy that keeps sand arriving at Lorne beach. But the oblique waves end at the Life Saving Club, and so this system does not extend very far. At the outer edge of the shore platform at Doble Street the top of the sand is at about mean sea level, down to near mean low water at Doble Street (so that the sea squirt *Pyura* is present), and beyond that it drops below low water level so that kelp (*Durvillea*) is present.

In connection with a micro-erosion meter measurement of rock wear on this coast (Gill and Lang 1982), a survey was made from Jump Rock to Albert Street near Lorne Hospital. During this survey, the sand levels were accurately checked.

Danger to Lorne Beach

Having learnt the nature of the relevant coastal processes, we can answer the question whether harbour construction will harm Lorne beach. If such construction interrupts the flow of sand along the south shore of Loutit Bay that

nourishes the beach, then the beach will suffer. Any harbour works must be planned so that the feeder stream of sand is not interrupted.

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Notes on the Range Extension of the Alpine Water Skink *(Sphenomorphus kosciuskoi)* in Victoria

BY IAN MANSERGH*

The Alpine Water Skink *(Sphenomorphus kosciuskoi)* was first discovered in Victoria at Davies Plain, East Gippsland, in January 1975, by staff of the National Museum of Victoria (NMV) (Coventry and Robertson 1980). Despite extensive searching by Coventry and Robertson (1980) in other suitable areas (e.g. Bogong High Plains), all subsequent records were within 15 km of the N.S.W.-Victorian border and they suggested that the Victorian population represented merely a small southward extension of the known range in N.S.W.

In February, 1981, I captured a specimen 1 km N of Mt Cope, on the Bogong High Plains (36° 55′ S, 147° 17′ E; NMV D55111; Fig. 1). Thus this record extends the known range of the Alpine Water Skink 80 km WSW, but since there have been no extensive searches in the intervening areas it is not known whether the range is continous, or disjunct as in N.S.W. (Cogger 1979). All Victorian specimens have been taken from areas above 1400 m although in N.S.W. the skink occurs in areas above 1000 m (Jenkins and Bartell 1980). The habitat where the Mt Cope specimen was taken was a sphagnum bog, similar to that described at other Victorian localities (Coventry and Robertson 1980). The Alpine Water Skink was the only skink observed at the Mt Cope site although the cool temperate form of *S. tympanum* was noted in apparently similar habitat 4 km N, around the Rocky Valley Storage Dam.

Coventry and Robertson (1980) noted that the known habitat of the Alpine Water Skink in East Gippsland was being threatened by trampling and grazing. Similar conditions were evidenced at the Mt Cope site, and these factors should be considered in the future management of the species.

* Fisheries and Wildlife Division, Arthur Rylah Institute for Environmental Research, 123 Brown Street, Heidelberg, Victoria, 3084.

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Fig. 1. The Alpine Water Skink *(Sphenomorphus kosciuskoi) in situ* one km N of Mt Cope, Victoria.

Errata

Vol. 99 (1)

P.40, Col. 1, Par. 4 — for "nine metres" read 12 metres high.
P.40, Col. 2, Par. 2 — for *"repidium"* read *rhipidium*
P.40, Col. 2, Line 9 from bottom — for "Dennstaeditaceae" read Dennstaedtiaceae
P.40, Col. 2, Line 8 from bottom — for *"Histiopsis"* read *Histiopteris*
P.40, Col. 2, Line 4 from bottom — for "Lindsayaceae" read Lindsaeaceae
P.41, Col. 1, Line 2 — for "Teadia" read Tender brake
P.41, Col. 2, Line 11 from bottom — for *"obligua"* read *obliqua*
P.41, Col. 2, Line 11 from bottom — for *"tesselata"* read *tessellata*
P.42, Col. 1, Line 15 — for *"Compholobium"* read *Gompholobium*
P.42, Col. 1, Line 16 — for *"heugelii"* read *huegelii*
P.42, Col. 1, Line 25 — for *"Swainsonia"* read *Swainsona*
P.42, Col. 1, Line 26 — for *"lessertifolia"* read *lessertiifolia*
P.42, Col. 2, Line 1 — for *"Exocarpus"* read *Exocarpos*
P.42, Col. 2, Line 5 from bottom — for *"Avicenna"* read *Avicennia*

Vol. 99 (2)

P.53 — the captions for the two figures should be exchanged.
P.67 — the final paragraph should appear at the end of the discussion on p.69.
P.76, Col. 1, Line 17 from bottom — for *"Uticularia"* read *Utricularia*
P.76, Col. 1, Line 9 from bottom — for *"heugelii"* read *huegelii*
P.76, Col. 1, Line 8 from bottom — for *"ecoststum"* read *ecostatum*
P.76, Col. 2, caption under photo. — for *"tumerensis"* read *toomansis*
P.77, Col. 1, Line 2 — for *"disocarpa"* read *discocarpa*
P.78, Col. 1, Line 3 from bottom — for *"Dicnemolome"* read *Dicnemoloma*
P.78, Col. 1, Last line — for *"billardierc"* read *billardieri*
P.78, Col. 2, under List of Fungi — for *"cyanothantha"* read *cyanoxantha*
P.78, Col. 2, under List of Fungi — for *"Cymatodeoma"* read *Cymatoderma*
P.78, Col. 2, under List of Fungi — for *"Daldina"* read *Daldinia*
P.78, Col. 2, under List of Fungi — for *"repidium"* read *rhipidium*
P.76, Col. 1, Line 38 — for *"juniperinum"* read *"laevigatum"*
P.77, Fig. 3 caption — read *Calacdenia carnea* var. *gigantea*.

Book Review

"Flora of Australia", Volume 1 (Introduction)

Bureau of Flora and Fauna, Canberra
(Griffin Press, Netley, S. Aust.)
25.5 x 18 cm, 200 pp., 5 col. plates,
26 fig.
ISBN 0-642-06652-3 (case bound)
Price $12.50

There is only one modern taxonomic treatment of all the vascular plants in a contiment, viz *Flora Europaea* Vols. 1-5 (1964-1980). Australian botanists are still using the text of George Bentham's *Flora Australiensis*, in seven volumes (1863-1878); this very useful standard work contains descriptions of 8125 species, about half of the vascular flora known to occur in Australia at the present time. The need for a new continental flora becomes increasingly urgent, so one welcomes the initial book in a series of at least 48 volumes that will systematically cover all Australian flowering plants, cycads, conifers and ferns, both indigenous and naturalized.

This first volume is purely introductory, but should be followed early in 1982 by a monograph on the Solanaceae (Vol. 29). Five contributors to the present book have written on: the "Background to the Flora of Australia" (22 pages by Mr Alex S. George); "The Australian Flora: its Origin and Evolution" (42 pp. by Dr Bryan A. Barlow); "An Introduction to the System of Classification" (29 pp. by Dr Andrew Kanis); "Key to Families of Flowering Plants" (56 pp. by Dr H. T. Clifford); and "Glossary" (29 pp., incl. 4 with illustrations, by Dr Alison McCusker). All of these chapters are pertinent and excellently presented.

Alex George's "Background" admirably sets out the history of sundry endeavours to up-date last century's *Flora Australiensis* by Bentham — a remarkable achievement by one man in 16 years. A brief summary of the last significant years of that history seems appropriate.

At the instigation of Dr Hansjoerg Eichler and Professor Joseph G. Wood (then practising botanists in South Australia), the subject of a National Flora was placed on the agenda at the 33rd ANZAAS Congress held in Adelaide during August 1958. After extensive discussion, ANZAAS set up a seven-man *Flora of Australia Committee* to prepare detailed plans, with estimates, for presentation to its next meeting in Perth (August 1959). The Committee worked hard, and adoption of its report by ANZAAS resulted in an approach to the Prime Minister's Department which, in turn, referred the matter for further study and recommendations to the Australian Academy of Science. The Academy tied the Flora of Australia project to a much wider biological survey (including fauna) of the continent; but the Government in 1960 expressed inability to finance such a scheme. So the matter rested until April 1967, when ANZAAS again contacted the Prime Minister, urging support for a new National Flora, and once more the proposal was thrown into the lap of the Academy of Science. A Flora and Fauna Committee was immediately appointed by the Academy to examine this new proposal — the present reviewer was a member of this committee, also of the succeeding Standing Committee for a Flora of Australia established by the Academy in November 1971.

In 1973, with formation by the Government of an Interim Council of the Australian Biological Resources Study ("ABRS"), a small trickle of financial support became available for botanical taxonomic and ecological studies (including the curation of collections). Finally, in March 1979, the ABRS Advisory Committee was appointed by the Minister for Science and it recommended that work on a consise Flora of Australia begin at once and be completed within the next 30 years. The consolidating administrative step was taken in November 1979, with establishment of a Bureau of Flora and Fauna under the federal Department of Science and Environment. Thus, after more than two decades of uncertainty and frustration, a modern flora of our continent was at last under way, having experienced in the words of A. S. George "a long gestation and a difficult birth."

Dr Bryan Barlow's biogeographical story of the Australian flora is equally fascinating and informative. With a series of maps he explains the disposition of land and sea from the disintegration of the large continental mass, Gondwanaland, beginning in the Cretaccous period (65-135 million years before present), to recent time. At least

throughout and since the Miocene epoch (10-27 million years BP), Australia has been drifting northward at rates as much as 7.4 cm per year, and the high endemism of its existing flora can only be explained by a long development in geographical isolation on fairly stable land surfaces. The fluctuations of climate (particularly wet and successively very arid periods) have undoubtedly sifted and modified the flora and dependent fauna. Barlow refers to previous writers, and their theories, on plant migration routes; he believes that undue importance has been attached to land bridges. Torres and Bass Straits are seen more as ecological boundaries than geographical barriers to more recent migration. "The absence from Tasmania of so many families which occur elsewhere in south-eastern australia is probably due mainly to the small area of the island and its limited habitat diversity; most of the families now absent probably never occurred there."

From the artificial system of Linnaeus (1751-54) to natural phylogenetic schemes of the 19th century, Dr Andrew Kanis provides an outline of plant classifications by leading taxonomists. In greater detail he explains the systems used by seven modern 20th century authors (A. Engler, J. Hutchinson, H. K. Airy Shaw, A. Takhtajan, A. Cronquist, R. F. Thorne and R. M. T. Dahlgren), summarising their agreements and differences in treating taxa above the rank of family. The 1981 edition of Arthur Cronquist's *The Evolution and Classification of Flowering Plants* has been adopted as the framework for the new *Flora of Australia*.

The simple, numbered key to plant families by Dr Trevor Clifford (University of Queensland) is a model of its kind and will prove increasingly useful as the *Flora of Australia* proceeds toward completion. For instance, if a leafless parasitic twiner of lucerne paddocks keys to the family Cuscutaceae (true dodders), the alphabetical index to families on the rear end-covers in each volume will show that Vol. 30 contains an account of this small group. Clifford's key has stood the test of repeated trial identifications, but there are a few sections where one may strike difficulty. Thus on page 162, section 826, "Leaves alternate" should be expanded to read "Leaves alternate *or* in whorls", leading to Casuarinaceae and Haloragraceae; while on page 163, section 838, "Plants of marine or brackish habitats" leads to six families which do not include Juncaginaceae, yet several juncaginaceous species (of *Triglochin*) grow habitually in or around salt-marshes.

The concluding Glossary by Dr Alison McCusker affords crisp definitions of every conceivable botanic term in common use, as they apply to vascular plants — even such unusual adjectives as *didynamous* and *quincuncial* are there. The first two colour plates attractively portray the floral emblems of Commonwealth and seven States, while the historical section is enhanced by full-page black-and-white portraits of five important 19th century workers on Australian plants — G. Bentham, R. Brown, J. Lindley, J. D. Hooker and F. J. H. Mueller. For any serious student of floristics or plant ecology, access to this and subsequent volumes of the new *Flora* is a 'sine qua non'.

— J. H. Willis

Books on Eucalypts

Two publications on Eucalypts have been issued by Australian National Parks and Wildlife Service (P.O. Box 636, Canberra City, A.C.T., 2601). They are Special Publication 5 "Australian Endangered Species: Eucalypts" by L. D. Pryor, and Special Publication 6 "The Natural Distribution of *Eucalyptus* in Australia" by George M. Chippendale and Ludek Wolf.

In Special Publication 5, Pryor lists 62 species which are considered endangered in their natural state because of their very restricted occurrence or changes in land use threatening their habitat. Some, however, are reasonably safeguarded in national parks or reserves. (I cannot agree that *E. yarraensis* is "one of most threatened of eucalypt species." Certainly the odd trees surviving on farms have little chance of regeneration but it is far wider-spread than has been generally recognized.) Each species is described with an accompanying photo and map of Australia showing major grid in which it has been found.

Special Publication 6, after a few pages of introductory information, lists every known eucalyptus species under the name of each of the over 500 maps of the Australian National

1:250,000 grids (each 1° latitude x 1½° longitude), on centre pages is a map of Australia showing each grid, and the latter half of book consists of smaller maps showing on which grids each species occurs. This all combines an immense amount of work and should be a great aid in extending knowledge of distribution and provide the basis for more detailed mapping within major grids.

The computer data for this mammoth collection is based on records in Australian and British herbaria, and unfortunately, for Victoria, this has resulted in a number of obvious errors, possibly because some facts of distribution are so well known they have never been recorded. Examples of important omissions are: St Arnaud — *E. melliodorea;* Colac — *E. regnans, E. radiata; Tallangatta — E. camaldulensis.* Also some errors may have arisen from lack of awareness of the geographic boundaries of the major grids, e.g. maybe the inclusion of *E. perriniana* and *E. stellulata* on the Melbourne grid has resulted from confusion with the larger Melbourne Study Area of the Land Conservation Council.

Therefore, for this State, the data should be compared with Costermans'[1] maps and Beauglehole's[2] checklists.

Pat Carolan
(1/92 Were St., Brighton)

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2. Beauglehole, A. C. 1980. Victorian Vascular Plant Checklists. Western Victorian Naturalists Clubs Association — Portland. E. Davis & Sons Pty. Ltd.

(Major Grid maps can be purchased from National Mapping Division and numerous map sellers.)

Skin-sloughing by *Pseudechis porphyriacus*

BY P. E. HORNSBY*

During a recent visit to the Adelaide Zoo, my son and I were able to watch the complete process of a Red-bellied Black Snake *Pseudechis porphyriacus* shedding its skin. The movements of the snake when first seen suggested the sequence was about to commence, with the snake running its head through the grass with repeated corkscrew movements. After about ten such movements, it had succeeded in loosening the skin from the front of its head. What followed may be categorised in three discrete stages.

For the first stage, it continued to work its head and foreparts through the tough dry basal stems of the couch grass in the enclosure, with the skin gradually peeling back. This lasted until about 15 cm of the skin had been removed. It then began instead to remove the skin by rhythmical movements of its own body. It would contract itself about the last section where the old skin had been folded back, and then distend its body ahead of the fold, at the same time pressing down so as to "hold" the old skin. This sequence was repeated in rapid succession, gradually easing itself forward and out of the old skin, which in turn was being slid back inside out over its body, like removing a glove. The position of these muscular movements showed that it had fine control over the siting of the distal part of the actions, since these were concentrated at precisely the point where the skin was being removed. However this was not a localised action as the movements were occurring over a length of the snake well to the fore of the sloughing point. This suggests that the snake is capable of accumulative muscular activities, but not localised ones. In other words, if it wants to flex its muscles in one part of its length, it achieves this by gross movement up to and including the desired spot, but not necessarily beyond it. The process of shedding its skin became increasingly difficult as it reached the point of greatest girth and this was the only point at which the skin started splitting as it passed over.

In the full sunlight, with a shade temperature of 36°C, the snake seemed to find this an exhausting exercise and it stopped for a drink just before, and just after, the section of greatest girth. After the second drink, it unsuccessfully attempted to crawl under another snake. It was then onto the third stage for removing its skin.

At this juncture, it ceased the muscular

* Nent Oura Research Unit,
University of Adelaide, Adelaide, S.A. 5000.

movements and instead looped itself about so that its forward end was lying across the lower part just beyond the point the slough had reached. It then pressed down with its foreparts while easing the end part out from underneath. It repeated this sequence about three times, repositioning itself for a better grip after each sequence. The shedding became progressively easier towards the end, with the reduction in the snake's girth. The final 10 cm was easily removed, with the snake merely lying on the old skin, now well beyond its body.

The action took place in the early afternoon in mid-November, and lasted approximately 13 minutes. The unbroken skin was subsequently measured at 142 cm. It was also interesting to note that the dark pigmentation was visible throughout the length of the sloughed skin and particularly on the skull, but none of the pink underbody colour could be seen.

A new record of the New Holland Mouse (*Pseudomys novaehollandiae*) from Anglesea, Victoria.

BY KATHRYN M. KENTISH*

The New Holland mouse (*Pseudomys novaehollandiae* Waterhouse, 1843), a species of native rodent endemic to Australia, was recorded in the Anglesea district during May, 1981. This is now the western-most record for this species, which previously had not been captured further west than Langwarrin on the Mornington Peninsula (Dixon, 1975).

Fossil evidence indicates that the distribution of *P. novaehollandiae* once extended into areas of western Victoria (Mahoney and Marlow, 1968). However, recent Victorian records have been restricted to coastal areas of eastern Victoria between Melbourne and Lakes Entrance (Watts and Aslin, 1981). The species also occurs widely, though patchily, from the northern coast of New South Wales to just south of Sydney, and is also found in the north-east of Tasmania (Watts and Aslin, 1981).

The recent discovery of *P. novaehollandiae* in the Anglesea district was made during a small-mammal trapping survey, which was part of a general ecological study of the area being undertaken by our research group at Deakin University. The 4 ha. grid was trapped for 4-day periods in May, August, September, and October (1981). A total of 9 individuals has been caught (7 males, 2 females). One male, caught on 23 May, is lodged at the National Museum of Victoria, Melbourne (Registration No. C24995); all others were released at their point of capture.

The trapping site occurs on a well-drained slope down from a stony ridge. The dominant habitat type is open woodland (Specht, 1970) of Brown Stringybark *Eucalyptus baxteri*, with a low (25-40cm.), generally dense understorey of heath plants. (Dominant species are Common Heath *Epacris impressa*, Myrtle Wattle *Acacia myrtifolia*, Dwarf She-Oak *Cassuarina pusilla*, Silver Banksia *Banksia marginata*, Heath Tea-tree *Leptospermum myrsinoides*, Showy Parrot-pea *Dillwynia sericea*, Smooth Parrot-pea *D. glaberrima*, Honey-pots *Acrotriche serrulata*, Common Flat-pea *Platylobium obtusangulum*, and Wire Rapier-sedge *Lepidosperma semiteres*.) Occasional dense stands of taller (1-4m) shrubs (Sweet Wattle *Acacia suaveolens* and a stunted, many-stemmed form of the Narrow-leaf Peppermint *Eucalyptus radiata*) also occur. This type of vegetation corresponds to descriptions of the preferred habitat of *P. novaehollandiae* recorded from previous studies (Keith and Calaby, 1968; Posamentier and

* Division of Biological and Health Sciences
School of Science
Deakin University
Waurn Ponds, 3217.

Recher, 1974; Braithwaite and Gullan, 1978).

Other small mammal species captured in this trapping area include the marsupial mice Brown Antechinus *Antechinus stuartii* and White-footed Dunnart *Sminthopsis leucopus* and the introduced rodent House Mouse *Mus musculus*. Swamp Rat *Rattus lutreolus lutreolus* and Swamp Antechinus *Antechinus minimus* have also been caught here in a wetter, more densely-vegetated patch.

Further trials are being conducted, both on this grid and in other areas of similar habitat, in order to determine more precisely the distribution and abundance of *P. novaehollandiae* in the Anglesea district.

Acknowledgements

I should like to acknowledge with gratitude the assistance of ALCOA of Australia Ltd., which is funding this research; Joan Dixon, Curator of the Department of Mammalogy, National Museum of Victoria, for identifying the mouse; and Dr A. Bourne, for helpful comments on the manuscript.

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(Continued from inside back cover)

Naturalist. A grant from the Victorian Government and from the Ingram Trust, and interest from investments, have enabled all accounts to be met leaving a surplus of $3.00! Nevertheless, the Club is in a sound financial position.

The remarkable profit from book sales conducted by Mr Dan McInnes cannot be used for general expenses because it is earmarked for Club improvements. As well as augmenting the Club Improvement Fund by $2248, this service saved members a similar amount in the books they bought.

Election of Officers and Council Members. Officers elected: President Miss Wendy Clark, Vice-President Dr Brian Smith, Secretary Mrs Sheila Houghton, Treasurer Mr David Dunn, Editor Mr Robert Wallis, Assistant Editor Mr Dane Panetta, Excursion Secretary Miss Marie Allender, Programme Secretary Miss Cathie Zerbe, Assistant Librarian Miss Madge Lester. Offices vacant: Assistant Secretary, Assistant Treasurer, Librarian.

Council members elected: M.Allender, P.Carardine, D.Dunn, J.Grusovin, S.Houghton, D.Lee, J.Scott, E.Turner, H.Weatherhead, C.Zerbe, plus the President (W.Clark) and Vice-President (B.Smith).

Other appointments were: Minutes Secretary A.Walker, Conservation Co-ordinator M.Turner, Club Reporter M.Lester, CCV Representative D.Lee.

Speaker for the evening was Dr Bill Birch, Curator of Mineralogy at the National Museum. Speaking on minerals in Victoria, Dr Birch said that Victoria has only about 10% of the 3000 species of world minerals. He defined minerals as natural-occurring chemical compounds and usually occurring as crystals. He showed a geological map of Victoria and directed our attention to five main zones — the granites, basalts, old sedimentary, young sedimentary, and the oldest rocks Cambrian. Then followed slides of representative minerals obtained from those five types of rocks. The shapes of crystals and variety of colours are quite astonishing to a novice.

Field Naturalists Club of Victoria

Reports of recent activities

General Meeting
Monday 15 March

Mr Ros Garnet received the Order of Australia at the Australia Day honours. We congratulate Ros that his work for conservation and natural history has been recognised in this manner.

Speaker for the evening was Miss Margaret Blakers of the RAOU on the Bird Atlas. The project was started in 1976 working on a grid system to plot the distribution and breeding distribution of birds in Australia. Some 2600 observers, mostly from bird groups, contributed information to nine regional directors, from whence data was passed to HQ and stored in a computer data bank. The project was closed in 1981 and is now bieng prepared for publication next year. The atlas will also include comparison with records of three earlier periods: before 1901, 1901-50, 1951-76.

During the project special expeditions were made to several regions beyond the usual observation areas. Miss Blakers showed slides of such a trip to the Great Sandy Desert south of the Kimberleys in Western Australia, a region not visited by white men since Dale Carnegie's trip of 1896. 23 people with 11 vehicles took part, all voluntary and all at their own expense. Surveyors in the party marked the grid divisions as they went along.

Exhibits. There were several large maps etc. relevant to the Bird Atlas.

A toadstool about 18cm across (7") with a stalk almost as long was probably *Lepiota gracilenta*. A specimen of the NSW Pink Tea-tree *Leptospermum squarossum* displayed its large pink flowers which occur in autumn and winter. A sprig of Black Wattle carried a bulky gall, cause not known.

Under microscopes were some beetles and various stages of a leaf-eating beetle *Paropsis atomaria* — a frill of eggs round a stalk at base of leaf, a larva (about 3mm) feeding on a leaf, and the adult beetle (about 1cm).

Volcanoes Excursion
Sunday 4 April

With Graham Love as leader, we went to Broadmeadows, then turned north along Mickleham Road — the old road to Sydney.

Before reaching Mickleham we took a road to the left for a short distance. With Mt Crowes behind us, we had a wide view to the south. Immediately ahead was Mt Fairbank with Aitkin Hill to the left. They are little more than rounded hillocks although Mt Crowes is larger and higher. But from one million to 20 million years ago one or other of them was actively volcanic, and their lava flows filled valleys and caused streams to alter direction more than once. They are three of the many small volcanoes that created the great basalt plain of western Victoria.

A blue-tongue lizard by the roadside added further interest to this stop.

We continued along Old Sydney Road — the route used by horse vehicles for it follows ridges while the present Sydney road (Hume Highway) is in valleys and was often swampy and difficult for horse-drawn traffic.

Somewhere north of Mickleham the terrain changed — no longer flattish with gentle rounded hills, but less rounded hills with erosion and gullying; we had left the lava and were on silurian soils. We continued around the west side of Pretty Sally, still on silurian, and lunched at Kilmore. As we entered the town several bluestone buildings caught the eye. Bluestone, of course, is the builders' term for basalt or lava.

We returned via the Hume Highway, and shortly after passing the peak of Pretty Sally we were again on lava.

At Beveridge we took an easterly road to see the quarry at Mt Frazer (Mt Bland). The quarried material is dark reddish brown with a somewhat foamy

(Continued on inside back cover)

texture — scoria emitted by explosive action instead of the viscous lava flows of the other volcanoes.

Returning to the Highway we paused at Kalkallo. Now it consists of a garage and a few houses but was a substantial town in the coaching days of the 1850s. The bluestone shell of a church is the only sign of its former importance.

Like all excursions led by Graham Love, this was full of geological and historical information, only a fraction of which can be reported here. But we each received pages to be read at leisure. We thank Graham for a very interesting day, supplemented by sunny mild weather.

General Meeting
Monday 19 April

Speaker for the evening was Dr Elizabeth Turner on Volcanoes of Hawaii. First Dr Turner spoke briefly of the structure of our planet, of plate tectonics, and the different kinds of volcanoes. The string of islands forming the Hawaii archipelago has arisen by volcanic action. There has been no volcanic activity in the extreme north-west islands for 6 million years, but the period of inactivity is progressively reduced as one moves down the string to Hawaii at the south-east end. Here is one of the largest active volcanoes in the world — Mauna Loa. There was an eruption in 1976 and Dr Turner visited the area in 1981 when the lava was still hot. Dr Turner showed a film of the volcano during its eruption, a film taken by herself of the strenuous activities of the 1981 tourist party, and spoke of the facilities of the Hawaiian Volcano Observatory situated almost on the rim of Kilauea crater.

Our Kinglake property now costs $165 in annual rates and it is proposed to form a "Friends of Kinglake" group to raise money.

Queensland Fruit Bats are again in the Botanic Gardens — 300-400. They have also been reported at Patterson Lakes and at Leongatha.

Annual General Meeting
Monday 10 May

Annual Report for 1981 was read by President Miss Wendy Clark. The main points were:

The die of the Natural History Medallion had worn out and lengthy investigations resulted in commissioning Mr Macham Skipper to design a new one. Our spare medallion of the original design will remain in our archives.

Club property is dispersed among several members' houses and garages so there is a pressing need to find premises to house all such property and for use for meetings. Application for the old Canterbury Library failed, but the search continues.

Five major submissions and several minor ones regarding conservation were made to government and other bodies.

Four honorary memberships were conferred during the year.

General excursions and Group excursions continued, but the Special Study Trips lapsed without a leader to organise them.

The Mammal Survey Group and the Botany Group made useful contributions in their respective spheres. The Geology Group, Microscopy Group and Day Group continue, but the Marine Biology and Entomology Group has gone into recess due to lack of attendance.

The bookstall run by Mr Dan McInnes continued to provide cheaper books for members and revenue for the Club Improvement Fund.

1981 Australian Natural History Medallion was presented to Dr Elizabeth Marks — the first to receive the new design.

Treasurer's Report for 1981. Financial statements were printed in full in March/April Naturalist.

Treasurer Mr David Dunn reported there was a heavy cost in replacing the Natural History Medallion but only a moderate increase to cost of printing the

(Continued on page 129)

Field Naturalists Club of Victoria

Established 1880

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron:
His Excellency Rear Admiral Sir Brian S. Murray, KCMG, AO.

Key Office-Bearers 1981-1982

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Secretary: Mrs. Sheila Houghton, 30 Golf Links Crescent, Dingley, 3172 (551 2708)
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Editor: Mr. R. WALLIS, Victoria College — Rusden Campus, 662 Blackburn Road, North Clayton, 3168 (544 8544)
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Excursion Secretary: Miss M. ALLENDER, 19 Hawthorn Avenue, Caulfield, 3161 (527 2749)
Book Sales Officer: Mr. D. E. McINNES, 129 Waverley Road, East Malvern, 3145 (211 2427)

Group Secretaries

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Day Group: C/- National Herbarium, The Domain, South Yarra, 3141
Geology: Mr. T. SAULT, C/- National Herbarium, The Domain, South Yarra, 3141
Mammal Survey: Mr. A. FAITHFUL, 67 Athelstan Road, Camberwell, 3124 (29 5108 A.H.)
Microscopical: Mr. M. H. MEYER, 36 Milroy Street, East Brighton (596 3268)
FNCV Kinglake Nature Reserve: McMahons Road, Kinglake
Booking and keys: Mr. I. F. MORRISON, 788 Elgar Road, Doncaster (848 1194)

MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1982

Metropolitan	$15.00
Joint Metropolitan	$18.00
Country Members and Retired Persons	$12.00
Joint Country and Joint Retired	$15.00
Junior	$3.00
Subscription to Victorian Naturalist	$13.00
Overseas Subscription to Victorian Naturalist	$15.00
Individual Journals	$2.20

All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary.

JENKIN BUXTON PRINTERS PTY. LTD., WEST MELBOURNE

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GENERAL MEETINGS

Monday, 9th August, 8.00 p.m.
Mr David Staples: Pycnogonidis — sea spiders.
Dr George Thomas and Mr J. L. Provan will be awarded Honorary Membership.
Monday, 13th September, 8.00 p.m.
"Dry forest". FNCV Groups.
Monday, 11th October, 8.00 p.m.
John Beumah. Eels.

New Members — July/August General Meetings.

Metropolitan
Tony Lathlal, 107 Cardigan St, Carlton South
Geoff Linnell, 11/10 Larbert Rd, Noble Park
Dennis Marsh, 11/59-61 Athelston Rd, Camberwell
Pamela Murray, 7 Agnes St, Beaumaris (Mosses, ferns)
Carl Rayner, 13 Judith St, East Keilor (Botany)
Andrew Read, 2 Bluehills Ave, Mt Waverley. (Botany, birds)
Kathy Spence, 18 Wewak Rd, Ashburton (Botany, microscopy)
Betty Trueman, 3/136 Windsor Cres, Mont Albert
Myra White, R.S.D., Arthur's Creek

Joint
I. L. & I. M. Barnett, P.O. Box 51, Yarra Glen
Richard & Jane Crow, 24 Diana St, Croydon
M. Green & family, 17 Jannali Drive, Dingley.
Nicholas & Marilyn Olliff, 7/241 Burke Rd, Glen Iris.
Cheryl & Andrew Wellington, 35 Kenilworth Rd, Ivanhoe. (Mammals)

FNCV EXCURSIONS

Sunday, 8th August, 10.30 a.m. to 4.30 p.m. Boneseed blitz at Studley Park. FNCV members are invited to join the Yarra Bend Park Trust and Kew Garden Club in removing boneseed from the Park. Our work in past years has had a marked effect and it is hoped as many as possible will assist even if they can only spare an hour. Meet at Hane's Bridge at 10.30 a.m. Bring a picnic lunch.

Saturday, 28th to Sunday, 29th August. Bendigo. This is a combined weekend with the VFNCA hosted by Bendigo FNC. Saturday afternoon there will be an excursion to the Whipstick. Saturday evening a meeting at the Department of Agriculture Regional Veterinary Laboratories, Echuca Rd, Epsom, about 5km out on the Epsom Rd. Sunday there will be a morning excursion. Members going in the coach party leave from the Gas and Fuel building in Flinders St at 8.30 a.m. and stay at A.N.A. Uptown Motel D.B.B. Cost for coach and accommodation $55.00 and should be paid to the Excursion Secretary by August 16th. Members going by private cars should meet at 12.45 p.m. at the Bendigo Post Office or 1.00 p.m. at the Veterinary Laboratories. The Ascot Lodge Caravan Park, Hine St, White Hill is closest to the meeting place for those who wish to camp.
Mr William Perry will be awarded Honorary Membership.

Sunday, 5th September. Botanic Gardens. Note change of venue. Meet at 10.45 a.m. at Gate D near the corner of Anderson St and Birdwood Avenue or after lunch by the kiosk at 1.00 p.m. This walk will be led by Miss M. Lester.

Thursday evening, 23rd September — Sunday morning, 10th, October. Western Australia. Meet at Airways Hotel Apartments, 195 Adelaide Terrace, Perth on Thursday evening where B & B accommodation has been booked. Details of the itinerary are in the March/April Naturalist but change Moora for Wongan and note most lunches are now included. Balance of $900.00 less deposit already paid should reach the Excursion Secretary by Monday, 9th August and bookings will be accepted until then.

Sunday, 3rd October. National Rhododendron Gardens at Olinda. The coach will leave Batman Ave at 9.30 a.m. Fare $7.50 plus entrance fee. Bring a picnic lunch.

Saturday, 13th — Sunday, 14th November. Ballarat. This weekend will include a ride in a horse-drawn cart to the Lal Lal area, limit 24 but a few horses are available at an extra cost if anyone wants to ride. Accommodation will be in a motel D.B.B. details later.

January, 15-21, 1983. Falls Creek.

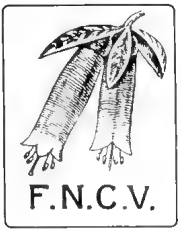
GROUP MEETINGS

FNCV members are invited to attend any Group meeting, no extra charge.

Day Group — Third Thursday.
Thursday, 19th August. Darebin Parklands. Meet at Darebin Station, 11.30 a.m. Eltham-Hurstbridge train departs Princess Bridge 10.55 a.m. Leader: A. Blackburn 379 8960.

Sunday 5 September. Cheltenham Park. Meet at Botanic Gardens (cnr Park St and Domain Rd.) at 11.30 a.m. or outside kiosk at Cheltenham Park at 1.15 p.m. Leader M. Lester.

(continued on inside back cover)



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Cover illustration: Excavation of Dunn's Rock — see "The Derrinal Permian Glacial Valley" by F. Robbins. This photo was taken from the same position looking south as that of Howitts' photo of Dunns Rock in Dunn (1892).

A Short History of the Discovery and Naming of Banksias in Eastern Australia

Part VI James Hamlyn Willis and Alexander S. George

BY A. I. SALKIN*

James Willis was Assistant Government Botanist in November 1962 when William Cane, a Maffra apiarist, and very well known naturalist drew his attention to a *Banksia* sp. growing in the upper Wellington River, East Gippsland. This proved to be a species that had not previously been described even though it had been collected on two previous occasions. It had been dismissed as an aberrant mountain form of *B. marginata*. Whilst *B. marginata* does have many forms and wide ecological tolerance the new species is distinct from *B. marginata* in two important ways. Firstly the cone is larger, no perianth parts are retained, and the follicles have a woolly tomentum. Secondly, the seed requires a cold period before it will germinate. It is probably because of the size of the cone that it was either not collected or not mounted on the herbarium sheet.

The first collection was the one of Mueller's already mentioned. The second collection was made from Kydra Peak in the Kybean Range in the vicinity of Cooma, New South Wales, and was made by R. H. Cambage in 1980. This collection contains both juvenile and adult leaves as well as an open flower spike and is held by the National Herbarium of New South Wales (n 77820). A small piece with leaves only is held at Melbourne.

Once the species had been confirmed as a distinct entity it was found to be much more widespread than had previously been thought.

The species is also recorded in Willis (1973) as possibly occurring in Tasmania. The Collection from Mt Fulton has been examined as well as other collections made from south-west Tasmania and it would appear that *B. canei* is now located only in the subalpine area east of Jamieson, Victoria, and south of Tumut in the Snowy Mountains, New South Wales. It should, however, be noted that there is considerable variation between these isolated colonies and this variation is described in Salkin & Hallam (1978).

Banksia canei was not the last species to be named in eastern Australia. In 1974 a project to produce a definitive work on the whole *Banksia* genus was begun. The first volume of this important work has now been published with full size water colour paintings of the flowers, foliage and fruits reproduced in colour. The extraordinary painstaking work of painting the intricacies of banksia flowers has been done by Mrs Celia Rosser who has been employed by Monash University as a botanical illustrator since 1970. The text is by Mr Alex George a botanist from the Western Australian Herbarium who is now the executive editor of the new "Flora of Australia" (George 1981 b). The first volume of "The Banksias" (Rosser & George 1981) contains the twenty-four *Banksia* spp. that were first discovered and two other volumes, one for 1985 and another for 1989 are to be published. The edition is limited to 720 copies and the size is 720 mm by 550

* Science Department,
Brentwood High School,
Heath Street,
Glen Waverley 3150.

mm. The cost is nearly $2,000 Australian (stg £965).

Whilst the work was proceeding with "The Banksias" Alex George published in Nuytsia, the journal of the Western Australian Herbarium, his long awaited revision of the genus *Banksia* (George 1981 a). Three new species are described for eastern Australia and variation in a number of named species is given varietal status.

Like *Banksia canei* all the species and varieties had been collected previously but what the revision does is to establish sound taxonomic reasons for the new classification.

The first of the newly described species is *Banksia saxicola*. This species is found only in two very widely different localities; the Grampians and Wilsons Promontory. The species had been collected on numerous occasions and described as *Banksia integrifolia*. Indeed Mueller himself had made collections from both the Grampians and Wilsons Promontory, the later collection he ascribed to *Banksia verticillata* indicating that he was aware of its unusual properties. *Banksia saxicolia* is in fact more closely related to *Banksia canei* than to the two above, the seed requiring a period of cold (stratification) before dormancy is broken and the seed will germinate. The flowering period is also the same as for *B. canei*.

The second new species is *Banksia conferta* and like *Banksia canei* was collected as early as the 15th of August 1906 by that indefatigable collector R. H. Cambage at the Walgan River in the Blue Mountains.

Two varieties of this species occur, the ones from Queensland where collections have been made in the Glasshouse Mountains and the Lamington Plateau have been named *Banksia conferta* var. *conferta*, and those from the Blue Mountains *Banksia conferta* var. *penicillata*.

George Althofer (pers. comm.) recalls his first encounter with *B. conferta* var *penicillata*:

"In 1961 I saw it when I first ascended Mt Darcy — I saw a remarkable plum coloured brush on a banksia, height of plant about 6'."

He saw it again in the early 1970's on the Newnes Track near Glen Davis while searching for *Prostanthera cryptandroides*.

The last new species to be described appears as an addendum to the main body of the revision. This is the "lost" species discussed in part five under Mueller, and is the species that Mueller did not describe sent by John Dallachy from Rockingham Bay. It was thought to be yet another species that had been eliminated from the Australian flora.

The species was rediscovered by F. D. Hocking on the upper slopes of Mt Bowen on Hitchinbrook Island in August 1979. A collection with leaves, flowers and a cone is in the Brisbane Herbarium.

In June 1981, Alex George received more material collected by Arthur and Margaret Thorsborne of Cardwell and M. Goodwin of the National Parks and Wildlife Service from Cairns. The species is closely related to *Banksia oblongifolia* Cav. (*B. aspleniifolia* Salisb.), but is distinguished by the obliquely triangular follicles and the bluish limb to the flower noted by Dallachy. The species is called *Banksia plagiocarpa*.

This completes as far as can be seen the discovery and naming of *Banksia* spp. in eastern Australia. One thing only remains and that is the changes from what were considered species to varieties.

It will be recalled that the first Oncostylis *Banksia* sp. to be described was *Banksia ericifolia*. This was collected by Banks and Solander at Botany Bay. This form differs markedly from the form

that is found in northern N.S.W. in coastal areas from the Tweed River just south of the Queensland border to the McLeay River just north of Kempsey. The form has larger flowers with deep red styles. Seedling leaves are smaller and have few if any separations. This form has been given the varietal status of *Banksia ericifolia* var *macrantha*.

Banksia ericifolia var. *ericifolia* is confined to coastal areas south of the McLeay River to as far south as Jervis Bay and inland in the Blue Mountains and the Budawang Range.

The so called *Banksia spinulosa* complex has been split into three varieties. The first described by Smith with a lignotuber and very revolute leaves is now known as *Banksia spinulosa* var. *spinulosa*.

The form described by Robert Brown as *Banksia collina* from north of the Hawkesbury River with flat entire or serrated leaves will be known as *Banksia spinulosa* var. *collina*. The form that grows in Victoria which Mueller named and Meissner published as *Banksia prinophylla* has been included with *Banksia cunninghamii* and the name that Sieber used to commemorate Alan Cunningham has been retained as the variety *Banksia spinulosa* var *cunninghamii*. This is the only variety of the *B. spinulosa* complex that grows in Victoria.

The last species where changes have been made is *Banksia integrifolia*. The coastal form that grows from Point Lonsdale in Victoria to Fraser Island in Southern Queensland is *Banksia integrifolia* var. *integrifolia*.

Robert Brown described and named a *Banksia* sp. he collected at Keppel Bay in north Queensland as *Banksia compar*, Bentham (1870) in his revision of the genus included it in *B. integrifolia*. The form has glossy undulate leaves and, unlike the coastal form in Victoria and N.S.W., the follicles invariably remain closed. The form occurs in northern Queensland as a coastal plant and is also found in southern Queensland and northern N.S.W. in the highlands. The variety was common on the New England Tablelands before clearing and is now mainly restricted to National Parks such as that in the Gibraltar Range. Brown's original name has been retained as a variety and the form will be known as *Banksia integrifolia* var. *compar*.

The last variety was originally collected by Dallachy and a specimen in the Melbourne Herbarium has a note from Dallachy to Mueller that reads "Mount Macalister; 3 April 1867; does this Banksia differ from the coast one (?); there is one that grows down somewhere here on the coast; if I can get it I will send it in flower".

Mueller thought it sufficiently different to name it as a new species, *Banksia caerulescens* but took no steps farther than placing slips with the two specimens sent by Dallachy. The form which has long narrow leaves, which are scattered rather than whorled, is given the varietal name of aquilonia meaning northern: *Banksia integrifolia* var. *acquilonia*.

It is now just over 200 years since the first *Banksia* species were named and 212 years since the first ones were discovered. Alex George's monograph resolves many of the complex problems of nomenclature but I suspect that this may not be the last word. I have recently heard of seed from *Banksia integrifolia* producing seedlings with very deep indentations and William Cane, that noser-out of new species, has recently shown me a plant with a lignotuber and leaves like *Banksia integrifolia* from southern Queensland. Graeme O'Neil of C.S.I.R.O. Canberra reports a similar plant from northern Queensland, but this, after all, is the nature of science; everything that is published is sooner or later out of date and all we can do is record the milestones along the way.

Table 1

Eastern Banksia Species in order of Publication			Location
1.	1781	*B. serrata* L.f.	Tas. Vic. N.S.W. Q.
2.	1781	*B. integrifolia*, L.f. var. *integrifolia* A. S. George	Vic. N.S.W. Q.
3.	1781	*B. ericifolia*, L.f. var. *ericifolia*, A. S. George	S. N.S.W.
4.	1781	*B. dentata*, L.f.	N.Q.
5.	1793	*B. spinulosa*, Smith var. *spinulosa*, A. S. George	N.S.W. Q.
6.	1800	*B. oblongifolia*, Cav. syn. *B. aspleniifolia* Salisb.	N.S.W. Q.
7.	1800	*B. robur*, Cav.	N.S.W. Q.
8.	1800	*B. marginata*, Cav.	S.A. Tas. Vic. N.S.W.
9.	1810	*B. aemula*, R. Br syn. *B. serratifolia*, Salisb.	N.S.W. Q.
10.	1810	*B. collina*, R. Br. *B. spinulosa* var. *collina* A. S. George	N.S.W. Q.
11.	1810	*B. compar*, R. Br. *B. integrifolia* var *compar* A. S. George	N.S.W. Q.
12.	1810	*B. palludosa*, R. Br	Vic.* N.S.W.
13.	1827	*B. cunninghamii*, Sieber ex Reichb *B. spinulosa* var. *cunninghamii* A. S. George	Vic. N.S.W.
14.	1853	*B. ornata*, F. Meier ex Meissner	S.A. Vic.
15.	1967	*B. canei*, J. H. Willis	Vic. N.S.W.
16.	1981	*B. conferta* var. *conferta*, A. S. George	Q.
17.	1981	*B. conferta* var. *penicillata*, A. S. George	N.S.W.
18.	1981	*B. saxicola*, A. S. George	Vic. (Grampians, Wilsons Promontory)
19.	1981	*B. ericifolia* var. *macrantha*, A. S. George	N. N.S.W.
20.	1981	*B. integrifolia* var. *aquilonia*, A. S. George	N. Q.
21.	1981	*B. plagiocarpa*, A. S. George	Mt Bowen Hinchinbrook Island.

* Howe Range Vic., W. Cane.

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A Record of *Thomisus spectabilis* Dolesch 1859 (Araneida: Thomisidae) Feeding on a Scarab Beetle.

By T. J. Hawkeswood*

Little has been documented on the food of Australian spiders, although it is generally known that many native spiders commonly feed on other spiders, soft-bodied insects (including flies, butterflies and moths), while some large spiders (e.g. Theraphosidae) may attack and feed on small reptiles, amphibians and birds.

This note records one observation of a thomisid spider, *Thomisus spectabilis* Dolesch (Araneida: Thomisidae) feeding on the fluids of a cetonid beetle, *Cacochroa decorticata* (Macleay) (Scarabaeidae: Cetoniinae) at Townsville, north Queensland on 23 November, 1981.

The Thomisidae are a large group of spiders occurring throughout the world. Australia has about 112 species (Musgrave, 1965, p. 239), although the number of known species will probably be higher when the tropical species are fully studied. A majority of spiders belonging to this family are characterized by having legs (the first two pairs of which possess ventrally paired spines), which are able to move forwards or sideways (i.e. laterigrade), in a manner similar to that of crabs; hence the popular vernacular name of "crab spider" for the group. Thomisid spiders do not construct a web, but rely on concealment, attractive coloration or resemblance (mimicry) to their prey, in order to capture their prey (Clyne, 1969). This has resulted in a myriad of forms and colours amongst the Thomisidae. A majority of the light-coloured species await in ambush at the centres of flowers, below petals and whole inflorescences, tips of leaves etc., with their anterior legs extended typically sideways and forward to form a half circle (Clyne, 1969).

The sub-family Misumeninae, to which most of the Australian species belong, are characterized by having legs I and II much longer and thicker than the two posterior pairs with leg II being slightly longer than leg I. These are adaptations for capturing prey whilst resting on their ambush sites.

There is only one species of *Thomisus* Walckenaer in Australia (Clyne, 1969, p. 59; Mascord, 1970, p. 48), namely *T. spectabilis* Dolesch. The genus is found in warmer latitudes of the world and also occurs from India to New Guinea (Clyne, 1969, p. 59). *Thomisus spectabilis* (Fig. 1) is a slow-moving, medium-sized spider which prefers to wait in ambush on pale yellow or white flowers. It is characterized by having a triangular abdomen which is broadly truncate behind and a broad cephalothorax extended laterally above the clypeus into two horns (Clyne, 1969). Musgrave (1965, p. 232a) illustrates the species in colour (as *T. pustulosus*). Clyne (1969, p. 112) and

Fig. 1. *Thomisus spectabilis* Dolesch (Araneida: Thomisidae). Bar indicates 5 mm. (Photograph by P. Finch).

* 23 Luya Street, Fairfield, Brisbane, Queensland, 4103.

Mascord (1970, p. 49) also illustrate in colour, females of *T. spectabilis*. Mascord (1970, p. 48) notes that the males are smaller than the females (♂, c. 6.2 mm, ♀, c. 10 mm, body length) and that the species feeds on other spiders and other small insects.

Whilst observing insects feeding on open flowers of *Acacia bidwillii* Benth. (Mimosaceae) on 23 November 1981, I noticed a large female of *T. spectabilis* which had captured a male of the cetonid beetle *Cacochroa decorticata* (Macleay). The spider was clinging to the top of an *Acacia* inflorescence, 1.5 m above the ground, by the two posterior pairs of legs and was grasping the beetle around the head and pronotum with the two pairs of anterior legs. The beetle was dead and dangling, abdomen downwards, with the functional wings unfolded beneath the elytra. The spider was apparently feeding on the muscular tissue between the head and thorax. Unfortunately I did not have a camera in order to take a field photograph, so the predator and prey were captured for later identification and photographed in the laboratory.

Cacochroa decorticata (Macleay) (Fig. 2) is one of the more common species of beetle visiting the flowers of *Acacia bidwillii* at Townsville (Hawkeswood, pers. obs.). It is a wary beetle and usually flies away rapidly at the least disturbance. *C. decorticata* is a distinctive black beetle, measuring 1.2-1.5 cm in body length, with the sides of the pronotum in the male white and with pale yellow to cream blotches on the elytra. Macleay (1862, p. 17) first described this insect from Port Denison (Bowen) in north Queensland. Lea (1914, p. 140) recorded the species from Queensland only. Nothing has been written on its biology.

It is remarkable that the spider was able to capture and kill such a large and strong flying beetle as *C. decorticata* without allowing the beetle to escape. I have recorded the jewel beetles (Buprestidae) *Stigmodera (Castiarina) picta* L. & G. (Hawkeswood, 1980) and *Cisseis scabrosula* Kerremans (Hawkeswood, 1981) as prey for two spiders (*Araneus* sp., Araneidae and *Uloborus* sp., Uloboridae, respectively), but in these cases, the prey was smaller than the spiders.

Fig. 2. *Cacochroa decorticata* (Macleay) (Coleoptera: Scarabaeidae). Bar indicates 5 mm. (Photograph by P. Finch).

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Density Estimates of Three Herbivores on Rotamah Island, Gippsland.

By J. A. Raines*

Introduction

Rotamah Island is a 260 hectare island within the Lakes National Park, Gippsland Lakes, Victoria. It is connected to the Ninety Mile Beach dune system by a 30 metre long, vehicular causeway. Sheep and cattle were grazed on the island up until February 1975. During this period much of the area was cleared and several pasture plants, including *Trifolium*, *Dactylis* and *Bromus* were established. In 1975, Rotamah was purchased by the National Parks Service of Victoria. Domestic stock were removed and farming practices discontinued. In consequence, the vegetation is changing and now comprises 53% open woodland, including open grassy areas, 23% *Banksia-Eucalyptus* forest, 6% samphire flats and 12% *Melaleuca* scrub (Buchenroth, unpub.; Burbidge and Raines, 1982). In 1980 Rotamah Island Bird Observatory was established by the Royal Australasian Ornithologists Union, for teaching and research purposes.

Swamp Wallabies *(Wallabia bicolor)* and Hog Deer *(Axis porcinus)* are often sighted on the island, but their populations are much smaller than that of the Eastern Grey Kangaroo *(Macropus giganteus)*. Large numbers of kangaroos are seen every day, particularly in the open woodlands where they feed in the morning and late afternoon (Burbidge and Raines, 1982). It is not known if the kangaroo population is increasing. If this population does increase it may (1) effect changes in the structure of the plant community, (2) cause a loss of condition amongst the kangaroos themselves, by competing with each other for food, space and other resources, or (3) compete more strongly with the other herbivores on the island. Clearly it would be of interest to monitor the composition of both the vegetation and the herbivore populations over a period of time.

In October 1981 a survey was conducted to determine the size of the populations of large herbivores on Rotamah Island. The aim of this count was to provide some data against which future counts can be compared.

Methods

A straight line was formed by 30 people approximately 20 metres apart at the western end of the island. This line slowly advanced along the island and all the Hog Deer, Swamp Wallabies and Grey Kangaroos were counted. Each person recorded the animals on his or her right hand side as they passed behind the line. Verbal contact between adjacent persons facilitated the detection of all animals, even in dense vegetation, and enabled a straight line to be maintained. The count took 4.5 hrs. During this time the line halted at two points on the island so that the group could visually realign themselves. One person stood at the causeway to count the animals which passed across it.

Results

Rotamah Island is supporting a very large population of Grey Kangaroos and smaller numbers of Hog Deer and Swamp Wallabies (Table 1.). Although most observers were able to accurately

* Rotamah Island Bird Observatory. Box 75, Paynesville, Vic. 3880.

Species	Number counted	Number per hectare
Grey Kangaroo*	438 ± 11	1.6
Swamp Wallaby*	27 ±11	0.1
Hog Deer	50	0.2
Total	515	2.0

* Not including pouch young.

Table 1: Number of individuals and densities of three large herbivores on Rotamah Island, October 1981.

distinguish wallabies and kangaroos a few were less confident with some of their identifications. By talking to each observer this source of error was taken into account. The estimation of wallabies and kangaroos may have had an error of up to 11 individuals. This count did not include pouch young.

Discussion

The presence of "improved" pasture and the availability of artificial fresh water supplies, has probably favoured the kangaroo population of Rotamah Island, leading to a high density of individuals. Since kangaroos feed almost entirely in the open woodlands (Gaines, unpub.) and this habitat constitutes only 53% of the island's vegetation, this large population is being supported by 138 ha of feeding area (3.2 kangaroos/"feeding hectare"). The kangaroo population may not necessarily be static, since incidental sightings and tracks indicate that there is movement across the causeway.

One large herbivore not included in this count was the Common Wombat *(Vombatus ursinus)*, but a population survey is planned for 1982. Another species which will also need to be considered in the future is the Rabbit *(Oryctolagus cuniculus)*. The introduction of myxomatosis by the National Parks Service in nearby areas is thought to have reduced the rabbit population of Rotamah Island. However, over the past two years the population has grown as indicated by the increasing number of incidental sightings (Burbidge, pers. comm.).

The effect that the kangaroo population is presently having on the other herbivores is unknown. The preferences and quantities of foods consumed by the herbivores on Rotamah have not been investigated. However, competition is not so severe as to be causing a lack of condition in any of these species as judged by their general appearance, the condition of their coats and the number of young born this year. In the future, counts will be combined with an assessment of movement across the causeway, in order to follow any changes that may occur in the composition of the herbivore populations. It would also be of interest to monitor any vegetative changes to determine whether the kangaroos are affecting the regenerating vegetation.

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Notes on Winter-active Invertebrates Beneath the Snow

By K. Green*

Summary

Two subnivean (below snow) pitfall traps were examined in August 1981 in the alpine region of Kosciusko National Park. Thirteen invertebrate specimens were obtained from four classes: Insecta, Collembola, Arachnida and Symphyla. One class, Symphyla, is an addition to previously known active subnivean fauna, along with two insect orders, Lepidoptera and Blattodea, and two families of Coleoptera (Leiodidae and Melandryidae).

Introduction

It is commonly believed in Australia and elsewhere that where snow lies throughout winter, invertebrates enter diapause and only become active again when the snow thaws. In the past 20 years, however, techniques have been developed to study subnivean (below snow) activity of invertebrates and a number of studies have shown that many invertebrates are active beneath the snow (Aitchison 1974). These include spiders (Araneida), mites (Acari), springtales (Collembola), bugs (Homoptera), beetles (Coleoptera), flies (Diptera) and wasps (Hymenoptera).

In Australia prolonged periods of snow cover are restricted to subalpine and alpine altitudes which, in New South Wales, occur above altitudes of about 1530 m and 1830 m respectively and cover approximately 2500 sq km (Costin *et al.* 1979).

Methods

The results presented here were obtained during a study of small mammal predation on invertebrates. The study area was in the vicinity of South Ramshead, Kosciusko National Park. Two study sites were investigated, one just below the treeline at 1850 m and the other above the treeline at 2000 m.

Twenty pitfall traps of 7 cm diameter were set at each site in January and February 1981. The fixative used in the pitfall traps was composed of 5 parts propylene phenoxytol, 4.5 parts propylene glycol and 50 parts formalin in 900 parts of water (Upton and Norris 1980). Delays in erecting vertical pipes to allow continued winter access through the snow to the pitfall traps, coupled with heavy snow in the winter of 1981, made it impossible to regularly monitor the traps.

In early August when the snow was approximately 130 cm deep in the subalpine site and 100 cm deep in the alpine site, 5 pitfall traps were excavated. Of these, 3 were in the subalpine site and 2 were in the alpine site. Special care was taken as the excavation approached the subnivean space (a space between the soil and the snow), and digging at this stage proceeded by hand. The 5 pitfall traps were emptied and reset. Snow blocks were used to seal the shaft into the subnivean space, and the hole was filled with loose snow.

By late August a further 50 cm of snow had accumulated on the subalpine site, burying the pegs that marked the pitfall traps. Snow depth in the alpine site, however, did not increase markedly as wind kept extra snow from accumulating.

Only two pitfall traps were therefore recovered, and the results represent the accumulation in these two alpine pitfall traps over a 4 week period.

* Department of Zoology
Australian National University
PO Box 4
Canberra, ACT, 2600

Table 1. Invertebrates collected from subnivean pitfall traps.

Insecta
- Coleoptera
  - Carabidae *Pterocyrtus* sp. nr *traucaticollis* Sloane
  - Leiodidae *Austronemadus* sp.
  - Melandryidae *Orchesia* sp.
- Hemiptera: Homoptera
  - Cicadellidae *Austrolopa* sp.
- Lepidoptera
  - Psychidae *Narycia* sp. (larva)
- Blattodea
  - Blattellidae Genus and species unknown

Collembola
- Neanuridae *Womersleymeria* sp. n. nr. *bicornis*

Arachnida
- Oribatidae Genus and species unknown

Symphyla
- Scutigerellidae
  - *Hanseniella* sp.

Results

Due to the very small number of pitfall traps examined the results presented here can only be considered as indicative of a possible wider range of active subnivean invertebrates.

Thirteen specimens were collected from the pitfall traps. These were from 4 classes: Insecta (10 specimens), Collembola (1), Arachnida (1) and Symphyla (1) (Table 1).

Discussion

Aitchison (1979b) found representatives of five families of Coleoptera active in winter beneath the snow. In order of abundance these were Staphylinidae, Carabidae, Lathridiidae, Cantharidae and Erotylidae. Staphylinidae were also the most numerous of the subnivean Coleoptera fauna in Germany (Heydemann 1956). This study failed to show the presence of Staphylinidae, due possibly to the extremely small sample size; however, the Carabidae were represented by one species. Two families, Leiodidae and Melandryidae, have been added to the list of winter-active subnivean Coleoptera.

The Cicadellid *Austrolopa* sp was found swimming in a pitfall trap when it was first excavated on August 1. Leafhoppers are well known for their ability to remain active at temperatures below 0°C in unfrozen leaves (Holmquist 1926). Aitchison (1978) collected 2 species of Cicadellidae from subnivean pitfall traps in Manitoba.

To my knowledge, the capture of *Narycia* sp is the first record of subnivean activity by Lepidoptera and the Blatellid is the first capture of a subnivean cockroach. This cockroach is very active beneath the snow commonly occurring in and around subnivean mammal traps throughout winter.

Although activity of Acari at low temperatures has not been well documented, Aitchison (1979c) found mites of 8 families to be the most abundant winter active subnivean group in Manitoba over two winters.

Collembola are generally abundant and species rich in alpine habitats (Agrell 1941; Fjellberg 1975), and Aitchison (1979a) stated that they may form the base of the food chain for subnivean invertebrate predation. Collembolans were commonly trapped in both the alpine and subalpine sites during the summer and autumn. The finding of only one specimen in winter traps probably reflects the small sample size.

The specimen of Symphyla also represents the first subnivean capture of a member of this class.

The finding of active subnivean invertebrates in the Australian high country poses many questions regarding behavioural, physiological and especially metabolic adaptations to subnivean conditions and whether these adaptations are similar to those possessed by

invertebrates in the northern hemisphere.

Future work in the winters of 1982 and 1983 involving monthly monitoring of subnivean pitfall traps should add to the list presented here of Australian active subnivean invertebrates and give a better indication of abundance and the role these invertebrates play in the diet of the marsupial insectivores of the genus *Antechinus* at high altitudes.

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F.N.C.V. Council Meeting 29 June 1982

Amendment of By-laws. By resolution of Council the By-laws were amended as follows: By-law 10. Deleted. By-law 11. Reprints of any papers or articles contributed to The Victorian Naturalist may be requested by the author, who shall be required to contribute to the cost of production; the amount to be set by the Council. Applications shall be made to the editor.

A Checklist for Studley Park and Yarra Bend Reserves

By Sue McIntyre* and Jeffrey Yugovic†

Studley Park is situated on the east bank of the Yarra River at Kew, four kilometres north-east of the Melbourne GPO. It encompasses a series of steep spurs of folded Paleozoic sediments overlooking the meandering river. An extensive Newer Basalt plain lies to the west.

Reserved in 1877, the park was unusual in its day as little modification of the original vegetation was attempted. This was partly in order to preserve the local bush scenery and partly because the steep infertile terrain discouraged development. As a venue for recreational pursuits and as a place of considerable scientific interest, the park gained immense popularity with the Melbourne citizenry. The adjacent Yarra Bend Reserve, situated on the basalt plain, was extended to include Studley Park in 1934 and the total area of over 120 ha. officially became the Yarra Bend Park. Thus the area was never raised to formal national park status, despite it being known as the "Yarra Bend National Park" since the early part of this century.

Today, several areas of the Yarra Bend Park retain something of their former character despite the encroachment of a motor boulevard, a major arterial road, two golf courses and a freeway. The park still supports eucalypt woodland formations similar to those described by Hardy in 1911, with River Red Gum growing on the river banks and lower slopes and Yellow Gum on the spur tops and slopes. Yellow Box is occasional on the upper slopes whilst Manna Gum has restricted occurrences on the moister southern aspects.

* CSIRO Div. of Irrigation Research, Griffith, NSW 2680.
17 Kingston St., Hampton, Vic. 3188.

The floristics of the understory have changed dramatically in over one hundred years of weed invasion. More than 130 exotic species have been recorded within the park (J. H. Willis, unpublished), including many aggressive weeds e.g., Veldt Grasses (*Ehrharta longifolia* and *E. erecta*), Blackberry and Boneseed. There are a number of factors contributing to the establishment of exotics in the park: grazing by stock (long ceased), rabbit infestations, dumping of garden refuse, soil disturbance and damage to existing vegetation. Understandably the native flora has suffered and only small areas of relatively intact vegetation persist. The understory is best preserved in those areas furtherest from human disturbance on the drier aspects of the spurs. Moist southern slopes as well as river banks and flats have largely succumbed to vigorous invasion by exotic herbs, shrubs and trees.

A checklist of the flora of the Yarra Bend Park was compiled by J. H. Willis in 1973 (unpublished), being a collation of surveys made by S. Hannaford (1856), F. Reader (1885 a, b), J. H. Willis (1943) and others. A total of 205 native vascular species have been recorded in the park since 1856. The checklist presented here is based on a survey conducted by the authors in 1978-81 and comprises 118 indigenous vascular species. It is regrettable that so many of the original species could not be relocated and that among the survivors are species known only from one or a few specimens. Some of the species now absent were representatives of vegetation types which no longer exist in the area. A heath woodland outlier of the Sandringham Flora occurred on the Brighton Group sands and gravels which cap the broad hill to the east and which

are included in the park at two localities. The basalt plain to the west of the river supported grassland flora. Landworks and buildings have rendered these areas unrecognizable.

Of interest, are several new records for the park. *Acianthus reniformis* and *Thelmyitra pauciflora* are the first orchids to be recorded since 1885 when *Diuris maculata* and *Pterostylis curta* were last observed. *Pomaderris racemosa* is known from only one specimen growing near the river and may have recently become established from seed washed downstream by floodwaters. *Burchardia umbellata*, *Acacia longifolia* (one specimen, possibly planted), *Solanum laciniatum*, *Danthonia setacea* and *Wahlenbergia quadrifida* were either overlooked by earlier observers, are new to the park or records of their discovery have been lost.

The Studley Park Red Gum (*Eucalyptus studleyensis* Maiden) was previously recorded only from a group of four trees growing near the former police station in Studley Park. Progeny trials have established the hybrid origin of these trees (*E. camaldulensis* X *E. ovata*) and herbarium specimens show characters which are intermediate between the parental species. Efforts to relocate the original trees have been unsuccessful (J. H. Willis, pers. comm.) so it is pleasing to report the discovery of a single specimen growing on the 9-Hole Golf Course. Also of note is the record of *Lissanthe strigosa* (Peach Heath). The isolated occurrence of this plant attracted the attention of members of the F.N.C.V. early this century. Their interest lead to the construction of a fence to protect the only known specimens in the park (Hardy 1911). The single patch of heath remains today, although no remnants of the fence can be found.

Management for the Future

The deterioration of the Yarra Bend Park highlights the problems facing all urban bushland reserves. The combination of small size and heavy usage makes them especially vulnerable to weed invasion and subsequent displacement of the native flora. Without sensitive manage-

Fig. 1. Yarra River and fringing reserves.

ment, these reserves have little chance of remaining viable.

Hand pulling of weeds is an effective method of control for certain species. The authors have experienced some success in controlling *Ehrharta longifolia* using this method at Studley Park. Eradication of Boneseed is possible if hand pulling is undertaken following a fire as burning promotes almost 100% germination of soil seed Lane (1976). Such labour intensive activity calls for community involvement along the lines of the annual "Boneseeding" days organised by members of the F.N.C.V. and the Kew Garden Club.

Another important feature of management is the choice of species for restoration of damaged areas. It is impossible to retain the authentic character of local vegetation if "exotic natives" are planted i.e. species not growing naturally in an area. Ideally, specimens growing on, or near, the reserve would be used as sources of propagating material, thus promoting the survival of ecotypes adapted to the particular locality.

Urban bushland reserves are valuable public assets with a significance as museums of local natural history that is all too often unrecognized by the community. The once famous Sandringham Flora and extensive basaltic grasslands are now reduced to very small pockets with their accompanying hazards. We cannot allow these isolated reserves to become wastelands of neglect.

Acknowledgements

We would like to thank Mr Bruce Muir of the National Herbarium for his encouragement in writing this article, and for his help with the identification of plants. We would also like to thank Dr J. H. Willis for his freely given assistance.

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INDIGENOUS VASCULAR PLANTS FOUND IN THE YARRA BEND PARK 1978-1981

PTERIDOPHYTA
DENNSTAEDTIACEAE
Pteridium esculentum
Austral Bracken
ADIANTACEAE
Cheilanthes tenuifolia
Rock Fern

SPERMATOPHYTA
MONOCOTYLEDONS
JUNCAGINACEAE
Triglochin procera
Water Ribbons
ALISMATACEAE
Alisma plantago-aquatica
Water Plantain
POACEAE
Microlaena stipoides
Weeping Grass
Agrostis avenacea
Blown Grass
Poa australis
Tussock Grass
Phragmites australis
Common Reed
Cynodon dactylon
Couch Grass
Danthonia caespitosa
Bristly Wallaby-grass
D. geniculata
Kneed Wallaby-grass
D. purpurascens
Wallaby-grass
D. setacea
Common Wallaby-grass
D. racemosa
Wallaby-grass

Stipa elegantissima
Feather Spear-grass
S. semibarbata
Fibrous Spear-grass
S. variabilis
Variable Spear-grass
Echinopogon ovatus
Hedgehog Grass
Themeda australis
Kangaroo Grass

CYPERACEAE
Scirpus nodosus
Knobby Club-rush
Schoenus apogon
Common Bog-rush
Lepidosperma laterale
Variable Sword-sedge

JUNCACEAE
Juncus subsecundus
Finger Rush
Luzula flaccida
Field Woodrush

LILIACEAE
Lomandra filiformis
Wattle Mat-rush
L. longifolia
Spiny-headed Mat-rush
Dichopogon strictus
Chocolate Lily
Tricoryne elatior
Yellow Rush-lily
Dianella laevis
Pale Flax-lily
D. revoluta
Black-anther Flax-lily
Wurmbea dioica
Early Nancy
Burchardia umbellata
Milkmaids

ORCHIDACEAE
Thelymitra pauciflora
Slender Sun-orchid
Acianthus reniformis
Mosquito Orchid

DICOTYLEDONS
CASUARINACEA
Casuarina littoralis
Black She-oak
C. stricta
Drooping She-oak

SANTALACEAE
Exocarpus cupressiformis
Cherry Ballart
E. strictus
Pale-fruit Ballart

LORANTHACEAE
Muellerina eucalyptoides
Creeping Mistletoe

POLYGONACEAE
Rumex brownii
Slender Dock
R. bidens
Mud Dock
Polygonum minus
Slender Knotweed
P. subsessile
Hairy Knotweed

CHENOPODIACEAE
Rhangodia hastata
Saltbush
R. nutans
Nodding Saltbush
Atriplex semibaccata
Berry Saltbush
Enchylaena tomentosa
Barrier Saltbush

AIZOACEAE
Carpobrotus modestus
Inland Pigface
Disphyma clavellatum
Rounded Noon-flower

CARYOPHYLLACEAE
Spergularia rubra
Red Sand-spurry
Stellaria pungens
Prickly Starwort
Sagina procumbens
Spreading Pearlwort

RUNUNCULACEAE
Clematis microphylla
Small-leaved Clematis

LAURACEAE
Cassytha melantha
Coarse Dodder-laurel

BRASSICACEAE
Lepidium hyssopifolium
Common Pepper-cress
Rorippa palustris
Yellow Marsh-cress

CRASSULACEAE
Crassula macrantha
Spreading Crassula
C. sieberiana
Sieber Crassula

PITTOSPORACEAE
Bursaria spinosa
Sweet Bursaria

ROSACEAE
Rubus parvifolius
Small-leaved Bramble

Acaena anserinifolia
Bidgee-widgee
A. ovina
Sheep's Burr

MIMOSACEAE
Acacia acinacea
Gold-dust Wattle
A. paradoxa
Hedge Wattle
A. dealbata
Silver Wattle
A. implexa
Lightwood
A. longifolia var. sophorae
Coast Wattle
A. melanoxylon
Blackwood
A. phycnantha
Golden Wattle

FABACEAE
Platylobium obtusangulum
Common Flat-pea
Bossiaea prostrata
Creeping Bossiaea
Indigofera australis
Austral Indigo
Kennedia prostrata
Running Postman
Hardenbergia violacea
Purple Coral-pea

GERANIACEAE
Geranium solanderi
Austral Crane's-bill

OXALIDACEAE
Oxalis corniculata
Yellow Wood-sorrel

LINACEAE
Linum marginale
Native Flax

SAPINDACEAE
Dodonea cuneata
Wedge-leaf Hop-bush

RHAMNACEAE
Pomaderris aspera
Hazel Pomaderris
P. racemosa
Pomaderris

MALVACEAE
Gynatrix pulchella
Hemp Bush

HYPERICACEAE
Hypericum gramineum
Small St. John's Wort

VIOLACEAE
Hymenanthera dentata
Tree Violet

THYMELACEAE
Pimelea curviflora
Curved Rice-flower
P. humilis
Common Rice-flower

MYRTACEAE
Eucalyptus camaldulensis
River Red Gum
E. leucoxylon
Yellow Gum
E. melliodora
Yellow Box
E. ovata
Swamp Gum
E. viminalis
Manna Gum
E. X studleyensis
Studley Park Red Gum
Leptospermum obovatum
River Tea-tree
Melaleuca ericifolia
Swamp Paperbark

HALORAGACEAE
Gonocarpus tetragynus
Common Raspwort

EPACRIDACEAE
Lissanthe strigosa
Peach Heath

CONVULVULACEAE
Convulvulus erubescens
Blushing Bindweed
Dichondra repens
Kidney-weed

SOLANACEAE
Solanum laciniatum
Kangaroo Apple
Nicotiana suaveolens
Austral Tobacco

MYOPORACEAE
Myoporum viscosum
Sticky Boobialla

SCROPHULARIACEAE
Veronica gracilis
Slender Speedwell

PLANTAGINACEAE
Plantago varia
Variable Plantain

RUBIACEAE
Coprosma quadrifida
Prickly Currant-bush
Asperula conferta
Common Woodruff
Galium gaudichaudii
Rough Bedstraw

CAMPANULACEAE
Wahlenbergia communis
Tufted Bluebell
W. quadrifida
Sprawling Bluebell

GOODENIACEAE
Goodenia ovata
Hop Goodenia

ASTERACEAE
Vittadinia triloba
New Holland Daisy
Olearia ramulosa
Twiggy Daisy-bush
Cassinia arcuata
Drooping Cassinia
C. longifolia
Shiny Cassinia
Helichrysum bracteatum
Golden Everlasting
H. semipapposum
Clustered Everlasting
Helipterum australe
Common Sunray
Cotula australis
Common Cotula
C. coronopifolia
Water Buttons
Senecio hispidulus
Fireweed
S. quadridentatus
Cotton Fireweed

List compiled by Jeffrey Yugovic and Sue McIntyre

Names used as in;
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Day Group Celebrates a Decade of Activities

Ninety-five outings to fifty-eight different places of interest — and only one cancellation following some days of rain!

The Day Group celebrated ten years of activity on 18 March, by courtesy of the Authority, aboard the launch m.v. "Commissioner" for our third tour of the Port of Melbourne, a popular outing. The party included two of the thirteen Club members who attended the inaugural meeting on 22 March, 1972 — president Alf Fairhall and vice president Dan McInnes — and six other regulars from the first year of the Group.

Average attendance over the period has been 17 — the largest outing 35 and the smallest five; and approximately 160 Club members have been involved. A number of visitors have accompanied us, quite a few from overseas, and new members for the F.N.C.V. have resulted.

The formation of this Group for retired, leisured members and those unable to attend evening meetings was the idea of our president, and much of its success is due to his enthusiasm and to the support and planning of the late Mrs Peg Strong, secretary for the first four years.

Most outings are within the metropolitan area and accessible by public transport, and some new areas are visited each year. New members are welcome.

The Derrinal Permian Glacial Valley
Part 1

BY FRANK ROBBINS*

Foreword. This is the beginning of a series recording recent discoveries by F. Robbins, H. E. Wilkinson, and J. Kellam of the Bendigo Field Naturalist Club since 1957 in the Permian Glacial area between Bendigo and Heathcote.

The only previously published accounts of our work were two articles in the *Bendigo Naturalist* (Vol. 6.1, 1973; Vol. 6.2 1973) on Kellams† Rock and Dunns Rock, brief references in *Geology of Victoria* (1976) (Geol. Soc. of Australia — Permian chapter), and an abstract in Gondwana Five (5th International Gondwana Symposium in Wellington N.Z. 1980).

The author attended this symposium, and maps, diagrams and photos to be shown in this series were displayed there.

This series is complementary to the original Gondwana Five abstract, and is intended to give future workers some precise details of the numerous features discovered, notably the numerous glacial pavements.

E. J. Dunn (1892) had represented the glacial deposits as filling a N-S glacial valley in the Ordovician rocks which form the basement between Bendigo and Heathcote. Subsequent mapping of these indicated a series of N-S faults based mainly on fossil evidence. As these rocks are tightly folded on N-S axes, it would be natural to infer that the glacial deposits were preserved by downfaulting i.e. in a graben.

Our discovery of numerous glacial pavements along both E and W boundaries, and on Ordovician inliers indicates that this was not so. Our conclusion is that the Permian glacials are in a long wide glacial valley, which we have called The Derrinal Permian Glacial Valley.

This gives a new picture of a wonderful exhumed Permian subglacial topography, especially along the E-W edges and on the Ordovician inliers. The N-S faults are thus pushed back into pre-Permian times.

* 87 MacKenzie St
Bendigo, Vic. 3550

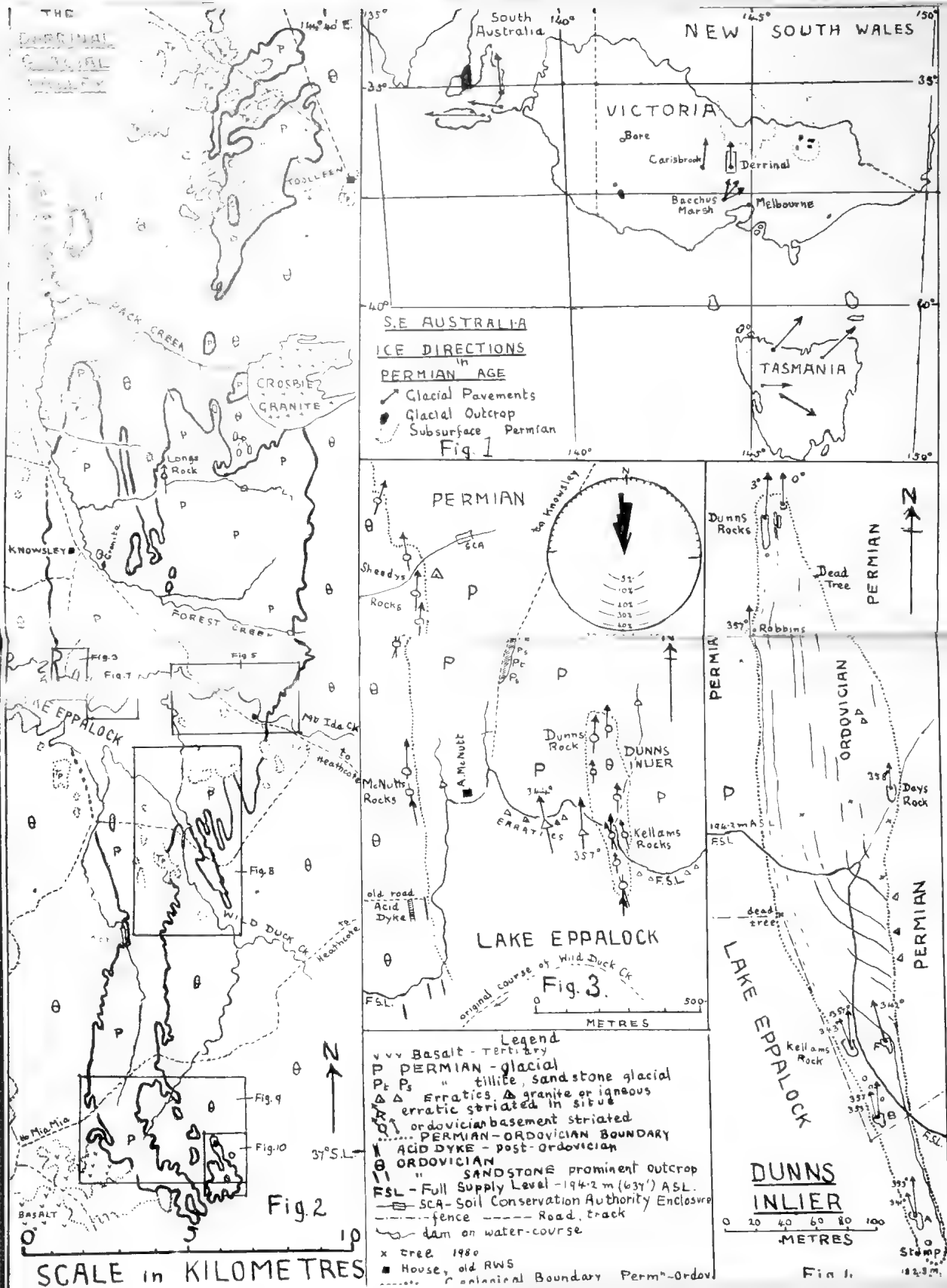
†The following sites are now written without the apostrophe — Dunns, Kellams, Days, Allens, McNutts, Sheedys, Edmunds.

Introduction

Our special interest in this glacial area arose in the formation in 1945 of the Bendigo Field Naturalist Club (BFNC), which included it in its field trips. Information available was limited to Parish Plan geology maps of:— Weston (1930), Knowsley (1930 — published 1956) by J. J. Caldwell; Heathcote (1940), Crosbie (1940), Knowsley East (1941), Langworner (1941) by D. E. Thomas. No explanatory notes were published with these maps. E. J. Dunn — Special Report Dept. of Mines — notes on the Glacial Conglomerate, Wild Duck Ck. (1892) — was the only general paper on this glacial area. R. L. Bowen, a Fulbright scholar, spent some time in the area in the 1950's, and left a detailed unpublished thesis dated May 1959 in the Melbourne University Baillieu library, but I did not learn about Bowen and his paper till late 1967.

It was natural to assume that, after 60 years, there would be little left to be discovered in the area, but two events were soon to alter this. In the 1950's, a new lake was to be created right across the central glacial area (Lake Eppalock), and D. E. Thomas had expressed an opinion that the "famous" glacial pavement of Dunn was not such, but a slickenside on an anticlinal axis. The latter was widely quoted, and accepted in subsequent literature. I disagreed with this opinion.

I checked that Dunns Rock would not be inundated, but, that a second large glacial pavement (which we called Kellams Rock) would be inundated several metres below F.S.L. (Full Supply Level — 194.2m or 637 feet A.S.L.), so also would be much of the lower Moorabbee glacial sandstone cliffs area. I photographed both Dunns and Kellams Rocks in Jan. 1957, and meanwhile the Eppalock Dam and Reservoir were under construction. The water began rising and I again photographed small excavations on both Dunns and Kellams Rocks on 27.5.62 showing the extent of ice-scratched surfaces. I regret that I did not traverse the full length of the Wild Duck — Mt. Ida Ck. to be inundated for evidence of glacial beds or basement Ordovician rocks, since the published


THE
PERMIAN
GLACIAL
TILL
TOOLLEEN
PACK CREEK
CROSBIE GRANITE
Longs Rock
KNOWSLEY
FOREST CREEK
Fig.3
Fig.7
Fig.5
LAKE EPPALOCK
Mt Ida Ck
to Heathcote
Fig.8
Wild Duck Ck
to Heathcote
Fig.9
Fig.10
to Mia Mia
BASALT
37°S.L.
Fig.2
SCALE in KILOMETRES
South Australia
NEW SOUTH WALES
VICTORIA
Bore
Carisbrook
Derrinal
Bacchus Marsh
Melbourne
S.E AUSTRALIA
ICE DIRECTIONS in PERMIAN AGE
Glacial Pavements
Glacial Outcrop
Subsurface Permian
TASMANIA
Fig. 1
PERMIAN
to Knowsley
SCA
Sheedys Rocks
McNutts Rocks
A McNutt
Dunns Rock
DUNNS INLIER
ERRATICS
Kellams Rocks
357°
F.S.L.
old road
Acid Dyke
original course of Wild Duck Ck
LAKE EPPALOCK
Fig. 3.
0 500
METRES
Legend
Basalt - Tertiary
P PERMIAN - glacial
Pt Ps " tillite, sandstone glacial
Erratics, granite or igneous erratic striated in situ
ordovician basement striated
PERMIAN-ORDOVICIAN BOUNDARY
ACID DYKE - post-Ordovician
ORDOVICIAN
" SANDSTONE prominent outcrop
FSL - Full Supply Level - 194·2 m (637') ASL.
SCA - Soil Conservation Authority Enclosure
fence
Road, track
dam on water-course
tree 1980
House, old RWS
Geological Boundary Permn-Ordovl
Dunns Rocks
Dead Tree
Robbins
PERMIAN
ORDOVICIAN
Days Rock
194·2 m ASL
F.S.L.
dead trees
Kellams Rocks
LAKE EPPALOCK
PERMIAN
DUNNS INLIER
0 20 40 60 80 100
METRES
Stamp
Fig 4.

maps showed nothing but hill-wash and gravel there. I thus missed the important glacial-Ordovician junction at the Meadow Valley Fault, on which Bowen had made important comments.

The lake filled by December 1963, and thus began the story of our discoveries, which form the basis of the following papers.

The Carboniferous-Permian Ice Age

It is generally accepted now that in the Carboniferous and Permian Ages, Antarctica, New Zealand, Australia, Africa, South America and India were all joined together in one super-continent called Gondwanaland. There was an ice-age lasting 100 million years or so covering much of it in one or more vast ice-sheets. That was 250 million years ago or more. Gondwanaland broke up into smaller continents about 100 million years or so ago, and these are now wandering further apart as "plates", which collide causing earthquakes, volcanic phenomena, mountain building, ocean ridges and trenches.

Fig. 1 shows the general directions of the ice-scratches in S.E. Australia in the Permian age, and where other Permian glacial deposits are found. Note the Derrinal arrow and another at Carisbrook, which we actually found. Does it not look as if the ice came from somewhere south of Australia where there is now deep sea, as if Antarctica could have been joined there once?

The Derrinal Glacial Valley

Fig. 2 shows our whole glacial area, and the insets or areas of interest, which will appear in this and future issues. Notice that all (except one) of the glacial pavements on basement Ordovician rocks cease just north of Lake Eppalock, where the whole glacial valley seems to be filled with thick glacial deposits (morainic?). This would suggest that the glacier ice ended here, and the melt-water fanned out as wide outwash plains further north. Ordovician inliers projecting up through the glacial area deposits suggest that the ice moved in a wide open shallow valley, not a deep U-shaped valley, around and over the tops of these inliers, rounding, shaping, scratching them, as will be shown for Dunns Inlier in this issue. This agrees with the picture presented by Dunn and David at the end of last century. It was not till the 1930's that the 'graben' interpretation arose.

The presence of sub-surface Permian glacial deposits further west at Marong, Leichardt, the Loddon valley at Newbridge, Tarnagulla, and further north widespread sub-surface Permian mudstones in the Campaspe, Goulburn and Ovens river valleys to far beyond the Murray river into N.S.W., suggests either a great northern Permian sea, or a great outwash plain from a great ice-sheet to the south. We have no marine evidence at present.

Again in Fig. 2, note the 8 tongues or fingers of glacial deposits, which represent ice feeding in along glacial valleys from the S.E. from what is now Ordovician country i.e. high land in Permian times. As the strike of the tightly folded Ordovician beds coincides with the direction of these feeder valleys, it is obvious that the bottom-ice direction was controlled here by the axes of the anticlines and synclines, which actually form the small glacial valleys here.

Again in Fig. 2, note the two or three lines of high-level gravels and ironstones, which represent former high-level ancestors of the Mt. Ida Ck. — Wild Duck Ck. drainage system. Obviously, after all the ice had melted 250 million years ago, the whole Permian deposit was buried by material derived from the higher Ordovician to the south. Such deposits are today characterized by rounded water-worn quartz pebbles. Erratics, which could have been expected from Permian glacials left further south are conspicuously absent.

The stripping of this former Tertiary cover has uncovered the former Permian valley deposits only recently, exposing much of the original Permian glacial topography, as it must have appeared along the boundaries and tops of the inliers. Thus, the striated pavements, when exposed, would soon lose their striations by weathering, but by digging down a little, we should expose perfectly preserved striations, which was just what we found by searching. Many such pavements, having lost their tell-tale striations, would still often show the roundness, smoothness and shape of glacially eroded rocks. We recognized many of these, and recorded them on our maps.

We developed our own technique of search — we always carried digging equipment, water, brushes etc. for cleaning and washing surfaces, camera with stereo accessories, two

large mirrors to reflect sunlight obliquely in a desired direction for viewing the surfaces, compass mounted on a one metre arm for measuring bearings of glacial striae, strike etc., golf ball to find direction of surface dip (10° was always added to get true bearings for our area), and a complete set of aerial photographs of the entire glacial area. (1967, 1971). From the aerial photographs, I constructed a complete map of our glacial area at photograph scale. All figures in this series of papers are reductions of this large scale map.

We now begin descriptions of the pavements etc. discovered in the *Central Western* inset (or Fig. 3), which shows excellent glacial evidence on *Dunns Inlier* and along the *Western Boundary* in McNutts and Sheedys properties. Fig. 4 is an enlargement of Dunns Inlier. The reader is referred to the labelled diagrams to save verbal description.

Dunns Inlier — a narrow hard west-dipping meta-sandstone Ordovician outcrop striking close to north — about 0.55 Km long with 3 Dunns Rocks at the N end at 214 m (702 ft.) A.S.L., and with a long succession pavements (Kellams Rocks) at the S end reaching down to about 182 m (598 ft.) A.S.L. i.e. perhaps 12 m (40 ft.) below the F.S.L. A main glacial advance from S to N is indicated close to 000° T, followed later by a shorter one at about 343° T at least at the lower S end. Two large spectacular grooves were carved at 337° T by the former advance on Kellams main rock, where the ice was climbing uphill at about 10° on a remarkable W-dipping face. The second shorter phase still climbing uphill at about 5° intersected the main striae, but there is no evidence of such on Dunns No. 1 rock, which is characterized by absence of intersecting striae. Note the five Robbins Rocks on the same W-dipping stratum as the original Dunns No. 1 pavement, and also another pavement, Days Rock, on the E side.

The reader is referred to The Bendigo Naturalist March 1972 V6.1 and August 1973 V6.2 for information on Kellams Rock (3 photos), and the final excavation of Dunns Rock (2 photos) in May 1973. Another photo of the excavated Dunns Rock appears on p136 of Geology of Victoria (Geol. Soc. of Australia). We called it Dunns No. 1 Rock. Dunns No 2 is the large somewhat rounded sandstone rock on the E side nearby, which failed to show any evidence of striae, but did show at the extreme N end evidence of planing and polishing of its quartz crystals below soil level. I have no doubt that ice had overflowed the whole of Dunns Inlier at one stage of glaciation. Long exposure evidently would have removed other striae by weathering. Dunns No. 3 Rock, about 15 m further N.E., had excellent glacial striae at 000° T below soil level. The Dunns Rock photo in Dunn (1892) shows clearly the striae, yet now 90 years later, they still show up well if viewed in favourable oblique light. Similarly, the clean washed and dried surface of the excavated rock in oblique morning light showed clearly by reflection its glacial polish, which I photographed.

Kellams Rocks — I think Dr D. E. Thomas before 1940 must have seen the main rock — "down near the fence" (pers. comm. — BFNC lecture — 12.7.61) — which I have shown in Fig. 4 below F.S.L. Every year during the irrigation season, the lake level falls exposing Kellams Rock to wave damage. During the 1968 drought, it fell to its lowest (185.5 m or 608.63 ft. A.S.L.) exposing a long line of 5 more glacial pavements (we called them Kellams A.B.C.D.E), and we made excavations on A and B uncovering a similar two sets of strong and weak intersecting striae as on the original pavement. Later, a Kellams F was uncovered above F.S.L., which showed excellent striae plus very good examples of "crescentic gouges" They are plucked out by the ice, especially at joints, and are common on glaciated basement rocks. Several are still visible on the S end of the main rock — 1981 — 18 years after first uncovered.

The cover-picture of the March/April issue shows abundance of erratics on McNutts Beach in the foreground. Kellams Rock is in the shade under the L.H. red-gum tree reflected in the Lake, and the other Kellam pavements E . . . A extend down-hill to below the water-surface to the right. (On 8.7.77, the lake-level shown would be well down to 189.3 m (621.2 ft) A.S.L. i.e. 4.83 m (15.8 ft) below F.S.L.) (See Figs. 3 and 4 Part 1). The Moorabbee Caravan Park is in the distance on R.H.S. (See Fig. 7 of Part 3 — not printed yet.)

Robbins Rocks — the central large one of the five had a rough lichen-covered plane surface with what appears to be a very large undercut groove on the W side (like Kellams Rock grooves). Digging on the W side con-

firmed the existence of well preserved striae at 357° T. Digging further south uncovered two more striated surfaces, while the two smaller ones further north resembled the groove on the central rock.

The Western Boundary — this was originally shown on Caldwell's map of Knowsley (1930) as Meadows Valley Fault with an acid dyke in the Mt. Ida Ck. Thomas (1941) in his Langworner map continued it as an un-named fault with acid dykes at 3 places, but not shown in the Mt. Ida Ck.

Our observations disagree (see Fig. 3). The acid dyke is noted on the old road with Ordovician on both sides of it, and at least two parallel acid dykes in Langworner on the opposite side of Mt. Ida Ck. *within* the Ordovician in the Victorian Speed Boat area. Bowen (1959) had inspected the Ordovician-Permian junction in the bed of the Mt. Ida Ck. (we unfortunately missed seeing it) before inundation by the rising lake-water, and concluded that the Permian was down-faulted here about 61 m (200 ft.). I question this (a) as it would have taken Dunns Inlier down out of sight, whereas today Dunns Inlier is as high, if not higher, than the Ordovician western boundary (b) the acid dyke is not a Permian boundary anywhere (c) we have discovered numerous striated basement Ordovician rocks along the boundary (6 behind McNutts house and 11 more in Sheedys) — something we would not have expected, if this were a post-Permian fault. Later, we discovered an unpublished geology map by Whitelaw (1904) in the Bendigo Dept. of Minerals and Energy, which showed striated pavements in Sheedys property where I had found them. Obviously, this map had not been noticed by later workers. It covered the area from Dunns Inlier to Toolleen in the far north.

Of course, the above does not necessarily dispose of the Meadows Valley Fault. It could have been pre-Permian and post-Ordovician as are so many other N-S faults shown on our N-Victorian maps between Heathcote and Leichardt based largely on fossil evidence.

McNutts and Sheedys Rocks — see Fig. 3. I have detailed plans and drawings of these — obviously remnants of scratched and polished harder sandstones on the western bank of a glacial valley, now largely filled up with glacial debris. In general, many show uphill striae on the S, S.E, or E faces below soil level (especially McNutts No. 1) giving striking proof that the ice moved S to N — more easterly at Sheedys end. There were good examples of polished and microscopically striated quartz vein surfaces, which could only be seen in obliquely reflected light.

McNutts Beach — occupies the narrow glacial valley between Dunns Inlier and their house. It is a wonderful museum of diverse erratic types, far travelled, not local derivation, washed out of the tillite since late 1963. Large and small sedimentary, metamorphic, igneous, granites (numerous types), porphyries, rhyolite, quartzites, beautifully facetted and striated erratics abound. Two very large embedded sandstone erratics, apparently striated in situe at 357° T (Allens Rock) and 344° T (Edmunds Rock) — see Fig. 3 — agree so closely with Kellams Rock striae, that I am tempted to suggest that Allens Rock was "lodged" from the bottom of the earlier advane, and striated in its new position (357° T), and Edmunds Rock similarly "lodged" and striated from the second phase at 344° T at the higher level. Since 1944, Edmunds Rock has split and the top half is sliding down-hill. I have not noticed any clear evidence of the two phases of glacial deposition on this beach. The beach on the east side of Kellams Rock is somewhat similar, but further on, glacial sandstone and conglomerate become abundant upper units. Note in Fig. 3, glacial sandstone and tillite occur in a higher unit on the Knowsley road cutting.

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Some observations on Hydroids at Black Rock (Port Phillip Bay, Australia)

By D. E. McInnes*

Introduction

Giving a talk on Hydrozoa at the July 1981 meeting of the F.N.C.V. Marine Group made me interested to see whether I could once again find some of the Walking Jellyfish on the Fourth Street reef at Black Rock (see map, fig. 1), where I had found them several years ago. I also hoped that the hydroid stage of this species, and perhaps other kinds of hydroids as well, might be found there.

7th August, 1981, was a lovely sunny day with a very low tide at 4.30 p.m. and a perfectly calm sea. About an hour before extreme low water, I arrived at the seaward end of Fourth Street, where there are steps leading straight down to the reef; this is composed of clean rock stretching out in the form of a narrow strip to about 30 metres from the beach, and surrounded on all sides by clean sand. My collecting-gear (all "marine-clean", that is to say, carefully scrubbed and rinsed in tapwater until it was clean enough to keep seashore animals alive for a reasonable length of time) consisted of a plastic bucket, a 4-litre icecream container, and two reserve containers each capable of holding 5 litres of clean seawater with which to fill my aquaria on returning home.

Pulling up a stem of the brown seaweed *Ecklonia* sp., I could see with the naked eye a fine lacework on the lower parts of the "leaves" (=thalli); under a handlens and in seawater in the icecream container, I could see that the lacework was in fact a network of hydroid stolons from which branches of the hydroid arose at intervals, so into the bucket it went, well covered with clean seawater. Thus encouraged I gathered further samples of red, brown, and green seaweeds, and the bucket was soon filled to be examined at home, partly with the weeds but mostly with enough clean seawater to cover them and thus ensure their survival on the return journey. Next, I filled the icecream container with clumps of coralline seaweed picked exclusively from pools that were never above the low-water mark, because it was on this seaweed and in this habitat that I had previously found the Walking Jellyfish. Topping up the icecream container and filling the reserves, both with clean seawater, I set off for home. The Walking Jellyfish cannot be seen in its natural habitat even with a x10 handlens; it must be searched for by scrutinising the weed bit by bit under a stereomicroscope, which normally cannot be done on the shore, but only in some kind of laboratory or at any rate indoors.

Care of the Hydroids and Medusae

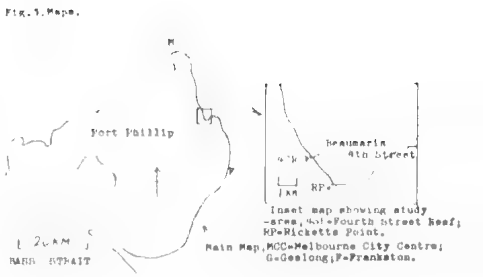
On arriving home with the collection (after about 20 minutes' driving from the shore), I put the icecream container with the corallines on one end of a shelf, and next to it in a row along the shelf I put four more similar marine-clean containers, into each of which I put some of the weeds from the bucket with enough seawater to cover them (fig. 2); prompt, continuous, but not violent, aeration was set up as shown, and is essential because otherwise the organisms in the samples quickly begin to decay, and the hydroids and medusae are among the first to die. One must also be very careful not to include in any marine-clean container sponges, molluscs, or sea-urchins, because these are among the first to foul the water, either with

*F.N.C.V. Microscopical Group

their excretions or with the products of their decay.

Aeration as described (and the topping-up of the icecream containers to a constant level as required, with filtered pondwater) was kept going for about the next week, being the time it took me to examine all the seaweeds bit by bit under the stereomicroscope; only the branches actually bearing hydroids were kept, the rest being thrown away. Each tuft of weed was examined to begin with in a large petri-dish under about x20, and bits of weed bearing hydroids or other items of interest were examined under a research microscope using overall magnifications of x20 to x100 (the most usual overall magnification was x50, produced by a x5 objective in conjunction with paired x10 eyepieces). The water containing the weeds waiting to be examined, or those selected because they bore hydroids, developed large numbers of actively moving ciliates and numerous harpacticoid copepods (apparently a species of *Tisbe*); what *Tisbe* feeds on I have not yet discovered, but it is in turn an excellent food for the hydroids. In general, the smaller polyps eat the young stages of *Tisbe* and the bigger polyps eat the adults, but this is be no means always true, and on occasion it is quite incredible to see how an apparently small and feeble polyp can first sting to death, and then gradually wrap itself around, a *Tisbe* or other small crustacean much bigger than itself, leaving the polyp grossly bloated for some hours (up to a couple of days or so) between swallowing the prey and regurgitating the cleaned-out exoskeleton via the mouth. The Walking Jellyfish is equally voracious; one, about fullgrown (body diameter 0.37 mm), ate an isopod 1.9 mm long at 11.30 a.m., and regurgitated the exoskeleton at 9.00 p.m. the same day.

Because hydroids are so delicate, it is very important to give them a safe and



Inset map showing study area, 4St=Fourth Street Reef; RP=Rickett's Point. Main Map, MCC=Melbourne City Centre; G=Geelong; F=Frankston.

inexpensive, yet certain, culture-system in which to grow and (with luck) reproduce. They quickly die and decay if merely kept in a petri-dish full of seawater, but the following system costs hardly anything and has proved very satisfactory for the maintenance of the hydroids up to and including the liberation of the young medusae, although some other method (which I have not yet devised) would probably be better for keeping the newly liberated medusae until they grow to maturity. For the hydroids, further similar marine-clean icecream containers were taken (fig. 3A) and the rims of the snap-on lids were carefully cut off (fig. 1B), so that the remainder of the lid formed a flat plate that would drop into the container while leaving a narrow space all round, between the plate and the container wall. A hammer and punch were then used to make a number of holes in the lid, many of them marginal (the number and size of the holes are not critical), as shown in side view and in perspective in fig. 3C, the result being called the perforated plate. The support is formed by punching similar holes all over the walls but not the floor, of a suitable-sized plastic tub (figs. 3E and 3F), which is then stood in the middle of the icecream container so as to carry the perforated plate; the air pipe was led (fig. 3D) through a marginal hole in the perforated plate, and a hole low down in the wall of the support, to an airstone resting on the floor of the latter and emitting a stream of tiny bubbles which caused the water to circulate as shown by the heavy ar-

rows. Petri-dishes without lids stood on the perforated plate, and contained the hydroids, which thus had clean cool water about 2 cm deep flowing steadily over them the whole time. Up to the time of writing (mid-December, 1981) only one medusa had been budded off, from the hydroid listed below as *Stauridiosarsia producta;* this medusa is being kept in a petri-dish (covered with fine gauze to prevent its escape) in the above culture-system, but as mentioned above a more suitable system needs to be devised specifically for medusae.

Looking at hydroids

Under the stereomicroscope the lacy network on *Ecklonia* thalli was once again found to consist of a network of hydroid stolons, but the upright branches were now seen to consist each of a single polyp in a hydrotheca (fig. 4A), rather like a transparent flower in a wineglass; the tentacles of the polyp are studded with tiny stinging-cells (=nematocysts), by means of which the polyp renders helpless any small animal brushing against it, and then crams the prey into its mouth with its tentacles, exactly as does its wellknown relation, the freshwater *Hydra*. However, there is one significant difference, in that the colonial hydroids (such as this species on *Ecklonia*) have all their digestive cavities

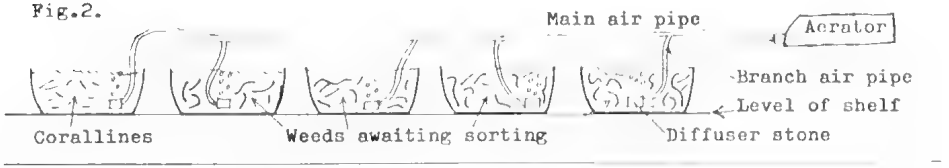


Fig.2.

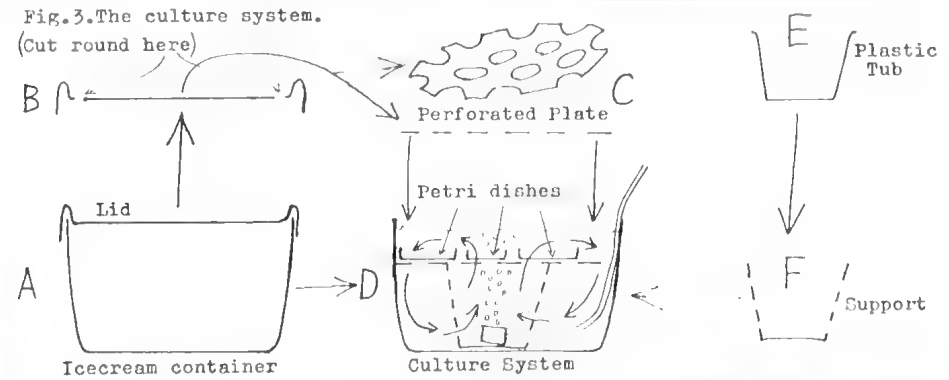


Fig.3.The culture system.

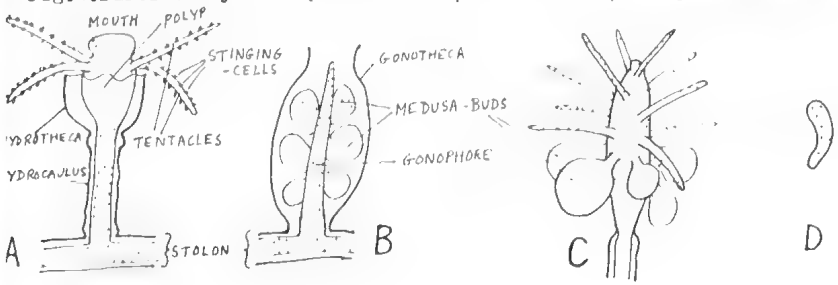


Fig.4.Parts of hydroids(not accurate,nor to scale;soft parts dotted).

connected together through the stolons so that, when one polyp catches and digests a food-item, the benefit is eventually shared by all the polyps connected to it, and by the colony as a whole which uses the food-reserves thus gained to promote further growth of the colony and the construction of new polyps as well as the renovation (and ultimate destruction) of existing ones. When the colony is big enough it begins to produce, not merely more feeding-polyps, but also the reproductive polyps or gonophores (fig. 4B); in some instances the feeding-polyp itself becomes the gonophore as well, as in fig. 4C. The female gonophores either fertilise their eggs on the spot by sperm swimming from a male gonophore nearby, or both sexes produce medusae (miniature jellyfish) which, having been loaded before liberation with a supply of gametes, swim and grow in the plankton before shedding their gametes, perhaps many weeks later and far from the parent colonies. The fertilised egg develops into a tiny swimming larva, the planula (fig. 4D), whose sole object is to glue itself onto a suitable support and grow into the stolon from which an entire colony develops in due course, thus completing the life-cycle. The reproductive process varies quite a bit in different kinds of hydroids, and only an outline is given here (see Barnes, 1974; Hincks, 1868; and Marshall & Williams, 1971, pp. 104-137); the hydroid stages of many medusae, and the medusae of many hydroids, are still not known, while in many other hydroids the medusa has been shortcircuited out of existence, as explained above. Hydroids and medusae are most closely related to sea-anemones and corals; all are put together in the Phylum Coelenterata (=Cnidaria), whose members are all of a very simple structure and have stinging-cells; certain non-stinging jellyfishes, the comb-jellies, were at one time included in the coelenterates, but are now put by themselves in the Phylum Ctenophora which does not concern us here.

Notes on the species found

To my gratification, the very first bit of coralline examined under the stereomicroscope had one Walking Jellyfish (which gets its name from the fact, that, unlike most medusae, it creeps on the bottom instead of swimming; see Bishop, 1972), and several more were found during further search of the sample. The present species was first found by Mr Bishop at Ricketts Point, not quite 2 km south of Black Rock, and from his very good description as well as from more recent observations it appears to be very close to, if not identical with, the British species *Eleutheria dichotoma* Quatrefages, described and superbly figured by Russell (1953). *Clavatella prolifera* Hincks, the name used by Mr Bishop for this medusa, is in fact an obsolete synonym applied to the hydroid stage before the relationship between it and the medusa was realised. Whereas the Walking Jellyfish may sometimes be found in large numbers on suitable shores, the hydroid stage is very small and hard to find, and has thus not yet been seen for certain even by Mr Bishop, who regularly keeps the Walking Jellyfish in a small aquarium through whose walls he surveys the interior and floor of the tank through a stereomicroscope mounted for the purpose.

I have also found the hydroids in the following list at Black Rock; all the Athecata have been assigned to their nearest British equivalents in Hincks (1868), and all the Thecata have been identified from Ralph's papers (see references). Papers dealing with hydroids from Port Phillip are still very few (Ralph, 1966; Watson, 1978 & 1980), and do not cover all of the species found by me. The first three species of Athecata in the following list have been

recorded on movie film by Mr Paul Genery.

Acknowledgements

I am very grateful to Mr Bishop and to Mr Paul Genery (both of the F.N.C.V.) for sharing their records and observations with me, and to Dr R. Hamond (Zoology Department, Melbourne University) for helping me to prepare this paper for publication.

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List of Black Rock hydroids to date

ATHECATA

Stauridiosarsia producta (Wright). On the holdfast of *Ecklonia*.
Cladonema sp. Hydroid growing in Mr Bishop's tank.
Eleutheria dichotoma Quatrefages. On coralline.
Eudendrium capillare Alder. On Brown seaweed.
Turris neglecta Lesson. On stem of brown seaweed.
Perigonimus sp. (very like several of the alleged spp in Hincks, 1868). On coralline in December 1981; grows well in culture-system.

THECATA

Silicularia bilabiata (Coughtrey), forma *subtropica* Ralph (1956, p. 286). On *Ecklonia*.
Orthopyxis caliculata (Hincks). On brown seaweed.
Clytia johnstoni (Alder). On red and brown seaweeds.
Undetermined campanulinid (I could not detect any webbing at the base of the tentacles, but am still unable to choose between *Opercularella humilis* and *Phialella quadrata).* On coralline.
Amphisbetia minima (Thompson). On *Ecklonia* holdfasts.
Halecium corrugatissimum Trebilcock. On *Ecklonia* holdfasts.
Sertularella sp. or spp., not yet closely identified. On *Ecklonia* holdfasts.
Monotheca flexiosa Bale. On *Ecklonia* holdfasts.
Aglaophenia plumosa Bale. On *Ecklonia* holdfasts.

Studies of the Giant Gippsland Earthworm *Megascolides australis* McCoy, 1878.

BY BRIAN J. SMITH[1] AND J. A. PETERSON[2]

The Giant Gippsland Earthworm (*Megascolides australis* McCoy 1878) is probably one of the most famous of Victoria's endemic animal species. Quoted as the largest species of earthworm in the world in such basic zoological texts as Barnes (1980), and many others, the Earthworm has been known as a scientific oddity by generations of Australian school children (e.g. Barrett, 1935, p.38; Mackness, 1981, p.43) and biology students (e.g. Buchsbaum, 1951 and later editions), in many parts of the world. Visiting scientists, and biological supply houses from overseas have been interested in acquiring specimens for museum display and teaching purposes, sustaining a small trade in the preserved specimens over many years. Historians (e.g. Hartnell, 1974, p.107) have pointed out that the worm has given South Gippsland a measure of national and international fame, which helped to reduce insularity, especially during the first fifty years of settlement. Regard for the worm among the people of South Gippsland is now manifest through the Karmai (local aborignal word for the Worm) Festival in Korumburra and the children's book "Karmai the Giant Earthworm" by local author Frank Smith (1980). A "float" of the Earthworm has appeared in Melbourne's Moomba procession and the species has been used in various ways for local tourist promotion in South Gippsland.

Early Interest and Studies

Since discovery of the giant worm a little over a century ago in the Brandy Creek-Warragul area it was subsequently recorded as a common South Gippsland species. Reports came from the upper Bass Valley and from around Loch, Korumburra and Poowong during the extensive land-clearing activities whereby so much of the original forest of South Gippsland was to disappear in the process of converting large areas of pasture land for dairy production (e.g. see South Gippsland Pioneers Association, 1966). The worm was first described scientifically by McCoy (1978) who regarding its discovery, states . . . "On the first entry of the surveyors into that paradise of land selectors, the Brandy Creek district on the new Gippsland line of railway I received from them numerous specimens . . ." (op. cit. p.24). The railway mentioned would have been the Moe to Bunyip section (opened 1/3/1878, Harrigan, 1962) of the Melbourne to Sale railway. This was the last section to be opened except for the link between Oakleigh and Melbourne, all sections being open by April 1879. Work began on the Melbourne-Sale railway (the Gippsland line) following passage of the Railway Construction Act Number 475 through the Parliament in Melbourne in November 1873 (Beardsell, 1979, p.6). It would appear from this that the first specimens were despatched to McCoy sometime in 1877. Apparently McCoy, at that time professor of Natural Sciences at the University of Melbourne and Director of the National Museum of Victoria, received specimens from a number of people. The sending of one early specimen to Melbourne was described as follows:

(Copeland, 1934, p.141)

"Some days after he had gone, a worm came to hand, which measured up to requirements. It was packed in a tin, with damp

(1) Division of Zoology, National Museum of Victoria
(2) Department of Geography, Monash University, Victoria

Fig. 1. Giant Gippsland Earthworm, photographed about 80 years ago by Mr Perret of Kongwak. (Photograph kindly lent by Mr H. Grimshaw of Arawata.)

moss, and sent to his firm (Garrard and Nunn, Queen Street) and a wire sent announcing despatch. His description of result was somewhat as follows: "Got tin, opened it on Mr Nunn's table, and we measured it, slack and stretched. It came up to standard quoted. While measuring it, Mr Garrard opened the door, but seeing the worm on the table quickly got out again. Being assured it was not a live snake, he came back to study the worm. For two days it was exhibited to many legal men, and then it was sent to Professor McCoy."

Besides its large size McCoy recorded that the worm lays curious large cocoon-like egg-capsules, and may emit an odour resembling creosote.

McCoy's description in the *Prodromus of Zoology of Victoria* (1878) erected both the genus *Megascolides* and the new species *Megascolides australis*, the latter being the type species by monotypy. In a review of the megascolecoid earthworm genera, Jamieson (1971) characterizes the genus as having eight setae per segment, clitellum over four segments between XII and XIX, male pores 1 pair XVIII combined with the pores of a pair of prostate glands, female pores on XIV, spermathecal pores 1-5 pairs, calciferous glands present or (typically) absent, spermathecae diverticulate.

The members of the genus are known from Australia including Tasmania, the North Island of New Zealand and North America.

The most wide-ranging and authoritative work on the worm is that of Spencer (1888). Besides offering a brilliant, detailed description of the creature's anatomy, including details of the microstructure and histology for all its main organ systems, Spencer gives a variety of interesting facts and observations on its biology and habitat requirements.

He records the worm as having 300 to 500 segments and reaching a length of 6 ft. (about 2m.) (e.g. see Fig. 1). It is mainly found in moist sloping country on the sides of creeks. No casts are left on the surface by the worm, though some early reports to the contrary were probably based on the nearby presence of burrows of "land crabs" (yabbies — family Parastacidae). The most reliable way of detecting the presence of the worm is to listen for the gurgling sound it makes as it travels through the burrows underground. Worms held in the hand contract and jet out a milky fluid to a height of several inches from dorsal pores. It is thought that the primary role of this fluid is to moisten and lubricate the wall of the burrows to make the passage of the worm easier. It is reported that old "natives" say that the secretion is good for rheumatism. The strong smell of creosote referred to above, may be why either living or dead, it is said to be repulsive to domestic fowls, (McCoy, p.25), and probably most other birds (see Barrett, 1951, p.722), although the kookaburra is known to eat them (see below).

The worm is reported to move very fast along its burrow system. Setae are very short and thought to be of little use in burrowing. The worm appears to move down its burrows by alternating strong body contractions and extensions between alternative swelling of the anterior and posterior ends of its body. Burrows are reported to be about 1 inch (25 mm) in diameter and are found to contain masses of faecal soil material and, occasionally, the cocoons. The cocoons (see Fig. 2) are about 2 inches (50 mm) long, light yellow to dark brown in colour, depending on age, and are tough and leathery with a stalk at each end. They each contain one embryo.

Since this work by Spencer nothing further of note appears to have been published about the biology of the worm apart from a description by Eve (1974) of field observations of habitat requirements in the Lillico area north of Warragul. The writers know of several people who have claimed to have suc-

Fig. 2. Giant Gippsland Earthworm cocoon (probably mature) photographed during worm collecting excursion about 80 years ago by Mr Perret of Kongwak. Montage printed and lent by Mr H. Grimshaw of Arawata.

cessfully bred the worm in captivity but so far none of these experiments are recorded in the literature.

One brief reference in a popular book of the area, (South Gippsland Pioneers Association 1966) is as follows:

"One curiosity of the soft deep soil were the gigantic earthworms. Stretched out, they measured fully six feet and as thick as one's thumb. A person walking over their holes would cause them to recede rapidly deeper down, making a queer, subterranean noise or gurgle sufficient to scare anyone. Often being flooded out, they would lie stretched out on the mud in the tracks and prove an easy prey to the jackass or the naturalist."

Present Study

Most of our present knowledge of the worm can be divided into two main categories. Firstly the "scientific" knowledge, recorded in books and scientific journals and largely confined to species anatomy and taxonomy. Little or nothing has been recorded in the scientific literature about its biology, distribution or ecological requirements. On the other hand there is a great deal of local or anecdotal knowledge about the worm scattered amongst the community of South Gippsland. Some of this is recorded in the many reports that have appeared regularly over many years in the local newspapers. There is a need for a more detailed understanding of the distributional ecology of the Giant Gippsland Earthworm now that a call has been made for a review of its conservation status (Land Conservation Council Report on the Melbourne Study Area, 1973). The present study arose out of this need and is an attempt to elucidate the current status of the species in this context.

Zoogeographical distributions cannot be mapped satisfactorily until a survey technique has been found that is related to the habits and ecology of the particular animals under study. Birds are best surveyed by travelling through their area observing with binoculars or listening for the song. Frogs can also be surveyed by voice, but cryptic animals like snails must be surveyed by spot collecting under logs or in streams. Surveying a large earthworm which reportedly spends its whole life deep underground seemingly presents significant problems. The technique employed for this study was to attempt to tap the wealth of knowledge about the worm in the community of South Gippsland.

A questionnaire was drawn up asking for details of records or sightings of the worm, either first-hand by the respondent or second-hand as a report, including an exact locality description, a detailed description of the habitat and the circumstances of the sighting. In addition the respondents were encouraged to make additional observations about their understanding of the worm. These questionnaires, with a reply-paid envelope, were sent to about 2000 people from within the supposed distributional range of the worm and a further 1000 people in a buffer zone immediately surrounding this area. Potential respondents were chosen from the latest electoral roles with an emphasis on those listed as having occupations connected with the land. Printing and postage was met from a research grant from Monash University.

From the 3000 or so questionnaires sent out about 600 replies were received. Localities where the worms were recorded were plotted on county maps. The distribution pattern was compared with that of topography, soils and rock types. The detailed results of this study will be presented elsewhere. Preliminary findings are given here in a generalized map (Fig. 3).

Results and Observations

The distribution of the worm given by the survey reinforces the previously-held notional distribution of the species. It is largely confined to the hilly areas of the western Strzelecki Ranges of South Gippsland and the undulating country around Warragul. The worm is found mainly within areas characterized by zonal or azonal soils derived from the weathering of Tertiary basalt (Older Volcanics — Geological Survey of Victoria, 1971) and Cretaceous sediments, *loc. cit.* It favours deeper organic-rich soils in pockets and along riparian tracts within the more sloping well-drained country with higher rainfall (1000 mm) and abundant soil moisture above the watertable. A closer assessment of habitat requirements and the limiting factors of distribution must await more detailed ecological studies.

The replies to the questionnaire also contained a wealth of anecdotal observations on the biology and ecological requirements of the worm. These are summarised below under a variety of headings:

Habitat. Nearly all the respondents agreed that the worms are found in the deep dark grey clay soil. Several said that the species was rarely to never found in the red soils of the basalt areas. Worms have been found from close to the surface to as deep as 3 to 4 metres. Several people referred to the territory in which the worms were found as "blue gum country". However, some stated that while the blue gum was the dominant tree of the high ground, the lower slopes and gullies were characterized by paperbarks, blackbut, blackwood and treeferns. Most worms were to be found in these gully areas on the banks of creeks or associated with springs or soak areas. The habitat must be constantly damp but situations where the watertable comes to the surface for long periods of time are unfavourable. Many said that the worms were sometimes found in areas also populated by yabbies. Worms are more commonly found on slopes with a southerly or westerly aspect and are rarely found on north-facing slopes.

The country where the worms are found was first subject to clearing and settlement from the 1870s. Extensive ploughing of the land had been undertaken by the 1930s and most of it is used for dairy farming, sown down to permanent pasture. Much of the land receives a regular light dressing of superphosphate. Opinion was divided amongst the respondents as to whether the worm populations are declining. Some are of the opinion that draining and application of "super" has diminished the populations while many others stated that the worm is still widespread and common.

Circumstances of Sightings. The most widely reported evidence of the presence of the worm is the gurgling or sucking noises made if you walk on ground in which the worms are living, particularly if the ground is wet. A few people reported seeing the heads of worms protruding from holes in the ground. One description of this and of the sucking noise phenomenon is as follows:

"We saw the heads of worms sometimes sticking out a couple of inches above ground. The worm sensed footsteps and would withdraw down the hole making a sucking, gurgling noise as does a bath tub when water drains out and causes airlocks in the pipes" (pers. comm. S. Hobley, Korrumburra).

However, apart from the gurgling and

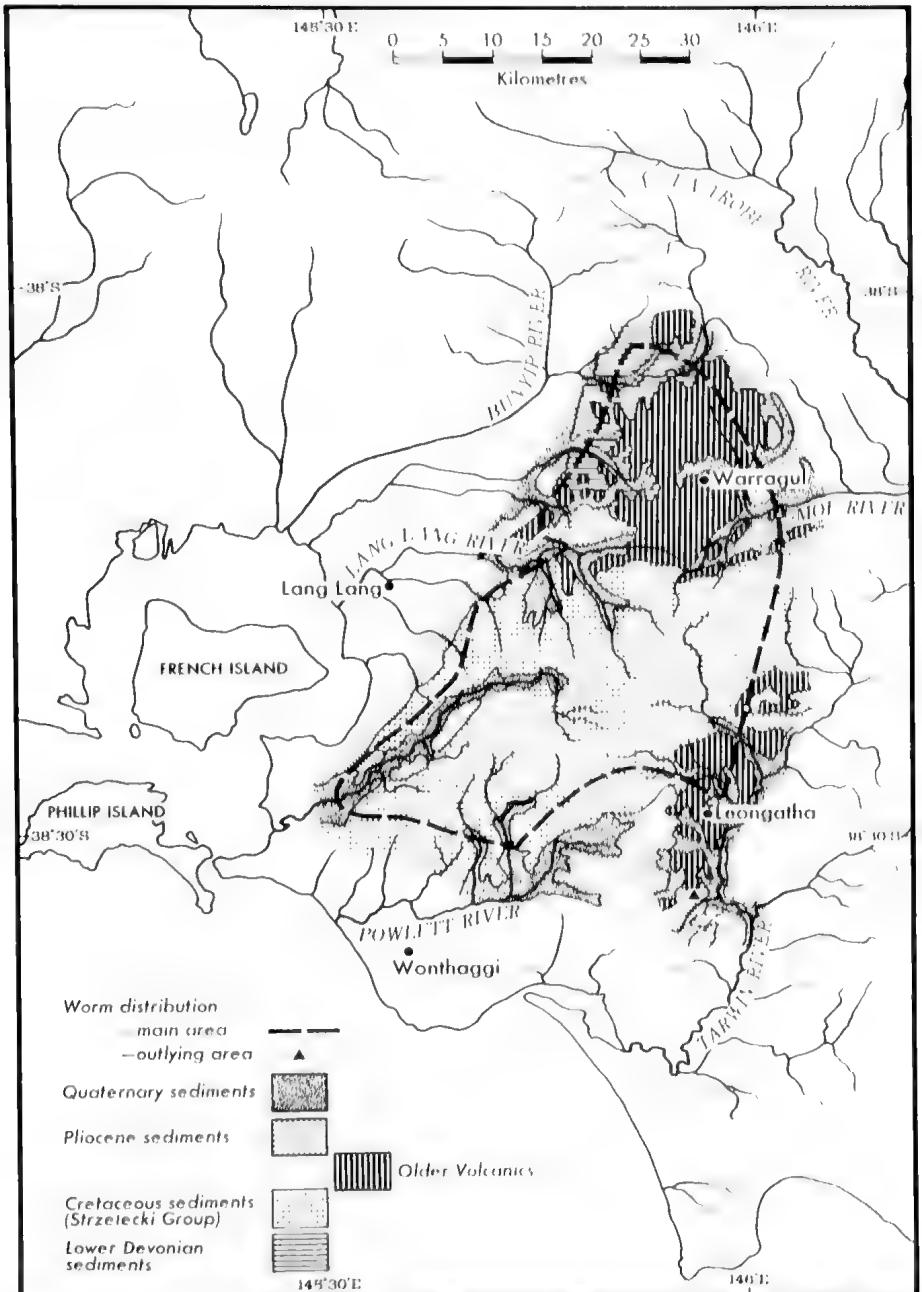

Fig. 3. Distribution map of Giant Gippsland Earthworm also showing relative extent of lithological types upon which soils harbouring the worm are found.

sucking sounds, no other indications are present to demonstrate the presence of the worm.

The circumstances of sighting from the respondents fall into two main categories. Firstly, specimens are exposed or brought to the surface by processes which disturb the ground. Such activities as digging up rabbit burrows, ploughing, excavating for dams, road or rail cuttings or digging post-holes or stumps, bring worms to the surface. On some occasions these activities have revealed large populations of worms, with reports of specimens becoming entangled in dozer tracks and pieces hanging from them like streamers. The other category of sighting is for worms forced out onto the surface of the ground by complete water-logging. Several people report that flooding, after heavy rain or as a result of natural or artificial damming of streams, has brought worms to the surface and has drowned some individual specimens. In one case it was reported that the overflowing of pigs skim-milk feed had caused several worms to surface.

Predation. Several of the respondents reported the worm being taken by kookaburras. A number of these events are described as follows:

"I saw what I thought was a jackass with snake. On getting closer I discovered it was a live worm about 5 ft. long. The bird would fly into a large dead tree, then drop the worm, a thing I have seen many times with snakes." (pers. comm. A. Jackson, Loch).

"During the ploughing, quite a number of the worms would be sliced by the plough. It used to be a real bonanza for the kookaburras as they used to tug and pull at the severed pieces of the worms. It was rather amusing at times to watch these birds when they flew to a nearby tree trailing a 2-3ft. length of worm. Sometimes the worm would get snagged on a branch and they would swing to and fro on the length of worm trying to dislodge it." (pers. comm. M. Hillberg, Bena).

"My attention was drawn to a kookaburra sitting on the road. I thought it had been injured and stopped with the idea of moving it off the road. I noticed that it had about 4 inches of the large worm protruding from its beak and obviously would not be able to fly for sometime. I therefore took the bird with me to Korumburra and placed it in an aviary for safe keeping. It was 36 hours later before the bird was able to fly. It was then released and I hope returned to its territory. When the bird was picked up it appeared to be in some sort of stupor; maybe just from being over fed, or perhaps the worms contain some substance which causes that effect." (pers. comm. A. Stubington, Korumburra).

Many other observations were given of instances where kookaburras were seen feeding on the worm. There was also one observation of a magpie trying to pull a worm out of the ground.

General Observations. The size of the worm is always of interest and while some replies quoted worms of 7, 10 and 11 feet, most quoted lengths of from 4 to 6 ft. (1-2m). Several replies were scornful of reports of very long specimens with one warning of a trick of holding three worms to look like one 10 ft. specimen. A number of replies mentioned the trade in specimens with several reports of sending specimens to many parts of the world or assisting overseas visitors to find and preserve specimens to take away.

Many of the replies said that the worm is still locally very common, one quoting a density of 1 worm per 100 sq. ft. in parts of the Bass Valley. Local landslides have been attributed to the activities of the worm while several respondents quoted instances of dam walls being weakened or undermined by the burrows of the worm.

The egg capsules were frequently mentioned, being accurately described as like a large sausage-shaped chrysalis, transparent and amber in colour, about 2-3 inches (50-75 mm) long containing one developing embryo in a milky fluid. These eggs were commonly dug up with

the worms close to the surface in damp ground, some being said to be laid around the root systems of rushes. It was suggested (pers. comm. J. T. Clark, Nyora) that a breeding season could be detected for the worm. Freshly layed capsules are seen in early winter after the soil becomes cool and moist after the summer, and worms hatch in late winter and early spring when the ground is wet.

A number of respondents reported seeing the worm protrude its "head" from the hole and one went as far as to speculate that the anterior tip of the worm was usually a dark purple colour in order to camouflage it while at the surface. Several people commented on the fluid the worm exudes from its skin but only one person specifically mentioned any sort of oily or creosote-like smell. One or two respondents speculated on the possibility of more than one species of giant earthworm being present in the area, stating that a size difference occurs between those worms found on flats to those found in hills.

Discussion

From these preliminary studies it is plain that the Giant Gippsland Earthworm is not only widely known about and highly thought of in the local community, but has almost entered the folk-mythology of South Gippsland. There are strong indications that the species is held to be an important part of the "make-up" of the area and that most people would react positively to any reasonable move towards its conservation.

This study has presented substantive evidence on the distribution of the worm. It appears that the worm is confined to the deep grey soil, formed mainly from Cretaceous rocks, in the western Strzelecki Ranges, and to the alluvial areas derived from this soil to the north and south-west. A great deal of observational evidence has been collected from which many aspects of the ecology of the worm can be inferred pending further study. This includes habitat requirements, some aspects of the reproductive cycle and some of the factors which might control the population, such as flooding and predation by kookaburras and magpies.

The only area reserved for nature conservation by the State Government in the distribution area of the worm is 164 hectares representing the last forested areas of the Western Strzelecki Ranges and known as the Mount Worth State Park. It is on the extreme western boundary of the range as shown in Fig. 3. Worms have been reported in parts of this park but nothing is known of their numbers or status there. Any future discussion about setting aside further land for the conservation of the species should include consideration of an area close to the centre of its distribution.

The information and anecdotal observations documented here should be used as a baseline from which more detailed and controlled observations and experiments can be constructed. It is hoped in the near future to undertake more detailed field-studies on specific populations to determine their composition, the breeding cycles and to characterize more precisely the habitat requirements of the Giant Gippsland Earthworm.

Acknowledgements

We could like to express our gratitude to all the people of South Gippsland who took the time and trouble to respond to the questionnaire. We would like to thank the Monash University Special Research Grants Committee for the research grant which made the sending of the questionnaire possible. Thanks are due to Ms Helen Malcolm for preparing and addressing most of the questionnaires, to Messrs Jack Missen, Gary Swinton and Ms Jenny Pascoe of the Geography Department for preparing the distribution map, and to Mesdames Lyn Anderson, H. MacDonald and C. Battersby for typing the manuscript.

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Are You a Bird Caller?

If so, you could possibly be Australia's champion! The Maryborough Field Naturalists' Club is calling all "bird callers" to enter their Second Australian Bird Call Imitation Championship at Maryborough on Saturday, 28th August. The Club presents this unique and entertaining Championship as part of the city's Golden Wattle Festival.

Each contestant MUST imitate the Laughing Kookaburra and at least three other Australian native birds, within a time slot of five minutes. No whistles, artificial aids or backing permitted! All entrants will combine in a Kookaburra Chorus after the judges have made their decisions.

Judging will be done by two well-known Victorian ornithologists. Total prize money of $500 will be awarded at the Judges' absolute discretion. There is a valuable trophy for the winner as well as a perpetual trophy.

Entry forms are available now from Mrs Eileen Courtney, 45 Carrick Street, Maryborough, 3465. Closing date for entries is 25th August.

(Continued from page 174)

Rotamah, the RAOU has another observatory at Eyre and is establishing a third at Barren Grounds in NSW.

Rotamah is an old farm house and slides were shown of the environment and some of the mammals and reptiles that can be seen there. The bird projects include mist netting and breeding studies.

Exhibits. Coral Gum *Eucalyptus torquata* that was growing in Hopetoun streets; rust fungus gall on black wattle that also attacks 48 other Acacias; cocoons or hairy caterpillars that had been parasitised; snails *Cernuella virgata* from western wheat areas where they are damaging crops; a marsupial mouse *Antechinus flavipes*(?) that a cat had brought in at Tallarook.

Conservation. Malcolm Turner tabled LCC recommendations for South Gippsland and for Hill End to be cleared for pines, and literature on "Conservation Strategy" and "Endangered Species".

Editors. A vote of thanks was passed in appreciation of our editors.

Serve-yourself-Supper was available.

Naturalist Review

"A Field Guide to the Tracks and Traces of Australian Animals"

BY R. G. B. MORRISON

Rigby, Adelaide. Field Guide Series, 1981. ISBN 0 7270 1489 7. Rrp $14.95 (discount to F.N.C.V. members).

Biologists have long recognized the validity of animal survey techniques which are not based on direct observation or trapping, but rather on the identification of animal remains, droppings, tracks and scratchings. However, a difficulty is that it takes a great deal of field experience and knowledge of the possible animals responsible for the signs for such techniques to be of any use. This field guide certainly help in overcoming a deficiency in such experience.

Morrison's book is first-class. It begins with a chapter on classifying and naming animals. It is so refreshing to see his taxonomy is based on the recent works contained in Stonehouse and Gilmour (*The Biology of Marsupials*, MacMillan, 1977) and not on now more outmoded, but still often cited reference works. It is also pleasing to see his common names of mammals are those suggested as standard book names by the Australian Mammal Society (*AMS Bulletin 6:* 13-23). Hyett and Shaw's failure to use these names represents a serious disadvantage of their otherwise good field guide to our mammals (Hyett, J. and Shaw, N. *Australian Mammals: A Field Guide for New South Wales, Victoria, South Australia and Tasmania*. Nelson 1980).

The second chapter in Morrison's book provides a very good methodology for identifying skulls. A user with only an elementary knowledge of biology should be able to classify a skull as either reptile, bird or mammal; if the latter, decide if it is a monotreme, marsupial or eutherian, its likely diet and even its order. 170 photographs of skulls assist in this task. The next chapter, "Droppings and Owl Pellets" also uses photographs (48) and useful notes to assist in identifying the scat depositor. Then follow chapters on "Tracks and Trails" (including scaled sketches of hind and fore feet of representatives of the marsupials, 126 photographs and diagnostically useful notes), "Scratchings and Diggings" ("Lavatories" seems a strange subtitle to describe places where cats cover their scats) and an interesting (but somewhat irrelevant) chapter on how aborigines record and reproduce animal tracks. A final chapter ("Collecting and Storage Techniques") includes a most useful description of how to make a plaster cast of a footprint.

Morrison's field guide has a glossary, is well indexed and the use of photographs (all with scales) is excellent. It is not only a must for naturalists and bushwalkers who would like to know what vertebrates could have left their signs in an area — it is also an essential aid for those undertaking a more serious survey of fauna in a particular habitat.

R.L.W.

Fungus Excursion at Kinglake
Sunday 6 June

On such a bitter morning it was heartening to be welcomed by two roaring fires; Keith and Joan Risinen had arrived early and got things going.

Dr Jim Willis spoke briefly about fungi, what we might expect to find here and where to look. It was not until after lunch that we scattered and began to collect. It is astonishing what our little Kinglake property can produce — more than 60 different species! They were all spread out in an orderly manner, Jim Willis was kept busy naming the various species, and everybody was able to examine them or photograph them. It was an exciting collection and, to mention a few of its riches, there were 6 different Cortinarius, a fascinating pineapple Boletus *B. pallescens*, and a bracket fungus *Paxillus panuoides* with unusual sculptured frills.

Our thanks go to Jim Willis for his enthusiasm and knowledge, and to the Risinens for their fires, etc.

General Meeting
Monday 21 June

The speaker was Mr David Robertson who is researching various aspects of Gellibrand Hill, 1500 acres near Tullamarine Airport recently declared a national park. It is open grassy woodland that was previously grazed by stock and little native vegetation is left. Mr Robertson hopes to find out what regeneration, if any, can occur when lightly grazed by kangaroos only, and the effect of burning and frequency of burning. He has sundry fenced plots for the various projects but the undertaking is still young.

Exhibits. There was a fine display of photos and pressed plant specimens from Gellibrand Hill. The skull of an albatross, about 22cm long (9″), had been found on the beach. Another skull about 3cm long (1¼″) was the bush rat *Rattus fuscipes*. Preserved in a bottle was a baby bandicoot that had been evicted from the pouch; it was about 5cm long (2″) with large head and large eyes.

Tall plants of native blady grass *Imperata cylindrica* had several nesting shelters of skipper moth larvae. One had been eaten by a wasp and the shelter now contained wasp cocoons.

Conservation. Our new conservation co-ordinator Malcolm Turner said he saw his job as a funnel — to funnel members ideas to the proper quarters and to funnel back their reception. He read a letter protesting against forest logging in the Grampians and a submission concerning Mt Eccles.

Objectives of the new Council stated by President Wendy Clark included a more active role in conservation, more member participation at general meetings with exhibits and nature notes, continued search for new premises, and other items.

Coffee and tea was available after the meeting and many members stayed longer in the relaxed atmosphere.

General Meeting
Monday 12 July

Speakers were Alan Burbidge and Julie Raines, rangers in charge of the RAOU Rotamah Island Bird Observatory. Situated in the Gippsland Lakes National Park, Rotamah is a narrow island of about 260 hectares. As well as researching sundry aspects of birds, mammals and reptiles, one of the objects of the observatory is to enable ordinary people to partake in such activities. Several courses have been run, of 3 or 4 days duration, at $14 each night. Anyone can go. As well as

(Continued on page 172)

(from inside front cover)

Thursday, 16th September. Ringwood Lake etc. Meet at barbecue area 11.30 a.m. Train leaves Flinders St 10.30 a.m. Leader: Gwyneth Taylor 878 3415.

Thursday, 21 October. George Pentland Botanical Gardens, Frankston. Leader: A. Fairhall 578 2009.

At the National Herbarium, the Domain, at 8.00 p.m.

First Tuesday — Mammal Survey Group.

Tuesday, 7th September. Glider ecology. Speaker: Stephen Henry.

Tuesday, 5th October. MSGV activities. Speaker: Jill Poynton.

Third Wednesday — Microscopy Group.

Wednesday, 18th August. Basic use of optics.

Wednesday, 15th September. Hydroids of Black Rock. Speaker: Dan McInnes.

Wednesday, 21st October. 35mm slides — Club members.

Second Thursday — Botany Group.

Thursday, 12th August. Some peas of Victoria. Speaker: Mrs M. Corrick.

Thursday, 9th September. To be announced.

Thursday, 14th October. Pollination in native plants. Speaker: Mr P. Lumley.

GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

Mammal Survey.

Saturday, 14th — Sunday, 15th August. Mt Worth.
Saturday, 11th — Sunday, 12th September. Big River.
Saturday, 9th — Sunday, 10th October. Buxton.

Botany Group.

Saturday, 26th September. Rushworth.
Saturday, 30th October. Kinglake National Park.

Field Naturalists Club of Victoria

Established 1880

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Members include beginners as well as experienced naturalists.

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MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1982

Metropolitan	$15.00
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GENERAL MEETINGS

Monday, 8th November, at 8.00 p.m.

Presentation of the Australian Natural History Medallion 1982, awarded to the late Howard Jarman. Mrs Beryl Jarman will receive the Medallion on her husband's behalf. Mr Jack Hyett will speak on Howard Jarman's work as an ornithologist.

Monday, 11th October, 8.00 p.m.

Mr John Beumah: Pels.

Tuesday, 9th November, 8.00 p.m.

Presentation of the Natural History Medallion.

Monday, 12th December, 8.00 p.m.

Microscopical film "Wonders of pond life". Mr Paul Genery.

New Members September/October General Meetings.

Metropolitan

Robin Adair, 37 Fairmont Ave., Camberwell
Valerie Curtis, 71 McComb Blvd., Frankston (Mammals and birds)
Margaret Fahrocndin, 1 Hicket Ave., Greensborough
John James, 27 McArthur St., Malvern
Kath Lithgow, Department of Physiology, Monash University
Mrs A. B. Nuttall, 15 Koolkuna Ave., Doncaster (Botany)
Sonia White, 2/3 Balcombe St., Frankston
Jeffrey Yugovic, 1/14 Brougham St., North Melbourne

Joint

Moira Devane, 810 Drummond St., Carlton North
Kate Gowland, 16 Kumala Rd., Bayswater

Country

Timothy Lufwisle, W.S.D. Yapeen

FNCV EXCURSIONS

Tuesday, 2nd November, Cup Day. Lallatook/Mt Piper area. Leader: Peter Kelly. The coach will leave Batman Ave., at 9.00 a.m. Fare $8.00. Bring a picnic lunch and a snack.

Saturday, 13th — Sunday, 14th November. Ballarat and Lal-Lal. This weekend includes a ride in horsedrawn carts through the bush around Lal Lal where we could not take the coach to see some of the historic sites in the district as well as native plants etc. The vehicles will take about 24 but some horses are also available at extra cost if anyone wishes to ride. Lunch is included on this day and motel accommodation has been booked in Ballarat on a D.B.B. basis at the Miners Rest Motel. The coach will leave Flinders St., from the Gas and Fuel at 8.20 on Saturday morning. Bring one picnic lunch. Cost for the weekend is $60.00 which should be paid to the Excursion Secretary by 31st October.

Sunday, 5th December. Marysville. The coach will leave Batman Avenue at 9.30 a.m. Fare $9.00. Bring one meal and a snack.

Saturday, 15th January-Friday, 21st January. Falls Creek. Accommodation has been booked at a motel D.B.B. for the period and a coach chartered. Cost $290; a deposit of $20.00 should be paid to the Excursion Secretary when booking and the balance by the December General Meeting.

GROUP MEETINGS

FNCV members are invited to attend any Group meeting.

Day Group — Third Thursday.

Thursday, 21st October. George Pentland Botanical Garden, Frankston. (Melway 120 D4) Meet at Victoria Parade gate, 11.30 a.m. Train from Flinders St., 10.00 a.m. Leader: Alf Fairhall 578 2009.

Thursday, 18th November.

Edwardes Lake Park, Reservoir. (Melway 18 D5) Meet at Reservoir station 11.15 a.m. Epping train from Princes Bridge 10.47 a.m. Leader: F. Graham 469 2509.

No meeting in December.

At the National Herbarium, the Domain, at 8.00 p.m.

First Tuesday — Mammal Survey Group.

Tuesday 7th December. Members night.

Third Wednesday — Microscopy Group.

Wednesday, 20th October. 35 mm slides — Club members.

Wednesday, 17th November. Film — "Insects". Paul Genery.

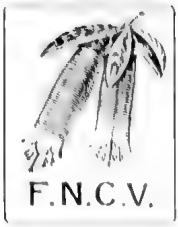
Second Thursday — Botany Group.

Thursday, 14th October. Pollination in native flowers. Mr Peter Lumley.

Thursday, 11th November. Hawaiian flowers and fruits. Dr Elizabeth Turner.

Thursday, 9th December. To be announced.

(continued page 219)



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Cover illustration: Sclerostegia tenuis, a samphire from a river floodplain west of Merbein

Some Bird Records for Beagle Reef, Tasmania

By J. S. Whinray*

Beagle Reef is in south-eastern Bass Strait, about eight kilometres north-west of Cape Barren Island (see Fig. 1). As its area is about one hectare, this islet is one of the smallest in the Furneaux Group.

Beagle is a granite islet and has two small beaches. The eastern one is a boulder beach, and the western one is a sand beach behind a very rough coast. These beaches, and the bare rocky coast, are about a quarter of a hectare in area.

About two-thirds of the islet's surface is flat or gently-sloping land about two metres above high water level. The summit, which is 6.5 metres above high water level, is a granite outcrop at the south end.

The north-east reef runs from about 100 to about 250 metres off the north-eastern point. The north-west reef is about 600 metres north-north-west of the islet. Both these outlying reefs are granite.

My first visit, on 6 February 1979, lasted for five hours. The second visit, on 15 December 1979, lasted but two hours as the wind was freshening.

Vegetation

The main species was Seaberry Saltbush *Rhagodia baccata* which covered about three-eighths of the vegetated part of the islet. Coast Saltbush *Atriplex cinerea*, which was about a quarter of the cover, was the other major species. Both these shrubs grew to 0.6 of a metre high (see Fig. 2).

The vegetation of a coastal strip along much of the north, east and south-eastern coasts had been modified by nesting of the Blackfaced Cormorant. On both visits, there were few plants in the most recently used areas. In the guano-rich strip of the east and south-eastern coasts, and of the south-eastern point, the main dominant was the Berry Saltbush *Atriplex semibaccata* which grew to 0.3 of a metre high (see Fig. 3).

The main grass was Prickly Speargrass *Stipa stipoides*, the hassocks of which formed a broken belt of varying width along the west coast. There were also a few on the north-eastern point. The native tussockgrass *Poa* sp. was much less common and its main occurrence was a small patch near the north coast.

The islet's vegetation was in very good condition and only one plant of each of two exotic species was seen.

Both of the outlying reefs had no vegetation.

Bird List

Little Penguin *Eudyptula minor*

In February an adult was found moulting in a hollow under Seaberry Saltbush on the north-west point.

Fig. 1. Part of the south-western section of the Furneaux Group.

* Flinders Island, Tasmania, 7255.

Fig. 2. The southern part of Beagle Reef, February 1979. Prickly Speargrass hassocks rise above a main cover of Coast Saltbush. The small darker patches in the latter are Seaberry Saltbush. The summit is in the distance. Photograph by I. S. Whinray.

A downy chick was found in a nesting hollow just west of the summit in December.

No other signs of this species were noticed during the visits.

Tasmanian Muttonbird *Puffinus tenuirostris*

In February about 100 burrows were occupied by this species. The smaller rookery was behind the north coast and extended a little way on to the north-west point. Three nestlings and four adults were found in some checked burrows.

The larger rookery was at the south end. It began at the northern end of the summit outcrop and extended about forty metres to the north-west. It was up to twenty metres wide. One nestling, an egg and an adult were found in a few checked burrows.

The most intensively burrowed part of the islet's rookeries was at the northern base of the summit outcrop. There the Coast Saltbush had been given a brown coating by dirt scratched out recently from the burrows.

No burrows were checked in December but I noticed that those in the rookery just north of the summit had been scratched out, discolouring the Saltbush again.

Whitefaced Stormpetrel *Pelagodroma marina*

On 15 November 1907, Armstrong (1908) found many burrows of this species "situated in sandy grounds (sic) amongst tussocks" and, with his companion, took several fresh eggs. "In each case" he added, "where there was an egg the bird was in the hole".

In February I found only one burrow which could have been made by this species. It was at the southern edge of the northern tussockgrass patch. Although empty, it was in good condi-

Fig. 3. The south-eastern coast and point of Beagle Reef, February 1979. Unmodified shrub vegetation on the left gives way to Berry Saltbush in the guano-rich, rocky central strip which then slopes to the bare coastal rocks. The north-eastern point is in the background. Photograph by J. S. Whinray.

tion, and might have been used during the recent breeding season.

The burrow found in February was not in use in December. No other burrows of that size were seen.

Blackfaced Cormorant *Phalacrocorax fuscescens*

On 15 November 1907, Armstrong (1908) found a large rookery "in progress, containing, I should say, 200 nests". It was "On the rocks" and this probably meant on the rocky coastal area.

The islet was listed as a rookery by Serventy et al. (1971).* They indicated neither when this record was made nor by whom.

At the time of my February visit the most recently used rookery on the islet was on the western part of the north coast and the adjacent part of the north-west point. The latter part was very rocky and the rookery finished about thirty metres from the tip of the point.

In the rookery were about 200 nests that seemed to have been used in late 1978. A few dead adults and dead nestlings were found amongst them. Some nests along the southern edge of the rookery had been built amongst Coast Saltbush, most of which had been killed, presumably by the birds' droppings and trampling.

All but two small sections of the coastal strip running from this rookery around the east and south-eastern coasts to just south-east of the summit had been used previously as rookery by this species. The exceptions were part of the eastern side of the north-eastern point and a short piece of the rocky coast at the southern end of the eastern beach.

* While the islet is entered on their list as Beagle Reef, it is lumped in their index with two Western Australian islands under the single name of "Beagle Island".

The species was present throughout this visit and the larger count was made just after landing. At that time there were eight adults in sight on the islet, one on the north-east reef and eighteen on the north-west reef. Later there were fifteen at the southern end of the islet but the north-west reef was too far away to be checked from there.

In December the first sighting was of one mature and four large immature birds. The largest count after that was nine adults and two immature birds for the islet and an adjacent rock. At the same time there were eighteen on the north-west reef but it was impossible to tell how many of the latter were mature birds. All the immature birds recorded during this visit could fly.

A strip of coastal land from about thirty-five metres north-west of the south-eastern point to about twenty metres north-east of the summit had been used as a rookery since February. The most recent nests were those furthest to the north-west of the point. They numbered about sixty and seemed to have been used late in the year. One dead nestling was found at them. There had been about 350 nests in the rest of the rookery, and they seemed to have been built soon after my February visit.

Cape Barren Goose *Cereopsis novaehollandiae*

Guiler (1967) listed Beagle as one of the islands that "may be used occasionally by geese for feeding but generally are little utilized by the birds and were not studied in any detail" during his Furneaux Group survey from 1957 to 1965.

No birds were present in February but a large nest, with the typical down of this species, was found amongst some Prickly Speargrass hassocks about forty metres north-north-west of the summit. It would have been built by the species during the 1978 season.

There were no birds in December but a few droppings were found.

Sooty Oystercatcher *Haematopus fuliginosus*

Just after landing in February I noticed one on the north-east reef and another on a bared rock off the west coast.

In December one was seen on the bared rocks of the south-eastern point.

Ruddy Turnstone *Arenaria interpres*

An adult rose from the very rough, bouldery north coast when I landed there in February. One, which might have been the same bird, was flushed later from the bared rocky coast east of the summit.

In December one bird rose from the bared boulders of the eastern beach. Later four were seen on a bared south-eastern point rock.

All the birds of both visits had non-breeding plumage.

Silver Gull *Larus novaehollandiae*

This species was one of those which Armstrong (1908) listed as "flying about" the islet when he recorded birds there "in great numbers" on 15 November 1907.

My sighting in February was one bird on the north-west reef just after I landed on the islet.

The sole December record was two mature and three immature birds which landed on the sea near the eastern beach. Later they flew north away from the islet.

Pacific Gull *Larus pacificus*

This species was also one of those which Armstrong (1908) listed as "flying about" the islet when he recorded birds there "in great numbers" on 15 November 1907.

It was present throughout the February visit and the count taken just after my arrival was the larger one. At that time there were one mature and two immature birds on the north-east reef. Fourteen mature and eight immature birds were on the islet and its adjacent bared rocks.

A later count from the summit record-

ed six mature and two immature birds for the islet. All the immature birds seen during the visit were brown and could fly.

There were many mature birds on and flying above the islet in December. The largest count was thirty-nine and there could have been more out of sight. Seven nests were found. Five were empty and two had one addled egg each. A dead chick 150 mm long was found beside one empty nest; two live chicks of about the same size were found near another empty nest.

Caspian Tern *Hydroporgne caspia*

On 15 November 1907, Armstrong (1908) recorded a pair flying about the islet and he found a fresh egg.

During the early part of my February visit an adult flew around occasionally over the islet but did not dive at me. A little later there were two adults on the north-east reef.

There was a pair of adults at the islet in December and they dived at me twice.

Fairy Tern *Sterna nereis*

In December there were eight nests of this species in sand at high water level amongst driftwood near the northern end of the western beach. Eighteen adults were present when my count was taken.

There were two nests with two eggs each; one nest with one egg; one nest with two chicks about 75 mm long; one nest with a chick and an egg; one empty nest with broken egg shells nearby, and two more empty nests. All the nests were shallow depressions in the sand.

Crested Tern *Sterna bergii*

In 1893 Campbell (1900) was "informed that these Terns bred in number on a rock (Bramble?) lying to the south of Goose Island". For several reasons I consider that this report refers to Beagle Reef. There are neither islands nor reefs due south of Goose Island but Beagle is southwards of it. On the Admiralty Bass Strait chart it is called "Beagle Rock"* and its small size makes that name reasonable. In addition, "Bramble" is closer to its name than it is to the name of any other south-western islet or reef of the Furneaux Group.

This species was another of those which Armstrong (1908) listed as "flying about" the islet when he recorded birds there "in great numbers" on 15 November 1907.

Little Grassbird *Megalurus gramineus*

Grassbirds were recorded in most of the shrubby parts of the islet in February and were heard calling during most of the visit. The largest number seen at the one time was six. (The locality of that sighting is the foreground area of Fig. 2.) I estimated the islet's population as about twelve birds.

Only two were seen in December. Both were in low shrubs near the north coast.

Comments

This list of thirteen species is the second set of records published for the islet and includes all the prior records known to me.

Beagle Reef is a very important Blackfaced Cormorant rookery because the one recorded there in December 1979 is the fifth largest I have found, to December 1981, during visits to sixty islands, islets and reefs in the Furneaux Group. The area of modified vegetation is the largest I have seen in the Group and suggests long, frequent usage by this species. But of course I cannot say if it breeds on the islet every year.

It seems that some listings in Serventy et al. (1971) should be used with caution. In the Blackfaced Cormorant list, for example, they give no indication of the sources nor any dates for the records. The unstated assumption of this, and their other lists, is that the species concerned continue to breed on the listed islands. This is an arguable assumption for those species which are

* Chart 1695A, 1921 edition, with corrections to 1964.

known to change their breeding sites. For such species, the present lists merely indicate that the birds have bred on the named islands. The years when the records were made, and the sources, should be given in future lists of that sort.

On both visits I walked over most of the islet and consider that few burrows could have been missed. So I conclude that the Whitefaced Stormpetrel numbers have decreased considerably since 1907. Armstrong's account of his 1907 Furneaux Group visit made no mention of Tasmanian Muttonbirds (Armstrong, 1908) and so his failure to record the species for Beagle Reef is not an indication of the absence then of rookeries of that species. Either he might not have bothered to record so common a species, or the birds might not have returned by then to the rookeries for their annual egg laying.

Because of its distance from my home, and the small size of the borrowed boat which is used for my trips, it was not possible to check the islet regularly for breeding birds. Cape Barren Geese, Fairy Penguins, Tasmanian Muttonbirds, Caspian Terns, Pacific Gulls and Sooty Oystercatchers are likely to breed there regularly. Silver Gulls, Crested Terns and Fairy Terns are likely to breed there from time to time.

The record of the Little Grassbird is yet another local one of this species in an atypical Tasmanian habitat. Some prior local records were given in an earlier paper (Whinray, 1976).

Because of its use by cormorants, and because the vegetation was in such good condition, I suggested in mid 1979 to the National Parks and Wildlife Service that the islet should be made a reserve. They told me that it had been so declared in 1976 as part of the Chappell Islands Nature Reserve, and added that it was done without any knowledge on their part of either its vegetation or its birds.

So I am pleased to have shown that it is a very worthwhile addition to Tasmania's reserves, and to be able to add that the National Parks and Wildlife Service carries out investigations of local areas nowadays before making them into reserves. However the Service has only two officers to do such work for the entire State, and their investigations are hampered by the lack of money.

Acknowledgements

The generous loan of Mr G. W. G. Goode's boat made the visits possible. Mr R. B. Filson commented helpfully on an early draft of this note.

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Old Photos of Wilsons Promontory

By December 1982, Wilsons Promotory National Park, or "The Prom" as it is affectionately known, will have a new information and Education Centre at Tidal River. To inject human interest into the visitor displays and slide programmes featuring different aspects of the park, the National Parks Service is keen to look at photos taken by the general public in and around "The Prom" up to the early 1950s. If members of the public have photographs which they feel may be interesting, please contact Barbara Cameron-Smith (03) 651 4152 or Sandra Bardwell (03) 651 4473. The original would be returned.

Notes on Inland Samphires of Victoria

By J. H. Browne*

Those members of the plant family Chenopodiaceae generally called samphires, beadbushes or glassworts (subfamily Salicornioideae) in Victoria have recently been taxonomically revised (P. G. Wilson 1980 Nuytsia *3:* 3-154). With satisfactory taxonomy now available for the first time, this paper provides notes on the ecology and distribution of samphires in parts of NW Victoria between Mildura and the Natimuk area. This includes parts of the plant distribution grid squares A, B, C, F and G (the boundaries of these grids are shown in 'A Handbook to Plants in Victoria' Vol. II by J. H. Willis. Melbourne Univ. Press).

A. *Halosarcias*

1. *Halosarcia flabelliformis*

This species is found in Grid A (small stand on W edge of Raak Plain, and Grid C (large stand on E side of Mitre Lake, small stand on S end of unnamed lake just NE of Lake Wyn Wyn).

This species occurs on its own in a different habitat to the others in the genus, in that it is found on the lowest ground which is subject to flooding. With the rise in the water table, this would most likely occur every winter. The soil in all stands that I have found is sandy with a high kopi (flour gypsum) content. There is no sign of salt when it is dry in the Raak Plain stand. Surface salinity may not become high, even in summer, if in dry periods the water table sinks down through the sand rather than water remaining on the surface till evaporation raises the salinity.

Some other *Halosarcias* are also winter-flooded, but possibly for a shorter period, the water is shallower (about 5 cm) and the soil clayey. Such soils are often firm enough to walk on but in the Raak *H. flabelliformis* stand, I sink past my ankles when it is flooded.

2. *H. halocnemoides*

In Grid A, this species has been seen just W of Nowingi and in the Raak Plain proper, and at Hattah Lakes National Park. In Grid B it has been seen in Pink Lakes State Park; in Grid F at Lake Myall; in Grid G at Towan Plains, Lake Wahpool and Lake Tyrrell.

The species is a complex with many variants differing in the size of the plant, the articles and fruiting spikes. Sometimes even the size and markings on the seed differ. It is not known to what extent this variation is genetic.

All individuals I have found have been around the margin of salt lakes or pans, mostly in the Raak and Pink Lake areas. A tall variant (1 m) with 1 cm spikes is found in the red loam on the samphire zone around some of the Raak salt lakes and the species grades to a small variant along the seepage lines. One variant extends into the strongly saline area and looks like *H. nitida*, another is close to and in similar soil to the Raak *H. flabelliformis*. Most are in the moderately saline area. The main samphires with them are *H. pergranulata, H. indica, H. pruinosa* and *Sclerostegia moniliformis*.

3. *H. indica* subsp. *leiostachya*

This is a common plant in the samphire areas in Grids A, B, F and G. It is much rarer in Grid C. During a recent field trip, one stand was found near Picnic Point at Lake Hindmarsh and another around a salt lake just E of the highway a few km N of Jeparit (both in C6). However, only a single fruiting plant was seen further south, despite ex-

*Fitzroy Ave., Red Cliffs, Victoria. 3496, Australia.

tensive searching.

This species forms part of the outer zone in some samphire flats and around salt lakes but constitutes the next zone in, in areas where *H. pterygosperma* is present. It is never or seldom on its own, usually growing with *H. pergranulata* and, where they occur, *H. pruinosa* and *Sclerostegia moniliformis*. It occupies the moderately saline zone. It does not vary as much as some *Halosarcias* although some with small spikes are hard to distinguish from some *H. pruinosa* without checking the seed.

4. *H. lylei*

In Grid A, it has been seen just W of Nowingi and in the Raak Plain proper, and at Hattah Lakes NP. In Grid G it occurs at Towan Plains and Lake Tyrrell.

It is found along the seepage line of some salt lakes and samphire flats, usually where there is high ground behind them. These are seasonally wet areas that would have a thin salt crust when dry. Sometimes it occurs as a narrow band on its own, at other times with *H. pergranulata*.

5. *H. nitida*

In Grid A it has been seen just W of Nowingi and in the Raak Plain proper, and at Hattah Lakes NP. In Grid G it occurs at Lake Wahpool.

It is found on strongly saline and gypseous soil. It forms the innermost zone before the unvegetated part of the lake or occupies the centre of pans where there is often seasonally shallow water. Sometimes it is found on its own, at other times with *H. halocnemoides* and *H. pergranulata*. Both of the last two in this situation are stunted, red, and have very few fruiting spikes.

6. *H. pruinosa*

In Grid A it has been seen at Lake Ranfurley near Mildura, just W of Nowingi and in the Raak Plain proper, and at Hattah Lakes NP. In Grid G it occurs at Pink Lakes State Park and salt flats N of Boinka, in Grid C on flats SW of Jeparit and in Grid G at Lakes Timboram, Wahpool, Tyrrell and at Towan Plains.

Pl. 1: *Halosarcia pruinosa* from a large salt lake just west of Nowingi.

It occupies much the same zone as *H. indica* subsp. *leiostachya* but when the samphire flat is moderately saline, it extends further into it.

7. *H. pergranulata*

This is the most common *Halosarcia* in all areas. Plants vary from 1 m high to prostrate. The seed morphology and the shape but not the size of the fruiting spike are always the same. It is seldom found in the outer zone where there are other *Halosarcias*. In some of the Raak and Pink Lake salt pans, the species extends into the strongly saline area as red and stunted plants.

8. *H. pterygosperma*

It occurs in the outer zone of most samphire areas in Grids A and B. It is found in Grid G at Towan Plains and Lakes Timboram, Wahpool and Tyrrell. It occurs in possibly the least saline soil of all *Halosarcias*. It always constitutes the outer zone on samphire flats. It is also found on higher, almost pure, kopi areas away from salt lakes.

9. *H. syncarpa*

It is found only in Grid C S of Jeparit and W of the Wimmera River. The main stands are on flats SW of Jeparit. Others are at Pink Lake near Dimboola and an unnamed lake 7 km N of there; also in the Natimuk area at Mitre Lake and the unnamed lake just NE of Lake Wyn Wyn.

It is found in the outer zone of samphire flats and also on rises with *H. pergranulata* in the next zone inwards.

When the *Halosarcias* are ranked in order from least saline zone to most saline zone for the area north of Jeparit, the likely order is:

H. pterygosperma
H. indica subsp. *leiostachya*
H. pruinosa
H. halocnemoides
H. pergranulata
H. nitida

while south of Jeparit the likely order is:

H. syncarpa
H. pruinosa and (rarely occurring) *H. indica*
H. pergranulata.

It seems likely that in general on going north from Jeparit, the place of *H. syncarpa* is taken by *H. indica* subsp. *leiostachya.*

B. *Other samphires*

10. *Sclerostegia tenuis*

My knowledge of this plant is confined to those along the road between the 142° Meridian Road west of Merbein and then west to Lake Wallawalla. The

Pl. 2: *Scleroskgia tenuis* from river floodplain west of Merbein.

area is open, flat, old river flood plain. Dominant plants are *Atriplex* and *Maireana* with a few scattered *Eucalyptus largiflorens.* The soil is clayey, heavy in places and only slightly saline. *S. tenuis* is found in small, scattered stands and is not a common plant. A likely spot would be around the roadside pools where earth had been removed to form the crown on the road.

Distribution: Grid A (Merbein to Lake Wallawalla) but also recorded for Grid G.

11. *Sclerostegia moniliformis*

This species was previously only known from 9 locations in Western Australia. Searches made in NW Victoria during 1981 resulted in 5 locations for this state. It is possible that in some areas it could have been confused with the rather different-looking *S. tenuis* in the past. It is not a widespread plant,

but where found it is usually dominant amongst the mixed *Halosarcias* around the margin of salt lakes. It is also on the small ridges of reddish sandy clay loams around these lakes but 6 km north of Boinka it occupies darker-coloured clay flat.

Distribution: Grid A: Raak Plain, private property west of Nowingi and Hattah Lakes National Park. Grid G: Pink Lakes State Park and N of Boinka.

12. *Pachycornia triandra*

The prominently-lobed articles (stem segments) make this an easy plant to recognize. With the exception of a few small stands, its occurrence in Victoria is confined to the same area and the same slightly saline clays as *Sclerostegia tenuis*. It is a common plant there. It is not as palatable to sheep as the *Atriplex* and *Maireana* occurring with it and where these have been heavily grazed by sheep, it becomes the dominant plant.

Distribution: Grid A: Road from Merbein to Lake Wallawalla, Lake Cullulleraine and Abbotsford Bridge, Merbein.

13. *Sarcocornia quinqueflora*

This is a common plant in southern Victoria. Although there is a vouchered record for Grid A, I do not known its location, so it is a rare plant this far north. In NW Victoria, I only know it from where it forms a thick mat along the seepage line of several salt lakes in the Pink Lakes State Park. It is a common plant around the salt lakes in the Natimuk and Mount Arapiles areas.

Distribution: Grid B: Pink Lakes State Park. Grid C: most salt lakes. Grid G: Lake Tyrrell.

Acknowledgements

I gratefully acknowledge the assistance of P. G. Wilson for checking the identification of many specimens.

New F.N.C.V. Conservation Committee

Conservation has become a major concern for the public in general and Field Naturalists in particular. The appreciation of our natural environment by naturalists naturally leads to the urge to conserve it. To facilitate the exchange of views and information between naturalists and relevant authorities a conservation committee has been set up by the FNCV.

Issues we are currently concerned with include South Gippsland, Gippsland Hinterland and Hills End LCC Study Areas, The Grampians, The Otways, East Gippsland Woodchipping, The Alps, proposals to mine within national parks, protection of the habitat of threatened species and SW Tasmania.

If you have issues which require action, information which may be useful, or would like to help please contact the Conservation Co-ordinator, Malcolm Turner, 63 Laurel Gve, Blackburn, 3130 (Tel. 877 2835).

New Victorian Records: *Soliva* (Compositae)

By Helen I. Aston*

Abstract

Until recently, *Soliva pterosperma* was the only species of *Soliva* recognised as naturalized in Victoria (Willis, 1973). Now an additional three species, *S. anthemifolia, S. stolonifera* and *S. valdiviana,* together with a fifth *Soliva* taxon which is not yet satisfactorily identified, are known from this State. An account of the distribution and distinctions of all five is given here. Records are documented by specimens held at the National Herbarium of Victoria (MEL).

Introduction

When revising the genus in 1949, Cabrera distinguished nine species. All are small annuals in the family Compositae (Asteraceae) and all are native to South America. Several have become weed species in various countries including Australia and New Zealand (Healy, 1953) where they occupy disturbed sites, pastures, or open bushland and are particularly prevalent in lawns and city parklands. In the latter situations they are unwelcome because unsightly brown patches form when the plants die off in summer and because the sharp-spined fruits are uncomfortable for bare feet.

Johnson and Lovell (1980) report that fruit production by *S. valdiviana* and *S. pterosperma* in New Zealand is mostly from mid-November to the end of January, with germination being delayed until the first heavy rain in autumn. From collections in the National Herbarium of Victoria it appears that the fruiting period of *S. pterosperma* in Victoria is about one month ahead of that in New Zealand, as most fruiting plants are dated from mid-October to mid-December.

With their finely-divided foliage resembling that of our native *Cotula australis,* all species except *S. anthemifolia* and *S. stolonifera* can be overlooked in the vegetative condition. The latter two have leaves which are a little more distinctive (fig. 1). However, when flowering or fruiting all species are readily distinguished from *Cotula* or other genera, the achenes (fruits) being particularly distinctive. The achene of all species has an apical spine formed from the hardened style. In addition there are other achene characters which are distinctive for the particular species. These are described below and illustrated in fig. 2.

Soliva anthemifolia (Juss.) R.Br. ex Less.

This is known in Victoria from only one location, near the Murray River about 3 km south-west of Tocumwal, N.S.W., where it was found and collected on 4 June 1979 by A. C. Beauglehole (ACB 63962; MEL 597465). Plants were 10-20 cm in width and about 4 cm high. About a dozen plants occupied each of several isolated depressions which had held water earlier.

It is surprising that this adventive has not reached Victoria before as it has been long-established in both New South Wales and southern Queensland, e.g. MEL holds collections from the Brisbane River, 1855; from Port Jackson, pre-1867; Clarence River, 1875 and Wagga Wagga, 1886. The present distribution in New South Wales (Jacobs & Pickard, 1981) is extensive, including the whole coastal and western plains regions, and therefore it is very

* National Herbarium of Victoria, Birdwood Avenue, South Yarra, Victoria 3141.

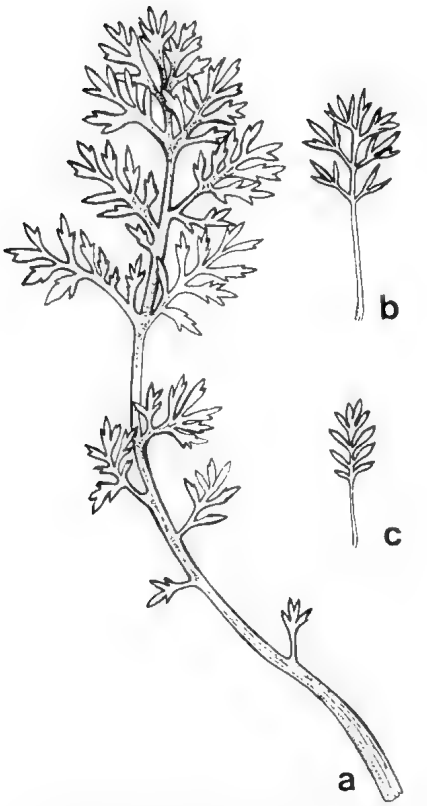

Fig. 1. Representative leaves of a, *S. anthemifolia;* b, *S. pterosperma, S. valdiviana*, and *Soliva* sp., c, S. stolonifera. All natural size.

probable that other occurrences will be located in northern Victoria.

Each mature fruiting head is crammed with numerous fruits and forms a near-globular, burr-like mass up to 1 cm across. A few heads may be clustered at the plant base and are then quite conspicuous. The leaves are irregularly bipinnate with acute segments, moderately densely arranged, up to 9-13 cm long and usually overtop and more or less hide the short basal stems.

The **achene** has a solitary apical spine and lacks membranous wings. Its body is compressed-oblanceoloid, the upper portion being obtuse to truncate with no lateral appendages and with long fine hairs at the summit. The lower portion of the body has thick transverse wrinkles encircling both edges.

Soliva pterosperma (Juss.) Less.

This is the most widespread, common, and oldest-established species in Victoria. The earliest collections at MEL are from Hawkesdale, north of Port Fairy, 1893 and from near Coburg, Melbourne, 1895, with the next oldest collections being from the Bruthen area about 1937, Black Rock 1939 and Kelvin View, near Euroa, 1942. Present-day distribution in the State is widespread south and east of a Nelson-Grampians-Chiltern line, excluding the Otways, Wilsons Promontory and the eastern highlands. There are no specimens at MEL to authenticate any records north of this line.

S. pterosperma apparently became established in New South Wales at about the same time as it did in Victoria, i.e. in the 1890's. It was not recorded by Moore (1884) but was present in at least the Port Jackson district by 1899 (specimen at MEL). Today it is distributed through eastern New South Wales from the western slopes to coastal areas, avoiding the north and central tablelands (Jacobs & Pickard, 1981). Establishment in Queensland was somewhat later as Bailey (1900 and 1913) did not record *S. pterosperma* for that State although it is now present through coastal areas from Rockhampton south to the border (Kleinschmidt & Johnson, 1977). It is also recorded for Western Australia (Green, 1981) and South Australia (Black, 1957, as *S. sessilis*).

In Australia, the name *S. pterosperma* has been applied to this species only since about 1960. Prior to that it was wrongly referred to as *S. sessilis* Ruiz & Pav. The usual vernacular name is Jo-Jo but in suburban Melbourne, where the species is particularly prevalent in lawns, the spiny fruits have led to public usage of Bindii or Bindy-eye. Adoption of this alternative name is unfortunate as it is already applied to a number of unrelated, sharp-fruited plants.

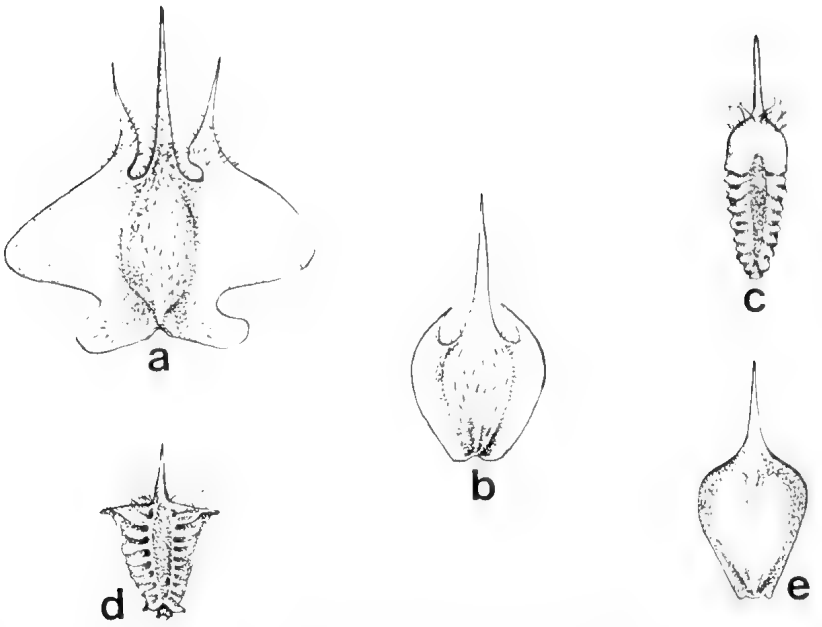

Fig. 2. Fruits of *Soliva* spp. a, *S. pterosperma* (from MEL 76153, Mallacoota). b, *Soliva* sp. (from MEL 76148, Strathewen). c, *S. anthemifolia* (from MEL 591938, Warialda, N.S.W.). d, *S. stolonifera* (from MEL n.n., Santiago, ? S. America). e, *S. valdiviana* (from MEL 76167, Valdivia, S. America).

Leaves arise from the plant base and the stem nodes and are mostly 1-3 cm long, with each pinna divided into 3-5 short, fine, acute segments. Mature fruiting heads are flattish, perhaps 6 mm or less across, sessile and solitary in the leaf axils and usually hidden by the foliage until the plant is examined.

The **achene** has three terminal spines, of which the central stylar one is the longest. The two lateral spines are projections from the apical portions of the achene wings. The wings themselves are broad, stiffly membranous, lateral projections from the achene body, each wing having a moderately to strongly pronounced basal lobe as well as its apical spine.

Soliva stolonifera (Brot.) Loudon

This species is recorded in Victoria from only two collections, both gathered recently by E. Chesterfield of the Forests Commission of Victoria. The first is from Long Plain, Barmah State Forest, 31 September 1979 (MEL 600361) and the second from Killawarra Forest, about 5 km north to NNE. of Mt Killawarra, Wangaratta district, 13 October 1981 (MEL 591828). The species also occurs in New South Wales, in the central and southern portions of the western slopes (Jacobs & Pickard, 1981).

Mature fruiting heads are small and relatively inconspicuous, sessile at the leaf bases. Leaves are short, only 2.5 cm long on the few collections seen, and differ from those of the other *Soliva* species discussed in being simply pinnate with the pinnae remaining undivided and short.

The **achene** has a solitary apical spine. Its body is more or less narrow-ellipsoid with lateral wings, each wing being broader above than below and mem-

branous with transverse ridges conspicuously raised on one side of the membrane. The upper corner of each wing is extended laterally into an acute, horizontal projection and the summit of the achene has long fine hairs.

Soliva valdiviana Phil.

There are only two Victorian records, one from lawns in the Queen Victoria Gardens, Melbourne, 29 November 1981 (MEL 595183-4) and the other from lawns beside the Camberwell City Hall, Camberwell Road, Camberwell, 1 February 1982 (MEL 600362). Both records were made by the author, who found plants spread over an area of a few square metres at each site. The species also occurs in Tasmania where it was considered new for that State in 1956 when a collection (MEL 76152) was made from plants infesting sports grounds in Hobart. Unfortunately at that time it was thought to be *S. sessilis* and this misidentification remains in the present "Student's Flora of Tasmania" (W. M. Curtis, 1963). More recent Tasmanian collections of *S. valdiviana* from lawns in Lindisfarne, November 1979, Parliament House Hobart, December 1981 and Rose Bay, December 1981, have been forwarded to MEL by D. I. Morris who reports (in litt., December 1981) that the species is apparently the only one in Tasmania and that it is not rare as a lawn weed, although not excessively common.

Mature fruiting heads and foliage of *S. valdiviana* are very similar to those of *S. pterosperma* and the two species are apparently indistinguishable except for their different achenes.

The **achene** has a solitary terminal spine and lacks wings. Its body is obovate in outline but flattened ventrally and mildly-keeled dorsally.

Soliva sp.

This is recorded in Victoria from only three collections, viz. Strathewen, Kinglake district, 1910 (MEL 76148); Lake Corringle area, Orbost district, 1970 (MEL 521158); South Yarra, Melbourne, 1981 (MEL 595178-182). It is not known whether this entity occurs in other States.

The **achene** is similar to that of *S. pterosperma* q.v. except that the achene wings are usually narrower and are entire, the basal lobes being absent. A slight indentation or nick may be present in the wing edge at the position where, in *S. pterosperma,* the basal lobe is separated from the major part of the wing.

The achenes agree with descriptions of those of *S. sessilis* Ruiz & Pav., a name which prior to about 1960 was wrongly applied in mainland Australia to *S. pterosperma*. The entity may prove to be the genuine *S. sessilis* but investigation of this point is not complete. It is possible instead that the entity is a form of *S. pterosperma* in which the basal lobes of the achene wings are not differentiated from the remainder of the wing. Certainly the degree of lobing at the achene wing-base in *S. pterosperma* is variable, and the lobes can be reduced to about half the size shown in the figure. Apart from the achenes, collections of *Soliva* sp. and *S. pterosperma* appear identical.

Current investigations on *S. pterosperma* in New Zealand may provide information which will solve the identity of the Victorian *Soliva* sp.

Further collections of all species, particularly from country areas and with mature achenes, could readily extend the distribution ranges outlined here and would be appreciated.

Acknowledgements

I wish to thank Dennis I. Morris, Weeds Officer, Tasmanian Department of Agriculture, Hobart for supplying recent Tasmanian collections of *S. valdiviana* and information on the species in that State; Evan Chesterfield and A. Cliff Beauglehole for their collections and new discoveries of *S. stolonifera* and *S. anthemifolia* respectively; Walter Stebbing, Katunga for his response to

my enquiries, Anita Podwyszynski for preparation of the figures and Prof. P. H. Lovell, Department of Botany, University of Auckland, New Zealand for preliminary information on work in progress there.

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Naturalist Review
"Frogs"

BY MICHAEL J. TYLER

The Australian Naturalist Library, Collins, Sydney. Second edition, 1982. ISBN 0 00 216450 7.
Rrp $9.95.

There are few changes in this new edition of Michael Tyler's "Frogs". The author states in his preface to this edition that "The body of the text remains the same". This is certainly true, even the errors remain from the first edition, although these are few and trivial. Consequently a review of this edition would be very similar to that of the first edition.

Michael Tyler is one of Australia's foremost authorities on amphibia and this book does much to stimulate interest in Australian frogs, a long neglected element of our fauna. The book is well written, well laid out and entertaining to read. It starts with five chapters describing the four families of Australian frogs and the introduced Cane Toad. These chapters are then followed by a consideration of frog biology which includes anatomy, prey, predators, parasites, dispersal and distribution. The book concludes with a brief history of herpetology in Australia and guidelines for further study.

One criticism which could be aimed at the book is that the author too often digresses away from the Australian fauna into other parts of the Australasian region. This emphasis is often too heavy considering that the book is part of "The Australian Naturalist Library".

In addition, there are a number of significant changes to this edition. Since the first edition the field guides of Cogger and Barker and Grigg have been published. These along with a number of other references have been added to the chapter on the "Study of Frogs". Furthermore, the Appendix "Changes in Frog Names" has been brought up to date, as has the lists of frog fauna from each state. One superficial change is in the format. The book is now limpback or has a laminated soft cover which "is ideal for home or field use". I don't see that this offers any advantage (the book is not a field guide anyway) except that this version is cheaper than the original hardback edition.

Overall there have been few substantial changes from the first edition. If you already own the first edition, I cannot see much point in buying the second edition, however, if you don't own the first edition I would recommend that you buy this new edition, if you have any interest in Australian frogs.

Geoff Duke

The Early Devonian Fauna of the Mt. Ida Formation in the Heathcote District

By J. V. Neil.*

Introduction

This paper is intended to update the faunal lists for the youngest and most fossiliferous beds in the important Palaeozoic sequence of rocks in the Heathcote District of Central Victoria. Detailed taxonomic work on the trilobites is in preparation, and the bivalve molluscs will be the subject of further study by a New Zealand worker. It is, however, believed that detailed faunal lists based on the latest information will be of assistance to palaeontologists and others interested in the Early Devonian rocks of Australia, and may be valuable in refining stratigraphical correlation of such sequences.

Previous Work

The mapping and collecting undertaken in the Heathcote district more than forty years ago by Thomas (1937) and the monograph by Talent (1965) based on Thomas's collections represents the foundation on which knowledge of the faunas of this richly fossiliferous area has been established. In the words of Talent (1965): "Without Dr Thomas's labours this important succession would not have been known in such detail, for most workers would have been disheartened by the poorly preserved material forming such a large part of the collections made in the Heathcote district." In 1951, Gill described two new species of brachiopod from the fauna. Together with Talent's memoir, and a brief paper by the writer (Neil, 1981), this is all that has been published on the faunas. However, since 1973, the writer has collected extensively from Thomas's original localities, and along the strike of the fossiliferous beds.

* 23 Michael St., Bendigo, 3550, Victoria.

Stratigraphy of the Heathcote Succession

In the Heathcote-Costerfield-Redcastle area almost 7500 m of sandstones, siltstones, mudstones and, at the top of the sequence, conglomerate, represent a lengthy period of marine deposition from the Silurian into the Devonian. The Early Silurian Costerfield Formation crops out in the east, and successively younger rocks occur until the Mt Ida Fault and the Melvor Fault truncate the succession where it is faulted against the Cambrian "greenstones" in the west. Thomas and Talent have used formation names which have become established by usage, and they are used here. Above the Costerfield Formation (Costerfield siltstone of Vandenberg, Garratt and Spencer-Jones, 1976) is the Wapentake Formation which includes the fossiliferous "Hlaenus Band" monographed by Opik in 1953. There follows the Dargile Formation, including Thomas's "Aegiria — Encrinurus Beds", the Melvor Formation ("Sandstone" of Vandenberg *et al*) and finally the Mt Ida Formation. This last has been informally divided into four "units", of which Unit 3 — the *Pleurodictyum* Beds, is the major subject of this paper. (See Fig.1).

Correlation of the sequence is the subject of continuing discussion, largely on palaeontological grounds, though it is agreed that the total range is from earliest Silurian to Early Devonian. A fuller discussion will be found in Holloway and Neil (in prep.), particularly in relation to the Siluro-Devonian boundary. The accompanying stratigraphical column is based on that of Vandenberg in Vandenberg, Garratt and Spencer-Jones (1976). (See Fig.1)

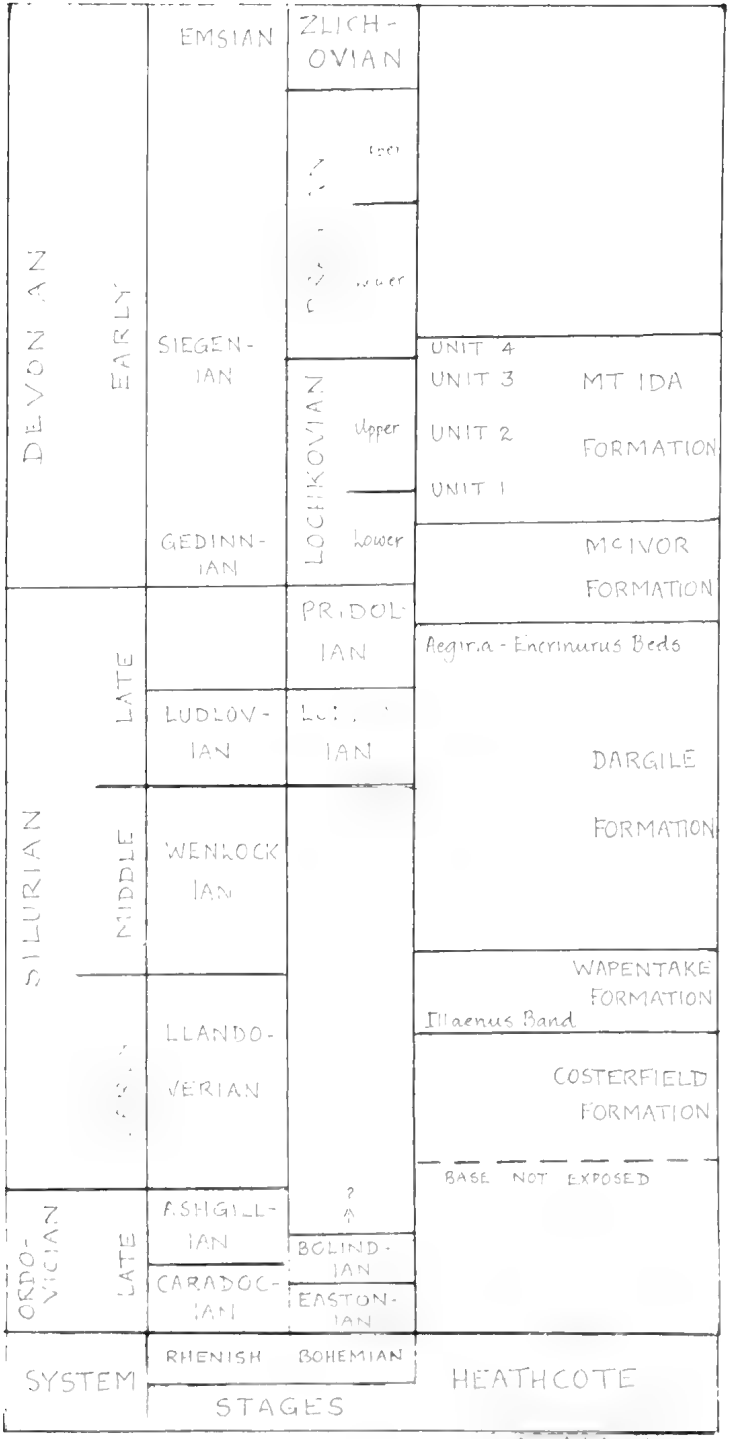


FIGURE 1

After A H M Vandenberg

Fig. 1. Stratigraphic column for the Heathcote succession

The Unit 3 of the Mt Ida Formation is thus referred to the Early Devonian.

Area, Outcrop and Lithology

Although the Mt Ida Formation crops out most conspicuously in the parishes of Dargile and Heathcote, where a strike ridge of resistant sandstone culminates in Mt Ida itself, the localities yielding the most abundant and diverse faunas occur in the parish of Redcastle, immediately to the north. Additional exposures in this area were revealed in 1977, by extensive bulldozing and ripping during subdivision. Many gullies were filled in, resulting in the temporary loss of some of the best localities, though subsequent erosion has re-exposed the fossiliferous beds in the vicinity.

The area is one of gently undulating topography lying to the east of the Mt Camel Range (Cambrian "Greenstones"). The strata strike North-South, and have dips ranging from 65° to 75°. Occasional outcrops occur on the hillsides, but the best exposures are found in the gullies of a number of tributaries of Cornella Creek. Floaters in the creek beds and on the hillsides have provided a significant proportion of the specimens.

The beds consist of sandstones ranging in colour from grey, through orange and yellow to purplish tones together with brown, reddish and olive-green siltstones and mudstones. The degree of induration varies markedly in outcrop, sometimes within a few metres. For instance, at Thomas's locality 25, soft, richly fossiliferous, reddish siltstones are associated with hard, grey sandstones showing some evidence of recrystallization. With one exception, it has not been possible to identify thin, marker beds, which could be used for correlation. The exception is the grey, indurated sandstone, mentioned above,

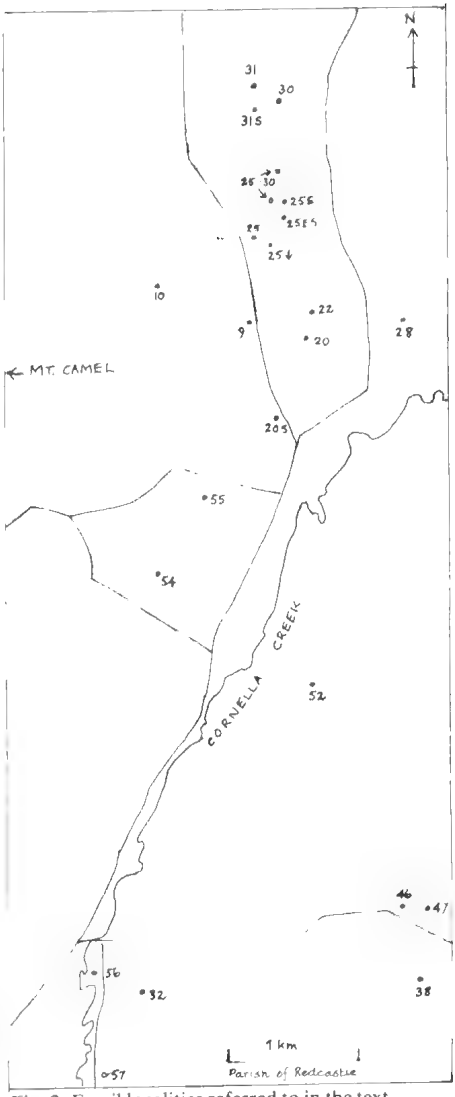


Fig. 2. Fossil localities referred to in the text.

which is characterised by an unusually large number of gastropods. This bed can be identified at localities 25 and 31, about 1.1 km apart.

The Localities

(See Fig. 2 — part of the parish of Redcastle) Most of the localities shown occur in Unit 3 ("Pleurodictyum Beds") of the Mt Ida Formation. New localities

were discovered south of 31 (31S); along the strike (25-30); east of 25 (25E and 25SE) and south of 20 (20S). All of these are in Unit 3, with the possible exception of 25E, which is very close to the boundary between Units 2 and 3 on Thomas's map. Localities 28, 38, 46, 47 and 52 are in Unit 2 ("Pentamerus Beds"). No specimens at all were obtained from some of Thomas's localities (10, 55) because the intervening years of grazing and cultivation have removed all trace of outcrop. The most prolific sites are in the area bounded by 25, 25E, 30 and 31; at 54 and at 52 (for Unit 2).

Factors Influencing the Collections Made Since 1973

(1) The collections began with Thomas's localities, and the search was for the forms identified in Talent's memoir.

(2) Brachiopods were more numerous and varied than other elements in the fauna and hence more of them were probably collected than would be proportionate to their importance. Expert advice was available from Drs Garratt and Mackinnon.

(3) Bivalve molluscs were not as numerous or varied, but since sending specimens to Dr Bradshaw and receiving word of new species present, it seems reasonable to assume that further work will extend the fauna.

(4) Gastropods, like bivalves, were not numerous. Expert advice was not readily available, hence knowledge of the fauna remains incomplete.

(5) Trilobites were of particular interest to the writer and hence the collections are probably more representative than for any other group except brachiopods. As a consequence of this special interest, and expert advice from Drs Campbell, Holloway and Shergold, there was a high "success" rate in the collecting of trilobites.

(6) Fresh material was available because of bulldozing. Collecting was intensive and carried out over a long period of time. In the circumstances it is not surprising that the stratigraphic ranges of certain taxa were extended, and better preserved specimens of many of the characteristic forms that Talent had worked on were collected.

(7) The collections benefited from the increased knowledge and expertise of the writer, accumulated over the nine-year period.

The Fauna

No distinction will be drawn between those elements of the fauna from Unit 2 and those from Unit 3, except to note that *Notoconchidium thomasi*, *Meristella* sp. and *Encrinurus* sp. are confined to Unit 2. In the list which follows, those taxa marked * are not included in Talent's memoir.

BRACHIOPODA — *Isorthis* spp., *Salopina* sp., *Sowerbyella plebia*, *Plectodonta bipartita*, *"Chonetes"* spp., **Notanoplia australis*, *Leptaena* sp., *Stropheodonta limbimura*, *Strophonella manta*, *Nadiastrophia* sp., **Leptostrophia plateai*, *Maoristrophia banksi*, *Schellwienella* sp., *"Camarotoechia"* sp., *Stegerhynchus* sp., *Lanceomyonia* sp., *Phoenicitoechia* sp., *Straelenia* sp., *Notoconchidium thomasi*, *Molongia* aff. *elegans*, *Atrypa* spp., *Lissatrypa lenticulata*, *Lissatrypa* sp., *Macropleura corvus*, **Eospirifer parahentius*, *Howellella* spp., *Meristella* sp., *Nucleospira* sp., **Cyrtina* sp., **Hysterolites lilydalensis*, **Gypidula* sp., ?*Schizophoria* sp., ?*Leptocoelia* sp., **?Megakozlowskiella* sp., **Delthyris* sp., *Dalmanellidae* indet., *Rhipidomellidae* indet., *Stropheodontidae* indet., **Athyrididae* indet., *Schuchertellidae* indet., *Strophomenidae* indet., *Rhynchonellidae* indet., *Orthidae* indet.
BIVALVIA: *Actinopteria* sp., *Modiomorpha* sp., *Nuculites* sp., *Nuculana* sp., *Ctenodonta victoriae*, *Palaeoneilo* sp., **Nuculoidea* sp., *Cypricardinia crenestria*, *Eoschizodus*

Fig. 3. Looking east towards locality 25E Parish of Redcastle.

Fig. 4. Locality 25 Parish of Redcastle.

sp., *Paracyclas* sp., *Glossites* sp., **Pterinea* sp., **Phestia* sp., **Sphenotus* sp., *Modiolopsis* sp., **Cosmogoniophora* sp.

A number of indeterminate forms.

TRILOBITA: (Detailed taxonomic work on the Mt Ida trilobites is in preparation as part of a study of the Early Devonian trilobite faunas of the Melbourne Trough, being carried out by Dr D. J. Holloway of the National Museum of Victoria.) *Proetus (Coniproetus)* sp., **Cheirurus (Crotalocephalina)* sp., **Encrinurinae* indet., *Homalonotinae* indet., *Ananaspis* sp., *Dalmanites* sp., *?Odontochile* sp., **?Acastella* sp., **Scutellum* sp., *Sthenarocalymene* sp., *Acanthopyge (Lobopyge)* sp., *Harpidella* sp., **Tropidocoryphinae* indet. **Leonaspis* sp.

GASTROPODA: **Machurites* sp., *Murchisonia* sp., *Stylonema* sp., **Stragarolus (Eucomphalus) northi, Bellerophontidae* sp. indet., *Loxonemafidae* indet.

COELENTERATA: *Pleurodictyum megastoma, Pleurodictyum selcaum, Cladopora* sp., *?Favosites* sp., *Auloporidae* indet., solitary rugose corals.

OTHER INVERTEBRATE PHYLA: **Crotalocrinites pulcher,* Crinoid columnals, *Fenestella* sp., **Allonema* sp., *Bryozoa* indet., *Tentaculites* spp., *?Lentitheca* sp., *Conulariinae* spp., *?Plumulites* sp., **Blastoidea* indet., *Cystoid plates, *Michelinoceras* sp., Orthoconic nautiloidea indet., *Ostracoda* spp.

VERTEBRATA: Some large, poorly pre-served plates with a tuberculate ornament have been examined by Drs K. S. W. Campbell and P. A. Jell; the former believes they may be from an agnathan ostracoderm, the latter that they are from an echinoderm. The question clearly remains an open one. *?Acanthodian spines.

COMMENTS ON FAUNA: In very general terms the fauna is clearly indicative of an Early Devonian shallow-water community (Old World Province, Rhenish Community) in the sense defined by Boucot, Johnson and Talent (1969). (See also Gill, 1951). Those taxa occurring in large numbers at any given locality are listed, and of these, those

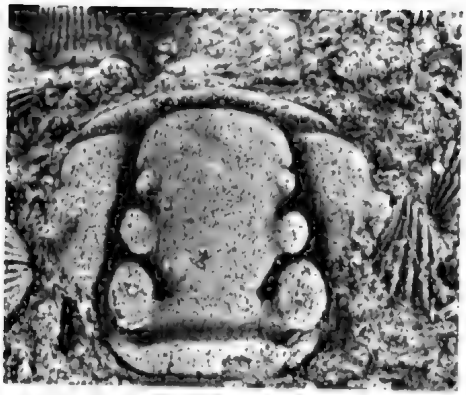
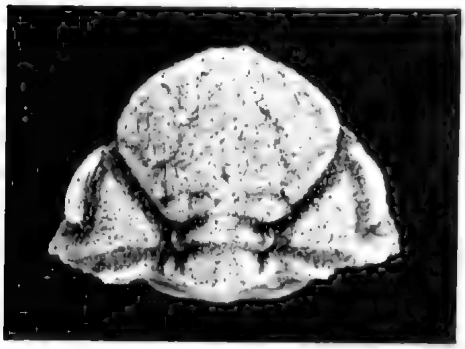


Fig. 5. *Sthenarocalymene* sp., Mt Ida Formation.

Fig. 6. *Ananaspis* sp., Mt Ida Formation.



marked * occur at ten or more localities and may be regarded as ubiquitous.

**Salopina*, **Isorthis*, **Schellwienella*, **Stropheodonta*, *Meristella*, *"Chonetes"*, *Cyrtina*, *Maoristrophia*, **Straelenia*, *Howellella*, *Eospirifer*, **Lissatrypa*, **Atrypa*, *Notoconchidium*, *Ctenodonta*, *Actinopteria*, **Pleurodictyum*, Orthoconic nautiloids, *Tentaculites*, solitary rugose corals, *Ostracoda*, *Crinoid columnals, **Odontochile*, *Coniproetus*, *Sthenarocalymene*, *Ananaspis*, *Homalonotids*, *Gastropoda* indet., **Rhynchonellids* indet., **Rhipidomellids* indet.

Some ubiquitous species do not occur in large numbers at any locality — *"Camarotoechia"*, *Stegerhynchus*, and some indeterminate bivalves and gastropods.

The localities which yielded the widest range of taxa were Locality 25, with 75 taxa; 25-30 (44); 31S (38); 54 (36); 30 (30); 52 (29); 30-31 (26) and 31 (25). These can be grouped into three areas — the northern section of the parish, with the greatest diversity; Locality 54, with a characteristic coral and *Eospirifer* fauna, and Locality 52, with a *Notoconchidium*-dominated fauna.

The following points can be made:

(1) The assemblages are brachiopod dominated.

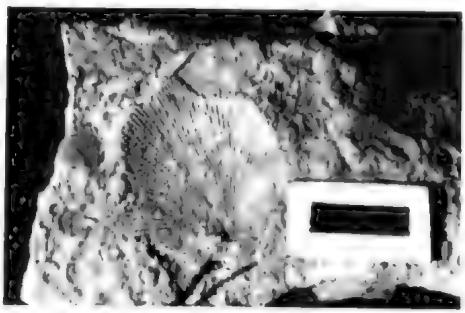
(2) The assemblages are of consistently shallow-water types and consequently it is not possible to draw distinctions between them on the basis of ecological adjustment to differing environments. Instead, current research with living benthic communities suggests that species tend to adapt to each other at least as much as they do to the environment, and that communities are often characterised by the same genera, even though different species of those genera may occur in different places and at different times. (Gray, 1981).

(3) Trilobites are not a major constituent of the fauna, except locally, but they are ubiquitous, except where corals donimate.

(4) Crinoid remains are common and widespread, but articulated remains are extremely rare, reflecting the conditions in a high-energy, shallow-water environment.

(5) Some characteristic forms are abundant only at one locality and these

Fig. 7. *Schellwienella* sp.



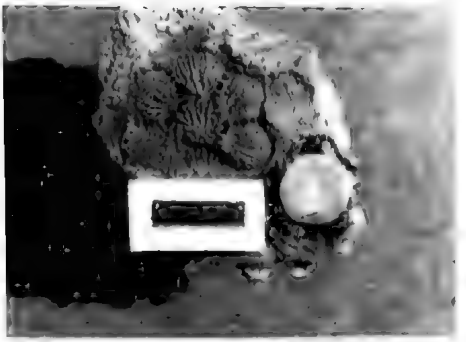


Fig. 8. *Pleurodictyum megastoma.*

include *Notoconchidium thomasi* at Locality 52; *Ananaspis* sp. at Locality 25E; *Homalonotids* (one species) at Locality 25ES, and *Atrypa* sp. at Locality 25E.

Conclusion

These extensive collections of fossils from the Mt Ida Formation could be the basis for a wide range of studies in the various fields of palaeontology: taxonomic studies of bivalves and gastropods; palaeoecological studies; studies of the communities and their diversity; evolutionary studies through measurements of populations of species; correlations with faunas of similar age, and so on. That so much palaeontological work remains to be done on one of the most fossiliferous sequences of beds of Palaeozoic rocks in Victoria is a clear indication that the fossil record has still a great deal to tell us about the history and evolution of early forms of life. It might even be suggested that the gaps in the fossil record, which are so often quoted in the literature, are still worthy of exploration, despite Eldredge and Gould's (1972, 1977) increasingly plausible suggestion that "stasis is data" — that is, that the gaps are real and not artefacts of the history of fossil collecting. So many elements of a typically Early Devonian shallow-water fauna (*Plectodonta bipartita, Notanoplia australis, Megakozlowskiella* sp., *Cyrtina* sp., *Gypidula* sp.) turned up because they were looked for, that one can only surmise how much more will turn up from further studies.

Acknowledgements

I have received great assistance in the field and in discussions with K. N. Bell, A. Jenkin and Geological Survey of Victoria — Bendigo Regional Geologist H. E. Wilkinson. Encouragement and guidance have been most Generously given by Prof. K. S. W. Campbell (A.N.U.), Drs M. J. Garratt (Geol. Surv. Vict.), and D. J. Holloway (National Museum of Victoria). In addition further help with identifications has been given by Drs P. A. Jell (National Museum of Victoria), J. H. Shergold (B. M. R. Canberra), M. Bradshaw (Canterbury Museum, Christchurch, N.Z.) and D. I. Mackinnon (University of Canterbury, N.Z.).

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The Derrinal Permian Glacial Valley
Part 2

BY FRANK ROBBINS*

The Central East Boundary of the Permian Glacial Valley — Fig. 5.

The *main features* are;(a) a series of glacial pavements in areas numbered 1 to 6 on the east Boundary in Farleys property; (b) abundance of large erratics at both high and low levels, especially granites; (c) steep rise of about 60 m (200 ft.) in glacial terrain along the N bank of the Mt. Ida Ck., contrasted with the gently rising alluvium covered Permian terrain on the S side; (d) glacial beds exposed in the new McIvor highway cutting and in Mt. Ida Ck., Precipice Gully, Salt Gully, and Hollingsworth Ck., (e) the Ordovician-Permian contact in the railway cutting.

The East Boundary Glacial Pavements — Thomas' (1940) Heathcote map shows a fault contact in the old railway cutting, but not in the adjacent Mt. Ida Ck. bed, which looks very obviously like a fault contact with tillite and a granite erratic close to a prominent vertical Ordovician sandstone bar. Also he had a fault boundary where we have a long line of pavements. This throws doubt on an eastern boundary fault, which I question on the following grounds. (i) *Railway fault?* — the rudely stratified tillite dipping westerly away from the steeply W-dipping Ordovician sandstone stratum, could be due to slumping instead of fault drag. The adjacent road cutting shows no clear cut junction. (ii) *Mt. Ida Ck. junction* — the actual contact is so obscured by big sandstone boulders, that I could not excavate its west face for evidence of glacial striae to disprove the fault idea.

Farleys No. 1 pavements (Farleys 1a, 1b, 1c, 1d) — these are on off-set continuations of the creek-bed strata, and almost obliterated glacial striae on the west face of 1a indicate a post-Permian fault conclusion untenable. 1a and 1b were excavated on top for a distance of 12 m (12 yd.) with very clear striae at 11°–13°T indicating unusual spread of ice easterly from the valley on the west side.

Farleys No. 2 — sandstone with smooth polished quartz face with microscopic striae at 8°T.

* 81 MacKiwni St., Bendigo, Vic.

Farleys Inlier — see Fig. 5 — a low rounded W-dipping Ordovician outcrop elongated in the strike and ice direction i.e. S to N — as if shaped by over-riding ice. We failed to find any evidence of glacial striae along its edges, which could be explained since it is surrounded by recent alluvium deposited by the Mt. Ida Ck., and we didn't dig down far enough to reach the glacial deposits only a few metres down. As this inlier is at almost the same elevation as Farleys No. 1 rocks, a post-Permian fault here is untenable, unless it was of very small throw.

Farleys No. 3 — near the gate — contorted bedding striated at 15°–18°T — obviously ice had overflowed over all the prominent Ordovician rocks to the south of here.

Farleys No. 4 — an outstanding example of ice colliding with a meta-sandstone bar striating it on top and all along its west side at

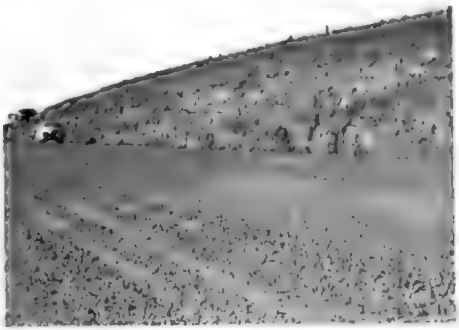


Fig. 1. Cutting through horizontal Permian beds, McIvor Highway, Derrinal, (7. 9. 61).

Fig. 2. Farley's No. 4 rock, showing ice-shaped South end as excavated on 14. 5. 71.

FARLEY'S AREA
at DERRINAL
Fig 5
SCALE IN METRES
0
200
400
600
800
1000
LEGEND
Geological Boundary
Tertiary High-level gravels
Permian Glacial Sandstone
" " Conglomerate
" " Tillite
" " Yellow clay
" " Erratics-Small-large
" " granites
" " Heap
" " Pavement on basement
" " Erratic striated in situ
Ordovician-basement
Cutting - road or railway
Fence
Road
track
Highway
SCA Soil Conservation Authority
enclosure-omitted Salt Gully
Alluvium boundaries omitted.
dam
House
LAKE EPPALOCH
FSL
OLD RAILWAY
Mt IDA CK ORIGINAL COURSE
Mt IDA CK
MAIDEN COVE
largest ERRATIC SANDSTONE (R.L.BOWEN)
F.S.L. 1942 m.A.S.L
Crowell's Boulder Pavement
PORPHYRY 3 kms
Pebble Pavement
The STRANGER
I. HOLLINGSWORTH
Many large ERRATICS
Large outcrop
Many ERRATICS
Porphyritic
THIN ALLUVIUM
COVER
DERRINAL ROAD
J.FARLEY
Farley's Inlier
SALT GULLY
Deep gorge
PRECIPICE GULLY
SALT AREA
SWAN GULLY
ORDOVICIAN
Mt IDA CK.
McIVOR HWY
Telephone gate
Line
yards
N
Z
readings

2°–5°T, while grinding off the south end with striae radiating conspicuously from 347° to 035°T — striking evidence that the ice moved S to N.

Farleys No. 5 rocks — two small sandstone domes shaped by ice on which we found by excavation etc. striations 352°–356°T on Ordovician strata striking at 337°T.

Farleys No. 6 rock — one sandstone bar striking at about 323°T with its northern end bevelled off and striated at 352°T almost on top of the highest Permian hill at over 260 m (850 ft.) A.S.L.

Note how this line of striated rocks runs at about 45° E of N, but the actual contact is quite irregular since the strike of the outcrops

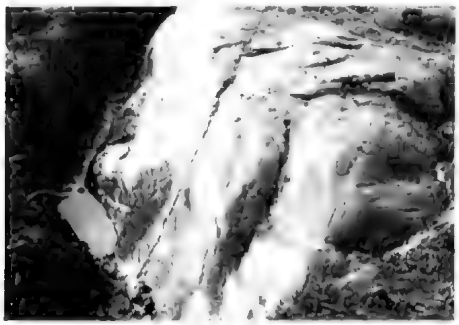


Fig. 3. Close up of South end of Farleys No. 4 showing radiating striae, spectacular proof that the Permian ice moved S to N.

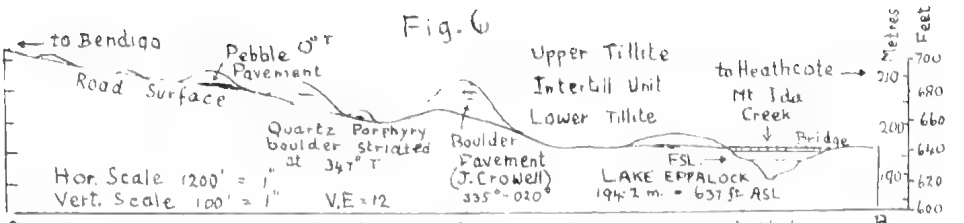
varies from 2°T in the south to 337°T further to the N.E. Note also the ice must have come from the south where today there is only Ordovician or lowland alluvial flats of the Mt. Ida Ck. This would indicate at least 91 m (300 ft.) thickness of ice, since large granite erratics on the highest parts of the boundary up to 274 m (900 ft.) A.S.L. in Farleys N.E. corner occur.

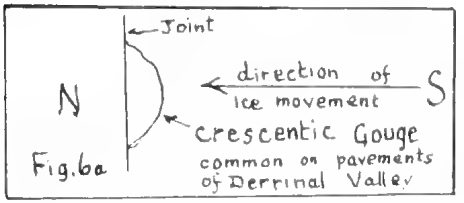
The big erratics — I have marked big granite erratics with large triangles and a dot. Note three near Farleys No. 6 rock. Two of these have broken up into pieces indicating long exposure obviously belonging to glacial beds much higher up but now washed away. The third is still almost buried, but quite fresh looking. All three would be rivals in size of the famous *Stranger Rock* now sign-posted and visible from the observation platform on the McIvor highway. Three more at the heads of Salt and Precipice gullies. 18 and 3 (porphyritic) in two groups of granites in the bed of Mt. Ida Ck., and about 12 near the junction of Precipice Gully and Hollingsworth Ck., 2 more on the McIvor Highway cutting roadside specially left there at my request. Finally, the famous Stranger Rock with its top planed and grooved at 0°T alleged to weigh 30 tons (or tonnes). Dunn (1892) showed a photo of it (by A. W. Howitt), and thought it must have been dropped from the base of an iceberg, and landed upside down. Today, the opposite idea is considered more likely. Rocks gradually sink through moving ice, and sooner or later can "lodge" firmly in the glacial deposits below (preferentially with longer axes parallel to the ice motion). Thus the over-riding ice charged with fine and coarse rock fragments could polish or grind grooves and striations parallel to the ice movement as seen on the top surface of The Stranger. It is noticeable that the large quartz and the unweathered felspar crystals are planed and polished so evenly, and fresh-looking, in spite of long exposure to weathering. I looked for microscopic scratches on these crystals, but failed to detect any.

Nearby, another large sandstone erratic (photo in Dunn 1892) beautifully striated at about 340°T could have been striated in situe, but since toppled backwards a little down the sloping surface due to removal of under-lying soil (tillite).

A third very large sandstone erratic well striated on one side nearby has apparently rolled downhill as the underlying tillite washed away. I suggest it might have been also originally striated in situ. I have shown 2 of these 3 on Fig. 5, using "arrowed triangles".

Finally, in the six nearby McIvor Highway cuttings, I have also shown (using triangles with arrows) three more erratic features most likely striated in situ. A large porphyry striated at 347°T on its longer axis, a pebble pavement with one large pebble striated at 0°T, and Prof. J. Crowell's "boulder pavement" with a number of sandstone boulders striated on top at various bearings from 335°T to 020°T. He noted these during the ANZAAS field trip in 1967, and assumed they were once all striated on top in one direction, but disturbed since then (see Jour. Geol. Soc. Aust. Vol. 17 Pt. 2. p.127). A typical undisturbed parellel striated embedded boulder bed in an interglacial pavement will be described in Part 3 issue. Two other large erratics striated in situ were described in Part 1, p.158.





Other glacial features of the McIvor Highway cuttings are mud-clots, abundance of rounded facetted striated erratics of igneous, sedimentary and metamorphic origins, flatlying interbeds of glacial sandstone, conglomerate, etc. indicating our Derrinal Valley area has been tectonically stable ever since Permian times. Fig. 6 shows a section along AB of the Highway cuttings. These were freshly cut before 1963 when the old highway (see Fig. 5) was inundated by the lake, and, in time, many interesting features may be obscured by plant growth e.g. Pigface (Carpobrotus) and Galenia pubescens, which has mysteriously appeared here. A large beautifully smoothed and striated grey quartzite erratic is below the Observation Point, and the largest unbroken erratic so far discovered, a grey quartzite, is marked just below F.S.L. in the bed of Mt. Ida Ck. (R. L. Bowen 1959). Erratic heaps (marked E.H.) or Museum Heaps are good places to inspect the variety of erratics originally collected by the farmers long ago when clearing the land. A lone tree is often a good place to find them.

A full day's outing would be needed to cover Farleys area of Fig. 5 with permissions from Messrs Farley and Hollingworth. Unfortunately Farley's bridge has now been washed out, but you can wade across a nice concrete ford in the Mt. Ida Ck. bed at the Ordovician-Permian contact.

Dunn (1892) mapped the positions of 45 of the biggest erractics, a copy of which would be needed to locate and identify each one, especially the large number near Hollingsworth Ck. In addition, I have added all the outcrops of glacial tillite (t), conglomerate (c), sandstone (s) etc. as observed by me in the beds of Mt. Ida Ck., Precipice Gully, Salt Gully gorge, Hollingsworth Ck. and elsewhere, for any future worker interested in trying to work out the sequence of the units here. Bowen (1959) made a special study of these in Precipice Gully, but I was unable to clearly follow him. The Salt Gully gorge is a wonderful example of what happens in unconsolidated glacial beds, and that is why the S.C.A. (Soil Conservation Authority) has constructed so many erosion control enclosures on every water course in the Lake Eppalock catchment. Many significant Permian exposures, which Bowen was able to examine, were thus hidden from me.

Dunn (1892) showed a photo of a large glacial sandstone outcrop with a Banksia marginata growing on top near Precipice Gully mouth. It was still alive there in 1962 when I first led an excursion there to see the Hollingsworth erratic field, but I think it has since died of old age. Note what appears to be a prominent interbedded glacial sandstone unit near the Salt Gully course.

Finally, note from the rose showing the 23 readings of pavements on basement, that the ice was spreading out more easterly than on the western side of the Derrinal Glacial Valley.

The next issue will be on the interesting Moorabbee area in between the E and W sides.

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Aboriginal Hatchet From Cape Paterson, South Gippsland, Victoria

BY EDMUND D. GILL* AND E. R. SEGNIT**

The Rock Chosen for Manufacture

Many years ago a small Aboriginal hatchet was collected from an eroded midden on the coast at Cape Paterson, south of Wonthaggi. It measures 9.2 by 6.4 cm, and is 2 cm thick. It consists of a greyish fine-grained quartz andesite, an acid volcanic rock, and has a ground cutting edge (Fig. 1). The opposite end from the cutting edge has two straight sides. One is a natural joint of the rock mass from which it came, while the short one is where a sample was taken for chemical analysis and the preparation of a microscope slide.

The main mineral of the rock is feldspar, but it has an appreciable amount of quartz. The rock has a greenish tinge, which is due to two of the constituent minerals. One is a greenish pyroxene (showing some alteration), and the other is a serpentine-like mineral filling the spaces between the other minerals.

Because the unground natural edges are rounded, the piece of rock used probably originated as a pebble in a river bed.

Analysis of the Rock

A chemical analysis of the rock from which the hatchet was manufactured was carried out at the CSIRO Division of Mineral Chemistry, with the following result:

SiO_2	52.94%
TiO_2	2.72
Al_2O_3	13.02
*Fe_2O_3	13.50
CaO	7.03
MgO	2.99
K_2O	1.26
Na_2O	2.40
P_2O_5	0.75
SO_3	0.05
Loss on ignition	2.66
TOTAL	99.32%

* Total iron as Fe_2O_3. Analysis by XRF; analyst I. Madsen.

The thin section of the rock (Fig. 2) reveals a lath-like texture. These laths are plagioclase feldspar crystals about 0.1 mm in length. This information enables us to consider why the Aboriginal chose this rock for the manufacture of his hatchet.

Why this Rock was Chosen

A great deal of work is involved in the manufacture of an axe, so the Aboriginals by experience learned to choose a rock that was not too soft for the required work, but at the same time not too brittle. A hatchet that shattered was a waste of the considerable time and effort of manufacture. The fine-grained quartz andesite from which this axe is made is not particularly hard, and not brittle, but it is very tough. Being of moderate hardness, it was not too difficult to grind, and because tough not too brittle in use. The interlocking lath-like texture imparts strength to the rock, and the serpentine-like mineral contributes to the toughness.

Origin

Aboriginal hatchets of andesite, rhyolite and basalt are found in Gippsland. Andesite is clearly a suitable rock and was apparently readily available. Quartz andesites are widely available in

* 1/47 Wattle Valley Road, Canterbury, Victoria 3126.
** CSIRO Division of Mineral Chemistry, P.O. Box 124, Port Melbourne, Victoria 3207.

Fig. 1. Quartz andesite Aboriginal ground-edge hatchet with anvil scars from Cape Paterson, South Gippsland.

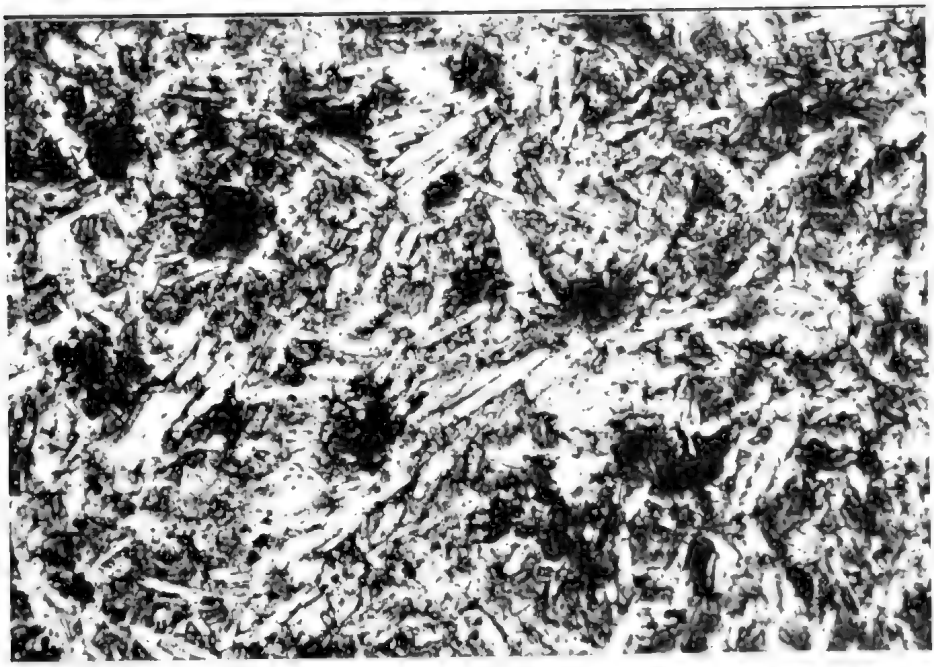

Fig. 2. Section of the rock used in hatchet manufacture, X 220.

Western Victoria also, but the diabases and basalts there were preferred. Sandstone and quartzite were used, but are second class materials because brittle. Calcrete was rarely employed because, although tough, is far too soft.

The published descriptions of andesites in Victoria have been examined, and also the rocks illustrated by McBryde (1979), but none corresponding to that in the hatchet from Cape Paterson has been found, so the source of the rock is unknown. Wherever the rock came from, it is certainly a long way from where it was found, because no rocks of that type occur near Cape Paterson.

Hatchet Use

Miniature chips from the cutting edge of the Cape Paterson hatchet show that it has been well used. On one side of the hatchet is a rough, slightly depressed area (Fig. 1) with scars that show it has been used as an anvil. The hatchet would also have been used as a hammer stone.

The hatchet has been donated to the National Museum of Victoria, where its registered number is X84135.

Acknowledgements

Dr Isabel McBryde of the Australian National University pointed out that there appears to be some indication of waisting — "less common but not unusual". "Near the position of the waisting there seems to be a roughening of the surface of the blade to assist keying in of the resins used in hafting." Dr W. Birch of the National Museum of Victoria provided information on the quartz andesites of Victoria.

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A Possible Tri-hybrid Eucalypt near the Cathedral Range, Victoria

BY STEPHEN YORKE* AND DAVID H. ASHTON +

In 1979 two gum-topped stringy-bark trees were found by one of us (S. Y.) in the midst of a stand of *Eucalyptus macrorhyncha* at Bisset's Pinnacles 300 m above the Little River gorge (Fig. 1) at latitude 37°15′ longitude 145°46′. The Pinnacles consist of a set of huge rhyodacite tors on an otherwise steep, but smooth slope at an altitude of 670 m a.s.l. (Fig. 2).

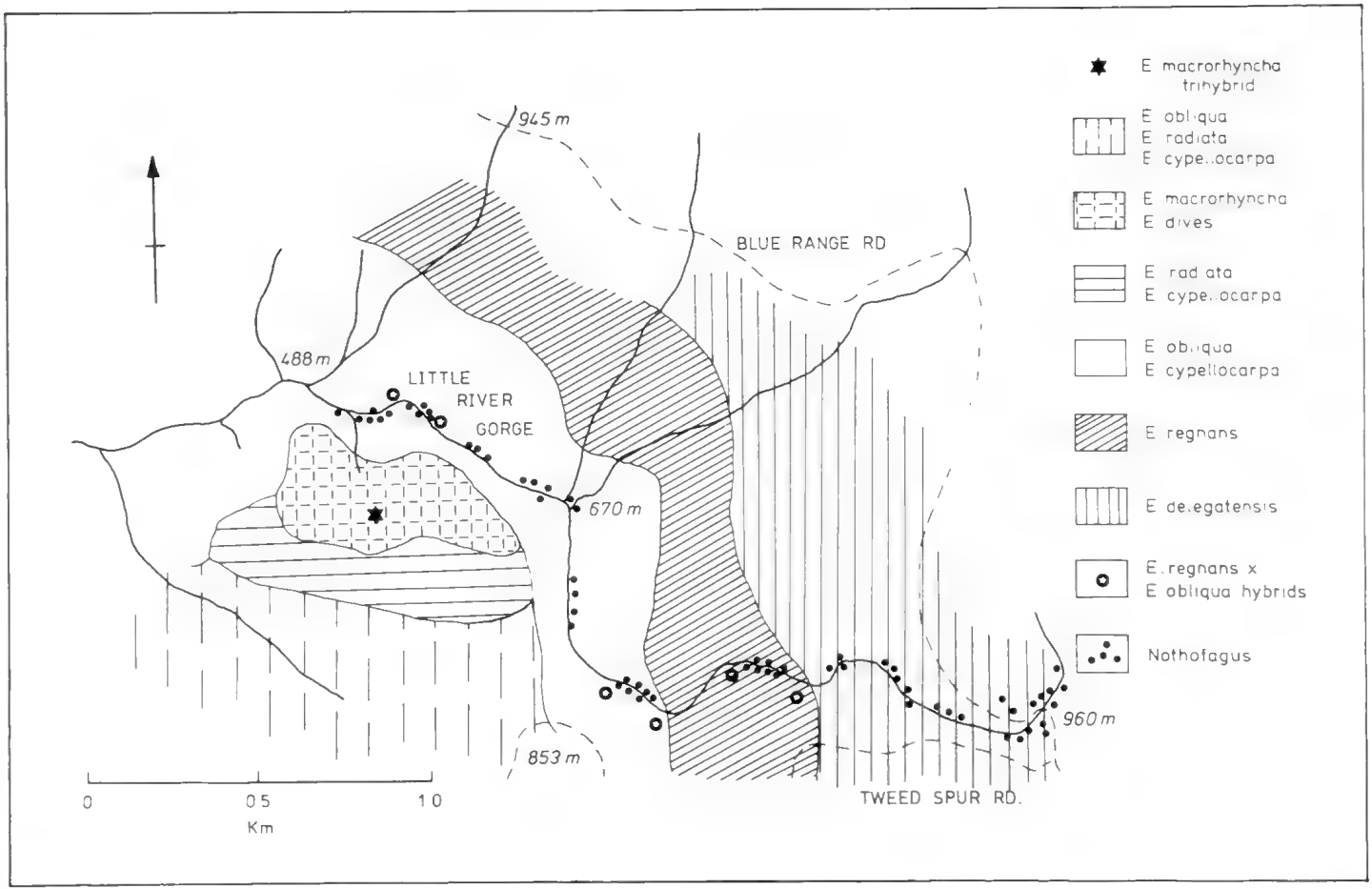
The trees were suspected of being hybrids between *E. macrorhyncha* and a gum-barked member of the Monocalyptus breeding group (Pryor and Johnston, 1971). The only feasible gum-barked species in the region are *E. regnans* and *E. pauciflora*. The latter species occurs at Mt. Sugarloaf (910 m a.s.l.) 4 km to the SW, and at Lake Mt. (1310 m a.s.l.) 12 km to SE. Trees of *E. regnans* however, occur in gullies within 400 m of the site.

The putative hybrid trees were about 25 m tall, and were stringy-barked to about 18 m (Fig. 3.). The fruits were broad-turbinate with a decided raised rim and resembled features of both of the putative parent species, *E. regnans* and *E. macrorhyncha* (Fig. 4).

The general eucalypt distribution in this area is typical for this section of the Great Dividing Range; aspect, slope and altitude being important controlling factors. Species occur in descending altitude zonation from *E. pauciflora*, to *E. delegatensis, E. nitens, E. regnans, E. cypellocarpa, E. obliqua, E. radiata, E. dives, E. goniocalyx, E. macrorhyncha* and *E. polyanthemos*. On the northern aspect, the *E. macrohyncha-E. dives* community at Bisset's Pinnacles is surrounded by *E. radiata-E. cypellocarpa* forest. *E. obliqua* is found nearer the river and further upslope. *E. regnans* occurs 0.6 km from the Pinnacles directly across the valley or upsteam at the same altitude (Fig.1). In the gorge, an attenuated rainforest community occurs, containing sporadic trees of *Nothofagus cunninghamii*. Hybrid intermediates between *E. regnans* and *E. obliqua* occur in the ecotone in this area, in common with many other similar boundaries in Victoria and Tasmania (Ashton 1958, 1981). Such intermediates extend down the gorge of the Little River to a point directly below Bisset's Pinnacles.

Seed from one of the gum-topped stringybark trees was collected by climbing to the top of one of the tallest tors. Seedlings were raised in a glasshouse for 6 months and compared with those of *E. regnans, E. obliqua* and *E. macrorhyncha*. The results of the study of seedling leaf morphology at the 3rd to the 5th node confirms the suggestion of the hybrid origin. None of the progeny revealed the *E. pauciflora* characteristics of glaucousness and prominent longitudinal venation. Variability of seedlings however, was great; some resembled *E. regnans*, some *E. macrorhyncha*, some the features of both. The assessment of shape, hairiness, colour, oil odour, the number of juvenile nodes and lignotuber development are illustrated in Table 1. However, the leaf shapes of *E. regnans* and *E. obliqua* at the 3rd node, are sometimes difficult to distinguish, and the oil odour of *E. obliqua* and *E. macrorhyncha* are likewise similar. The

* National Parks Service, East Melbourne 3002
+ Botany School, University of Melbourne 3052.


945 m
BLUE RANGE RD
488 m
LITTLE
RIVER
GORGE
670 m
853 m
960 m
TWEED SPUR RD.
0
0·5
1·0
Km
E macrorhyncha trihybrid
E obliqua
E radiata
E cypellocarpa
E macrorhyncha
E dives
E radiata
E cypellocarpa
E obliqua
E cypellocarpa
E regnans
E delegatensis
E regnans x
E obliqua hybrids
Nothofagus

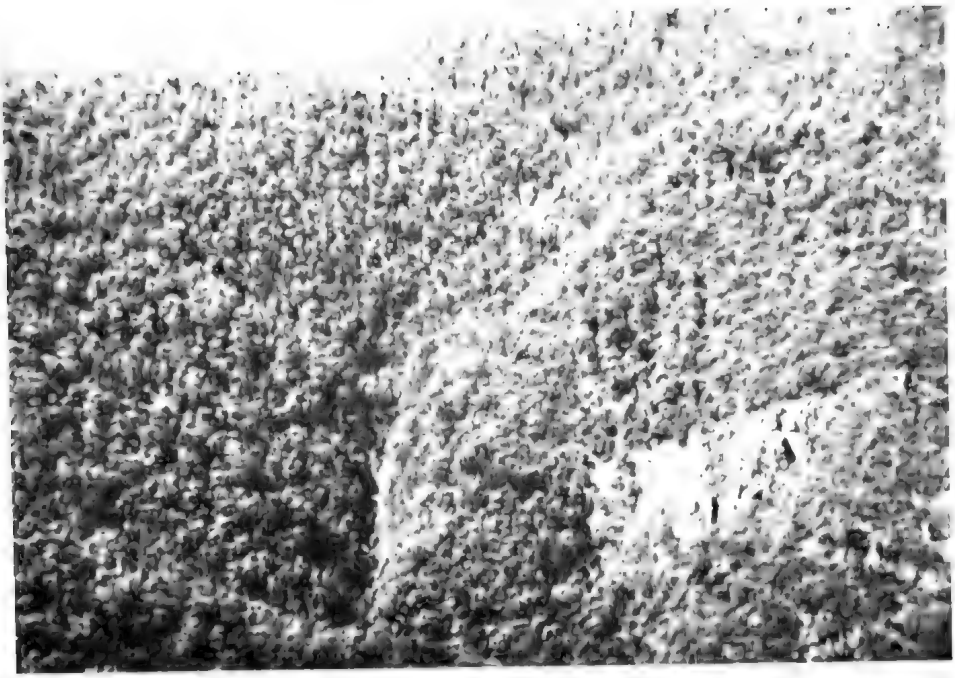


Fig. 2. An oblique aerial photograph of the Little River Gorge. The large rock outcrops to the lower left are Bisset's Pinnacles.

microscopic examination of the oil glands by direct light transmission through the whole leaf was therefore used to assist discrimination. The results of a scatter diagram of gland density against gland diameter is shown in Fig. 5. These results show clearly the relationship of the hybrid tree progeny with both *E. regnans* and *E. obliqua*. The raised rim of the fruit and the tough stringyness of the bark are characters of *E. macrorhyncha*. It is therefore postulated that these trees are the product of hybridization between an intermediate *E. regnans* x *E. obliqua* and *E. macrorhyncha*. It is most likely that if

Table 1

Selected features of seedling morphology — mean quantitative and qualitative values from 8 plants 6 months old. Hairs stellate to absent (1-3). Scent sweet to sharp. (1-3). Lignotuber absent to present (0-3).

Species	Height (cm)	Leaf at third node: length (cm)	width (cm)	tip angle (degrees)	hairiness (1-3)	oil scent (1-3)	No. leaf pairs (mean)	Lignotuber score (0-3)
E. regnans	15.3	7.2	2.9	60	1.0	1.0	4.2	0
E. obliqua	11.1	8.1	3.1	65	1.2	3.0	4.0	2.0
E. macrorhyncha	11.9	6.8	3.3	106	3.0	3.0	6.8	3.0
Gum-topped Hybrid	20.7	6.6	2.8	77	1.4	2.0	4.0	1.0

Fig. 1. Map of Little River Gorge area showing the distribution of the major eucalypt types and the occurrences of hybrid trees. The large black star indicates the position of the two tri hybrid trees at Bisset's Pinnacles. Spot altitudes are indicated.

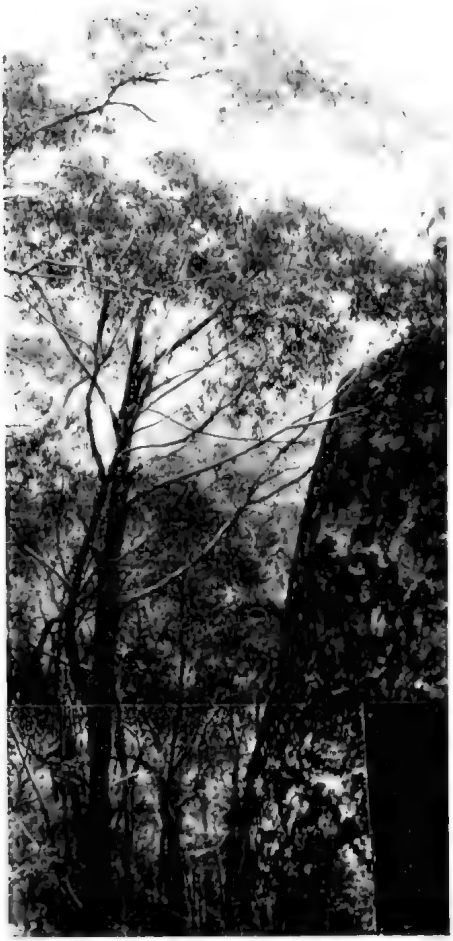


Fig. 3. A composite photograph of one of the hybrid trees at Bisset's Pinnacles showing the gum-topped crown. The figure (K. Clayton-Greene) on the rhyodacite tor is 1.9 m tall.

this were so, the early pollen of the intermediate were transferred to the stigmas of an *E. macrorhyncha* parent in the years immediately prior to the last bushfires. From this regeneration an even-aged stand arose containing, after 40-50 years, two interesting hybrid individuals.

The possibility of important segregates arising from such rare crosses is considerable. Trees combining high

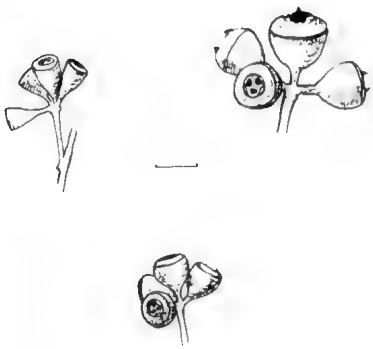


Fig. 4. Fruit shapes of *E. regnans* (left), Hybrid (lower) and *E. macrorhyncha* (right).

growth rate with timber quality and fire and drought resistance may thus be found. Recorded tri-hybrids in eucalypts are uncommon. The possibility of a population being so derived in southern western Australia was discussed by Hopper et al (1978). Such natural occurrences as these may increase the variability of populations and provide the material available for selection by the variations of the natural environment. With the permission of the Forests Commission of Victoria five progeny have been planted in the R. J. Hamer Arboretum at Olinda, Victoria so that their potential development may be observed for future decades.

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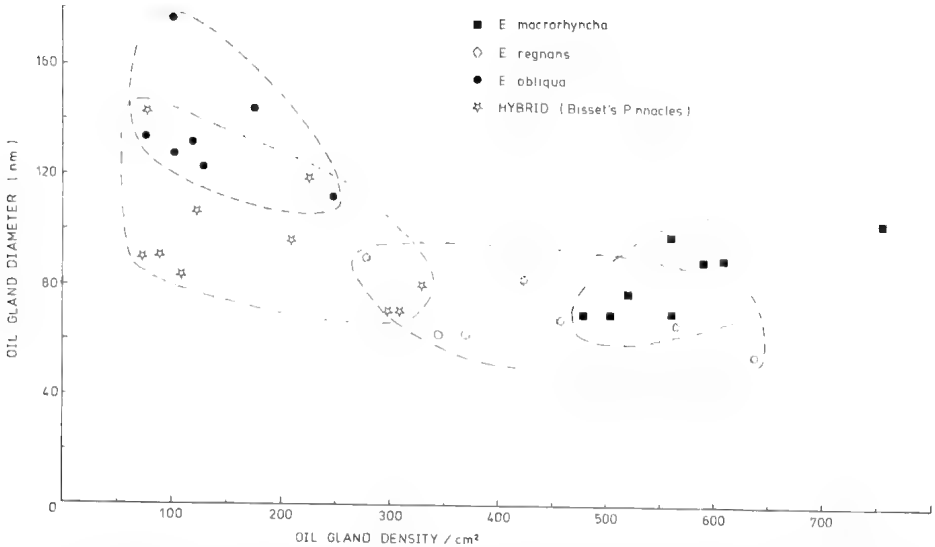

Fig. 5. Oil gland diameter/density relationships from leaves of the third node of progeny raised under glasshouse conditions.

Obituary — John Cecil LeSouef

J. C. LeSouef was born on 5th November, 1905 at the Melbourne Zoological Gardens where his father was curator, following on from his grand-father who had established them. Whilst his two brothers took no interest in animals John did, and was encouraged in his early years by the keepers at the Gardens. Even before schooling he had earned the nickname "Zoo" which remained with his throughout his life, as did his deep interest in natural history and a wide range of other subjects.

After attending Melbourne Grammar School he joined Dalgety's and later became a jackaroo in Queensland and New South Wales. A series of jobs followed, including a spell with the old Australian Broadcasting Company in Melbourne where he was responsible for obtaining speakers, arranging venues and later included giving nature talks on the Children's radio session. In 1938, when he was selling radios in Warragul, Victoria, and working for radio 3UL, he met his future wife — a nursing sister. They were married in 1941. Just before the war he met Llew Gooding in Warragul and was invited to see his wonderful insect collection. He was so impressed that he decided to collect insects himself and was soon in the field with Gooding.

In 1940 "Zoo" moved back to Melbourne to assist the Army in horse training for its Remount Squadron. With his new interest in insects he joined the Entomology Club in

Melbourne in 1941, to associate with such collectors as, Ras Wilson (a friend of his father), Alex Burns, Clarrie Borch, John Clarke, Alex Brown and others. Unfortunately, due to the War, the Club was disbanded in 1942, the last meeting being held in "Zoo's" home.

At the end of the War, "Zoo" and his wife Mary purchased a cordial factory at Kyabram, Victoria, which they ran till 1953 when they bought the local store at Blairgowrie on the Mornington Peninsula. "Zoo" felt there was potential in the growing interest in natural history and that this could be developed among the throngs of holiday-makers on the Peninsula. After many bureaucratic hitches he ultimately obtained a foreshore site at Rosebud and built the Aquarium/Museum which opened in 1960, with its remarkable range of live and historical exhibits. These he continued to expand and improve over the years.

During the off-peak seasons at the aquarium, "Zoo" and Mary travelled throughout Australia, collecting specimens for the museum and his private collection. He amassed a valuable collection, mainly in butterflies, moths and beetles, discovering many new localities and new varieties, some of which were named after him. He became very well known to and respected by the resident naturalists and entomologists throughout Australia, but particularly on the east coast. He was an excellent entomologist but in the field had the most disconcerting habit of picking up live snakes and putting them in sacks in the back of his car for subsequent display at the aquarium. The results of his collecting trips made fascinating articles, as he had been a freelance journalist since the Depression.

In 1960 he was approached by several Melbourne entomologists with the idea of re-establishing the old Entomological Club to cater for the increasing interest in insects. This he agreed to do and the Entomological Society of Victoria was re-born at a well-attended meeting in 1961 at which he was elected President, a position he held till 1965 and on several occasions since. He has always been a Councillor and until recently was Editor. At all times he was an enthusiastic driving force in that Society.

"Zoo" had many interests. He joined the Field Naturalists' Club of Victoria in 1944 and wrote articles for the Club magazine. He was an active member of the Frankston Field Naturalists' Club which he joined in 1957, and was its President. He had been a dedicated member of Rosebud Rotary Club since 1960, and its President also, and was made a Paul Harris Fellow.

His humor, vitality, anecdotes and, above all, his ever-ready willingness to help others, particularly youngsters, will be greatly missed by his wide circle of friends. He is survived by his wife, son and three grandchildren.

D. F. Crosby
74 Gipps Street
East Melbourne

Naturalist Review

"The Distribution and Conservation of Vascular Plants in the North Central area, Victoria"

BY A. C. BEAUGLEHOLE

The Western Victorian Field Naturalists Clubs Association. Portland 1982 106 pp. + sheet map
ISBN 0 9595293 5 7
Available from The Portland Field Naturalists Club, P.O. Box 470, Portland, Victoria 3305 for $6 a copy including postage.

This is the fifth in a series of reports which will eventually cover the whole thirteen study areas into which Victoria is divided. The North Central study area with which this report deals stretches from Glenorchy to the Waranga Basin, and includes the St Arnaud, Maryborough and Bendigo districts.

The style of the report follows the pattern

of the earlier publications, which began with the Mallee area in 1979. Then followed Corangamite-Otway in 1980, and the Alpine area and East Gippsland, both in 1981. In essence, the reports provide a complete and up-to-date inventory of all vascular plants, both natives and naturalized aliens, with emphasis on plant records from public land, as this carries almost all the significant remnants of native vegetation.

To record the distribution of plants, Mr Beauglehole has devised a system of Sectors (13, in the case of the North Central area) which he has divided into Blocks and Sub-blocks. This is more suitable than rectangular grid systems for this purpose because of the irregular outlines of the areas of public land, most of which are, in any case, far smaller than even the minor ten-minute grids.

The excellent map (110 x 60 cm), which is part of the report, indicates not only boundaries of the sectors, blocks and sub-blocks, but also the ten-minute grid lines. As all roads and streams are clearly marked too, the locating of the various reserves and other areas of public land is quite straightforward.

The checklist of the area, which gives both botanical and common name for each species, arranges the plants in alphabetical order within their families. Opposite each name columns indicate in which of the 13 sectors the plant is found. About 435 species of native plants have a very limited distribution within this study area. These Mr Beauglehole designates as "Rare-Interesting-Restricted" species, and he gives particulars of where they are found, indicating sector, block, sub-block, minor grid and land status for each. Land status is categorized under a number of headings such as State Parks, Wildlife Reserves, Uncommitted Land, Education Areas, Hardwood Production etc.

The question of land status is closely allied to that of conservation. The author is concerned not only that many of the rarer species are not found within any reserve, but also that even within some reserved areas grazing and timber production are allowed, which makes the future of rare species even more uncertain.

The production of these publications has obviously required a tremendous amount of time and effort, chiefly of course by the author, both in field work and in clerical activities. Their value is not only in the present. In future years too, conservationists, foresters, botanists and many others concerned with the vegetation of this state from various aspects, will have cause to be grateful to Cliff Beauglehole for his untiring labors during these years.

E. G. Errey

"Islands of South West Tasmania"
"A natural history study of Tasmania's offshore South West"

BY GARY WHITE

Retail Price $3.95
Enlarged 2nd edition published by the author in 1981. 92 pages (16cm x 22 cm)
13 black and white photographs plus map.
Available from G. White P.O. Box N308 Grosvenor St., Sydney. N.S.W. 2000.

Twenty islands offshore of the south west coast of Tasmania are included in this book, six in a wealth of detail. The author is to be congratulated in cramming as much as he has in the 92 pages available and for taking on the additional roles of publisher and distributor.

All available space is utilised and the detail includes fauna and flora lists, of particular interest are the birds.

Pedra Branca, the southern most island, provides a nesting place for both albatross and gannet, the only place in Australia where the two species nest together, it is also a home for a species of lizard found nowhere else in the world.

Little is known of the islands in the way of records and the author has faced considerable problems in obtaining first hand experience, they are remote, difficult of access and inhospitable. In the seas around, swells travel uninterrupted by land from Macquarie Island in the south and from South America in the west. The full force of frequent westerly wind storms can hit with gusts that exceed 150 kilomtres an hour, and this is not unusual.

Small wonder then that these islands previously visited only by fishermen looking for bait and something for the pot are now attracting scientific interest. As more and more

man made development takes away the breeding habitats on the main land, the islands become the last frontier for major breeding grounds for birds and seals alike. Over a million mutton birds nest on the 53 hectares of Flat Island, together with penguins, prions cormorants, gulls and oyster catchers.

This book was first published in 1980 and this second edition is larger and updated and in future editions I would like to see a little on physiography of each island and something of the topography, but I appreciate the difficulties involved. One small thing caught my imagination, would anyone other than an Australian naturalist know what a pademelon is, perhaps some other clue should be given; even "joeys left the pouch" may not mean much to the uninformed.

D. J. Lee

Robert Brown and the cell nucleus*

BY JOHN TIMSON

Everyone who has even a passing acquaintance with modern biology knows that each living cell contains a nucleus. Yet it was only 150 years ago, in 1831, that a British botanist, Robert Brown, realised that all the cells he saw under his microscope contained a small, spherical object which he named the nucleus from the Latin for a "small nut". His observations were published in the *Transactions of the Linnean Society of London* for 1833 (vol 16, p 685).

Brown, who is probably better known for his discovery, in 1827, of the strange random motion that minute particles exhibit under the microscope (Brownian movement), did not regard the nucleus as being of particular importance. His main interest was plant classification and his discovery of the nucleus did not arouse widespread interest at the time. It was not until many years after Brown's death that its functions in cell division and reproduction were established.

It was while he was studying medicine at Edinburgh University that Brown met John Walker, the professor of natural history, who introduced him to field botany. After qualifying, Brown became an army surgeon in the Fifeshire Regiment of Infantry in 1795. Three years later while on a recruiting mission in London he met Sir Joseph Banks, who was president of the Royal Society and a man of considerable influence in scientific circles.

In 1801 Brown abandoned his military career and sailed as a naturalist on a Admiralty expedition to explore the coasts of Australia. This appointment he owed to Banks's influence. The expedition under the command of Captain Matthew Flinders was provided with a leaky ship, *Investigator*, which was condemned at Port Jackson in 1803 before the survey was completed. While returning to England for a new ship Flinders was captured by the French who held him until 1810.

Brown was more fortunate. After waiting in vain for Flinders he returned to England in 1805 with 4000 specimens of Australian plants many of which were new species. This collection formed the basis of a massive work on Australian plants and of Brown's botanical career.

When Banks died in 1820 he left his extensive collections to Brown who transferred them to the British Museum in 1827. At the same time he was appointed keeper of the Botany Department at the museum, a post which he held until his death in 1858. Brown was certainly one of the pioneer members of the British Association for the Advancement of Science, and is viewed by many as the greatest botanist of his time. Within his work is found the basis of much fine work of later years in the classification of plants which replaced the Linnaean system.

To Brown's contemporaries the cell nucleus, like the Brownian movement, was just an interesting observation. To them his important work was in plant classification especially in his studies of the orchids where he established 40 genera. He was also the first to divide the seed plants into gymnosperms and angiosperms.

Robert Brown saw and recorded things which others had previously seen but not noticed. He was one of the first taxonomists to use a microscope in his work. Because of this he was the first person to realise that different types of living cells all had one thing in common — a nucleus.

* This article appeared in New Scientist, London, the weekly review of science and technology. It is reproduced here with the kind permission from that journal's editor.

Field Naturalists Club of Victoria

Reports of recent activities

General Meeting
Monday 9 August

Honorary Membership was awarded to Dr George A. Thomas and to Mr J. Laurie Provan. This month each completed 40 years in the FNCV.

Speaker for the evening was Dr David Staples. He spoke about pycnogonids, or sea spiders as the layman would call them for that's what they look like. However, although they superficially resemble spiders, pycnogonids are not related to them, but their classification is still uncertain.

Pycnogonids are wholly marine and occur in all waters from tropical to polar, intertidal or at depths. There are about 1000 species, about 100 in Australian waters. They vary from 3 or 4mm to 40cm long (16″) but most are well within those extremes. All pycnogonids have at least four pairs of very long, jointed walking legs and a long snout; in addition, most have a pair of palps, a pair of food claspers and, on underside of the body, a pair of egg-carrying legs. The body is so slim that internal organs extend into the legs. In mating, the male receives the eggs on his "egg legs" and carries them long after they have hatched. We saw photos of males with two large white masses of eggs as big as the parent's body. Other photos showed various species. Many were camouflaged to match their food substrate (polyzoans or hydroids) but others were yellow, red, blue, or banded in bright colours across the legs.

Although not common, pycnogonids are not rare and they move very sluggishly on the ocean floor or under coastal rocks so more of us will be eagerly alert for them in future.

Exhibits. A large model showed a typical pycnogonid, and bottles contained preserved specimens of *Colossendeis robusta* about 9cm long (3½″) and *Parapallene challengeri* about 4cm (1½″) with young.

Four microscopes purchased from the Latrobe University showed cross sections of various plants. A glass tube contained the radula of a limpet that looked like a white thread about 18cm long (7″) and a piece under a microscope revealed the fine teeth.

General Meeting
Monday 13 September

Dr Barrie Cooper and his wife were given a warm welcome. Dr Cooper was previously a vice-president of this club.

Dry Forests, subject for the evening, was introduced by Miss Cathy Zerbe. Miss Zerbe stated that lack of moisture was the dominating factor in dry forests so that trees were shorter and wider spaced to allow more light for smaller plants. Aspect, exposure to wind and soil contributed to a lesser degree. She

spoke of the ironbark forests of the goldfield areas north of the Divide and the foothills forests of peppermints and stringybarks as at Warrandyte. Miss Zerbe introduced the speakers in turn.

Mrs Hilary Weatherhead showed beautiful colour slides of wildflowers to be found in dry forests. They included several orchids.

Mr Peter Carwardine talked about a group of butterflies, the "browns", which inhabit dry forests but also occur in wet forests. We heard about their habits, caterpillars, pupa and eggs.

Dr Brian Smith said that dry leaf litter was not favourable to invertebrates but a few small snails manage to survive in dry forests. He showed slides and ended with a greatly magnified shot of the shell sculpture of a small snail that is considered a survival factor.

Miss Wendy Clark spoke of spiders sheltering under bark and logs in dry forest. Amongst others, she talked of the fast moving Suppunna, of jumping spiders that will obligingly jump from one finger to another, and of the outsize web-building Nephila.

Mr Charlie Silveira showed slides of a wonderful variety of birds to be seen in dry forests — birds of the ground, of the trees, of the canopy, and night birds. Then followed some taped calls.

Miss Lindy Lumsden showed slides and gave some fascinating comments on the habits of several dry forest mammals. She began with gliders and possums, then ground-dwellers and ended with bats.

Exhibits included some wildflowers some typical of dry forests, books on butterflies showing a variety of "browns", and a pink-orange flatworm about 2cm long that later became active and extended to about 6cm (2½ ").

It was richly full programme which ended late, but people still stayed to chat over a cup of tea or coffee.

Birdwatching For The Disabled
Seabirds Need Your Help

These are two leaflets recently printed by the Bird Observers Club for free distribution to any person or group interested in either of these two worthy aims.
Write to The Bird Observers Club
P.O. Box 185, Nunawading, Vic. 3131

Flora Of Central Australia

The Australian Systematic Botany Society
537 pages, 648 illustrations. Price $35.00 (discount to members)
Postage Victoria $2.00. Other States at 2 kg rate.
Order from Sales Officer F.N.C.V.

GROUP EXCURSIONS

All FNCV members are invited to attend Group excursions.

Mammal Survey.

Saturday, 30th — Tuesday, 2nd November. Cup weekend. Chiltern.

Sunday, 26th — 1st January. East Gippsland.

Botany Group.

Saturday, 30th October. Kinglake National Park and FNVC block.

Saturday, 27th November. Starlings Gap. Leader: A. Thies.

Invertebrate camp to Mt Elizabeth (Gippsland) October 30 — November 2. Details contact Wendy Clark A.H.: 859 8091. Bus.: 377 2336.

Field Naturalists Club of Victoria

Established 1880

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

Patron:
His Excellency Rear Admiral Sir Brian S. Murray, KCMG, AO.

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MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1982

Metropolitan	$15.00
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Junior	$3.00
Subscription to Victorian Naturalist	$13.00
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All subscriptions should be made payable to the Field Naturalist Club of Victoria and posted to the Subscription Secretary.

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GENERAL MEETINGS

Monday, 10th November, 8.00 p.m.
Members night.

Monday, 14 February, 8.00 p.m.
Mr Peter Brown: the role of zoos.

New Members – November/December General Meetings.

Metropolitan
Mrs L. V. Crohn, 1 Durham Rd, Surrey Hills
Dorothy Palmer, 28 Princess St, Kew

Country
Magnus Peterson, 49 Venner Rd, Annerley, Qld

Joint
John & Valerie Milligan, 4/18 Buckingham Ave, Bentleigh
(Botany & geology)

FNCV EXCURSIONS

Saturday, 15th — Friday, 21st January. Falls Creek. A coach has been chartered and motel accommodation booked on a D.B.B. basis. The coach will leave Flinders St from the Gas and Fuel at 8.00 a.m. Bring a picnic lunch. Payment of $290.00 less deposit paid is due by the December General Meeting.

Sunday, 6th February. Marine biology excursion to be led by Dr Brian Smith, probably to Westernport. The coach will leave Batman Avenue at 9.30 a.m. Bring one meal and a snack.

Sunday, 6th March. Entomology excursion to be led by Peter Carwardine. Details in the next Naturalist.

Saturday, 12th — Monday, 14th March. Combined weekend. This will be hosted by the Mid-Murray F.N.C. and based at Kerang. This is an area with many lakes which are noted for water birds. A coach will be chartered if numbers warrant it; otherwise transport will be by private car. Please let the excursion secretary know if you are interested.

GROUP MEETINGS

FNCV members are invited to attend any Group Meeting.

Day Group — Third Thursday.
Thursday, 17th February. Polly Woodside and the maritime museum. Meet at the entrance at 11.30 a.m. Leader: E. Gillespie 578 1879.

At the National Herbarium, the Domain, at 8.00 p.m.

First Tuesday — Mammal Survey Group.
Third Wednesday — Microscopy Group.
Wednesday, 19th January. Members exhibits night.
Wednesday, 16th February. Plankton. Mr H. Bishop.
Second Thursday — Botany Group.

GROUP EXCURSIONS

All FNCV members are invited to attend Group Excursions.

Mammal Survey.
Sunday, 26th December — Saturday, 1st January. East Gippsland.

Saturday, 29 — Monday, 31 January. East Gippsland river survey. Contact Wendy Clark AH 859 8091; bus. 377 2336.

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Cover illustration: Limestone columns at Cape Bridgewater. See report on FNCV Excursion.

Root Fusion between *Eucalyptus regnans* F. Muell and *E. obliqua* L' Herit in the Cathedral Range Area, Victoria.

BY TREVOR J. DESS* AND DAVID H. ASHTON†

Abstract

Root fusion between major laterals of pole stage *E. regnans* and *E. obliqua* occurs in ecotone regions in Sugarloaf Saddle between the Cathedral and Mt Margaret Ranges, Victoria. In some cases, fusion involves *E. obliqua* introgressants with *E. regnans*. It is suggested that such fusions may prove to be important in determining stand development and local tree survival.

Introduction

Root fusion between roots of individuals of the same species and intratree root fusion is well known for both conifers (Adams, 1940; Bormann, 1966; Graham, 1960; Lanner, 1961; Stone, 1974) and angiosperms (Beddie, 1941; Jacobs, 1955; Leroy-Deval, 1973). However, interspecific root fusion is rare (Beddie, 1941).

Root fusion between trees of *E. regnans* is known to occur in dense sapling stages as young as 6 years of age (Incoll, 1979). It is also recorded for mature trees (Ashton, 1975). Fusion between roots of the same tree is quite common. It would be surprising if similar intraspecific grafting did not also occur in the closely related *E. obliqua*.

The phenomenon of root grafting is not fully understood. Various patterns of fusion occur and the commonest range from the 'X' type where fusion occurs at the point of root cross-over to the 'Y' or 'T' type where the less vigorous root may abort beyond the point of fusion (Beddie, 1941).

* 4th year Forestry Student, University of Melbourne.
† Botany School, University of Melbourne.

The frequency of root grafts is inversely related to the distance between trees (Pawsey, 1962). Where initial spacing is compact, grafts may occur at any time after the root becomes woody.

Natural root grafts, which may occur very early among dense stands of young trees, probably influence the pattern of spacing and the establishment of dominance in forest stands (Graham and Bormann, 1966).

Root grafting often occurs between trees of markedly different vigour (Leroy-Deval, 1973; Incoll 1979). Kozlowski and Cooley (1961) consider that some form of growth pressure is necessary for grafting. Thus the phenomenon may be promoted by the pressure of one root on another, or where they are lodged against a large stone. Millner (1932) concluded from experimental work that grafting was initiated if callus tissue was induced by slight wounding and bark rupture at the point of contact.

Thinning of stands tends to increase the frequency of grafting due to the increased diameter growth of remaining roots and the consequent increase in pressure points of root contact (La Rue, 1934).

Many grafts enable the translocation of photosynthates, minerals such as phosphorus (Kabashnikova 1972), and water (Bormann and Graham, 1959; Incoll, 1979; Stone and Stone, 1976). They may also permit transference of fungal disease (Boyce, 1962) and silvicides (Bormann and Graham 1960).

Description of the site

Sugarloaf Saddle, at an altitude of

762m, (latitude 37°25'S; 145°47'E longitude) lies precisely on the geological boundary of massive Silurian sandstones in the west and upper Devonian dacites to the east. The soils range from skeletal red or yellow podzolics to deep krasnozems. On the lower slopes they are deeper due to greater weathering and to accumulated hillwash. The annual precipitation in this area is about 1100-1200 mm.

Mature *E. regnans* with *Pomaderris aspera, Olearia argophylla,* tree ferns and ground ferns occupies the head of the south facing gully. A zonation of younger forest occurs on the slopes. About 90 m up the western slope of sandstones, *E. regnans* gives way to *E. obliqua* and *E. cypellocarpa.* This zone in turn is replaced by *E. macrorhyncha, E. radiata* and *E. cypellocarpa* a further 50 m upslope.

In the *E. regnans-E. obliqua* ecotone the understorey consists of scattered shrubs, such as *Lomatia fraseri, Coprosma quadrifida* and *Olearia phlogopappa* and occasional bracken fronds. Pole stage *E. regnans* almost invariably exhibits superior height growth compared to associated *E. obliqua.* The latter therefore tends to represent the suppressed and intermediate crown classes. Patches of hybrid individuals are common in this general ecotone and are recognizable by their recombinations of bark and fruit characteristics (Ashton, 1981).

Root Fusions

Closely spaced pairs or groups of pole stage trees are frequent in the *E. regnans — E. obliqua* ecotone (Fig. 1). Where trees butts are contiguous, root fusion can be demonstrated by excavation and exposure of the common cambium.

In Fig. 2, the compressed X shaped fusion pattern is shown, which demonstrates the fusion of large laterals from each species within 5-15 cm of the trunk and at a depth of 0-12 cm.

Although the *E. obliqua* trees closely associated with *E. regnans* appeared

Fig. 1. Profile diagrams of four species pairs at the Sugarloaf Saddle. F = fusion, A = avoidance, I = incompatible.

typical, most were suppressed and bore no buds or fruits.

Since the characters of the oil gland discriminate between these species, they were assessed microscopically according to the method previously employed (Ashton, 1958; Ashton and Williams, 1973). Mean gland densities and diameters obtained from canopy foliage are shown in Table 1. One of the *E. obliqua* trees root fused to *E. regnans* appears typical (4b in Fig. 1), the other (1a) appears to be an introgressant with *E. regnans* because of its less fibrous bark and the higher density of its foliar oil glands.

Apparent incompatibility occurs where no fusion takes place, even though strong contact pressures exist between adjacent roots. In Fig. 3, the root of *E. obliqua* has been arched up by the expansion of *E. regnans* roots below. The integrity of the root has been maintained by a thin separation of bark and sometimes by plaques of exuded kino.

In some juxtaposed trees no root contact has been made due to divergent lateral root growth or the failure to produce laterals on the mutually opposing sides of the trunks. This has been termed 'avoidance' in Table 1, Fig. 1.

Discussion

The excavation of seven *E. obliqua* trees growing in close contact with *E. regnans* revealed two instances of fusion and two of 'incompatibility'.

One fused *E. obliqua* tree showed evidence of hybridity which may have ameliorated any incompatability between the species. Although the other fused *E. obliqua* tree appeared typical it may have been likewise affected, although in a more subtle, physiological fashion. Experimental grafting would be

Fig. 2. Photograph of X-shaped fusion of laterals of *E. regnans* (above) *E. obliqua* (below) — see 1 in fig. 1.

Oil gland characters of tree foliage at the Sugarloaf Saddle.

(See Fig. 1)

Tree pairs or groups. (*E. obliqua* only)		Lateral root association	Oil gland Density/cm^2	Oil gland Diameter µm	Tree status
1	a	fusion (x type)	1130	123	Intermediate crown Introgressive features
2	a	incompatible	632	143	suppressed, typical *E. obliqua*
	b	avoidance (no contact)			
3	a	incompatible			recently dead *E. obliqua*
	b	avoidance			" " "
4	a	avoidance	400	167	suppressed, typical *E. obliqua*
	b	fusion (y type)	447	175	Co-Dominant typical *E. obliqua*
Isolated trees, typical of the species.					
		E. regnans.	1634-1840	86-123	
		E. obliqua.	540- 575	163-170	

Table 1. Oil gland characteristics of tree foliage at the Sugarloaf Saddle.

necessary to test any hypotheses of incompatibility. The 'avoidance' of contact between adjacent trees may be due to chance or to an active inhibitory effect of one tree upon the other.

If root fusions are efficient and common, it is possible that a stand may act not so much as an assemblage of competing individuals but as symbiotic units. Competition within the unit may still be an important factor shaping the structure and floristics of the ecosystem (Bormann, 1966). If so, one result may be an extension of species ranges in local habitats, at least in the short term.

Survival of *E. regnans* on relatively stressful sites on the mid-west and lower eastern slopes of the Sugarloaf Saddle may be related to the ability of groups of individuals to obtain moisture from these sandy loam soils in critical periods. Root fusions with a more xeric species such as *E. obliqua* therefore could be an advantage. To what extent this is mitigated by introgression is not yet known. Clearly much physiological and

Fig. 3. Photograph of an incompatible root contact between *E. regnans* and *E. obliqua* (up-arched) — see tree 2a in fig. 1.

genetical work remains to be done to explain the role of root fusion in stand development and tree survival.

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The Mammals of the Woolsthorpe Area, Western Victoria: And The Changes That Have Occurred Since European Settlement

BY A. F. BENNETT*

Introduction

Most of the sites now reserved for wildlife conservation in Australia are areas that were originally found to be unsuitable, or of marginal value, for agriculture. Those areas best suited for agriculture were rapidly taken up for settlement in the 19th century. Grazing by large herds of domestic stock, and clearing and burning of natural vegetation to form improved pastures, brought about marked changes to the natural landscape. Marlow (1958), in a survey of the marsupials of New South Wales, found that the greatest changes to the marsupial fauna had taken place in the woodland and open plains formations comprising the principal pastoral areas of that state. He attributed these changes primarily to modification and destruction of the original natural habitats occurring in these areas.

This paper examines the changes that have taken place in the mammalian fauna (excluding bats) of the Woolsthorpe area, a long-established agricultural community in Western Victoria, by comparing the contemporary fauna with those species believed to have been present at the time of first European settlement in the 1840's.

*Department of Zoology, University of Melbourne, Parkville, Victoria, 3052, Australia

Study Area

Woolsthorpe (38°11' N, 142°27' E) (Fig. 1) is a small township situated on the flat basalt plains which extend across south-western Victoria. The farming land surrounding Woolsthorpe has long been cleared of the original vegetation, and now supports improved pastures, chiefly of rye grass (*Lolium perenne*) and clover (*Trifolium* sp.) Windbreaks of pine (*Pinus radiata*), cypress (*Macrocarpus* sp.) and the introduced sugar gum (*Eucalyptus cladocalyx*) are widespread. The climate is temperate with warm dry summers and cool winter months when the majority of the annual rainfall of 650-700 mm falls. Spring Creek, a small but perennial watercourse, passes through Woolsthorpe and flows into the Merri River, which in turn opens to the sea at Warrnambool, some 25 km to the south. Numerous peat swamps, many of which drain into Spring Creek by way of its tributaries, occur throughout the area.

Sources of Information

As conventional mammal survey techniques could not practicably be used in open farmland, the survey of the contemporary fauna has relied primarily on observations and incidental sightings of mammals occurring around farm dwellings and in open paddocks throughout the area. Limited amounts of trapping

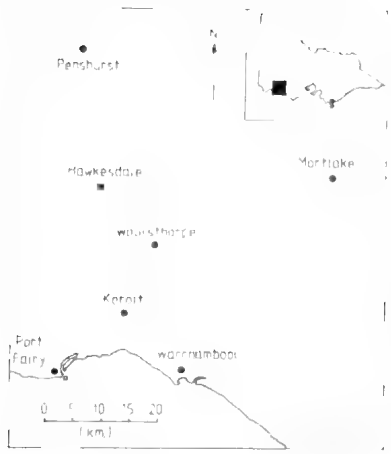

Fig. 1. Locality map.

(122 trap-nights) and spot-lighting (several hours) were carried out in the single remaining forest fragment. Most contemporary records apply to an area within a radius of 10 km of the Woolsthorpe township.

There are no formal historical records concerning mammals of the Woolsthorpe area; hence, to reconstruct the fauna originally present, information was gathered from local residents who have lived in the area for many years. This was supplemented by literature reports and museum records of specimens collected from localities close to Woolsthorpe.

Agricultural Settlement and Changes to the Vegetation

Following the overland exploration of Major Thomas Mitchell in 1836, the basalt plains of western Victoria were rapidly taken up for agricultural settlement by settlers moving out from Port Phillip (Melbourne) and Portland Bay (Peel, 1974). These men grazed large herds of cattle and sheep, by squatting on huge runs of land. By the early 1840's, most of western Victoria was settled in this way. The Woolsthorpe area was typical of this pattern of settlement, with 'Minjah' station originally of 35,000 acres, 'Union' of 15,000 acres and 'Quamby' of 25,000 acres, being the principal stock runs. Together these holdings occupied much of the land around Woolsthorpe, which by the 1870's was described as "a grazing township on Spring Creek, surrounded by large land holders with a few selectors; wool the staple product." (Sayers, 1972, p.78).

The original vegetation as observed by these pioneer settlers was greatly different from the improved pastures and open paddocks seen today. Quamby station was described as "heavily timbered, rough country, much of it swampy, a characteristic of the district." (Sayers, 1972, p.13). The banks of Spring Creek on which Quamby was situated carried heavy manna gum (*Eucalyptus viminalis*), and blackwood (*Acacia melanoxylon*) forest, with swamp gum (*E. ovata*) growing in wetter areas. There were large swampy marshes along the course of the creek, and elsewhere numerous shallow swamps in low-lying areas. These swamps were covered with dense reed beds and flanked by stands of tea-tree (*Leptospermum* sp.). Away from the creek the country was drier and less heavily timbered, supporting open forest of manna gum, blackwood, black wattle (*Acacia mearnsii*), silver banksia (*Banksia marginata*) growing to tree form, wild cherry (*Exocarpus cupressiformis*), and occasionally she-oak (*Casuarina stricta*). Bonwick (1857), commenting on the area to the north-east around Mortlake (see Fig. 1), noted that "Travellers . . . enthused about the park like appearance of the country, with its lush grass, abundant wildlife, scattered lightwood (*A. melanoxylon*), she-oak *(Casuarina)* and honeysuckle (*Banksia*) trees." Kangaroo grass (*Themeda australis*) apparently provided an abundant source of food for the settlers' stock. Boldrewood (1884, p.139) when describing 'Kangatong' station at Hawkesdale (see Fig.1) noted

Table 1: Occurrence and status of mammals of the Woolsthorpe area.

Species	Occurrence		Present Status
	1840	1982	
Echidna, *Tachyglossus aculeatus*	+	+	very rare
Platypus, *Ornithorhynchus anatinus*	+	+	rare
Tiger Quoll, *Dasyurus maculatus*	+		extinct
Eastern Quoll, *Dasyurus viverrinus*	+		extinct
Brush-tailed Phascogale, *Phascogale tapoatafa*	+		extinct
Fat-tailed Dunnart, *Sminthopsis crassicaudata*	+	+	uncommon
Eastern Barred Bandicoot, *Perameles gunnii*	+		extinct
Brushtail Possum, *Trichosurus vulpecula*	+	+	common
Feathertail Glider, *Acrobates pygmaeus*	+		extinct
Sugar Glider, *Petaurus breviceps*	+		extinct
Ringtail Possum, *Pseudocheirus peregrinus*	+	+	uncommon
Eastern Grey Kangaroo, *Macropus giganteus*	+	+	common/restricted
Red-necked Wallaby, *Macropus rufogriseus*	+	+	uncommon/restricted
Koala, *Phascolarctos cinereus*	+		extinct
Wombat, *Vombatus ursinus*	+		extinct
Water-rat, *Hydromys chrysogaster*	+	+	uncommon
*House Mouse, *Mus musculus*		+	very common
Swamp Rat, *Rattus lutreolus*	+		extinct
*Brown Rat, *Rattus norvegicus*		+	rare
*Black Rat, *Rattus rattus*		+	common
Dingo, *Canis familiaris*	+		extinct
*Fox, *Vulpes vulpes*		+	common
*Cat, *Felis catus*		+	common
*Brown Hare, *Lepus capensis*		+	common
*European Rabbit, *Oryctolagus cuniculus*		+	common

* introduced species

that ". . . the whole countryside was covered with a sward of kangaroo grass two or three feet high and as thick as a field of barley".

By the turn of the century much of the original vegetation had disappeared. Forests and woodlands were burnt and cleared, swamps ploughed, and Spring Creek, described in 1880 as a shallow drain passing through a sea of head high rushes (J. Bennett, pers. comm.), was ploughed by station bullock teams allowing winter floods to wash down and carve a deeper course. Numerous subdivisions of the large properties took place, and the smaller holdings were increasingly farmed more intensively. The last of the native grasses were lost with the widespread use of superphosphate and the introduction of exotic pasture grasses. Pines, cypress and the introduced sugar gum became the prominent farm trees, planted as windbreaks around houses and as plantations to shelter stock.

Other than scattered blackwoods and black wattles regenerating along road verges, only a single isolated remnant of natural vegetation remains of the original vegetation of the Woolsthorpe area. 'Wickham Park', reduced from hundreds of hectares in the 1940's, to less than 100 ha today, is a regrowth forest of manna gum, swamp gum, blackwood and black wattle. Prickly tea-tree (*Leptospermum juniperum*), prickly moses (*Acacia verticillata*), and tree everlasting (*Helichrysum dendroideum*) are prominent shrub species, with bracken (*Pteridium esculentum*), sword sedge (*Lepidosperma laterale*), maidenhair (*Adiantum aethiopicum*), mat-rush (*Lomandra longifolia*), rushes (*Juncus* sp.) and grasses occurring in the field layer. This forest remnant has been heavily logged over the years and is still grazed intermittently by cattle.

Mammals

The present day occurrence and status of mammals in the Woolsthorpe area, together with those believed to be present at the time of settlement, are shown in Table 1 and discussed in the following annotated list.

Echidna (*Tachyglossus aculeatus*)

Echidnas were probably widespread and common in the original forest and grassy woodland habitats. On very rare occasions individuals are still observed crossing open paddocks, possibly having dispersed over large distances from natural habitat.

Platypus (*Ornithorhynchus anatinus*)

Platypus have always been present in Spring Creek. In 1946 several platypuses were observed washed up on the bank of the creek after a severe flood (Miss C. Lindsay, pers. comm.). Individuals have been sighted on a number of occasions since (J. Bennett, pers. comm.), and are believed to be still present though shy and rarely seen.

Tiger Quoll (*Dasyurus maculatus*) and **Eastern Quoll** (*Dasyurus viverrinus*)

These two dasyurids are discussed together as it is not certain which species of 'native cat' occurred in the Woolsthorpe area until the early 1900's. However, it is likely that both species were present throughout the area. James Dawson, a squatter who settled on "Kangatong" station at Hawkesdale, described the aboriginal tribes of south-western Victoria in a book published in 1881 (Dawson, 1881). He listed the aboriginal names for many mammal species, including names for 'Dasyure, tiger cat', 'Dasyure, brown and spotted native cat', and for 'Dasyure, black and spotted native cat'. Not only were both species apparently present, but the aboriginals distinguished between the darker and lighter forms of the Eastern Quoll (see Fleay, 1932). A remnant population of the Tiger Quoll still occurs in the manna gum woodland of the

Table 2: Changes to the native mammal fauna of the Woolsthorpe area.

Species	Change	Probable Causes	Critical Period of Time
Echidna	decline/extinction?	habitat destruction	early 1900's
Platypus	decline	habitat modification	early 1900's
Tiger Quoll	local extinction	killing/habitat destruction?	before 1900
Eastern Quoll	local extinction	killing/habitat destruction?	before 1900
Brush-tailed Phascogale	local extinction	habitat destruction	~ 1900
Fat-tailed Dunnart	decline	habitat modification/ predation	~ 1900's onwards
Eastern Barred Bandicoot	local extinction	habitat modification/ predation	~ 1946
Brushtail Possum	increase	adaptation to exotic habitats	
Feathertail Glider	local extinction	habitat destruction	early 1900's
Sugar Glider	local extinction	habitat destruction	early 1900's
Ringtail Possum	decline	habitat destruction/ killing	early 1900's
Eastern Grey Kangaroo	decline	killing	~ 1900-1930
Red-necked Wallaby	decline	habitat destruction	before 1900
Koala	local extinction	habitat destruction/ hunting?/epidemic?	before 1900
Wombat	local extinction	killing	before 1900
Water-rat	decline/no change?	hunting?	
Swamp Rat	local extinction	habitat modification	early 1900's
Dingo	local extinction	killing	before 1880

Stones State Faunal Reserve, some 40 km to the west of the Woolsthorpe area (Emison *et al.*, 1977).

Brush-tailed Phascogale (*Phascogale tapoatafa*)

Miss C. Lindsay, a long-time resident of Woolsthorpe, described an animal last seen 75 years ago (i.e. ~ 1906) as being the size and colour of a rat and having a long tail with a black brush on the end. This animal, also described as eating meat, was undoubtedly a Brush-tailed Phascogale. These animals were apparently 'quite common' in earlier years according to her uncle. Emison *et al.* (1976) suggested that this species occurred widely in woodlands and open forests on the plains, and subfossils have been found at several localities (Wakefield, 1964).

Fat-tailed Dunnart (*Sminthopsis crassicaudata*)

These small marsupials still occur in open grassy farmland, particularly where there are boulders to provide shelter. On occasions individuals are discovered sheltering under old posts or abandoned farm implements. Several specimens from Woolsthorpe are housed in the National Museum of Victoria (NMV, Nos. C2317 and C2663).

Eastern Barred Bandicoot (*Perameles gunnii*)

Bandicoots were common before the 1940's, often occurring in farm gardens where they constructed nests of grass and leaves in small depressions in the ground. Their disappearance from the Woolsthorpe area coincided with a locally severe flood in 1946, which may have contributed to their final extinction. However, other factors, including predation by foxes, cats and farm dogs, and the gradual loss of suitable habitat associated with the increased use of superphosphate and the development of improved pastures, were probably more important factors (see Seebeck, 1979). Closely grazed pastures of ryegrass and clover replaced the last areas of long native grasses, tussocks and bracken in which the bandicoots sheltered and foraged.

Brushtail Possum (*Trichosurus vulpecula*)

Brushtail Possums may have increased greatly in number since settlement. Dawson (1881) describes them as uncommon before European settlement, when their skins were highly prized by the aboriginals for making fur rugs. Today they commonly occur around most farm dwellings and gardens, and are often considered pests due to their habits of clambering over roofs, sheltering in ceilings and damaging fruit on trees. Brushtails are occasionally seen feeding on grassy roadside verges adjacent to plantations, and are often killed on roads by passing traffic.

Feathertail Glider (*Acrobates pygmaeus*) and **Sugar Glider** (*Petaurus breviceps*)

Neither of these species occurs in the Woolsthorpe area today, but it is most likely that both species, certainly at least Sugar Gliders, were originally present. Miss C. Lindsay recalled 'flying squirrels' she saw on the property 'Kilmorey South' at Woolsthorpe many years ago, and gave a good description fitting that of a Sugar Glider. Mr H. Quiney, an amateur naturalist from Mortlake wrote, in a letter (November 1910) to the Director of the National Museum of Victoria regarding collection of marsupials, that "I can get possums (2 kinds), bandicoots, and might by a fluke get some of the pygmy squirrels". Both Sugar Gliders and Feathertail Gliders have been described as occurring throughout all native woodland and forest communities in this part of Western Victoria (Emison *et al.*, 1975).

Ringtail Possum (*Pseudocheirus peregrinus*)

Small numbers of Ringtails have persisted in the plantations and gardens surrounding some farm dwellings, but such populations are now rare. This species has not adapted well to an environment that has changed dramatically from continuous forest, to small isolated groups of exotic tree species. Ringtails are also present in the remnant natural habitat at 'Wickham Park'.

Eastern Grey Kangaroo (*Macropus giganteus*

Kangaroos increased rapidly in number shortly after settlement to the point that shooting drives were held to reduce their numbers. Sayers (1972) quotes from the notes of a former resident of 'Goodwood' station (15 km north of Woolsthorpe) who describes a kangaroo drive in 1865. "My father decided to try what could be done by yarding them, so he built yards with wings about a mile long . . . When it was decided to have a hunt notice was sent around and sixty to a hundred people would turn up . . . They would spread across a paddock about a hundred yards apart and drive the kangaroos into the wings of the yard . . . At the first hunt in the Lochaber yard there were 3,700 killed in one day. Later there were three yards on Goodwood, which soon got rid of the pest".

Despite these efforts, kangaroos were common in the Woolsthorpe area into the 1900's, until by the 1930's they were reduced to a small population facing complete extinction. These animals were protected by the Douglas family on their property 'Quamby East', and today a protected population of several hundred animals shares the open paddocks with sheep and cattle.

Red-necked Wallaby (*Macropus rufogriseus*)

A population of Red-necked Wallabies has survived at Wickham Park, sheltering in the denser vegetation and feeding in the surrounding grassy woodland and open paddock. However, with the decline in the area of this habitat over the last 50 years, the population is now small, probably numbering less than 30 animals. The long-term survival of this population is doubtful.

Koala *(Phascolarctos cinereus)*

Koalas were present at the time of settlement, but became locally extinct before 1900 (J. Bennett, pers. comm.). Little is known concerning their original occurrence or abundance in this area.

Wombat (*Vombatus ursinus*)

Before settlement Wombats were considered 'excellent eating' by the aboriginal tribes of western Victoria (Dawson, 1881). After settlement they were rapidly exterminated as 'pests' due to the damage they caused to fences. Skeletal remains of Wombats have been recorded from Mortlake (NMV, C6714) and from Penshurt (NMV, C7477).

Water-Rat *(Hydromys chrysogaster)*

Water-rats have always been present in Spring Creek, and on occasions are still seen swimming along the surface on summer evenings (J. Bennett, pers. comm.). Small collections of cracked shells found on rocks along the creek indicate where water rats have been feeding on freshwater molluscs.

House Mouse (*Mus musculus*)

This species is widespread and common, occurring around and within houses, sheds and haystacks, as well as in open paddocks. There is often a marked increase in the number of mice observed inside houses and sheds at the onset of cold winter weather; apparently resulting from the migration of individuals from open habitats to more sheltered sites.

Swamp Rat (*Rattus lutreolus*)

Specimens of Swamp Rats from Mortlake (NMV, C137), and Hawkesdale (NMV, C166), both collected before 1910, are held in the National Museum of Victoria. This species was probably common at the time of settlement as swamps, with their surrounding habitats of thick grasses and sedges, were widespread. No contemporary records or observations of the swamp rat within this area are known.

Brown Rat (*Rattus norvegicus*)

Single occurrence of the Brown Rat is known from a specimen lodged in the National Museum of Victoria (NMV, C7006) in 1966, from a property near Hawkesdale. This species is most common in urban situations, but populations can become established in farming areas (Watts and Aslin, 1981).

Black Rat (*Rattus rattus*)

Black Rats are widespread in this area. They occur irregularly around farm dwellings, sheds and fodder stores, occasionally increasing to large numbers while at other times seldom observed. A substantial population exists in the native vegetation at Wickham Park, where 19 captures were recorded from 122 trapnights. No native rodents or dasyurids were trapped.

Dingo (*Canis familiaris dingo*)

Before European settlement Dingoes ran wild throughout western Victoria as well as being kept in a semi-domesticated state by aboriginals (Dawson, 1881). They were rapidly exterminated by squatters as they were considered a threat to stock. Boldrewood (1884) notes (p.106), "With the help of our kangaroo dogs, and an occasional murder of puppies, we pretty well cleaned them out". However, with the demise of their natural predators the kangaroo population greatly increased. Boldrewood (1884) continues: "Though he killed an occasional calf, the wild hound did good service in keeping down the kangaroo, which after his extinction, proved a much more expensive and formidable antagonist".

Fox (*Vulpes vulpes*)

The introduced Fox is common and widespread throughout the Woolsthorpe area. In open farming country rabbits probably form the main component of their diet, but poultry and new-born lambs are both vulnerable to predation by foxes. Twelve fox scats were collected from Wickham Park in February, 1982, and hair samples were identified in the manner described by Brunner and Coman (1974). Four scats contained hair from rabbits, two contained hair identified as Black Rat, and samples of Ringtail Possum and Brushtail Possum hair were present in one scat each. Nine of the scats consisted wholly or partly of exoskeletal material from the black cricket (*Teleogryllus commodus*).

Cat (*Felis catus*)

Many farms possess household cats which live in a free-ranging situation. Feral cats also occur throughout the area, being seen around farm buildings, haystacks and often along roadsides.

Brown Hare (*Lepus capensis*)

Sayers (1972) notes that in the late 1800's the boast was made that, "the country around Woolsthorpe is not to be surpassed in Victoria for hares, snipe, etc.". Hares are common throughout the area today, although usually seen singly on grassy roadsides or in open paddocks.

European Rabbit (*Oryctolagus cuniculus*)

The history of the introduction and rapid spread of the European Rabbit in Australia is well documented by Rolls (1969). In the Woolsthorpe area in the early years of the 1900's, stations

employed rabbiters with large packs of dogs to keep the rabbit population under control. By the 1940's, rabbits increased to plague proportions and many 'rabbit drives' were held to reduce the numbers. On these occasions thousands of rabbits were driven into fenced enclosures and killed. Later, the introduction of myxamatosis and the use of 1080 poison (sodium monofluoroacetate) allowed a balance to be achieved, but rabbits remain common throughout this farming community.

Other Species Possibly Present at Settlement

The early settlement of the western plains of Victoria and the associated widespread changes to the natural habitat may have caused the extinction of a number of species before any formal records or collections of specimens were made. For example, the only evidence for the historical occurrence of the Brush-tailed Phascogale in the Woolsthorpe area is the clear recollection and description of an animal last seen 75 years ago, by a resident more than 90 years old. There may well have been a number of other species which disappeared without notice before the time of any contemporary residents. The following species also may have occurred in the Woolsthorpe area:

Red-Bellied Pademelon (*Thylogale billardieri*)

Red-bellied Pademelons originally occurred along the coastal regions of southern Victoria (Calaby, 1971), but the species has not been recorded in the State this century. As Woolsthorpe is less than 20 km from the coast it is quite likely that Red-bellied Pademelons originally occurred in this area, inhabiting dense undergrowth along the creek or around swamps. Mr H. Quiney of Mortlake, in a letter of November 1910 to the Director of the National Museum of Victoria regarding the collection of marsupials (as previously quoted), writes, "I am trying to see Mrs Lindsay, Quamby [a property at Woolsthorpe] and see if she or her brother can get some joyes [sic] for the park, also some of the red-bellied wallaby". This reference to 'red-bellied wallaby' may refer to Red-bellied Pademelons, but Miss C. Lindsay, daughter of the above Mrs Lindsay, had no recollections of these wallabies being present in the Woolsthorpe area within her memory.

Broad-Toothed Rat (*Mastacomys fuscus*)

A single specimen of the Broad-toothed Rat, collected 11/4/1919 at Mortlake by Mr H. Quiney, is lodged at the National Museum of Victoria (NMV, C134). Warneke (1960) considers that this specimen was collected in the Otways and implies that the species is unlikely to have occurred at Mortlake. However, from correspondence held at the National Museum of Victoria, Quiney appears to be a regular collector, sending a variety of material to the Museum from the Mortlake area over at least 20 years.

Broad-toothed Rats have been collected from a variety of habitats in southern Victoria (Seebeck, 1971), and are represented as subfossils from several locations on the basalt plains (Wakefield, 1964). They may well have inhabited the wet swampland vegetation located throughout much of the Woolsthorpe area.

Rabbit-eared Tree-rat (*Conilurus albipes*)

Dawson (1881) lists the names given by the aboriginal tribes of south-western Victoria for 'rabbit-rat', implying the presence of this species in western Victoria. Watts and Aslin (1981) suggest that Rabbit-eared Tree-rats were distributed widely throughout Victoria

at the time of settlement, although live specimens have not been collected from Victoria during this century. The species has also been recorded from subfossil deposits at several sites in western Victoria (Wakefield, 1964). Rabbit-eared Tree-rats are thought to have inhabited woodland and open forest habitats (Watts and Aslin, 1981).

Pseudomys sp.

Wakefield (1974) suggests that four species of *Pseudomys* recorded as subfossils in western Victoria were probably present in parts of western Victoria at the time of settlement.

The paucity of the small terrestrial mammal fauna known to have been present in the Woolsthorpe area at the time of settlement (Table 1) makes it quite likely that at least one or two small mammals were also present, but became locally extinct before any specimens were collected.

Changes to the Fauna

The mammalian fauna of the Woolsthorpe area has changed dramatically between 1840 and the present day. Of at least 18 species of native mammals believed to have originally occurred in the area (Table 1), at least 10 species have become locally extinct and most of the remaining eight species occur in limited numbers, or in restricted habitats. For example, Eastern Grey Kangaroos and Red-necked Wallabies both survive as remnant populations confined to protected habitats, owing their survival to the goodwill and favourable land management practices of the respective property owners. Elsewhere in the district populations of these species became locally extinct more than 50 years ago (Table 2).

Echidnas are very rarely seen, and Ringtail Possums presently survive in limited numbers at a few isolated sites. Only one native species, the Brushtail Possum, can still be considered common in this area.

In contrast to the changes that occurred to native mammals, introduced mammals have flourished since their introduction to this area. Six of the seven recorded species (see Table 1) now have firmly established populations despite persistent attempts to eradicate them by shooting, poisoning or trapping over at least fifty years.

Causes of Change

There are three factors associated with European settlement which appear responsible for most of the changes to the mammalian fauna of the Woolsthorpe area: direct killing by humans, habitat modification or destruction, and the impact of introduced mammals on the native fauna (see Table 2).

Shooting, trapping, poisoning and other forms of direct destruction were vigorously carried out by the early settlers against those species considered 'pests', posing a threat to livestock or to agricultural practices. Dingoes occasionally killed stock and consequently were rapidly eliminated. Quolls were also considered a menace so they too were shot, apparently in large numbers in some localities in western Victoria. Rolls (1971), p.26) quotes a sporting magazine of 1867 which lists ". . . native cats, 622; . . ." as part of the previous years shooting tally for a single property, 'Barwon Park', in western Victoria.

Wombats caused damage to fences, and the greatly increased numbers of Grey Kangaroos grazed pastures reserved for the settlers' sheep and cattle. Both of these species were also destroyed.

The natural forest habitat was progressively cleared from the time of settlement, but the greatest changes took place in the late 1800's and early 1900's when ring-barking, burning and clearing removed large belts of forest. These changes meant a direct loss of habitat for the arboreal gliders, possums and

Koala, and severe modification of the terrestrial habitat for ground dwelling mammals such as the Eastern Barred Bandicoot, Red-necked Wallaby and Echidna. Draining and ploughing swamps, erosion of the creek and the loss of riparian vegetation severely modified these habitats for species such as Swamp Rat, Platypus and Water-rat. Undoubtedly, habitat modification and destruction has been the most important factor causing the decline and extinction of native mammals in the Woolsthorpe area. Indeed, when one considers that the original habitat has been transformed from forest to open pasture land, and from native vegetation to introduced pasture grasses and trees, together with the invasion and spread of introduced mammals and the introduction of huge numbers of domestic stock, it is surprising that any native mammals remain at all!

It is difficult to evaluate the impact of introduced species on the native fauna. Both Foxes and Cats are known to prey on native fauna (Brunner *et al.*, 1981) and have probably had some impact on the terrestrial small mammals, particularly the Eastern Barred Bandicoot (Seebeck, 1979). Heavy grazing by rabbits and domestic stock may have reduced the ground cover for small terrestrial species such as the Fat-tailed Dunnart, and Seebeck (1979) has suggested that compaction of the soil by stock may have reduced the availability of soil arthropods for bandicoots.

There are also suggestions of widespread epidemics decimating populations of Koalas (Frith, 1973) and Eastern Quolls (Fleay, 1932) in eastern Australia around the turn of the century, and both Koalas and Water-rats were hunted and slaughtered for their fur in the early 20th Century (Frith, 1973).

Implications

Calaby (1966), after recording 45 native and seven introduced species of mammal from a region on northern New South Wales, concluded that despite 120 years of European occupation the area retained an abundant and diversified mammal fauna. He attributed the survival of such great diversity to the large amount of natural habitat preserved on mountain ranges and in State Forests within the area, and considered that the mammal fauna should retain its present diversity provided there were no important changes in land management practices. By contrast, after 140 years of European occupation and intensive land use in the Woolsthorpe area, few original native mammal species remain. Only a single species, the Brushtail Possum, remains widespread and common throughout the area.

Clearly, few native mammals can persist in the face of sustained and intensive agricultural practices involving the loss or modification of the original natural habitat. If wildlife conservation and agriculture are to successfully co-exist in the same region, it is essential that substantial areas of natural habitat be reserved and maintained as reservoirs for faunal populations. These natural reserves must be complemented by planned and ecologically sound farm-management practices within the agricultural community.

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A Review of Larval Host Records for Australian Jewel Beetles (Coleoptera: Buprestidae).

BY T. J. HAWKESWOOD* AND MAGNUS PETERSON +

Abstract

Larval food plant records for 37 species in 15 genera of Australian Buprestidae are summarized from the literature and previously unpublished information. Observations on ovipositing females of 2 species in 2 genera are also recorded. Photographs of the adults of *Araucariana queenslandica* Levey, *Pseudotaenia waterhousei* (Van de Poll), *Stigmodera (Stigmodera) goryi* Laporte & Gory, *S. (S.) roei* Saunders, *Stigmodera (Themognatha) heros* Gehin, *S. (T.) imperialis* Carter and *S. (T.) martini* Saunders, and larvae of *P. waterhousei* and *S. (T.) heros,* are provided. Although much information is yet to be gained on larval hosts, some trends are apparent. Most buprestid genera breed in one or two plant genera. A majority of the plant species utilized are primitive members of the Australian flora (as presently recognized by botanists) having undergone speciation from Gondwanaland before or shortly after the breakup of the continents.

* 49 Venner Road, Annerley, Brisbane, Qld., 4103
+ 69 Alvah Street, St James, Perth, W.A., 6102.

Introduction

Very little information is available on

the larval food plants of Australian Buprestidae. Froggatt (1892) first recorded the unusual behaviour of *Ethon* and *Cisseis* larvae which breed in galls of *Dillwynia* and *Pultenaea* (Fabaceae) in the Sydney area. Froggatt (1893, 1894, 1895) furthered work on the life-histories of some Australian Coleoptera and mentioned their food plants, including records for some Buprestidae, but unfortunately, did not continue work on larval buprestid biology.

Little attention was paid to breeding biology of jewel beetles until McMillan (1950a, b, 1951, 1952) recorded observations on several Western Australian Buprestidae. Both Froggatt's and McMillan's work however, is of limited value to present-day studies on larval taxonomy and morphology.

Hadlington and Gardner (1959) provided the only extensive work on the biology of an Australian buprestid when they examined *Diadoxus erythrurus* (White) in western New South Wales. However, the eggs, larva and pupae of this species, remain to be described in detail.

Levey (1978a) has provided the only detailed description of an Australian buprestid larva and provided brief notes on the biology of *Prospheres aurantiopicta* (Laporte & Gory).

The present paper summarizes all the published information on larval food plants of Australian Buprestidae and adds a number of previously unpublished records. It is hoped that this work will be a basis for further work since so little is known about buprestid biology.

Some information has been taken from specimens in the following institutions:- Queensland Museum (QM); Queensland Dept. of Forestry (QDF); Queensland Dept. of Primary Industries (QDPI); Australian Museum (AM); South Australian Museum (SAM); and the Western Australian Museum (WAM). Other unpublished data from the authors' personal observations and those of Mr M. Powell and Mr M. De Baar are included. The remaining records are taken from the scant and scattered literature and from H. W. Brown's private diary. The distribution on a state basis, follows each species name in parentheses. Species and genera are arranged according to the most recent nomenclature.

Larval food plants are recognized as those from which larva(e) and or pupa(e) have been extracted or plants from which adult(s) has have emerged or been collected.

List of species and larval food plants

Sub family Polycestinae, Tribe Polycestini

1. *Prospheres aurantiopicta* (Laporte & Gory) (Q, NSW, SA, NT). Levey (1978a) records *Araucaria cunninghamii* Don (Araucariaceae) as a larval food plant from Imbil, south east Queensland; larvae and adults were collected from log billets on 13 April 1972 by R. A. Yule. Another record is *Pinus patula* Schlet & Cham. (Pinaceae), adults were collected at Glastonbury, Queensland on 24 Nov. 1967, by N. W. Sheather (Levey, 1978a). Levey (1978a, pp. 122-125) has described the larva of *P. aurantiopicta* in detail.

Sub family Chalcophorinae, Tribe Epistomentini

2. *Araucariana queenslandica* Levey (Q) (Fig. 1). Levey (1978b) records single females from *Araucaria cunninghamii* Don from Jimmys Scrub, south east Queensland on 30 Dec. 1971 and Imbil State Forest, south east Queensland on 21 Dec. 1971, both records collected by R. A. Yule.

3. *Diadoxus erythrurus* (White) (Australia wide). Hadlington and Gardner (1959) recorded *Callitris hugelii* (Carr.) Franco and *C. endlicheri* (Parl.) F. M. Bail. (Cupressaceae) as the main larval hosts. French (1911) and Pescott (1932) have recorded the introduced tree *Cupressus macrocarpa* var. *lambertiana* Gordon (Cupressaceae) as a host in the Melbourne area. French (1911) also believed that *Acacia anemia* F. Muell. (Mimosaceae) was a host plant since he collected specimens from an area where no species of *Callitris* or *Cupressus* occurred. There since have been

no verifications of French's record; it is possible that the specimens emerged from processed timber or bred in *Pinus* or other conifers in the area where French collected. Recently, M. De Baar, M. Hockey and R. A. Yule have collected larvae and adults from *Callitris columellaris* F. Muell. in the Dunmore State Forest, south-east Queensland in March 1981.

4. *Diadoxus scalaris* (Laporte & Gory) (NSW, V, SA, WA). Hadlington and Gardner (1959) recorded *Callitris huegelii* (Carr.) Franco and *C. endlicheri* (Parl.) F. M. Bail. (Cupressaceae) as the main larval hosts.

Sub-family Chalcophorinae, Tribe Chalcophorini.

5. *Pseudotaenia waterhousei* (Van de Poll) (NSW, Q.). (Fig. 2). Mr M. De Baar is presently investigating some aspects of the biology of the species which breeds in living stems of *Acacia leiocalyx* (Domin) Pedley (Mimosaceae) in central south-east Queensland.

6. *Pseudotaenia spilota* Carter (WA). Breeds in *Acacia grasbyi* Maiden (Mimosaceae) on Yarlarweelor Station, north-west of Meekatharra, Western Australia (M. Powell, 1981, pers. comm.).

Sub-family Chalcophorinae, Tribe Julodimorphini.

7. *Julodimorpha bakewelli* (White) (WA, SA, V). Carter (1929) recorded the species as breeding in roots and trunks of mallee trees (*Eucalyptus* sp.) in inland Australia. Data on one female in the WAM, collected by A. M. Douglas on 3 Sept. 1978, 12 km E of Greenhead, W.A., records the beetle ovipositing 2.5 cm below the ground in damp sand near the base of an unidentified *Calothamnus* plant (Myrtaceae).

Sub-family Chrysobothrinae, Tribe Chrysobothrini.

8. *Chrysobothris* sp. (Q). One of us (T.J.H.) found larvae, pupae and adults of an undescribed *Chrysobothris* sp. breeding in the dead stems of *Acacia bidwillii* Benth. (Mimosaceae) on 5 Dec. 1981, at Townsville, north Queensland. A paper describing the species biology in detail will be published separately.

9. *Merimna atrata* (Hope) (Australia wide). One of us (M.P.) observed adults laying eggs into smouldering bark at the base of a *Eucalyptus (Corymbia) calophylla* R.Br. ex Lindl. (Myrtaceae) at Cannington, Perth. *M. atrata* is commonly known as the fire-beetle because of its habit of flying into camp fires, bush fires and to bright lights (Poulton, 1915). Fires appear to be an important part of its biology. As the species is widespread, it probably breeds in numerous native plants throughout Australia.

Sub-family Buprestinae, Tribe Agrilini.

10. *Ethon affine* Laporte & Gory (Q, NSW, V). Froggatt (1892) recorded this species breeding in galls on the stems of *Pultenaea stipularis* Sm. (Fabaceae) in May 1891 in the Sydney area. Froggatt noted "The galls containing the perfect insect, which were in the majority, were more soft and spongy than those containing the larvae; as the beetles do not emerge until the early summer months they must stay a considerable time in these galls after having undergone their metamorphoses". *Ethon affine* adults are present in Sept. — Oct., in the Sydney district on *Pultenaea* and flowering *Jacksonia scoparia* R.Br. (Fabaceae).

11. *Ethon corpulentum* Boheman (NSW, V, SA). Froggatt (1892) recorded this species breeding in galls in the roots of *Dillwynia retorta* (Wendl.) Druce (as *D. ericifolia* Sm.) (Fabaceae) in the Sydney area. Nothing further has been recorded on its biology.

12. *Cisseis acuducta* (Kirby) (Q, NSW, V, SA). Froggatt (1892) recorded this species breeding in galls in the roots of *Dillwynia retorta* (as *D. ericifolia*) in the Sydney area. Hawkeswood (1978) and M. Peterson (pers. obs.) have found adults on non-flowering and flowering *Jacksonia scoparia* in the Lapstone Hill area of the lower Blue Mountains from late Sept. — Dec.

13. *Cisseis maculata* Laporte & Gory (NSW, V, Tas, SA). Froggatt (1895) recorded this species breeding in dead branches of *Acacia longifolia* (Andrews) Willd. (Mimosaceae) at Rose Bay, Sydney and noted adults feeding on leaves of the plant.

14. *Cisseis semiscabrosa* Laporte & Gory? (*C. scabrosula* Kerremans?) (NSW, V). Froggatt (1895) recorded this species breeding in *Acacia longifolia* at Rose Bay, Sydney. Carter (1929) does not list *C. semiscabrosa* neither as a valid species nor a synonym. We suspect Froggatt may have found *C. scabrosula* Kerremans, which is found in coastal N.S.W. (Hawkeswood, 1981a) and Victoria.

15. *Paracephala cyaneipennis* Blackburn (NSW). Froggatt (1894) recorded this species breeding in small, rounded galls on the bran-

ches of *Casuarina distyla* Vent. (Casuarinaceae) at Rose Bay in Sydney. The beetle is rare in museum collections and little is known of its biology. Hawkeswood (1978) found an adult on *C. torulosa* Ait. in the Blue Mountains.

16. *Agrilus mastersi* Macleay (Q). Specimens have emerged from log billets of *Acacia leiocalyx* (Domin) Pedley (Mimosaceae) which were collected from the Dunmore State Forest, central south eastern Queensland in Nov. 1980 by M. De Baar.

Sub-family Buprestinae, Tribe Buprestini.

17. *Nascio similima* Van de Poll (Q). One of us (T.J.H.) found a dead adult under the bark of the Grey Ironbark *Eucalyptus (Symphyomyrtus) drepanophylla* F. Muell. ex Benth. (Myrtaceae) on 10 April 1981 at Townsville, north Queensland. This species has been rarely recorded.

18. *Nascio vetusta* (Boisduval) (NSW, V). The following larval host records are known for this species from adult specimens lodged in the N.S.W. Forestry Commission Collection, Sydney: Berowra, Sydney, 1 Dec. 1970, J. English; Middle Cove, Sydney, 28 May 1973, G. Dougherty (adult emerged 26 Oct. 1973); Pymble, Sydney, 4 Nov. 1964, K. G. Campbell (in main trunk). (All the above specimens in *Eucalyptus (Monocalyptus) haemastoma* Sm.); Lisarow, N.S.W., 21 Aug. 1954, K. M. Moore (in old fallen branch of *Eucalyptus (Symphyomyrtus) saligna* Sm.; Beecroft, Sydney, 22 Nov. 1981, E. E. Taylor, in *Eucalyptus (Symphyomyrtus)* sp. (Ironbark); Willoughby, Sydney, 17 Oct. 1980, E. E. Taylor (heavy infestation), in *Metrosideros* sp. All food plants are from the family Myrtaceae.

19. *Melobasis cupriceps* (Kirby) (NSW, Q, V, Tas). Froggatt (1895) recorded this species (as *M. iridescens* Laporte & Gory) breeding in branches of *Acacia longifolia* (Mimosaceae) at Rose Bay, Sydney and noted adults fed on *Viminaria denudata* Sm. (now known as *V. juncea* (Schrad. Hoff.) (Fabaceae).

20. *Melobasis purpurascens* (Fabricius) (Australia wide). Froggatt (1895) also recorded this species (as *M. splendida* (Donovan)) breeding in *Acacia longifolia* at Rose Bay, Sydney. Fricke (1964) records adults emerging from an unknown fruit tree at Ashfield, Sydney.

21. *Melobasis sexplagiata* Laporte & Gory (SA, WA, V). McMillan (1950 a, b) recorded notes on the general biology of this rare species which breeds in trunks of *Eucalyptus (Symphyomyrtus) rudis* Endl. in south west Western Australia.

22. *Amlata* sp. (near *A. obscura* (Macleay) (NSW). An unidentified *Amlata* species has been recorded breeding in, and causing extensive damage to, *Flindersia maculosa* (Lindl.) Benth. (Rutaceae) on 23 March 1966, at Moree, N.S.W. by K. M. Moore (NSW Forestry Commission).

Sub-family Buprestinae, Tribe Acherusini.

23. *Astraeus irregularis* Van de Poll (WA, SA, V, Q). Goudie (1920) records this taxon breeding in the branches of *Casuarina leuhmanniana* R. T. Baker (as *C. leuhmanni*) at Birchip, Victoria. Like most species of *Astraeus* it is found, as adults, on the leaves and branches of *Casuarina* species (Peterson, unpub. data).

24. *Astraeus prothoracicus* Van de Poll (WA, NSW, Q). Females of this species have been observed ovipositing on the cones of *Banksia prionotes* Lindl. (Proteaceae) at Jurien Bay, W.A. (M. Powell, pers. comm.) in November. Adults are usually recorded occurring on this plant (W.A. only).

Sub family Stigmoderinae, Tribe Stigmoderini.

25. *Curis intercribrata* Fairmaire (W.A.). McMillan (1951) provided brief notes on the species breeding in *Casuarina glauca* Sieb. ex Spreng. (Casuarinaceae) in Western Australia.

26. *Stigmodera (Stigmodera) cancellata* (Donovan) (W.A.). Whitlock (1947) recorded the species breeding in *Agonis flexuosa* (Spreng.) Schau. (Myrtaceae), while McMillan (1952) recorded "Peppermints" (*Agonis*) as host.

27. *Stigmodera (Stigmodera) gory* Laporte & Gory (NSW, Q). (Fig. 4). (a) On 3 Feb. 1981, Mrs N. Gawthorne of Toongabbie, Sydney, N.S.W. found an adult female which had died after attempting to emerge head first from the trunk of a *Eucalyptus (Symphyomyrtus) tereticornis* Sm. (Myrtaceae) after being trapped in small square mesh chicken wire which was tightly wrapped around the base of the tree. (The specimen was later lodged in the AM). One of us (M.P.) visited Toongabbie and examined the tree and emergence holes. The most recent hole, about 1m above ground level, measured 1.5 cm wide, 1.25 cm high and at least 7.0 cm deep. Other emergence holes ranged from 1.6 m above ground level on the main trunk

only. Despite the number of bore holes the tree was alive and healthy. (b) Two adults which emerged from *Eucalyptus (Symphyomyrtus) amplifolia* Naud. in Feb. 1969, at Stanthorpe, south-east Queensland, were collected by Mrs J. Harslett and are housed in her collection. (c) One female emerged from an unknown *Eucalyptus* sp. on 16 Dec. 1929 and was collected by H. Hacker at Kinkin, Queensland and is housed in the QM. (d) One male cut from an unknown *Eucalyptus* sp. on 19 Dec. 1963 at Fletcher, south Queensland is in the E. Sutton collection of the QM. (e) H. W. Brown recorded specimens cut from "living grey gums", (*Eucalyptus* sp.), on 12 Dec. 1912 at One Tree Hill (now Mt Coot-tha), Brisbane, south-east Queensland.

28. *Stigmodera (Stigmodera) gratiosa* Chevrolat (WA). McMillan (1952) recorded *Melaleuca* and *Leptospermum* (both Myrtaceae) as "breeding plants" for this Western Australian species.

29. *Stigmodera (Stigmodera) roei* Saunders (WA). (Fig. 5). McMillan (1952) noted that in coastal areas of south-west Western Australia the species breeds in *Agonis flexuosa* (Spreng.) Schau. (Myrtaceae).

30. *Stigmodera (Themognatha) excisicollis* Macleay (NSW, Q). An adult female from Sunnybank (Brisbane), Queensland, was "chopped out of dead grey gum" *(Eucalyptus Symphyomyrtus) propinqua* Deane et Maiden (Myrtaceae) and is housed at QDPI.

31. *Stigmodera (Themognatha) flavocincta* Laporte & Gory (SA, WA, V). Goudie (1923) recorded the species breeding in *Eucalyptus (Symphyomyrtus) leucoxylon* F. Muell. in north-western Victoria.

32. *Stigmodera (Themognatha) heros* Gehin (NSW, V, SA, WA). (Fig. 6). A specimen in SAM collection, collected on 28 June 1895, by A. B. Barrand, emerged from the trunk of an unidentified mallee, *Eucalyptus* sp., at Streaky Bay, South Australia.

33. *Stigmodera (Themognatha) imperialis* Carter (WA). (Fig. 7). On 25 Jan. 1938, H. W. Brown cut adults of this species from *Eucalyptus (Symphyomyrtus) striaticalyx* W. V. Fitz. at Milly Soak (Lake Austin-Cue district), Western Australia.

34. *Stigmodera (Themognatha) martini* Saunders (WA). (Fig. 8). One collection in the WAM, collected on 18 Jan. 1958 by R. P. McMillan records a male cut from a root of

Fig. 1. *Araucariana queenslandica* Levey. Bar indicates 10 mm. (Photograph by M. Peterson).

Fig. 2. *Pseudotaenia waterhousei* (Van de Poll). Bar indicates 20 mm. (Photograph by M. Peterson).

Fig. 3. Last instar larva of *Pseudotaenia waterhousei* (Van de Poll). Bar indicates 30 mm. (Photograph by M. Peterson).

Casuarina corniculata F. Muell. (Casuarinaceae).

35. *Stigmodera (Themognatha) similis* Saunders (NSW, Q). H. W. Brown recorded this species breeding in *Casuarina* sp. at Gladstone, Queensland.

36. *Stigmodera (Themognatha) suturalis* (Donovan) (NSW). K. M. Moore collected larvae on 12 Jan. 1965, from *Casuarina torulosa* Ait. at Lisarow (near Gosford), N.S.W.

37. *Stigmodera (Castiarina) rufipennis* (Kirby) (NSW, V, SA, WA). Froggatt (1893) recorded *Acacia brownii* (Poir.) Steud (Mimosaceae) (as *Acacia juniperina* Willd.), as a larval host from the Bendigo district, Victoria. Froggatt (1893) noted the larva fed on the stems of the *Acacia* hollowing out the majority of wood from the stems.

Fig. 4. *Stigmodera (Stigmodera) goryi* Laporte & Gory. Bar indicates 20 mm. (Photograph by M. Peterson).

Fig. 5. *Stigmodera (Stigmodera) roei* Saunders. Bar indicates 20 mm. (Photograph by M. Peterson).

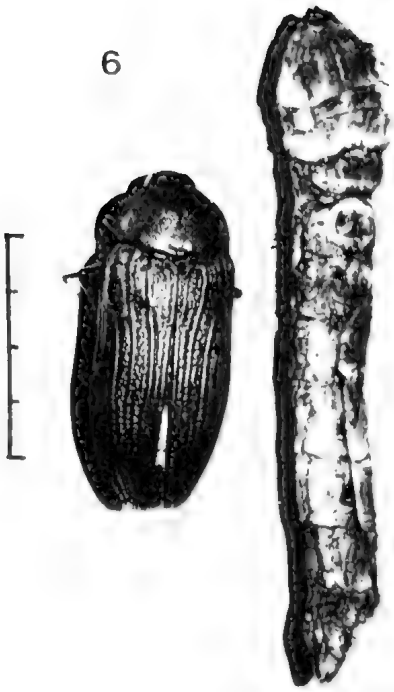

Fig. 6. Adult and last instar larva of *Stigmodera (Themognatha) heros* Gehin. Bar indicates 40 mm. (Photograph by M. Peterson).

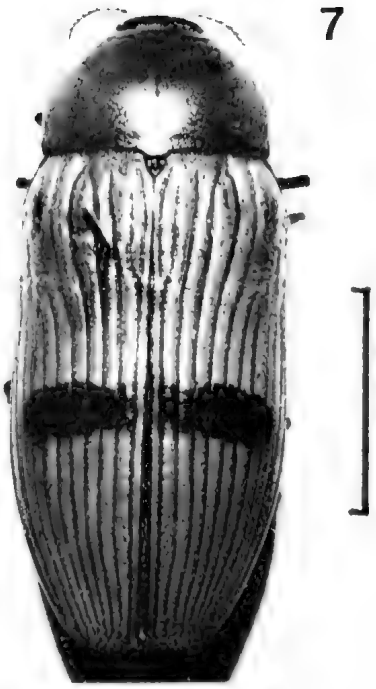

Fig. 7. *Stigmodera (Themognatha) imperialis* Carter. Holotype, National Museum of Victoria (NMV). Bar indicates 15 mm. (Photograph by M. Peterson).

38. *Stigmodera (Castiarina) verdiceps* Barker (WA). H. W. Brown bred a male beetle from an unidentified *Acacia* sp. on 23 Dec. 1946, from Port Samson, north-west Western Australia (Barker, 1979).

39. *Stigmodera (Castiarina) producta* Saunders (NSW, Q). A specimen in the NSW Dept. of Forestry Collection collected at Lisarow, near Gosford, N.S.W., on 13 Aug. 1954 by K. M. Moore, records *"M. eucalyptifolia"* as a larval host. We consider *"M. eucalyptifolia"* to be *Muellerina eucalyptifolia*, which is a synonym for the mistletoe *Muellerina eucalyptoides* (DC.) Barlow (Loranthaceae) (Barlow, 1966; Barlow and Weins, 1973).

Discussion

Of a total of about 800 species of Buprestidae recorded from Australia, only 37 (or c. 5%) of this total have food plants listed for them. The lack of knowledge of larval biology is further exemplified in the fact that the larva of only one species, *Prospheres aurantiopicta* Laporte & Gory, has been described in detail (Levey, 1978a).

Although the larval food plant data listed in the present paper is somewhat scanty and many of the records need further verification (i.e. some of the earlier records may have listed misidentified plant species) and relatively few host records have been made, some trends seem apparent and worthy of comment.

Levey (1978a) noted that the subfamily Polycestinae (Tribe Polyctesini) to which *Prospheres* belongs, appeared to be a relict group of the Buprestidae although some genera such as *Sponsor* (non-Australian) appeared to have undergone a period of recent speciation. Levey (1978a) also noted that the distribution, host associations and distinctiveness of the *Prospheres* species

suggests that the genus is an archaic one, which originated in the middle Cretaceous (c. 100 million years B.P.) or earlier. The association between the pine *Araucaria* (Araucariaceae) and *Prospheres* is probably therefore an ancient one, and the general association between conifers and other Polyctesini similarly may be ancient (Levey, 1978a).

Levey (1978b) erected a new tribe Epistomentini but did not state the subfamily to which it belonged. The present authors have assumed that it belongs to the sub-family Chalcophorinae. The new tribe now contains *Epistomentis* Solier (non-Australian), *Cyria* Solier (Australian), *Diadoxus* Thomson (Australian), *Cyrioxus* Hoschek (non-Australian) and the new genus *Araucariana* (Australian). As with *Prospheres* and the other Polyctesini, the members of the Epistomentini, especially *Araucariana, Diadoxus* and *Cyria* breed in softwood timbers, usually conifers (Pinaceae and Araucariaceae).

Levey (1978b) noting the relict distribution of the Epistomentini (i.e. *Epistomentis* in Chile and Argentina, *Cyrioxus* in New Caledonia and *Diadoxus* and *Araucariana* in Australia), suggested that, as with the Polyctesini, the group originated in the southern hemisphere and their present distribution is the result of the breakup of Gondwanaland. Like *Prospheres aurantiopicta* Laporte & Gory, *Araucariana queenslandica* Levey is known to breed in *Araucaria cunninghamii* G. Don and is probably also a primitive buprestid. *Diadoxus* species are definitely known to breed in softwood conifers (i.e. *Callitris* and *Cupressus*, both Cupressaceae, and may also breed in introduced *Pinus*, Pinaceae). Likewise, *Diadoxus* must be considered archaic members of the Buprestidae although evolved more recently than *Prospheres* and *Araucariana* since the distribution of the Australian genus *Callitris* tends to be in the arid and semi-arid areas of Australia and these plants presumably evolved during the drying of the central Australian land mass around 40 million years B.P., well after the breakup of Gondwanaland. *Cyria* has been suggested to breed in *Banksia* (Proteaceae) although the authors have been unable to obtain any published records or museum specimens bred from *Banksia* species. *Cyria imperialis* (Fabricius) however, is known to feed on *Banksia spinulosa* Sm. leaves in the Blue Mountains, N.S.W. (Hawkeswood, 1978) and do not visit flowers for food (Hawkeswood and Peterson, unpub. data).

Fig. 8. Two adults of *Stigmodera (Themognatha) martini* Saunders. Bar indicates 20 mm. (Photograph by M. Peterson).

Levey (1978b) noted the plant taxa associated with these three genera, i.e. *Araucaria (Araucariana), Callitris* (and *Cupressus) (Diadoxus)* and *Banksia (Cyria),* probably originated in the southern hemisphere and suggests an evolution from Gondwanaland. However, we feel that *Diadoxus* may have evolved during the time when Central Australia was drying out after the Gondwanaland breakup. The utilization of *Callitris* and *Cupressus* is unlikely to be a recent event in the evolution of *Diadoxus*. On the basis of

the host plant association, *Cyria* would not appear to be as old as *Diadoxus*, since *Banksia* is one of the most recent groups evolved in the Proteaceae (Johnson and Briggs, 1963, 1975). The earliest fossils of *Banksia*-like plants have been found in rocks dating back to the early Tertiary (Oligocene), c. 35 million years B.P. (Cookson and Duigan, 1950), compared to c. 100 million years B.P. when *Prospheres* and *Araucaniana* probably began evolving from buprestid ancestors, and at least 40-50 million years B.P. for *Diadoxus*. However, on the basis of *Cyria's* similarity to the South American genus *Epistomentis*, both these genera probably originated in Gondwanaland and therefore *Cyria* would be of similar age as *Prospheres* and *Araucariana* and older than *Diadoxus*.

It is possible that *Cyria* originally bred in a more primitive Proteaceous genus than *Banksia*, but changed to *Banksia* as the southern areas of Australia dried out.

The majority of Australian Buprestidae with known larval hosts, breed in hardwoods, i.e. *Acacia* (Mimosaceae) and *Eucalyptus* (Myrtaceae). The apparent close association between many genera of Buprestidae and *Acacia* (i.e. *Melobasis, Chrysobothris, Pseudotaenia, Agrilus, Cisseis)* as well as *Eucalyptus* (i.e. *Merimna, Julodimorpha, Nascio, Melobasis, Stigmodera (Themognatha))* suggests a long period of co-evolution, since Australian *Acacia* appears to have speciated at about the same time as the *Eucalyptus* in the late Cretaceous, about 80-90 million years B.P. (L. Pedley, 1982, pers. comm.).

The genus *Pseudotaenia* appears to have a strong relationship with *Acacia* — the larvae breed and feed in the wood and adults probably feed on the leaves. *Pseudotaenia waterhousei* (Van de Poll) breeds in *Acacia leiocalyx* (Domin) Pedley (a member of the Juliflorae, a sub-group of *Acacia* considered to be primitive and originating in northern Australia; L. Pedley, 1982, pers. comm.). The association with primitive *Acacias* of northern Australia may explain the northern distribution of *Pseudotaenia* and other members of the sub-family Chalcophorinae in Australia.

Chrysobothris, Agrilus and *Cisseis* also appear to have a strong association with *Acacia*, with the larvae breeding in the stems and adults usually feeding on the leaves only. Some members of *Cisseis* (i.e. *C. aeuducta* (Kirby)) and *Ethon* (i.e. *E. affine* Laporte & Gory and *E. corpulentum* Boheman) (considered by some to be a sub-genus of *Cisseis),* have diverged to breed in members of the Fabaceae. These taxa have been recorded to produce galls, in which the larvae feed and grow, on their food plants, an unusual habit for beetles. This specialization probably indicates a much more recent evolution than the other related species of *Cisseis* and *Melobasis*, which breed in *Acacia* and do not produce galls as far as we are aware.

Two species of *Stigmodera (Castiarina)* breed in *Acacia* (i.e. *S. verdiceps* Barker and *S. rufipennis* (Kirby)). Since this sub-genus is the largest of *Stigmodera* with over 300 species (many of which are widespread and occur in a number of habitats), numerous food plants from a range of families are probably utilized. Some *Castiarina* species may utilize only one food plant while others may breed in one species with adults feeding on two or more. For instance, adults of *Stigmodera (Castiarina) scalaris* (Boisduval) are known to have an association with *Cassinia uncata* A. Cunn. ex DC. (Asteraceae) flowers, but also may visit flowers of *Angophora bakeri* C. Hall and *Leptospermum flavescens* Sm. (both Myrtaceae) in one area of the lower Blue Mountains, N.S.W. (Hawkeswood, 1978, pp. 260-261). Whether or not this beetle breeds in all

these food plants, two or one only, remains to be determined.

Many buprestids have been recorded breeding in *Eucalyptus*, one of the largest genera in Australia with over 600 species. Johnson (1972) divided the genus into 8 sub-genera, with *Monocalyptus* and *Symphyomyrtus* the largest, with 91 and 285 species, respectively (from a total of 443 species he examined). *Corymbia* is next with 33 species (Johnson, 1972). It is therefore interesting to note that a majority of Australian Buprestidae which breed in *Eucalyptus*, (i.e. *Julodimorpha*, *Merimna*, *Nascio* and *Stigmodera*) breed in *Symphyomyrtus* species – *Nascio similima* Van de Poll (*E. drepanophylla*); *N. vetusta* (Boisduval) (*E. saligna*); *Stigmodera* (*S.*) *goryi* Laporte & Gory (*E. amplifolia*, *E. tereticornis*); *S.* (*T.*) *excisicollis* Macleay (*E. propinqua*); *S.* (*T.*) *flavocincta* Laporte & Gory (*E. leucoxylon*); *S.* (*T.*) *imperialis* Carter (*E. striaticalyx*) and *Melobasis sexplagiata* Laporte & Gory (*E. rudis*). Only one record, that of *N. vetusta* breeding in *E. haemastoma*, is known for *Monocalyptus*, while *M. atrata* was observed laying in the bark of *E. calophylla*, a *Corymbia* species. The remaining records are of unidentified *Eucalyptus* species.

Johnson (1972) suggested a polyphyletic evolution for *Eucalyptus*. There can be little doubt that *Eucalyptus* is of ancient Australian origin and although the fossil record does not show the appearance of *Eucalyptus* until the mid-Tertiary (Oligocene) (c. 30-35 million years B.P.), the genus was probably well advanced by the late Cretaceous (c. 80 million years B.P.). Therefore, the association between the species of *Nascio*, *Stigmodera*, *Julodimorpha*, *Merimna* and *Melobasis* and *Eucalyptus* appears to be an ancient one and probably co-evolutionary. *Symphyomyrtus* has radiated more widely than the other groups of *Eucalyptus* and therefore the probability of buprestids breeding in *Symphyomyrtus* species is greater than in other sub-genera which have fewer species.

The record of *Stigmodera* (*Castiarina*) *producta* Saunders breeding in *Muellerina eucalyptoides* (DC.) Barlow (Loranthaceae) is of much interest. We are unaware of any published reports of beetles breeding in Australian mistletoes or any overseas species of Loranthaceae or Viscaceae. (Several Buprestidae are known to visit flowers of *Nuytsia floribunda* (Labill.) R.Br. (Hawkeswood, 1981b), a Western Australian relict genus of the Loranthaceae, but it is not known whether any of these breed in the mistletoe). Barlow (1966) noted that *Muellerina* is a primitive genus and suggested that the early development and diversification of the Loranthaceae occurred in the late Mesozoic (c. 65-70 million years B.P.) when the geography and climate allowed more extensive distribution across the southern land masses (Barlow, 1963). The association between *S.* (*C.*) *producta* is possibly an ancient one (unless the record is erroneous, or the larva tunnelled into the mistletoe from the eucalypt on which the mistletoe was parasitic). Whatever is the case, further research is needed before a better understanding of the beetle/mistletoe relationship is gained.

The genus *Casuarina* (Casuarinaceae) contains about 70 species, distributed in Madagascar, Malaysia, Polynesia and Australia (which has 30 species). The present disjunct distribution of *Casuarina* can be partly explained by the break up of Gondwanaland where the genus probably originated c. 100 million years B.P. Further speciation of *Casuarina* occurred during the drying of the Australian land mass in the mid-Tertiary, probably at about the same time as *Eucalyptus* and *Acacia* were radiating, c. 30-35 million years B.P.

Casuarina species are important hosts to a number of Australian Buprestidae — *Paracephala cyaneipennis* Blackburn *(Casuarina distyla); Astraeus irregularis* Van de Poll *(C. leuhmanniana); Curis intercribrata* Fairmaire *(C. glauca); Stigmodera (Themognatha) saturalis* (Donovan) *(C. torulosa); S. (T.) martini* Saunders *(C. corniculata)* and *S. (T.) simulis* Saunders *(Casuarina* sp.). None of these buprestids are known to breed in any other plants. *Astraeus* is regarded as a primitive genus of the Polycestinae (Levey, 1978a) (although is probably not as ancient as *Prospheres* and *Araucariana)* and *Paracephala* appears to be a primitive member of the Buprestinae. *Curis*, one of the most primitive genera of the Stigmoderinae, is also known to occur in South America (Carter, 1929) and probably originated in Gondwanaland before the breakup occurred. Later speciation of *Curis* occurred throughout many dry areas of Australia, especially in Western Australia where the genus is well developed (Carter, 1929). Similar speciation appears to have occurred also in, for example, *Diadoxus., Chrysobothris, Pseudotaenia* and *Stigmodera (Themognatha).* Species of *Astraeus, Curis* and *Stigmodera (Themognatha)* have probably undergone a long period of co-evolution with *Casuarina* (i.e. 80 million years), although *Astraeus* is regarded by Levey (1978a) to have undergone a more recent speciation.

The genus *Flindersia* (Rutaceae) contains about 16 species of small to large trees distributed throughout eastern Australia, the Moluccas, New Guinea and New Caledonia (Armstrong, 1975). Australia has 14 species and 10 of these are restricted to the rainforests of eastern Australia, although none occurs in Tasmania. *Flindersia maculosa* (Lindl.) F. Muell. is one of four Australian species not confined to rainforests but grows in the dry open areas of central New South Wales and Queensland. It is likely that the genus originated in the southern hemisphere and that the rainforest species are more primitive than the arid-adapted ones. Little is known of the biology and taxonomic relationships of *Anilara*, but the *Anilara* species (near *A. obscura* Macleay) recorded breeding in *F. maculosa*, is likely to be a recently evolved species.

To conclude, in most cases, the relationships between Australian Buprestidae and their larval food plants, appear to be ancient ones, with many probably originating in Gondwanaland before or after the breakup, c. 80-100 million years B.P. or even later. This view is based on the available larval food plant records which, although fragmentary, show that some primitive genera e.g. *Prospheres* and *Araucariana*, breed in *Araucaria* pines. Other genera e.g. *Diadoxus, Chrysobothris, Pseudotaenia, Melobasis* and *Stigmodera*, breed in relatively primitive plants such as *Eucalyptus, Acacia* and *Casuarina*, (which although not as primitive as *Araucaria*, probably originated in Gondwanaland or evolved from Gondwanaland ancestors). Many buprestid genera probably co-evolved with these plant genera.

Much information is yet to be gathered on food plants of Australian Buprestidae. With the disappearance of habitats as a result of land-clearing practises by man, it is imperative that further records are made in order that a better understanding of the biology, distribution and ecology of Australian Buprestidae can be gained.

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Actinotus forsythii Maiden et Betche (APIACEAE): A Flannel Flower for Victoria.

By Neville G. Walsh*

Actinotus in Victoria

Actinotus, the "Flannel Flower" genus was first added to the Victorian list of genera on the basis of one collection of the diminutive *A. bellidiodes* near Mt Baw Baw in 1940. This species has eluded collectors since and its status as a Victorian plant is presently in question. This article reports the discovery of another species of *Actinotus* in Victoria.

The genus consists of some fifteen species, four of which, including *A. bellidioides*, are variously included in the Tasmanian and New Zealand endemic genus *Hemiphues*. These four species are diminutive plants with inconspicuous involucral bracts and few-flowered compound heads, unlike the more familiar flannel flowers of *Actinotus*.

The inflorescence of *Actinotus* consists of many small individual flowers clustered into a single head or capitulum and surrounded by a series of radiating involucral bracts. It is these bracts which generally bear a dense indumentum of silky or felted hairs and give rise to the common name. Although the plants resemble true daisies (family Asteraceae), they belong in the Apiaceae (or Umbelliferae) — the parsley family.

Description of *A. forsythii*

A small herbaceous species with flowering branchlets growing out from a central rosette of compound leaves. Flower heads 12-25mm. diameter. Bracts bearing white to pale pink silky hairs on the upper surface, the lower surface nearly glabrous, green with mauve margins or wholly mauve-pink in older plants. Flowers are unisexual. Within an inflorescence a single outer ring of smaller male flowers encircles up to 60 female flowers. Male flowers have 5 stamens, 5 minute (ca 0.3mm. long) papery petals and 5 smaller blunt sepals which are fused to form a conical tube. Female flowers consist of a single, 5-ribbed ovary bearing copious silky hairs on ribs and intervening faces. The 2 styles are inarched and the sepals fused into a 5-lobed "skirt" on the summit of the ovary; petals are absent. The ovary matures to a single, dark ovate seed (ca 2.5 x 1.5mm.). Leaves compound with 3-7 lobes, glabrous or nearly so, approx. 10mm. broad and 10-20mm. long, tapering to a longer patiole which may attain 30mm. on mature leaves. Branches are procumbent, up to 20 cm. long and bear the inflorescences on peduncles which elongate with age (up to 50mm.). Peduncles of new inflorescences are short, giving the impression that the flower heads spring directly from the soil. There is a single slender taproot with relatively few lateral rootlets toward the tip.

Habitat

The plants were collected in early flower on a recently burnt, exposed, subalpine spur in the Eastern Highlands. The substrate was a fine shaly material with no top-soil. A trip three weeks later to the same locality revealed that the plants had rapidly passed into fruit and were withering or dead. This rapid development suggests that the plants are ephemeral and appear only after fires, a feature noted also by several N.S.W. collectors (J. Thompson pers. comm.).

* 38 Paxton St., East Malvern 3145.

Fig. 1. a. single head or capitulum. b. entire plant. c. male flower, note minute petals between stamens. d. female flower. e. mature seed.


0
5
10 mm
a
b
0
60 mm
c
d
e
0
3 mm

Many species of regularly burned mallee-woodlands share this life habit but the wetter forests of eastern Victoria are presumably less regularly burnt, a factor which poses an interesting problem regarding the future of this presumably rare Victorian species. The species is otherwise known from only about a dozen collections, all from exposed situations in central and southern New South Wales (e.g. Upper Blue Mts., Kanangra Walls and Budawang Range). The Victorian locality is a further disjunct occurrence added to an already discontinous distribution.

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F.N.C.V. Excursion to Portland, Victoria. (16/1/82 — 22/1/82.)

At 8 a.m. on a Saturday morning under a clear sky and the promise of a hot day (in the mid thirties), 27 members of the F.N.C.V. led by Marie Allender left Melbourne by bus for Portland. We travelled via Geelong, Colac, Warrnambool — where the Fletcher Jones garden was glimpsed from the bus — and then on via the winding roads through the Otway forest where between Weeaproinah and Gellibrand masses of the lilac coloured flowers of *Prostanthera lasianthos* — the Victorian Christmas Bush gave a welcome splash of colour. Also the botanists noted the Satinwood *Phebalium squameum* which is confined in Victoria to the Southern Otways. Along the Ocean Road we stopped to observe the Twelve Apostles, the Loch Ard Gorge, the Graves site and London Bridge where the fernlike Silky Wilsonia *Wilsonia humilis* and creeping Brookweed *Samolus repens* were surviving a harsh environment.

Lunch was taken on the attractive foreshore at Port Campbell where some of our party cooled off in the sea. Various birds were noted during our journey namely the Magpie, Raven, Welcome Swallow, Pipit, White-fronted Chat, Singing Honeyeater, Brown Hawk, Swamp Harrier, Egret, White-fronted Heron, White-necked Heron, Straw-necked Ibis, White Ibis, Little Pied Cormorant, Black Swan, Yellow-tailed Thornbill, Mudlark, Galah, Wood Duck. At Portland, two more F.N.C. members from Bendigo were welcomed. At the Motel, the evening meal became a most leisurely affair. After waiting one and one half hours, one of the desperate members passed around his bananas. But the meals were worth waiting for and the delay was soon forgotten.

Sunday 17th January.

Mr and Mrs Colin Woolcock led the group and during the drive through the town of Portland many historic buildings such as the old Court House were admired. We were soon jolted back to the twentieth century by a short trip to the wharves where a ship with high rise sheep pens was waiting to be loaded with sheep for Saudi Arabia. Later in the day in the Cape Nelson area sheep by the thousands were seen in holding paddocks. A further reminder of man's will to power over the Earth was a visit to the Alcoa site of 70.5 ha. at Point Danger where fifty four (54) hectares of wet heathland have been cleared and made into a sandy wasteland surrounded by a great wire fence. In the clearing process was destroyed the habitat of a rare orchid — Mellblom's Spider Orchid *Caladenia hastata** which is similar to *Caladenia patersonii* except the sepals and petals are heavily clubbed. (See plate.) The orchid originally grew between stands of Shining Peppermint *Eucalyptus nitida* and Brown Stringybark *Eucalyptus baxteri.* Seeds from the orchid

* Nicholls, W. H. (1940) Two New Varieties of Orchids. Victorian Nat: 58. 115-116.

have been collected and have germinated but the survival of this orchid is uncertain. It seems that successful conservation of endangered terrestrial orchids like *Caladenia hastata* will depend on a proper understanding of the pollination agent and the symbiotic germination of these natives BEFORE they are destroyed in their natural habitat.

The group inspected a small adjacent area of the original heathland which is wet in winter and subject to strong coastal winds and consequently the shrubs are low growing to almost horizontal. The botanists found the red Correa *Correa reflexa*, Dodda Laurel *Cassytha glabella*, the yellow-flowered Scented Paper-bark *Melaleuca squarrosa*, Small Boronia *Boronia nana*, creeping Bassiaea *Bossiaea prostrata*, Hop Goodenia *Goodenia ovata*, Coastal Wattle *Acacia longifolia*, var. sophorae, Black Sheaok *Casuarina littoralis*, Bundled Guinea-flower *Hibbertia fasciculata*, with its thread-like leaves, Austral Grass-Tree *Xanthorrhoea australis*, Sea Celery *Apium prostratum*, Prickly Tea Tree *Leptospermum juniperinum*, Woolly Everlasting *Helichrysum blandowskianum*, Heath Parrot-pea *Dillwynia glaberrima*, Horny Cone-Bush *Isopogon ceratophyllus*, Rigid Bush-Pea *Pultanea stricta*, Dotted Sun Orchid *Thelymitra ixioides* (seed heads only), Brown Stringybark *Eucalyptus baxteri*, Twisted Beard-heath *Leucopogon glacialis*.

Fig. 1. *Caladenia hasta*. From the drawings by Colin Woolcock.

Blue-winged parrots were noticed whilst walking on the roadside to Blacknose Point and the botanists noted Ixodia *Ixodia achilleoides* with its clumps of white daisy flowers (where was the Achilles heel?), Angled Lobelia *Lobelia alata*, Love Creeper *Comesperma volubile*, Short Purple-Flag *Patersonia fragilis*, Mitchell Wattle *Acacia mitchellii*, Twiggy Daisy Bush *Olearia ramulosa*, Moonah *Melaleuca lanceolata*, Tall Daisy *Brachycome diversifolia*, Austral Stork's-bill *Pelargonium australe*, and the introduced Angular Noonflower *Carpobrotus acquilaterus* of the Pigface family, Coast Daisy Bush *Elearia axillaris* (in flower), Small-leaved Clematis *Clematis microphylla* (in the Old Man's Beard stage), Seaberry Salt-bush *Rhagodia baccata*, Coast Everlasting *Helichrysum paralium*, Coast Beard-Heath *Leucopogon parviflorus* with its attractive white berries, Silver Banksia *Banksia marginata*. At the Point, the group had an excellent view of the Gannet rookery — one of the five known breeding colonies of Gannets in Australian waters — on Lawrence Rocks. The remains of several dead Mutton birds which probably had been killed by foxes were seen amongst many nesting burrows. For lunch the group visited Cape Nelson Park (210 hectares) 12 km south of Portland, which was established to protect some unusual plants particularly the Soap Mallee — *Eucalyptus diversifolia* which grows nowhere else in Victoria. A walk was taken near the Lighthouse, then another longer walk of three km — the Sea Cliff Walk — followed by a scenic drive along the coast. During their rambles through Port Nelson Park the botanists noted, apart from the Soap Mallee, the Feather Bush *Apalochlamys spectablis*, Variable Groundsel *Senecia lautus*, Cherry Ballart *Exocarpus strictus*, Winged Spyridium *Spyridium vexilliferum*, Pale Turpentine Bush *Beyeria leschenaultii* — where the male and female flowers are on separate bushes, Climbing Lignum *Muehlenbeckia adpressa*, Prickly Moses *Acacia verticillata*, Flame Heath *Astroloma conostephioides*, Drooping Velvet Bush *Lasiopetalum schulzenii* which grows in South Australia and in Victoria only in the south west of the state, Coast Swainson Pea

Fig. 2. The Ink Pot.

Swainsona lessertiifolia, Boobialla *Myoporum insulare*, White Correa *Correa alba* var. panosum, Forest Pomaderis *Pomaderris oraria*, Silver Banksia *Banksia marginata*, Coast Twin Leaf *Zygophyllum billardieri*, Otway Bush Pea *Pultanea prolifera*, Soft Bush Pea *Pultanea mollis*, Coast Bush Pea *Pultanea canaliculata*, Sweet Bursaria *Bursaria spinosa*, Sticky Daisy Bush *Olearea glutinosa*, Morning Flag *Orthrosanthus multiflorus* and the rare maroon Leak Orchid *Prasophyllum hartii*.

On our return a stop was made at a large lagoon at Portland where there were spur-winged plovers, swans, chestnut teals and silver gulls. The birds listed for the day were the Tree Martin, Dusky Wood Swallow, Singing Honeyeater, Pipit, Gannets, Pied Cormorant, Crested Tern, Magpie, Spur-winged Plover, Grey Thrush, Grey Fantails, Yellow-winged Honeyeater, Tawny-crowned Honeyeater, Blue-winged Parrot, Brush Bronzewing Pigeon, White-browed Scrub-wren, Striated Field Wren, Red Wattle Bird, Silvereye, Swamp Harrier, Nankeen Kestrel, Blue Wren, Yellow-winged Honeyeater, Yellow-faced Honeyeater, Swans, Chestnut Teals, Silver Gulls.

Monday 18th January

Another warm day, max 26C. and the group led by Colin Woolcock headed for Mt Clay (620ft.) approximately 20km north-east of Portland. At the turn off near Narrawong cemetery, a stop was made to remember Captain Dutton, the whaler, who in 1828 landed near Portland and made his permanent home there before the Hentys who settled in 1834. Hyacinth orchids *Dipodium punctatum* were common along the roadside. At a stop near a soak a coral fern grew in abundance.

On the way botanists noted *Acacia mitchellii*, *Pultanea strieta*, *Pultanea canaliculata*, *Boronia nana*, and new friends in the Grooved Bush Pea *Pultanea teretifolia*, Furze Hakea *hakea ulcina*, Beaked Hakea *Hakea rostrata*, Shining Peppermint *Eucalyptus nitida*, Tall Saw-Sedge *Gahnia clarkei*, *Goodenia blackii(?)* (a new species not properly named), Hairy Boronia *Boronia pilosa*, Leafless Globe Pea *Sphaerolobium vimineun*, Downy Wedge Pea *Gompholobium ecostatum* and the Large Duck Orchid *Caleana major* which was found growing in the middle of a vehicle bush track.

After lunch at the Picnic Area on Mt Clay, a walk was made to Whalers' Lookout where there was a very fine vista of the ocean. Hyacinth orchids were numerous and it was noticed that some of the blooms were not spotted. Early in the afternoon the party moved to the Fitzroy River Coastal Reserve where refreshing river and surf swimming was enjoyed by many. A large patch of orange-brown algae* was noticed floating on the breaking surf. From the river's edge we watched Gannets, Silver Gulls, Crested Terns, Spur-winged Plovers showing their mastery of the air whilst a lone white egret rested on the opposite bank. Amongst the bushes a jewel spider was greatly admired.

The last stop was at Narrawong beach, a popular resort only 14 km east from Portland. For the day the bird observers listed Crimson Rosella, Golden Whistler, Yellow Robin, Striated Thornbill, Brown Thornbill, Yellow-winged Honeyeater, Yellow-faced Honeyeater, Grey Fantail, White-throated Tree Creeper, Pied Currawong, Eastern Spinebill, Sulphur-crested Cockatoo, Magpie, Mudlark, Blue Wren, White Egret, White-faced Heron, Pelican, Goldfinch, Red-necked Stint, Red-capped Dotterel, Greenfinch.

At dinner the members led by Elizabeth Turner offered congratulations to Alan and Win. Morrison on their 52nd wedding anniversary. Win. was presented with a bouquet of "exotics" from the bush and Alan was presented with a small souvenir spoon. A celebration cake was shared by all. Later, at the Portland Library, a showing of slides of orchids of the Portland district was enjoyed. Of particular interest were the slides of

* reproductive cells of a seaweed.

Caladenia hastata with its clubbed sepals and petals and the Swamp Greenhood *Pterostylis tenuissima*. Colin also brought along some of his drawings of native plants which were greatly admired.

Tuesday 19th January

Led by Colin, the group travelled through State Forest to a bridge over the dried-up bed of the Surrey River. Many of the party walked along the river bed where nearby on the banks were the dried-up flower heads of the Sickle Greenhood *Pterostylis falcata*. On the river bed were found two species of blue-flowered Pratia which are related to the Lobelias, Water Buttons *Cotula coronopilifolia* and Ivy-leafed Violet *Viola Hederacea*. Also noted was the wiry Bossiaea *Bossiaea cordigera* and Brooklime *Gratiola peruviana*. Fluttering amongst the bushes were grey and rufus fantails and overhead immature crimson rosellas chattered in the trees.

At Surrey Ridge, the group walked along a moist fern gully where were seen the Fishbone Water Fern *Blechnam nudum* and the golden striped Tender Bracken Fern (also called the False Bracken) *Pteris tremula*, River Mint *Mentha australis*, Maiden Hair Fern *Adiatum althropicum*, Sweet Bursaria *Bursaria spinosa*, Vanilla Lily *Auguillaria minus*, Blue Pin Cushion *Brunonia australis*, and Prickly Currant Bush *Coprosma quadrifida* with its masses of edible berries. Squawking in the trees were Yellow-tailed Black Cockatoos. Also listed for the morning rambles were Spiky Blue Devil *Eryngium rostratum*, the foreigner Paterson's Curse *Echima*, the mauve Swamp Mazus *Mazus pumilio*, Swamp Daisy Bush *Olearia glandulosa*, Rough Daisy Bush *Olearia asterotricha*, Woolley Tea Tree *Leptospermum lanigerum*, Prickly Geebung *Personia juniperina*. Along the roadside were seen one of the Saw-Sedges *Gahnia* and the Tassel Cord Rush *Restio tetraphyllus*.

During the afternoon a visit was made to Cape Bridgewater where unusual columns of limestone bore witness to the remnants of a petrified forest. Out at sea could be seen a large number of Short-tailed Shearwaters floating like rafts on the water. Near the Blow Hole were massive basalt blocks — evidence of volcanic action. Bridgewater Bay, a popular place for swimming, was an excellent place to cool off on the very hot day (35° max at Portland) but many of the party were not prepared for the icy waters. Probably the north wind blowing off the shore caused a circulation of the deeper colder water to well up towards the surface. The town of Bridgewater is no more but apparently it was a prosperous town during the eighteen-eighties. It was close to a fresh water supply but the soils were quickly depleted, rabbits became a pest, and the town died. Two km away were the scenic Bridgewater Lakes which were areas of fresh water as a result of the limestone springs. The Bird Observers list for the day was the Spine-tailed Swift, Eastern Swamp Hen, White Ibis, Staw-necked Ibis, Spur-winged Plover, Welcome Swallow, White-faced Heron, Magpie, Grey Fantail, Rufus Fantail, Eastern Spinebill, Rufus Bristle Bird, Crimson Rosella, Crescent Honeyeater, Spotted Pardalote, Grey Currawong, Yellow-tailed Cockatoo, Pied Currawong, Blue Wren, Grey Currawong, Yellow-faced Honeyeater, Kookaburra, Golden Whistler, White-fronted Chat, Brown Hawk, Nankeen Kestrel, Short-tailed Shearwaters, White-browed Scrub Wren.

During the evening many beautiful bird slides taken by Ina Watson and Maurice Streeter were shown to an appreciative audience at the Portland Public Library.

Wednesday 20th January

The day was much cooler and our destination was Richmond National Park. During the journey were seen several Yellow-tailed Black Cockatoos and a flock of Straw-necked Ibis were feeding in a paddock. At a stop along a fire-break the Brown Stringybark *Eucalyptus baxteri* was in flower and by the track there were some attractive specimens of Pussy Tails *Ptilotus spathulatus*. Further along the track where the ground was more swampy were found the Small Fairies Aprons *Utricularia dichotoma* and the even smaller Violet Bladderwort *Utricularia violacea*, the orchids Austral Ladies Tresses *Spiranthes sinensis* with the delicate pink flowers spiralling around the stem, and the Swamp Onion Orchid *Microtis orbicularis*. The botanists also listed Beaked Hakea *Hakea rostrata*, Apple Berry *Billiardiera scandens*, Cudweed *Gnaphalium* sp., and new on the list Mountain Conosperm *Conospermum mitchellii*, Angled Lobelia *Lobelia alata*, yellow Hakea *Hakea nodosa*. Wattle birds, grey fantails and yellow-winged honeyeaters were seen and

a small snake approximately 18 inches long. At the Mt Richmond summit were noted *Olearia speciosa* and *Olearia asterotricha* and a Brooklime *Gratiola*.

Mt Richmond is an extinct volcano which is covered with a layer of sand blown long ago from Discovery Bay. Under the sand is the tuff — the hardened volcanic ash. On the Ocean Walk, Blackwood often lined the path as did the Sweet Bursaria. The yellow-faced honeyeaters, wattle birds, crimson rosellas, silver-eyes, blue wrens and yellow-winged honeyeaters were seen on this walk. A lookout provided views of Cape Bridgewater and Discovery Bay. Noel's Walk descended through a tall stringybark to peppermint and swamp gum forest at the base of the mount. After lunch the group travelled to the Pipe Clay Picnic Area — a swamp area where Austral Ladies Tresses were abundant. One measured flower stalk was 13½ inches — the flower head being 5 inches. A pair of Gang Gang Cockatoos was seen — the male with the red head and the less colourful female. The Bird Observers supplied their list for the day; Yellow-tailed Black Cockatoos, Straw-necked Ibis, White-eared Honeyeater, White-naped Honeyeater, Yellow-faced Honeyeater, Little Wattle Bird, Buff-tailed Thornbill, Red-browed Finch, Grey Thrush, Yellow Robin, Crimson Rosella, Red Wattle Bird, Eastern Spinebill, White-throated Tree Creeper, Mistletoe Bird, Spine-tailed Swift, Gang Gang Cockatoo, Swamp Harrier, Kookaburra, Yellow-tailed Black Cockatoo, Black Duck, Silver-eyes, Martins.

In the evening, Colin Woolcock showed many fine slides of Western Australian Orchids.

Thursday 21st January

The destination was the Moleside Creek Picnic Area where the party had lunch beside a permanent stream fed by the water stored in the wet Kentbruck Heathlands. Close by was the Glenelg River and the botanists found growing in the area Pink Bindweed *Convolvulus erubescens*, Wirilda *Acacia retinodes* which has flowers all the year, Kangaroo Grass *Themeda australis*, Common Hemp Bush *Gynatrix pulchella* (with fruit), Rusty Bush Pea *Pultanea hispidula*, Small Daisy *Brachycome parvula*, Coast Beard Heath *Leucopogon parviflorus* and species previously noted *Leucopogon lanceolatus*, and one of the wild forget-me-nots *Cynoglossum*.

After lunch the group visited the Ink Pot, a very deep soak with a high tannin content. The still water looked like a black mirror reflecting the tree-lined perimeter. Noted was the Tassel Cord-Rush *Restio tetraphyllus*. Then on to the Kentbruck Heathe — many hectares of wetlands where many wild flowers flourished. Noted for the first time for the week were the small red flower of the Wiry Bauera *Bauera rubioides*, the small-leaf Pomaderris *Pomaderris elachophylla* and once again were seen *Boronia nana*, *Acacia verticillata* and a *Veronica* sp. At a creek stop were seen for the first time the Long Purple-flag *Patersonia longiscapa* and a sweet scented Austral Leek Orchid *Prasophyllum australe*. Also noted was *Bossiaea cinerea*. From the windows of the bus several emus were seen feeding in the fields. At the next stop several Horned Orchids *Orthoceras strictum* delighted the orchid fanciers and found nearby were *Prasophyllum australe*, the dried flower of the Large Tongued Orchid *Cryptostylis subulata*, Swamp Boronia *Boronia parviflora* (a first) and *Boronia nana*.

A snake, a leech and sulphur-crested cockatoos were also noted, the leech getting a warm reception. A red-necked wallaby was seen from the travelling bus.

Birds seen were the Black-shouldered Kite, Wedge-tailed Eagle, Swamp Harrier, Black-faced Cuckoo Shrike, Martins, White-eared Honeyeater, Yellow-winged Honeyeater, Kookaburra, Emus, Blue-winged Parrots, Crimson Rosellas, White-throated Treecreeper, Crescent Honeyeater, Yellow-faced Honeyeater, Grey Fantail, Pied Currawong, Blue Wren, Brown Thornbill, Silver-eyes, Brown Hawk and Magpies. Later on, two Black-shouldered Kites were seen at the Motel area. On this our last evening Mr and Woolcock honoured the F.N.C.V. members by accepting their invitation to have dinner with them. The only regret was that we could not meet Mr Cliff Beauglehole who was indisposed.

Friday 22nd January

On Friday we travelled to Tower Hill, the site of an extinct volcano. Emus and many varieties of water birds including swans, ducks, pelicans were seen. The area has been reclaimed from neglect and is an example of

enlightened government policy which has been responsible for the making of a delightful area. We arrived back in Melbourne at 4 p.m. Special thanks is given to Marie Allender who organised the excursion, to Elizabeth Turner and Mary Doery who supplied the plant lists, Dorothy Dawson and Pat Glancy who supplied the bird lists, Colin and Dorothy Woolcock who gave their time and knowledge unsparingly and the driver of the bus, Jim Church, who all helped to make our trip an enjoyable and instructive one.

Reuben Kent.

Koalas Feeding on Monterey Pine

BY KATHRINE A. LITHGOW*

It is generally accepted that the koala, *Phascolarctos cinereus*, feeds exclusively on foliage of *Eucalyptus* spp. and utilizes only a few species of this genus as staple dietary items. These include *E. viminalis* and *E. ovata* in Victoria (Eberhard 1978, Warneke 1978, Hindell, Lithgow and Lee, in press, Martin and Lee, in press), and *E. tereticornis* and *E. punctata* in New South Wales and Queensland (Eberhard, 1978). However, koalas have been reported feeding on *Bambax malabrica* (Degabriele 1973), *Tristania conferta* and *T. suaveolens* (Pearse and Eberhard, 1978), but do not survive solely on these species, nor use them as a substantial portion of the diet.

This note reports two further species utilized by koalas as food trees. First, at Phillip Island, Victoria, I have observed koalas feeding on *Acacia melanoxylon*, but the incidence is rare in comparison to the frequency of feeding on eucalypts (Hindell, Lithgow and Lee, in press).

Second, and of particular interest, are the frequent sightings of koalas in the exotic Monterey pine, *Pinus radiata*. On French Island, Victoria, koalas have been observed in *P. radiata* at three separate sites, one supporting a mixture of *P. radiata* and *E. viminalis*, one a mixture of *P. radiata*, *E. ovata* and a few *E. radiata*, and the third consisting of a mixed stand of *P. radiata*, *E. viminalis* and *E. ovata*.

Records of tree use by koalas at the *P. radiata/E. viminalis* site on French Island showed that 31% of koala sightings, (N = 122) were in *P. radiata*. This probably underestimates usage, as koalas were difficult to locate in the dense foliage of this species, and pine trees were not regularly checked for the presence of animals.

* Department of Zoology, Monash University, Clayton, Victoria, 3168

Koalas were not simply using pines for resting sites. On one occasion, masticated material taken from the mouth of a koala captured in a pine tree consisted of *P. radiata* foliage. At all three sites, faecal pellets collected beneath pine trees in which koalas were sighted showed large amounts of partially digested pine needles, indicating that the koalas were eating a substantial amount of *P. radiata* foliage.

Koalas have subsequently been sighted in *P. radiata* at the F. Oswin Roberts Koala Reserve, the David Forrest Reserve and the Ventnor Koala Reserve on Phillip Island. Examination of faeces confirmed that koalas feed on *P. radiata* at these sites.

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Migration of an Ichneumonid Wasp Over A Subalpine Pass

By K. Green*

Migration of insects of different orders through mountain passes is a well known phenomenon in the northern hemisphere. In the Pyrenees such migrations occur regularly each year in autumn (Johnson 1969). As far as I am aware no similar migrations have been recorded in Australia. In the case of the bogong moth, *Agrotis infusa* (Boisduval) the mountains are an objective of the migration rather than an obstacle to it. In the Pyrenees small numbers of Ichneumonid wasps have been observed migrating across the Port de Gavarnie (2290 m) (Williams *et al.* 1956). However, migration of hymenoptera generally is poorly documented (Johnson 1969).

On 19 November 1981 in Kosciusko National Park, I observed a stream of wasps which began crossing Dead Horse Gap at approximately 10.30 am eastern standard time. The day was warm and overcast with a strong wind blowing across the Gap from the S-W. These conditions preceded a thunderstorm later in the afternoon. Wasps were observed flying to the S-W, over the Gap directly into the wind. During a 6 minute period I counted 256 wasps crossing the Gap (ie. 2560 per hour). This count was probably an underestimate as I could only observe about 20 m of the treeless area of the Gap. When I left the Gap at 11.00 am the steam of wasps was continuing undiminished.

I returned to the Gap on 22 November 1981 with Mr W. S. Osborne and observed the wasps crossing in the same direction as before but at the reduced rate of about 5 to 10 per minute. The wind was not as strong but was again from the S-W. We collected two specimens of the wasp which were identified by Mr I. D. Gauld, BM(NH), as *Lissopimpla excelsa* (Costa) (Ichneumonidae: Pimplinae).

Dead Horse Gap at 1580 m above sea level, lies on the Crackenback fault which extends along the Thredbo River, through the Gap and down almost to the Murray River in the west (Browne 1967). To the north of the Gap lies the whole of the alpine country in New South Wales, with unbroken subalpine country extending 75 km N-E to the vicinity of Kiandra. To the south the subalpine tract reaches a maximum elevation of 1817 m and extends 18 km S-E to beyond Stockwhip Hill. Dead Horse Gap is the lowest point of the subalpine country between Purgatory Hill in the south and the northern limit of the Munyang Range in the north, a distance of 57 km. The unidirectional flight may therefore have been caused by the topography of a large area, coupled with any funneling effect of the Thredbo Valley.

Johnson (1969) stated that the narrow confines of mountain passes, especially where there is a cleft on a skyline, might impose directional flight upon non-migrants or migrants, whether they fly directionally in open country or not. In the case of *L. excelsa* there is some evidence of directional flight in non-mountainous country. Common (1954) recorded this species as flying in a WSW direction near Braidwood in NSW. The migration of *L. excelsa* over Dead Horse Gap may be part of a general migration, as searches in the vicinity of Dead Horse Gap over the ensuing two months did not reveal a high incidence of *L. excelsa*.

* Department of Zoology,
Australian National University,
P.O. Box 4,
Canberra, A.C.T. 2601.

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Field Naturalists Club of Victoria

Reports of recent activities

General Meeting
Monday 11 October

Speaker for the evening was Mr John Beumer of Fisheries and Wildlife Division. He spoke about eels, a large group of fish which includes wholly marine forms such as conger and moray eels, and some that spend all of their life in fresh water. Freshwater eels, *Anguilla*, occur mostly on eastern seaboards of continents and reflect the current system of oceans.

Australia has four species of *Anguilla*, three short-finned and one long-finned species. Those of eastern and southern Australia breed in the Coral Sea; West Australian species come from the Sumatra area. The larval forms are flat and leaf-like; they drift on currents and, when nearing the coast, metamorphose to the characteristic eel shape but are colourless and called glass eels.

After entering estuaries, the young eels develop pigmentation and are known as brown elvers. They resemble adults except in size. They move upstream, their life span being estimated at 15 to 25 years, are nocturnal feeders and live on small fish, frogs, ducklings or sometimes each other.

At maturity they become silver eels and move downstream. Great numbers of silver eels are in estuaries from January to May and migrate to the ocean on darkest nights. They stop eating. They are a mass of sperm or eggs (up to 5 million eggs per female) and take two to three months to reach the spawning grounds in the Coral Sea. It is assumed that they die after breeding.

Eels can move overland through damp grass during wet nights, and can survive for two or three years in the bottom mud of dried up lakes. Sometimes they block pipes. Very occasionally they occur in the Murray River. Much has yet to be learned about eels and 7½ thousand have been tagged.

The eel fishery in Victoria is worth about $1 million annually.

Exhibits. Bottles of preserved specimens showed glass eels, brown elvers, and silver eels of short-finned and long-finned species.

Under a microscope was an egg string of a nudibranch (identified by Mr Robert Burns as *Doto pita*, family Dotidae) of which some had hatched and the free-swimming veligers looked like tiny snails. There were two kinds of hydroids — some with a single hydranth (feeding polyp) like a knob at the top of the vertical thread-like stem, others with opposite pairs of hydranths all the way up the stem that looked like inverted arrow-heads; the vertical "stems" arise from the stolon which links the colony together and carries food from one polyp to another. Under another microscope a group of foraminifera (x 20) from South Molle Island Queensland looked like tiny white snails.

A skull and leg bone found near Rushworth was readily identified by our expert to be from a grey kangaroo. A fat grey moth about 3cm long (1¼"), with the cocoon from which it had emerged before expected, had been unable to develop its wings properly due to the limited space of its container.

New Librarian. We welcome Mrs Margaret Fahroedin as FNCV Librarian.

FNCV Honorary Membership awarded at WVFNCA meeting, 23 October

FNCV President and Secretary attended the annual general meeting of the Western Victorian Field Naturalists Clubs Association hosted by Creswick FNC. They went to Creswick to present

Mr Cliff Beauglehole with honorary membership as he had completed 40 years in the FNCV this month. Of the several people awarded honorary membership for 40 years in the Club, few could have contributed as much as Cliff Beauglehole to the cause of natural history and the aims of FNCV. His contributions on insects, birds, botany, national parks and conservation are remarkable. He received the Australian Natural History Medallion in 1971, and more can be learned about our latest honorary member from Victorian Nat. volume 88 page 344.

General Meeting
Monday 8 November

1982 Medallionist. The 1982 Australian Natural History Medallion was awarded to the late Mr Howard Jarman and was presented by Dr Churchill to his widow Mrs Beryl Jarman. Harold Jarman died earlier this year. In accepting the medallion Mrs Jarman said how very delighted her husband would have been by such a prestigious award although he had known he was nominated, and she thanked those who prepared his dossier and spoke in appreciation of the work carried out each year by the medallion selection committee.

Speaker for the evening was Mr Jack Hyett. He said that Howard Jarman had published much material about bird life and showed slides of birds as reported in one of Howard's first articles about Barrow Creek in the Northern Territory. Then followed slides of Mr Jarman's survey of gulls breeding at Altona, slides relevant to his paper on parrots, and more birds relevant to other articles. Howard Jarman ran bird study classes at the CAE, led many excursions, and was always eager to help others in understanding and enjoying birds.

Exhibits & Nature Notes. There were two large volumes from FNCV archives that enclosed photos of FNCV excursions in the Bass Strait islands — 1887 at King Island, 1893 in the Furneaux Group, and some excursions of the early 1900s. FNCV archives are now stored at the National Museum and are available to researchers. Photographic records of the mid 1900s and of recent activities are meagre.

Under a microscope was the larva of a caddis fly that looked like a tiny snail.

During the Mammal Survey camp at Mt Elizabeth 57 birds were listed, many reptiles and frogs, and 16 molluscs.

One member reported an echidna sitting in a little pool in the middle of a dried up dam and, when disturbed, it burrowed into the mud.

Before this meeting, the traditional dinner at Botanic Hotel in honour of the Medallionist was attended by council members and other FNCV people as well as the guests Mrs Jarman, Dr Churchill and Mr Hyett.

Field Naturalists Club of Victoria

Established 1880

OBJECTS: To stimulate interest in natural history and to preserve and protect Australian fauna and flora.
Members include beginners as well as experienced naturalists.

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MEMBERSHIP

Membership of the F.N.C.V. is open to any person interested in natural history. The *Victorian Naturalist* is distributed free to all members, the club's reference and lending library is available and other activities are indicated in reports set out in the several preceding pages of this magazine.

Subscription rates for 1982

Metropolitan	$15.00
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Leadbeaters Possum.

Already in trouble, Leadbeater's Possum is now under grave threat of extinction due to logging operations which threaten to destroy much of its remaining habitat. Until more can be learnt about the distribution and ecological requirements of this species its whole area of occurrance must be protected from logging, as existing reserves are totally inadequate. Unless action is taken promptly the State Government and community will be first in the State's history to knowingly condemn a species to extinction.

Native plants & animals

A Guarantee for Survival

JIM COOPER

The rare Long-footed Potoroo.

The Conservation Council of Victoria's proposal for legal protection for the State's wildlife, forests and vegetation.

Action form.

PLEASE TICK

☐ I have enclosed a cheque or money order for $ to support the campaign to give flora and fauna a right to exist.

☐ I wish to become an individual supporter of the C.C.V., and enclose a cheque for ordinary membership of $10, or $5 for students, pensioners or unemployed.

I am willing to become a volunteer to help with the campaign. My skills or interests are:

NAME

ADDRESS:

PHONE NO:

SEND TO: Conservation Council of Victoria,
Box 845J, G.P.O. Melbourne, 3001

Endangered plants.

The natural vegetation of the Western district has been almost completely cleared, the alpine highplains grazed and burnt and the wet mountain forests of the Central Highlands, the alps and East Gippsland been heavily logged. The same is true for many more of Victoria's plant communities. Overall in Australia we have lost 78 species of plant since European occupation, largely due to clearing for agriculture

The law can prevent a person picking a wildflower but it may not prevent the demise of Mellbloms Spider-orchid. Once this lovely rare orchid graced the appropriately named Point Danger near Portland. Though found nowhere else in the world, most of the known natural occurrance was bulldozed and the remainder will be cleared in the future, if present plans go ahead for further stages in the construction of an aluminium smelter.

This disaster demonstrates the need for laws to protect species or important populations from all activities or agents that may affect their survival.

Endangered animals.

Since European settlement in Victoria 20 species of mammals and birds have become extinct. Today there are grounds for concern about 47 species of animals, 17 of which are either endangered or vulnerable.

Top of the list is Leadbeater's Possum which lives in mixed age Mountain Ash forest in the Central Highlands. Tree hollows are crucial for nesting, but they do not develop in eucalypts until they are at least 80 – 100 years old. Unfortunately these old trees are now falling over with age and the regrowth from the 1939 fires is not yet suitable.

Endangered species: a world-wide crisis.

Brush-tailed Rat Kangaroo: now extinct in Victoria.

It is estimated that worldwide one plant or animal species is becoming extinct every day. Within 10 years we could be losing one every hour. In the last 25 years of the century one million species will have been eliminated. Overall the whole history of evolution this is unpredented.

Why Does It Matter?

- The most important reason is surely that existence in nature carries with it the unquestionable right to continued existence.
- A species cannot be removed from an environment without a chain reaction through the whole ecosystem. A disappearing plant can take with it 10 – 30 species of dependent wildlife. Extinctions often signal the general ill health of the whole ecosystem. Unless we do something promptly, humans may soon start to feel the direct effects of these extinctions.
- Extinctions mean losing the diversity of genetic resources to respond to new problems and fight old ones — a cure for cancer, a new breed of food or a new source of fuel, may exist unrecognised in our forests.

Habitat destruction.

Habitat destruction is the alteration of an animal's living environment. Without a suitable place to shelter, feed and breed an animal will perish. Often these requirements are quite precise and unless the animal has just the right set of conditions it will not survive.

Habitats are destroyed by forestry operations, clearing for agriculture, pine planting, mining, and alteration of wetlands and alpine areas for tourist facilities. They are also disrupted in more insidious ways by pollution of underground water and streams, salinization, and the introduction of pesticides and heavy metals. Disruption also occurs when exotic species such as blackberries, carp, trout, feral cats or pigs are introduced.

It is not enough to protect an animal from shooters or a wildflower from collection. These laws are only the beginning, as forestry operations and other exploitation cause the destruction of unique ecosystems, crucial

COLIN TOTTERDELL

Clearfelling native forest for pine planting.

habitat and numerous rare species, on a frightening scale.

If we are to protect our living natural inheritance we must give full legal protection to all threatened species, to their habitats and to significant plant communities, from direct and indirect threats to their survival.

A guarantee for survival.

Species of flora and fauna and significant plant communities need legal protection to guarantee their continued existence.

The Conservation Council of Victoria plans the following action:

- Assess the extent of protection of Victoria's significant plant communities and threatened species of flora and fauna.
- Apply pressure for the reservation of ecosystems and habitats not currently adequately preserved.
- Change the *Wildlife Act* to protect all the threatened wildlife from habitat destruction and indirect threats to their survival.
- Change the *Wildflowers and Native Plants Protection Act* and the *Forests Act* to protect plant species and ecosystems from damage or extinction by environmental destruction.

What you can do.

- Send a letter to the Premier Mr John Cain, the Hon Evan Walker (Minister for Conservation, 240 Victoria Parade, East Melbourne), and your local member of parliament supporting the ALP's policy on habitat protection and calling for the adoption of the measures outlined above.
- Become a volunteer helper with the Conservation Council of Victoria.
- Donate funds to the Conservation Council of Victoria to allow us to continue our work on this campaign.

Yellow-bellied Glider.

- Become an individual supporter of the CCV ($10 per year or $5 concession). As an individual supporter you will receive *Environment Victoria* bi-monthly and be entitled to a discount of 10% on all books sold at the Victoria Environment Centre.

"The ultimate resource is the biota – there is no other; and we are destroying it".

George M. Woodwell, Biologist.