PROCEEDINGS

OF THE

LINNEAN SOCIETY

OF

NEW SOUTH WALES

VOLUME

105

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Sydney

The Linnean Society of New South Wales

1981

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(Issued 8th April, 1982)

THE LINNEAN SOCIETY OF NEW SOUTH WALES

Record of the Annual General Meeting, 1980

The one hundred and fifth Annual General Meeting was held in the Activities Room of the Australian Museum, 6-8 College Street, Sydney on Wednesday, 26th March 1980 at 7.30 p.m.

The President, Dr Alex Ritchie, occupied the Chair. The minutes of the one hundred and fourth Annual General Meeting were taken as read and accepted by the meeting.

Report on the Affairs of the Society for the Year 1979-80

Publications

The Society's Proceedings were published on the following dates during the year:

Vol. 102, Part 4,	March 1979
Vol. 103, Parts 1 & 2,	August 1979
Vol. 103, Parts 3 & 4,	December 1979

Newsletter

The LINN SOC NEWS was issued quarterly, giving details of coming meetings, reports of resolutions from the Council meetings, titles of manuscripts accepted for publication and other items of interest to members.

Membership

During the year 12 new members have been elected to membership of the Society, 5 have resigned and one has died. Ten names of members who have been unfinancial for two years were removed from the list of members. At 1st March, 1980 the membership included 253 Ordinary Members, 26 Life Members and 6 Corresponding Members, making a total of 285.

The category of Associate Membership which was introduced last year has not attracted any enquiries so far.

We record with regret the death on 29th May of Dr Joyce W. Vickery M.B.E., F.L.S. who became a member of the Society in 1930, a member of Council in 1969 and was Honorary Treasurer from 1971 until 1978.

Dr Vickery's service to Science and the Society will be recorded in the Memorial Series of the Proceedings.

Meetings

Three Ordinary General Meetings and one Field Day were held during the year. Numbers attending were small but enthusiastic.

On 1st August, Mr Graeme Phipps gave a talk at the Macleay Museum on the Bird Collection of the Macleay Museum amidst a fine display of selections from the Museum's collection.

On 28th September, Dr Alex Ritchie and Dr Don Adamson presented a slide and film evening in the Australian Museum's Activities Room entitled 'Two Naturalists in Antarctica'. They dealt with the landscape, wildlife and geology of Antarctica.

A Field Day and Conversazione at Warrah, Sydney University's Field Station, was organized by Dr Peter Myerscough on 13th October.

A visit behind the scenes at the Australian Museum began with a talk from Mr Geoff Holloway in the Entomology Department where interesting specimens and illustrations were seen, followed by a preview of the almost completed Outer Urban Exhibition entitled 'Life in the Sea' explained by Mr Bodo Matzick. Dr Ritchie then showed us the skull of the recently discovered *Diprotodon* skeleton from northern New South Wales.

Library

In view of the high cost of maintaining our library, the Executive investigated the possibility of relocating our library with one of the university or other scientific libraries in Sydney. However no satisfactory solution to the problem has yet been found. Enquiries are continuing.

A new photocopier provides good quality copies of reference material. To simplify administrative procedures, Library Association of Australia vouchers are now accepted from other libraries as payment for copies.

Linnean Macleay Fellowship

Miss Barbara Porter, Linnean Macleay Fellow at the University of New South Wales in 1979, has been granted an extension of her tenure for a second year. She is investigating the morphology, ultrastructure and physiology of the salivary glands of Macropodid marsupials, with special reference to the Red Kangaroo (*Megaleia rufa*), the Red-necked Pademelon (*Thylogale thetis*) and the Tammar Wallaby (*Macropus eugenii*).

Central to the study is a consideration of the evolutionary convergence of the Macropods and their eutherian ruminant counterparts with respect to their digestive physiology. The study also looks at the mechanisms underlying 'saliva-spreading' as a means of thermoregulation.

Linnean Macleay Lectureship in Microbiology

Dr K. Y. Cho was on Study Leave in 1979. He first visited the Biochemistry Department at the Institute of Animal Physiology, Babraham, Cambridge and worked on the isolation of plasma membrane in Butyrlvibrio species, in order to study its membrane fluidity. It was demonstrated that under optimal conditions, rod-shaped protoplast can be obtained.

The second place he visited was the Department of Biology, Chinese University of Hong Kong where he studied the preservation of *Vorvariella volvaceae*. It was shown that this mushroom can suffer from chilling injury if kept below 15°C. The mushroom is best kept at 15-20°C under controlled atmosphere.

Science Centre

During 1979 a modified proposal for a Foundation was put to the Councils of the Linnean Society and the Royal Society. Both Councils agreed in principle. The resolution passed by the Council of the Linnean Society reads: 'It was resolved that the Council approves in principle the proposals to establish a Science House Foundation and to alter the Articles of Science House Pty Ltd to issue Class C shares to be taken up by the Foundation and that, in transmitting this resolution, the Council stresses that there are important details to be discussed at a later stage'.

The Council approved the President's acceptance of an invitation to join the Steering Committee formed to initiate the establishment of the Science House Foundation together with the President of the Royal Society.

Plans are now under way for the Steering Committee to establish the Foundation and apply to the Federal Government for tax deductibility. The appeal will then be run by the Fund Raising Counsel of Australia.

Science Centre bookings are rising steadily, the building is fully let, Conference servicing facilities have been booked for seven major meetings during 1980 and this activity is expected to increase.

In recognition of Dr Vickery's major contributions to the development of Science Centre one of the meeting rooms has been named the "Joyce Vickery Room".

Financial Report

Report given by the Honorary Assistant Treasurer, Dr F. W. E. Rowe.

Though the credit balance in the General Account has increased slightly to $3467.80, compared with the 1978 total of $2224, once again it must be noted that this does not denote the advent of a much healthier situation for the Society.

Invested funds in the General Account stand at $93,215.88, from which we derived interest of $10,317.64. The remainder of our investments (totalling almost $420,000) are tied up in loans to Science House Pty Ltd, from which we still see no financial return.

Among expenditure items, although anticipated increases occurred, particularly in postal charges ($1547) and printing costs of the Proceedings ($7742), these have been offset to some extent by reductions achieved in cutting the costs of Secretarial Services to Science House Pty Ltd.

Total expenditure for the year 1979 was $26,392 ($24,911 for 1978). In a year with an inflation rate of some 10%, this increase in expenditure was contained to no more than 6% over that of the previous year.

Total income for 1979 in the General Account was $29,860 ($27,135 for 1978) an increase of 10% over 1978.

Following the points made last year, relating to sources of income for the General Account we can see that: membership subscriptions have fallen; subscriptions to the Proceedings have slightly increased; interests on the General Account and surplus from the Fellowships Account have increased by 4.5 and 11.0% respectively, but much greater increases cannot be expected from the few remaining low-interest investments in the General Account which, when they mature, will be re-invested in higher interest-bearing investments; no donations to the *Proceedings* have been received; sales have yielded some $2500 during 1979.

Improvement by reduction of secretarial services carried out by Science House Pty Ltd has been mentioned, however, Council is still pursuing the matter of reallocation and reduction of servicing costs of the library.

That the increase in expenditure in the General Account has been contained to nearly half of the current inflation rate but that increase in income has achieved the same level as the inflation rate, is a mark of the Council's determination to improve the financial position of the Society in these difficult times.

In the Fellowships Account, total investments of $129,978 yielded an interest income of $11,620. The maximum amount permitted of $3200 was paid to the Fellow during 1979 and the surplus $8420 has been transferred to the General Account.

The Bacteriology Account, with total investments of $36,900, received interest of $2434, of which, through oversight, only $800 was donated to the University of Sydney towards the salary of the Linnean Macleay Lecturer in Microbiology. This will be rectified during 1980.

The Scientific Research Fund has been augmented by interest of $2471, bringing the balance to $24,366.

Following presentation of the Honorary Assistant Treasurer's report and discussion, a motion that the audited balance sheets for 1979 be adopted was passed unanimously by the members present.

Presidential Address

Dr Ritchie delivered the Presidential Address entitled "A review of recent Australian Devonian vertebrate discoveries" which he illustrated with slides and specimens. This address will be published in full in the Proceedings Volume 105, Part 4.

Declaration of Elections

As the number of nominations did not exceed the number of vacancies on the Council, no election was necessary. The President declared the following members elected: Dr M. Archer, Mr L. W. C. Filewood, Dr P. M. Martin, Dr P. J. Myerscough, Dr P. J. Stanbury, and Professor B. D. Webby.

Our Auditors continue to be W. Sinclair & Co.

Dr Ritchie introduced Dr F. W. E. Rowe as the President for 1980-81 and invited him to take the Chair.

LINNEAN SOCIETY OF NEW SOUTH WALES

GENERAL ACCOUNT

Balance Sheet as at 31st December, 1979

1978 $		$	$
	Accumulated Funds—		
	Balance, 1st January, 1978		502,626.96
	Add Surplus for the year	3,467.80	
	Interest — Westralian International Ltd not previously brought to account	16,989.57	
			20,457.37
502,627	Balance, 31st December, 1979		523,084.33
	Reserve—		
1,143	Bookbinding		1,142.66
	Science House Pty Limited—		
3	Donations held		10.00
157	Sundry creditors		—
$503,930			$524,236.99

1978 $		$	$
	Fixed Assets—		
	Furniture, Fixtures & Fittings — At Cost	1,670.91	
1,316	*Less* Depreciation written off	453.33	
			1,217.58
	Office Machines — At Cost	2,021.33	
1,419	*Less* Depreciation written off	815.18	
			1,206.15
	Investment — At Cost—		
1	Share — Science House Pty Limited		1.00
2,736	Total Fixed Assets		2,424.73
	Investments—		
	Deposits—		
1,476	N.S.W. Permanent Building Society	2,665.88	
36,700	Australian Resources Development Corp.	36,700.00	
9,300	Australian Resources Development Bank	9,300.00	
1,000	Commonwealth Loans — At Cost	1,000.00	
	Debentures — At Cost		
21,150	C.B.F.C. Limited	20,000.00	
1,800	Esanda Limited	1,800.00	
10,000	Metropolitan Water, Sewerage & Drainage Board	9,000.00	
12,750	Mutual Acceptance Limited	12,750.00	
94,176	Total Investments		93,215.88
	Current Assets—		
	Loans — Science House Pty Limited—		
400,000	Science Centre Account	416,989.57	
3005	Management Account	3004.60	
608	Sundry Debtors	1,555.90	
48	Linnean Macleay Fellowships Account	209.25	
3,357	Cash at Bank	6,837.06	
407,018	Total Current Assets		428,596.38
$503,930			$524,236.99

LINNEAN SOCIETY OF NEW SOUTH WALES

Income & Expenditure Account for the Twelve Months Ended 31st December, 1979

1978 $	EXPENDITURE	$
450	Audit Fees	450.00
17	Bank Charges	77.00
198	Cleaning	208.00
220	Depreciation	311.55
822	General Expenses	154.08
600	Fellowship Grant	—
25	Insurance	25.15
109	Legal Expenses	5.00
144	Library	50.09
173	Light and Power	186.20
993	Postages	1,547.10
2,287	Proceedings — Printing Costs	7,742.00
516	Printing and Stationery	647.55
10	Repairs and Maintenance	123.85
593	Reprints	250.00
290	Room Hire	30.00
5,702	Salaries	5,330.40
962	Science House Rent	986.80
10,633	Secretarial Services	8,096.86
167	Telephone	170.60
24,911	Total Expenditure	26,392.23
	Surplus for Year	
2,224	Transferred to Accumulated Funds	3,467.80
$27,135		$29,860.03

1978 $	INCOME	1978 $	$
	Subscriptions—		
1,484	Members	1,397.00	
6,197	Proceedings	6,625.60	
7,681			8,022.60
	Proceedings — Printing Costs		
1,100	Donations Received		—
9,864	Interest Received		10,317.64
601	Photocopying Receipts		617.10
	Fellowships Account		
	Surplus Income for the year ended		
7,527	31st December, 1979		8,420.79
8	Donations Received		7.50
327	Reprints Sales		1,215.00
27	Sales		1,259.40
27,135	Total Income		29,860.03
$27,135			$29,860.03

AUDITORS' REPORT

We have audited the books and records of the Linnean Society of New South Wales for the twelve months ended 31st December, 1979 and are of the opinion that the above balance sheet and accompanying income & expenditure account correctly sets forth the position of the financial affairs as at 31st December, 1979 according to the explanations given to us and as disclosed by the Books of the Society.

W. SINCLAIR & CO.,
Chartered Accountants
Registered under the Public Accountants Registration Act, 1945,
as amended.

DATED at Sydney this Twenty fifth day of March, 1980.

F. W. E. ROWE,
Hon. Treasurer.
March, 1980.

LINNEAN SOCIETY OF NEW SOUTH WALES

LINNEAN MACLEAY FELLOWSHIPS ACCOUNT

Balance Sheet as at 31st December, 1979

1978 $		$	$
	Accumulated Funds —		
	Balance, 1st January, 1979 —		
	Amount Bequeathed by Sir William Macleay	70,000.00	
	Transfers from Income Account	59,873.10	
	Increase in Value of Assets	272.02	
			130,145.12
	Less adjustment of transfers to general account in respect of interest received		318.69
129,826	Balance, 31st December, 1979		129,826.43
	General Account —		
48	Interest not transferred		209.25
$129,874			$130,035.68

1978 $		$	$
	Fixed Assets —		
46,200	Commonwealth Loans — At Cost		4,400.00
13,500	Australian Savings Bond — At Cost		13,500.00
	Debentures — At Cost —		
200	British Petroleum Company of Australia Ltd		200.00
—	Commonwealth Bank Finance Corporation		32,200.00
1,000	Electricity Commission of New South Wales		1,000.00
4,200	Esanda Limited		13,800.00
1,263	F.N.C.B. — Waltons Corporation Limited		1,262.90
8,500	Metropolitan Water, Sewerage & Drainage Board		6,000.00
13,250	Mutual Acceptance Limited		13,250.00
6,000	Telecom Australia		6,000.00
	Deposits —		
35,700	Australian Resources Development Bank		35,700.00
48	Permanent of Australia Building Society Ltd		1,540.00
—	N.S.W. Permanent Building Society		1,125.36
129,861	Total Investments		129,978.26
	Current Assets —		
13	Cash at Bank	13.53	
—	Sundry Debtors	43.89	57.42
$129,874			$130,035.68

Income and Expenditure Account for the Twelve Months Ended 31st December, 1979

1978 $		$
3,200	Salary of Linnean Macleay Fellow	3,200.04
7,527	Surplus for the year transferred to General Account	8,420.79
$10,727		$11,620.83

1978 $		$
10,727	Interest Received	11,620.83
$10,727		$11,620.83

AUDITORS' REPORT

We have audited the books and records of the Linnean Society of New South Wales for the twelve months ended 31st December 1979 and are of the opinion that the above balance sheet and accompanying income and expenditure account correctly sets forth the position of the financial affairs of the Linnean Macleay Fellowships Account as at 31st December, 1979, according to the explanations given to us and as disclosed by the books of the Society.

W. SINCLAIR & CO.
Chartered Accountants
Registered under the Public Accountants Registration Act 1945,
as amended.

DATED at Sydney this Twenty fifth day of March, 1980.

F. W. E. ROWE,
Hon. Treasurer.
March, 1980.

LINNEAN SOCIETY OF NEW SOUTH WALES

BACTERIOLOGY ACCOUNT

Balance Sheet as at 31st December, 1979

1978 $		$	$	1978 $		$
	Accumulated Funds—				Investments—	
	Balance 31st December, 1979—			26,900	Commonwealth Loans — At cost	1,600.00
	Amount Bequeathed by Sir William Macleay	24,000.00		1,600	Australian Savings Bonds — At Cost	1,600.00
36,900	Transfers from Income Account etc.	12,900.00			Australian Resources Development Bank	
			36,900.00	8,000	Transferable Deposits — At Cost	8,000.00
	Macleay Lecturer in Microbiology Reserve—				Debentures—	
	Balance 1st January, 1979	2,563.30		—	Esanda Limited	24,000.00
	Add Surplus for Year	1,634.78		200	British Petroleum Company of Australia Ltd	200.00
2,563	Balance 31st December, 1979		4,198.08		Commonwealth Bank Finance Corporation	1,300.00
					Metropolitan Water Sewerage & Drainage	
				200	Board — At Cost	—
					Deposits—	
				—	N.S.W. Permanent Building Society	204.60
				36,900		36,904.60
					Current Assets—	
				2,563	Cash at Bank	4,193.48
$39,463			$41,098.08	$39,463		$41,098.08

Income & Expenditure Account for the Twelve Months Ended 31st December, 1979

2,400	University of Sydney — Salary of Lecturer	800.00	2,399	Interest Received	2,434.78
—	Surplus for Year	1,634.78	1	Deficiency for Year	—
$2,400		$2,434.78	$2,400		$2,434.78

AUDITORS' REPORT

We have audited the books and records of the Linnean Society of New South Wales for the twelve months ended 31st December, 1979 and are of the opinion that the above balance sheet and accompanying income & expenditure account correctly sets forth the position of the financial affairs of the Bacteriology Account as at 31st December, 1979 according to the explanations given to us and as disclosed by the Books of the Society.

W. SINCLAIR & CO.,
Chartered Accountants
Registered under the Public Accountants Registration Act, 1945,
as amended.

DATED at Sydney this Twenty fifth day of March, 1980.

F. W. E. ROWE,
Hon. Treasurer.
March, 1980.

LINNEAN SOCIETY OF NEW SOUTH WALES

Scientific Research Fund Account

Balance Sheet as at 31st December, 1979

1978 $		$	$
	Accumulated Funds—		
	Balance, 1st January, 1979	21,894.98	
	Interest Received	2,471.53	
21,895	Balance 31st December, 1979		24,366.51
$21,895			$24,366.51

1978 $		$
	Investments—	
	Debentures — At Cost—	
1,800	Australian Guarantee Corporation Ltd	4,300.00
3,600	Beneficial Finance Corporation Ltd	3,600.00
1,200	British Petroleum Company of Australia Ltd	1,200.00
2,700	Commercial & General Acceptance Limited	2,700.00
3,100	Finance Corporation of Australia Ltd	3,100.00
1,021	Barclays Credit Corporation Limited	1,021.00
1,900	General Credits Ltd.	1,900.00
3,300	Citicorp Aust. Ltd.	3,300.00
3,200	Mutual Acceptance Limited	3,200.00
21,821		24,321.00
	Current Assets—	
74	Cash at Bank	23.51
—	Sundry Debtors	22.00
$21,895		$24,366.51

AUDITORS' REPORT

We have audited the books and records of the Linnean Society of New South Wales for the twelve months ended 31st December, 1979 and are of the opinion that the above balance sheet correctly sets forth the position of the financial affairs of the Scientific Research Fund Account as at 31st December, 1979 according to the explanations given to us and as disclosed by the Books of the Society.

W. SINCLAIR & CO.,
Chartered Accountants
Registered under the Public Accountants Registration Act, 1945,
as amended.

DATED at Sydney this Twenty fifth day of March, 1980.

F. W. E. ROWE,
Hon. Treasurer.
March, 1980.

PROCEEDINGS

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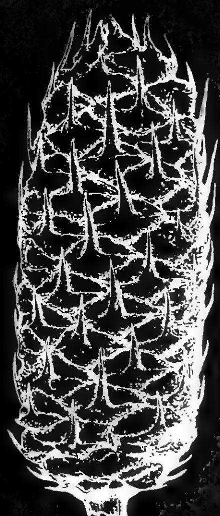
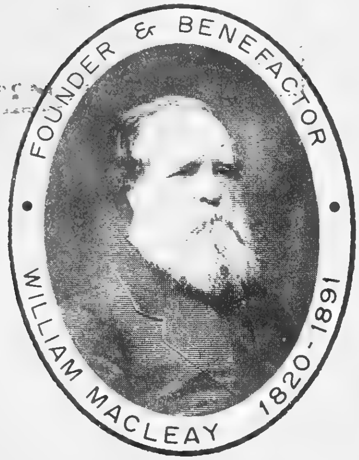
VOLUME 105
NUMBERS 1 & 2



NATURAL HISTORY IN ALL ITS BRANCHES

THE LINNEAN SOCIETY OF NEW SOUTH WALES



Founded 1874. Incorporated 1884.

The Society exists to promote 'the Cultivation and Study of the Science of Natural History in all its Branches'. It holds meetings and field excursions, offers annually a Linnean Macleay Fellowship for research, contributes to the stipend of the Linnean Macleay Lecturer in Microbiology at the University of Sydney, and publishes the *Proceedings*. Meetings include that for the Sir William Macleay Memorial Lecture, delivered biennially by a person eminent in some branch of Natural Science. The Society's extensive library is housed at the Science Centre in Sydney.

Membership enquiries should be addressed in the first instance to the Secretary. Candidates for election to the Society must be recommended by two members. The present annual subscription is $20.00.

The current rate of subscription to the *Proceedings* for non-members is set at $35.00 per volume.

Back issues of all but a few volumes and parts of the *Proceedings* are available for purchase. A price list will be supplied on application to the Secretary.

OFFICERS AND COUNCIL 1980-81

President: F. W. E. ROWE

Vice-Presidents: LYNETTE A. MOFFAT, A. RITCHIE, J. T. WATERHOUSE, B. D. WEBBY

Honorary Treasurer: A. RITCHIE

Secretary: BARBARA STODDARD

Council: D. A. ADAMSON, M. ARCHER, L. W. C. FILEWOOD, A. E. GREER[1], L. A. S. JOHNSON, HELENE A. MARTIN, P. M. MARTIN, LYNETTE A. MOFFAT, P. MYERSCOUGH, G. PHIPPS[2], A. RITCHIE, A. N. RODD, F. W. E. ROWE, C. N. SMITHERS, P. J. STANBURY[3], T. G. VALLANCE, J. T. WATERHOUSE, B. D. WEBBY, A. J. T. WRIGHT

Honorary Editor: T. G. VALLANCE — Department of Geology & Geophysics, University of Sydney, Australia, 2006.

Librarian: PAULINE G. MILLS

Linnean Macleay Fellow: BARBARA D. PORTER

Linnean Macleay Lecturer in Microbiology: K.-Y. CHO

Auditors: W. SINCLAIR & Co.

The office of the Society is in the Science Centre, 35-43 Clarence Street, Sydney, N.S.W., Australia, 2000. Telephone (02) 290 1612.

[1] resigned 17 September 1980
[2] appointed 18 June 1980
[3] resigned 18 June 1980

Cover motif: Mature megasporangiate cone of *Macrozamia communis*, south coast, New South Wales
Sketch by Len Hay, after *Proc. Linn. Soc. N.S.W.* 65, 1940, Pl. XV-8a (where described as *M. spiralis*)

PROCEEDINGS
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of
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VOLUME 105
NUMBER 1

Biology and Distribution of *Scymnodes lividigaster* (Mulsant) and *Leptothea galbula* (Mulsant), Australian Ladybirds (Coleoptera: Coccinellidae)

J. M. E. ANDERSON

ANDERSON, J. M. E. Biology and distribution of *Scymnodes lividigaster* (Mulsant) and *Leptothea galbula* (Mulsant), Australian ladybirds (Coleoptera: Coccinellidae). *Proc Linn Soc. N.S.W.* 105 (1), (1980) 1981: 1-15.

Notes are presented on life stages, reproductive systems, food and feeding behaviour, longevity, parasites, predators, competitors and distribution of the aphidophagous *Scymnodes lividigaster* (Mulsant) and the mycophagous *Leptothea galbula* (Mulsant). Comments on *Amidellus ementitor* Blackburn, a ladybird superficially similar to *S. lividigaster,* are included.

J. M. E. Anderson, School of Zoology, University of New South Wales, Kensington, Australia 2033; *manuscript received 8 April 1980, accepted in revised form 18 June 1980.*

INTRODUCTION

Ladybirds have potential value in integrated pest control programmes (Hodek, 1970), yet little is known of the biology of Australian species. Hales (1979) urges investigations of ladybirds' annual cycles, prey relationships, natural enemies and physiological mechanisms related to survival, in order that their effectiveness in biological control might be assessed and exploited.

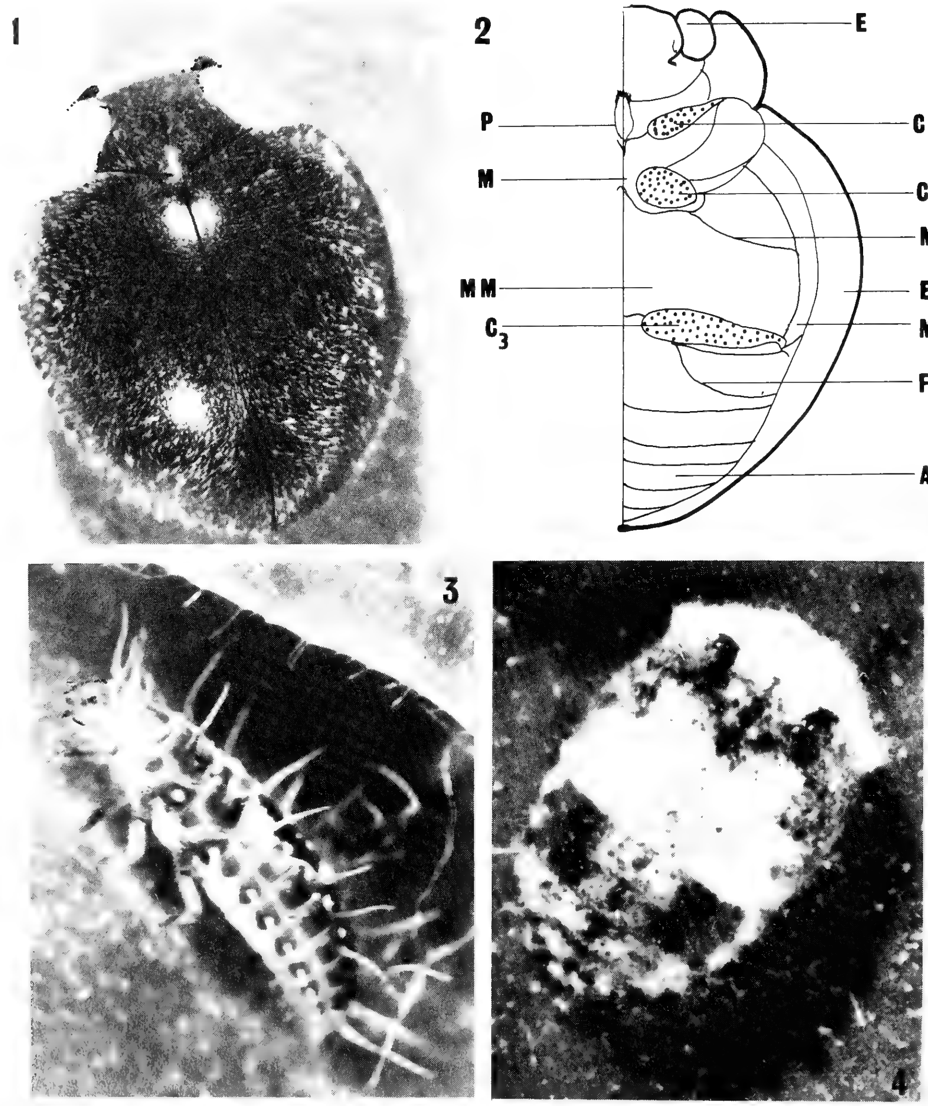
As part of a study of Australian ladybirds (Anderson, 1979; Anderson and Richards, 1977), the biology and distribution of the aphidophagous *Scymnodes lividigaster* (Mulsant) and mycophagous *Leptothea galbula* (Mulsant) are investigated and results are presented here.

RESULTS

Scymnodes lividigaster (Mulsant), 1853

Adult (Fig.1). Length 2-3.5 mm, width 2-2.5 mm. Body convex and pubescent; head, pronotum and elytra densely punctate. Colour black with 2 lateral lemon yellow spots on pronotum; abdomen orange-yellow; legs usually black, but yellowish in some specimens; males with yellow frons. Eyes black with small facets. Terminal segment of maxillary palp strongly securiform. Prosternum carinate, carina pointed anteriorly. Mesosternum emarginate and very slightly carinate in some specimens. Mesocoxae close together, separated by less than the width of one cavity. The femoral line ('metasternal lamella' of Blackburn (1895)) passes from posterior edge of mesosternum across metasternum to mid point of metepisternum (Fig. 2). Male genitalia (Fig. 5A) without lateral lobes (i.e. parameres); median lobe large, tubular and pointed anteriorly; sipho (Fig. 5B) slightly bent distally, flat on one side with few setae, rounded on other, with rows of tiny setae, apparently part of the internal sac, able to be ballooned out at the tip near the gonopore.

Amidellus ementitor Blackburn, 1895, closely resembles *S. lividigaster* which has led to some confusion in identification. *S. lividigaster* has been called *A. ementitor* by Hales and Carver (1976). Specimens of *S. lividigaster* from this study have been compared with the holotype of *S. lividigaster* in the British Museum (Natural History)



Scymnodes lividigaster. *Fig. 1.* Adult male ladybird, length 3 mm. *Fig. 2.* Ventral aspect of adult. Legs removed. (A) abdominal sternites, (C 1-3) coxal cavities, (E) eye, (EL) elytron, (F) post coxal line, (M) mesosternum, (MM) metasternum, (MS) femoral line, (MT) metepisternum, (P) prosternal carina. *Fig. 3.* Larva, 4th instar, length 6 mm. *Fig. 4.* Pupa, length 3.5 mm, attached to *Glochidion ferdinandi* leaf.

and their identity is confirmed. Two cotypes of *A. ementitor* in the South Australian Museum were examined and showed that *A. ementitor* differs from *S. lividigaster*, being smaller and slightly more pubescent and convex; femoral line meets metepisternum some distance anterior to the midpoint (cf. *S. lividigaster*, Fig. 2), male has distinct parameres (none in *S. lividigaster*, Fig. 5A), terminal segment of maxillary palp not strongly widened apically and the distance between mesocoxae greater than the width of one cavity. *S. lividigaster* is placed in the tribe Coccidulini at present, but several features including finely faceted eyes and relatively short antennae are unusual for the group (Pope, 1979). *Amidellus* is in the Scymninae, tribe Ortaliini (Sasaji, 1968). Distributions of *A. ementitor* and *S. lividigaster* overlap (Anderson, 1979), but *A. ementitor* is more common in central and northern Queensland while *S. lividigaster* is more common in coastal New South Wales and southern Queensland.

Eggs. Length 1 mm, spindle-shaped, yellow to bright orange. Laid singly in proximity of aphid colony; usually slightly on one side, in crevices, under bark, under dead and parasitized aphids or their cast skins, between plant hairs on stems and undersides of leaves, near leaf veins and inside flower buds.

Larvae (Fig. 3). Campodeiform; body elongate, tapering with armature of senti of different lengths. The armature and wax production is described by Pope (1979). First instar, length 1 mm, grey and very active, armature less pronounced than in later instars, legs long. Second instar, length 2-3 mm, grey to yellowish grey with one dark pigmented area on each thoracic notum and two darker areas on abdominal terga 2-7. Third instar, length 2.5 - 4.0 mm, colour pattern more distinctive, with orange head and pronotum and patches of white on thorax and abdomen. Fourth instar, length 3.5 - 7.0 mm, pattern similar to third instar. Larvae cease feeding some 2-3 days before pupation, attach to the substrate by the anal organ and deposit a fine heart-shaped layer of wax on the surrounding substrate. The wax is transferred from the body to the substrate with the legs.

Pupa (Fig. 4). Larval skin is shed completely and lies about the anal area. At first pupa is orange-yellow and smooth; after 1.5 h it begins to darken and white waxy secretions appear on dorsal body surface; waxy areas grow for about 36 h, particularly on head, pronotum and first three abdominal tergites, almost entirely covering pupa except for two pinkish-black shiny areas on the mesonotum devoid of wax, one similar area in the centre of metanotum, two large pink bare areas laterally on third and fourth abdominal nota and some small irregular bare areas in midline of abdominal nota posterior to the fourth.

On woody plants such as *Glochidion ferdinandi* or *Hibiscus* sp., pupae are most commonly found on bark, especially on lower sides of lateral branches, and sometimes along midribs of leaves on upper surfaces. On herbaceous plants such as *Coryza floribunda* they are found on dead and dying leaves furthest from the shoot apex. Most are found below the level of aphid infestation and observation suggests that prepupae before settling are positively geotactic. In extremely heavy infestations pupae are found on tree trunks, even in grass near trees where aphids migrate at the height of a population explosion. Pupae can erect if irritated by light or mechanical stimulation, however, they appear to be insensitive prior to emergence of the adult. Emergence is nearly always at night or early morning. Pupal skin splits dorsally in midline from head to anus and teneral adult remains on the pupal skin for up to 24 h while colouration develops and some hardening of the cuticle occurs.

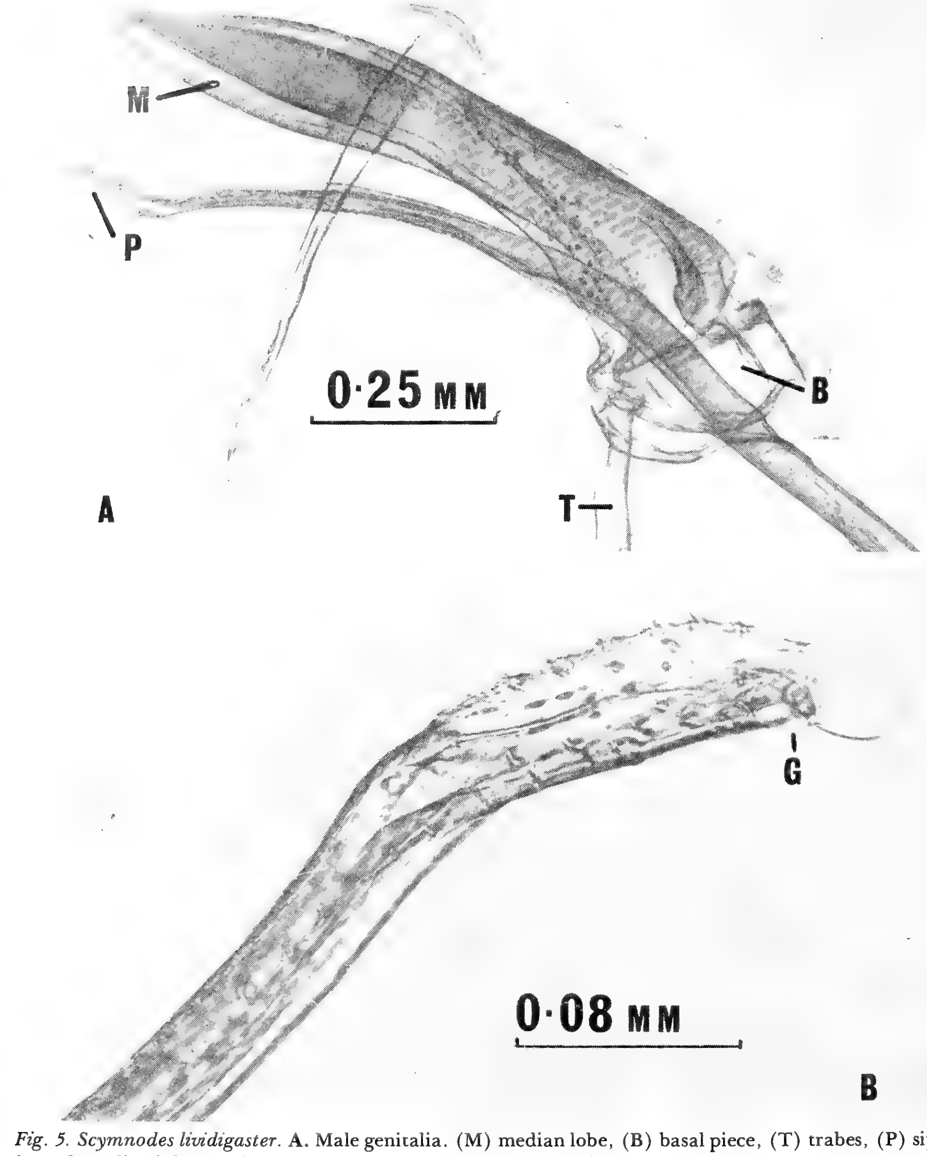


Fig. 5. Scymnodes lividigaster. **A.** Male genitalia. (M) median lobe, (B) basal piece, (T) trabes, (P) sipho. Length median lobe = 0.76 mm. **B.** Tip of sipho (P) enlarged, (G) gonopore.

Reproductive systems

Information was obtained by dissection of fresh specimens in Ringer's solution. Measurements were made with a micrometer eyepiece in a Zeiss stereoscopic microscope.

Female reproductive system is shown in Fig. 6. Ovaries paired, 7-13 ovarioles per ovary, often different numbers in each ovary of the same individual. Bursa copulatrix bright orange, beehive-shaped and ridged internally with a small funnel-shaped infundibulum anteriorly for the reception of tip of sipho. Spermatheca heavily sclerotized, hooked, attached to bursa copulatrix by a short sperm duct arising from infundibulum; spermathecal gland near infundibulum; its length half that of bursa.

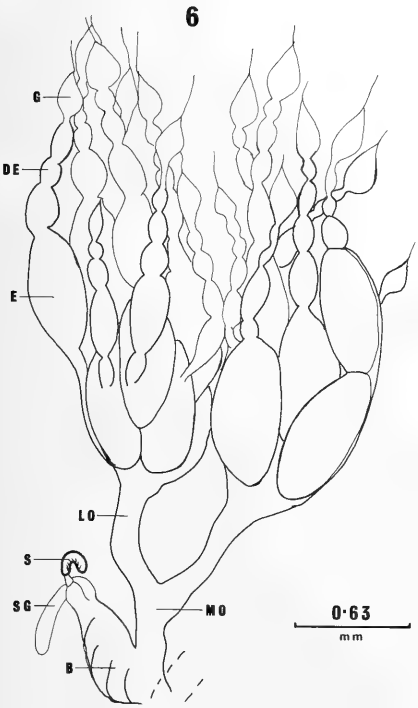
Male reproductive system shown in Fig. 7. Testes paired, 6-12 follicles in each testis, often different numbers in each testis of the same individual. Follicles joined to the vas deferens by short vas efferens; the whole appears like a bunch of small balloons. Seminal vesicle a variably sized swelling in vas, just below each testis. Two pairs of coiled accessory glands arise at junction of vasa deferentia. The united vasa deferentia, or ductus ejaculatorus join the sipho at its base.

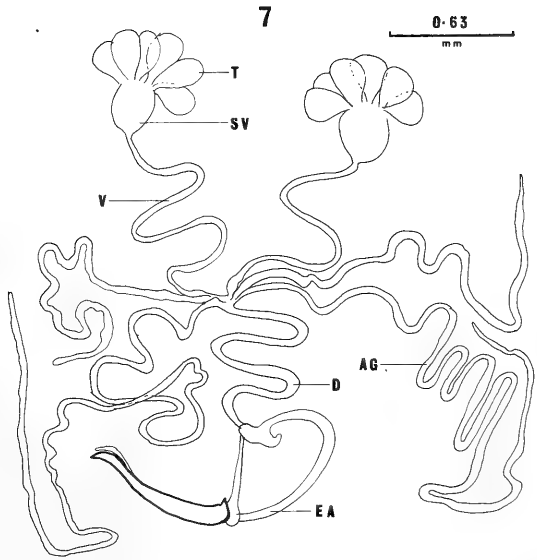
Food

S. lividigaster has been reported as aphidophagous (Schilder and Schilder, 1928; Wilson, 1960). This was tested in a series of breeding experiments, which also involved life cycle studies.

i) methods

Field-collected adult ladybirds were placed in perspex cages or gauze-covered glass specimen bottles under normal laboratory conditions, where temperature ranged from 19-27°C and fed an excess of aphid food daily. To avoid bias which might be caused by prior food consumption of parents, all adults were fed appropriate aphid species for 10 days before their eggs were used in experiments. Eggs were removed to





Scymnodes lividigaster. Fig. 6. Female reproductive system showing 2 ovaries consisting of ovarioles. Each ovariole has a germarium (G), a string of developing eggs (DE) and mature egg in base (E). Lateral oviducts (LO) pass to median oviduct (MO), which enters vagina as does bursa copulatory (B). Spermatheca (S) and spermathecal gland (SG) enter the distal part of the bursa copulatrix.

Fig. 7. Male reproductive system showing 2 testes consisting of a group of testicular follicles (T) which pass into seminal vesicle (SV). The vasa deferentia (V) meet and join 2 pairs of accessory glands (AG). The ejaculatory duct (D), passes to the ejaculatory apparatus (EA).

separate containers and larvae on hatching were caged individually to prevent cannabalism. Daily records of development were kept. Aphids used as food were *Toxoptera citricidus* Kirkaldy on cumquat, *Hyperomyzus lactucae* (Linnaeus) on milk thistle, *Macrosiphum rosae* (Linnaeus) on roses, *Aphis gossypii* Glover and *Rhopalosiphum padi* (Linnaeus) cultured on pumpkin and zucchini, and wheat, respectively. In life cycle experiments involving *T. citricidus* durations of early instars of some specimens were not recorded, hence a higher number of fourth instar and pupal results were obtained; with *A. gossypii*, durations of first and second instars were added together, as second instar duration was extremely short and was missed in some replicates.

Other diets were fed to field-collected adults which had been starved for 24 h, and to larvae of various instars bred in the laboratory on *A. eugeniae* or *A. gossypii*. These included an artificial diet (gelatine, vitamins, yeast, salt and 1% crushed *Aphis eugeniae* van der Goot, made into a firm jelly with hot water and thinly deposited on greaseproof paper, rolled and deep frozen until required, when it was cut into strips and hung in the cages); *Bombyx mori* (Linnaeus) (silkworm) eggs and larvae, *Lucilia cuprina* (Wiedemann) (Australian sheep blowfly) eggs and larvae and commercial bees pollen.

ii) results

Life cycles were completed on *T. citricidus* and on *A. gossypii* (Table 1). Mortality was high, up to 88% in experiments with *T. citricidus*. Many other life cycles were completed with *A. gossypii* on *Hibiscus* sp. and with *A. eugeniae* on *G. ferdinandi*, but these were not individually recorded. Only one life cycle from 60 attempts was completed on *M. rosae* from roses. The male adult that emerged was very small and the length of the life cycle was 38d.

No life cycles were completed with any of the other foods tested; results are presented in Table 2.

In the field adults and larvae were seen feeding on *Toxoptera ?aurantii* (Boyer de Fonscolombe) on *Cassia* sp., *Brachycaudus helichrysi* (Kaltenbach) on sunflower, *Aphis nerii* (Boyer de Fonscolmbe) on *Araujia hortorum, Aphis gossypii* Glover on *Bidens pilosa* and *Ablutilon indicum,* and *Aphis citricola* (van der Goot) on *Coryza floribunda*. Healthy adults emerged from pupae collected on these hosts.

TABLE 1

Duration of the life cycle of *Scymnodes lividigaster* fed two different aphid foods, *Toxoptera citricidus* on cumquat and *Aphis gossypii* on cucurbits. n = number of ladybirds. d = mean number of days (± 2 standard errors). Life cycle is from egg to adult.

		Duration of Instars (in days)							
Aphid Food		Egg	1	2	3	4	pupa	Total adults	Range (days)
T. citricidus	n	20	11	10	10	13	18	8	
	d	4.6 (0.55)	2.4 (0.40)	3.1 (1.59)	1.5 (0.33)	4.5 (1.51)	7.3 (0.96)	26 (7.64)	13-36
A. gossypii	n	26	26		24	22	11	11	
	d	4.4 (0.47)	4.2 (0.57)		2.0 (0.42)	4.4 (0.80)	6.5 (1.77)	22 (1.73)	19-29

Feeding behaviour

Adults observed in the field had speedy and vicious eating habits, snatching aphids from behind and moving quickly to a clear zone, where aphid, appendages and all, was dispatched in 3-5 min. Well-fed adults and larvae in culture were lackadaisical and tended to eat only soft parts of the aphid, rejecting thorax and appendages. Larvae in field and laboratory attack and consume aphids many times their own size. They hover near an aphid, waving their forelegs rhythmically, then move their head up and down the aphid's back for about 2 minutes, finally lunging mandibles into the aphid body in 6-7 distinct movements while still waving their legs. They then begin to suck out body contents and lift aphid from the substrate, thereby removing rostrum from leaf tissue. Aphid body contents are withdrawn and replaced up to 35 times, the process taking a maximum of 18 minutes to complete and indicating extra intestinal digestion. The final 'blow-up' bloats the aphid enormously and after deflating, the larva either shakes the shrivelled aphid exoskeleton free, wipes it off on a nearby plant or scrapes it off between its forelegs. One larva was observed to suck at a parasitized aphid 'mummy', but in this instance, parasitism was high and unaffected prey in short supply.

A. gossypii is nearly always attacked by larval ladybirds from behind. When attacked, aphids raise their abdomen and a drop of liquid appears on the end of each cornicle; sometimes they kick at the ladybird with their long hind legs and a huge drop of liquid is extruded from the aphid anus. These latter measures did not deter larger larvae, but may have been effective in allowing aphids to escape from small larvae. No escapes by dropping from plants were observed.

Longevity

A culture of *S. lividigaster* (n = 8) was kept alive for 5 months in the laboratory between March and August, 1976, when temperature varied between 15-24°C. This is a short time compared with other ladybirds kept under the same conditions during

TABLE 2

Diets fed to *Scymnodes lividigaster* which did not complete the life cycle. Number tested with each diet = 20.

Type of Diet	Result
Artificial diet	Accepted readily by adults and larvae but no development of larvae, death. After 6 weeks adults showed 70% mortality, produced no eggs and no fat body was laid down. Mating not observed, but all individuals were seen to consume the diet
Bombyx mori eggs and larvae (2-3 mm)	Not accepted by adults or larvae
Lucilia cuprina eggs and larvae (>2.5 mm)	Not accepted by adults or larvae, though one adult was seen scraping at a squashed fly larva
Hyperomyzus lactucae	Accepted, but no eggs laid. Adults died within a week. Possibly toxic. Larvae not tested
Rhopalosiphum padi	Accepted, but no eggs laid. Adults released after 3 weeks — not toxic. Larvae not tested
Commercial bees pollen	Accepted readily by adults, no long term experiment carried out. Larvae not tested

1976-1977. *Coccinella repanda* Thunberg*, *Micraspis frenata* Erichson*, *L. galbula**, *Archaioneda princeps* Mulsant and *Parapriasus* sp. were kept alive for 14 months and *Coelophora inaequalis* (Fabricius) for 12 months (unpublished data). The *S. lividigaster* result probably reflects poor nutrition rather than life span. Great difficulty was experienced in supplying suitable live aphids continuously; stocks of frozen aphids ran out in mid winter 1976, when life cycle work was in progress and no suitable long term alternative food was found. Field monitoring indicated that *S. lividigaster* females certainly overwintered, having laid eggs in the previous autumn (March, April) and presumably would lay again in spring (October). This encompasses a life span of at least 8 months.

Parasites, predators and competitors

Published records of parasitism of coccinellids in Australia (Timberlake, 1920; Hales and Carver, 1976) contain no records for *S. lividigaster* and no parasites were discovered in the course of the present study. The major predator and competitor of *S. lividigaster* was found to be the ladybird *C. inaequalis*. Adult *C. inaequalis* were observed to eat larvae, pupae and teneral adults of *S. lividigaster*, and *C. inaequalis* larvae ate *S. lividigaster* larvae as abundance of aphids decreased on host plants. Some protection from predation by *C. inaequalis* was no doubt afforded to *S. lividigaster* larvae by their armature of senti. More importantly, normal behaviour of *S. lividigaster* larvae and prepupae protected them in space from predation by *C. inaequalis*. Larger larvae of *C. inaequalis* were most commonly found at leaf tips, less often beneath leaves, where smaller *S. lividigaster* larvae congregated. *S. lividigaster* prepupae moved downwards away from the aphid infestation to pupate, while those of *C. inaequalis* pupated close to aphid colonies, seldom on bark, so that on emergence, these teneral adults were separated. Evidence suggests that prepupae of each species have different geotactic and possibly phototactic responses. Another important factor in separating these potential ladybird competitors was timing of their life cycles, which were separated by approx. 10 d. *S. lividigaster* was always first to reproduce and its pupae were those first recorded in the field. Predominance of *C. inaequalis* pupae normally signalled the end of aphid infestation in any one area. This timing difference, behavioral spacing of larvae and pupae, together with greater armature of *S. lividigaster* larvae, reduced competition between ladybird species and predation was observed only when aphid populations were declining.

Distribution

Locality data of *S. lividigaster* were obtained from specimens in The Australian Museum, Sydney; The Australian National Insect Collection, Canberra; New South Wales Department of Agriculture, Sydney; Department of Primary Industries, Brisbane; The University of Queensland, Entomology Department, Indooroopilly; The Queensland Museum, Brisbane; The South Australian Museum, Adelaide; The National Museum of Victoria, Melbourne; Bernice P. Bishop Museum, Honolulu, Hawaii; Department of Scientific and Industrial Research, New Zealand; British Museum (Natural History), London; and author's collection, detailed in Anderson (1979). Identifications were based on male genitalia and examination of thoracic sterna. In Australia, the range of *S. lividigaster* extends from Nowra in southern New South Wales to Thursday Island in North Queensland, but appears to be restricted to the coastal fringe. It is apparently common in the Brisbane area (K. J. Houston, pers. comm.) and in the Sydney region.

S. lividigaster was introduced into West Australia in 1902, but it apparently

* released after 14 months in culture.

failed to establish (Jenkins, 1946). A collecting trip in 1980 to Western Australia yielded no specimens. It is common in the Cook Islands on Rarotonga, Aitutaki and Atiu, where it was possibly introduced for biological control purposes. The earliest record of its presence in the Cook Islands is 1911 (New South Wales Dept. Agric.). Locality records show it recorded in New Zealand in 1961 (D.S.I.R.) and it appeared in Auckland late in 1976 (J. C. Watt, pers. comm.). It was introduced to Hawaii in 1894 (Swezey 1915, 1923) and is now well-established there (G. A. Samuelson, pers. comm.). It has been collected in the Austral, Society, and Gilbert Islands between 1969-1977 (Brit. Mus. (Nat. Hist.)).

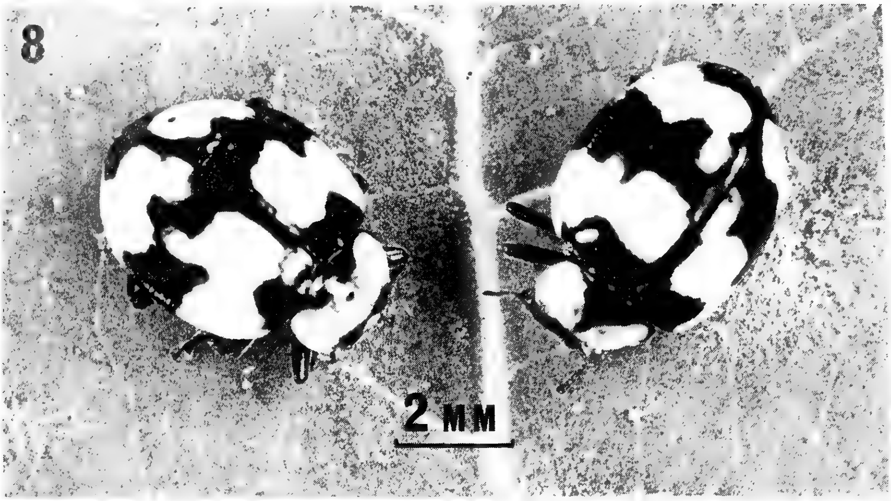
Leptothea galbula (Mulsant), 1850

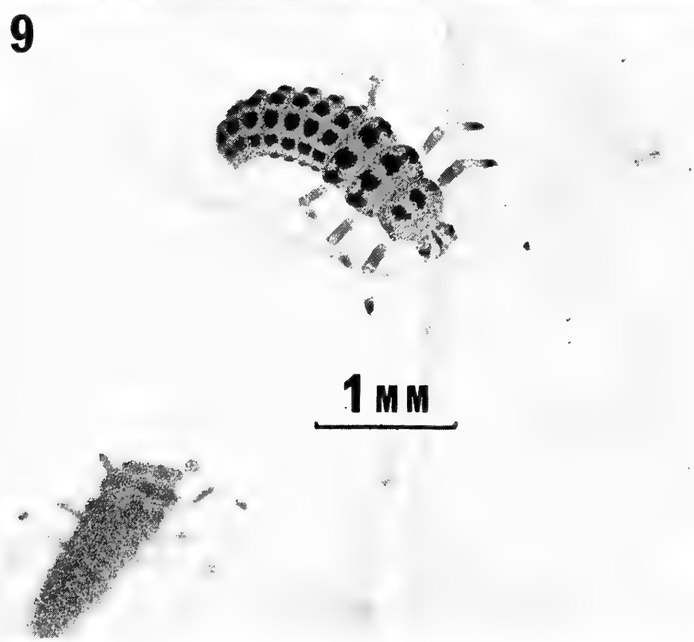
Adult (Fig. 8). Length 3-5.0 mm, width 2.0 mm, oval and glabrous, with characteristic lemon yellow and black patterning on head, prothorax and elytra, totally black ventrally. Pronotum much narrower than elytra, only barely emarginate anteriorly with broadly rounded anterior angles. The sexes cannot be reliably differentiated externally as is often the case in the family Coccinellidae (Hodek, 1973; Blackman, 1974) and dissection was found to be essential for accurate sexing. *Leptothea* is in the tribe Psylloborini of the Coccinellinae (Sasaji, 1968).

Eggs. Length 2 mm, spindle shaped, white, laid in clusters of 2-28, most commonly 7-8. Eggs laid on their ends, particularly on white patches of the fungus *Oidium* sp., on undersides of leaves, sometimes on stems, rarely on upper leaves. Eggs seldom laid on smooth cotyledons of cucurbits, nearly always on rough veined or hairy parts, possibly indicating a thigmotactic influence. In culture, females laid readily on white cotton wool and under white filter paper. Young females tended to lay preferentially on cotton wool, while females older than 2 weeks, showed preference for cucurbit leaves.

Larvae (Fig. 9). Campodeiform, with elongate, tapered body; armature reduced to stumpy senti. 1st instar, length just exceeding 1 mm, white on emergence, but larvae remain on egg capsule for up to 18 h after hatching, during which time they become light grey with some darker markings. 2nd to 4th instar larvae very characteristically patterned; head and prothorax yellow, rest of body white with 6 large black spots on prothorax and abdominal segments 1-8; and 8 spots on meso— and metathorax. Length of 2nd instar = 6 mm, 3rd instar = 7 mm, 4th instar = 10 mm. Prepupae cease feeding and attach to substrate with anal adhesive organ, after which some contraction of body occurs prior to pupation.

Pupa. The larval skin is shed completely and lies about anal organ. Pupa initially white and smooth, but melanic patterning quickly appears on thorax and abdomen, followed by yellow colouration of prothoracic and anterior abdominal regions. Patterning in black consists of stripes; 1 on lower edge of pronotum and one lengthwise in mid elytron; of dots; 2 on meso-metathorax and abdominal segment 6, 4 on abdominal segments 2 and 4; of black tipped protruding flanges; at tibia-femur elbow of each leg and laterally on abdominal segment 3. There are smaller unpigmented flanges on abdominal segments 4 and 5. Pupae erect in a similar manner to *S. lividigaster* when stimulated by heat, light or touch. Pupae are found under the older leaves and often cluster together in groups of up to 30. Certain pupae seem very attractive to male adults which may sit on a pupa for up to 5 d until eclosion. The male steps from pupal skin onto teneral's back on emergence and continues to cling there until wings are expanded, dried and withdrawn. Mating may then occur, before hardening is completed. Male aggression is associated with this behaviour (Richards, 1980)



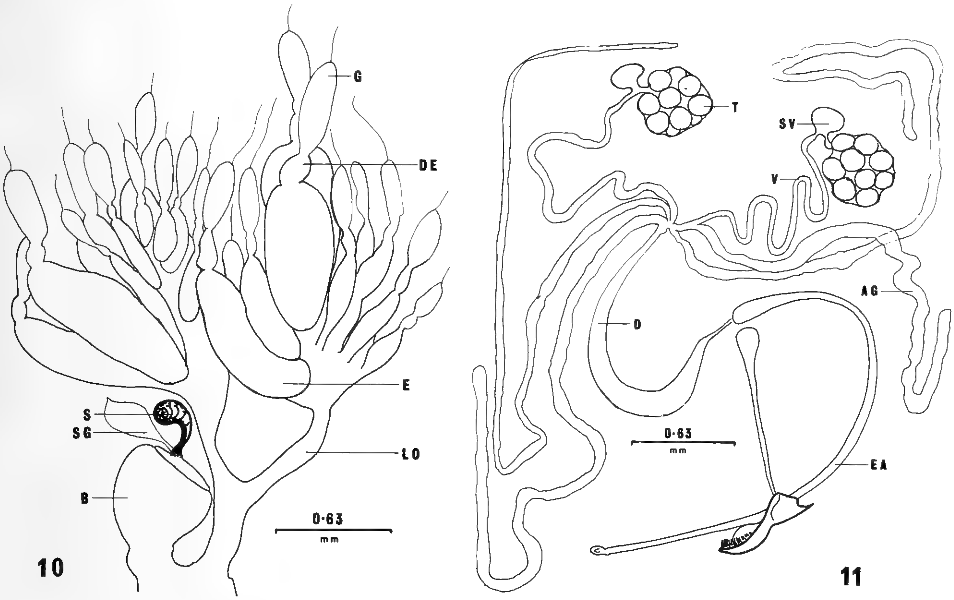


Leptothea galbula. *Fig. 8*. Adults. Length = 5 mm. *Fig. 9*. Second instar larvae. Length = 2.0 mm.

Reproductive systems

Method of examination similar to that used for *S. lividigaster*. Female reproductive system (Fig. 10) with same components as *S. lividigaster*, but differing in overall size and shape. Ovaries white, ovarioles vary from 9-12. Bursa copulatrix acorn-shaped, lightly sclerotized except for soft upper surface. Spermatheca black, heavily sclerotized, rounded anteriorly and hooked, passing into centre of upper surface of bursa; at junction of the two, a flattened, leaf-shaped spermathecal gland is attached.

Male reproductive anatomy (Fig. 11), basically similar to *S. lividigaster*, except



Leptothea galbula. *Fig. 10.* Female reproductive system. Labelling as in Fig. 6.
Fig. 11. Male reproductive system. Labelling as in Fig. 7.

for presence of 2 well-developed parameres. Each testis with 6-10 follicles. Testes smaller in diameter than *S. lividigaster*, despite the larger size of *L. galbula*. Seminal vesicle kidney-shaped and appears to be an offshoot of vas deferens, rather than a swelling of the vas.

Food

L. galbula has been described in association with aphids and scales (Froggatt, 1902). However, Koebele observed adults in association with powdery mildew (*in* Timberlake, 1943) and Schilder and Schilder (1928) similarly reported the ladybird's association with this fungus.

i) methods

Experiments were set up to determine whether powdery mildew *Oidium* sp. on cucurbits is an essential food of *L. galbula*; (a) where ladybirds were reared together in large numbers in constant temperature of 22 ± 2°C and constant light (LL), (b) where ladybirds were reared one per leaf in normal daylengths of approx. 13 h and temperature 20-25°C. Large perspex cages were used for experiments and ample fungal food supplied, plus sugar and water. In another experiment, *L. galbula* was fed a series of foods; the artificial diet previously described; *B. mori* larvae and eggs; *L. cuprina* larvae and eggs; aphids *T. citricidus, A. gossypii, H. lactucae, R. padi* and *M. rosae*, and commercial bees pollen. These foods were placed in Petri dishes with individual ladybirds.

ii) results

In both experiments involving powdery mildew, life cycles were completed (Table 3). Mortality was extremely low in the first experiment and zero in the individually monitored second experiment. Beetles offered any of the other foods did not complete their life cycle; the results are in Table 4.

TABLE 3

Duration of the life cycle of *Leptothea galbula* fed *Oidium* sp. (powdery mildew) on cucurbits. (a) larvae reared in groups in LL at 22 ± 2°C and (b) larvae reared individually in LD 13:11 at 20-26°C. n = number of ladybirds. d = mean number of days (± 2 standard errors).

(a)

Food	n	Mean duration of life cycle (d)	Range (days)
Oidium sp.	184	20.96 ± (0.45)	16-26

(b)

Food	Duration of Instars (d)										
	n	Egg	1	2	3	4	pre pupa	(4 + prepupa)	pupa	Total mean	Range (days)
Oidium sp.	17	3.0 (0.00)	3.7 (0.23)	2.3 (0.29)	2.2 (0.40)	3.8 (0.54)	2.5 (0.31)	6.3 (0.53)	5.2 (0.20)	22.6 (0.83)	20-26

In the field *L. galbula* was observed breeding regularly on *Oidium* sp., on *Lonicera fragrantissima* and cucurbits, and spasmodically on chrysanthemums.

Feeding behaviour

Feeding behaviour is remarkably uniform, both larvae and adults graze fungal spores and hyphae from surfaces of leaves. When *Oidium* sp. is dense, they feed on a front and visibly clear large areas of the leaf's white fungal covering; if infestation is light, both larvae and adults search leaf surfaces at random and if nothing is found, adults fly off. Adults and larvae are cannibalistic, eating their own eggs, but not larvae. Thus they can be reared in batches; in the field, high populations may build up in small areas.

Longevity

A culture of *L. galbula* (n = 5) was kept in the laboratory in similar conditions to that of *S. lividigaster* for just over 14 months when ladybirds were released. Mortality was minimal and reproduction almost continuous.

Parasites and competitors

The only possible parasite of *L. galbula* noted was a mite found attached to the body of adults. It was observed only after wet periods when habitats were overwatered, so its impact was apparently unimportant. No predators were observed at any stage. The only competitor, is the leaf-eating ladybird *Henosepilachna vigintioctopunctata* (Fabricius), which feeds on cucurbits and will eat leaves infected with powdery mildew. However, it poses no real threat.

Distribution

Locality data were obtained from institutions previously mentioned in the distribution of *S. lividigaster* and detailed in Anderson (1979). *L. galbula* is recorded along the east coast of Australia from Ferntree Gully in Victoria to Mossman in North Queensland and as far west as Warrumbungle National Park in New South Wales. It is abundant in the Sydney area and is common in Brisbane gardens, especially when crepe myrtle *Lagerstroemia* sp. becomes infested with powdery mildew (E. C. Dalms, pers. comm.).

TABLE 4

Diets fed to *Leptothea galbula* which did not complete the life cycle. Number tested with each diet = 20.

Type of Diet	Result
Artificial diet	Accepted very readily by adults and larvae, but no development of larvae, death. Adults showed a 90% mortality, after 6 weeks. Survivors dissected were in diapause with large fat body and gonotrophic regression. No eggs were laid and no mating was observed despite continual feeding
Bombyx mori eggs and larvae (2-3 mm)	Untouched by adults and larvae
Lucilia cuprina eggs and larvae (>2.5 mm)	Untouched by adults or larvae. Active avoidance if approached by a blowfly larva
Aphids	Untouched by adults or larvae. Active avoidance if approached
Commercial bees pollen	Accepted readily by adults, no long term experiment carried out. Larvae not tested

Discussion

Life stages and reproductive anatomy of *S. lividigaster* and *L. galbula* conform to the basic coccinellid type (Hodek, 1973) and variation in number of testicular follicles and ovarioles of certain individuals and between individual ladybirds is not unusual (Robertson, 1961; El Harari, 1966). However, of particular interest is the male genitalia of *S. lividigaster* which lack parameres. The primitive coccinellids of the tribe Serangiini have very small or vestigial parameres (Sasaji, 1968), whereas most other ladybirds have parameres (Ehara, 1952; Smirnoff, 1957; Sasaji, 1968).

The waxy 'heart' which surrounds the prepupa and pupa of *S. lividigaster* may be protective in function, as small wasps and ants were observed to skirt round the rim of the wax. There is no record of any such secretion in any other ladybird.

The ladybirds exhibit a high degree of food specificity; *S. lividigaster* is aphidophagous and *L. galbula* is mycophagous. Other foods offered did not allow completion of the life cycle. Not all aphid species promoted reproduction in *S. lividigaster*. *T. citricidus, A. gossypii* and *A. eugeniae* are suitable essential foods that allow completion of the life cycle normally; whereas *M. rosae* is a very poor essential food. The aphid *R. padi* was found to be a non-toxic alternative food, whilst *H. lactucae* was accepted, but was probably toxic. *H. lactucae* was toxic to *C. inaequalis* (Hales, 1976), but Houston (1979) reared this ladybird for several generations on that aphid. K. J. Houston (pers. comm.) suggests a sudden change in diet can be detrimental to ladybirds, especially larvae. Field observations indicate a number of other aphid species may act as essential food for *S. lividigaster*.

For *L. galbula, Oidium* sp., the imperfect form of the pathogenic fungus, powdery mildew, was the only essential food discovered, though other foods were accepted and a few adults laid down fat on the artificial diet. In other experiments with ladybirds *Micraspis frenata* Erichson and *C. inaequalis*, it was found that the artificial diet and *Tribolium confusum* Jacquelin du Val (flour beetle) larvae and pupae acted as alternative food and mortality was negligible. Infertile eggs were laid by *M. frenata* (unpublished data). This indicates the narrow food specificity of *S. lividigaster* and *L. galbula* compared with more polyphagous species which live side by side with them in the study area. Even less specificity is reported in some overseas polyphagous ladybirds such as *Coleomegilla maculata* (De Geer) (Attalah and Newsom, 1966) and *Harmonia axyridis* Pallas (Matsuka and Okada, 1975). Meridic artificial diets have been concocted for them. To date, despite the food preferences of *S. lividigaster* and *L. galbula* there is no useful information on the economic impact of either species.

Mean duration of the life cycle of *S. lividigaster* is very similar to that of other aphidophagous species from temperate regions (Davidson, 1923; Thompson, 1926; Bagal and Trehan, 1948; Hales, 1976), but is shorter than that recorded from cool temperate regions (Hawkes, 1920), while that of *L. galbula* compares favourably with other mycophagous ladybirds (Kapur, 1943; Bagal and Trehan, 1948).

Very high mortality experienced in breeding experiments with *S. lividigaster* may have been due to size of aphids supplied. Newly hatched ladybird larvae have difficulty in capturing their first aphid (Dixon, 1959) and cannot manage large ones (Dixon, 1959; Gurney and Hussey, 1970). No size-selection of aphids was made during experiments and this may have prejudiced survival of smaller larvae, especially in experiments with large *T. citricidus* aphids.

Coccinellids are known to be long lived insects and it would not surprise to find that *S. lividigaster* and *L. galbula* lived for periods of over a year in the field. Hodek (1973) reports coccinellid field life spans of two or three years and Smith (1965) kept *Anatis mali* (Say.) alive in culture for over 1000 d and *C. maculata* for over 400 d fed on various synthetic foods. It appears that alternative foods enhance longevity, whereas essential foods allow reproduction but life span is reduced (Smith, 1965).

ACKNOWLEDGEMENTS

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Dr V. F. Eastop, British Museum (Natural History), was kind enough to identify for me the aphids associated with this study. Dr Aola M. Richards, University of New South Wales, and Mr R. D. Pope, British Museum (Natural History), assisted me with the naming of the ladybirds.

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Posticobia norfolkensis (Sykes), an apparently-extinct, fresh-water Snail from Norfolk Island (Gastropoda: Hydrobiidae)

W. F. PONDER

(Communicated by A. RITCHIE)

PONDER, W. F. *Posticobia norfolkensis* (Sykes), an apparently-extinct, fresh-water snail from Norfolk Island (Gastropoda: Hydrobiidae). *Proc. Linn. Soc. N.S.W.* 105 (1), (1980) 1981: 17-21.

Recent sampling on Norfolk Island has indicated that *Paludestrina norfolkensis* Sykes 1900 is almost certainly extinct. The original material collected in 1855 and samples collected in 1909 and 1913 are the only reliably-dated material that has been located in collections. It is assumed that this species became extinct following damage to the fresh-water habitats by forest clearing and subsequent stock activity. Examination of the dried remains of the animal indicate that it is very closely related to *Posticobia brazieri* (Smith 1882), an eastern Australian species.

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INTRODUCTION

Norfolk Island (Lat. 29°S, Long. 168°E) is a small volcanic island, 676 km from New Caledonia and 1,368 km from eastern Australia. Its small size and isolation have resulted in the evolution of a largely endemic fauna and flora. Unfortunately several endemic plant and animal species are in danger of extinction or have already become extinct (Turner *et al.,* 1968).

The writer and Mr E. K. Yoo visited Norfolk Island in June 1979 to determine the present distribution of a small, endemic, fresh-water snail, *Paludestrina norfolkensis* (Hydrobiidae), described by Sykes (1900). Fresh-water habitats were sampled at 20 stations (Fig. 1) but failed to reveal the presence of any fresh-water molluscs. An additional 21 temporary water courses were examined and found to be dry at the time of the survey. Many terrestrial habitats were also sampled during the survey.

Paludestrina norfolkensis was named from specimens collected by John Macgillivray during a voyage of HMS "Herald" to Norfolk Island in May, 1855. Other dated collections (see details below) extend to 1913. No dated material collected since 1913 has been located.

The available material contains the dried remains of animals and from these were extracted the radula and operculum which were examined using the SEM (for details of methods see Ponder and Yoo, 1976).

TAXONOMY

Family Hydrobiidae

Genus *Posticobia* Iredale 1943

Type species (original designation): *Hydrobia brazieri* Smith 1882; Recent, eastern Australia

The type species of *Posticobia* has a shell, radula and operculum (Fig. 2, 6-8)

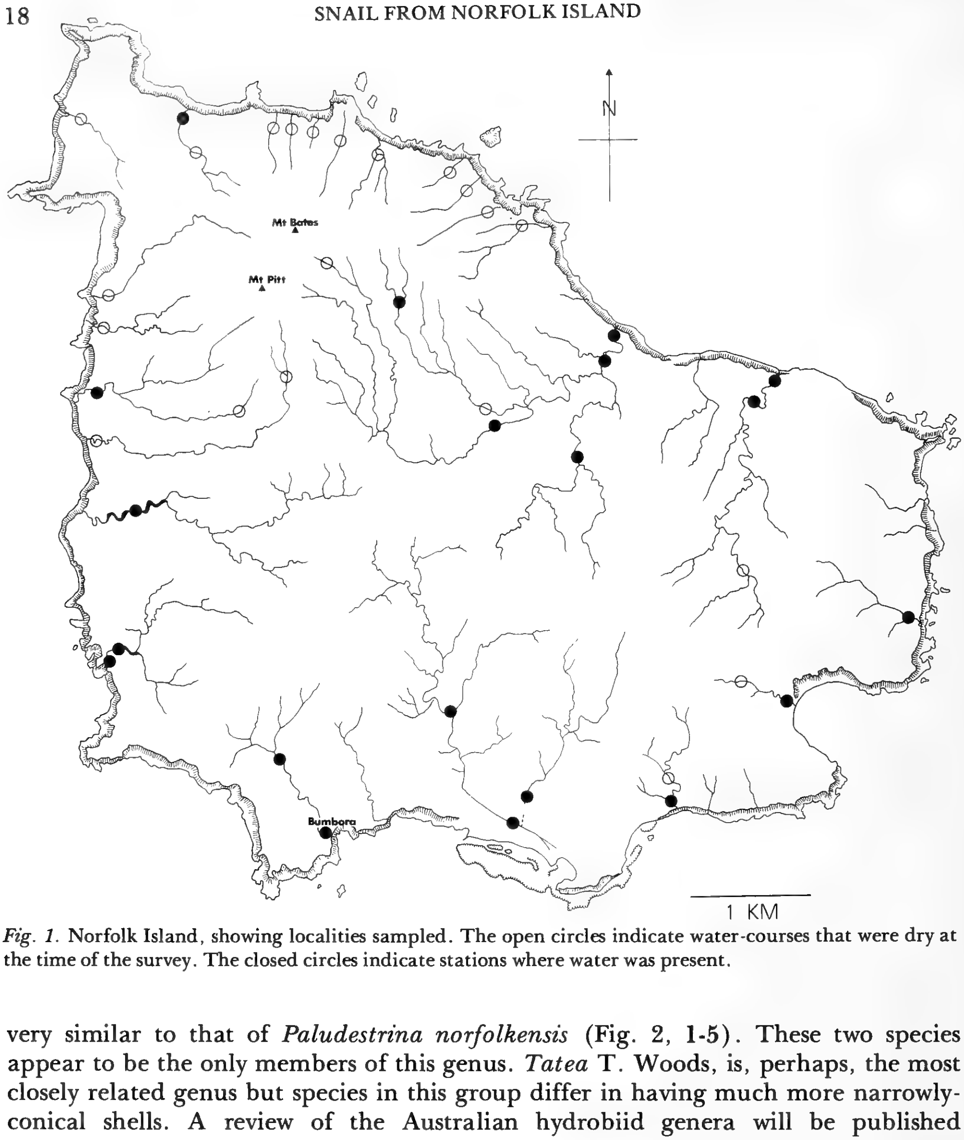

Fig. 1. Norfolk Island, showing localities sampled. The open circles indicate water-courses that were dry at the time of the survey. The closed circles indicate stations where water was present.

very similar to that of *Paludestrina norfolkensis* (Fig. 2, **1-5**). These two species appear to be the only members of this genus. *Tatea* T. Woods, is, perhaps, the most closely related genus but species in this group differ in having much more narrowly-conical shells. A review of the Australian hydrobiid genera will be published elsewhere.

Posticobia norfolkensis (Sykes, 1900). Fig. 2, **1-5**.

Paludestrina norfolkensis Sykes, 1900: 146, pl. 13, fig. 14.

Remarks: The shell differs from all known species of Hydrobiidae in the Australasian region by its broadly ovate shape, somewhat D-shaped aperture weakly angled anteriorly and posteriorly, rather thickened peristome, small umbilical chink and rounded to subangled periphery (Fig. 2, **1**). The shell of the Australian species, *P. brazieri* (Fig. 2, **7**) is thinner, has a peripheral keel or marked peripheral angulation, a slightly taller spire, and a less strongly prosocline outer apertural lip.

The opercula of *P. brazieri* and *P. norfolkensis* are similar in having a row of small pegs on their inner surfaces (Fig. 2, **2, 3, 6**). The radulae of both species are also almost identical; the formula of the central teeth (Fig. 2, **4, 5, 8**) $\frac{4+1+4}{(3-4)+(4-3)}$,

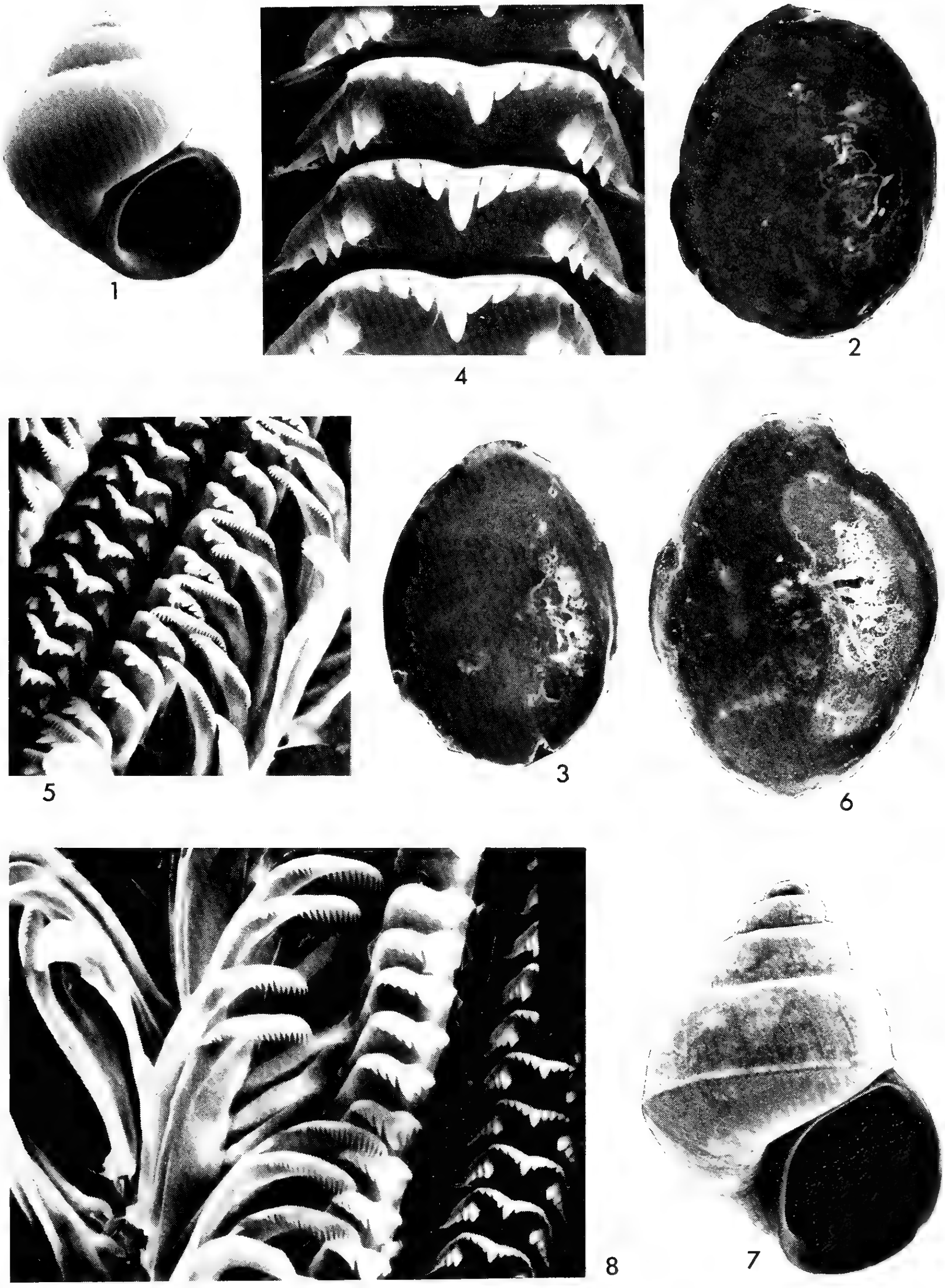

Fig. 2. **1-5.** *Posticobia norfolkensis* (Sykes), Bumbora, Norfolk Island. **1,** shell; **2, 3,** opercula (inner side); **4,** central teeth of radula; **5,** a portion of the radula.
6-8. *Posticobia brazieri* (Smith), South Grafton, Clarence River, New South Wales. **6,** operculum; **7,** shell; **8,** a portion of the radula.

lateral teeth 4 + 1 + 4 in *P. norfolkensis* and 4 + 1 + (4 − 5) in *P. brazieri*. The marginal teeth have numerous small denticles (Fig. 2, 5, 8).

Material examined: Syntypes, Norfolk Island, ex Admiralty Colln., BMNH*, 1856.10.27.94 (32 specimens). Bumbora, coll. F. A. Bassett-Hull, 1909, AMS**, C.30992 (33 specimens). Bumbora, (collected R. Bell?), 7.vi.1913 (many specimens), BMNH, 1932. 25.300-319. Same data but lacking date, BMNH, 1931. 12.29.206-225 (many specimens). Norfolk Island, pres. C. Hedley, purchased from H. Preston, AMS, C.34522 (4 specimens). Norfolk Island, no other data, BMNH, 58.3.19.511 (1 specimen). Norfolk Island, ex Bryant Walker Colln., MZUM***, 137772 and 48595/119233 (2 lots, 5 specimens).

Dimensions of Syntypes:

Length (mm)	Width (mm)
2.36	1.94
2.40	2.12
2.53	2.04
2.40	2.06

Discussion

All of the permanent fresh-water bodies and many of the temporary creeks on Norfolk Island were examined during the survey. The result was negative so it is concluded that *P. norfolkensis* is now almost certainly extinct. The rather large numbers of specimens comprising the museum material available suggests that the species was once abundant, at least at Bumbora.

The Island was uninhabited when Captain James Cook discovered it in 1774. It was first settled in 1788 but was only partly cleared in 1856 when the Pitcairn Islanders arrived there to settle. Now only a small proportion of the land-surface is covered with original vegetation (Turner *et al.*, 1968).

There is little doubt that man-made environmental changes affecting the fresh-water streams on the island have led to the probable extinction of *P. norfolkensis*. These changes include: — (a) Clearing of the forest allowing greater penetration of sunlight leading to greater algal and other plant growth and increased evaporation, causing pools to dry out more frequently. (b) Grazing by cattle causing damage to stream beds and fouling of water. (c) Erosion through clearing and stock damage causing shallowing of stream beds and increasing silt load. (d) Building of dams on streams resulting in changes of habitat and altering of water flow below the dams. (e) Introduction of chemicals (fertilizers, pesticides etc.) to the land and their subsequent drainage into streams.

All or some of these factors may have been responsible for the probable extinction of *P. norfolkensis*. The most obvious damage seen during the survey was inflicted by cattle on the banks and beds of streams leading to erosion of the banks, fouling of pools and extreme disturbance to the stream beds. We could not find a pool or stretch of stream bed that did not show signs of cattle damage, even in the Mount Pitt Reserve.

The apparent close relationship of *P. norfolkensis* to the eastern Australian *P. brazieri* is of interest, particularly as none of the species comprising the relatively large hydrobiid fauna of Lord Howe Island (Lat. 31° 33′S, Long. 159°05′E) is closely related to these species. *Posticobia brazieri* was probably transported to Norfolk Island

* BMNH = British Museum (Natural History), London
** AMS = The Australian Museum, Sydney
*** MZUM = Museum of Zoology, University of Michigan, Ann Arbor, Michigan.

by birds during the Pleistocene or Holocene and subsequently differentiated. The fresh and brackish-water habitats where *P. brazieri* occurs have a rich bird fauna so that the accidental dispersal of this species is not improbable. The rocky streams of Lord Howe Island do not provide the same opportunities for mud (containing snails) accidentally to adhere to feet, bills or feathers of birds. The extremely limited distributions of the fresh-water snails on Lord Howe Island itself indicate their inability to disperse readily by this or any other means (Ponder, in MS). Hydrobiids on the Australian mainland, however, where muddy streams and rivers are common, are generally widely distributed.

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Tertiary Non-marine Diatoms from Eastern Australia: Descriptions of Taxa

D. P. THOMAS and R. E. GOULD

THOMAS, D. P., & GOULD, R. E. Tertiary non-marine diatoms from eastern Australia: descriptions of taxa. *Proc. Linn. Soc. N.S.W.* 105 (1), (1980) 1981: 23-52.

Non-marine diatomites from eleven localities in New South Wales and southeastern Queensland, ranging in age from Late Oligocene to Middle Miocene, have yielded twenty-nine taxa of diatoms (Bacillariophyta) which are figured here. Genera present include *Melosira, Fragilaria, Synedra, Eunotia, Achnanthes, Cymbella, Gomphonema, Navicula, Pinnularia, Stauroneis,* and *Nitzschia*. *Navicula seminuloides* Hustedt var. *rhombica* Thomas is recognized as a new variety. Effects of diagenetic dissolution and re-deposition of silica on frustular morphology are discussed and illustrated.

Sponge spicules (Porifera: Spongillidae) are present in all diatomites examined and some examples of these are figured.

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INTRODUCTION

Beds of non-marine diatomite and other lake sediments are widely associated with Cainozoic and generally basaltic lavas in eastern Australia (Crespin, 1947). Many of the lavas have been isotopically dated (e.g. Wellman, 1974, 1978; Wellman and McDougall, 1974) enabling relative geological ages to be assigned to deposits that are widely separated geographically. The deposits in New South Wales and south-eastern Queensland that we have investigated (Fig.1), have been assessed geologically by Herbert (1968) and Bonner (1950, 1951, 1953). Skvortzov (1937) detailed the fossil diatom flora from the Middle Flat deposit near Cooma, and Crespin (1947) listed species from most localities. Hill *et al.* (1970) figured three specimens from the south-eastern Queensland deposits.

In this paper we discuss the taxonomy and illustrate the morphology of diatom frustules from selected Oligocene and Miocene diatomites in south-eastern Queensland and New South Wales. The majority of fossil taxa observed are represented in living assemblages, so lessening reliance on the relatively sparse literature on fossil non-marine diatoms (e.g. Andrews, 1971; Abbott and Van Landingham, 1972); our identifications, principally the work of DPT, are based upon reference to European and North American taxonomic works that include both extant and fossil forms (e.g. Hustedt, 1930a, 1959, 1966; A. Schmidt *et al.*, 1874-1959; Patrick and Reimer, 1966, 1975).

Our conclusions on environments of deposition, geological history of non-marine diatoms, and biostratigraphic implications follow in a second paper (Thomas and Gould, 1981). The diatomites were probably formed in slightly eutrophic freshwater lakes.

MATERIALS AND METHODS

Diatomite samples were obtained from adits and cuttings at known localities. Lump samples were removed from exposed surfaces at intervals of 0.1 to 1.0 m and from any layers in between which differed visually from those above and below; an auger was used to obtain samples at some localities. Samples were individually packaged in polythene bags at the time of collection. Each sample was then dissected in the laboratory to obtain subsamples from within it, avoiding contamination from any adhering surface sediments or surficial, living algae.

Subsamples were scraped into a sample tube where ethyl alcohol was added and

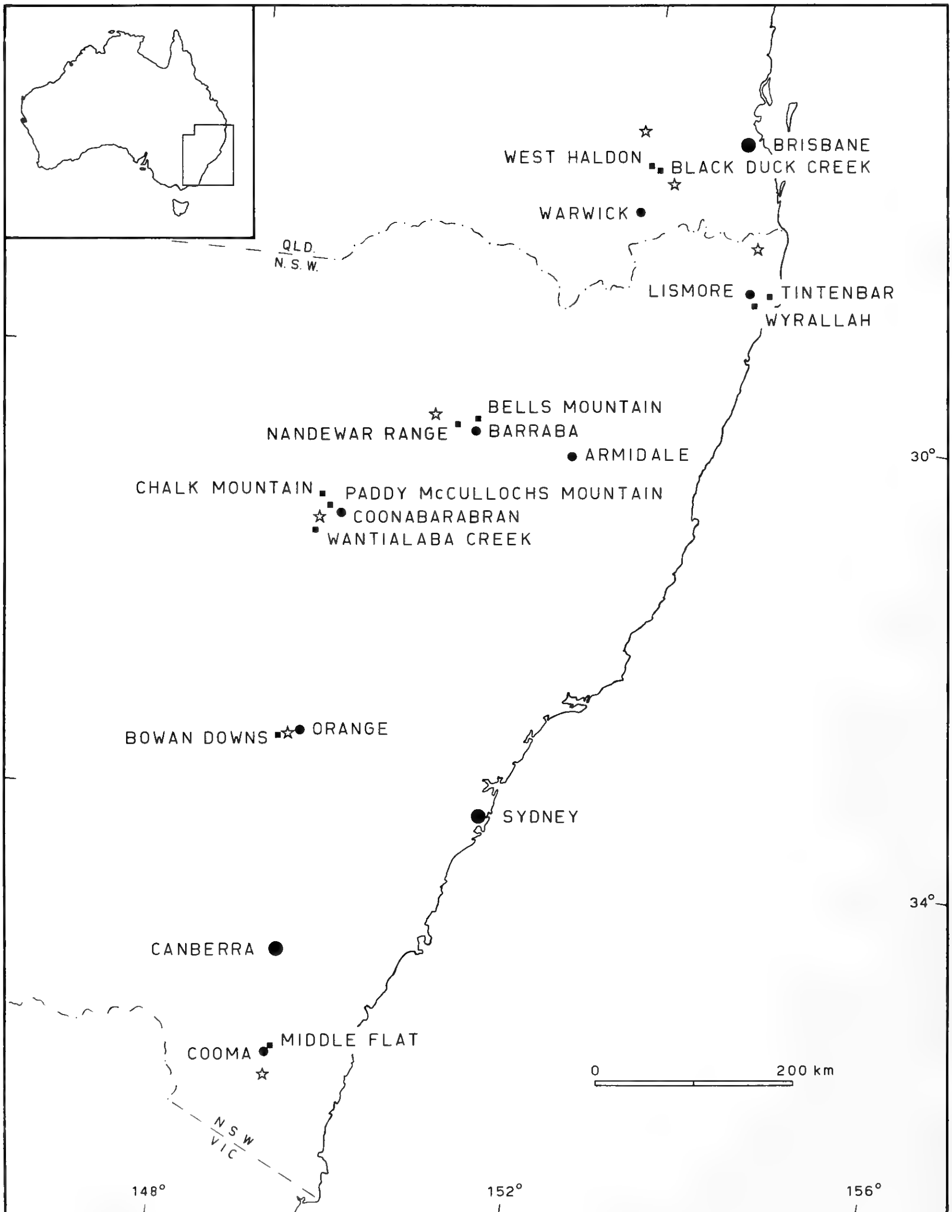

Fig. 1. Locality map. Black squares mark diatomite deposits and stars show centres of volcanic eruption for lavas associated with the diatomites.

the sediment disaggregated using a glass rod. The suspension was then sampled using a pipette to transfer some of the liquid to a cover glass placed upon a hot plate set at 70°C.

For light microscopy the suspension was dried down upon 22 mm diameter, round cover glasses and mounted on a microscope slide using Canada Balsam as the mounting medium. Higher refractive index mounting media, such as HYMOUNT (Gurrs) and NAPHRAX (N.B.S.) were found to be less useful for studying diatoms with the Nomarski Differential Interference Contrast optics employed in this study, though better than Canada Balsam for ordinary transmitted light study. The light microscope slides were scanned with the aid of a ZEISS Photomicroscope III to determine what taxa were present in each sample from each locality.

For scanning electron microscopy the sediment and alcohol suspension was dried down onto 10 mm diameter cover glasses previously coated with colloidal graphite (AQUADAG; Agar Aids) and plated with gold using a sputter coater. These samples were observed using a JEOL JSM-35 scanning electron microscope at the Electron Microscope Unit of the University of New England, Armidale, New South Wales. Some samples for electron microscopy were cleared of organic material prior to being placed in alcohol by warming them in concentrated nitric acid for 12 hours at 60°C (Crawford, 1971) followed by dilution using distilled water and resuspension in ethyl alcohol. This had the advantage of also removing some of the clay particles but meant the loss of a proportion of the small diatoms and could not be used for quantitative or semi-quantitative assessment of the diatom assemblages.

Fig. 2. Diatomite at Bells Mountain north of Barraba.
(a) Base of diatomite deposit (from butt of hammer handle and above) overlying fine-grained lacustrine sediments, to south of Bells Mountain.
(b) Exposure of top of diatomite in collapsed roof of mine, north-north-western side of Bells Mountain; head of hammer at top of diatomite, overlain by tuff (shank of hammer) and basaltic lava (butt of hammer handle).

Localities

Deposits sampled included those at West Haldon and Black Duck Creek in Queensland, Tintenbar and Wyrallah near Lismore, Bells Mountain and Nandewar Range near Barraba, Paddy McCullochs Mountain, Chalk Mountain (Bugaldie), and Wantialaba (or Wantial) Creek, all near Coonabarabran, Bowan Downs near Orange, and Middle Flat near Cooma, New South Wales (Fig. 1). Some details for each locality are listed here, including a grid reference for the appropriate 1:250 000 topographic sheet, and radiometric ages for associated lavas from Webb *et al.* (1967), Wellman and McDougall (1974) or Wellman (1978). Further information on the localities can be obtained from Bonner (1950, 1951, 1953), Herbert (1968), and Mumme *et al.* (1975).

West Haldon. On tributary of Sandy Creek at Ipswich 516552; interbedded with the Late Oligocene, lower, basaltic portion of the Main Range Volcanics (Cranfield *et al.*, 1975); radiometric age 24-23 m.y; small disused adit.

Black Duck Creek. South of Rocky Shrub Creek at Ipswich 525548; Late Oligocene, similar horizon to West Haldon; currently mined.

Tintenbar. Disused Snow Queen Mine, Milne's Hill, south of Teven-Tintenbar road at Tweed Heads 667427; interbedded with Lismore Basalt (Duggan and Mason, 1978) which lies between Early Miocene units dated at 22.4 and 20.8 m.y.

Wyrallah. Disused mine, corner Hensons and Rous Road, east of Wyrallah, Tweed Heads 648418; Early Miocene, horizon the same as Tintenbar.

Bells Mountain. Disused mines just east of Barraba-Bingara road, Manilla 358252; immediately underlies basaltic lava and tuff (Fig. 2) of the Nandewar Mountains (Wilkinson *et al.*, 1969) assigned a Miocene age of 18 m.y.

Nandewar Range. Sequence along Barraba-Mount Kaputar road, west of Little Creek, at Manilla 337245; Miocene, similar horizon to Bells Mountain.

Paddy McCullochs Mountain. Hill-top sequence overlying Mesozoic sediments, west of Coonabarabran-Baradine road near Yearinan, Gilgandra 207140; overlain by flows from the Miocene Warrumbungle Volcano (Wilkinson *et al.*, 1969) of 16-15 m.y.; small, disused workings.

Chalk Mountain. Currently mined deposit west of Coonabarabran-Baradine road at Bugaldie, Gilgandra 199148; interbedded with lavas from the Miocene Warrumbungle Volcano of 16-15 m.y., at a somewhat similar horizon to Paddy McCullochs Mountain.

Wantialaba Creek. Small deposit in creek bank south of Newell Highway, Gilgandra 197108; interbedded with flows and tuffs from the Miocene Warrumbungle Volcano of about 15-14 m.y.

Bowan Downs. Disused mines west of Orange-Cargo road, at Bathurst 185876; interbedded with basaltic flows of the Middle Miocene Canobolas Volcanic Complex of 12-11 m.y.

Middle Flat. Old workings, currently being opened up for production, at Middle Flat on western side of Middle Flat Creek, Bega 221533. The deposit overlies Palaeozoic sediments, with nearby basaltic rocks of at least 39 m.y. old, or Eocene age; however it

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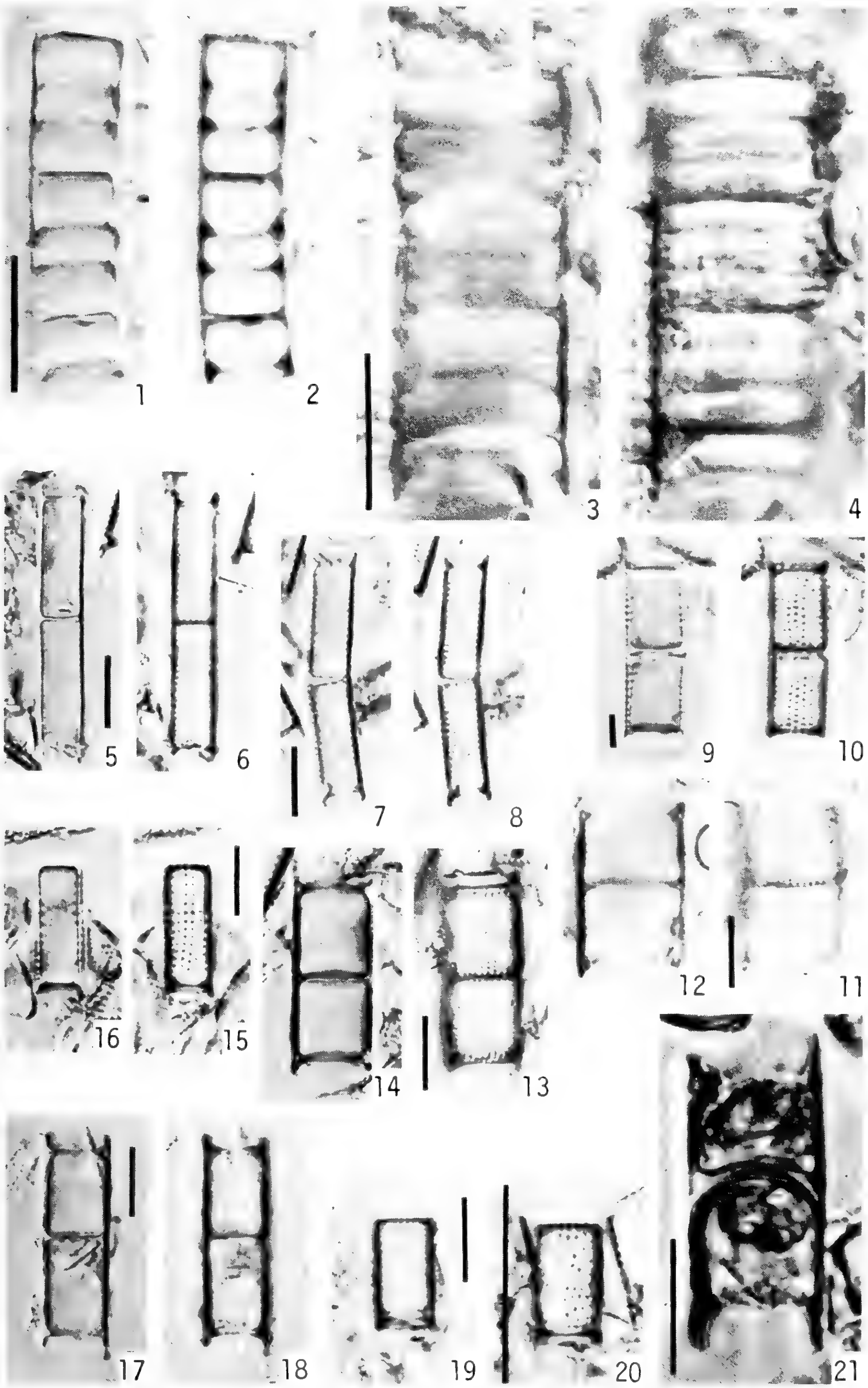
Fig. 3. **1-4**. *Melosira* sp. A. **1**,**2**, UNEF15646, Bells Mountain, girdle view of narrower frustules. **3**,**4**, UNEF15648, Bells Mountain, girdle view of broader frustules.

5-21. *Melosira granulata*. **5**,**6**,**11-20**, UNEF15801a-g, Bowan Downs; **7-10**, UNEF15814a, b, Middle Flat. **5-16** show range of valve length to breadth ratios and areola size and distribution. **17-20**, valves with irregular and sparse areolation. **21**, UNEF15569a, Tintenbar, showing distortion of valve features probably due to mobilization of silica.

Transmitted light micrographs, Nomarski DIC; all scale bars 10 μm, **1-18** paired micrographs of outline and surface foci.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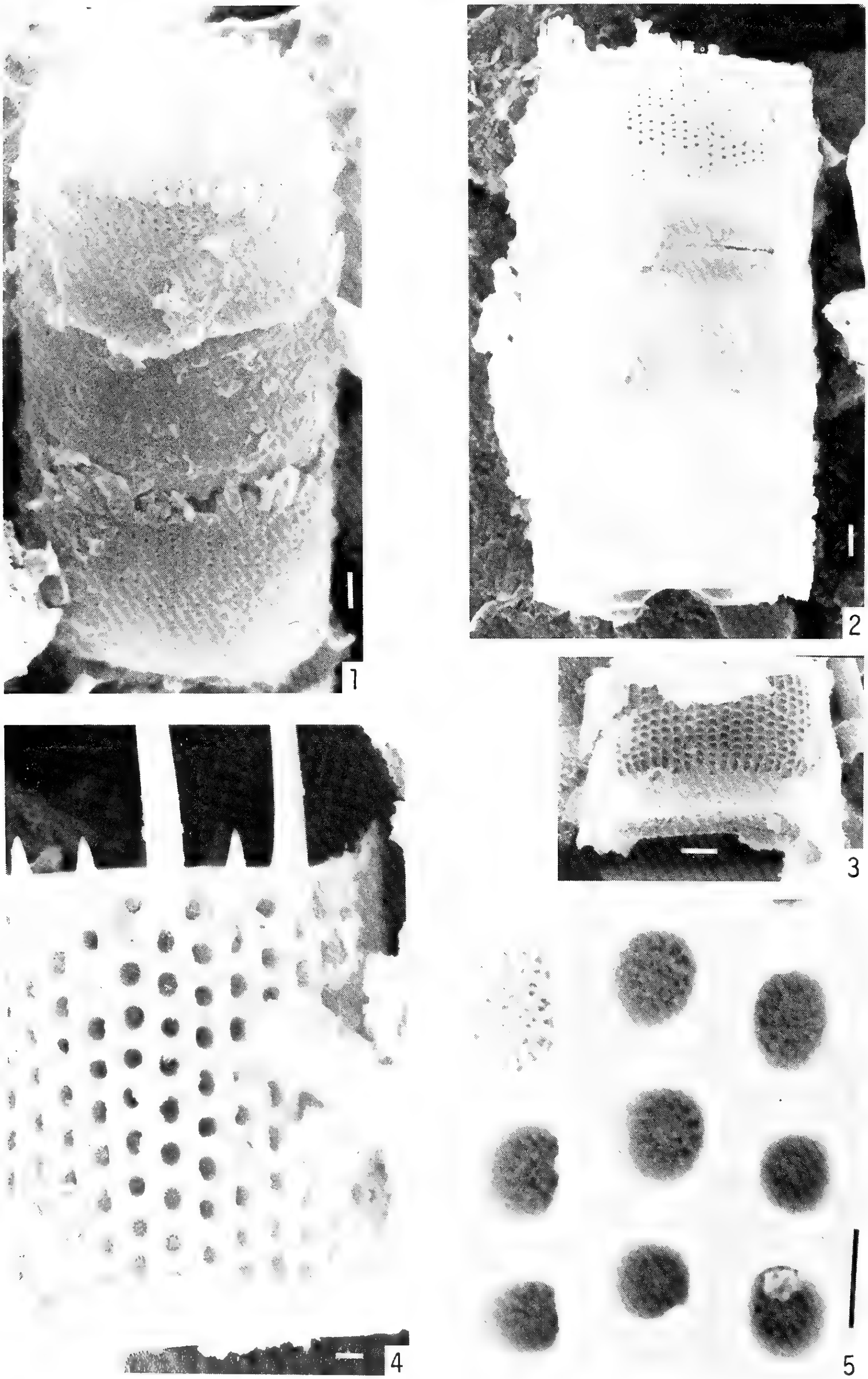
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appears the basalt does not actually overlie the diatomite and so the exact age of the deposit is open to question, but we believe it to be no older than the Black Duck Creek deposit.

SYSTEMATIC SECTION

Introduction. The Australian diatom flora, both fossil and living, has been little studied with few published works (e.g. Crosby and Wood, 1958, 1959; Foged, 1978; Wood, 196la, b, 1963; Wood *et al.*, 1959) and very few papers dealing with non-marine fossils (e.g. Skvortzov, 1937). Identification of Australian taxa has therefore to rely on European and North American works and on literature based indexes (e.g. Mills, 1933-1935; Van Landingham, 1967-1979).

There is no implication that taxa which have not been identified to specific level here are new species, but we are unable to ascertain whether they have been described in some of the vast, extra-Australian diatom literature as yet unavailable to us. These taxa have been given an alphabetic code name, rather than add further, perhaps unnecessary, names to an over-crowded diatom systematics.

Taxomonic slides together with slides representative of each sample locality (designated with prefix UNEF), are held in the Geology Department, University of New England, Armidale, New South Wales. Duplicate taxonomic slides of all taxa have been lodged in the phycology herbarium, Botany Department, University of Adelaide, South Australia, and the British Museum (Natural History), London, by DPT. Taxonomic slides are designated by the prefix ADU-D.

The following notes and descriptions are set out in six phylogenetic groups with genera arranged in alphabetical order within each group. Descriptions and terminology follow the outlines suggested in Anonymous (1975) and Hendey (1964). Where possible, species names follow those considered appropriate by Mills (1933-1935) and Van Landingham (1967-1979) which also contain a full listing of synonyms. The occurrences listed refer to localities investigated in this study only. Where species have been previously described, a listing of the literature upon which the identification is based follows the name and precedes any listing of synonymy.

I. Suborder COSCINODISCINEAE

MELOSIRA C. Agardh, 1824

Melosira species A

Fig. 3, 1-4; Fig. 4, 1-3.

Occurrence. Bells Mountain, Nandewar Ra. and Bowan Downs.

Description. Frustule: outline in girdle view square-rectangular. Length of pervalvar axis 8.5 — 11.0 μm. Growth habit: brief colonies of cells attached by interdigitating spines at the margin. Girdle: valvocopular open, non-ligulate, maternal girdle not observed. All bands observed were too corroded for further structure to be elucidated. Two bands observed per frustule. Valve: outline circular, mantle cylindrical with parallel sides, valve face slightly convex. Diameter 6.4 — 10.0 μm. Majority of valve face apparently unpunctured but covered with broad, small granules. Radially directed punctate striae form a marginal ring extending towards the centre for 0.25 of

Fig. 4. 1-3, *Melosira* sp. A. 1, oblique surface view of vegetative valves. 2, girdle view of one vegetative and two separation valves showing the characteristic spine morphologies. 3, interior girdle view of valve showing section through pseudoseptum.
4,5, *Melosira granulata*. 4, girdle view of separation cell with typical spines. 5, detail of same valve showing outer and inner cribra and surface granules.
Scanning electron micrographs; all scale bars 1 μm. All specimens from Bells Mountain.

the radial distance. Mantle with punctate striae extending down to the pseudoseptum but not below. Striae composed of a single row of small puncta and formed between costae parallel to the pervalvar axis on the inner surface of the valve. Striae 28-31/10 μm, puncta 35-58/10 μm. Striae and puncta invisible in the light microscope. Labiate and strutted processes absent. Spines located at the valve margin and directed parallel to the mantle. Vegetative cells have ligulate spines, 1.0 — 1.1 μm long and 0.30 — 0.32 μm wide with bilobate apices. Separation valves have triangulate spines, 1.0 — 1.1 μm long and 0.5 μm wide at the base. Density of spines: a single ring of 15-18/10 μm. Special structures: a pseudoseptum is formed within 1.0 — 1.5 μm of the open end of the valve and parallel to the valvar plane. The pseudoseptum extends into the valve up to 0.14 of the radial distance.

Remarks. The wall structure, presence of separating cells and the form of spines on both the vegetative and separating cells, indicates that this taxon is closely related to *Melosira granulata* and should be considered as part of that diverse group of freshwater *Melosira* species.

Melosira granulata (Ehrenberg, 1841 (1843)) Ralfs *in* Pritchard, 1861
Fig. 3, **5-21**; Fig. 4, **4,5**; Fig. 5, **1-5**; Fig. 6, **1-4.**
Ralfs *in* Pritchard, 1861, p. 820.

Van Heurck (1896), p. 444, pl. 19, fig. 621; Hustedt (1930a), p. 248-250, fig. 104; Hustedt (1930b), p. 87-88, fig. 44; Van Landingham (1964), p. 13-14, pl. 31, figs 15-20, pl. 32, figs 1-20, pl. 33, figs 1-34.

1841 (1843) *Gallionella granulata* Ehrenberg, p.415.

1882 *Melosira granulata* f. *australiensis* Grunow *in* Van Heurck, pl. 87, figs 13, 14, 16.

1908 *Melosira granulata* var. *australiensis* (Grunow *in* Van Heurck) Tempere and Peragallo, 1907-1915, p. 30, No. 51-53.

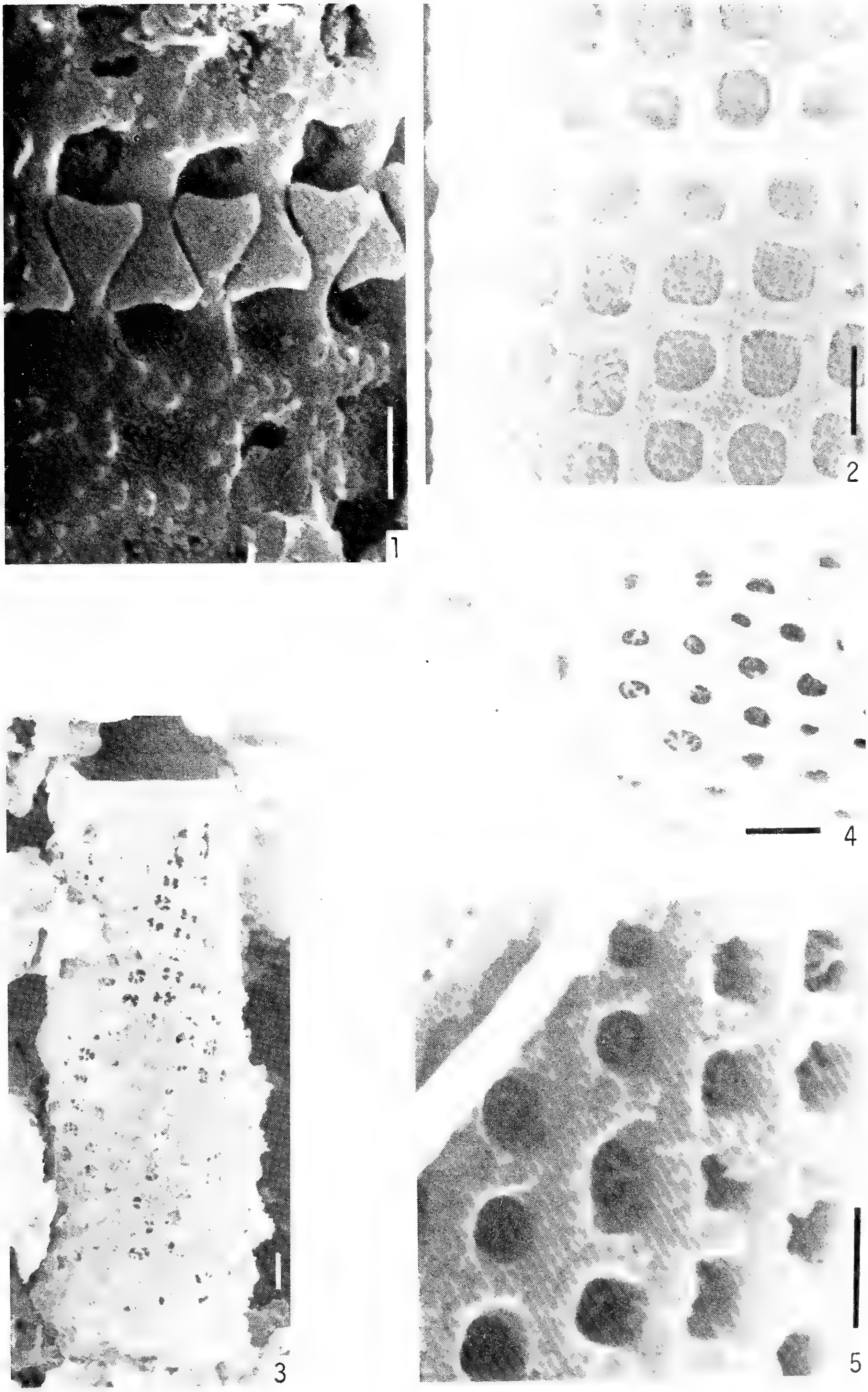
1925 *Melosira polymorpha* subsp. *granulata* (Ehrenberg) Bethge, p. 30.

Occurrence. Found at all the localities from which diatomite was collected.

Remarks. The *M. granulata* observed in the diatomite collections and in fresh material collected from various parts of Australia (see Thomas and Gould, 1981) cause us to agree with the findings of Hustedt (1930a, p. 250) and Florin (1970) that there are two distinct forms of the taxon. In the fossil material these forms are frequently found occurring together (e.g. Fig.3, **13, 15**). Hustedt (1930a) nominated them as form α (a large-pored form) and form β (a small-pored form). These do not coincide with the two forms recognized by Crespin (1947) who distinguished a long narrow form and a short broad form. This shape difference has been shown by Kilham and Kilham (1975) to be part of the normal variability of *M. granulata.*

Florin (1970) showed that the large-pored form differs from the small-pored form in the presence of a velum on the external surface of the loculate areola (e.g. Fig. 4, **4-5**; Fig. 5, **1-2**; see also Akutsu, 1974) whereas the small-pored form has what is more accurately a poroid areola occluded on the inner surface by a velum (e.g. Fig. 5, **3-5**). The fossil material observed has both these characteristic forms with the addition that the small-pored form exhibits two types of velum structure. Depending upon the diameter of the areola, in one form the velum varies from a rota through to one or two volae (Fig. 5, **3-4**). These may occur anywhere from the inner to the outer

Fig. 5. 1-5, *Melosira granulata.* 1, Bells Mountain, 2, extant, Murray River, South Australia, showing vegetative cell cribrum and spine morphology. 3, Middle Flat. 4,5, Bowan Downs, showing variation in velum morphology in "small-pored" vegetative cells.
Scanning electron micrographs; all scale bars 1 μm.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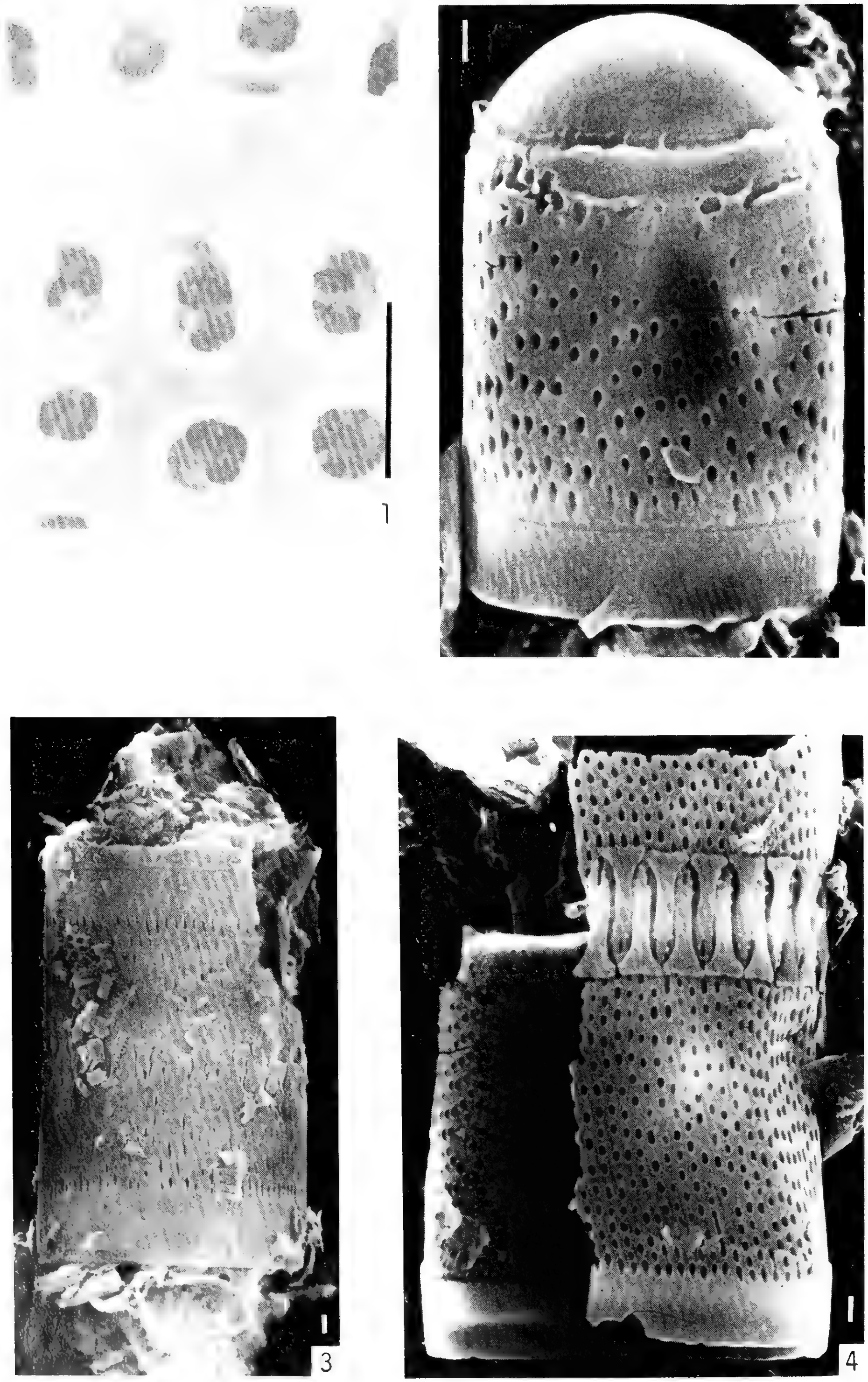
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surface of the valve. In the other small-pored form, the velum has a more complex, three dimensional structure with a cribrum being suspended in the inner opening of the areola by struts which form near the outer opening (Fig. 6, **1**). The small-pore form may also be irregularly and sparsely areolate (Fig. 3, **17-20**).

The large-pored form has a cribrum at the external opening, as reported by Florin (1970), but has also a cribrum at the inner opening (Fig. 4, **4-5**; Fig. 5, **1-2**). Both cribra are more ornate on the separation valves (e.g. Fig. 4, **4-5**).

A further differentiation occurs in the shape of the spines which hold the ordinary vegetative cells together. This variation does not follow the division based upon areola form. The spine shapes vary from pyriform, with more or less concave apices (see Fig. 5, **1-2**), to more or less "T" shaped (see Fig. 6, 4). The pyriform spine is found in both large- and small-pore forms but the "T" shaped spine is found only in the small-pore forms of both velum types.

Identification of the various forms is hampered by the effects of diagenetic mobilization of the silica from the frustules in some samples. This may lead to redeposition on the frustules or corrosion and loss of the silica. If this mobilization only occurs to a minor extent, the velum is lost (e.g. Fig. 6, 4), but in many cases corrosion leads to loss of shape for the spines, variation in the areola size and variation in shape in the valve face (e.g. Fig. 3, **21**; Fig. 6, **2-3**). If redeposition occurs, then the areolae may become all but filled in to form slits and pores (e.g. Fig. 6, **3**).

Finally, there are present in many samples a few valves whose size, shape, and size and distribution of areolae, could cause them to be placed in almost any one of the fifty or more 'species' which belong to this group of *Melosira* and are indicative that this group, so common in freshwater assemblages, is long overdue for taxonomic revision. We agree with Van Landingham (1964, p. 10) in supporting the hypothesis of Bethge (1925) which combines the common species of the *M. granulata* group (*M. granulata, M. islandica, M. ambigua, M. italica, M. distans* and *M. lirata*) into *M. polymorpha* and considers that this may be part of the answer in coping with these numerous species with similar morphology.

Recorded from Oligocene and Miocene diatomites of eastern Australia by Crespin (1947) and Skvortzov (1937).

Melosira granulata var. *curvata* Grunow *in* Van Heurck, 1882

Fig. 7, **1**.

Grunow *in* Van Heurck, 1882, pl. 87, fig. 18.

Van Heurck, 1896, p. 444, pl. 19, fig. 622.

1882 *Melosira granulata* f. *curvata* Grunow *in* Van Heurck, pl. 97, fig. 24; Hustedt, 1930a, p. 250.

1930a *Melosira angustissima* f. *curvata* Hustedt, p. 251, fig. 80/7.

Occurrence. Nandewar Range.

Remarks. This taxon is similarly structured to the small-pored form of *M. granulata* with one cribrum formed on or towards the inner surface of each poroid areola. The only difference then being the curvature of the valve.

Melosira undulata var. *spiralis* Skvortzov, 1937

Fig. 9, **1-3**.

Skvortzov, 1937, p. 178, figs 23-24.

Occurrence. West Haldon, Black Duck Ck, Tintenbar, Wyrallah, Bells Mountain, Bowan Downs.

Fig. 6. 1-4, *Melosira granulata*. **1**, extant, Lake Picton, Tasmania, showing complex velum morphology of vegetative cells. 2-4, Tintenbar, showing effects of diagenetic mobilization of silica.
Scanning electron micrographs; all scale bars 1 μm.

Remarks. Not common in any of the samples collected. Skvortzov (1937) described this taxon from Middle Flat, where it was noted as infrequent; it has not been found in any of the samples collected there during this investigation.

II. Suborder ARAPHIDINEAE

FRAGILARIA Lyngbye, 1819

Fragilaria construens var. *venter* (Ehrenberg, 1854) Grunow *in* Van Heurck, 1881

Fig. 7, 3-5; Fig. 8, 1.

Grunow *in* Van Heurck, 1880-1885, pl. 45, figs 21B-23, 24B, 26A-B.

Van Heurck, 1896, p. 325, fig. 11/451; Hustedt, 1913 *in* A. Schmidt *et al.* 1874-1959, pl. 296, figs 30-33, 47; Hustedt, 1959, p. 158, figs 670h-m.

1854 *Fragilaria venter* Ehrenberg, pl. 8/1, fig. 12, pl. 11/14, pl. 13/1, fig. 4.

Occurrence. West Haldon, Tintenbar, Wyrallah, Bells Mountain, Nandewar Ra., Chalk Mountain, Wantialaba Ck, Middle Flat, Bowan Downs.

Remarks. The distribution of this taxon ranges from Miocene to the present and is found most abundantly in samples containing a high proportion of silt, and may be indicative of periods of high run-off from the surrounding area.

Fragilaria lapponica Grunow *in* Van Heurck, 1881.

Fig. 7, 2; Fig. 9, 4.

Grunow *in* Van Heurck, 1880-1885, fig. 45/35.

Hustedt, 1930b, p. 145, fig. 155; Hustedt, 1959, p. 170-171, fig. 678.

Occurrence. West Haldon, Tintenbar, Wyrallah.

Remarks. Described by Abbott and Van Landingham (1972) as epiphytic and therefore probably indicative of shallow water or the nearness of swamp or marsh land to the lake in which the diatoms were deposited.

Fragilaria leptostauron (Ehrenberg, 1854) Hustedt, 1959

Fig. 8, 3; Fig. 9, 5.

Hustedt, 1959, p. 153-154, figs 668a-f.

1854 *Biblarium leptostauron* Ehrenberg, pl. 12, figs 35-36.

Occurrence. Middle Flat.

Remarks. Found only in a reworked sample from beneath the third dark, clay layer 3.9 m below the roof of the mine and 4.1 m below the overlying basaltic soil, in the northwestern adit figured by Herbert (1968, p. 24).

Fragilaria leptostauron var. *dubia* (Grunow, 1862) Hustedt, 1959

Fig. 9, 6, 7.

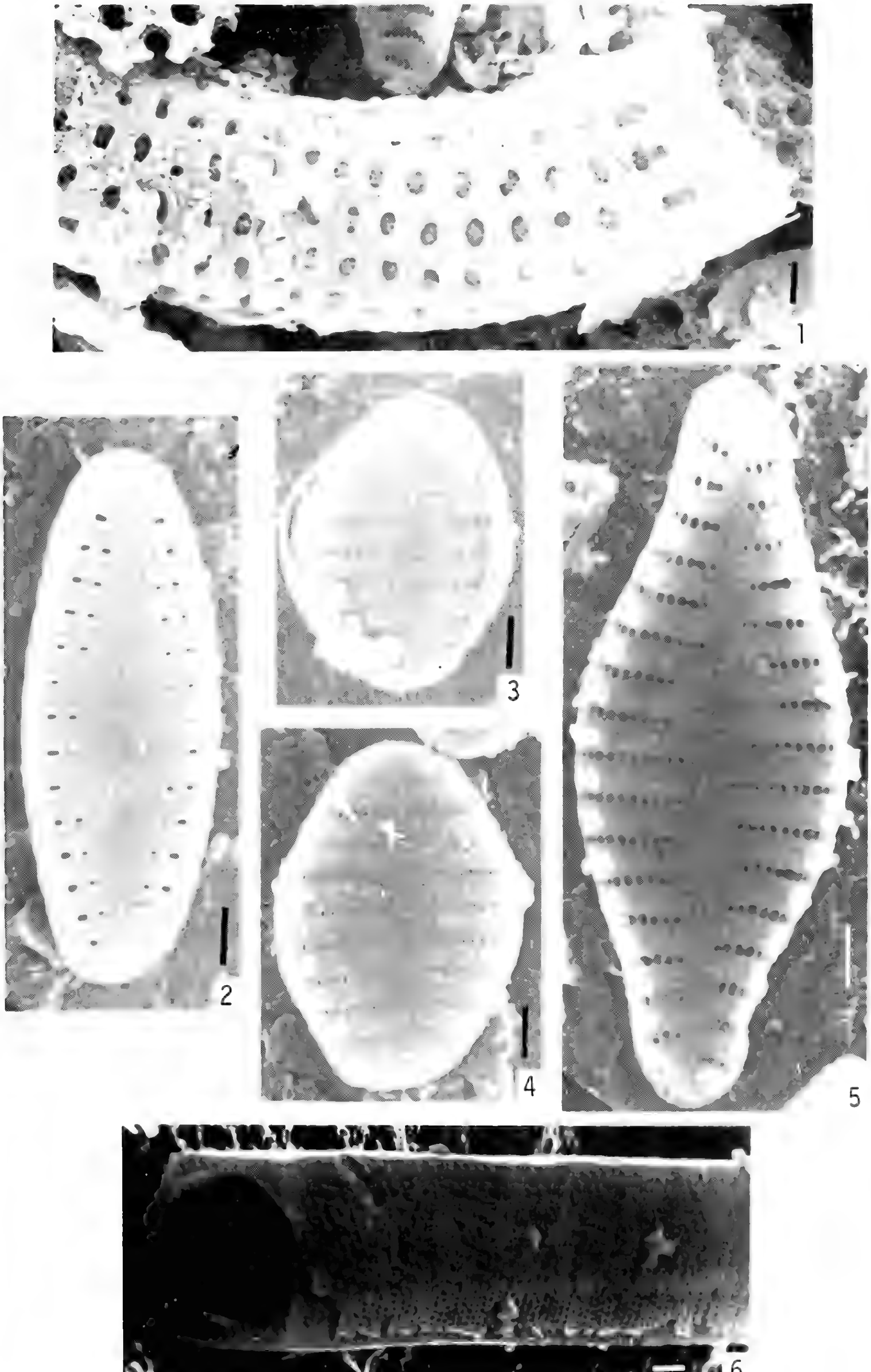
Hustedt, 1959, p. 154-155, figs 668h-i.

1862 *Fragilaria harrisonii* var. *dubia* Grunow, p. 368, pl. 7, figs 8a-d.

Occurrence. Bells Mountain, Nandewar Ra.

Remarks. Occurs rarely in the two localities. Hustedt (1959) describes the habit of this taxon as benthic, commonly found in the littoral region of freshwater bodies.

Fig. 7. 1. *Melosira granulata* var. *curvata*, Nandewar Range, girdle view of vegetative valves.
2. *Fragilaria lapponica*, Tintenbar, valve surface.
3-5. *Fragilaria construens* var. *venter*, West Haldon, valve views showing variation in valve outline with length.
6. Cf. *Synedra* sp., Bells Mountain, oblique view showing girdle morphology and section through frustule.
Scanning electron micrographs; all scale bars 1 μm.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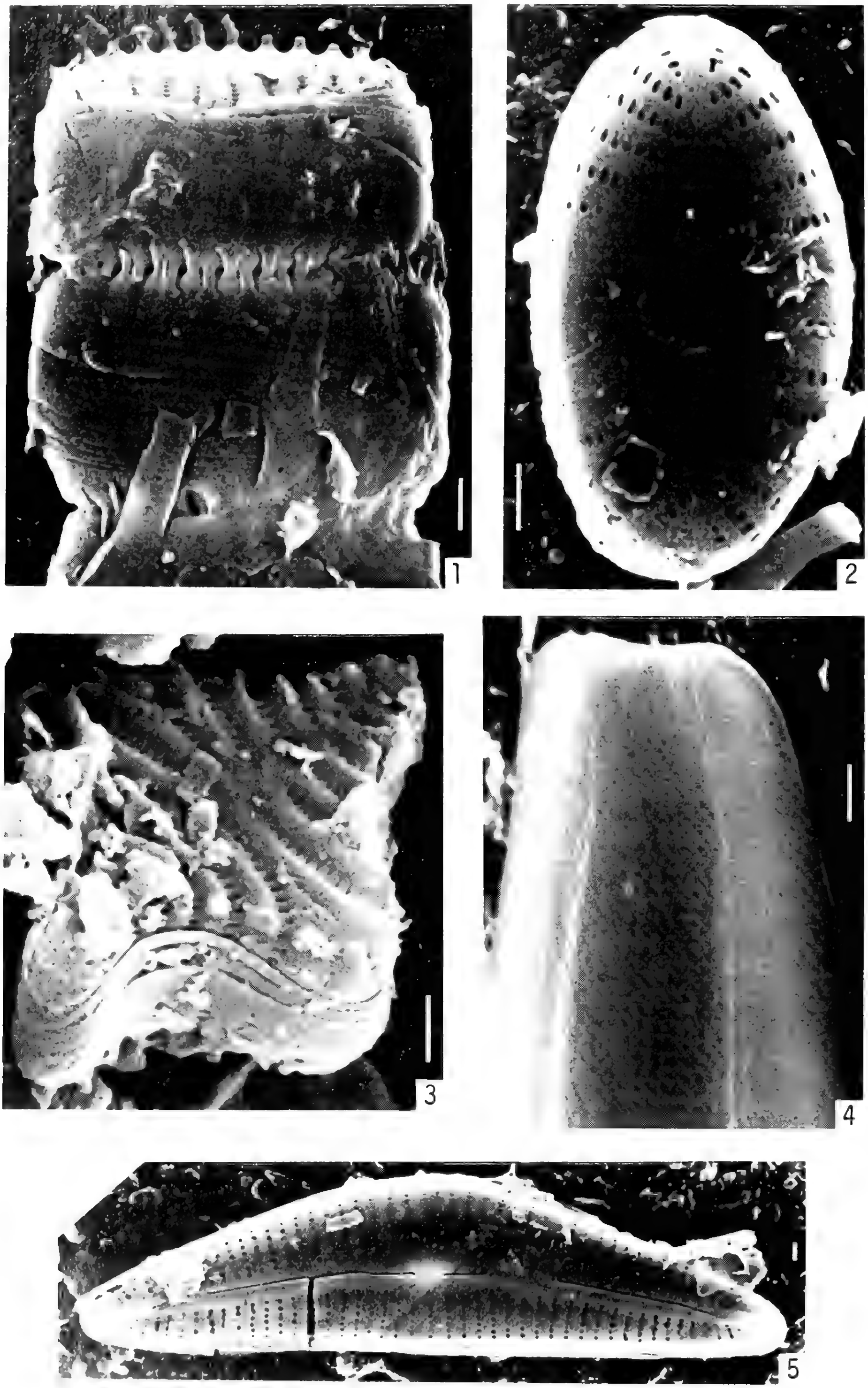
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SYNEDRA Ehrenberg, 1830

Synedra ulna (Nitzsch, 1817) Ehrenberg, 1838

Fig. 9, **8.**

Ehrenberg, 1838, pl. 211, pl. 17, fig. 1.

Van Heurck, 1896, p. 310, pl. 10, fig. 409; Hustedt, 1914 *in* A. Schmidt *et al.*, 1874-1959, pl. 301, figs 1-26, pl. 302, figs 1-17, 19-22, pl. 303, figs 1-4; Hustedt, 1930b, p. 151-152, figs 158-159; Hustedt, 1959, p. 195-198, figs 691Aa-c.

1817 *Bacillaria ulna* Nitzsch, p. 99.

Occurrence. West Haldon, Bowan Downs.

Remarks. The form observed varied from that of the typical *S. ulna* to that of *S. ulna* var. *danica*. *Synedra ulna* has been reported from Miocene and younger deposits of Australia by Crespin (1947) and Tindale (1953). Crespin (1947) records *S. ulna* from Tintenbar and Chalk Mountain as well as Bowan Downs but it has not been observed from the first two localities in this study.

cf. *Synedra* sp.

Fig. 7, **6;** Fig. 8, **4**; Fig. 9, **9**.

Occurrence. West Haldon, Tintenbar, Wyrallah, Nandewar Ra.

Description. Frustule: outline in girdle view inflated-linear to very narrow-elliptical with truncated apices. Length of pervalvar axis 2.5-4.2 μm. Girdle apparently absent. Valve: outline; linear, narrowing to an almost rostrate apex. Shape; valve face flat, the mantle extends outwards at an angle of approximately 10-15° to the pervalvar axis. Dimensions; apical axis 25-60 μm, transapical axis 1.7-2.0 μm. Valve structure; valve face appears to have fine, parallel striae when observed in the light microscope but is seen in the scanning electron microscope to be unpunctured on the external surface and punctured by two parallel rows of pores on the inner surface. The inner pores are apparently connected to the exterior of the valve by tunnels in the valve wall which open externally towards the outer edge of the mantle where punctate striae occur. Striae 45-47/10 μm, puncta 50-65/10 μm. Pore fields and processes absent.

Remarks. This taxon looks like a freshwater sponge spicule when seen under low power in the light microscope but appears more like a diatom at high power and in the electron microscope. The structure of the valve does not readily imply that the form should be placed into *Synedra* but it is more closely related in form to *Synedra* than to any other diatom genus and the possibility exists that this may be a resting spore of one of the *Synedra* species.

III. Suborder RAPHIDOIDINEAE

EUNOTIA Ehrenberg, 1837

Eunotia pectinalis (Dillwyn, 1809 *ex* Kützing, 1844) Rabenhorst, 1864

Fig. 9, **10, 11**; Fig. 13, **5**.

Rabenhorst, 1864, p. 73.

Van Heurck, 1896, p. 300, figs 9/370, 371; Hustedt, 1911 *in* A. Schmidt *et al.* 1874-1959, pl. 271, figs 10, 11, 15; Hustedt, 1959, p. 296, figs 763a, k.

1809 *Conferva pectinalis* Dillwyn, pl. 24.

Fig. 8. **1.** *Fragilaria construens* var. *venter*, West Haldon, girdle view.
2. *Achnantes* sp. A, West Haldon, araphic valve view.
3. *Fragilaria leptostauron*, Middle Flat, oblique view of frustule showing surface features.
4. Cf. *Synedra* sp., Tintenbar, oblique view of frustule polar region; note lack of perforation on the external surface of the valve face.
5. *Cymbella cistula* var. *maculata*, West Haldon, valve view; note slight enlargement of puncta due to dissolution of the silica.
Scanning electron micrographs; all scale bars 1 μm.

1844 *Himantidium pectinale* (Dillwyn, 1809) Kützing, p. 39, pl. 16, fig. 11.
Occurrence. West Haldon, Black Duck Ck, Tintenbar, Wyrallah, Bells Mountain, Nandewar Ra., Chalk Mountain, Wantialaba Ck, Bowan Downs.
Remarks. The form observed here covers the range from *E. pectinalis* to *E. pectinalis* var. *minor* and *E. pectinalis* var. *minor* f. *intermedia.* Skvortzov (1937) recorded the very similar species *E. valida* from the Middle Flat deposit but no *Eunotia* species have been observed from that locality in this study.

IV. Suborder MONORAPHIDINEAE

ACHNANTHES Bory, 1822

Achnanthes sp. af. *atomus* Hustedt, 1937

Fig. 10, **7, 8.**

Hustedt, 1937, p. 194-195, pl. 13, figs 33-36.

Occurrence. West Haldon, Tintenbar.
Remarks. This form differs from *A. atomus* in being lanceolate instead of linear and is hence wider (6.3-6.8 μm *vs* 2.5-3.0 μm) and in having a lower strial density (14-15/10 μm *vs* 22-25/10 μm on the araphic valve; 18-20/10 μm *vs* 28-30/10 μm on the raphic valve).

Achnanthes lanceolata (Brébisson *in* Kützing, 1849) Grunow *in* Cleve and Grunow, 1879

Fig. 9, **12**; Fig. 10, **1, 2.**

Cleve and Grunow, 1879, p. 23.

Van Heurck, 1896, fig. 8/336; Hustedt, 1959, p. 408-409, fig. 863.
1849 *Achnanthidium lanceolatum* Brébisson *in* Kützing, p. 54.
Occurrence. West Haldon.
Remarks. Reported from other fossil deposits in Australia by Tindale (1953). Foged (1978) collected this species from rivers and creeks with both stagnant and running waters.

Achnanthes sp. af. *lapidosa* Krasske, 1929

Fig. 10, **9, 10.**

Krasske, 1929, p. 350.

Occurrence. West Haldon, Tintenbar, Wyrallah, Bells Mountain, Nandewar Ra.
Remarks. This form differs from *A. lapidosa* in being slightly larger (length 25-28 μm *vs* 20-24 μm) and more lanceolate than linear-lanceolate. In addition the central area is more restricted than is indicated by the illustration in Hustedt (1959, fig. 852a-c).

Fig. 9. **1-3.** *Melosira undulata* var. *spiralis*, West Haldon. **1,2**, UNEF15623a, outline and surface foci of girdle view. **3**, UNEF15619, valve view.
4. *Fragilaria lapponica*, UNEF15566, Wyrallah, valve view.
5. *Fragilaria leptostauron*, UNEF15836, Middle Flat, valve view.
6,7. *Fragilaria leptostauron* var. *dubia*. **6**, UNEF15731, Nandewar Range, **7**, UNEF15799, Bowan Downs, showing range of valve outline.
8. *Synedra ulna*, UNEF15811, Bowan Downs, fragment of valve.
9. Cf. *Synedra* sp., UNEF15569b, Tintenbar, girdle view.
10-11. *Eunotia pectinalis.* **10**, UNEF15580a, Tintenbar, **11**, UNEF15694, Bells Mountain, showing range of size and morphology.
12,13. *Achnanthes lanceolata*, UNEF15635a, West Haldon. **12**, raphic valve view. **13**, araphic valve view.
Transmitted light micrographs, Nomarski DIC; all scale bars 10 μm.


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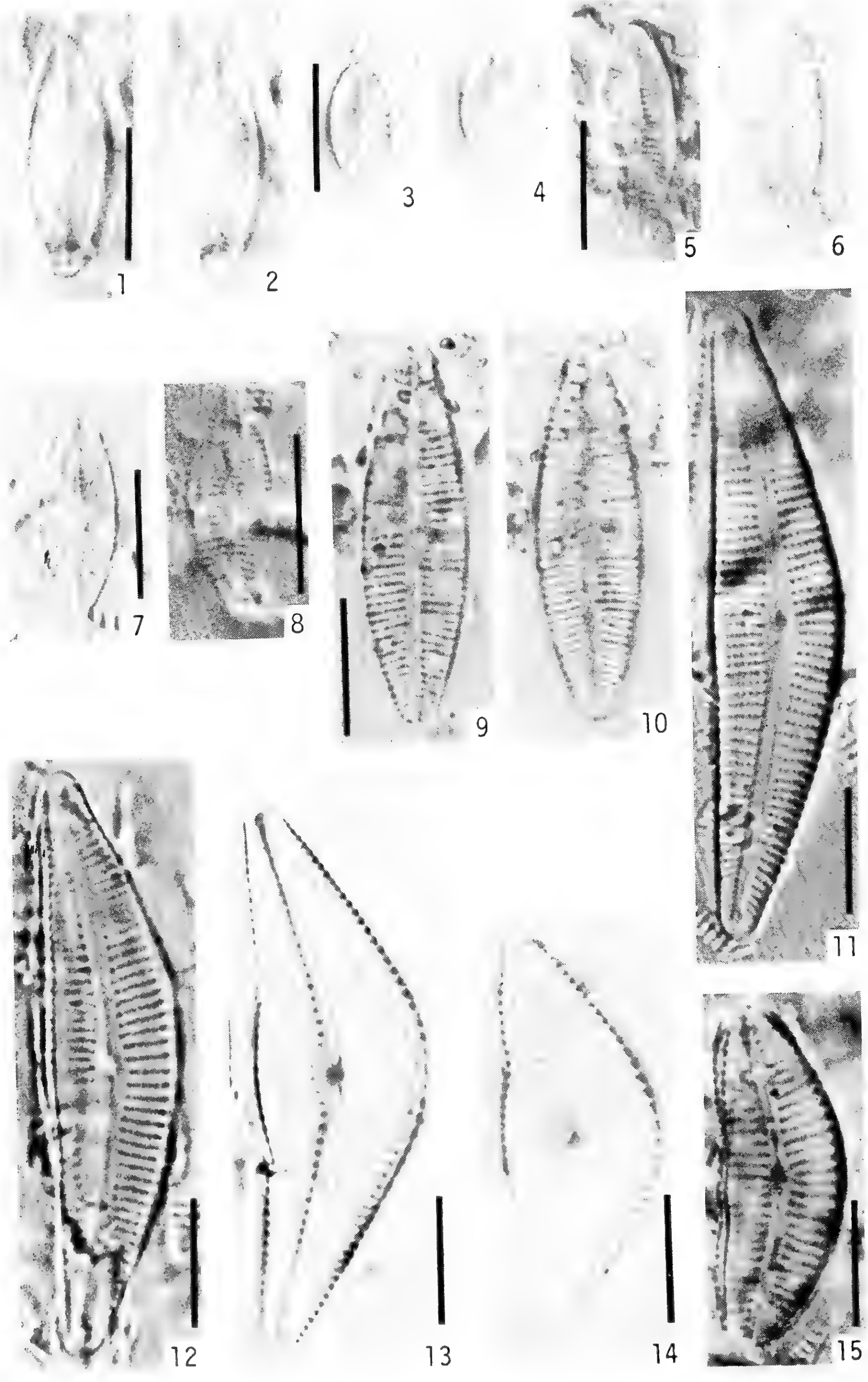
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Achnanthes species A
Fig. 8, 2: Fig. 10, 3, 4.

Occurrence. West Haldon.
Description. Valve: outline elliptical-lanceolate. Apical axis 7.8–9.8 μm, transapical axis 4.0–4.9 μm. Raphic valve with narrow axial area and small circular to lanceolate central area. Araphic valve with narrow axial area and large central area, semilanceolate on one side and extending to the margin on the other side. Central area 3.0–3.5 μm long. Axial areas of both valves straight and situated on the midline of the valve. Striae radiate, less dense opposite the central area on the raphic valve. Density of striae 15-16/10 μm on the raphic valve, 14-18/10 μm on the araphic valve. Striae composed of slits formed parallel to the margin. Slits 52-58/10 μm of stria. Pore fields absent. Processes absent. Raphe located in the axial area, straight. Length of central node 1.0 μm.

Achnanthes species B
Fig. 10, 5, 6.

Occurrence. West Haldon.
Description. Valve: outline broad-elliptical to almost lanceolate. Apical axis 16.0–17.5 μm, transapical axis 6.0–6.3 μm. Axial area of both valves narrow-linear and situated on the midline of the valve. Central area on both valves narrow, delimited by one brief stria on either side of the mid-point of the valve. Striae straight and radiate. Strial density 16-18/10 μm on the raphic valve, 16-17/10 μm on the araphic valve. Pore fields and processes absent. Raphe located in the centre of the axial area, straight. Central node 0.8–0.9 μm long.

V. Suborder BIRAPHIDINEAE
Superfamily NAVICULACEAE
CYMBELLA C. Agardh, 1830
Cymbella cistula var. *maculata* (Kützing, 1833) Van Heurck, 1880-1885.
Fig. 8, 5; Fig. 10, 11-15; Fig. 11, 1.
Van Heurck, 1880-1885, p. 64, fig. 2/16.

A. Schmidt *et al.*, 1874-1959, pl. 71, figs 21-22; Hustedt, 1930b, p. 363, fig. 676b; Van Landingham, 1964, p. 46, pl. 21, fig. 5.

1833 *Frustulia maculata* Kützing, p. 11, fig. 4

Occurrence. West Haldon, Black Duck Ck, Tintenbar, Wyrallah, Bells Mountain, Nandewar Ra., Bowan Downs.
Remarks. This taxon has been recorded previously from the eastern Australian diatomites under the name of the co-occurring *C. ventricosa* by Crespin (1947) and was illustrated by Hill *et al.* (1970) from the Black Duck Creek deposit. This would appear to be an epiphyte species and is indicative of shallow waters somewhere in the area of deposition.

Fig. 10. **1**,**2**. *Achnanthes lanceolata*, UNEF15635b, West Haldon. **1**, raphic valve view, **2**, araphic valve view.
3,**4**. *Achnanthes* sp. A, UNEF15598, West Haldon. **3**, raphic valve view. **4**, araphic valve view.
5,**6**. *Achnanthes* sp. B, UNEF15605, West Haldon. **5**, raphic valve view. **6**, araphic valve view.
7,**8**. *Achnanthes* sp. af. *atomus*, Tintenbar. **7**, UNEF15580b, raphic valve view. **8**, UNEF15582, araphic valve view.
9,**10**. *Achnanthes* sp. af. *lapidosa*, UNEF15554, Wyrallah. **9**, raphic valve view. **10**, araphic valve view.
11-15. *Cymbella cistula* var. *maculata*, West Haldon. **11**,**12**,**15**, UNEF15587a,b,c, **13**, UNEF15625a, **14**, UNEF15631a, showing variation in valve morphology with size.
Transmitted light micrographs, Nomarski DIC; all scale bars 10 μm.

Cymbella ventricosa C. Agardh, 1830
Fig. 11, **2**; Fig. 12, **1-5**.
Agardh, 1830, p.9.

A. Schmidt *et al.*, 1874-1959, pl. 9, fig. 32, pl. 72, fig. 11; Hustedt, 1930b, p. 359, fig. 661; Van Landingham, 1964, p. 47, pl. 23, figs 1-39.
Occurrence. West Haldon, Black Duck Ck, Bells Mountain, Nandewar Ra., Chalk Mountain, Bowan Downs.
Remarks. Recorded from Australian fossil deposits by Crespin (1947) and Tindale (1953). A tube-dwelling, epiphytic taxon more indicative of shallow streams and creeks than of lakes or ponds.

GOMPHONEMA C. Agardh, 1824
Gomphonema intricatum Kützing, 1844
Fig. 11, **3**.
Kützing, 1844, p. 87, fig. 9/4.

Van Heurck, 1896, p. 273, fig. 7/313; A. Schmidt, 1874-1959, pl. 234, figs 47-50, 58, pl. 235, figs 15-17, 34-39, pl. 236, figs 1-8, pl. 247, figs 34-38, pl. 248, figs 23-25; Hustedt, 1930b, p. 375, fig. 697.
Occurrence. West Haldon, Black Duck Ck, Tintenbar, Wyrallah, Nandewar Ra., Chalk Mountain, Wantialaba Ck, Middle Flat, Bowan Downs.
Remarks. Crespin (1947) recorded *G. intricatum* from Wyrallah and Tindale (1953) recorded it from some of the deposits in Victoria. Skvortzov (1937) recorded a similar species, *G. longiceps* var. *subclavata* (= *G. montanum* var. *subclavatum* Grunow *in* Van Heurck, 1880-1885) from the Middle Flat deposit.

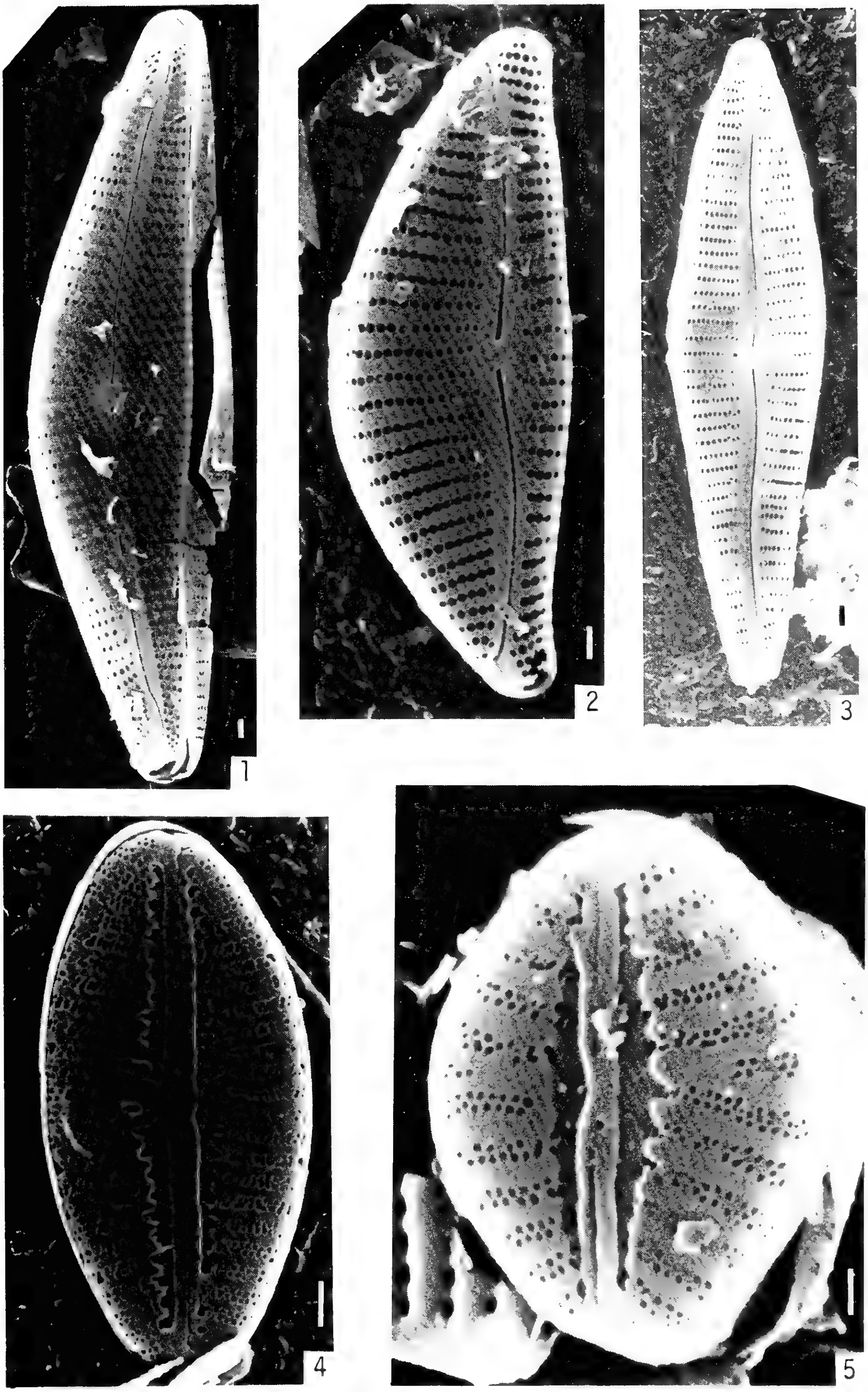
NAVICULA Bory, 1822
Navicula amphibola Cleve, 1891
Fig. 12, **6**.
Cleve, 1891, p. 33.

Cleve, 1894, p. 45; A. Schmidt *et al.*, 1874-1959, pl. 244, fig. 15, pl. 398, figs 20-22; Hustedt, 1966, p. 792-795, fig. 1767.
Occurrence. West Haldon, Tintenbar, Wyrallah, Nandewar Ra., Wantialaba Ck, Bowan Downs.

Navicula sp. af. *laterostrata* Hustedt, 1925
Fig. 12, **11**.
Hustedt, 1925, p. 349, fig. 4.

Hustedt, 1966, p. 146, fig. 1279.
Occurrence. West Haldon, Bells Mountain.
Remarks. This form differs from the type in being elliptical-lanceolate in valve outline and having a lower density of striae opposite the central area.

Fig. 11. 1. *Cymbella cistula* var. *maculata*, West Haldon, oblique valve view; note the pore field at each pole.
2. *Cymbella ventricosa*, West Haldon, valve view; note effect of dissolution on punctum diameter and raphe.
3. *Gomphonema intricatum*, Tintenbar, valve view; pore field at basal pole damaged and incomplete.
4. *Navicula seminuloides*, West Haldon, valve view.
5. *Navicula seminuloides* var. *rhombica* Thomas var. nov., West Haldon, valve view.
Scanning electron micrographs; all scale bars 1 μm.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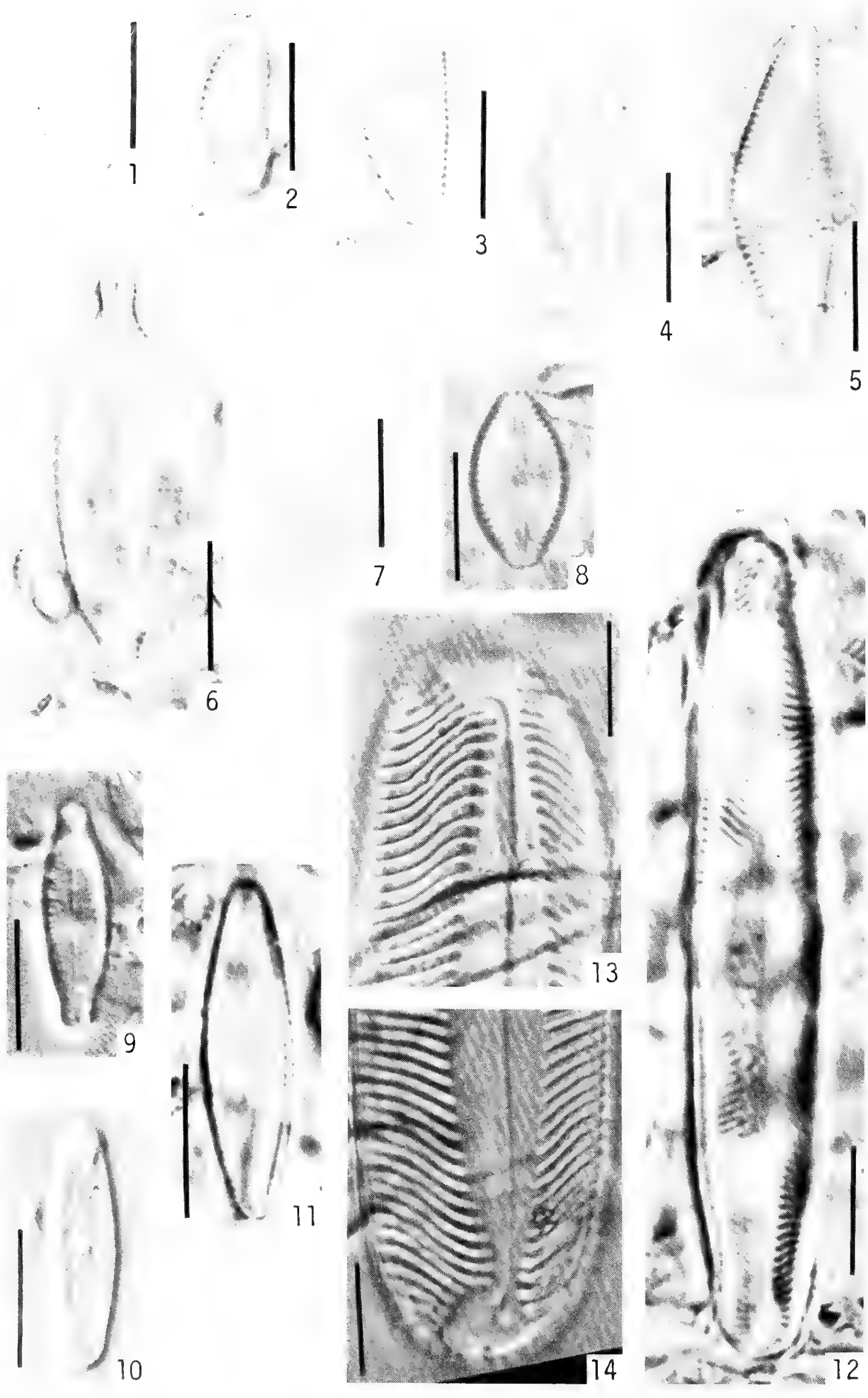
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Navicula naumannii Hustedt, 1942
Fig. 12, **9**.
Hustedt, 1942, p. 115, figs 22-24.
Hustedt, 1966, p. 96-97, fig. 1243.
Occurrence. Tintenbar.

Navicula sp. af. *perpusilla* Grunow, 1860
Fig. 12, **10**.
Grunow, 1860, p. 552, pl. 4, fig. 7.
Occurrence. West Haldon, Tintenbar.
Remarks. This form differs from the type by having a lower strial density (16-17/10 μm *vs* 36 or more/10 μm).

Navicula seminuloides Hustedt, 1936 *in* A. Schmidt *et al.*, 1874-1959
Fig. 11, **4**; Fig. 12, **7**.
Hustedt, 1936 *in* A. Schmidt *et al.*, 1874-1959, pl. 401, figs 68-71.
Hustedt, 1966, p. 244-245, fig. 1369.
Occurrence. West Haldon, Tintenbar, Wyrallah, Bells Mountain.
Remarks. Described by Hustedt (1966) as a tropical freshwater form.

Navicula seminuloides var. *rhombica* Thomas var. nov.
Fig. 11, **5**; Fig. 12, **8**.
Varietal Type: UNEF15611, figured in Fig. 12, **8**.
Occurrence. West Haldon.
Remarks. This form differs from *N. seminuloides* in having a broad-rhombic valve outline with rounded to slightly rostrate apices. Over a period of approximately 2000 years this form diverged from the typical *N. seminuloides*, which dominated some of the earlier assemblages, replaced *N. seminuloides* as the dominant taxon, and eventually disappeared from the assemblage to be replaced by *N. seminuloides* again (see Thomas and Gould, 1981, fig. 3G). This appears to have been an entirely localized variation and hence has been given a name, in defiance of the general policy stated in the introduction to this section.

PINNULARIA Ehrenberg, 1840
Pinnularia graciloides Hustedt, 1936 *in* A. Schmidt *et al.*, 1874-1959
Fig. 12, **12**.
Hustedt, 1936 *in* Schmidt *et al.*, 1874-1959, pl. 406, "Berichtigungen".
1934 *Pinnularia gracilis* Hustedt *in* A. Schmidt *et al.*, 1874-1959, pl. 392, figs 2-3.

Fig. 12. **1-5**. *Cymbella ventricosa*, West Haldon. **1**,**5**, UNEF15629a,b, **2**, UNEF15634, **3**,**4**, UNEF15626a,b, showing variation in valve morphology with size.
6. *Navicula amphibola*, UNEF15623b, West Haldon, valve view.
7. *Navicula seminuloides*, UNEF15631b, West Haldon, valve view.
8. *Navicula seminuloides* var. *rhombica* Thomas var. nov., varietal type, UNEF15611, West Haldon, valve view.
9. *Navicula naumannii*, UNEF15580c, Tintenbar, valve view.
10. *Navicula* sp. af. *perpusilla*, UNEF15580d, Tintenbar, valve view.
11. *Navicula* sp. af. *laterostrata*, UNEF15600, West Haldon, valve view.
12. *Pinnularia graciloides*, UNEF15636, West Haldon, valve view.
13,**14**. *Pinnularia* sp. af. *major*, UNEF15587d, West Haldon, polar views of specimen illustrated in Fig. 13, **3**. **13**, external focus. **14**, internal focus of opposite pole.
Transmitted light micrographs, Nomarski DIC; all scale bars 10 μm.

Occurrence. West Haldon, Tintenbar, Bells Mountain, Nandewar Ra., Bowan Downs.
Remarks. An uncommon taxon which is very similar to the common freshwater species *P. microstauron* and may be easily misidentified as such.

Pinnularia sp. af. *major* (Kützing, 1833) Rabenhorst, 1853
Fig. 12, 13, 14; Fig. 13, 1-3.
Rabenhorst, 1853, p. 42, pl. 6, fig. 5.

1833 *Frustulia major* Kützing, p. 547, pl. 14, fig. 25.
Occurrence. Found in samples from all localities.
Remarks. These specimens differ from the type in having striae which are more convergent near the poles, where they are almost sigmoid. In addition a stigma is present level with the central node end of each raphe slit and on the side of the axial area towards which the terminal fissure veers. This form was recorded by Crespin (1947) as *P. major*.

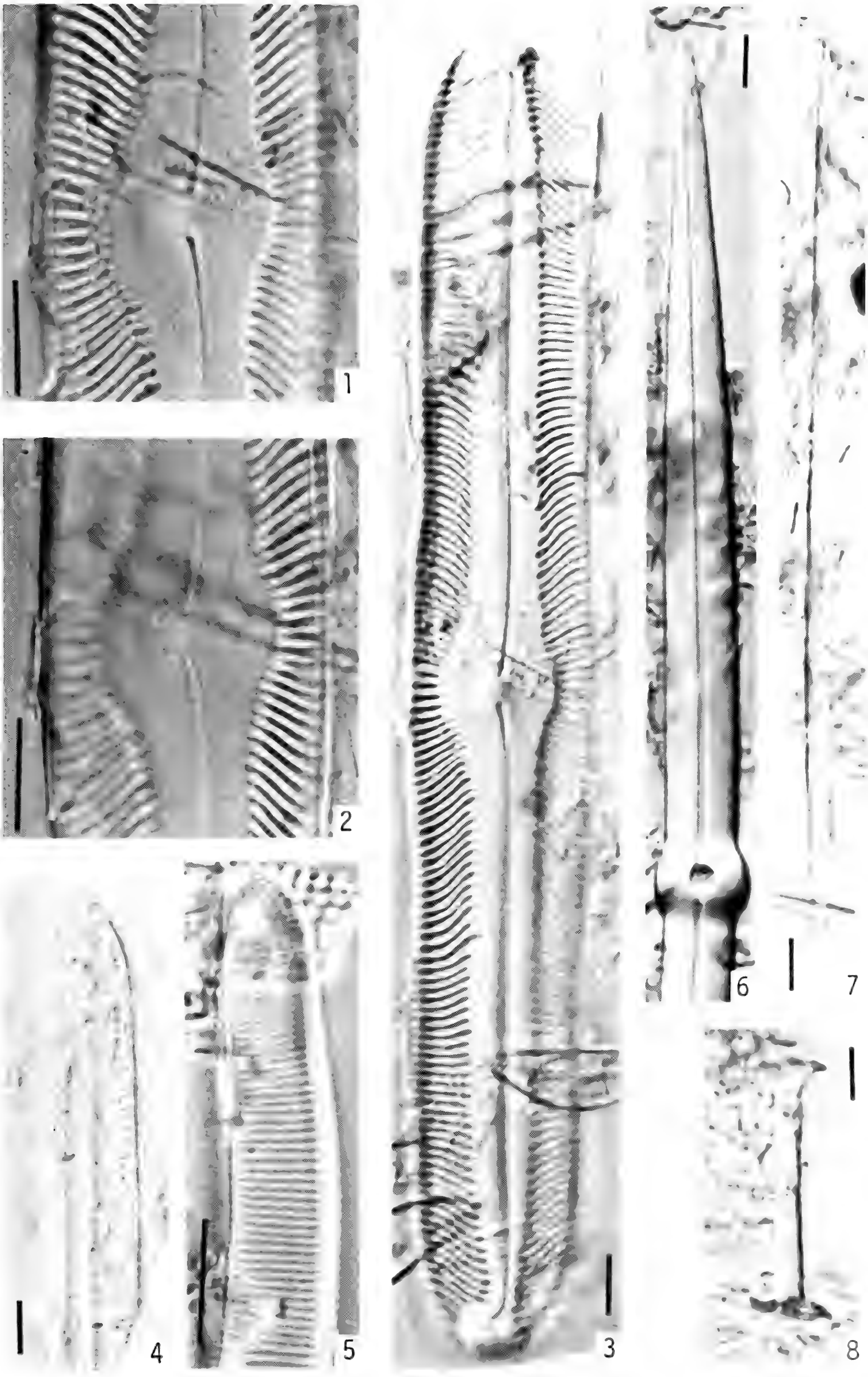
STAURONEIS Ehrenberg, 1841
Stauroneis frauenfeldiana (Grunow, 1868) Heiden, 1903 *in* A. Schmidt *et al.*, 1874-1959
Fig. 14, 1.

Heiden, 1903 *in* A. Schmidt *et al.,* 1874-1959, pl. 242, fig. 19.
1868 *Pleurostauron frauenfeldianum* Grunow, p. 21, pl. 1, figs 13a-d.
1937 *Stauroneis playfairiana* Skvortzov, p. 179, fig. 21.
Occurrence. West Haldon, Tintenbar, Wyrallah, Bells Mountain, Nandewar Ra., Chalk Mountain, Middle Flat, Bowan Downs.
Remarks. Foged (1978) noted the present occurrence of this species as rare, but this does not apply to its distribution during the Tertiary in eastern Australia. The species described as *S. playfairiana* by Skvortzov (1937) from Middle Flat appears to be a slightly deformed frustule of *S. frauenfeldiana* in that it is illustrated with a slight constriction in the valve outline opposite the central node.

VI. Superfamily NITZSCHIACEAE
NITZSCHIA Hassal, 1845
Nitzschia scalaris (Ehrenberg, 1841 (1843)) W. Smith, 1853
Fig. 13, 4.
W. Smith, 1853, pl. 14, fig. 115.

Van Heurck, 1896, p. 391, pl. 32, fig. 894; Hustedt, 1921 *in* A. Schmidt *et al.*, 1874-1959, pl. 333, figs 1-3; Hustedt, 1930b, p. 409, fig. 783
1841 (1843) *Synedra scalaris* Ehrenberg, p. 425, fig. 18, pl. 2, fig. 2.
Occurrence. Bowan Downs.
Remarks. The Nitzschiaceae are notable for their absence from the Miocene deposits of eastern Australia and this one occurrence was found in only one sample from the

Fig. 13. 1-3. *Pinnularia* sp. af. *major*, UNEF15587e, West Haldon. 1,2, detail of central area; 1, external focus, 2, internal focus; note stigmata near central fissure of the raphe. 3, valve view.
4. *Nitzschia scalaris*, UNEF15802, Bowan Downs, polar fragment of valve and girdle bands in girdle view.
5. *Eunotia pectinalis*, UNEF15693, Bells Mountain, detail of valve.
6-8. Sponge scleres. 6, UNEF15592, West Haldon. 7, UNEF15593, West Haldon. 8, UNEF15565, Wyrallah.
Transmitted light micrographs, Nomarski DIC; all scale bars 10 μm.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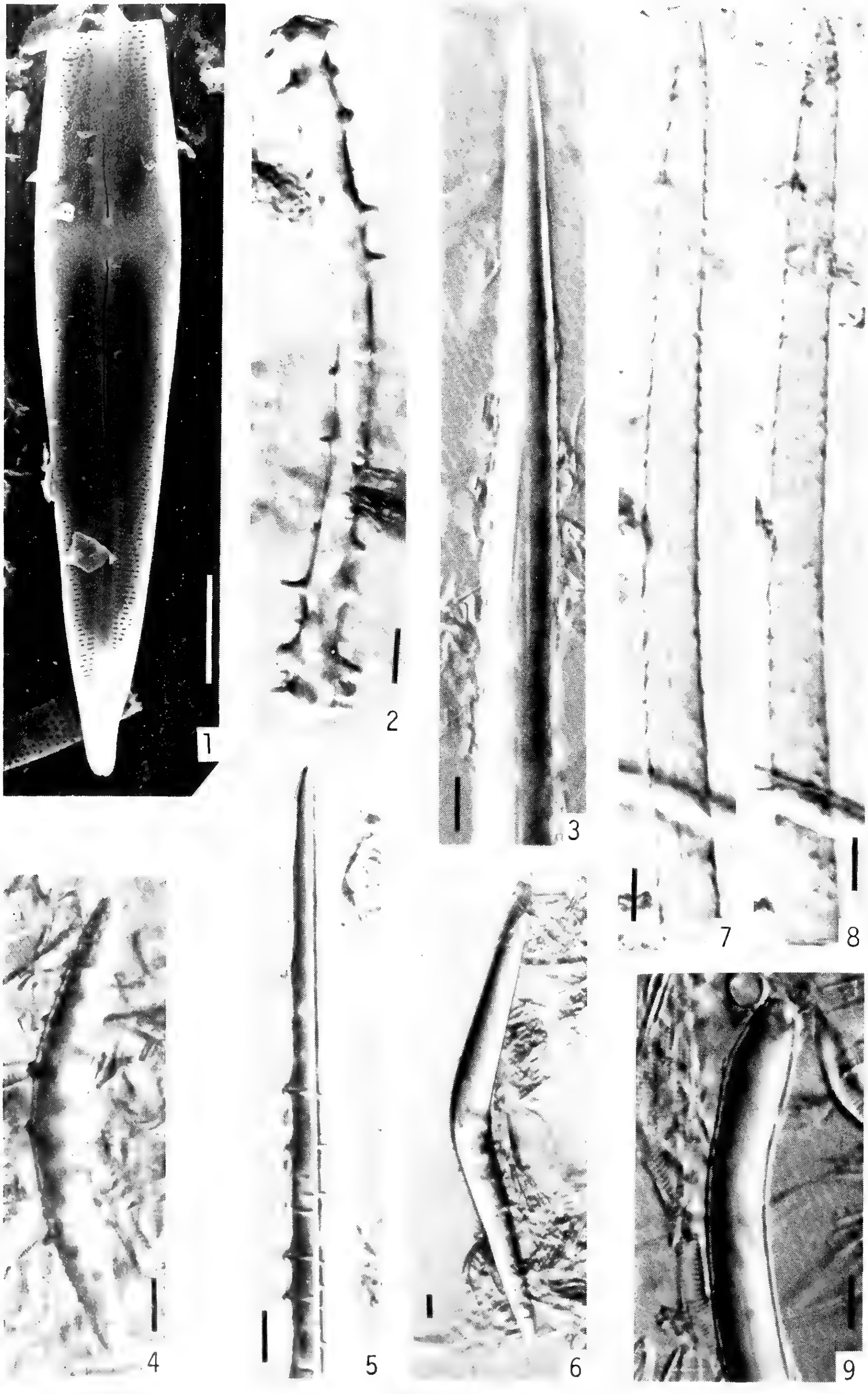
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locality. *Nitzschia scalaris* was characterized by Hustedt (1930b) as a salt water form but also has been found in fresh to brackish water peat deposits by Hanna (1933) and is therefore not useful as an environmental indicator.

Concluding Remarks

The diatom assemblages observed in this survey of Tertiary diatomites are very similar to those observed in non-marine diatomites from North America (e.g. Abbott and Van Landingham, 1972; Andrews, 1966, 1970, 1971; Lohman and Andrews, 1968; Van Landingham, 1964, 1967), Japan (Okuno, 1952) and Europe (Ehrenberg, 1854; Pantocsek, 1892). The marked difference is the relative paucity of taxa in eastern Australian diatomite assemblages.

There are several taxa which have not been observed in this study but which have been recorded from the deposits studied. Skvortzov (1937) recorded the presence in the Middle Flat deposit of three marine species, *Melosira sulcata* (p. 178, fig. 20), *Coscinodiscus subconcavus* (p. 179, fig. 22) and *C. wittianus* (p. 178-179, fig. 26) but we have found no evidence for these species or for any marine influence on the fossil assemblages. Crespin (1947) recorded *Epithemia turgida* (Tintenbar), *Cocconeis* sp. (Wyrallah) and *Neidium* sp. (Chalk Mountain) and again these have not been observed here.

Quite a variety of freshwater sponge spicules (Porifera: Spongillidae) were observed in all diatomite samples (Fig. 13, **6-8**; Fig. 14, **2-9**). Because of the disaggregation and dispersion of scleres and possibility of extinct forms being present, confident identification of the species would require further detailed study. However species of the genus *Radiospongilla* Penney and Racek 1968 seem to be the most prominent, with possible representatives of *Ephydatia* Lamouroux emend. Penney and Racek 1968 and *Heterorotula* Penney and Racek 1968 also present (see Penney and Racek, 1968; Racek, 1969, 1974; Stanisic, 1979).

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Fig. 14. **1**. Scanning electron micrograph of *Stauroneis frauenfeldiana*, Tintenbar, incomplete valve.
2-9. Transmitted light micrographs, Nomarski DIC, of sponge scleres. **2**, UNEF15579, **5**, UNEF15571, Tintenbar. **3**, UNEF15618, **4**, UNEF15627, **6**, UNEF15625b, **9**, UNEF15588, West Haldon. **7**,**8**, UNEF15553, Wyrallah; **7**, median focus, **8**, surface focus.
Scale bars all 10 μm.

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Tertiary Non-marine Diatoms from Eastern Australia: Palaeoecological Interpretation and Biostratigraphy

D. P. THOMAS and R.E. GOULD

THOMAS, D. P., & GOULD, R. E. Tertiary non-marine diatoms from eastern Australia: palaeoecological interpretation and biostratigraphy. *Proc. Linn. Soc. N.S.W.* 105 (1), (1980) 1981: 53-63.

Late Oligocene to Middle Miocene non-marine diatomites from eleven localities in New South Wales and south-eastern Queensland are considered to be of lacustrine origin, being formed in eutrophic, slightly alkaline, freshwaters. Weathering of associated contemporaneous basaltic lavas probably contributed to the favourable water quality. Evidence from varves in some of the diatomites suggests the life of each water body was relatively short in comparison to the accuracy with which the geological age of a deposit can be estimated. Planktonic, epipelic, and epiphytic taxa were represented at all localities; some assemblages were largely planktonic while others were composed mostly of benthic taxa. It is concluded that similarity between the non-marine diatom floras indicates similar conditions prevailed at the sites of deposition, and this environmental control of the floras over-rides any other biostratigraphic conclusions.

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INTRODUCTION

Diatoms are known to have inhabited non-marine waters at least since Late Eocene (Lohman and Andrews, 1968) with the most probable origin of these freshwater diatoms being the invasion of non-marine environments by marine taxa (Van Landingham, 1967). As the earliest known non-marine floras are taxonomically quite diverse, perhaps earlier records are limited either by the absence of conditions allowing deposition of diatomite or by the subsequent reversion of the metastable opaline silica of which the diatom frustules are composed. Occurrence of fossil marine diatoms extends from at least the late Early Cretaceous (Ross, 1967; Haig and Barnbaum, 1978), well before the first appearance of non-marine taxa.

Because of their sensitivity to the ambient environment in which they grow, the value of extant non-marine diatom floras as indicators of environmental conditions has been given prominence of late (e.g. Patrick, 1977). However in many previous studies of fossil non-marine diatom floras (e.g. Andrews, 1971; Abbott and Van Landingham, 1972), while details of water quality were derived from knowledge of the represented taxa, the complete picture of the depositional environment from both geological and biological viewpoints (see Conger, 1942) was not as well covered as might be desired. We acknowledge that such an ideally complete interpretation is not always possible since all relevant information may be unobtainable, and this applies to several localities involved in the present study, but we have tried to integrate all information available over the range of deposits investigated. Of course contraints on any environmental interpretation from fossils, dependent on comparison with living examples, include the sometimes incomplete or conflicting data available for extant taxa and the need to assess if any changes have taken place from the past to the present.

Details of diatom occurrences and palaeoecological interpretations for some eastern Australian diatomites have been previously presented by Skvortzov (1937), Crespin (1947), Tindale (1953), Gill (1953), and Herbert (1968). Information on the taxa discussed in this paper has been presented previously (Thomas and Gould, 1981).

MATERIALS AND METHODS

Diatomite samples were obtained and prepared as outlined by Thomas and Gould (1981). The taxa present in each sample and their relative abundances were noted.

The qualitative system of relative abundance recommended by Andrews (1972) was adopted. This was considered the best method for handling numerous samples at a level of information commensurate with the probable degree of preservation of the original diatom flora. Each taxon was thus rated: 1, dominant, numerous specimens in all fields of view. 2, abundant, at least one specimen in every field of view. 3, common, at least one specimen in every 2-5 fields of view. 4, frequent, several specimens on entire slide. 5, rare, one or two specimens on entire slide. When studying preparations of a microfossil flora, what is observed is generally an integrated sample of the remnants of the original assemblage. In the case of diatoms, some species, due to thicker frustules or having suffered low predation rates, as well as those with a greater initial abundance, are likely to be better represented in the subsequent fossil deposit than other species. Thus the qualitative method proposed by Andrews (1972) was considered better suited to the purpose than any semiquantitative method, avoiding the trap of trying to read too much into variations in the data.

LOCALITIES

The eleven localities in New South Wales and south-eastern Queensland from which samples were investigated have been listed together with pertinent geological information by Thomas and Gould (1981). All deposits are of shallow lacustrine origin and are generally associated with basaltic lavas and tuffs. They range in age from Late Oligocene to Middle Miocene. Some ideas, derived from available geological exposures, on the physiography of the various lakes prior to the outpouring of the overlying basalts, are discussed here, including an estimate of the initial minium depth.

West Haldon. Small lake, at least 4 m deep but most likely 8-9 m, probably relatively sheltered, on north facing slope of the lower lavas of the Main Range Volcanics.

Black Duck Creek. Small lake, at least 4 m but up to 6 m deep in centre, probably exposed position, on eastern flanks of lower lava flows of Main Range Volcanics.

Tintenbar. Small lake, at least 5 m deep in centre, shallowing to less than 0.3 m, exposed, on the south-eastern side of the Tweed Shield Volcano.

Wyrallah. Small lake, at least 2.5 m deep, exposed, on the southern slopes of the Tweed Shield Volcano.

Bells Mountain. Larger (though still small) lake, 6-12 m deep, exposed, to the east of the Nandewar Volcano.

Nandewar Range. Larger, though still small, lake, at least 8 m deep, exposed, on the south-eastern side of the Nandewar Volcano.

Paddy McCullochs Mountain. Larger lake, occurring in depression in Jurassic sediments, at least 30 m deep, on eastern side of Warrumbungle Volcano.

Chalk Mountain. Larger lake, at least 14-17 m deep, exposed, on north-eastern flank of Warrumbungle Volcano.

TABLE 1

Distribution and number of taxa in some extant and fossil diatom assemblages from eastern Australia with respect to families.

	Murray R. Pool, S.A.	*Lake Picton, Tas.*	*Lillicur, Vic.*	*Bowan Downs*	*Middle Flat*	*Wantialaba Ck*	*Chalk Mt.*	*Paddy McCullochs Mt.*	*Bells Mt.*	*Nandewar Ra.*	*Wyrallah*	*Tintenbar*	*West Haldon*	*Black Duck Ck*
Suborder COSCINODISCINEAE														
Fam. MELOSIRACEAE	3	1	–	3	1	1	1	1	3	3	2	2	2	2
Fam. THALASSIOSIRACEAE	2	1	–	–	–	–	–	–	–	–	–	–	–	–
Suborder ARAPHIDINEAE														
Fam. DIATOMACEAE	3	–	3	2	2	1	1	–	2	3	3	3	4	–
Suborder RAPHIDIOIDINEAE														
Fam. EUNOTIACEAE	1	1	1	1	–	1	1	–	1	1	1	1	1	1
Suborder MONORAPHIDINEAE														
Fam. ACHNANTHACEAE	2	–	2	–	–	–	–	–	1	1	1	2	5	–
Suborder BIRAPHIDINEAE														
Fam. NAVICULACEAE	7	1	3	4	2	2	2	1	4	4	4	7	8	1
Fam. CYMBELLACEAE	3	1	2	3	1	1	2	–	2	3	2	3	3	3
Fam. NITZSCHIACEAE	5	–	1	1	–	–	–	–	–	–	–	–	–	–
Fam. EPITHEMIACEAE	1	–	1	–	–	–	–	–	–	–	–	–	–	–
Total Taxa	27	5	13	14	6	6	7	2	13	15	13	18	23	7
Total Genera	17	5	11	10	5	6	7	2	8	10	10	10	10	5
Estimated Age (my)	0	0	2.5	11–12	?	14–15	15–16	15–16	18	18	21	21	23–24	23–24

Wantialaba Creek. Very small depressions in flows and tuffs of southern side of Warrumbungle Volcano.

Bowan Downs. Larger lake, at least 6 m deep, exposed on south-western flank of Canobolas Volcanic Complex.

Middle Flat. Larger lake, situated in depression in Palaeozoic siliceous sediments, at least 9-16 m deep, exposed position, just beyond the northern flank of the Monaro Province lavas.

In addition to the eastern Australian diatomite samples which form the basis of the study (see Thomas and Gould, 1981), two samples taken from living assemblages were noted to aid as reference material. One sample came from the oligotrophic Lake Picton, Tasmania, and the other from an eutrophic pool beside the Murray River, near Mannum, South Australia. Both samples were cleared with concentrated nitric acid, after the method of Crawford (1971), and mounted on cover glasses in similar fashion to the fossil material.

Samples from the non-marine diatomite deposit near Lillicur, Victoria, associated with basalts of the Newer Volcanics that have been assigned Late Pliocene ages of approximately 2.5 – 2 m.y. in nearby regions (Aziz-ur-Rahman and McDougall, 1972), were added to fill in the gap between the Miocene deposits and the Recent samples (see Table 1).

ESTIMATED RATES OF DEPOSITION

As some of the diatomites exhibit seasonal varves, which we assume to be annual increments of deposition (see Round, 1964), the rate of accumulation for the various deposits can be estimated. Some of the best preserved varves come from the West Haldon deposit (Fig. 1A) where they average 20-30 varves per centimetre or an annual increment of 0.33 — 0.5 mm. The West Haldon deposit has a measured thickness of 4-5m representing some 8,000-10,000/12,000-15,000 years deposition. Where varves occur at other localities, e.g. Black Duck Creek, and Chalk Mountain, the varves are of similar thickness averaging 0.33-0.5 mm.

This information regarding the time taken for the formation of any one diatomite deposit, being evidently restricted to tens of thousands of years, carries with it the possibility that ponds or lakes considered to be of similar geological age may not necessarily be precisely contemporaneous.

Palaeoecological and Biostratigraphic Interpretation

The environmental requirements for some of the taxa present in the eastern Australian diatomites that we examined have been elucidated for examples from the Miocene of North America by Abbott and Van Landingham (1972) and for living eastern Australian diatoms by Foged (1978). From their information we deduce that the water bodies in which the Australian diatomites formed were eutrophic, slightly alkaline, and fresh.

In general, for freshwater diatoms in aquatic habitats any one of several factors may limit diatom production (see Patrick, 1977). Presence of nutrients such as nitrogen and phosphorus are important for maximum development while potassium and calcium carbonate may also play a part; silica must be present for some diatoms

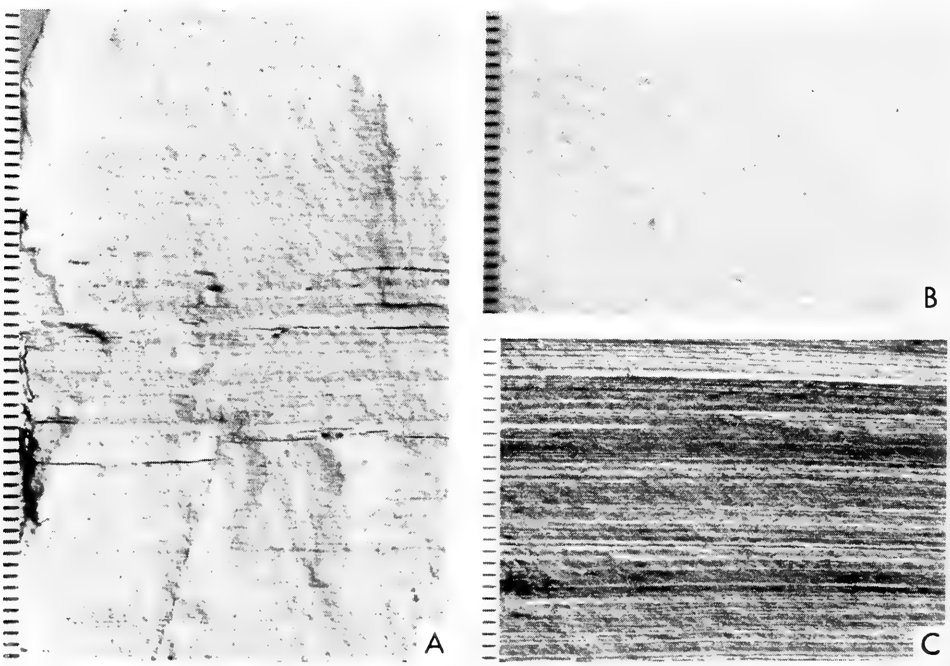


Fig. 1. Diatomite samples viewed in sections approximately perpendicular to bedding; scales in millimetres. A, sample from West Haldon, showing depositional varves. **B**, massive diatomite from Milne's Hill, Tintenbar. C, varved diatomite from the Black Duck Creek deposit; organic matter is responsible for the dark colouration.

to occur in abundance but is not a major limiting factor unless completely absent, and metals can be important in determining which species are present. Different concentrations of these substances result in the development of different diatom floras. Weathering of the alkali basaltic rocks that are characteristically associated with Australian non-marine diatomite deposits would provide most of these substances apart from nitrogen and analyses of these rocks indicate high phosphorus contents (Wilkinson *et al.*, 1969).

The climate in eastern Australia during the Oligocene-Miocene time of diatomite deposition was equable with a very high rainfall and stable temperatures (Martin, 1978). The reconstructed palaeolatitudes during this time show a gradual northward drift away from Antarctica, the region containing the diatomites in question being approximately 36°-48°S in the Late Eocene and 28°-38°S in the Late Miocene (see Smith and Briden, 1977) compared to the present day 27°-37°S. The deposits are almost always situated on the northern, eastern, or southern slopes of approximately contemporaneous volcanic complexes, one exception being Bowan Downs which is on the south-western slopes of Mount Canobolas (see Thomas and Gould, 1981, fig. 1); the localities would thus normally have lain in the path of the prevailing moisture-laden winds from the Pacific Ocean in contrast to the western slopes which would presumably have been rain-shadow areas.

The geometry of the diatomite deposits indicates they were formed in relatively shallow lakes. Apart from the varves exhibited at some localities, and fossils of fish, leaves, and occasionally wood (see Herbert, 1968), the diatomite itself is devoid of sedimentary structures although containing interbedded claystone, sandstone, and tuffaceous layers. Wind-driven waves and currents are the important causes of water movement and mixing in lakes (Reading, 1978); the effects of this can be seen in the diatomite at different localities. In some the annual layers of diatom sediment, or varves, were undisturbed by mixing when the water was greater than 3-4 m in depth, but the sediments deposited above this depth were well mixed, presenting a massive appearance, in agreement with the findings of Round (1964). An example of this is the Black Duck Creek deposit in which the varved layering in the lower part of the section (Fig. 1C) is in contrast to the upper 3.5 m of massive diatomite; the lake in this case had filled up, or at least ceased deposition of diatomite due to an influx of clay with an uppermost carbonaceous layer, prior to being capped by lava. At West Haldon the water body was either sufficiently deep or well protected, or both, for varves to be preserved throughout the upper 4-5 m exposed by the mine (Fig. 1A). At Bells Mountain the lake was bigger, being at least 1 km long, and perhaps even connected to the Nandewar Range site some distance to the west, so presenting a larger fetch for the wind; here, except for the more dense interbedded sandstone and clay layers, the diatomite is mostly massive to a depth of at least 12 m from the base of the overlying lava. Many of the varved layers at Black Duck Creek (Fig. 1C) and Chalk Mountain still contain a quantity of organic matter resulting in a brownish, grey, or almost black appearance; this organic matter probably originated with the diatoms as outlined by Conger (1942) but has not been leached, decomposed or oxidized to produce the normal bleached white colour.

Thus there was likely to have been considerable between-site differences in environment at the time of deposition and this must be taken into account when evaluating the palaeohabitat and biostratigraphic significance of species presence and absence.

Planktonic, epipelic and epiphytic taxa are present in all the localities thus implying that the water bodies were shallow enough to support benthic macrophytes and microphytes, or that floating algae or macrophytes were present, or the lakes had

TABLE 2

Distribution of taxa in eastern Australian diatomite localities. Key: +, present in at least one sample; + +, dominant in at least one sample.

	Bowan Downs	*Middle Flat*	*Wantialaba Ck*	*Chalk Mt.*	*Paddy McCullochs Mt.*	*Bells Mt.*	*Nandewar Ra.*	*Wyrallah*	*Tintenbar*	*West Haldon*	*Black Duck Ck*
Nitzschia scalaris	+										
Melosira granulata	++	++	++	++	++	++	++	++	++	+	++
Gomphonema intricatum	+	++	+	+			+	+	+	+	+
Fragilaria construens var. *venter*	+	+	+	+		+	++	++	+	++	+
Pinnularia sp. af. *major*	+	+	+	+	+	+	+	+	++	+	+
Stauroneis frauenfeldiana	+	+		+		+	+	+	+	+	
Eunotia pectinalis	+		+	+		+	+	+	+	+	+
Cymbella ventricosa	+			+		+	+		+	++	+
Navicula amphibola	+		+				+	+	+	+	
Melosira sp. A	+					++	+				
Melosira undulata var. *spiralis*	+					+		+	+	+	+
Cymbella cistula var. *maculata*	+					+	+	+	+	++	+
Pinnularia graciloides	+					+	+		+	+	
Synedra ulna	+									+	
Fragilaria leptostauron		+									
Fragilaria leptostauron var. *dubia*						+	+				
Achnanthes sp. af. *lapidosa*						+	+	+	+	+	
Navicula seminuloides						+		+	+	++	
Melosira granulata var. *curvata*							+				
Cf. *Synedra*							+	+	+	+	
Fragilaria lapponica								+	+	+	
Navicula naumannii									+		
Achnanthes sp. af. *atomus*									+	+	
Navicula sp. af. *perpusilla*									+	+	
Navicula seminuloides var. *rhombica*										++	
Achnanthes sp. A										+	
Achnanthes lanceolata										+	
Achnanthes sp. B										+	
Navicula sp. af. *laterostrata*										+	
Total taxa	14	6	6	7	2	13	15	13	18	23	7
Total genera	10	5	6	7	2	8	10	10	10	10	5
Estimated Age (my)	11-12	?	14-15	15-16	15-16	18	18	21	21	23-24	23-24

peripheral or upstream shallows and marshes from which the benthic diatoms were washed into the area of deposition. For example, the majority of the species represented in the diverse West Haldon assemblage are benthic taxa which, if found in the plankton, would usually be there adventitiously. The difference between the West Haldon assemblage and that of Middle Flat, one of the least diverse localities, is the relative contribution of the benthic (e.g. *Cymbella* spp.) and largely planktonic (e.g. *Melosira granulata*) taxa respectively. *Melosira granulata* is presently distributed world wide in euthrophic freshwaters and was characterized by Abbott and Van Landingham (1972) and Foged (1978) as alkaliphilous, mesosaprobic, oligohalo-

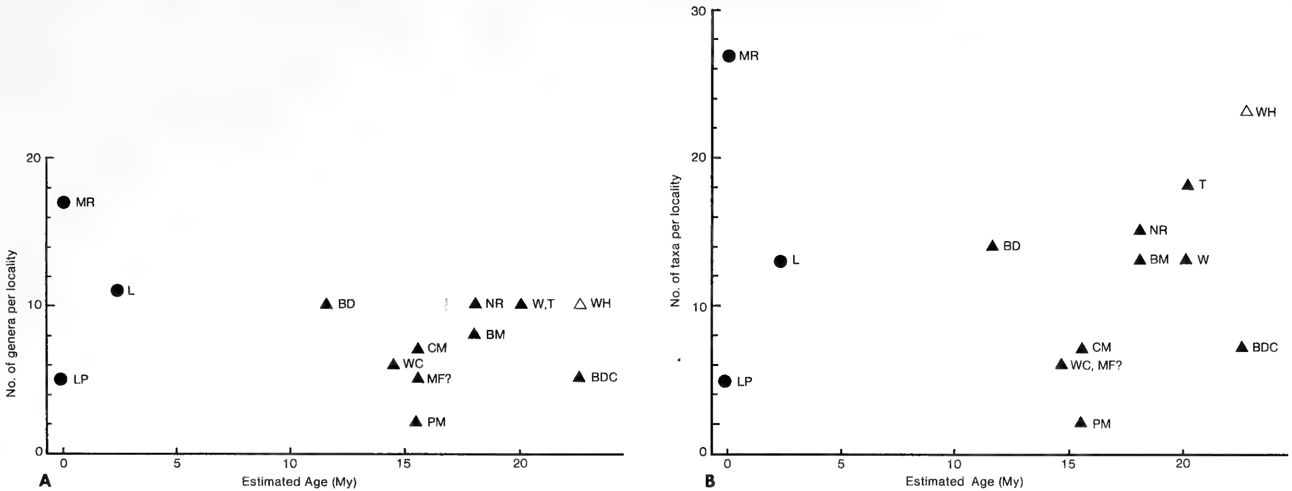


Fig. 2. **A**, scattergram of the number of diatom genera represented at each locality compared to the estimated geological age. **B**, scattergram of the total number of taxa represented at each locality compared to the estimated geological age. Key: BD, Bowan Downs; BDC, Black Duck Creek; BM, Bells Mountain, CM, Chalk Mountain; L, Lillicur; LP, Lake Picton; MF, Middle Flat; MR, Murray River pool near Mannum; NR, Nandewar Range; PM, Paddy McCullochs Mountain; T, Tintenbar; W, Wyrallah; WC, Wantialaba Creek; WH, West Haldon; ●, additional information outside of study area; ▲, locality where *Melosira granulata* was dominant in some samples; △, locality where *Cymbella* spp. were dominant in some samples.

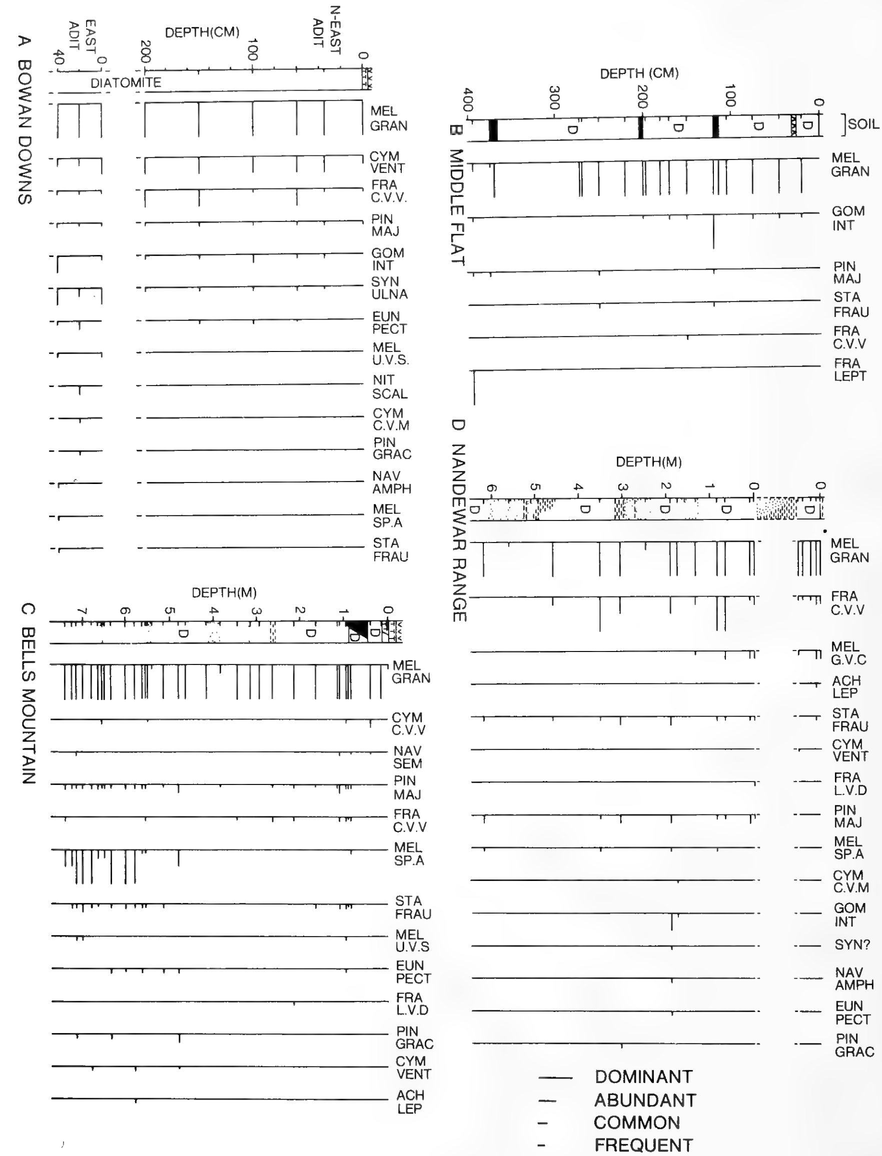
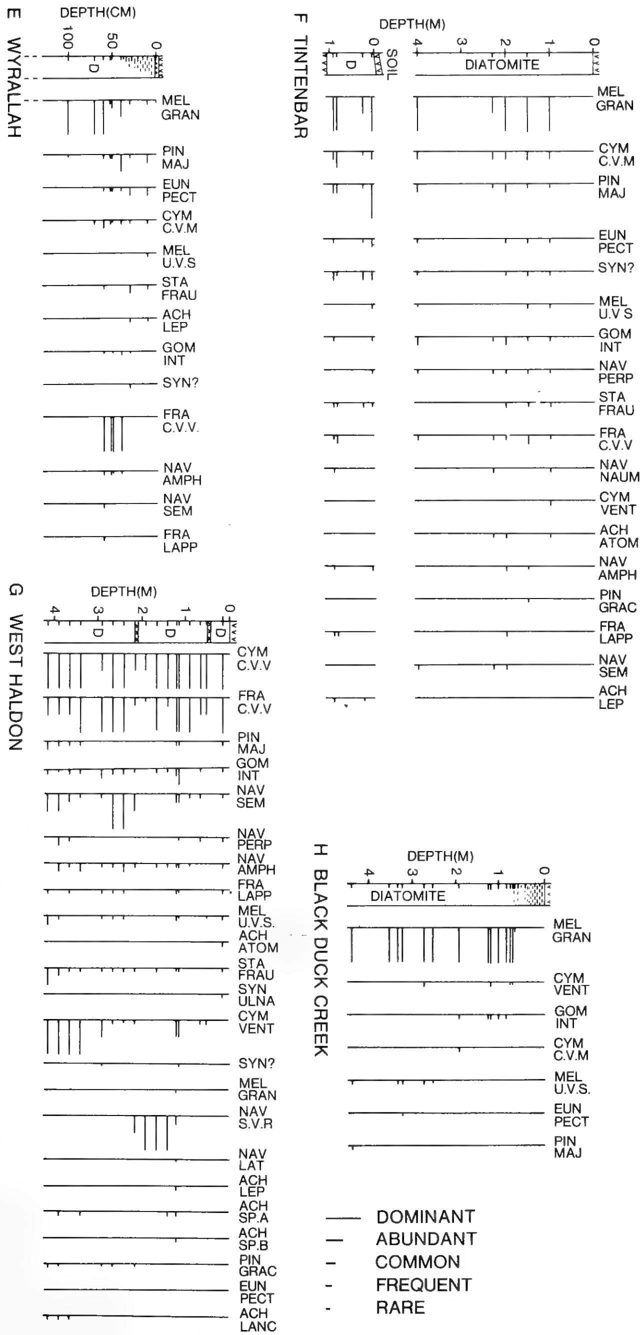


Fig. 3. **A-D**

Fig. 3. Stratigraphic sections with qualitative diatom analyses for: **A**, Bowan Downs; **B**, Middle Flat; **C**, Bells Mountain; **D**, Nandewar Range; **E**, Wyrallah; **F**, Tintenbar; **G**, West Haldon; **H**, Black Duck Creek. Key: ACH LAP, *Achnanthes* sp. af. *lapidosa;* ACH SP. A, *Achnanthes* sp. A; ACH SP. B, *Achnanthes* sp. B; CYM C.V.M, *Cymbella cistula var. maculata;* CYM VENT, *Cymbella ventricosa;* EUN PECT, *Eunotia pectinalis;* FRA C.V.V., *Fragilaria construens* var. *venter;* FRA LAP, *Fragilaria lapponica*; FRA LEPT, *Fragilaria leptostauron*; FRA L.V.D, *Fragilaria leptostauron* var. *dubia*; GOM INT, *Gomphonema intricatum;* MEL GRAN, *Melosira granulata*; MEL G.V.C, *Melosira granulata* var. *curvata*; MEL SP. A, *Melosira* sp A; MEL U.V.S., *Melosira undulata* var. *spiralis*; NAV AMPH, *Navicula amphibola*; NAV LAT, *Navicula* sp. af. *laterostrata*; NAV NAUM, *Navicula naumannii*; NAV PERP, *Navicula* sp. af. *perpusilla*; NAV SEM, *Navicula seminuloides*; NAV S.V.R, *Navicula seminuloides* var. *rhombica*; NIT SCAL, *Nitzschia scalaris*; PIN GRAC, *Pinnularia graciloides*; PIN MAJ, *Pinnularia* sp. af. *major*; STA FRAU, *Stauroneis frauenfeldiana;* SYN ULNA, *Synedra ulna;* SYN?, cf. *Synedra* sp.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ABUNDANT
COMMON
FREQUENT
RARE

Fig. 3. **E-H**

bous, limnophilous and planktonic. *Fragilaria lapponica* has been described by Abbott and Van Landingham (1972) as epiphytic and therefore probably indicative of shallow water or nearness of swamp or marsh land to the lake in which the diatoms were deposited. Hustedt (1959) described the habit of *F. leptostauron* as benthic, commonly found in the littoral region of freshwater bodies. Foged (1978) collected *Achnanthes lanceolata* from rivers and creeks with both stagnant and running water, and with pH ranges from neutral to slightly acidic. *Cymbella cistula* var. *maculata* appears to be an epiphytic species and is indicative of shallow water somewhere in the area of deposition. *Cymbella ventricosa* is a tube-dwelling, epiphytic taxon more common in shallow streams and creeks than in lakes or ponds. Hustedt (1966) described *Navicula seminuloides* as a tropical freshwater form.

Due to the obvious environmental control of non-marine diatom floras, we are cautious about drawing any biostratigraphic conclusions. Deposits with the same estimated age, e.g. West Haldon and Black Duck Creek, may show considerable differences in both number (Table 1, Fig. 2) and kinds (Table 2) of taxa present; in fact without the clear-cut information on their correlative stratigraphic positions (see Thomas and Gould, 1981), evidence for the equivalence of the West Haldon and Black Duck Creek deposits would be substantially lacking on the basis of the diatom floras alone. There is considerable variability in the total number of taxa from each locality (Table 1, Fig. 2). The West Haldon assemblage, one of the oldest, compares well with that from the present day eutrophic pond alongside the Murray River near Mannum; however the living assemblage has more genera and so could be considered a "richer" flora. Both West Haldon and the Murray River pond have a far greater number of taxa than found in the oligotrophic Lake Picton or the younger fossil deposit at Lillicur. Much of the variation in the diatom floras can be attributed to differences in environment of the lakes, rather than broader scale climatic changes or geological activity, although the latter were likely to be responsible for much of the local vertical variability as evidenced by the effects of sandstone and tuff layers in the diatomite (e.g. Fig. 3B, D). If there is a trend shown by the species data it is towards a reduction in the number of taxa with time, somewhat the reverse of what might be expected if non-marine diatoms were initially immigrants from marine environments in the early Tertiary.

We conclude that the biostratigraphy of isolated non-marine diatomites is not feasible beyond the determination of deposits of similar palaeoecological heritage. Since the deposits which are presently mined in Eastern Australia are those of low diversity, largely planktonic assemblages, like Middle Flat, Black Duck Creek, and Chalk Mountain, this could be of some commercial importance; the Bells Mountain deposit which has been extensively worked exhibits a higher diversity of taxa (Fig. 3C) but the majority are planktonic (mostly *Melosira* spp.) and it can be included in this commercially viable group. Other deposits, composed of predominantly benthic orientated taxa (Fig. 3A, D-G), display the presence of non-diatomaceous material such as clay minerals and sponge scleres.

ACKNOWLEDGEMENTS

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NOTE: The references listed here include only those additional to the ones in Thomas and Gould (1981).

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A Report on a Collection of Lice (Boopidae: Phthiraptera) on *Petrogale* (Rock Wallabies)

THERESA CLAY

(Communicated by D. K. McALPINE)

CLAY, T. A report on a collection of lice (Boopidae: Phthiraptera) on *Petrogale* (rock wallabies). *Proc. Linn. Soc. N.S.W.* 105 (1), (1980) 1981: 65-78.

The collection comprises Phthiraptera belonging to two groups (*octoseriatus* and *ampullatus*) of the genus *Heterodoxus* Le Souëf and Bullen 1902, their distribution being shown on a map. Only the *octoseriatus* is dealt with taxonomically, seven new species being described. Some suggestions are made regarding host relationships based on the distribution of the lice.

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INTRODUCTION

The lice in this collection belong to the genus *Heterodoxus* (family Boopidae) divisible into two groups: *octoseriatus* Kéler 1971 and *ampullatus* Kéler 1971. Members of the *octoseriatus* group are distinguished from the *ampullatus* group in having two lateral macrochaetae with one spiniform seta between them each side of the prosternite, while in the *ampullatus* group there are three macrochaetae with one spiniform seta between the first and second. In the males of the former group the vesica has longitudinal rows of spines or denticles (Figs. 3, 13) while in *ampullatus* the spines and denticles are arranged otherwise.

DISTRIBUTION

In the present collection the members of the *octoseriatus* group are restricted to the eastern subcoastal areas of Australia (Map 1) the furthest west being 143.09 E, host *P. godmani*, 14 km N of Coen, Queensland, this record also being the furthest north (13.50 S): the most southerly record is Gorge Creek, Bonalbo, New South Wales (28.39 S, 152.35 E). There are no records of members of the *ampullatus* group east of the line drawn on Map 1 with the exception of the population parasitic on *Petrogale* n.sp. Maynes (in press) from Kelsey Creek, Queensland (20.26 S, 148.27 E). All specimens of *Heterodoxus* examined from rock wallabies in other areas of Australia belong to the *ampullatus* group.

There is no record in this collection, except from an unconfirmed one (see p. 70) of a host taxon in the same locality being parasitized by more than one taxon of Boopidae, whereas in many groups of birds and mammals the host may not only be parasitized by members of more than one genus, but by members of two species-groups of one genus. The pocket gophers (Geomyidae) of North America may be parasitized by three taxa of *Geomydoecus* (Trichodectidae), sometimes on the same host individual. The pocket gophers, like the rock wallabies, have been divided into many subspecies, 25 in the case of *Pappogeomys castanops* for example, and in which the distribution of the lice seem to throw some light on the gopher relationships (see Hellenthal and Price, 1976, for a full discussion). The hyraxes (Hyracoidea) of

Map 1. Distribution of *Heterodoxus* groups on Rock Wallabies (*Petrogale*). The solid black symbols represent distribution of the *ampullatus* group of *Heterodoxus*; open symbols represent the *octoseriatus* group. The distribution of the taxa of the *octoseriatus* group is also shown as, for example, 1a (see also Table 1).

Africa, in which a number of genera and many species and subspecies have been recognized, tend to be heavily infested with lice. A subspecies of host may be parasitized by up to eight species or subspecies of lice belonging to a number of genera or to different species-groups of the same genus. The number of Hyracoidea taxa and their lice may perhaps be explained by the ancient origin of the host group, it being known at least as early as the Lower Oligocene (Hopkins, 1949: 510, 549) and by the isolation of its populations.

Material

The material comprises 77 tubes of specimens in alcohol collected from 19 taxa of *Petrogale* by Dr Gerald M. Maynes during 1976/77. A small number of specimens in the British Museum (Natural History) and the Australian National Insect Collection were also examined. The taxonomic status of the various forms of the host genus mentioned in this paper is tentative only and is the subject of current research by Dr Maynes and colleagues. The spirit specimens were sorted into two groups by the prosternal chaetotaxy and either mounted on slides after the treatment with KOH, some specimens being stained in Safranin O, or examined in lactophenol. Samples of specimens from all host taxa and localities were prepared by the KOH method, such specimens being used for measurements.

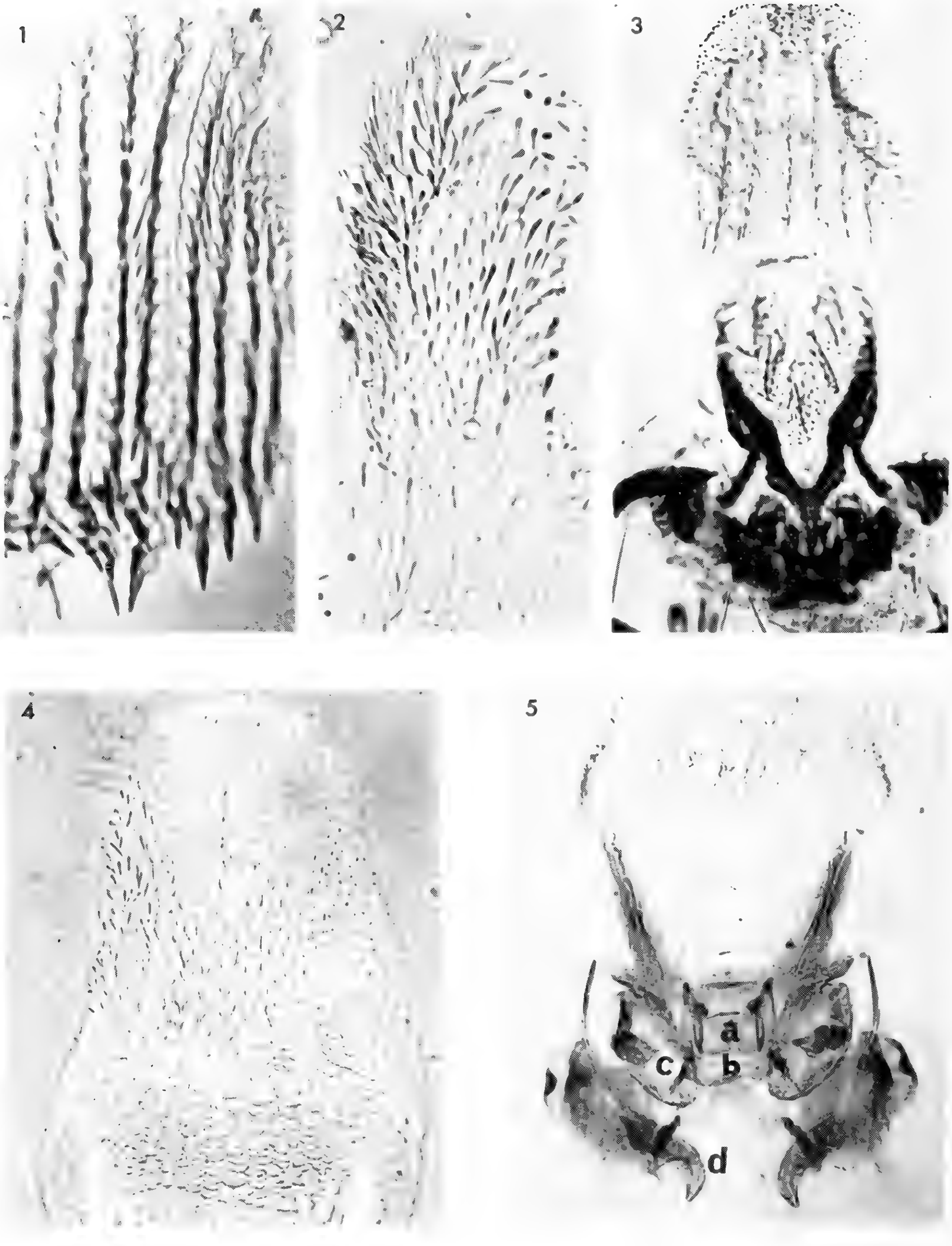
Holotype specimens are deposited in the Australian National Insect Collection; paratypes, when available, in the above collection and in the British Museum (Natural History).

TAXONOMY

The species of *Heterodoxus* are similar to each other in the majority of characters and cannot easily be separated into species-groups; for this reason the term group, not species-group, has been used. The present group is separable from all other known species only by the characters of the sac-like part of the copulatory apparatus. This is divided into two areas: the posterior part (that is the part nearest to the main plates of the apparatus) covered with scales (Fig. 4) with or without colourless spines or sometimes thickly covered with spines (Fig. 21); the anterior area has longitudinal rows of spines (Fig. 1) dorsally and finer spines (Fig.2) ventrally. As the two sides of the sac are usually pressed against each other in prepared specimens, the fine spines appear to be intermingled with the stout spines (Fig. 21) and being more numerous, often obscure the latter. *Heterodoxus quadriseriatus* Kéler 1971 from *Setonix brachyurus* (Quoy & Gaimard 1830) has a vesica with similar longitudinal rows of spines and should perhaps be included in this group; however, the sac is not divided into two areas and there are only two rows of large spines set within an elongated area of smaller spines (see Kéler*, fig. 62-63), whereas in the species dealt with below there are four or more such rows. In addition, all the species discussed below have the following characters in common and these will not be repeated in the species descriptions. There are some meristic characters such as general measurements, length of oral spines, mesonotal spiniform setae, number of submarginal setae of the prosternite and length and number of abdominal and vulval setae which show some intra- and perhaps interspecific variation. Longer series and statistical analysis may show significant differences in these characters between populations. However, as the taxa can easily be separated on gross morphological characters it is unnecessary at this stage.

General shape of head, thorax and abdomen as shown in Kéler, figs 56-57, for *octoseriatus*. Arrangement of head setae as in Kéler, fig. 117, for *spiniger*; unlike *ampullatus*, it has temporal seta 3 (Kéler, fig. 124) nearer to the posterior margin of the antennal groove than to the alveolus of 2. Seta 2 is seta 27 of Clay (1969, fig. 2) identified by its close association with the minute seta 26; Kéler's seta 3 is most probably seta 30 of Clay (1969, figs 2, 3). Pronotum with 8 marginal setae each side as follows: 2 short spiniform setae (nearest to head), 1 medium in length, 1 stout and spiniform, 1 minute, 2 long, with a short seta on the outer side of the more central of the two long ones; outer dorsal pronotal seta stout and spiniform, inner minute; posterior pronotal seta present and minute (see Clay, 1971: 528). Prosternite triangular, laterally with 2 macrochaetae and 1 spiniform seta between them; posteriorly without spiniform setae and with a number of submarginal setae. Some or all of these prothoracic characers distinguish this group from *H. ampullatus, pygidialis,* and *mitratus* Kéler and *maai* Emerson. Mesonotum with the usual large wart each side bordered posteriorly by a thickened arc from which arises dorsally a stout spiniform seta and more ventrally a short colourless seta. Mesosternum with indefinite plate with a minute seta each side (see Clay, 1971, fig. 26), thickened ridges of mesosternum with 10-11 setae each side, the most posterior being stout and spiniform. The apparent metanotum, as shown elsewhere (Clay, 1970: 80), is almost certainly the fused metanotum and tergum I, there are therefore two lines of setae

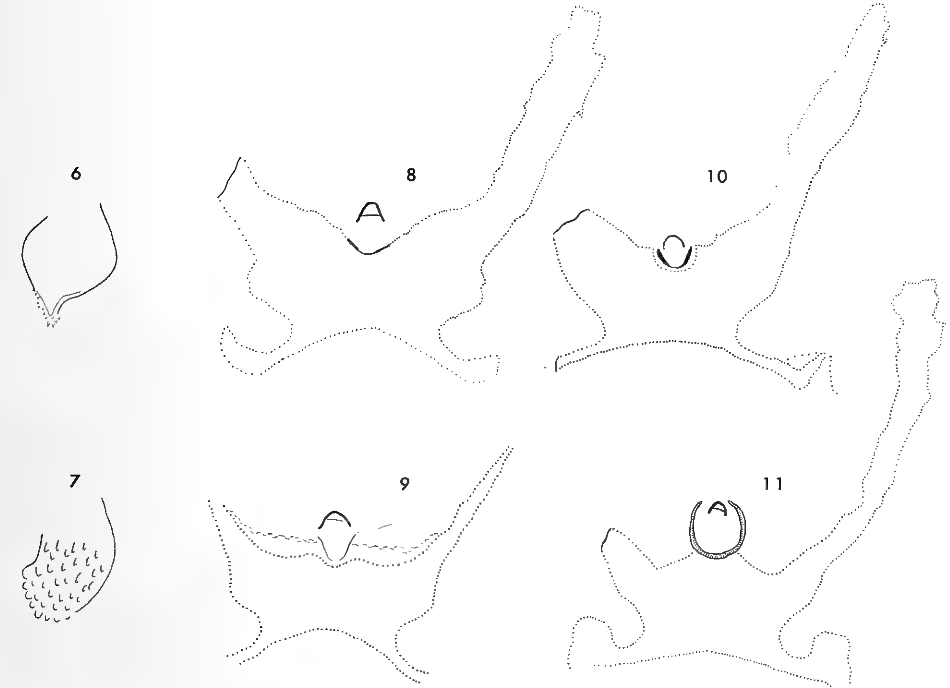
*All mentions of Kéler refer to Kéler, 1971.



Figs 1-5. Heterodoxus spp. 1-2, *H. octoseriatus* from *Petrogale herberti*, armature of vesica sac: 1, dorsal; 2, ventral. 3, *H. orarius* to show the 6 lines of spines and long colourless spines in vesica sac. 4-5, *H. maynesi* sp.n.: 4 vesica sac; 5 central mesosomal sclerites.

Key to lettering on text figures:

a. Anterior median plate (Kéler : 6 = dorsal median plate Kéler, fig. 118).
b. Posterior median plate (Kéler : 6 = ventral median plate Kéler, fig. 118).
c. Inner dorso-lateral plate. d. Dorso-lateral sclerite (Kéler, fig. 118)
e. Ventro-lateral sclerite. f. Ventral central bilobed sclerite.



Figs 6-11. Heterodoxus spp. **6-7**, Sclerite c.: **6**, *H. octoseriatus*; **7**, *H. maynesi*. **8-11**, Female genital sclerite and genital papilla: **8**, *H. octoseriatus*; **9**, *H. maynesi*; **10**, *H. lesouefi*; **11**, *H. insulatus*.
[Note: **8-11**, **18-20** same magnification, **6-7** same magnification.]

similar in all the species: the anterior line (metathoracic) comprises two stout spiniform setae on each lateral plate, 3 + 3 marginal setae and 2 + 2 anterior lateral spiniform setae. The posterior line (segment I) comprises a stout spiniform lateral seta each side and 1 + 1 marginal setae with 4-5 minute or short setae each side. The arrangement of these can be seen in Clay (1970, fig. 26). Metasternal plate, which may be the fused metasternal and sternite I, with shape as in *Heterodoxus keleri* Clay, 1971, fig. 8, and normally with 8 setae.

Abdominal tergites IV-V without wide semicircular indentations on each end of the posterior margin and sternite II without finger-like prolongations, the absence of these characters distinguishing this group from *H. longitarsus* (Piaget) and *ancoratus* Kéler. In the female the central part of tergum VIII does not form a separate plate as *H. longitarsus* (Kéler, figs. 120, 125); shape of median plate of tergum IX as in Kéler, fig. 116, Z.

The characters of the male copulatory apparatus of *Heterodoxus* provide the best diagnostic features for the separation of the species, but are probably of little phylogenetic value. As shown above, the characters of the sac-like part of the vesica separate this group from the rest of the genus. Kéler (: 6) gives a general account of the apparatus in the Boopidae and has attempted to name the sclerites, but apart from the dorso-lateral sclerites and the anterior median plate (Kéler: 6 = dorsal median plate, Kéler, fig. 118) it has not been possible to homologize all the sclerites in the following species. In the female the diagnostic characters are found in the form of the internal genital sclerite (Keler, fig. 120, g.s.) of which there are two main types (see p. 73). This sclerite is characteristic for the species, although irregular in outline and often varying in detail even from side to side of the same specimen. The taxa have been arranged in two groups according to the type of sclerite as this probably reflects relationships rather than does the male copulatory organ, which has diverged to a greater extent. The position and shape of the genital papilla (Kéler, fig. 115, 0) may be diagnostic, although it can vary somewhat in shape within a species due to the pressure of the cover slip during mounting.

Chaetotaxy of the abdomen is similar throughout the group with a certain amount of individual variation. Terga, each segment with a number of long, stout marginal setae of uniform length (m), interspersed with shorter marginal or submarginal setae of varying length (s); post-spiracular setae not included in the m. number (see below). II, 4 m. 13-16 s; III, 6 m. 14-19 s; IV-VII, 6 (occasionally 5) m; IV, 18-23 s; V, 14-20 s; VI, 13-21 s; VII, 13-21 s; ♂ VIII, 6 m. 7-11 s; ♀ terminal segments as in Kéler, fig. 125. The post-spiracular setae are the outermost seta each end of the tergite and as in all *Heterodoxus* those on II-IV are modified as trichobothria (see Clay, 1970: 83); in this group those on V and VI are short and approximately the same length, longer on VII and very long on VIII, as for example on a female paratype of *octoseriatus*: V, 0.19 mm. VI, 0.19. VII, 0.31 and VIII, 0.41 mm. Sterna, each segment has a number of marginal (m.) setae and shorter submarginal ones (s.). II, 4 m. 6-11 s. (the two minute anterior setae found in all the Boopidae not included); III, 6-7 m. 10.14 s; IV, 8-10 m. 12-16 s; V, 9-11 m. 13-16 s; VI, 10-15m. 13-19 s; VII, 12-15 m. 15-19 s; ♂, VIII, 6-10 m. 12-15 s; IX, 13-14; ♀ as in Kéler, fig. 125. The variation in the numbers of marginal sternal setae is partly due to the end ones sometimes being marginal and sometimes submarginal.

Species Description.

The first five species, although mostly differing distinctly in the characters of the male copulatory organ, are similar in the characters of the female genital region (type I) and for this reason have been grouped together.

Heterodoxus octoseriatus Kéler (Figs 1, 2, 6, 8, 13; Map 1, 1a)

Heterodoxus octoseriatus Kéler, 1971, *Aust. J. Zool. (Suppl.)* 6: 60.

Type-host: *Petrogale penicillata* (Griffith, Smith & Pidgeon 1827)

Specimens examined: Holotypes and paratypes as listed in Kéler: 60-61 from Bonalbo, N.S.W. In the present collection from *P. penicillata*, QUEENSLAND:- 2♂, 10♀, Emu Vale (28.14 S, 152.15 E) (15/16.v.1976, RW* 10-11). From *P. herberti* Thomas:- 9♂, 5♀, Yarraman Creek (26.47 S, 152.01 E), (23.v.1976, RW 15-16); 3♂, 3♀ Cania Gorge (24.38 S, 150.58 E) (29/31.v.1976 RW 25-27); 1♀ Mt. Ball (23.20 S, 147.39 E) (6.vi.1976, RW 35).

The diagnostic characters not clearly shown in Kéler's figures are the form of sclerite c (Fig. 6), the presence of the ventro-lateral sclerite (e) (Fig. 13) and the length of the proximal spines in the vesica sac (Fig. 1). These characters, together with the form of the female genital sclerite (Fig. 8) distinguish it from *maynesi* which amongst the species described here it resembles most closely. The group of spicules on the ventral wall of the genital chamber in both species is bilobed anteriorly.

In addition to the specimens of *octoseriatus* from Mt. Ball, there is a single male (RW 31, 5.vi.1976), belonging to the *ampullatus* group and probably conspecific with the taxon found on *P. purpureicollis* (Squirrel Hills, Qld, 21.47 S, 140.46 E, 15.vi.1976 RW 37). As this is the only case in the collection of more than one taxon on

* All the material with RW numbers was collected by G. M. Maynes.

the same host species in the same locality and as it is based on a single specimen of which the date and number are near the Squirrel Hills specimens, the record needs confirmation.

Heterodoxus maynesi sp. n. (Figs 4-5, 7, 9; Map 1, 1b).
Type-host: *Petrogale inornata* Gould 1842.

Types: Holotype ♂ in the Australian National Insect Collection, CSIRO, from *Petrogale inornata,* QUEENSLAND: Blue Mtn. (21.33 S, 148.57 E) (19.ix.1976, RW 152). Paratypes: 10♂, 15♀ from the same host taxon and locality (18.ix.1976, RW 146, 147, 148. 19.ix.1976, RW 152, 153. 20.ix.1976, RW 155).

This species resembles *octoseriatus* most closely, being distinguished, as shown above, by the apparent absence of the ventro-lateral sclerite (e), the form of sclerite c (Figs 5, 7) and the type of spines in the vesica sac (Fig. 4). Although it is not always clear exactly how many longitudinal rows of these spines are present, *maynesi* has five to six full rows compared to the eight of *octoseriatus*. The female is distinguished by the form of genital sclerite (Fig. 9).

Specimens from *P. inornata* from Apis Creek (Map 1, 1.bs) and Guthalungra (Map 1, 1.bt) differ from *maynesi* and from each other in small but apparently constant differences in the position of the genital papilla relative to the genital sclerite.

Specimens examined: 8♂, 19♀, QUEENSLAND: Apis Creek Station (22.59 S, 149.34 E) (23/24.ix.1976, RW 158, 164, 166, 167). 1♂, 2♀, QUEENSLAND: Guthalungra (19.56 S, 147.50 E) (8/9.ix.1976, RW 136, 137, 138).

Heterodoxus insulatus sp. n. (Figs 11-12, 14-15; Map 1, 1c)
Type-host: *Petrogale inornata* Gould 1842.

Types: Holotype ♂ in the Australian National Insect Collection, CSIRO, Canberra, from *P. inornata,* QUEENSLAND: Magnetic Island (12.xi.1966, J. H. Calaby). Paratypes: 2♂, 4♀ from the same host individual as the holotype.

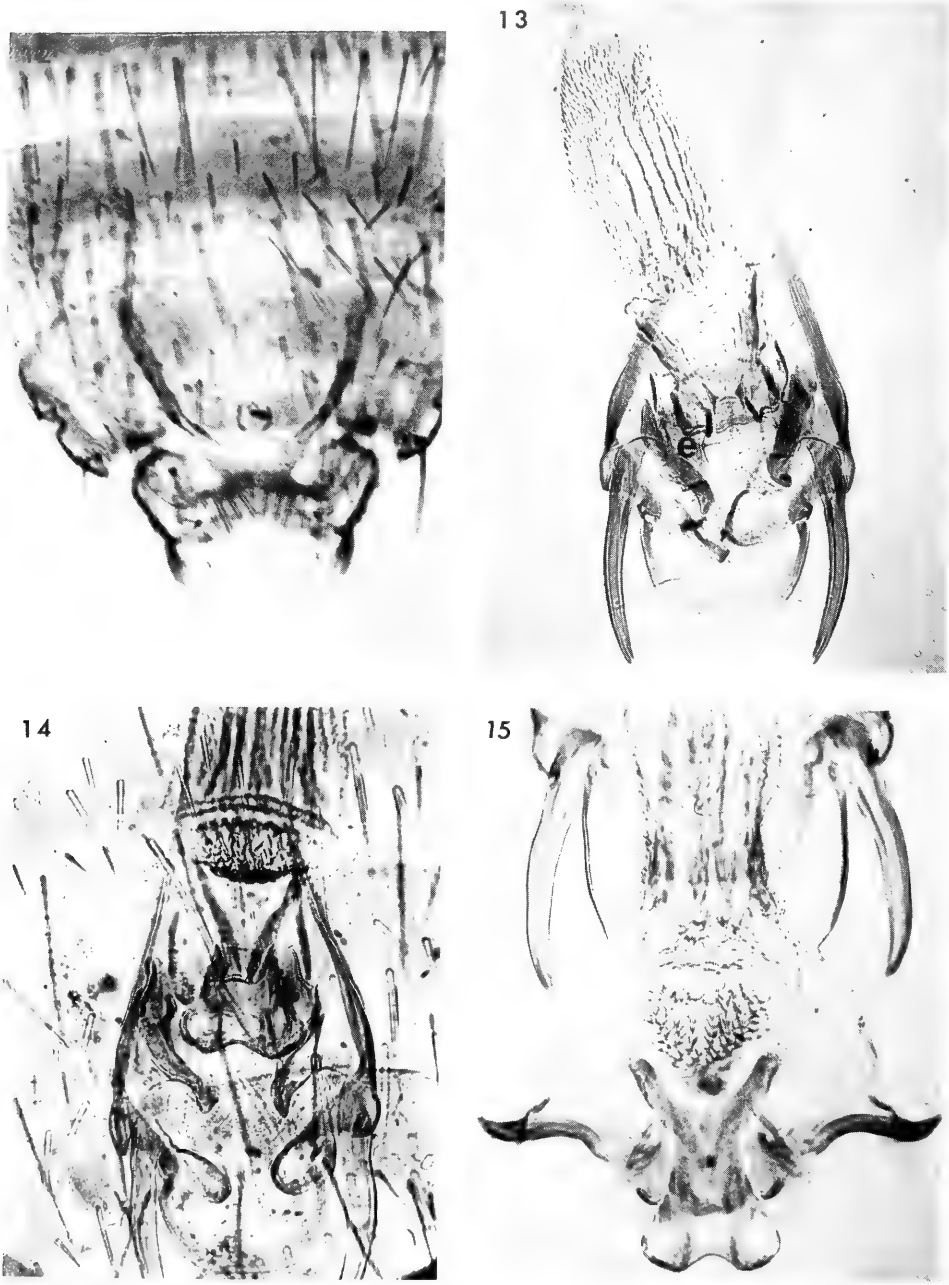
The male is distinguished by the lower part of the vesica sac having a patch of short broadly-based colourless spines as well as flattened scales (Fig. 14); the spines in the six longitudinal rows are elongate, but mostly hidden by the thick covering of the ventral spicules; other characters as shown in Figs 14-15. The genital sclerite of the female (Figs 11-12) is of the *octoseriatus* type but quite distinct; the ventral patch of spicules in the genital chamber dense and rounded or flattened anteriorly. Although this species is parasitic on the same host species as *maynesi*, it shows marked differences in both the male copulatory organ and the female genital sclerite.

Heterodoxus lesouefi sp. n. (Figs 10, 21; Map 1, 1d)
Type-host: *Petrogale puella* Thomas 1926.

Types: Holotype ♂ in the Australian National Insect Collection, CSIRO, Canberra, from *P. puella,* QUEENSLAND: 16 km S of Lyndhurst (19.20 S., 144.20 E.) (13.vii.1976. RW 90). Paratypes: 1♂, 1♀ from the same host individual as the holotype.

Other specimens examined: 3♂, 5♀ from *P. puella,* QUEENSLAND: 42 km N.E. Hughenden (20.25 S., 144.30E) (18.xi.1977, RW 291, 293).

In spite of the unique characters of the male organ, this species has been placed near *octoseriatus* on the characters of the female genital region (Fig. 10). The male has 8 longitudinal rows of spines in the vesica and the lower part of the vesica sac is covered by colourless spines; the central plates are also diagnostic (Fig. 21). The group of spicules on the ventral wall of the genital chamber is bilobed anteriorly.



Figs 12-15. Heterodoxus spp. **12**, *H. insulatus*: ♀ genital region. **13-15**, Male copulatory organ: **13**, *H. octoseriatus* from *Petrogale herberti*; **14-15**, *H. insulatus*.

Heterodoxus harrisoni sp. n. (Figs 16-18; Map 1, 1e)

Type-host: *Petrogale puella* Thomas 1926.

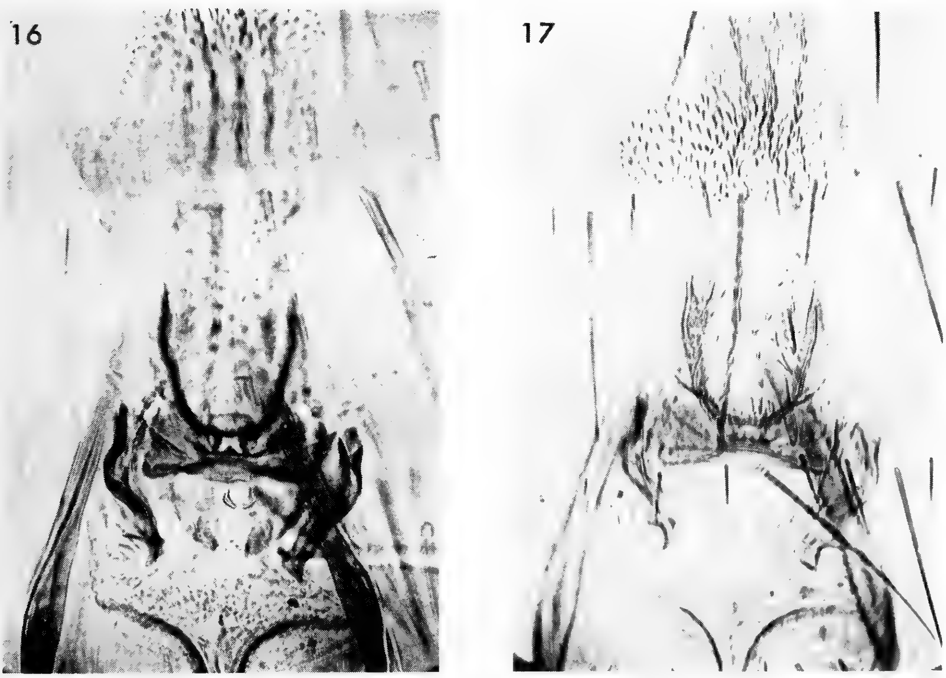
Types: Holotype ♂ in the Australian National Insect Collection, CSIRO, Canberra, from *P. puella*, QUEENSLAND: Black Rock, Lyndhurst Station (19.12 S, 144.22 E) (12.vii.1976, RW 85). Paratypes: 1♂, 4♀ from the same host individual as holotype.

The male organ of this species is quite unlike that of any other species in the form of the spines in the lower part of the vesica sac, the shape of the dorso-lateral sclerites and the central plates of the mesosome (Figs 16-17). The female genital sclerite, although distinctive (Fig. 18) is nearer the *octoseriatus* type and the patch of spicules in the genital chamber is bilobed as in that species. The genital papilla is also distinctive being fez-like in shape.

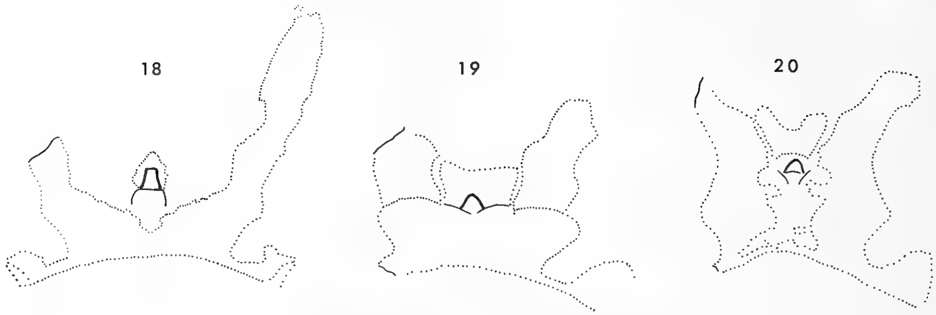
The following five taxa, two of which are represented by females only, are recognized in the female by the form of the genital sclerite (type II). This does not have the pair of elongate arms as in type I, but has stouter shorter arms with accessory thickening anterior to the papilla (Fig. 19). The three males resemble each other in the presence of sclerite f (Figs 25-27) and the central pointed structure may also be homologous in the three species. The female specimens listed below with type II sclerite cannot yet be named:

1♀ from *P. godmani* Thomas, 1923, QUEENSLAND: Desailly Creek (16.24 S, 144.57 E. Map 1, 2c) (21.viii.76. RW 103).

3♀ from *P. penicillata* ssp. nov. QUEENSLAND: Kirrama Range (18.06 S, 145.41 E. Map 1, 2d) (26/27.viii.1976. RW 113, 115).



Figs 16-17. Heterodoxus harrisoni, male copulatory organ.



Figs 18-20. Heterodoxus spp. Female genital sclerite and genital papilla: **18**, *H. harrisoni;* **19**, *H. orarius;* **20**, *H. insularis.*

Heterodoxus orarius sp. n. (Figs 3, 19, 23, 25; Map 1, 2a)

Type-host: *Petrogale godmani* Thomas, 1923.

Types: Holotype ♂ in Australian National Insect Collection, CSIRO, Canberra, from *Petrogale godmani*, QUEENSLAND: Byerstown Range, 13 km S. of Lakeland (15.57 S., 144.50 E.) (30.vii.1976, RW 94). Paratypes: 12♂, 3♀ from the same host taxon and locality as the holotype (30.vii.1976, RW 94, 95; 31.vii.1976, RW 97).

This and the following species resemble each other and differ from other known species in the presence of a stout sclerotized point in the male copulatory apparatus of the kind shown in Fig. 23, and of long colourless spines in the lower part of the vesica sac (Figs 3, 23). *H. orarius* is distinguished from *H. insularis* in having the sclerites of the apparatus larger and in the difference in shape of sclerite f (Fig. 25). The sclerotization of the female genital sclerite also differs in the two species (Fig. 19).

Heterodoxus insularis sp. n. (Figs 20, 24, 26, Map 1, 2b)

Type-host: *Petrogale assimilis* Ramsay 1877.

Types: Holotype ♂ in Australian National Insect Collection, CSIRO, Canberra, from *Petrogale assimilis,* QUEENSLAND: Munday Bay, Great Palm Is. (18.45 S., 146.37 E.) (1.ix.76, RW 125). Paratypes: 12♂, 26♀ from the same host taxon and locality (1.ix.1976, RW 125; 5.ix.1976, RW 129) and from the same host taxon from Onion Bay, Great Palm Is. (3.ix.1976, RW 127).

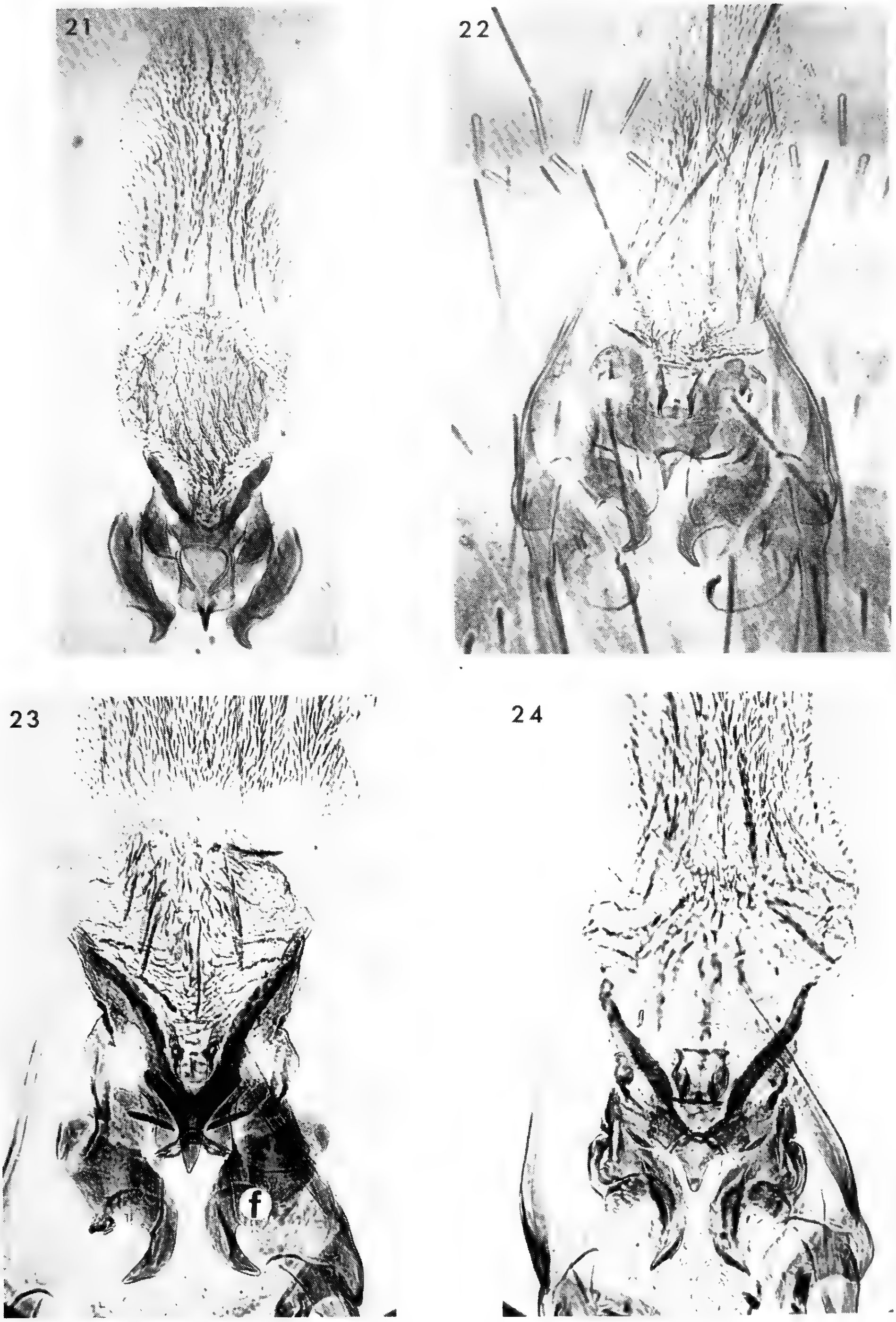
This species resembles most closely *H. orarius*, differing as shown above in the size of the sclerotized point and the shape of sclerite f in the male copulatory apparatus (Fig. 26) and in the sclerotization of the female genital sclerite (Fig. 20).

Heterodoxus murrayi sp. n. (Figs 22, 27; Map 1, 2e).

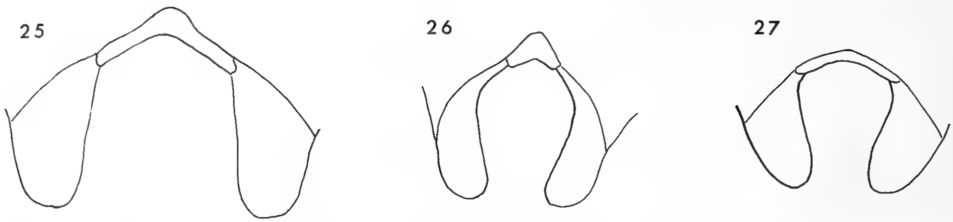
Type-host: *Petrogale godmani* Thomas 1923.

Types: Holotype ♂ in the Australian National Insect Collection, CSIRO, Canberra, from *P. godmani,* QUEENSLAND: 14 km N. of Coen (13.50 S., 143.09 E.) (5.viii.1976, RW 100).

This species is placed here with *orarius* and *insularis*, although the female is unknown and the male shows considerable differences in the copulatory organ. However, it has sclerite f (Fig. 27) and a central pointed sclerite (Fig 22) as in the other species, but this may not be homologous. There are six longitudinal rows of spines and a small number of colourless spines in the lower part of the vesica sac (Fig.



Figs 21-24. Heterodoxus spp. Male copulatory organ: **21**, *H. lesouefi*; **22**, *H. murrayi*; **23**, *H. orarius*; **24**, *H. insularis*. [Note: **23** and **24** same magnification.]



Figs 25-27. Heterodoxus spp. Sclerite f (see Fig. 21): 25, *H. orarius;* 26, *H. insularis;* 27, *H. murrayi.* [Note: All to same magnification.]

22). As other taxa parasitic on *P. godmani* have type II female sclerite, it is probable that the female of this species will have the same.

This species is named for Mr M. D. Murray in gratitude for his assistance in the publication of this paper.

Host-Parasite Relationships

Throughout the Phthiraptera it is usual to find a group of related hosts parasitized by related species of lice, so it is of interest to consider whether the lice of the rock wallabies throw any light on the relationships of their hosts. However, any deductions of host-parasite relationships within the *ampullatus* group must wait for further material, especially from the Northern Territory populations, and for a more detailed analysis of the possible taxa.

In the *octoseriatus* group the following points may be of interest:

1. As all the east coast *Petrogale,* with the exception of the new species from Kelsey Creek, are parasitized by members of the *octoseriatus* group, it seems likely that they are all derivatives from one ancestral stock. Further, it is possible that the hosts are divisible into two groups, those parasitized by *Heterodoxus* 1a-1e on one hand, and 2a-2e (Map 1) on the other.
2. The similarity of the populations of *P. inornata* and *P. penicillata* sens. str. suggests that the hosts of these should be grouped together.
3. Material from *P. inornata* from four localities is available, each locality having a separate taxa.
4. The differences between the parasites from *P. puella* south of Lyndhurst (20.25 S and 19.20 S) and those from Black Rock, Lyndhurst (19.12 S), (*H. lesouefi* and *H. harrisoni*), suggests that two host taxa may be involved.
5. The differences between the species from *P. godmani* from Byerstone Range (*H. orarius*) and from Coen (*H. murrayi*) suggests that the hosts may be taxonomically separable.
6. The similarity between *Heterodoxus orarius* and *H. insularis* suggests that the host of the latter (*P. assimilis* from Palm Is.) may have been derived from *P. godmani.*
7. As the females from the new taxon of *P. penicillata* from Kirrama Range belong to the group of taxa found on *godmani* and *assimilis* it is possible that the new host taxon is related to these hosts.

Within the *octoseriatus* group the taxa are similar in most of the external features, but are separable by the characters of the male copulatory apparatus and those of the female genital region. The differences in these features are presumably due to isolation of the populations and not to adaptive changes to their environment.

TABLE 1

Heterodoxus taxa	*Petrogale* taxa	Localities	Host collection No. (RW series)
	penicillata	Gorge Creek, Bonalbo, N.S.W.	Types*
octoseriatus	(Griffiths *et al.* 1827)	Emu Vale, Qld	10, 11
Kéler,		Yarraman Creek, Qld	15, 16
1a†	*herberti*	Cania Gorge, Qld	25, 27
	Thomas 1926	Mt Ball, Qld	35
maynesi n.sp. 1b	*inornata* Gould 1842	Blue Mtn, Qld	146, 147, 148 152, 153, 155
1bs	*inornata*	Apis Creek, Qld	158, 164, 166, 167
1bt	*inornata*	Guthalungra, Qld	136-138
insulatus n.sp. 1c	*inornata*	Magnetic Is., Qld	ANIC, BM(NH)
lesouefi n.sp. 1d	*puella* Thomas 1926	16 km S. of Lyndhurst, Qld 42 km N.E. of Hughenden, Qld	90 291, 293
harrisoni n.sp. 1e	*puella*	Black Rock, Lyndhurst, Qld	85
orarius n.sp. 2a	*godmani* Thomas 1923	Byerstown Range, Qld	94, 95, 97
insularis n.sp. 2b	*assimilis* Ramsay 1877	Palm Is., Qld	125, 127, 129
taxon nov. 2c	*godmani*	Desailly Creek, Qld	103
murrayi n.sp. 2e	*godmani*	14 km N.E. of Coen, Qld	100
taxon nov. 2d	taxon nov.	Kirrama Range, Qld	113, 115

* Types of *H. octoseriatus.*
ANIC. Australian National Insect Collection. BM(NH). British Museum (Natural History) Collection.
† See Map 1.

It is possible that the cases cited above under 3-5 may represent small isolated populations which have diverged in these characters on isolated populations of hosts which themselves have not become taxonomically separable. It cannot necessarily be assumed where the male copulatory apparatus of two taxa is similar that they have been separated for a shorter time than those in which the apparatus appears very different. Further, adjacent hosts with the same or similar parasites do not necessarily denote relationship between the hosts. Factors which may have confused the original host-parasite distribution such as secondary infestation, extinction of one of a sympatric pair and others are discussed in Clay, 1957. The relationships between the host taxa, suggested here, can only be hypothetical, these must of course be based on mammalian characters, not on those of the insect parasites. However, knowledge of louse-host associations in this and other mammal and bird groups, does suggest that such information may throw light on host relationships.

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THE SIR WILLIAM MACLEAY MEMORIAL LECTURE 1980

Cambrian Animals: their Ancestors and Descendants

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Synopsis

In the largely soft-bodied, Cambrian, Burgess Shale fauna, species intermediate between major taxa are unknown, wide morphological gaps separate species of arthropods and worms, and there is a high proportion of animals which cannot be placed in any recognized group. Morphological discontinuities also separate earliest known kinds of trilobites, brachiopods and echinoderms, and species of the latter group occur in widely separated geographical areas. New discoveries extend back in time the ranges of major taxa, so that the Cambrian pattern of evolution shows many discrete, parallel lines of descent, which may reflect less strong competition during the initial occupation of marine environments. In the Ordovician period many groups having hard parts show spectacular adaptive radiation patterns, concomitant were extinctions of many of the strange animals of the Cambrian, and in succeeding periods Recent phyla become dominant. The complex pattern of Phanerozoic evolution reflects varying rates, extinctions, and the influence of geography on isolation as well as dispersal. The Precambrian pattern may have been equally complex because of similar factors. Metazoan animals may have arisen more than once, first soft-bodied, later secreting hard parts, and the arthropod, brachiopod, echinoderm or other grade of organization may have arisen independently in separate lines of descent.

Sir William Macleay studied living animals from the land and the sea, but he was aware of palaeontological work, for his collections included Palaeozoic fossils. The theme of this Memorial Lecture is what the oldest fossils reveal about the early evolution of the marine faunas that engaged Macleay's attentions. At most fossiliferous localities in Cambrian rocks only the hard parts of invertebrate marine animals are preserved. These parts may be dissociated, fragmentary, or altered in composition or shape from their original condition. Relatively rarely the hard parts are well-preserved, and still more rare are localities at which traces of soft parts have been found. It is from such remains that the palaeontologist tries to reconstruct the once-living animal, suggest its activities, and surmise how it may have been related to older and younger forms. The rare fossils which have soft parts preserved assume major importance in such work. However imperfect their preservation, and irregular their occurrence in time and space, fossils reveal kinds of animals that lived in the past, and thus the course of evolution. This unique evidence has to be integrated with that from biology if we are to understand evolutionary patterns. In recent years there has been a renewed interest in such patterns and in relationships within and between major groups (e.g. Hallam, 1977; House, 1979), and a vigorous controversy about the application of Hennig's methods in palaeontology (e.g. Campbell, 1975; Cracraft and Eldredge, 1979). Diagrams portraying relationships between major groups of animals have long been argued (e.g. Kerkut, 1960, pp. 101-111; Valentine, figs. 1, 2, pp. 29, 38, *in* Hallam, 1977). They show a single type of animal at the base, and an upward, ever-increasing number of branches. Whether or not such diagrams imply that metazoans arose from a single stock is not explicit, but if they are intended to do so, it follows that metazoans arose from a single interbreeding population, a species that occupied a particular geographical area at a particular time in the past. However, Cloud (1968) suggested that the metazoan grade of organization may have arisen more than once, implying that 'stem metazoans' arose more than once, in different areas at different times. New palaeontological discoveries are extending back in time the earliest occurrences of kinds of animals, but have not revealed animals intermediate in structure between major groups. It is assumed by many authors that animals having basic structures in common, such as jointed limbs (arthropods), or a particular microstructure of the hard parts (echinoderms), had a common ancestor. Palaeontology has not so far provided firm evidence for or against this assumption, but does not appear to exclude the possibility that higher grades of metazoan organization, even of animals which secreted hard parts, may have arisen independently in different geographical areas.

In any consideration of marine faunas of the Cambrian period, that of the Burgess Shale must loom large, because of the exquisite preservation of some 150 species of animals, two thirds of which lacked hard parts. It gives us a highly

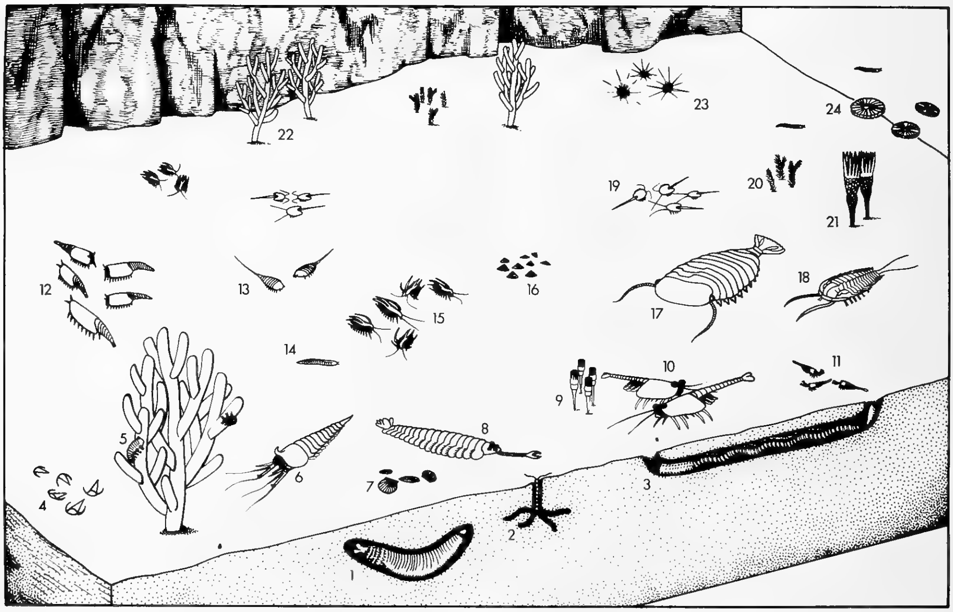

Fig. 1. Diagrammatic representation of some of the species of the Burgess Shale fauna which lived above, on and in the muddy sediments deposited at the foot of a submarine cliff (in background) considered to have been over 100 m high. Animals shown have been numbered from left to right in successive rows across the drawing, beginning with the vertical section in the foreground: branching and globular sponges (*Vauxia*, 22; *Choia*, 23; *Pirania*, 20), the articulate brachiopod *Nisusia* (7), the monoplacophoran mollusc *Scenella* (16), *Hyolithus* (4), the coelenterate *Peytoia* (24), two priapulid (*Ottoia*, 1: *Louisella*, 3) and one annelid (*Burgessochaeta*, 2) worm, a variety of arthropods (the trilobite *Olenoides*, 18; the non-trilobites *Sidneyia*, 17; *Leanchoilia*, 6; *Marrella*, 15; *Canadaspis*, 12; *Molaria*, 13; *Burgessia*, 19; *Yohoia*, 11, *Waptia*, 10; and *Aysheaia*, 5, crawling on the sponge *Vauxia*, 22), the echinoderm *Echmatocrinus* (21), the chordate *Pikaia* (14). In addition are shown two animals of uncertain affinities, *Opabinia* (8) and *Dinomischus* (9). The animals are drawn to show approximate relative size. This diagram is a variant on an earlier one by Conway Morris and Whittington (1979), drawn from my sketches by Adele Prouse.

significant glimpse of early Middle Cambrian metazoans (Whittington, 1980 and references) that appear to have lived on, in and above the muddy sea bottom at some 100 m depth (Fig. 1). Over 50,000 specimens were collected by Charles D. Walcott from this unique locality in British Columbia, Canada. About one-third are of the two arthropods, *Marrella* and *Canadaspis*, and next most abundant are the arthropod *Burgessia*, the priapulid, burrowing worm *Ottoia*, and certain of the sponges. Less abundant are the arthropods *Yohoia, Waptia, Sidneyia* and *Molaria*, while others such as *Leanchoilia* and *Aysheaia* are rare. Not shown in Fig. 1 is *Anomalocaris*, an animal which may have reached a length of 1 m, but only the large detached limbs are known. The arthropods, including trilobites, dominated the preserved fauna in numbers and kinds, and were particle feeders, predators and scavengers, walking on the bottom, digging into it, and drifting and swimming above it. Coelenterates, inarticulate and articulate brachiopods, and annelid worms were not abundant, the cap-shaped shells of the monoplacophoran, and hyolithids, being commoner. A few species of chordates, hemichordates, and echinoderms are known, each rare and strikingly different from others in the group. Second in variety of kinds to the arthropods are the sponges, and third is an assemblage of miscellaneous animals which cannot be placed in any recognized group. Fig. 1 shows two examples of the latter: *Opabinia*, a worm-like animal which had a flexible frontal process for food-gathering, and the sessile *Dinomischus,* a cup fringed with plates, anchored by a long stem.

This fauna was seemingly not that of an isolated backwater, but inhabited muds at the foot of a submarine cliff, facing the ocean, on the present western side of the North American continent. This site was open to migration, but how widespread the fauna may have been is unknown. In the shallow waters around other continents of Cambrian times there may have been equally varied and different faunas — there certainly were different faunas of animals with hard parts, and perhaps in them soft-bodied animals were twice as varied in kinds. The significance of the Burgess Shale fauna is that it opens a new perspective on Cambrian animals, for among its characteristics are:

1) the wide morphological gaps between kinds of animals in groups such as worms, echinoderms and arthropods. In the latter, for example, there are rarely two related species of a genus, most genera are monospecific and separated from each other at a family, or higher taxonomic level, and most have no known descendants;

2) an absence of animals showing structures intermediate between those of any two phyla (Conway Morris, quoted by Valentine *in* Hallam, 1977, p. 32);

3) particular species which show characters typical of major later groups, such as the crustacean *Canadaspis*, the crinoid-like *Echmatocrinus, Pikaia* with its chordate-appearing structures, and such animals as the onychophoran-like *Aysheaia*, the kind from which tardigrades, myriapods and insects may have been derived;

4) a high proportion (19 per cent) of the genera are animals that cannot be placed in any Recent higher taxon, a few such animals are known from soft-bodied faunas of younger Palaeozoic rocks but none so far as I am aware from rocks of subsequent eras.

The only Precambrian metazoans known are the late Precambrian Ediacara faunas (Glaessner, 1979), widely distributed, three-quarters of them coelenterates (mainly medusae), and a few genera of supposed annelids and arthropods, together with the enigmatic *Tribrachidium*. This assemblage of soft-bodied organisms, preserved in unusual circumstances in shallow-water environments, offers little clue to the ancestry of Cambrian animals. Precambrian sponges and archaeocyathids are unknown, as are skeleton-forming protistans. If the Burgess Shale fauna is assumed to be typical of mid-Cambrian marine faunas, then evidently a great diversification had taken place earlier. Presumably there was abundant food and space in the varied marine environments which were being occupied initially by these new animals, and competition was less severe than in succeeding periods. In these circumstances diverse combinations of characters may have been possible, as new ways of sensing the surroundings, of obtaining food, of moving about, of forming hard parts, and of behaviour (e.g. predation and scavenging) were being evolved. Thus may have arisen strange animals, the remains of some of which we see in the Burgess Shale, and which do not fit into our classification. The diverse arthropods may have arisen from different ancestors, not diverged from a single ancestral stem, by sclerotization of the exoskeleton. In the earliest Cambrian are three very different kind of trilobites, the eodiscoids, olenelloids, and ptychoparioids. They may not have had a common ancestry, but have arisen from discrete, soft-bodied, segmented metazoans. Having acquired the ability to mineralize the exoskeleton, and so to appear as fossils, they each radiated from the stem type during the Cambrian period. A similar suggestion as to brachiopod ancestry has recently been made by Wright (*in* House, 1979), who proposes that the heterogeneous groups of the early Cambrian arose independently from different lophophorates, worm-like animals having a crescentic lophophore. A further possible example is afforded by the several strange echinoderms, each localized in time and space, of the western United States (Sprinkle, 1976), the unique early Cambrian lepidocystids of the eastern United States (Sprinkle, 1973), and the enigmatic remains from Queensland (Whitehouse, 1941). Each may have evolved independently in a different geographical area, preserved when it acquired the ability to secrete the characteristic endoskeleton. The influence of geography on Cambrian evolution in the marine realm was undoubtedly strong, but difficult to assess. Fig. 2 is a Middle Cambrian palaeogeography, which in common with other such maps shows a large Gondwanaland continent and an uncertain number of other, smaller land areas. Shallow seas, in which Cambrian rocks were deposited, surrounded the land masses, separated one from another by oceans of uncertain width and depth. These oceans, and the current patterns would have acted as filters, partial barriers to migration between shallow seas. Evolution may thus have proceeded independently in different areas at particular times, and the distribution of kinds of trilobites and echinoderms in the Lower and Early Middle Cambrian suggests that it may have. The Cambrian period may have lasted 70 or more million years, and the Ediacara fauna is thought to have lived 80 or 100 million years before the beginning of the Cambrian. During these immense lengths of time continental masses may have moved great distances relative to one another. How such relative movements may have aided geographical isolation or dispersal is unknown, and knowledge of the distribution in time and space of Cambrian faunas is inadequately known. Thus the geographical factor in the early evolution of metazoans is impossible to assess at present, but should not be discounted.

During the Cambrian period particular groups of animals appear to have radiated into many related species, genera and families, and become widespread. The Archaeocyatha of the Lower Cambrian, and the major groups of trilobites, especially the ptychoparioids, are conspicuous examples. Other groups are present but markedly limited in kinds, such as the articulate brachiopods and diverse but rare echinoderms. Molluscs (Runnegar, 1980) are diverse in kinds but not common fossils, and many are of small size (Runnegar and Jell, 1974). The Burgess Shale reveals something of the variety of arthropods and worms that had evolved, as well as miscellaneous animals, but it would have been difficult for a contemporary observer to have picked out the crustacean *Canadaspis*, the chordate *Pikaia,* or *Aysheaia* as fore-runners of groups that would later become so important in so wide a variety of environments. In the latest Cambrian and succeeding Ordovician period the variety of shelled animals in

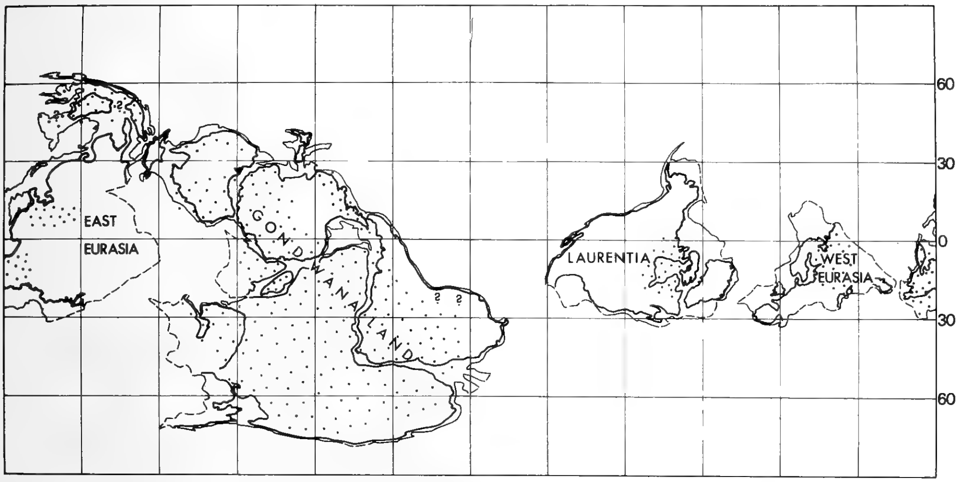

Fig. 2. Middle Cambrian palaeogeography, based upon Smith, Hurley and Briden (in press), cylindrical equidistant projection. Each continental block is delineated by a thin continuous or dashed line at the present 1000 m submarine contour, inside which is a heavier line showing the present coastline as an aid to recognition. The division between East and West Eurasia is at the Urals, and West Eurasia lies north of the present Alpine chain. There is great uncertainty about the position of the four continental masses, and the gaps between them may have been greater or less than shown. Stipple shows areas where Cambrian rocks are unknown, and which may have been land (after Palmer, *in* Hallam, 1973; 1979). The remainder of each continental block was probably covered by sea.

marine communities increased, with major radiations of articulate brachiopods, bryozoans, pelecypods, gastropods, cephalopods, tabulate and rugose corals, trilobites and classes of echinoderms. Many of these groups are preserved for the first time, and in most cases their Cambrian ancestors are problematical (various authors *in* House, 1979). Each of these radiations was a typical diversification giving related species, families and genera, and does not show the morphological gaps between species so characteristic of many Cambrian groups. It was a time of much stronger competition for food and space, of radiation of groups which happened to be best adapted, following the elimination of those that were not. In the Ordovician and younger periods (Hallam, 1973), sufficient is known to reveal in some detail faunal provinces and the importance of geographical factors in evolution.

From the foregoing I select the following points:

a) Geographical isolation as well as dispersal, affected the evolution of early metazoans, so that animals may have arisen that were similar in organization but independent in origin. Such animals may have acquired the ability to secrete hard parts in similar ways, at the same time, or at different times, in these independent lines of descent. Thus the earliest trilobites, brachiopods or echinoderms may not have had a common ancestry, but rather be animals of similar organization which had separate origins.

b) If the Burgess Shale fauna was characteristic of world faunas, then soft-bodied animals may have been far more numerous and varied than animals with mineralized skeletons. Characteristic of these soft-bodied faunas may have been the morphological discontinuities between kinds, for example of arthropods and worms; they may not have been groups of closely related species and genera. During the Cambrian period certain groups which had hard parts, such as molluscans and articulate brachiopods, remained restricted in numbers and kinds, whereas trilobites and archaeocyathids, which also had hard parts, evolved in a typical radiating manner and were widely distributed. An exceptionally high proportion of kinds of soft-bodied animals may have been so strange in organization that they could not have been placed in our presently-recognized higher taxa, even at phylum level. Because the Cambrian was the time when marine environments were first being occupied by animals varied in morphology and habit, competition may have been less severe than in subsequent periods. In these circumstances, for example, widely different animals with jointed legs may have evolved, and also animals having new combinations of structures and ways of living. Evolution in the Cambrian seems to have had a different character from that of later periods.

c) Neither in the Burgess Shale nor at other localities have been found animals which are intermediate between phyla. New discoveries, such as the probable chordate *Pikaia,* what appears to be a Middle Cambrian rugose coral (Jell and Jell, 1976), or an early Cambrian pelecypod (Jell, 1980), take the range of known kinds of animals farther back in time.

d) Late in the Cambrian period, and soon thereafter, came the major radiations of groups with hard parts. During the Palaeozoic strange arthropods and animals of unknown affinities (leaving aside those having problematic hard parts, such as conodonts) became progressively rarer and do not seem to be known after this era. Thus many of the strange animals of the Cambrian were eliminated as others radiated to occupy a wide variety of environments. Pre-adaptation and selection acted as a filter, extinguishing many lines and leaving those that have come to dominate later Palaeozoic to Recent times. A diagrammatic representation of such an evolutionary pattern (Fig. 3) shows in the early Palaeozoic many lines of descent, parallel and of varying duration. On the left side are lines, most of which extend from the Precambrian or early Palaeozoic to the present, and represent the largely unknown geological history of the modern soft-bodied marine faunas. The Ediacara fossils imply that some at least originated early. Area A suggests that a group of animals with hard parts may appear abruptly, descended from soft-bodied ancestors which may have had a long history; an example may be the Mesozoic hexacorals (Oliver, 1980). On the right of Fig. 3 are parallel lines which represent the plethora of soft-bodied animals, some arthropods and others of unknown affinities, upon which the Burgess Shale opens a partial window. Most of these may have been eliminated in the early Palaeozoic, few persisting longer. Typical histories of major groups of animals with hard parts are shown by the shaded areas. Area B might represent the post-Cambrian expansions of gastropods, pelecypods or cephalopods, or of echinoderms, from somewhat uncertain Cambrian ancestors and after elimination of strange early types. The post-Palaeozoic renewals are also shown. Area C represents trilobites, a Cambrian radiation from diverse early lines, a new burst of evolution in the Ordovician followed by decline and extinction. Area D could represent the mid-Palaeozoic conquest of the land by myriapods and insects, perhaps to be traced back to Cambrian marine animals of *Aysheaia* type; it could represent vertebrate history. The isolated Lower Cambrian Archaeocyatha are suggested in area E. The diagram does not indicate the existence of forms intermediate between phyla, because none is known.

The major taxa that we use are based largely on Recent faunas, and are relatively easily extended back through the Cainozoic and Mesozoic into the middle Palaeozoic. They are retrospective, subdivisions of the living world, made after 800 million years or more evolution of metazoans. What animals should, or should not, be placed in these phyla and classes becomes more a matter of debate as one goes back into the Cambrian, and what we know of Precambrian metazoa is also difficult to fit into Recent groupings. The strangeness of Cambrian metazoans, the large morphological

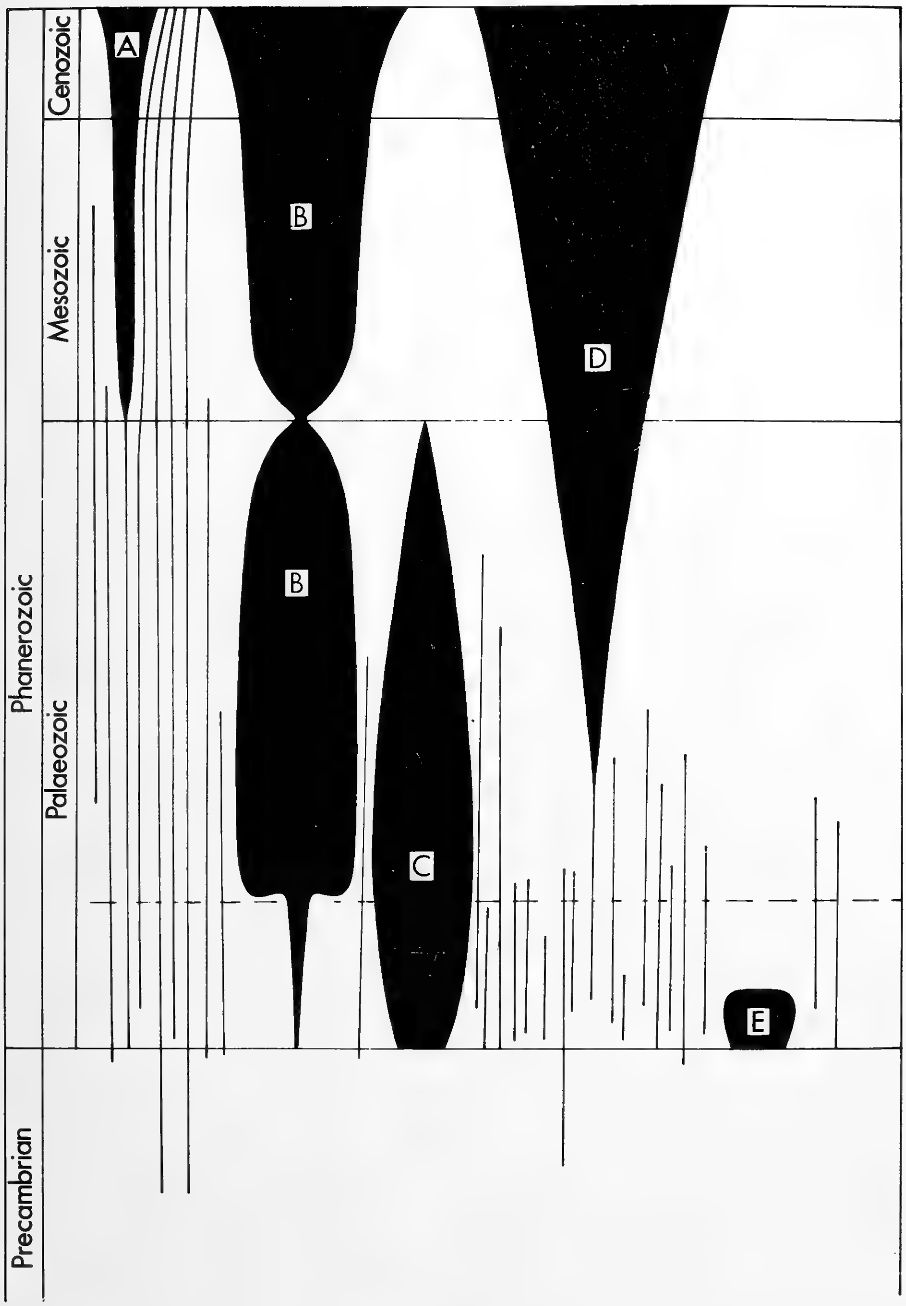

Fig. 3. Diagram expressing the pattern of Phanerozoic evolution in metazoan animals suggested by palaeontology. Thin continuous lines represent known and unknown groups without hard parts, black areas groups with hard parts. Width of black areas suggests increase or decrease of numbers of kinds in time. No two lines are shown joining downwards because animals intermediate between major groups are not known. Vertical axis is time, horizontal line is omitted at base of diagram because the Precambrian was approximately seven times as long as the Phanerozoic. Horizontal dashed line indicates boundary between Cambrian and Ordovician periods.

gaps that characteristically separate the forms, may be a pointer to how evolution proceeded. I suggest that in the late Precambrian and Cambrian when the evolution of plants had provided ample food in a wide variety of environments, metazoans evolved independently around the margins of scattered continents. Migrations and increases in numbers and kinds led gradually to occupation of available environments, so that competition intensified during the Cambrian. The Burgess Shale, by chance of preservation, shows us a selection of these strange creatures, some of which appear to be the ancestors of groups which subsequently radiated and became the major taxa of the living world. Large numbers of these animals may have been relatively short-lived, successions of populations which lasted only a few tens of millions of years, and have little place in our records. This filtering process in the latest Cambrian and succeeding period led, through combinations of circumstances which are still obscure, to the emergence of the major groups. The pattern is thus one of limited but persistent beginnings, followed by the adaptive radiation that established the group, a pattern repeated, for example, by mammals in the Mesozoic and Cainozoic. In outlining this pattern it is customary to show a single origin. However, palaeontological evidence (Fig. 3) begins after an unknown history of metazoan animals, of uncertain length, in a world so far hidden even in outline. The pattern of Phanerozoic evolution reveals that the rate varied, from place to place as well as in time, and that extinctions as well as radiations and dispersals played their part. The preceding pattern may have been equally complex, resulting from independent origins, varying rates, and extinctions. In his preface Kerkut (1960) writes that he will 'present evidence for the point of view that there are many discrete groups of animals and that we do not know how they have evolved nor how they are interrelated. It is possible that they might have evolved quite independently from discrete and separate sources'. In the early Phanerozoic there are many discrete lines of descent, the relationships between which are matters of speculation. Whether or not they had a single origin is an open question, and evolutionary patterns in the Precambrian may have been as complex as those of the Phanerozoic.

I am greatly honoured to have been invited to give this lecture, and thank Professor G. M. Philip, University of Sydney, for making my visit possible, and enabling me to discuss these ideas with a wide circle of Australian colleagues. In England I have received helpful comments on the manuscript from Drs D. W. T. Crompton, S. Conway Morris, and R. A. Fortey.

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A new Genus and Species in the Family Ophidiasteridae (Echinodermata: Asteroidea) from the Vicinity of Lord Howe Island, Tasman Sea

F. W. E. Rowe

Rowe, F. W. E. A new genus and species in the family Ophidiasteridae (Echinodermata: Asteroidea) from the vicinity of Lord Howe Island, Tasman Sea. *Proc. Linn. Soc. N.S.W.* 105 (2), (1980) 1981: 89-94.

A new genus and species in the asteroid family Ophidiasteridae is described from a specimen collected from Ball's Pyramid (31°46′S; 159°16′E, depth 100-180m), near Lord Howe Island, Tasman Sea. This genus shows affinities with the genera *Cistina* Gray, 1840, *Leiaster* Peters, 1852 and *Devania* Marsh, 1974.

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Introduction

Since H. L. Clark's (1921) revision of the family Ophidiasteridae — which he considered comprised 20 extant genera, seven new genera and two new subgenera have been described. These genera are: *Copidaster* A. H. Clark, 1948; *Celerina* A. M. Clark, 1967; *Drachmaster* Downey, 1970; *Calliophidiaster* Tommasi, 1970; *Heteronardoa* Hayashi, 1973; *Paraferdina* James, 1973 and *Devania* Marsh, 1974. A. M. Clark, 1967, described *Andora* as a subgenus of *Nardoa* Gray. Rowe (1977) raised *Andora* to generic rank, redefining *Andora* as the nominative subgenus and describing a second but new subgenus *Dorana*.

In his assessment of genera within the family, H. L. Clark (1921) laid greatest emphasis on the regular or irregular arrangement of the abactinal plates, the form of the adambulacral armature and the occurrence and arrangement of papulae on the actinal surface. These criteria have been generally adopted by subsequent workers in describing new ophidiasterid taxa.

The type species of the new genus described herein shows affinities with several established genera within the family. It also shows several distinctive features which, according to current concepts of generic limitations within the Ophidiasteridae, require that the species be assigned to a new genus.

Systematic Description

Family OPHIDIASTERIDAE Verrill, 1867.

Genus *Oneria* nov.

Description: An ophidiasterid sea-star with seven longitudinal rows of primary abactinal and marginal skeletal plates, quadrilobed, separated laterally so that the internal, connecting plates are visible; actinally, a row of plates adjacent to the adambulacrals and twice as numerous as the inferomarginals and a second row corresponding in number to the inferomarginals; all plates smooth, skin covered; skin

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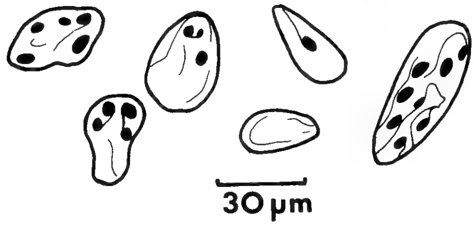

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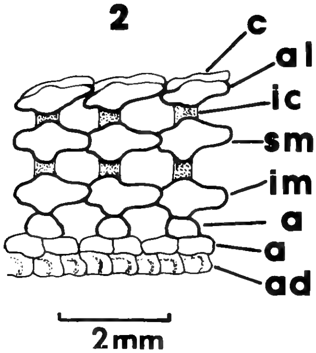

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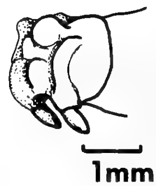

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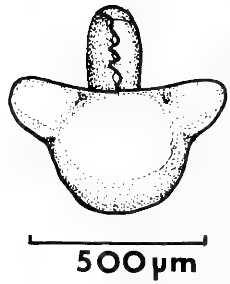

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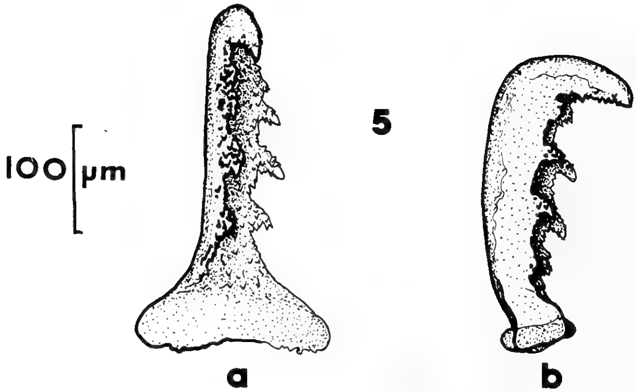


Fig. 1. Perforated skin grains.

Fig. 2. Denuded skeleton of arm, lateral view at half R.
c = carinal plate, al = abactinolateral plate, ic = internal connecting plate, sm = superomarginal, im = inferomarginal plate, a = actinal plate, ad = adambulacral plate.

Fig. 3. Terminal plate, oblique lateral view

Fig. 4. Boat-shaped pedicellaria

Fig. 5. Jaws of pedicellaria

contains small, flat perforated grains; small spines occur on a few marginal plates; adambulacral armature in two rows; papulae in eight longitudinal rows; pedicellariae large, alveolae boat-shaped, jaws laterally compressed and dentate.

Type Species: Oneria tasmanensis n.sp., herein designated.

Etymology: Oneri = Aboriginal for sea-star, gender of genus herein feminine; *tasmanensis* = type-locality the Tasman Sea.

Oneria tasmanensis n.sp.
Figs 1-6

Material examined: One specimen, holotype, Australian Museum No. J11715, off Ball's Pyramid (31°46′S: 159°16′E), near Lord Howe Island, Tasman Sea, dredged from about 100-180m, C.S.I.R.O. Fisheries (Dr. J. MacIntyre on "Gascoyne", stn No. G3/255/60), 22.xi.1960.

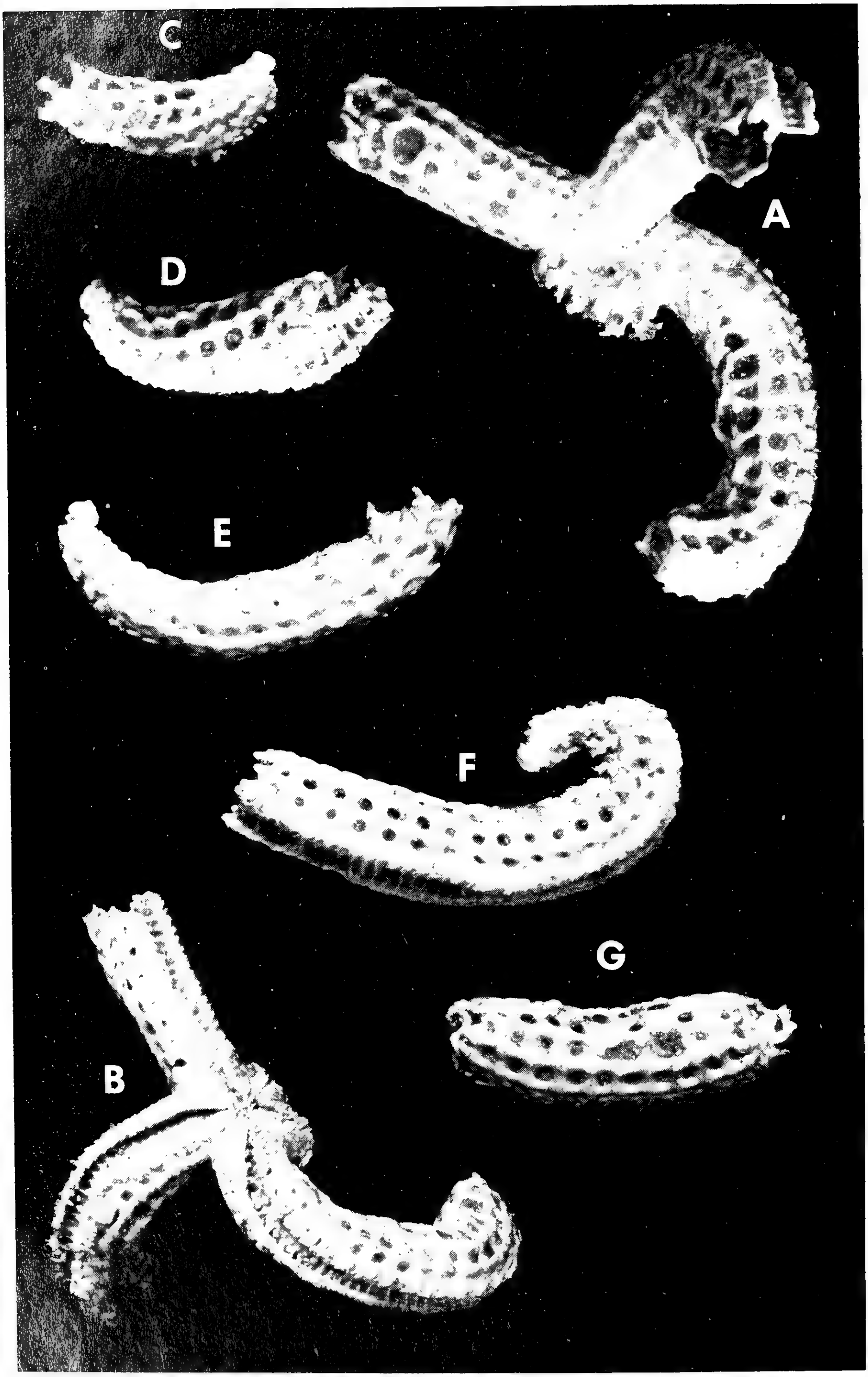
Diagnosis: A species of *Oneria* with irregularly quadrilobed plates; short broad terminal plate with two ventrally directed, ventrally placed spines; furrow spines irregularly two and one per adambulacral plate; subambulacral spines one per plate proximally, one per two plates after half R; alveolae of pedicellariae up to 630μm long; small flat grains in skin up to 67μm long.

Description: The holotype has five arms (all broken) (Fig. 6) R = 30mm (maximum), r = 3.5mm, br = 4mm, R = 8.57r and 7.5br. The disc is small and arms more or less cylindrical, slightly constricted at the base and tapering slightly distally to a width of 2.25mm. The body is covered by a thin skin which does not obscure the limits of the skeletal plates. The skin contains oval, flat, perforated grains (37-67μm x 18-37μm) (Fig. 1) which are most numerous in the disc area. The madreporite is small (0.7mm diameter), circular, slightly elevated above the disc and lying slightly nearer the margin of the disc than the centre. The anus is surrounded by an inner ring of five prominent granules and an outer ring of smaller granules.

The skeleton of the arms comprises marginally and abactinally seven rows of quadrilobed plates. The marginals are not differentiated from the other abactinal plates. The elongated proximal lobe of each plate overlaps the distal, shorter lobe of each preceding plate. The lateral lobes of each plate are not in contact with laterally adjacent plates (except on the distalmost 5mm of the arms) so that the internal connecting plates are visible externally (Fig. 2). A small, pointed spine (about 0.2mm long) occurs towards the distal end of some of the supero- and inferomarginal plates. Between the inferomarginal and adambulacral plates are two series of plates. The first actinal row (adjacent to the adambulacral plates) has two plates corresponding to each inferomarginal plate. Between this row and the inferomarginals is a second row of plates which correspond in number with the inferomarginal plates. These plates are overlapped by the actino-lateral lobe of the inferomarginal immediately above but overlap the two actinal plates immediately below (Fig. 2). None of the skeletal plates bear crystal bodies.

The terminal plate is shorter than broad (1mm x 1.5mm), has a bossed surface and bears two stout, ventrally directed spines on its ventral surface (Fig. 3).

The adambulacral plates bear usually two, but sometimes only one, furrow spine which tapers to an acute tip and is up to 0.7mm long. The spines are connected near their tips by a web of skin. There are no granules between the spines. A subambulacral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spine occurs on each adambulacral plate for up to half R and thereafter on every other plate. These spines are up to 1mm long, flattened, but taper to a rounded point. They are connected at about half their length by a web of skin.

The oral plates each bear four oral spines, continuous with the furrow series, with the innermost the largest. There is a single sub-oral spine adjacent to and behind the fourth oral spine.

The papular areas are large (up to 0.75mm square) but contain usually one or occasionally two papulae. There are eight rows of papulae.

The large, deep boat-shaped pedicellariae (Fig. 4) are not abundant, are scattered and occur abactinally in the papular areas above the superomarginal line where they are exposed but held by a thin layer of skin. The alveoli are about 630µm in length and 430µm deep. The jaws are elongate curved, and laterally compressed, with a sharp, glassy terminal spine and three to four lateral spines each side. The ventral aspect of the terminal spine and the lateral spines are themselves thorny (Fig. 5). Some stages in the development of the pedicellariae can be found distally on the arms. These are almost totally embedded in skin so that only the jaws are visible at the surface.

Colour: The colour of the dry holotype is generally pale straw, but the skeletal plates and the pedicellariae show through white.

Remarks: Within the initial dichotomy in Clark's (1921) key, the genus described herein falls, together with *Copidaster, Drachmaster* and *Devania* among the subsequently described genera, within the group possessing longitudinally arranged abactinal plates (i.e. in his groupings AA). Within this group *Oneria* appears to be most closely related to *Leiaster, Cistina* and *Devania*, the only genera with a skin-covered skeleton, as opposed to the granulated covering of the plates of the other genera in the group. *Oneria* differs from *Leiaster* and *Cistina* in possessing flat discoidal grains in the skin, in lacking crystal bodies on the skeletal plates and in possessing exposed pedicellariae with large, bulbous, boat-shaped alveolae. The presence of a few, albeit small, marginal spines shows a similarity to the presence of the single, large spine on each of the abactir al and marginal plates of *Cistina*.

Although very similar to *Devania* in general form, skin covering and shape of the pedicellariae, *Oneria* differs from that genus in the presence of two rows of actinal plates, grains in the skin, the arrangement of the furrow and subambulacral spines, the presence of spines on the marginal plates and thorny teeth on the pedicellariae.

Acknowledgements

I am indebted to Dr. Dennis Devaney, Bernice P. Bishop Museum, Hawaii, for the loan of part of the holotype of *D. naviculiforma* for comparative study, and to Mrs L. M. Marsh, Western Australian Museum, Perth, Western Australia, for her comments on the manuscript.

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Fig. 6. Oneria tasmanensis n. gen. et sp. (holotype; Australian Museum J11715: A, C-G x 3; B x 2.3)

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Three new Species of the Earthworm Genus *Plutellus* s. strict. (Megascolecidae: Oligochaeta) from New South Wales and Queensland

G. R. DYNE

DYNE, G. R. Three new species of the earthworm genus *Plutellus* s. strict. (Megascolecidae: Oligochaeta) from New South Wales and Queensland. *Proc. Linn. Soc. N.S.W.* 105 (2), (1980) 1981: 95-106

Three new species of the restricted genus *Plutellus* are described, elevating the generic total to eight species, to which a key is provided. The new forms further consolidate the genus as a distinct and homogeneous eastern Australian entity. All the new species are characterized by only two pairs of spermathecae, and the two sympatric New South Wales forms are shown to possess only three pairs of calciferous glands, requiring amendment of the generic definition. The close overall resemblance of one of the latter species to the previously-described *Heteroporodrilus lamingtonensis* emphasizes the tenuous distinction existing between the two genera, namely, the presence or absence of calciferous stalks. *Plutellus* is viewed as the apomorph sister-group of *Heteroporodrilus*, with the insular *Paraplutellus* constituting a yet further derivation.

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INTRODUCTION

The large circum-mundane genus *Plutellus* has for some years been recognized as an ill-defined species-aggregate (Gates, 1961; Jamieson, 1971a), with a distribution encompassing India, Burma, Australia, New Caledonia, New Zealand, Guatemala and a northern portion of South America. Considerable doubt has been shed on the true origin of material of the type-species, *P. heteroporus* Perrier 1873, supposedly Pennsylvanian, but now assumed to be Australian. On the basis of detailed morphological examination, Jamieson (1970, 1971b) found that *P. heteroporus* must be considered strictly congeneric with the New South Wales species, *Cryptodrilus manifestus* Fletcher 1889. Of particular significance was the mutual possession of distinctly stalked calciferous glands, and a regular alternation of the nephridiopores (the latter condition also seen in the endemic Australian *Heteroporodrilus* Jamieson, 1970). Accordingly, *Plutellus* was tentatively restricted to Australian forms exhibiting a considerably refined combination of morphological characters.

Some 44 species of Australian earthworm conforming to the 'classical' *Plutellus* definition (requiring only the possession of the lumbricine condition of setae, male pores united with or near the pores of a single pair of tubular prostates, and holonephry throughout and as summarized in Jamieson, 1971a), have, in part, been redistributed amongst other Australian genera with possible phyletic affinities with *Plutellus* s. strict. The residue are non-Plutelloid s.s., and are likely to be almost entirely absorbed into the extensive genus *Diporochaeta*.

Two additional *Plutellus* s. strict. species have been recently described from Queensland (Jamieson and Nash, 1976), bringing the generic total to 5 (including a species from Lord Howe Island). The present paper deals with three additional species, two of which are from northern New South Wales, and one from southeast

Queensland. These forms further consolidate the concept of a restricted, purely Australian *Plutellus*, as herein re-defined.

SYSTEMATICS

Genus *Plutellus* Perrier, 1873, Emend.

Small to moderately large terrestrial worms (37-410 mm long), with c. 100-300 segments. Prostomium epilobous to tanylobous. Dorsal pores commencing at 4/5-8/9. Setae 8 per segment, in regular longitudinal rows, commencing on II; ventral setal couples (*ab*) wide, dorsal setal couples (*cd*) significantly wider and only a little smaller than, or not significantly different from the intervening distance (*bc*); dorsal median intersetal distance (*dd*) 0.20-0.35 of the circumference (*U*). Nephropores large, a pair anteriorly in each segment, commencing with II; alternating segmentally from the vicinity of *b* to *d* lines from V-X posteriorly, sometimes in an asymmetric pattern, one side with respect to the other; in more anterior segments in *c* and *d*, commencing in either setal line in II, and persisting in one or the other location for some consecutive segments. Clitellum annular, on XIV-XVII or part of XIII also. A pair of combined male and prostatic pores on XVIII in line with the ventral setal couples. The prostates with thickly tubular or racemose glands and strongly muscular, ectally dilated ducts (sometimes cylindrical and less muscular); vasa deferentia joining either the duct or the glandular portion of the prostate. Penial setae absent. Accessory genital markings present. Spermathecal pores two to five pairs, the last at mid-IX or, more commonly at the anterior margin of that segment.

Some pre-clitellar septa strongly thickened. Gizzard strong, in V. Large, paired reniform calciferous glands with moderate to long ducts, three or four pairs, in X-XIII; intestine beginning in XV, or, individually, XVI, muscular thickening and typhlosole absent. Dorsal blood vessel single, continuous onto the pharynx. Supra-oesophageal vessel present or absent. Dorso-ventral commissural vessels in V or VI to XII or XIII, those in X-XII, XI-XIII, or X-XIII respectively forming latero-oesophageal hearts, each of which receives two connectives, one from the supra-oesophageal vessel or the calciferous vessels, the other from the dorsal vessel. Subneural vessel (always?) absent. Nephridia stomate, vesiculate and exonephric. Pharyngeal tufting absent. Bladders elongate-subspherical or bilobed; the first pair in II. Testes and funnels either free in X and XI or enclosed in a pericardiac testis-sac; seminal vesicles in IX and XII. Ovaries and funnels in XIII; ovisacs absent(?). Spermathecae 2-5 pairs, each with a digitiform to clavate diverticulum which may be bifid or duplicated.

Diagnosis: Holonephric with large nephridial bladders; nephropores in *c* or *d* lines, and from V-X posteriorly, alternating from *b* to *d* lines. 3-4 pairs of discretely stalked reniform calciferous glands in X or XI-XIII. Combined pores of a pair of tubular or racemose prostates and the vasa deferentia in XVIII.

Type Species: Plutellus heteroporus Perrier, 1873.

Distribution: Eastern subregion of Australia: New South Wales, south-eastern Queensland, Lord Howe Island.

CHECKLIST OF SPECIES

1. *Plutellus clarkei* sp. nov. New South Wales.
2. *P. heteroporus* Perrier, 1873. Locality unknown, ? N.S.W.
3. *P. hutchingsi* Jamieson, 1977. Lord Howe Island.
4. *P. incommodus* Jamieson and Nash, 1976. Queensland.

5. *P. manifestus* (Fletcher, 1889). New South Wales.
6. *P. minyoni* sp. nov. New South Wales.
7. *P. notatus* sp. nov. S.E. Queensland.
8. *P. raveni* Jamieson and Nash, 1976. S.E. Queensland.

KEY TO SPECIES

1. 5 pairs of spermathecal pores, at anterior margins of segments V-IX 2
   3 to 4 pairs of spermathecal pores, at anterior margins of segments VI or VII-IX 3
   2 pairs of spermathecal pores 4

2(1) Spermathecal pores in *b* lines. Last hearts in XII ..... *P. heteroporus*
   Spermathecal pores in *a* lines. Last hearts in XIII ..... *P. hutchingsi*

3(1) Spermathecal pores 4 pairs, almost contiguous mid-ventrally . *P. manifestus*
   Spermathecal pores 3 pairs, in or slightly median of *b* lines 6

4(1) 4 pairs of calciferous glands. Series of postclitellar accessory markings absent ..... *P. notatus* sp. nov.
   3 pairs of calciferous glands. A series of median postclitellar accessory markings present 5

5(4) Large worms (>300 mm in length). Spermathecal pores close to the anterior margins of 7/8 and 8/9. Supra-oesophageal vessel paired ..... *P. minyoni* sp. nov.
   Small worms (<120 mm in length). Spermathecal pores slightly presetal in VIII and IX. Supra-oesophageal vessel single ..... *P. clarkei* sp. nov.

6(3) Female pores paired (exceptionally united midventrally). Dorsal median intersetal distances (*dd*) in segment XII ≑ 3.6 times the width of the ventral setal couples (*ab*). Prostate duct short and straight ..... *P. incommodus*
   Female pore single (exceptionally paired). Dorsal intersetal distances (*dd*) in segment XII ≑ 4.7 times the width of the ventral setal couples (*ab*). Prostate duct long and sinuous ..... *P. raveni*

Plutellus clarkei sp. nov.
Figs 1A, 2C, E, Table 1.

1 = 96, 81 mm; w (midclitellar) = 3.8, 3.4 mm; s = 154, 150 (H., P1). Uniformly circular in cross-section throughout, pigmentless buff in alcohol. Prostomium tanylobous, peristomium much furrowed. First dorsal pore 5/6 (6/7 in P1). Setae *a* and *b* absent from XVIII. Nephropores distinctly visible; in II-IV in *d*-lines, V-VII in *c,* VIII in *d,* IX in *c,* X in *d,* XI in *c,* XII in *d,* XIII in *b,* thereafter alternating regularly between *d* and *b* throughout; in P1 a similar sequence, but with regular alternation commencing with first *b*-line pore in XI. In P2 there is an asymmetric sequence as follows: *right side*: II-XI (*d,d,d,c,c,d,c,d,b,d,* et seq.); *left side:* II-XIV (*d,d,d,c,c,c,d,c,d,d,d,b,d,* et seq.); this asymmetry continues throughout. Clitellum annular, faintly developed over XIV-XVII; intersegmental furrows, dorsal pores or setae not obscured. Male genital field (refer to Fig. 1A): A series of 4 broad, tumid pads extending longitudinally across the segment, and laterally to slightly beyond *b*-lines present in XVII-XX; each bears a varying number of small, glandular, dimple-like markings. Male pores are visible as minute orifices in *b*-lines, each pore with a dimple-like marking immediately anterior to it. A pair of broad mid-ventral pads similar to those in XVII-XX is present in X and XI; these also

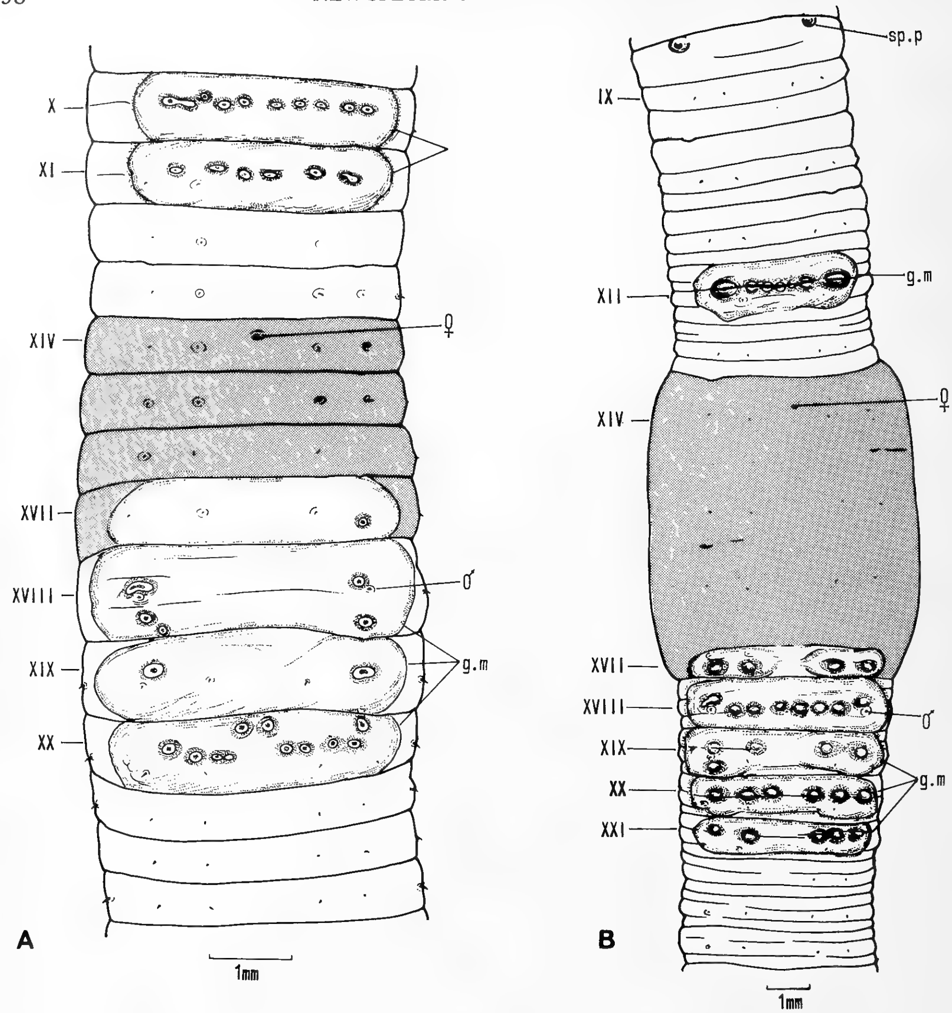

Fig. 1. Genital fields; **A** — *P. clarkei* (Holotype), **B** — *P. minyoni* (Holotype).

bear rows of dimples. Female pore faint, unpaired median, slightly presetally in XIV. Spermathecal pores on small papillae, presetally in VIII and IX, slightly lateral to *b*-lines.

Septa: 5/6 diaphanous, 6/7 thin, 7/8 with slight thickening, 8/9-10/11 moderately-strongly muscularized, 11/12 slightly thickened, remainder thin. Dorsal blood vessel single, continuous onto the pharynx, bifurcating under the brain. Last hearts in XIII; only commissurals XI-XIII are distinctively heart-like, though the remainder are still quite large, decreasing in size anteriorly. Commissurals X-XIII may be considered latero-oesophageal, receiving a short, thick, connective from a prominent latero-calciferous trunk on each side, and a much thinner connective from the dorsal vessel. The calciferous vessels fuse in the mid-dorsal line to form a prominent supra-oesophageal vessel. Beginning in mid-XIII, this vessel runs forwards to XII, to join the point of fusion of the latero-calciferous trunks in that segment. In H., there is no apparent continuity of the supra-oesophageal forward to 11/12, though this is discernible in P1. Thereafter, the vessel continues anteriad through XI to X, where it terminates at or near 9/10. A paired sub-oesophageal vessel supplying the calciferous glands is present. Gizzard large, cylindrical, and well vascularized, in V; though obviously muscular, it is somewhat compressible, with a conspicuous anterior rim. Oesophagus of moderate width, well vascularized, over VI-XIV; 3 pairs of flattened-discoid (almost reniform) calciferous glands present ventrally in XI-XIII. (In H., the middle pair, in XII is greatly reduced, appearing like simple oesophageal pouches; in both paratypes, however, normal glands are present, suggesting that the condition seen in the Holotype should be regarded as an abnormality). Each highly vascular, lamellate gland is attached dorso-laterally to the oesophagus by a long, though broad, stalk. Intestine commences abruptly in XV, typhlosole absent. Nephridial bladders crinkled, somewhat lobulated, those overlying the dorsal-most nephropores (i.e. in *d*-lines) more pronounced than the other series. Holandric; 2 pairs small-medium sized sperm funnels, and flocculent sperm masses in X and XI; 2 pairs of racemose seminal vesicles in IX and XII. Septa 9/10, 10/11 and 11/12 are joined dorsally by a thin, but definite, pericardial testis-sac. Vas deferens not traceable, excepting in XVII-XVIII; prostates simple tongue-shaped lobes in H. (simple S-shaped in P1, extending into XIX), restricted to XVIII, with a short, but much coiled duct entering the parietes in that segment. The unpaired vas deferens enters the glandular portion of the prostate ventrally, a little distance from the point of visible origin of the duct. (Refer to Fig. 2C). Ovaries a discrete sheaf of small oocytes, and large funnels, in XIII; ovisacs absent. Spermathecae 2 subequally sized pairs in VIII and IX, discharging anteriorly in their segments. Each comprises a tubular ampulla, with long bent duct (of ill-defined origin), and (in rt. IX, H.) a single, uniloculate, inseminated, digitiform diverticulum, arising approximately midway along the length of the duct. Length right spermatheca of IX = 1.78 mm; length spermatheca: length of duct = 4.5; length of spermatheca: length of diverticulum = 3.00. (Refer to Fig. 2E). Considerable variation exists as to the number and nature of the spermathecal diverticula; in H., the left IX spermatheca diverticulum is flattened, and appears biloculate; in right VIII, there are 2 quite discrete diverticula; in P1 all but left IX spermathecae have 2 diverticula.

TABLE 1

Intersetal Distance in Segment XII expressed as a Percentage of the Circumference (U).

	aa	ab	bc	cd	dd	dc	cb	ba	U (mm)
Plutellus clarkei									
Holotype	12.45	5.36	11.26	12.08	30.06	11.55	11.71	5.53	9.65
AM W6646	12.78	5.36	10.46	10.13	32.66	11.81	10.55	5.74	9.37
QM G8913	13.51	5.90	11.95	12.87	25.90	11.59	11.99	6.29	9.92
$\overline{X}$	12.91	5.71	11.22	11.69	29.54	11.65	11.42	5.85	
Plutellus minyoni									
Holotype	13.02	6.39	7.13	13.64	32.55	13.76	7.07	6.39	12.80
Plutellus notatus									
Holotype	10.68	5.41	12.99	14.24	22.57	13.39	15.31	5.41	11.10
QM G8914	9.77	5.20	15.06	12.33	25.64	12.53	14.26	5.20	13.75
QM G8915	10.42	4.71	15.02	10.53	28.80	11.24	14.97	4.30	14.52
$\overline{X}$	10.29	5.11	14.36	12.37	25.67	12.39	14.85	4.97	

Material Examined: From 153° 24′E, 28° 37′S. Scrubland at the top of the Minyon Falls, Whian Whian State Forest, approx. 12 km SW of Mullumbimby, N.S.W., under *Casuarina, Eucalyptus pilularis,* and shrubby understory, with extremely dense litter layer on the soil. Soil rocky in patches, formed on rhyolite. Coll. G. Dyne and H. Clarke, 19 Mar 1978. Holotype (AM W6645), P1 (AM W6646), P2 (QM G8913).

Remarks: The combination of 3 pairs of calciferous glands, posteriorly shifted spermathecal pores (2 pairs only), and single supra-oesophageal blood vessel distinguishes this species from the remainder of the genus. Morphologically, apart from the size discrepancy, *P. clarkei* is very similar to its sympatric congener, *P. minyoni.* The comparatively close conformity in, amongst other characters, the general appearance of the genital fields and setal ratios, suggests that reproductive isolation between the two populations has been a relatively recent process. In this instance, as in the case for the vast majority of earthworm species where breeding data are unavailable, specific integrity is assumed if (a) consistent morphological differences indicate a lack of gene flow between any 2 populations; (b) consistent major discrepancies exist either in size and/or the configuration of the genital fields as to preclude the operation of a specific mate recognition system (sensu Patterson, 1978).

Plutellus minyoni sp. nov.
Figs 1B, 2A, B, D. Table 1.

l = 410 mm; w(midclitellar) = 3.3 mm; s = 387. Form long, relatively thin, whitish in life, pigmentless buff in alcohol. Prostomium epilobous $\frac{1}{3}$-$\frac{1}{2}$, closed, peristomium furrowed. First dorsal pore in 6/7 (slightly imperforate). Setae *a* and *b* absent from XVIII. Nephropore configuration: II-IV in *d* (R and L); V-VI in *c* (R and L); VII in *d* (R) or *c* (L); VIII-IX in *c* (R and L); X in *b* (R) or *d* (L); XI in *d* (R) or *b* (L), thereafter alternating regularly between *b* and *d* lines, though asymmetrically on each side of the body. Clitellum annular, strongly protruberant, in XIV-XVII; dorsal pores and intersegmental furrows obscured, nephropores and setae visible. Male genital field (refer to Fig. 1B): a series of conjoined or paired tumid pads in XVII-XXI, extending across the segment to slightly beyond *b*-lines on each side. Each tumescence contains a series of low, roughly circular nodules appearing as small glandular blisters. In XVII, the tumescences are paired, extending post-setally, with 2 pairs of nodules in the setal lines; in XVIII, the tumid pad fills the segment, with a line of 6 blister-like processes across the mid-segment. At the extremities of this series are the male pores, on very slight papillae, in *b;* immediately anterior to each pore is a further nodule. In XIX, the pads are paired; in XX, the pad is median, unpaired, with a set of 6 pre-setal nodules; similarly for XXI, with a pair of nodules (R) and set of 3 (1 faint) on the left. The tumid pads may be furrowed to a greater or lesser extent, or depressed at their centres. Additional markings: a single, unpaired median tumescence extending across *bb* in XII, filling the segment; the centre somewhat depressed, and containing a series of 5 more or less conjoined circular nodules or blisters across the midsegment; immediately ventral of the lateral rims of the tumescence are 2 larger glandular patches. Female pore a minute, unpaired median slit, barely pre-setal, in XIV. Spermathecal pores 2 conspicuous pairs in VIII and IX, slightly posterior to intersegments 7/8 and 8/9, on glandular papillae.

Septa: 5/6 thin, 6/7 slightly thickened, 7/8-10/11 highly muscularized and thickened; 11/12 moderately thickened, remainder thin. Dorsal blood vessel single, continuous onto the pharynx; supra-oesophageal vessel present, paired, in XI-XIII (though very faint in XI). Last hearts in XIII, commissurals in XI-XIII large and

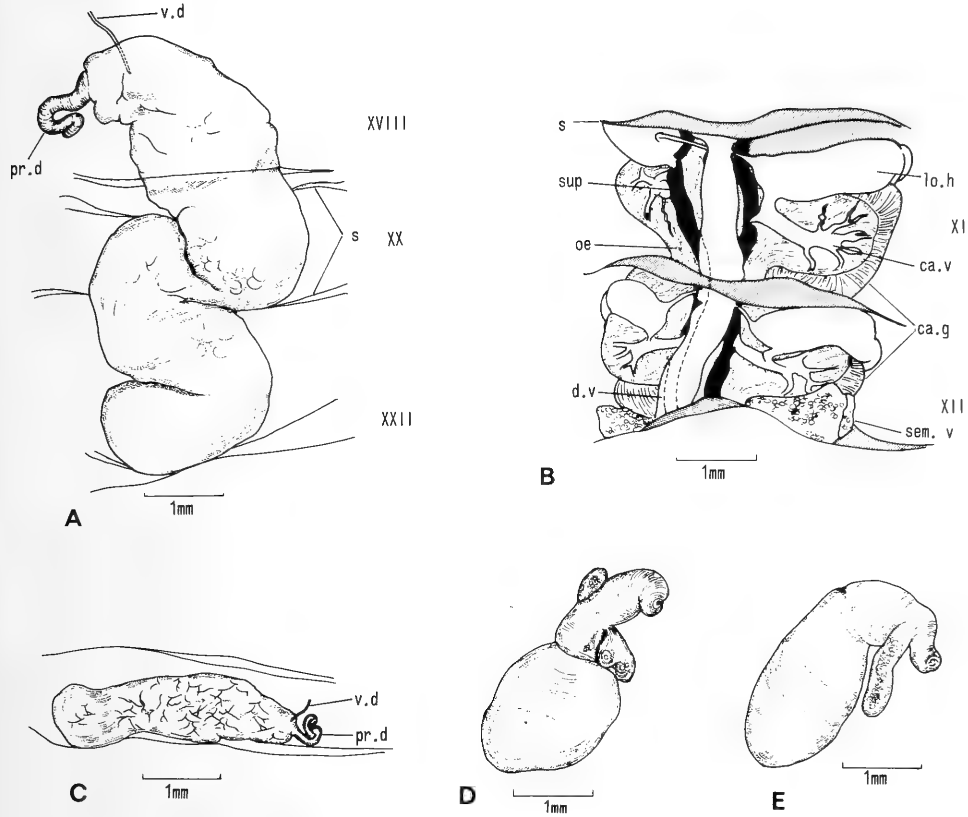

Fig. 2. **A** — *P. minyoni* right prostate gland *in situ* (H); **B** — *P. minyoni* dorsal aspect of gut vascularization in XI and XII (H); **C** — *P. clarkei* left prostate gland *in situ* (H); **D** — *P. minyoni* right spermatheca of IX (H); **E** — *P. clarkei* right spermatheca of IX (H).

heart-like, arising from a strong pair of connectives from the lateral calciferous vessels in XI-XII, and from long, much more tenuous connectives from the dorsal vessel (refer to Fig. 2B). The paired supra-oesophageal trunks connect the lateral calciferous vessels in XI-XIII, but the former are not discernible in X. Definite sub-oesophageal vessel apparently absent. Commissurals VI-X dorso-ventral only. Paired collecting vessels from the calciferous glands are present ventrally, and pass forwards through the septa, also sending branches to the body wall. Gizzard firm, muscular and barrel-shaped in V, with a comprehensive blood supply and distinct anterior rim. Oesophagus narrow, VI-XIV, becoming more dilated in the region of the calciferous glands. Three pairs of discrete, rounded-discoid calciferous glands vento-laterally disposed in XI-XIII, each with a definite, broad, dorso-lateral stalk connecting the gland to the oesophagus; the diameter of the stalk lumen as it communicates with the oesophagus is quite narrow, but broadens at the gland. The latero-calciferous trunks are adherent to, and begin to bifurcate, on the stalk. Intestine commences with abrupt expansion in XV, typhlosole absent. Stomate holonephridia throughout, each with collapsed semi-spherical bladders at the ectal extremes of their excretory ducts; these often appearing crinkled and/or bilobed. The ducts conspicuously alternate asymmetrically on each side of the body in the position of exit to the exterior.

Holandric; testis tissue (?), 2 medium-sized pairs of slightly plicate, iridescent sperm funnels, and some free sperm masses in X and XI; both these segments appear to be at least partially sealed dorsally by thin, pericardial testis-sacs. Two pairs of small seminal vesicle masses in IX and XII, the latter pair the larger, comprising small dorsally situated loculi grading into much larger, globose, ventral component loculi. Seminal vesicles in IX simple glandular sacs on the anterior wall of 9/10. Prostates somewhat sinuous S-shaped glands, tubular in appearance, extending into segment XXII (L). The duct is short and narrow, with a single loop. The fused vasa deferentia join the gland on the ventral surface some distance from the entry of the duct (refer to Fig. 2A). Small ovaries and small-medium funnels in XIII. Spermathecae 2 subequal pairs in VIII and IX, discharging anteriorly in their segments (refer to Fig. 2D). The larger of the two inseminated diverticula may be bilobed (as R IX) or uniloculate (remainder). Length right spermatheca of IX = 3.28 mm; ratio length spermatheca: length of duct = 2.08.

Material Examined: From 153° 24′E, 28° 37′S. Scrubland at the top of the Minyon Falls, Whian Whian State Forest, N.S.W.; (Locality data identical to that listed for *P. clarkei*) a single intact specimen, designated the Holotype (AM W6647), together with several anterior amputees not designated as types.

Remarks: The combinative possession of 3 pairs of calciferous glands, 2 pairs of spermathecae, and paired supra-oesophageal blood vessel is unique to this species. The affinities of *P. minyoni* with *P. clarkei* have been discussed under the relevant section for the latter species. Of considerable interest is the striking similarity between *P. minyoni* and a species of *Heteroporodrilus* from the Lamington Plateau, S.E. Queensland, *H. lamingtonensis.* In addition to the close resemblance in the configuration and nature of the genital field markings, there is close conformation in a number of important internal characters, including the mutual possession of 3 pairs of calciferous glands, testis-sacs, and 2 pairs of spermathecae. Apart from the size discrepancy, nature of the calciferous glands (stalked or not), and some details of the vascular system, there is little to separate the 2 species. Although the specific status of either is not in doubt, their gross overall similarities serve to emphasize the tenuous nature of the generic distinction between *Plutellus* and *Heteroporodrilus.*

The distribution of the latter genus is something of an enigma, for, though there is a great diversity of species in S.E. Queensland, and representatives in the basins of the Murray-Darling River systems, including a species from South Australia, *Heteroporodrilus* has not been recorded from eastern New South Wales. Though the MacPherson Range intervenes between S.E. Queensland and N.E. New South Wales, no significant climatic, pedologic or floristic discontinuities that might hinder the spread of earthworm species are recognizable.

Plutellus notatus sp. nov.

Fig. 3 (A-E), Table 1.

l = 105, 85 mm; w (midclitellar) = 2.7, 2.4 mm; s = 232, 262. (H., P1). Uniformly circular in cross-section throughout, pigmentless buff in alcohol, clitellum pinkish. Prostomium tanylobous, peristomium narrow. First dorsal pore 6/7. Setae *a* and *b* absent from XVIII. Nephropores distinctly visible; in II-IV in *d,* V-VI in *c,* VII in *d,* VIII slightly lateral of *b,* thereafter a regular alternation between *d* and *b* lines.

Clitellum strongly developed, cingular, embracing segments XIV-XVII; dorsal pores obscured, setae, intersegmental furrows distinct. Male pores situated on small

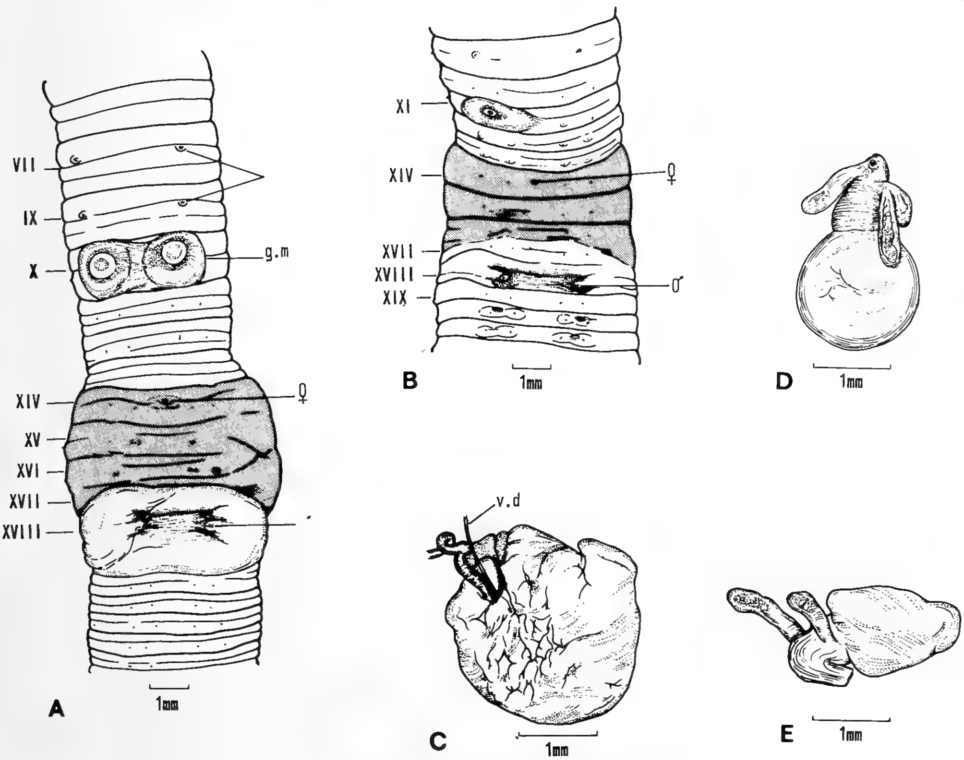

Fig. 3. P. notatus: **A** — genital field of Holotype; **B** — genital field of QM G8914; **C** — right prostate gland *in situ* (H); **D** — right IX spermatheca of QM G8914; **E** — right IX spermatheca of Holotype.

papillae in conspicuous depressions, in *ab*. The papillae are separated by a slightly raised intervening strip, and surrounded by a thick rim of highly tumescent tissue which incorporates XIX, and slightly overhangs XX. This tumid area extends beyond *b,* and forms a rough ellipse, with the male pores approximating the foci. Female pore unpaired, median, slightly presetal, in XIV. Spermathecae 2 pairs, opening in the midsegment of VIII and IX on small papillae, in *b*-lines. The left set of pores open posterior to the mid-segmental furrow, whilst the anterior set open anteriorly. Accessory markings: a single, highly tumescent swelling of bipartite appearance, the two portions with a central depressed 'dimple' region; this marking fills segment X longitudinally, extending laterally to *b*-lines.

Septa: 5/6 diaphanous, 6/7 moderately muscular, 7/8-10/11 strongly thickened and muscular, 11/12-13/14 slightly thickened. Dorsal blood vessel single, continuous to the pharynx. Last hearts in XIII; supra-oesophageal vessel absent. Hearts in ?X, XI-XIII apparently drain the lateral calciferous vessels directly, before the latter vessels fuse mid-dorsally as a contiguous loop. In X-XIII (P1), there appears to be a further, much smaller connective to the dorsal vessel (from the dorso-ventral commissurals). Calciferous glands with a moderate vascularization only (though the entire vascular system is somewhat bleached). Commissurals diminish rapidly in size anteriad from X. Gizzard globular, slightly elongate, and highly muscular, (slightly compressible), in V. Oesophagus narrow, not vascular to any degree, excepting the final 5-6 segments. Four pairs of discrete ventro-lateral calciferous glands in X-XIII, their blood system bleached, the individual glands of each pair virtually contiguous, and each with numerous, well-developed lamellae. The glands are connected to the oesophagus by medium-length, stout, dorsolateral stalks, these appearing, at least superficially, to be more highly vascularized than the glands themselves. Intestine commences in XXI (H) or XVI (P1, 2), typhlosole and caeca absent. Nephridial ducts terminate in conspicuous ovoid bladders, which discharge through a wide tube to the exterior; the bladders themselves are rather diaphanous and collapsed, with little variation in shape. Nephridial funnels and necks lie transversely in the segment preceding, in *a*-lines, the neck running transversely to *b*, then dipping into the setal line, and running posteriad through the septum to join the nephridial body. Holandric; 2 pairs of large, iridescent funnels and coagulated sperm masses, seemingly enclosed in a very thin membrane under the oesophagus, in X and XI. Seminal vesicles 2 prominent pairs, with large component loculi, in IX and XII, with a pair of smaller agglomerations just anterior to the funnels in XI. Vasa deferentia visible as single iridescent ducts on each side, not tortuously winding, joining the prostate gland at the point of insertion of the duct. Prostate glands roughly squarish lobes, conspicuously fissured, extending from XVIII into XIX. Duct long, narrow and muscular, somewhat coiled, entering the parietes in XVIII (refer to Fig. 3C). Ovaries, comprising a racemose cluster of smallish oocytes, and a large folded funnel close to the nerve-cord on each side in XIII. The oviducal ducts are visible passing through septum 13/14, and fusing just prior to entering the parietes under the nerve-cord. Spermathecae 2 pairs in VIII and IX, discharging into the midsegment. Each comprises a conico-sacciform ampulla, and long, stout duct, which is bent through an acute angle before entering the body wall. From either side of the ental region of the duct arise 2 subequal, digitiform diverticula, each containing what appear to be a number of brightly iridescent sperm clusters (refer to Fig. 3D, E). Length right spermatheca of IX = 2.8 mm; ratio length spermatheca: length of duct = 2.3; ratio length of spermatheca: length diverticula (mean) = 2.75.

Material Examined: From 152° 55′E, 26° 25′S. Six Mile Creek, near Cooroy; under ferns in riverine rainforest, near creek bank. Coll. G. Dyne and J. Wampler, 3 Feb 1978. Holotype (AM W6648). Same locality, coll. G. Dyne and M. Williams, 27 June 1976. Paratypes 1 and 2 (QM G8914-5).

Remarks: The possession of two pairs of spermathecae and four pairs of calciferous glands serves to distinguish this species, which, together with *P. raveni* and *P. incommodus*, defines a northerly extension of the generic range. Like the latter two species, *P. notatus* has racemose prostate glands (as in *Heteroporodrilus*), in contrast to the tubular or tubulo-racemose organs found in the remainder of the genus (and *Paraplutellus*). In other respects, however, *P. notatus* is morphologically dissimilar to the other Queensland *Plutellus* species.

Discussion

Apart from *Plutellus* s. strict. itself, only 2 other Australian genera may be referred to as being truly 'plutelloid', or, more satisfactorily, as 'heteropore'. These are *Paraplutellus*, an insular, monotypic genus from Lord Howe Island, characterized by an unusually anterior commencement of nephropore alternation, and restriction of the calciferous glands to a single pair, in XIII; and *Heteroporodrilus*, which differs from *Plutellus* consistently only in the possession of sessile, rather than stalked, calciferous glands. A number of other Australian species, previously confined within the broadly defined classical *Plutellus*, have largely been redistributed amongst genera such as *Simsia* and *Graliophilus*, now more appropriately regarded as 'Diporochaetoid'.

In consideration of morphological trends seen elsewhere within the Megadriles, and the more widespread distribution of the sessile-glanded forms, it seems justifiable to consider the stalk-glanded *Plutellus* as the more derived genus. In Hennigian terms, *Heteroporodrilus* would be seen as the plesiomorph sister-group of *Plutellus* s. strict. Although close resemblances have been demonstrated between different species across the two genera (e.g. *P. minyoni* and *H. lamingtonensis*), with the possibility of the existence of truly intermediate forms, maintaining the two assemblages as distinct entities is probably warranted, in that the calciferous arrangement of *Plutellus* s. strict. represents a discrete apomorphic divergence that has attained fixation in a number of divergent species.

As Jamieson (1977) suggests, *Paraplutellus* appears to be yet further derived, having lost the gizzard, and reduced the calciferous gland series to a single pair, perhaps secondarily sessile. Wallace (1972), in a numerical analysis of 49 'plutelloid' species from Australia and North America, employing 36 characters over 95 character states, found a consistent cohesion of the *Plutellus* — *Heteroporodrilus* — *Paraplutellus* group, as distinct from clusterings identifiable as *Simsia* — *Graliophilus* and *Diporochaeta* — *Fletcherodrilus* groups. Wallace (1971) also notes that the former assemblage is 'remarkably homogeneous' with respect to nephridial characters such as nephropore arrangement, vesicle shape, lack of pharyngeal tufting, and overall morphology.

Detailed interpretation of the fate of the large extra-Australian residue of species created by the restriction of *Plutellus* must be deferred, but clearly, the North American species analysed in the above computational study which segregated at a high level of dissimilarity from other groupings into a well-defined cluster, appear to demand generic identity. In an independent assessment, Gates (1972) resurrected Eisen's genus, *Argilophilus*, ostensibly to absorb North American forms, and comments further: 'Burmese, if not all Oriental species (of *Plutellus* s. lat.) can go better into *Argilophilus* than any genus of which *heteroporus* is the type-species'. These, like the American species, lack calciferous glands, but the reservations conceded by the same author (op. cit.), namely the apparent further excretory modifications of the oriental worms and 'the vast oceanic gap', also deserve consideration.

Acknowledgements

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APPENDIX

ABBREVIATIONS USED IN THE TEXT AND FIGURES

AM	Australian Museum	s	septum
ca.g.	calciferous gland	s (descr)	number of segments
ca.v	calciferous vessel	sem.v	seminal vesicle
d.v.	dorsal vessel	sp.p	spermathecal pore
g.m.	genital marking	sup	supra-oesophageal vessel
lo.h	latero-oesophageal heart	v.d	vas deferens
l	length	w	width
oe	oesophagus	♂	male pore
pr.d	prostatic duct	♀	female pore
QM	Queensland Museum		

The Start of government Science in Australia: A. W. H. Humphrey, His Majesty's Mineralogist in New South Wales, 1803-12

T. G. VALLANCE

VALLANCE, T. G. The start of government science in Australia: A. W. H. Humphrey, His Majesty's mineralogist in New South Wales, 1803-12. *Proc. Linn. Soc. N.S.W.* 105 (2), (1980) 1981: 107-146.

From 1803 until 1812 A. W. H. Humphrey held the post of mineralogist in the civil establishment of New South Wales. At the time he had no counterpart in the United Kingdom. His appointment marked a development in official British attitudes to science, begun with the Admiralty's acceptance of civilian scientific staff on exploring voyages. Other European nations, notably France, already acknowledged the value of science and the British decision to send Humphrey may have been related to the fact that a French expedition then active in the Australian region included two mineralogists. Whether or not that was the case, Humphrey in Australia — paid even less than the miner who went with Flinders on the *Investigator* voyage — was soon all but forgotten; early colonial records give little about the man or his work. What tends to be remembered is Governor Macquarie's stinging indictment when he accepted Humphrey's resignation in 1812.

The present study is based chiefly on Humphrey's letters, here printed for the first time (Appendix), and other papers in Australian and English archives. They extend knowledge of the London dealing trade with which Humphrey's family was closely connected. To those connections Humphrey owed his appointment. His letters are valuable records of early Australian settlement and reveal an active association with Robert Brown. The papers show the injustice of Macquarie's dismissive view. Humphrey, as H.M. Mineralogist, may not have contributed much to Australian science but, it is suggested, the circumstances of his employment hardly encouraged achievement. Government had established a post without bothering to define adequately either purpose or expectations. At the outset, at least, Humphrey pursued what he saw as duty with intelligence and enterprise.

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INTRODUCTION

From 1803 until 1812 the civil establishment in Australia included an officer whose duty, nominally at least, was science. If government involvement in science nowadays is taken for granted, it was quite otherwise with British administrations at the time A. W. H. Humphrey, Gent., became His Majesty's Mineralogist in the settlements of New South Wales. Even in the United Kingdom, crown patronage of natural science then hardly went beyond the Royal Observatory at Greenwich and the British Museum at Montagu House where, in the Department of Natural and Artificial Products, natural history kept company with antiquities under the care of a keeper (E. W. Gray [1748-1806]) and one assistant (Miller, 1973). In 1803 only the assistant, the naturalist George Shaw [1751-1813], was at all active. The first mineralogist at the museum, C. D. E. Konig [1774-1851], joined in 1807 to assist Shaw, by then himself keeper. Not until 1814 was a mineralogical and geological surveyor attached to the Trigonometrical Survey in the United Kingdom (Close, 1926) and another twenty-one years passed before establishment of a separate Geological Survey (Flett, 1937).

Despite the novelty of Humphrey's appointment, little attention hitherto has been paid either to the man or his duty. Giblin (1939: 33), an industrious student of early Tasmanian history, gave a typical explanation — the poverty of documentary evidence made it 'impossible even to figure the role of A. W. H. Humphrey, the mineralogist'. In fact, copies of letters from Humphrey to his father, written in the period 1803-4 and preserved among the Hamilton and Greville Papers in the British Library, London, undermine that claim. The London manuscripts, here transcribed and printed for the first time (Appendix), throw light on Humphrey, his activities, his associates — who included the botanist Robert Brown [1773-1858] — and a fascinating period of Australian settlement. They extend the account in Stancombe's (1966) short biographical essay, a useful contribution despite its failure to recognize the significance of Humphrey's origins. In that regard papers now in the Tasmanian Archives, Hobart, yield details important to historians of natural history.

A note in *Historical Records of Australia* (series III, vol. I: 782), a collection hereafter designated *HRA*, queries the date (14 January 1803) given on Humphrey's commission. The note claims the post was not offered until 1 February and accepted only on 18 February 1803. That source further identifies the offer as coming from Charles Greville and, paraphrasing Greville, explains 'that the position required more knowledge than that usually possessed by a working miner, and the duties would consist of making a collection of minerals and earths, and of directing some miners in their search for minerals'. The involvement of the Rt Hon. and Hon. Charles Francis Greville [1749-1809] is not surprising. This strangely-forgotten figure — forgotten that is except for his association with Emma Lyon or Hart, later Lady Hamilton — in his time almost rivalled Sir Joseph Banks [1743-1820] as a patron of science in London. Greville shared certain botanical interests with Banks — both are honoured as founders of the Horticultural Society (Anon., 1942) — but Greville's enthusiasm as a collector was directed particularly towards minerals and there he and Banks parted company. Banks had ignored Governor John Hunter's plea of 1797 that a mineralogist be sent to New South Wales and when, in 1801, Matthew Flinders [1774-1814] sought such a person for the *Investigator* expedition Banks chose a practical miner from his Derbyshire estates as sufficient for the purpose (Vallance and Moore, 1981). In 1803 Greville had the chance to promote his field of interest.

Greville's mineral collection, built-up over more than thirty years, then had no rival in England. Its acquisition by purchase in 1810 for the British Museum raised that institution's holdings of minerals to 'the first rank among the collections of the world' (British Museum, 1904: 345). To create this and his other natural history collections, Greville depended chiefly on dealers but also on correspondents in distant parts. Robert Brown, going to Australia with Flinders, was reminded of Greville's needs (Vallance and Moore, 1981); the genus *Grevillea* (Brown, 1810: 375) is a memento. Greville, like Banks, used his influence to place protégés. One such already in Australia (*Hist. Rec. N.S.W.* III: 652) was the explorer F. L. Barrallier [1773-1853] whose father, a dockyard surveyor and engineer, worked at Milford Haven, south Wales, on the estates managed by Greville (Beazley, 1976 — where Greville is confused with his brother!) for his uncle Sir William Hamilton, the ambassador at Naples and student of Mt Vesuvius. Peter Good, the gardener and Brown's assistant on *Investigator* until his death in Sydney, 12 June 1803 (*Sydney Gazette*, 19 June 1803), likewise owed his position to Greville's influence (Anon., 1942: 230), as well as to the support of W. T. Aiton of Kew (Edwards, 1976: 387).

Greville's patronage of one who was to collect minerals in Australia might seem an expression of self-interest, and an unusual privilege Humphrey received with his appointment to deepen suspicion. In fact, there is no evidence that Greville received anything directly from the mineralogist in Australia; the privilege, as will be shown, was more likely a response to commercial instinct in the Humphrey family. At any rate, Humphrey held the right to ship home free of charge and for his own disposal one set of all samples he collected. The concession was made known in a despatch (*HRA* (I) IV: 37) to Governor Philip Gidley King [1758-1808] in Sydney announcing the appointment of Humphrey, a man 'in every respect well qualified for the duty'. As to the duty, King received only the vaguest advice. One wonders what, if any, more specific instructions were issued to Humphrey. Had the government itself any clear ideas as to his role? If Humphrey were deemed qualified for a post supposedly requiring some special knowledge, the salary offered (£50 *per annum*) compares miserably with the £105 paid to the miner who went with Flinders. Colonial records, indeed, show that Humphrey received a yearly stipend of £95.5.0. in Australia — the same as that paid in Hobart to the assistant surgeon, the deputy commissary and deputy surveyor — but when it is recalled that Robert Brown's salary as naturalist on *Investigator* and in Australia amounted to £420 *per annum*, the lowly status of H.M. Mineralogist becomes abundantly clear. The government was paying Humphrey not as a scientist but rather as a prospector. In spite of the official confidence, did Humphrey's background really prepare him for either sort of work?

A Collection Of Dealers

During the 18th century an extensive trade in objects of natural history arose to satisfy wealthy Europeans who through genuine interest or mere fashion wished to have their own collections or cabinets. At least three generations of the Humphrey family were active in that trade. Others, related to them by marriage, combined to give a century's service to one or other branch of natural history dealing. Theirs is a story that deserves to be told separately; here it is intended only to fix the place of Humphrey the mineralogist and to correct seeming errors in recent papers. The main source for this revision is a genealogy prepared by Humphrey's eldest sister and now preserved in the Tasmanian Archives as part of Caveat Board Report 525 (Supreme Court of Tasmania, SC 285/25).

According to the Hobart document, Adolarius William Henry Humphrey was baptized at the Church of St Martin-in-the-Fields, London, on 26 May 1782. One presumes he was born in London earlier that year or late in 1781. That would agree with a note (*HRA* (III) I: 782) indicating Humphrey was 22 years of age when he landed at Hobart in February 1804 and his obituarist's advice (*Hobart Town Courier*, 16 May 1829: 2) that the former mineralogist died aged 47 on 11 May 1829. From the genealogy it appears he predeceased two elder sisters and a younger sister and brother. Their father, George Humphrey, the most prominent of the Humphrey dealers, is known chiefly for his concern with shells. He will be referred to here as George (II), to distinguish him from his father, according to Swainson (1840: 219) also a dealer, and his younger son George (III). Swainson gives a fulsome account of George (II), acknowledging the encouragement Humphrey showed him when a boy. The genus *Humphreyia* (Gray, 1858a) and family Humphreyiadae (Gray, 1858b) recall his name. Their author, J. E. Gray [1800-1875], had known Humphrey as an old man and thought him, while 'comparatively an uneducated person', one 'far in advance of the state of natural history of his time' (Gray, 1858b).

George (II) was associated with a number of sales still remembered by their catalogues — his own *Museum Humfredianum* (1779), for instance, as well as the Portland sale (1786) and the *Museum Calonnianum* (1797). Whitehead (1973, 1977), Dance (1962) and Iredale (1937) refer to Humphrey's part in the preparation of one or other of these catalogues. George (II) contributed one paper to the Linnean

Society of London (*Trans*, 2, 1794: 15-18) and, as Whitehead (1977) shows, was involved with E. M. da Costa [1717-1791] in the unfinished *Conchology, or natural history of shells* (1770-71). Another work printed in London, *Rare subjects in conchology* (2d edition), is attributed to Humphrey by the Library of Congress, Washington D.C., owner of what may be a unique copy. The first edition is unknown but if the date (1790?) assigned to the second is a guide this short account of specimens belonging to the French emigré C. A. de Calonne [1734-1802] shows that Humphrey knew the collection long before he was involved in its sale following Calonne's ruin in the Bourbon cause. An apparently-unpublished *Directions for collecting and preserving all kinds of natural curiosities, particularly insects and shells*, dated London 1776, in the library of the University of Pennsylvania, Philadelphia, is also attributed to George (II) Humphrey.

George (II)'s dealings in minerals are exemplified in the unpublished *Catalogue of Fossils* listing a collection possibly prepared for, and certainly sold to, the Rev. C. M. Cracherode [1730-1799] who bequeathed his mineral cabinet, built on this purchase from Humphrey, to the British Museum. The collection, Humphrey's manuscript catalogue considerably extended by Cracherode's later acquisitions and a transcript of the whole made by E. W. Gray, are now in the Department of Mineralogy at the British Museum (Natural History). Humphrey's work clearly belongs to the period 1786-88, for certain items listed in his hand refer to purchases at the Portland sale and the catalogue bears Cracherode's monogram with the year 1788. The arrangement adopted by Humphrey appears to follow broadly Linnaeus's scheme in the 12th (Stockholm, 1768) edition of *Systema Naturae* but with variations that give the whole a character *sui generis.* Humphrey evidently had a fair working knowledge of minerals.

The Humphrey genealogy in Hobart disagrees with information recently reported by Frondel (1972) and Whitehead (1973) on George (II) and other members of the family. George (II), according to the Hobart document, was baptized 19 August 1739 at St John's, Wapping (London), where his parents had married in 1733 or 1734. George (II), in turn, was married at 'St Anne Westminster' (St Anne's, Soho) on 3 August 1771 and buried there 8 January 1826. His brother William, one of the artists employed on da Costa's *Conchology* (Whitehead, 1977) was baptized at Wapping in 1745 and buried in the Soho churchyard 27 May 1810. Whitehead (1973) refers to William's sponsorship of the caricaturist James Gillray, with whom his unmarried sister, Hannah Humphrey [1750?-1818], had a 'curious relationship'. Whitehead adds that the print-selling business at 27 St James's Street was taken over after Hannah's death by her nephew George (III) who, in 1823, had his own shop three doors away. This George, the youngest child of George (II), seems to have continued his father's business. The genealogy records the baptism of George (III) at 'Christ Church Surrey' 24 May 1789, his marriage at St Marylebone (no other details) and burial in Soho 19 June 1831.

Through George (II)'s elder sister Elizabeth the Humphreys became linked with another family of dealers, known especially for their trade in minerals. Baptized at Wapping 3 April 1735, Elizabeth Humphrey married (Adolarius) Jacob Forster or Förster [1739?-1806] at St Martin-in-the-Fields on 16 August 1768; she was buried in Soho 29 February 1816. Her husband is commemorated in the olivine mineral *forsterite* (Frondel, 1972). A German by birth, Forster had business interests in London, Paris and St Petersburg, and travelled widely both as collector and dealer. The last ten years of his life, in fact, were spent in Russia and there he died, at St Petersburg 26 May 1806. During this period his wife ran the business in London. Frondel (1972) refers to the mineral store in Paris as conducted by a brother (Igham)

Henry Forster, whom Whitehead (1973) suggests was Ingham Forster, a London dealer and friend of E. M. da Costa. Any connection of Ingham Forster, however, with the Paris business must have been slight. Ingham Forster died in 1782 (*Gentleman's Magazine*, 82 (1), 1812: 515) whereas, according to Frondel (1972), Jacob Forster's will, written in 1800 and later, names a brother Henry and a nephew John Henry Heuland [1778?-1856] as legatees. A passage in Schneider (1809: 47-50) identifies the brother as Herr Bergrath Joh. Heinrich Forster who from time to time and for long periods had looked after the Paris business but when Schneider wrote was living in retirement at Breitenbach by the König See in Bavaria.

The nephew mentioned in Jacob Forster's will himself became a London dealer. Like his uncle, Heuland is remembered in the name of a common mineral, the zeolite *heulandite*. Despite this eponymous fame, little is known of the man — apart from his public career as a dealer. At least that is the impression one gets from his only biographer (Russell, 1950). Heuland, in fact, was German, and presumably a son of Forster's sister. Schneider (1809) refers to three brothers from Bayreuth, the youngest of whom — Herr Heinrich Heülandt — had assisted his uncle Jacob Forster with the collection acquired by Tsar Alexander I in 1802. The Bayreuth connection is admitted by Heuland himself in a letter dated 7 September 1807 to the Cornish antiquary and mineralogist Philip Rashleigh [1729-1811]: 'Not being an Englishman, I at this time luckily run no risk to go to Paris Sir. Till last year I was a prussian subject, but through the treaty of Tilsit a bavarian now, as Bayreuth in franconia to which I belong, was given to bavaria' (County Record Office, Truro, Cornwall — DDR 5757/1/101). Schneider's remark that the other brothers were in the service of the King of Spain, collecting minerals in South America for the royal cabinet is broadly confirmed by the Heuland — Rashleigh archive at Truro though by mid-1807 Heuland knew of the death of his brother Conrad in a Peruvian mine. Russell (1950: 405) plainly failed to notice these contemporary documents. Christian Heuland's account of scientific travels with his younger brother Conrad in Chile and Peru during 1795-96 (Heuland, 1929) likewise escaped Russell's attention. From the Heuland letters it also emerges that 'Addy' Humphrey, the mineralogist in Australia, was not only Jacob Forster's nephew by marriage but also a godson remembered with a legacy of £200 in Forster's will (DDR 5757/2/133 — 20 December 1808).

It is not clear when J. H. Heuland took up residence in London. His letters at Truro reveal that he left Jacob Forster at St Petersburg in 1803; early in 1807 he was in London helping Elizabeth Forster and attending to his inheritance. March 1808 saw the first of his long series of London sales (Russell, 1950). Elizabeth Forster by this time had decided to retire from business and so what presumably was her share of her late husband's natural history stock (5860 lots!) went under the hammer in four sales occupying 45 days of the period 2 May-4 July 1808 [Chalmers-Hunt (1976: 71) cites only the first three sales; catalogues of all four are to be found in the Mineralogy Library, British Museum (Natural History)]. Settlement of the Forster estate was plainly no simple, amicable affair and although Heuland seems to have been genuinely attached to his aunt, the letters to Rashleigh contain numerous caustic remarks about her family. George (II) Humphrey is accused of pocketing his son's legacy, supposedly as a way of recouping the expense of fitting-out 'Monsieur Addy' (DDR 5757/2/133), of acting against him at sales, of spying on his business and of turning Greville against him (DDR 5757/2/117 — 30 October 1808). Heuland suggests a character very different from the one praised by Swainson (1840), but then Swainson was not a competitor. As a comment on Greville's supposed coolness, Heuland's own claim that Greville died owing him £1900 for mineral purchases (DDR 5758/4/1) may be noted.

Such was the family of Humphrey the mineralogist. What he did before 1803 is unknown but is is presumed that he assisted in the dealing trade, learning thereby something of the materials of natural history as well as the collectors who patronized the Humphrey and Forster businesses. Among those patrons was C. F. Greville, to whom Humphrey owed his position in Australia. How Humphrey's background qualified him for pioneering work in the field (cf. *HRA* (I) IV: 37) remains obscure. How he responded to his ill-defined duty will now be considered.

H.M. Mineralogist in Australia

For reasons political, commercial and penal (see *HRA* (III) I: 1-3), the British government late in 1802 resolved to establish a settlement in the vicinity of Bass Strait, then still within the territory of New South Wales. David Collins [1756-1810], at home on half-pay since his return from Sydney in 1797, was to be lieutenant-governor of the outpost. His commission bears the same date as Humphrey's and to his staff the mineralogist was assigned. The haste with which appointments and other preparations for the voyage were made may well have expressed British uncertainty about French intentions regarding Australia. Nicolas Baudin [1754-1803] and his expedition had spent much time in the region of Bass Strait and Tasmania and were still occupied in Australian waters. Did the fact that Baudin was known to have two mineralogists (Vallance, 1975: 23) with him prompt the British to send Humphrey? If so, it was a poor answer, for the Frenchmen had both received tertiary training in mineralogy. Certainly, representations were made in London that the French scientific initiative should be matched. For instance, among the Pelham Papers in the British Library (Add. MS 33124, ff109-116) is a memorandum by the traveller, collector and dealer John Mawe [1764-1829] proposing a mineralogical expedition to New South Wales. The document is undated but reference to French preparations suggests the year 1800. Mawe's remark that 'it will be truly Mortifying to see the French publish the Geology of our settlements' perhaps was kept in mind by Lord Pelham, in 1802 a principal secretary of state in the British cabinet. But if Humphrey, despite his lowly status and reward, is to be seen as Britain's representative in science, at least one lesson had been learned — science and war ought not mix. Unlike all commissions hitherto issued to government officers in Australia, those of Humphrey (*HRA* (III) I: 6) and the chaplain Robert Knopwood [1763-1838] specifically excluded reference to the 'Rules and Discipline of War'.

Of the two ships detailed to take Collins and his contingent to Australia, H.M.S. *Calcutta* had been expected to leave in October 1802 with convicts for Port Jackson. Instead, it remained in port pending a decision on the new settlement. Once that was made and the convicts diverted to Collins's care a privately-owned vessel the *Ocean* had to be chartered to carry the necessary stores. The grossly-overcrowded condition of the *Ocean*, to which Humphrey was assigned, drew protest from Collins on 21 March 1803 (*Hist. Rec. N.S.W.* V: 74) but what, if anything, followed to alleviate the problem is unknown. Just over a month later the ships sailed in convoy from the Isle of Wight.

Accounts of the voyage to Port Phillip by several travellers on the *Calcutta* are known. J. K. Tuckey [1776-1816] published his soon after returning home with the ship (Tuckey, 1805). Parts of Knopwood's diary have long been in print; all the surviving text is now available (Nicholls, 1977). Pateshall (1980) is a recent addition to the literature. As the two ships parted company during a storm in the South Atlantic leaving the *Ocean* to make straight for Port Phillip, Humphrey has a somewhat different story to tell. Though a 'dull sailer', according to Collins, the

Ocean managed to reach her destination two days ahead of *Calcutta.* Unpublished letters and the journal (British Library, Add. MS 45156) of a colleague on the *Ocean*, G. P. Harris [1775-1810], deputy surveyor, supplement Humphrey's narrative. The Harris Papers have still to repay careful attention; Harris and Humphrey plainly shared many interests in natural history. A few remarks on the voyage and more about the settlement made at its end can be found in a letter by the missionary W. P. Crook [1775-1846], another passenger on the *Ocean* (*Hist. Rec. N.S.W.* V: 254-257).

Sullivan Bay (near the present Sorrento — see Appendix, note 15), where convicts and stores were landed and a camp set up, was plainly unsuitable for a permanent settlement; it lacked even an adequate supply of fresh water. Collins could not know that Port Phillip had been charted, by Charles Grimes [1772-1858] from Sydney, only a few months earlier (*Hist. Rec. N.S.W.* V: 263) and had to order his own reconnaissance led by surveyor Harris. Lt Tuckey of the *Calcutta* joined the work. Humphrey appears rather self-righteous in his letters explaining why he did not assist. Then, as later, Collins showed a reluctance to command Humphrey's services, leaving him to volunteer as he chose (cf. *HRA* (III) I: 322). Humphrey's failure to come forward at Port Phillip gave Harris and Tuckey opportunity to report geological matters — and each was a reasonably well-informed observer. The Harris Papers in London and the report printed at *HRA* (III) I: 31-32 show what Harris could do. Tuckey's report (*HRA* (III) I: 110-122) and book (Tuckey, 1805: 158-160, 165) are quite as rewarding. Tuckey, by the way, has another claim to remembrance by geologists. During his ill-fated expedition to the River Zaire (Congo) in Africa, Tuckey took much trouble to collect rocks. Konig's work on the samples, printed as an appendix to Tuckey (1818), is the first published study of a rock collection made by a British explorer.

Humphrey seems to have contented himself at Port Phillip with walks in the 'woods' and work about the camp which, incidentally, was recorded by Harris in map and topographic sketch (British Library, Add. MS 45156, ff12, 13), with the tents of surveyor and mineralogist indicated. If Humphrey's letters repeat what Harris and Tuckey saw, there is evidence in them also of subtle observation. His account of signs of 'Encroachments of the Sea' in the Point Nepean area must be among the earliest discussions of marine erosion in Australia. Of interest likewise is the suggestion, based on observation of the coasts adjacent to Bass Strait and its islands, that 'at some former Period, Van Diemen's Land [Tasmania] was connected with, and formed part of New Holland [Australia]". The thought seems original; there is no hint of it in the only published source (Flinders, 1801) he might have read though, of course, geographers not long before had assumed the link still existed.

The arrival of the schooner *Francis* from Sydney in mid-December 1803 gave Collins the capacity to seek a better site on the Tasmanian side of Bass Strait. This time Humphrey volunteered to join a small party that would examine Port Dalrymple, the only known harbour on the northern coast (Flinders, 1801: 15). Humphrey's narrative of the journey adds considerably to the reports of William Collins [1760?-1819] and Thomas Clark(e) [1756?-1828] printed in *HRA* ((III) I: 583-585 and 585-587, respectively). A storm forced the leaky *Francis* to seek shelter at Kent's Group of islands (Appendix, note 38) where the *Lady Nelson*, overdue and feared lost on a run from Sydney to Port Phillip, was found safe. She was promptly requisitioned for the Tasmanian survey and the *Francis* sent to Sydney with news of the transfer. By this chance Robert Brown, a passenger on the *Lady Nelson*, and Humphrey came together. They were to be closely associated in the field during the following months. No lasting friendship may have resulted but the partnership had its effects on both men. While with Humphrey, Brown put down more about rocks and minerals in his diary and notes (British Museum (Natural History), Botany and Mineralogy libraries) than at any time during his travels with Flinders (Vallance and Moore, 1981), and did so in terms much as Humphrey used. If Humphrey did not botanize in return it is noteworthy that the only known occasions he ventured into unexplored country were in Brown's company. Brown evidently inspired Humphrey to action. Humphrey's respect can be gauged from the care taken to indicate his association with Brown. The converse is less obvious though Brown did not quite forget his erstwhile colleague. A footnote in Jameson (1811: 450) refers to topaz from the Bass Strait islands which 'my learned friend Mr Brown, informs me, was first discovered by Mr Humphrey *junior*, who was some years ago sent out by the Government to examine the mineralogy of New Holland and Van Diemen's Land'. It is strange that neither Humphrey nor Brown mention topaz in their notes — if it were found during their travels together — and even stranger how long the identity of Mr Humphrey *junior* has passed unrecognized.

The excursionists returned with generally-favourable impressions of Port Dalrymple only to find Collins had decided already to move his settlement from Port Phillip to the River Derwent (Tasmania) where, at Risdon Cove, a party from Sydney occupied a camp set up in September 1803. During the removal Humphrey gained credit by volunteering to travel overland to the camp with news that the *Ocean* was storm-bound in Frederick Henry Bay. The episode is reported in official despatches; in the letters Humphrey gives his account — and exaggerates the distance covered. Of wider interest is his record of the foundation of Hobart on a site discovered by surveyor Harris. That Humphrey, rather as an exception, was called on to inspect the place before Collins ordered the move from Risdon is a fact apparently not otherwise known.

Some two weeks after reaching the Derwent, Humphrey and Brown with three colleagues and men to row the boats went up the river to the rapids (near the present New Norfolk) where a survey in 1798 had ended. The trip probably had no serious purpose but Brown botanized and Humphrey took the trouble to examine alum-encrusted holes above the river. The locality is not specified though Brown, reporting a later excursion (27 March), mentions alum 'in the free stone cliffs about half a mile below Dart Head on the left bank (ascending)' (BM(NH), Botany Library, Brown diary f240). Geologically the occurrences seem to be like those at the 'Alum Rocks' (see *Walch's Tasmanian Guide Book*, 1871: 98).

The excursion (9-10 March) to the Coal River likewise covered known ground. Coal had been found there by men from the Risdon camp only a month or so before Collins's arrival; the discovery satisfied an instruction received by their commandant before leaving Sydney (*Hist. Rec. N.S.W.* V: 156). James Meehan [1774-1826] at the time surveyed the country north of Pitt Water and perhaps named the river. Humphrey's first, short visit can have allowed him opportunity for little more than a perfunctory view and the collecting of a few samples. The place soon gained a certain fame; even the lieutenant-governor announced his intention to examine the 'Stratum of Coals' (*HRA* (III) I: 317).

Table Mountain (now Mount Wellington), the towering backdrop to Hobart, had twice attracted Robert Brown to its summit before he and Humphrey made an ascent on 12-15 March 1804. Brown was first there (Brown diary f219 verso) on the day (18 February) Humphrey was inspecting the proposed site for Hobart. The story later put about in the *Hobart Town Gazette* (6 May 1826: 2) by Jorgen Jorgenson [1780-1841] that he had been with Humphrey on his first visit to the mountain is hard to credit. Until April 1804 Jorgenson was attached to the *Lady Nelson* — and she reached Sydney from Hobart on 14 March of that year.

Neither Humphrey nor Brown put down much detail concerning their first major excursion into unexplored country, that in search of the source of the Derwent (27 March-5 April). Humphrey even failed to remember correctly the exact period they were away, that surgeon Mountgarrett was with them and that the rest of the party (nine in all) did anything but lose his specimens. How far the group penetrated on foot beyond the rapids at New Norfolk is not clear. Brown estimated they had marched fifty-three miles; Humphrey's figure of upwards of eighty miles, if not a wild guess, must include the distance travelled by boat. Giblin (1939: 24) thought it probable they had followed the Derwent for rather more than forty miles as the crow flies but suggested the last fifteen miles were along either the Clyde or the Ouse, not the Derwent. On this country Humphrey was later to settle; in 1804 its fertility escaped his pen if not his observation.

In his diary for 16 May 1804, Knopwood (Nicholls, 1977: 52) wrote: 'At 4 [p.m.] Mr Brown & Mr Humphry came to the camp; they had been out 16 days and got to the Huon by land'. Humphrey also gives 16 days for the journey which Walker (1914: 74) claimed began on 1 May. According to Brown, the party set out next day and although one learns to be as careful with Brown's calendar as with Humphrey's times and distances the botanist's record is accepted here. Furthermore, Knopwood has Brown dining with him on 1 May. On this journey Brown and Humphrey reached their objective by an arduous and hazardous route over the summit of Mount Wellington and then down the gorge of what is now called the Mountain River. Brown had tried once before, in mid-April, but was deceived into following the North West Bay River off the mountain back to the Derwent side. Now successful, he and Humphrey traced the Huon River downstream, discovering the Egg Islands on the way. Giblin (1939: 24), who knew the country, considered the venture a notable achievement, if one of questionable value 'apart from the botanical garland garnered by Brown'. He failed to notice they also collected rocks, and thereby left puzzles perhaps unresolvable as the samples are lost.

Again, the travellers left little in the way of topographical record. Tracing their route, therefore, is an uncertain business. In typically vague fashion Humphrey mentions that, finding it impossible to retrace their steps, the party was 'forced to steer for Storm Bay Passage' (D'Entrecasteaux Channel); Brown has them emerging at North West Bay. It is not known where they crossed the peninsula but the 'run of water' (cf. *HRA* (III) I: 292) found between the Huon and the Derwent suggests a passage near the present Port Cygnet. That district is a possible source of the so-called pitchstone of both Brown and Humphrey, and of the latter's green garnet. Pitchstone to these observers may well have been simply a dark, compact rock, not necessarily glassy or even igneous. Neither at any stage reveals much inclination to speculate as to the origin of rocks, thereby betraying an attitude to the contrasting doctrines that then divided geologists (Vallance, 1975: 22). One suspects both men would have preferred Wernerian views. But regardless of doctrinal affiliations, the most likely sort of rock they might have seen and called pitchstone on the Huon trip would be part of the intrusive complex at Port Cygnet. Many dyke rocks there are also remarkable for their phenocrysts of garnet (Edwards, 1947; Leaman and Naqvi, 1967). While the commonest garnets are brown titaniferous andradites, honey-coloured and even colourless varieties have been reported. No sign of green garnet at Port Cygnet occurs in recent literature or in collections studied by the author but from what other locality passed by Brown and Humphrey could such material have come? — assuming, of course, it was a garnet they found.

Humphrey's excursions into unknown territory virtually ended with this journey to the Huon. Knopwood, in June 1804, recorded that Humphrey and Harris had followed the Hobart Rivulet to its head but, by then, the effort was more survey than exploration. The projected traverse of Tasmania, from which Humphrey was dissuaded by Collins as mentioned in the letters, became a reality for the mineralogist in 1807 — after others had pioneered a way. Brown, meanwhile, kept busy in the field — back to Mount Wellington where he made magnetic observations and to Bruny Island — before leaving Hobart on the *Ocean* 9 August 1804 bound for Sydney which he reached 24 August.

Detailed record of Humphrey's activities ends with his letter of 19 August 1804. The pattern of his first months in Tasmania was already changing. He had started with an impressive display of enthusiasm for scientific duty. Even in August 1804 he could write of plans to conduct experiments, grumbling, no doubt with justice, at the poor choice of apparatus supplied and the deficiency of reference books. But one notes also an increasing interest in commercial ventures unrelated to duty. The career of his then friend Lt Lord suggests that in him Humphrey found an enthusiastic guide to the ways of trade, ways the mineralogist seemed readier to adopt as the example of Robert Brown's diligence for science faded.

With Brown gone and Harris busy surveying, Humphrey all but disappears. Knopwood saw him from time to time, noting the occasions but not his business. The house built by Humphrey and Lord seems to have been used by the mineralogist only as a store and perhaps an investment to let. A year after reaching Hobart Humphrey still lived in a marquee, from which various of his possessions were stolen 19 February 1805 (*HRA* (III) I: 530). A map purporting to be based on Harris's survey of Hobart 1804-5 in Walker (1914: 60) shows separate places for Lord and the mineralogist. Neither was to continue in occupation of his residence, whether house or tent, beyond March 1805.

The despatch informing Governor King of Humphrey's appointment indicated that the mineralogist was to spend a short period with David Collins and then present himself in Sydney to receive such further instructions as the governor might 'think proper' (*HRA* (I) IV: 36-37). More than a year with Collins had passed and now King wanted to see the man sent to examine the minerals of his colony. Accordingly, on 2 March 1805 Collins advised London (*HRA* (III) I: 322) that Humphrey wished 'to extend his researches' at Port Jackson and was being transferred. It is not known exactly when he left Hobart. Knopwood says the *Sophia*, with Humphrey and Lord as passengers, left 7 March 1805 but two days later heard the vessel was still in the Derwent, held by adverse winds. Nothing more was reported until 21 April when the *Sydney Gazette* announced Humphrey's arrival by the *Sophia* two days before, adding that she had been 18 days from the Derwent, two of them spent at King Island. Just over a week later (30 April), the governor thought the mineralogist had come 'last Month' and expected 'some important and useful Discoveries' as soon as he began 'his professional pursuits' (*HRA* (I) V: 307). Humphrey's way was soon cleared by an official notice in the *Sydney Gazette* (4 May 1805) that he was 'to pass uninterrupted, and to receive such assistance in his Researches as his duty may require'. No doubt before Humphrey went anywhere he would have called on Robert Brown, then preparing for departure (23 May 1805) homewards on the *Investigator* — the ship Flinders had been forced to abandon as unseaworthy two years earlier.

Governor King's high-sounding announcements suggest he had matching expectations of his mineralogist. Writing to Banks on 20 May 1805, King remarked that Humphrey 'has a wide untrodden field before him, and, as I am told, he is very arduous and persevering, I hope science and the public will benefit by the result of his pursuits' (*Hist. Rec. N.S.W.* V: 627). It would be interesting to know the source of this good report; was it Collins, or perhaps Brown who had seen him at his best? But for all his hope, King seems to have had few thoughts for Humphrey's consideration.

By July, according to *HRA* (I) V: 498, the mineralogist had selected ten tins (another transcript — *Hist. Rec. N.S.W.* V; 659 — gives the word tons and may be correct) of iron stone for testing in England. Iron ore from New South Wales had been tested in 1801 (*Hist. Rec. N.S.W.* IV: 595, 608, 630-632) and another lot sent by H.M.S. *Glatton* in 1803. The material sorted by Humphrey was from a consignment sent by William Paterson [1755-1810], lieutenant-governor of the northern settlement in Tasmania, established late in 1804. Paterson or his men had found the ore in what he called the Rothsay Hills, beyond the Western Arm of Port Dalrymple. *HRA* equates these hills with the present Asbestos Range but the source, according to Twelvetrees and Reid (1919: 4) was the Ironstone Hills, just south of York Town. Humphrey and Brown had been near the place in January 1804. Brown's catalogue (BM(NH), Mineralogy Library), in fact, lists several specimens (now lost) variously described as 'iron stone' or 'Oxyd of iron' from different parts of Port Dalrymple, including Western Arm. Brown and Humphrey may not have been on the Ironstone Hills but clearly they found iron oxides in the district before Paterson and his people. Paterson, however, got the credit for discovery and Humphrey the labour of picking over the load sent to Sydney on the *Lady Nelson* in January 1805. Even the labour was vain. Humphrey's concentrate seems to have been that shipped by the *Sydney* on 12 April 1806. Ten months later came word she had foundered off the coast of New Guinea (*Sydney Gazette*, 15 February 1807).

Apart from sorting ore, the only task known to have been given Humphrey at this time was the examination of samples collected by Barrallier during his journey into the Blue Mountains (Vallance, 1975: 31). The study showed, at least, that the mineralogist had some awareness of contemporary ideas on the structure of mountains. In March 1804 (*HRA* (I) IV: 486) the governor had thought Humphrey himself might venture into the mountains but there is no evidence of such travel, nor indeed of any work in the limited tract of country then accessible overland from Sydney. It would be strange if Humphrey failed to inspect the coal mines at Newcastle but again the record is blank. There survives, however, evidence of a short stay on Norfolk Island. On 18 August 1805 Governor King wrote (Mitchell Library, Sydney, A2015 Gov. King's Letter Book 1797-1806: 495) to the commandant there informing him the mineralogist was about to leave on H.M.S. *Buffalo* and would take advantage of the ship's stay to make researches on the island. From the *Sydney Gazette* (25 August, 1 December 1805) it is known the *Buffalo* left Sydney 22 August, reached Norfolk Island 5 September and left there for the Derwent on 16 October. Humphrey's friend Knopwood noted his arrival (5 November) in Hobart and breakfasted with him 13 November prior to *Buffalo's* departure for Sydney. By 27 November Humphrey was back in Sydney. Beyond these bare facts nothing can be found of what Humphrey achieved for science by the voyage. Regarding his private interests, the story is otherwise. According to a despatch dated 24 December 1805 from King to Collins (*HRA* (III) I: 346-347), Humphrey had sought from the governor confirmation of the large grant of land discussed with Collins in Hobart. Later, it seems, Humphrey protested that Collins misunderstood the nature of his request (cf. *HRA* (III) I: 353) but there need be little doubt the mineralogist was anxious to have land and have it in Tasmania.

Perhaps the shipment of 'rare and apparently valuable minerals . . . among which is pure asbestos combined with a ponderous ore, which is found in great abundance' (*Sydney Gazette* 24 November 1805), brought from Port Dalrymple, demanded Humphrey's attention in Sydney. The newspaper has no more about the collection. Humphrey, though stationed in Sydney throughout 1806, likewise escaped notice — except for a strange business that took him to court.

In the *Sydney Gazette* for 27 April 1806 there appeared under General Orders a notice to the effect that a girl, Harriet Sutton, had 'eloped' from the protection of a Mrs Palmer in Sydney and that her father, a convict storekeeper in Newcastle, was come to claim her. The notice went on: 'all and every person whatever are hereby forbid harbouring or illegally secreting the said Harriet Sutton'. A like notice, strengthened by the governor's command, was printed in the next issue and, a week later, a reward of 5 guineas offered for the girl's return, no questions asked. On 8 June the Provost Marshal announced Sutton's appeal to the governor against the verdict of the Court of Civil Jurisdiction in the case *Sutton* against *Humphrey* and that Harriet Sutton was to be delivered into his custody by 10 the next morning. There the newspaper let the matter rest. The governor's decision, if he made one, is not reported; in his last months as governor, King left many more pressing issues in abeyance. No further action seems to have been taken against Humphrey but his interest in the abduction is all but proved by later events.

During 1807 Humphrey returned to Tasmania. Knopwood noted his arrival in Hobart 14 June on the *Albion* whaler. She had left Sydney on 27 May and called at Port Dalrymple. Humphrey may have sailed on her from Sydney but the reappearance of his name on the Tasmanian civil establishment by the end of March suggests an earlier departure. One possibility is 24 March when the ship *Lucy* left to take Paterson back to his station at Port Dalrymple and with him a party led by Charles Grimes to survey northern Tasmania and an overland route to Hobart. Humphrey could have worked with Grimes — a proposal to do so seems a plausible reason for the Tasmanian visit — and left on the *Albion* before the survey ended. Against that, however, it must be admitted as strange that Paterson, a man noted for his interest in science, makes no mention of Humphrey in letters or despatches. Knopwood's record of the days following Grimes's arrival in Hobart (24 September) shows that Humphrey knew the surveyor very well, but then both had lived some time in Sydney. What is certain is that Humphrey accompanied Grimes on his return (6 October) to Launceston. The next occasion Knopwood saw Humphrey was on 26 December when the mineralogist reached Hobart again, having walked from Port Dalrymple in three days — doubtless with no great load of specimens. Meanwhile, on 25 November Knopwood was visited by one he describes as 'Mr Humphry's friend'. The identity of this friend emerges later, as in the entry for 27 April 1808 — 'Mr Humphry and Harriet dind with me'. The circumstances of her removal from Sydney are as obscure as those of Humphrey; one suspects both would have thought that fortunate.

Presumably it was William Bligh [1754-1817] who authorized Humphrey's travel. Bligh had succeeded King as governor in August 1806 and, as George Humphrey's covering letter (Appendix) to Greville suggests, the mineralogist in name at least need have been no stranger to him. Bligh had plenty of time to peruse the Humphrey letters before leaving England in February 1806. Whatever the purpose for which Bligh released Humphrey in 1807, a letter dated 5 November 1807 to Banks (*Hist. Rec. N.S.W.* IV: 380) makes it clear that the governor expected him to return in due course to Sydney. In that letter Bligh went on to ask if Humphrey were under any obligation to send specimens to Banks and what claim the government had on him — a strange enquiry to make about a government officer. Bligh was reasonably impressed with the man but troubled by his private affairs: 'He appeared a clever young man; but I am sorry to find bills to a large amount which he drew are come out protested, and I fear may be the cause of depriving him of his liberty'. Humphrey's father, in fact, had declined to meet bills presented without warning (Heuland to Rashleigh, 20 December 1808: DDR 5757/2/133). One wonders if the 'pursuit' that took Humphrey back to Tasmania was really an excuse to distance himself from the governor's attention. Leaving that question as unanswerable, Tasmania must have had attractions for Humphrey; he already owned property there and it was conveniently remote if he meant to continue the liaison with Harriet Sutton.

Bligh need not have worried about Humphrey's liberty. It was his, not Humphrey's that was curtailed — even before the letter to Banks had reached its destination. The rebellion that deprived Bligh of his lawful authority gave Humphrey the chance to overlook the instruction about returning to Sydney. The mineralogist never again left Tasmania though he was careful to pay respects to the departing governor when Bligh called at Hobart on the way home (*HRA* (I) VII: 125). Knopwood's diary, hitherto a valuable source of information, fails at this stage — the volumes for the period 18 July 1808 to the end of December 1813 are lost. No doubt he commented on the dissensions that wracked Hobart society in the wake of the rebellion. Edward Lord, once Humphrey's friend, had modelled himself on John Macarthur of Sydney and now shared the rapacious Macarthur's hatred of Bligh. In December 1808, Lord provoked a quarrel with the surveyor G. P. Harris that got out of hand. Humphrey and Knopwood both became involved; their declaration defending Harris and other papers on the dispute are now in London (British Library, Add. MS 45157).

The public distraction can only have separated Humphrey still further from duty but at last, in 1810, came a sign of activity. It was to have unexpected consequences. A letter dated 2 February 1810 (*HRA* (III) I: 431) from Collins to Bligh's successor Lachlan Macquarie [1762-1824] carried as enclosures a sample of 'muriate of soda' (common salt) from the interior of Tasmania and a report by Humphrey on its occurrence. Sample and report are lost. Something of the locality, however, may be gleaned from an informative report (*HRA* (III) I: 758-773) on Port Dalrymple and vicinity prepared by John Oxley [1785?-1828] in the latter part of 1810. There (pp. 769-770) Oxley remarks that in 1809 a party gathered about a ton of salt from the Salt Lagoons, about halfway between Launceston and Hobart. Oxley also has a note (p. 770) on iron ore from Western Arm, taken to England in 1807 and tested at Portsmouth; according to the detail he gives, it was practically a pure hematite — magnetite mixture. One wonders if Humphrey had also selected this material.

Collins's letter drew attention to H.M. Mineralogist and, unlike his predecessors, Macquarie was not content to leave Humphrey to his own devices. He demanded monthly reports of progress. He also discovered Harriet Sutton and ordered her return to her father in Sydney. The order, given verbally when the governor met Humphrey in 1811, was repeated in writing to the commandant at Hobart (*HRA* (III) I: 458). There is no evidence that Humphrey obeyed but Macquarie's searching interest had its effect.

Writing to the governor 27 April 1812, Humphrey pleaded (*HRA* (I) VII: 622-623) that indisposition had prevented him making any researches since Macquarie's departure from Hobart in December 1811. He went on to explain how ill-health at various times had affected his work. Now he wished to resign his commission but to remain in Tasmania on an enlarged grant of land. The resignation was promptly accepted, effective from 30 June 1812, and Humphrey allowed to stay. Informing London (*HRA* (I) VII: 587), Macquarie spared nothing — 'Mr Humphrey, being Naturally an indolent Man, and of a Weakly and Sickly Constitution, has never made any Discoveries in this Country that are Worthy of Notice'. It was the man, not the office, Macquarie condemned. He went on: a man 'who has real Scientific Knowledge as a Mineralogist, Might be very Useful and Make Very important Discoveries in Various parts of this Widely extended Colony'. Such a person of robust constitution should be sent to New South Wales. Two years later he repeated the call (*HRA* (I)

VIII: 211) for 'an active, Clever, Scientific Mineralogist of respectable Character' — the antithesis of Humphrey as Macquarie saw him. No action was taken until 1823 (Vallance, 1975: 20) when a practical engineer and mineral surveyor with certain defined responsibilites became, in effect but not in title, Humphrey's successor; by then Macquarie's successor governed in Sydney.

For some of the unflattering opinion Macquarie sent to London, Humphrey could blame himself. The association with Harriet Sutton, continued in the face of repeated orders to desist, drew into sharper focus for the governor what little Humphrey seemed to show for eight years' official sojourn in the colony. He had started well and in the company of Robert Brown displayed commendable zeal for duty but by the end of 1804 that was being supplanted by a care for private interests. By 24 August 1807 J. H. Heuland could inform Philip Rashleigh (DDR 5757/98/1) that 'Mr. Humphrey at Botaney bay has no desire of returning, without a very great fortune'. Humphrey would never make that as H.M. Mineralogist. The indisposition offered to excuse his failure to furnish monthly reports seems transparent; disinclination might have been more honest. Humphrey had largely lost interest in his work. Macquarie, ever on guard against those he thought imposed on the government, clearly saw it that way and moved without delay to end Humphrey's career as mineralogist.

Macquarie's indictment, however, went too far. All blame lay with the man, none on the circumstances of his employment. The implied charge of deficiency in science makes one wonder how well Macquarie knew the manner of Humphrey's appointment and whether the governor's own slight acquaintance with science had not engendered false expectations of one officially called mineralogist. Unlike his naval predecessors, major-general Macquarie enjoyed no particular rapport with scientific circles in London. He could be sensitive enough to the needs of science — witness, for instance, his preferment of Charles Frazer [1788?-1831] as unofficial colonial botanist, and the despatch of rocks collected by Frazer and by Oxley to the Geological Society of London — but Macquarie was preeminently an efficient administrator, not a man of much subtlety. He may have sought reports from Humphrey but there is no evidence Macquarie was more interested than earlier governors in the mineralogist's results. Only exceptionally did any of them call on Humphrey for advice or direct him to make particular searches. This very lack of official concern can have done nothing to prevent aimlessness in a man so left to himself. For what purpose had he to strive?

According to Macquarie, Humphrey had found nothing 'Worthy of Notice'. The charge invites the question what might he have found? Coal was known and exploited before Humphrey arrived; iron ore, too, had been shipped to England for testing. Humphrey and Brown knew of iron ore at Port Dalrymple but Paterson, who came along later, received the discoverer's credit. In any case the colony lacked both capacity and need to develop a mineral-based manufacturing industry and no one in charge of a convict settlement like this would have welcomed the discovery of precious metals or gemstones. If these reduced the need for Humphrey's services, what was left? He could have gathered 'curiosities' — and perhaps gained a little from the sale of duplicates — but not much else. Even today, the areas that were accessible to Humphrey are hardly remarkable for mineral riches or choice specimens. In a letter to Greville dated 12 December 1804 (British Library, Add. MS 32439 f159) Robert Brown referred to his time with 'Mr Humphrey the Mineralogist of the Colony whose department I fear is fully as barren as mine'. Brown had the genius to make his barren field fruitful; to rebuke Humphrey, as Macquarie did, for not doing likewise is absurd. If in the end Humphrey failed to distinguish himself as H.M. Mineralogist, the greater fault lies, I believe, with the government that appointed a young man from a London dealing business to a frontier post with no particular purpose. The beginnings of government patronage in the name of science in Australia were hardly auspicious but Humphrey's letters of 1803-4 reveal a person who could respond positively to what then seemed a challenge.

Later Years

Humphrey's later career lies beyond the scope of this paper but as his interest in natural history to some extent continued a few notes seem justified. Humphrey was acting as a magistrate in Hobart even before his resignation as mineralogist. The appointment was eventually confirmed despite Macquarie's qualms. A succession of important posts followed — magistrate of all Tasmania, chief police magistrate, superintendent of police, member of the Executive Council and of the first Legislative Council in the colony. The relationship with Harriet Sutton was sealed by marriage at 'Pittwater' (Sorell), Tasmania, on 8 August 1812. Humphrey became a pillar of society, an upholder of law and order and of the rights of proprietors. In those interests, he supported the work of J. T. Bigge, the royal commissioner enquiring into the condition of New South Wales, during Bigge's visit to Tasmania in 1820. By then the commissioner's partiality to Macquarie's antagonists in Sydney was well known and Humphrey's enthusiastic collaboration with Bigge suggests that old scores were being settled. On two occasions, in 1813 and 1817, Macquarie had warned incoming lieutenant-governors (*HRA* (III) II: 23-24, 611) to be careful of a number of prominent citizens, Humphrey among them, whom he thought were unscrupulous. Ironically, Humphrey owed much to Macquarie for forcing a decision in 1812. The *pension* on which he retired in 1828 from the police post alone was more than four times his salary as mineralogist. Had he remained H.M. Mineralogist, would the chief justice have been a pall-bearer and the lieutenant-governor a mourner at his funeral (*Hobart Town Courier*, 23 May 1829)?

The old connections, however, could still be useful. On 6 May 1816 Humphrey addressed a letter to Macquarie (*HRA* (III) II: 588) explaining that his wife was coming to Sydney on a short visit (25 May-15 June) and would deliver his gift of 'some Specimens of Animals'. The letter following in *HRA* suggests a purpose for the unexpected gift. At the time Humphrey was seeking a more exalted magisterial position and the secretary in London to whom he had addressed a memorial on the subject advised application to the governor in Sydney. There is the possibility also, according to evidence discussed below, that Humphrey continued occasionally to send material to his family. A surer sign of connections maintained with London was his election to corresponding membership of the (Royal) Horticultural Society. Humphrey's property, then called Humphreyville but now Bushy Park, near Macquarie Plains, became a colonial show-place. Announcing the London honour, the *Hobart Town Gazette* (6 May 1826) added that the society 'could not have selected a more worthy and efficient associate than Mr Humphrey, who amidst the most arduous official duties, stands an unrivalled example in promoting the agriculture and gardening of this English Colony'. His old patron Greville, a founder of the society, surely would have approved.

Humphrey's Collections?

Not one specimen identifiable as collected by Humphrey has been traced, despite much search in the United Kingdom. What became of his samples? After all, collecting was a duty particularly assigned to H.M. Mineralogist. Official records yield no information about Humphrey's specimens — apart from the salt from Tasmania in 1810. Indeed the pointed remarks about Humphrey made by Bligh and Macquarie suggest those governors saw little evidence of the mineralogist's collecting. Yet at least one shipment went off to London during Bligh's term of office — a fact known not from despatches but from a stray remark of Heuland (DDR 5757/98/1 — 24 August 1807) that H.M.S. *Buffalo* was bringing from Humphrey 'Several boxes of his collecting' for the government. Colonial administrators, as well as their masters in London, apparently deemed such consignments unworthy of notice. If the collections were not thrown out with the rubbish where would they have gone? The British Museum comes to mind as an obvious repository but the principal record there — the manuscript Additions Book (1756-1876) held by the Keeper of Minerals — makes no mention of relevant donations from the department of war and the colonies.

The earliest gifts of Australian minerals to the British Museum came from Sir Joseph Banks. There are no clues in the Additions Book as to how Banks acquired the samples but official sources seem likely. Banks had long been recognized by British governments as a scientific adviser on New South Wales. Perhaps he, rather than the secretariat in Downing Street, was the consignee for scientific collections made in Australia for the government. At any rate, on 9 December 1809 the museum trustees received from Banks several specimens of minerals from New Holland. What they were is not specified but on 10 February 1810 Banks gave a 'Topaz (crystallized, white) from New South Wales'. Another 'Minerals (4 specimens) from New Holland' followed from the same donor on 8 June 1811. Brown or Paterson or Humphrey is each a possible collector, with Brown the least likely — his material ought to have formed part of the Admiralty's donation received 6 April 1811 (Vallance and Moore, 1981). The topaz draws attention to Humphrey for he, according to Brown (Jameson, 1811) first found that mineral in Australia and despite Jameson's remark about topaz in the Hawkesbury River the mineral then could have come only from the Tasmanian region. Whether Humphrey at the time had museum-quality material may be questioned. The samples he had sent to his family were condemned by Heuland on 27 February 1808 (DDR 5757/2/106) as 'rolled' [i.e., abraded]. Presumably they had been collected from beach gravels. Good material, however, was already known. Heuland, in the letter just noted, refers to a 'nest of topazes' found by Paterson and adds that a gentleman had arrived in London with 'a very perfect crystal of Topaze'. The gentleman is later (DDR 5757/2/109 — 7 March 1808) identified as 'Lt Tetly'. J. S. Tetley was a junior officer on the vessel that took Bligh to Sydney but while there was chiefly involved in an acrimonious dispute with his commanding officer that led to both being returned to London in 1807, the captain to face a court-martial which found the charges against him groundless (*HRA* (I) VI). Tetley's topaz, presumably acquired in Sydney, passed into Rashleigh's collection (*fide* Heuland), not the British Museum.

Whether Paterson or Humphrey or both were the sources of Banks's donations to the British Museum are now matters of academic interest. Search of the museum's mineral collections, made with the generous co-operation of the curator, P. G. Embrey, Esq., has failed to locate any of these samples. Nor was anything that might be due to Humphrey found in the Greville Collection.

The minerals and shells known to have been received by Humphrey's father in 1804-5 likewise cannot be traced. And it is clear from Heuland's letters that these were not the only collections sent to the family. George (II) Humphrey apparently had no auctions at this time but, of course, samples could have been dispersed through the shop. If George (II)'s circumstances were as bad as Heuland suggests (DDR 5757/2/126 — 21 October 1808), cash sales would have been welcome. There is the possibility also that some of Humphrey's specimens went to his aunt. The Forster sales of 1808, mentioned earlier, included nearly 70 lots of Australian shells, most of them simply listed as from New South Wales or some variant thereof but 20 specified as of Van Diemen's Land [Tasmania]. Against the easy assumption that these came from Humphrey, his own remark in the letter of 17 November 1803 (Appendix) that southeastern Australia was already a known source of fine shells must be noted.

Other intriguing examples of Australian material at auction occur in the mineral sales of J. H. Heuland. Russell (1950) gives a list of those sales for the period 1808-48; to it should be added that of June 1817, known from a catalogue in the library of the U.S. Geological Survey. Search of the catalogues known to Russell, from the first to that of 1839, reveals a number of Australian items, every one of which could have been gathered by Humphrey. Whether he did, of course, is another matter. At the time Heuland began his sales, any dependence on Humphrey seems improbable. Early in 1808 Heuland scorned Humphrey's topaz specimens and on 20 December of that year informed Rashleigh (DDR 5757/2/133) that 'Addy in New South Wales [had] turned out not to be what was expected from him.' The judgement might refer to Humphrey's failure to supply fine specimens but perhaps more likely it reflects on the mineralogist's private affairs. Either way, Heuland seemed ready to bracket 'Addy' with the rest of the Humphreys and they, he thought, were trying to deprive him and his uncle in Germany of their inheritance. The attempt to cheat Heuland and Heinrich Forster, if indeed there was such an attempt (we have only Heuland's word for it), did not succeed. Heuland came into his own; whether thereafter his attitude to the Humphreys mellowed remains unknown. But let the record of Heuland's sales appear.

The first Australian sample offered by Heuland was lot 3 ('Green garnets, New Holland') on the 4th day (7 May) of the 1812 sale. Such had been reported by Humphrey during the Huon trip of 1804; another possible source, King Island, was visited by Humphrey as early as 1805. 'Primitive and modified grossular, New South Wales' appeared in lots 32 and 96 on the 3rd day of the March 1816 and the 8th day of the April 1816 sales, respectively. At the time, such Australian material could only have come from Tasmania or the Bass Strait islands. Nothing more turns up in the sales until that for May 1829 when on the 5th day 'A matchless Crystal of white transparent tredecioctonal [sic] topaz, from New Holland' (lot 778) was offered at £5 — and bought by Louisa, Countess of Aylesford [1760-1832], for £5.15.0. It can be traced to no. 5199 [5025] in the Aylesford MS Catalogue (BM(NH), Dept of Mineralogy) but the specimen went back to Heuland when he bought the collection after Lady Aylesford's death. Another topaz from New Holland was put up at £3 in the May 1830 sale (3rd day, lot 402) and yet another (lot 9) at £2 on the 1st day of the sale in May 1835. Heuland in 1820 had sold crystals of topaz from 'New Holland' to the English collector C. H. Turner of Rooksnest, Surrey; descriptions of them can be found in Lévy (1837: 267-8, 274-6). Turner's collection eventually became the property of the Museum of Practical Geology (now Geological Museum) London, but neither there nor in Lévy's catalogue can the provenance of these Australian topazes be traced.

Heuland's 1833 sale introduced different sorts of Australian specimens, all specified as from Van Diemen's Land. No fewer than nine lots consisted of or included material variously described as fossil wood or wood opal. More such samples appeared in the April and May sales of 1834. Again, there is no indication of provenance but it will be recalled that Humphrey saw things like these at the Coal River as early as March 1804. The locality was not remote and he could have returned there many times during his years in Tasmania. The sale of May 1835 is the last at which anything possibly related to Humphrey went under the hammer. Catalogues for the next six sales (1836-39), in fact, list nothing from Australia. Was that gap connected with Humphrey's death in 1829? To this, and so many other questions no answers have been found. They may well remain unanswered unless more of Humphrey's and Heuland's letters are unearthed. The latter's business records would be another obvious source, but the chance that they survive now seems remote (cf. Russell, 1950). The thought that Heuland handled Humphrey's specimens in his sales meanwhile depends on no firm evidence but it is surely remarkable that, without exception, the sorts of Australian materials sold by Heuland to the year 1835 were those first found here by Humphrey. So much has yet to be discovered about the first scientific officer on the colonial establishment in Australia. One conclusion, however, seems already justified. Humphrey was not really the indolent free-loader Macquarie represented him to be. Considering his background and more particularly the circumstances of his employment, Humphrey deserves remembrance as a pioneer of Australian science.

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APPENDIX

HUMPHREY LETTERS

In the following transcript from British Library Add. MS 42071 (Hamilton and Greville Papers, Vol. IV, ff123-145) original spelling and punctuation are preserved; folio numbers are inserted to facilitate reference to the manuscript. Superscript numerals relate to end-notes. Place-names, other than those obsolete or unusual, are not noted. The series is introduced by a letter from George (II) Humphrey [1739?-1826] to Charles Francis Greville [1749-1809] and concludes with a transcript of the lieutenant-governor's certificate regarding the service of H.M. Mineralogist (A. W. H. Humphrey). Additions by George Humphrey are marked [G.H.].

[f123] *Sir,*

Herewith You will receive the Extracts from my Son's Letters, which, you will perceive, have proved more voluminous than I had given You reason to expect: But as my Son is in a great measure amenable to You for his Conduct, and as I learned that Governor Bligh would not go for some days, I thought it but proper that You should have a Copy of his whole Narrative, Private Affairs excepted.

Any Trivialities, or Incorrectness, You may find in the Perusal, I trust You will candidly overlook, making Allowance for his Youth and Inexperience.

I am rather unwell to day, or should have waited on You; but shall do myself the honor of calling on You Tomorrow Morning. I am respectfully

Sir,

Your most Obedient & obliged humble Servant
George Humphrey

Leicester Square
25th Sept^{r}. 1805.
Right Honble Charles Greville

[f125] *Extract of Letters from A.W.H. Humphrey, Mineralogist to His Majesty in the Settlements at New South Wales, and who sailed from the Isle of Wight, in the Ocean Transport, Cap^{t}. Mertho 28th April 1803.*[1] [G.H.]

Rio de Janeiro, Brasil.
17th July 1803

I hope You received my Letters, and small Box [*These Letters and Box have never come to hand.* — G.H.] *from Teneriffe,*[2] *and that the Shells &c turned to good account.*

We had a fine Passage, as we arrived here the 3d inst,[3] *and I have been ever since employed in collecting Shells to send You, therefore You must not expect to have a detail of our Voyage: I will, however, give You some few particulars of the City and People of S^{t}. Sebastian.*[4]

The City is large, and contains, as I am informed, about 100,000 Souls, of which about 40,000 are Whites and Mulattos, and 60,000 Blacks. The Streets are narrow, and very dirty, and the Houses low. There are many grand Churches: For the building and ornamenting of which they spare no expense; one of them is built of the same kind of Granite as the Specimen I have sent You in the Box [*This Box has also not been received.* — G.H.]*; and the inside of another is lined with the most beautifully carved Cedar and other fine Woods. Their Religious Ceremonies are grand, and frequent, and nothing pleases them more than Strangers paying respect to them. The People are very polite and friendly to the English; for instance, as Lieut Lord and myself were walking up the main Street, a Servant ran up to us, and pointed to a large House, at a short distance: We followed him to the Door, where we were received, in the most polite manner, by a Gentleman, who shewed us up Stairs, and introduced us to another Gentleman, and two Ladies; the latter Gentleman welcomed us in English, and made us take Tea. After some Conversation we found he was a Member of the Senate, & Judge of the State. He detained us till ten o'Clock that Evening, and, on leaving him, he begged we would consider his House as our own; and we have spent* *many pleasant Evenings with him and his Family. I could mention several other Adventures of a similar nature I have met with, but have not time for it.*

I have been endeavouring, ever since we arrived here, to get some Minerals, &c. but, strange to tell, I have not seen even one good Stone of any sort. A few Topaz Rings were brought to me, of a large size, but all foul: One was about 1½ Inch by 1 Inch, and of a good colour; the Person who brought it asked Ten Pounds for it; and I have seen none so cheap, as they are to be had in London. The good Stones are all sent to Lisbon.

[f126] *I am happy to say I have got many good Shells, part of which I have packed up in a Box, with the remainder of the Shells I got at Teneriffe, and some Volcanic Stones of that place: The Box* [*This Box, as beforementioned, has not been received.* — G.H.] *is directed to J.T. Swainson Esq*r.[5] *Custom House, London, and marked G.H. and I shall leave it here with a very rich Portuguese Merchant, with whom I have been dining to day; and who leaves this Place, in one of his own Ships, in about two Months, bound for England direct; and, I am informed, she will be with you sooner than any other Ship. He is a very polite, Gentlemanlike Man, and has promised to procure a large Parcell of Shells, and other Things for You. He will bring You a Letter from me* [*See page* (127) — G.H.]

My Hat was stolen off my head, by a Negro, the other Night, therefore be so good as to send me another Water-proof one, as soon as You can, and a Looking Glass.

We shall, most likely stop at the Cape of Good Hope; and, if so, you will hear from me from that place.

Have the goodness to send me one of Carey's[6] *small Pocket Globes, for the one I had has been stolen from me. I will give you a long account of all these things when I arrive at Port Philip.*

*The Gentleman I before mentioned, who will bring You the Box of Shells, &c. is Marius da Costa Esq*r.[7] *and I must recommend him to Your Favor. He has assured me he will employ Men to collect Shells, Minerals: &c, and, if possible, to procure some Groups of Topazes, Emeralds, and other Stones, which he will take with him to London for You.*

Before I close my Letter, let me beg you to send me, as soon as You conveniently can, Nicholson's Introduction to Natural Philosophy,[8] *and the Models of Crystals, and Instrument for taking the measure of the Angles of Crystals,*[9] *M*r. *Accum*[10] *promised to procure for me, from Paris; as also small Specimens of all the new Minerals you can obtain.*

This Letter, and the one from which the preceding passages were transcribed, were received by the Lisbon Mail 5 Sept. 1804 [sic]. [G.H.]

Rio de Janeiro, Brasil.
18th July, 1803.

*The Bearer of this, Marius da Costa Esq*r. *is a Gentleman from whom I have received great kindness at this Place. I therefore beg to recommend him to your Friendship and Favor.*

*He brings with him, in one of his own Ships, a Box for You, directed to J.T. Swainson Esq*r. *Custom House, London, and marked G.H.*

*M*r. *Da Costa has kindly promised to procure for You some Topazes, Emeralds and other Stones of this Country* [f127]: *and Sea and Land Shells, all which you will, I hope receive by this Opportunity. My best Respects to M*r. *Greville.*

This Letter was received per favor of Mr. Bromley[11] *(then Surgeon of the Calcutta armed Ship) 9th Septr. 1804* [G.H.]

Sullivan Bay, Port Philip,
New S. Wales, 15th Novr. 1803.

After a Voyage of Eleven Weeks we arrived here, and came to Anchor on the Morning of the 13th October.[12] *I shall not say much about what passed on our Voyage in this Letter, as I shall send you a long Account by the Calcutta, but that we have had several Gales of Wind, such as no one can have any idea of, who has not doubled the Cape of Good Hope; not that I make use of my Licence, as a Traveller, on this occasion.*

In one of these Gales, which came on about ten days after we left the Coast of South America, we parted from the Calcutta,[13] *in the night, and, in the morning She was not to be seen; nor did we see her, or any other Ship, till after our arrival at this place.*

The Captain of the Calcutta[14] *had, unfortunately, given our Commander strict Orders, in case of the Ships parting Company, not, on any pretence whatever to put into the Cape, but make the best of his way to Port Philip; which Order greatly disappointed me, and placed us in a very disagreeable Situation, for before two Months were elapsed our private Stock was expended, and we were necessitated to eat the Ship's Provisions, or starve, which was nearly the case with me, for the Beef was so bad, smelling like the steam from a Tallow Chandler's Copper; and the Bread having got wet, and mouldy was full of live Insects. I could not stomach either, and actually lived on Water-Gruel for 14 days: But this is passed, and we are a little more comfortable.*

This is a healthy place,[15] *but never can do for a Settlement, for there is no fresh water to depend on; we are supplied from Wells dug in the side of a hill; and there is no good Soil, every where Sand. The Governor expects to remove as soon as he can hear from Port Jackson.*

I have sent by Capt. Mertho,[16] *of the Ocean, who will leave us tomorrow for China, a small Box* [*This box was brought by Mr. Bromley, see page* 128. *and page* 131. — G.H.] *containing Shells and Stones of this place (directed for J. T. Swainson Esqr.) the best I have been able to get, though not so good as I hope to send hereafter.*

I have been under the necessity of drawing on You for £17.18.0 to make up my proportion to the Mess we have formed here, as it is the Governor's desire that the Civil and Military Officers mess together, for which purpose a Mess-House is building. I am allowed two Servants by the Governor,[17] *and have my Marquee pitched upon the same Hill*[18] *with himself and the Chaplain,*[19] *and his Excellency has done every thing in his power* [f128] *to make us happy: To hear from You would, however, contribute very much to make me so.*

Permit me to introduce to Your Friendship Capt. John Mertho of the Ocean Transport, to whom I am indebted very much, by his kind attention to me on my Passage out. My best Respects to Mr. Greville and Count Bournon.[20]

I intend to volunteer to go across the Country to Western Port, with Mr. Harris, [21] *who is ordered on that Service.*

Received per favor of Mr. Bromley 9 Sept. 1804. [G.H.]

Sullivan Bay, Port Philip,
New South Wales
17th Novr. 1803.

By the Ocean Transport that left this place Yesterday for China, I have sent you a small box of Shells and Minerals, and a Letter, both intrusted to the care of my Friend Capt. John Mertho, the former directed to J.T. Swainson Esqr. — Capt. Mertho has promised to forward them by the first Ship that leaves China for England, after his Arrival there.

The Shells are not such as I had hoped to have sent You, being all from the Beach, though many of them were taken alive, and mostly broken, and rubbed, but I hope soon to get some in the highest state of Perfection.

The Minerals I have sent, I am sorry to say, are but of little worth to you, though they are, and ever will be, of great consequence to the Colony: Those I allude to are, Carbonate of Lime, and Brick Clay. The former has not been discovered at Port Jackson, though no pains, as I am informed, have been spared by the Governors of that Colony to find so valuable and useful a Substance.[22]

According to my Promise, I will now relate a few Particulars of our Voyage from Rio de Janeiro to the Coast of New Holland, and then give you some account of this Port, and what has happened since our Arrival.

On the 20th July 1803, at 7 in the Morning we weighed Anchor, and at 11 passed by Fort St. Crux[23] *and cleared the Harbour, following the Calcutta at about 4 Miles distance. The Wind now began to die away, and the Tide setting strongly into the Harbour, hurried us very rapidly towards the Shore, and at 3 we were obliged to let go our Anchor, to save us from being dashed to pieces by the Surf on the Rocks: Fortunately for us, however, in a quarter of an hour a fresh breeze sprang up, and we again weighed, and stood out to Sea, the Calcutta Hull-down, and in the Morning were out of sight of Land.*

On our leaving the Harbour the Calcutta sent a Boat to us, with a Letter for Capt. Mertho, ordering him, in case of parting Company, to make the best of his way to Port Philip, and, on no pretence whatever, to put in to the Cape of Good Hope.

About a Week after, we parted Company in a heavy Gale of Wind; and in eleven Weeks made the Land of New South Wales, at 11 in the Morning, with a fair Breeze from the S. West. By night we were well in with the Shore, stood under easy Sail all night, and in the Morning stood into a large Bay, in which from our Latitude and Longitude, we supposed the Entrance to Port Philip must be.

At Six we saw an Opening, for which we steered a direct course, and at 11 we were well in.

[f129] *It now began to blow a Gale dead on Shore, and the Captain began to be uneasy, as he feared, if this was not the Port, he would not be able to beat off the Coast; and we could see with our Glasses the appearance of Breakers, with a Surf running over them, completely across the Opening.*[24] *We were all greatly alarmed, the Captain not excepted, as I could see by his looks, though he said but little.*

At this moment, Mr. Collins,[25] *late a Master in the Royal Navy, volunteered his Services, to go in an open Boat, and, if possible, to examine the mouth of the Harbour; which Offer the Captain accepted; the Boat was lowered, and six able Hands, with Collins, went off, having with them a Flag, which they were to hoist, in case they should find it to be Port Philip, or any other safe Place of Shelter; our Ship in the mean time was laying to, under her Main Top Sail.*

In an hour they returned, not having hoisted the Flag, and the Wind blew so strong, and the Sea running very high, we were fearful of their being lost. They returned safe, however, but with the dreadful Information, it would be impossible for any Ship to go in, as there was the Appearance of Breakers completely across the Mouth; on hearing which, I thought the Captain, though a brave Man, would have sunk on the Deck, and he exclaimed, My God, what shall I do! But, recollecting himself, he called to his Men to get the Mainsail set, and every other it was possible, though it blew a heavy Gale, and to our great satisfaction we found we were getting off Shore very fast. At four we were 12 Miles off Shore, and Cap[t]*. Mertho observed we must have had a strong Tide, which hurried us off, or we should not have got so far in so short a time.*

In the Morning the Weather was fine, and had every appearance of continuing so, and we again stood into the Bay, being persuaded the Harbour we had seen must be Port Philip. When we got within six Miles, M[r]*. Collins went in the Boat again, and, in about an hour, we perceived him in the middle of the Channel, and, a few minutes after, we saw the Flag, as a Signal that it was Port Philip, and that we were to follow, which gave us all the greatest joy. We made Sail, and soon got to the Mouth of the Harbour, where we found that the Appearance of Breakers we had seen the day before, was occasioned by the Tide running out of the Port at the rate of nine Knots an Hour, and the Wind against it. We were, unfortunately, at a wrong time of Tide again, for though we had a seven Knot Breeze, we could not tell whether we went ahead, or astern: A stronger Breeze at length sprung up, and we got in, and, at three, came to single Anchor, to the no small pleasure of all on board.*

The Captain went on shore immediately, in search of Fresh Water, and did not return that Night. The next Morning a Man at the Mast head said he saw a Sail, and in half an hour we had the pleasure to see the Calcutta at Anchor, about three quarters of a Mile from us. I then got my Razors in good order, and began to shave off my long Beard, for I had not shaved since our leaving Rio de Janeiro: By the time I had done this, and cleaned myself, the Captain returned, saying he could find no good watering [f130] *Place, nor any good Soil, which last I had myself observed the day before.*

As soon as a Boat could be got ready M[r]*. Fosbrook,*[26] *M*[r]*. Harris, M*[r]*. Bowden and I went on shore, with the Surgeon of the Ship. As we came near the Land, every one was eager to be the first on Terra firma; I sat still till the last, when seeing the Boat was almost on Shore, I made a Spring, and was the first of His Majesty's Officers on land; when, drawing my Sword, I exclaimed, I take possession of this Country in the Name of the King of England!*

We walked about ten Miles in the Woods, keeping along Shore, and during the whole of this Walk, we found no Soil but Sand, coloured by Charcoal, formed by the Natives Fires. The Trees were all small, and there was no Underwood, nor any appearance of fresh Water. We returned on board, and, as soon as Cap[t]*. Mertho was ready, Lieuts Sladden*[27] *and Lord*[28]*, and myself, went with him on board the Calcutta: We found all well, and learned that they had been driven into the Cape of Good Hope, by a Gale of Wind, in which they had sprung their Fore-Yard.*

The Next Morning Cap[t]*. Woodriffe and the Governor, went in search of a place to land the People and Stores; and, after four days they fixed on one, the best in the Port, although a very bad one, for we have no Water but by sinking Tubs, with holes in their sides, in the declivity of a Hill, for the Water to drain into, and no Boat, of any size, can come within half a Mile of the Shore.*

The Camp was formed, and the Ocean's Cargo landed in less than two Months, the Governor not being able to detain that Ship, as she was going to China. During the time the Ocean was unloading, M[r]*. Harris, the Surveyor General, Lieut Tuckey,*[29] *and M*[r]*. Collins, made a Survey of the Harbour; and, from their Report, the Governor was* *induced to send Mr. Collins, in an open Boat, to port Jackson, to inform Governor King of the State of the Colony;*[30] *which Service Mr. Collins volunteered, and every thing being got ready under his own inspection, he put to Sea with a fair Wind.*

A Week afterwards the Ocean sailed out of the Harbour for China. The Public Works of the Camp were carried on; a Battery was erected, and a Magazine of Stone, for the Powder, was almost completed; most People had got Gardens, and every thing was as forward as the Soil would permit. A signal Post was erected on a high hill, commanding the Entrance of the Harbour, and the Men on the look-out were ordered, on the first appearance of a Ship, to hoist a flag on the Staff, as a Signal to the Camp.

[f131] *On Monday the 12th December, the Signal was made, and I immediately went to the Hill, about two Miles from the Camp; and, on looking through a Glass I pronounced the Ship in sight to be the Ocean returning. At three she entered the Harbour's Mouth, and, at four came to an Anchor off One-Tree-Point, three Quarters of a Mile from the Calcutta.*

At five Capt. Woodriffe came on shore, with Capt. Mertho, and Mr. Collins, whom Capt. Mertho picked up at Sea, half-way between here and Port Jackson, in a Gale of Wind: A dreadful Sea was running at the time, and it is most likely he would have been lost, had he not fortunately fallen in with the Ocean. — Capt. Mertho did not intend to touch at Port Jackson, but, feeling for the Situation of Mr. Collins, should he leave him, and another Gale come on, he resolved, as the Wind was fair, to put in for 24 Hours; which he did, and Mr. Collins was landed in Safety.

On hearing the State of the Colony, Governor King sent for Capt. Mertho, and made him an Offer to return hither, and move the Colony to some other part; which Offer Capt. Mertho accepted, and he is taken up for four Months. The Lady Nelson Brig sailed from Port Jackson 24 Hours before the Ocean, for this place, but is not arrived, and it is feared she was lost in a Gale of Wind, the day after the Ocean left Port Jackson.

Wednesday the 14th. This day arrived the Francis Brig from Port Jackson, and, as soon as she can be got ready for Sea, being 9 Years old, and out of repair, Mr. Harris, Mr. Collins (and I shall this day volunteer my Service to go with them) will undertake to Survey Van Diemen's Land, and the Islands about it, among which, as I am informed by the Master of the Francis, the fine Shells seen in England from this part of the World were got.

The Box [*See page* 128. — G.H.], *which Capt. Mertho had in his charge, directed to J.T. Swainson Esqr. Custom House, London, I have given in charge to my Friend Mr. Bromley, Surgeon of His Majesty's Ship Calcutta, from whom Mr. Swainson will receive it.*

It is likely we shall remove to Van Diemen's Land, but that will be determined by the Survey.

The Journey, mentioned in my first Letter from hence, I did not go on, as the Surveyors Mr. Harris and Lieut Tuckey were accompanied by the following Gentleman who went for pleasure, which I knew could not agree with Service; Mr. Bowden[31] *First Assistant-Surgeon; First Lieut Johnson,*[32] *Second Lieut Macculloch,*[33] *both of the Royal Marines; and Mr. E. White,*[34] *purser of the Calcutta. They had with them seven Men to carry Provisions, &c. On Friday the 9th December, at 4 in the Morning, they left the Camp, and returned on Monday the 12th, at 5 in the Evening.*

The Mess of the Civil and Military Officers of this place will be very comfortable, as soon as it can purchase Stock to breed for its use, and will then be a cheap Mess: Its Regulations are, that no Member of the Mess can, on any pretence whatever, have more than One Pint of Wine a day, except when the Governor dines there; and His

Excellency is to be considered as a Mess Visitor. Any Member of the Mess inviting a Stranger, can, on paying for the same, have a Pint of Wine for his Friend, but no more. No Member can dine in his Marquee (excepting he is ill) from the Mess Stock, or have any Wine out of the Mess, except he is going [f132] *on a Journey, in which case he can draw his pint for as many days as he thinks he shall stay.*[35]

From the Master of the Francis I learn, that the five Shilling Tea in England, sells for fifteen Shillings at Port Jackson; that the moist Sugar of seven Pence sells for half a Crown the Pound; and that Brandy and Rum has been known to fetch three Guineas the Quart Bottle: In short, any thing may be purchased for a small quantity of Rum, Tea, Sugar, or Soap, when Money could do nothing.

I have two Convict Servants; their Names are Robert Kennedy[36] *and John Smith.*

Give my best Respects to Mr. Greville, Count de Bournon, and Dr. Crichton.[37]

16th Dec. 1803.

Rec̄ed per Capt. Mertho, of the Ocean Transport 11th Sept. 1805 [G.H.]

Hobart Town, Sullivan's Cove,
River Derwent, Van Diemen's Land.
1st August 1804 -

In my last I informed You it was my Intention to request permission to accompany Mr. Collins to Port Dalrymple; & in his Search for the Lady Nelson, then supposed to be lost on some one of the Islands in the Straits.

On the 18th December 1803, the Calcutta sailed out of Port Philip, with the Wind at S. W. fair through the Straits.

On the 20th I waited on the Governor, and gained his permission to go in the Francis Schooner. Immediately after which he gave Orders to the Master of that Vessel, to furnish me with as comfortable a Birth as possible; and on the 23rd His Excellency went on board the Schooner to examine the Accomodations, and, on his return, informed me they were tolerable for so small a Vessel.

On the 24th we dropped down to the Harbour's mouth, and, early on the 25th sailed out of Port Philip for Kent's Group; but owing to the ignorance of the Master, on the 27th, at ten in the Morning, we found ourselves 18 Miles beyond, or to leeward of the Group: It blew a Gale of Wind at the time, and our Pumps were kept constantly going to keep the Vessel above Water, as she made 13 inches an hour; and would go to Windward but very slowly. We beat about all day and night in this distress, and, at twelve the next day fortunately got in, and found the Lady Nelson there, in good condition, waiting for a fair Wind, having been repeatedly driven back by Gales.

It being unsafe to proceed in the Schooner, Mr. Collins wrote a Letter, on Service, to the Commander of the Brig, stating our Situation, and requesting he would convey us to Port Dalrymple, and order the Francis to proceed to Sydney: These requests he complied with, to my unspeakable Satisfaction.

The Group is composed of five Granite Rocks, on the largest[38] *of which I got some Specimens of Feldspar,* [f133] *and black Shorl; and, on the highest part of the Rock, some detached pieces of Carbonate of Lime! which Substance was by no means thinly scattered.*[39]

A fair Wind springing up, we left the Group in a hurry, and in the Morning after we *sailed (the 1st of January 1804) arrived at Dalrymple; and as soon as the Brig had come to an Anchor, Mr. Brown,[40] late the Botanist of the Investigator (which Gentleman I had the good fortune to find on board the Lady Nelson) Mr. Simmonds,[41] the Commander, Mr. Collins, Mr. Clark,[42] a Superintendent, and myself, went on shore on Sandy Beach.[43] Mr. Brown stopped in a Valley attracted by some Plants. Messrs. Collins, Simmonds, Clark, and I walked on about seven Miles up the Harbour. About four Miles from the Brig, Mr. Simmonds, finding himself fatigued, laid down on the Grass, where we left him.*

When we got to Outer Cove,[44] we heard a noise in the Bushes, and, in ten Minutes found ourselves nearly surrounded by Fire: We had therefore no other way than to run for the Water with all Speed; but unfortunately, Clark is lame of one leg, the use of which he lost, from extreme Cold, at the time of the Guardian's distress,[45] and is one of the few who bravely remained on board. We, however, escaped the Fire, but were no sooner clear of it, than we fell in with one of the Natives of the Country, who screamed in a dreadful manner, and ran in among the Bushes.

As we had but two Guns with us, we thought it imprudent to stay, and walked off as fast as Clark's lameness would allow; We soon, however, had a number of the Natives running after us, shouting and crying out; One of them threw a Spear at us, but did no hurt. We stopped, and put down our Guns, and made Signs of Friendship; but they beat the Trees with short Sticks which they had in their hands, and talked very quick and loud; so finding we could do nothing with them, we walked off as fast as we could. We soon found Mr. Simmonds, whose Gun strengthened our force, and seeing our Party increase, the Natives slackened their pace, and, by the time we were abreast of the Brig, we could see no more of them: This was a warning to us.

On the 3d we went up to Outer Cove in the Brig, and, on the 4th had an interview with two of the Natives, on a Hill,[46] about 3 Miles inland. They were very friendly at first, but soon went away, and returned with a great number of their Friends, who, after they had got all they could, behaved so ill, that, at the moment one of them was going to spear Mr. Brown, we fired on them: They fled to some distance, but watched us to our Boat.

On the 5th we proceeded to Western Arm, and, on the 6th I went with Mr. Brown to a Hill[47] 12 Miles inland, and got some curious Mica, Slate, &c. and returned the same night.

On the 7th we got under way, and went up the [f134] *Eastern, or principal Arm of the River, several Miles farther than Capt. Flinders and Mr. Bass had been;[48] and, at five in the Afternoon, ran aground in four feet Water: however, we soon got off again.*

The 8th was employed in looking for Water, which we were in great want of; and, on Monday the 9th Messrs. Simmonds and Collins, after searching all day, found a most beautiful Fall[49] of fresh Water, and returned with two Casks of it, which were a great comfort to us, as we were all ill, from drinking the Water we got at Kent's Group, which, though it ran down the Rock from a considerable height, was very brackish!!

On the 10th Mr. Brown and myself went to the Fall: It was interesting and beautiful, but we had no time to examine it, Mr. Collins wishing to get down the River again that day, there being nothing to induce him to stay here, having surveyed the whole the day before, when in search of Water. We returned to the Vessel at Twelve, and the hands were piped to heave up the Anchor; but before she could be got under way, she drifted aground on a Mud Bank, where she lay till the Tide rose again.

Wednesday the 11th got under way in the Morning, and, in the Evening came to Anchor in Shoal Bay,[50] near the Bank we were aground upon in our way up. On the 12th we got down as far as Egg Isle,[51] and here we came to Anchor again.

In the Morning of the 13th we went on Shore to examine a Water-Fall,[52] *which one of the Seamen had seen the night before, when in search of Kangarroo. We found it excellent Water, and filled several Casks at it. While this was doing, I amused myself with carving my Name [A.H. 1804] in the solid Basaltic Rock (the Rocks named in the Chart*[53] *Basaltic, are composed of Quartz and Hornblend) with Hammer and Chissel, in a place where it must be seen by any Boat's Crew that may hereafter visit the Spot for Fresh Water.*

On the 14th we got down to Middle Isle, and, on Sunday the 15th got under way, and at 9 came to an Anchor, in 25 fathoms Water, off middle Rock. On the Shore we saw a great number of the Natives, who called to us, apparently in a friendly way; but, on our approaching the Shore, they threw large Stones at us, and seemed determined to oppose our landing. After making Signs of Friendship in vain, we fired over their heads; on which they ran away into the Woods, and we saw them no more.

On the 16th I did not leave the Brig. I baited my Compass Net, and sunk it, but without Success. The 17th I employed myself in cleaning some Shells I had got from Middle Rock, Green Isle,[54] *and Kent's Group, the Net overboard, but caught nothing. On the 18th, the Wind being South West, at five in the Morning unmoored Ship, and got down to Lagoon Beach. On the 19th, at 5 in the Morning, sailed out of Port Dalrymple, and, on the 21st, at five in the Afternoon, came to an Anchor in Port Philip, and found the Ocean ready for Sea.*

[f135] *During my Stay at Dalrymple, I got several curious Minerals, which I have not yet had time to examine; in my next You shall have an account of them.*

Governor Collins had, in our absence, received Intelligence from Governor King respecting Port Dalrymple, which had determined him to sail for the River Derwent, as soon as he could ready for Sea.[55]

Monday the 23d Mr. Brown and I dined with the Governor, and on Tuesday the 24th that Gentleman and myself went to Arthur's Seat,[56] *at the foot of which we slept that Night, and on the following day, at 5 in the Afternoon, returned to the Camp, where we found the half of the Marines and Convicts were embarked, and that I was in public Orders to accompany the Governor.*

On Thursday the 26th, at 5 in the Morning my Baggage went on board; and, at the same hour in the Afternoon, the Revd. Mr. Knopwood and myself accompanied the Governor on board his Cutter.

The Ocean not being large enough to carry the whole Colony at once, it was determined that Lieut Sladden should remain behind with the Command, together with Lieut Johnson; Mr. J. Anson,[57] *First Assistant Surgeon; Mr. Fosbrook, Deputy Commissary; Mr. Hopley,*[58] *Third Assistant Surgeon, 20 Soldiers, and 100 Convicts: And the Revd. R. Knopwood, Assistant Chaplain; Mr. Bowden, First Assistant Surgeon; Second Lieut Lord; Mr. Harris, Deputy Surveyor General, A.W.H.H. Mineralogist, accompanied his Excellency, with 19 Marines, and 200 Convicts.*

On Monday the 30th we got out of Port. Tuesday the 31st we experienced a foul Wind, with heavy warm Weather. The Lady Nelson, which was to have accompanied the Ocean, was out of Sight. Wednesday, the 1st of February, the like Wind and Weather, the Lady Nelson, not yet to be seen.

On the 2d a fine Breeze having sprung up in the Night, at nine in the Morning we were off Cape Liptrap, Light Wind and hot Weather. At dark we were still to the Westward of Wilson's Promontory.

With a fair Breeze, on the 3d, in the Morning, we ran past the Promontory and the Isles off it. At three, when nearly abreast of Hogan's Group, were taken aback by a

Gale from the Eastward, and driven into the Straits again. The next day brought a fair Wind, and we got through the Straits: We then had a fair Wind that carried us to Cape Pillar, off which place we carried away our Main Topsail Yard; shortly after which a Gale from the South West sprung up, and we could not weather the Cape, but were kept beating off and on for some days. On the 10th a fair Breeze took us into Storm Bay; and, at 9 at Night, we made Betsy's Isle: We then took in the most of our Sail, and stood off and on, under close-reefed Topsails all night. In the Morning it blew one of the strongest Gales I have witnessed, directly down the River, so, at twelve, we bore up for Frederick Henry Bay, and got in at four.

Governor Collins being anxious that the Commandant [f136], *Capt. Bowen,*[59] *of the Royal Navy (who had been sent by Governor King, about 8 Months since, with an Establishment to form a Colony, at Risden Cove, in the River Derwent) should know of his Arrival, Lieut. Lord and myself offered our Services to go overland to the settlement. After pointing out the Dangers and Difficulties we had to encounter, finding we had a strong desire to go, he consented, and, at five that Afternoon, we left the Ship,*[60] *with two of the Convicts (trusty Men) and our two Body Servants. I had with me, as I was Pilot, a Map, drawn by Capt. Flinders, in which the Bay, and the Course of the Derwent were laid down. The distance, in a direct line, from the Ship to Risden Cove is about 25 Miles,*[61] *but the Country is very Mountainous, and every now and then You meet with Salt-Water Inlets. We had some difficulty in getting on shore, as the Sea ran very high, and we were wet through before we got half-way.*

On landing we divided the fresh Water and Provisions among the Men, and, each taking his load, we marched off, and, just before dark, got across the Neck of Land, which divides the River from Frederick Henry Bay; and walked round part of a large Bay, which opens into the River,[62] *called Ralph's Bay. At 9 at night, it being very dark, we stopped at a large Tree, and, after having made a Fire, and refreshed ourselves, laid down and slept till next Morning.*

At four we started, and, after travelling over some very high Hills, we stopped to Breakfast. We had not yet fell in with any fresh Water, but depending on finding some a little farther on, we ate heartily of Salt Pork; drank our last Drop of Water, and walked on. At ten we began to be very thirsty, as the Sun was powerful. The places, in which there was fresh Water in the Rainy Season, were all dry. At twelve we had passed some steep high hills, and the Men were tempted to drink at a Salt-Water Inlet. I had never suffered so much for want of drink, and was almost unable to walk. Shortly after my Servant fell down, unable to go any farther. We were forced to leave one of the other Men with him, who was very ill from Thirst also, and walk on. We passed over one or two Hills, from which we could see Mount Direction, at the Foot of which is the Settlement.

The Mount was not far, but we were so much fatigued and faint, for want of Water, that we could not attempt to get up a very steep high hill between it and us: We therefore endeavoured to walk round the Bays and Heads. By the time we were half way round the Bay in which we were, we saw a Boat, sailing down the River; we immediately fired our Guns, and shortly after saw her coming towards us. She had in her Lieut. Moore,[63] *then Commandant of the settlement, Capt. Bowen having returned to Sydney, in a Whaler from England, which put in there for Water; and from her he learned of the War. Lieut. Moore received us very kindly, and paid us every attention in his power; which the Governor told me he had requested the Commandant, in a Letter by Lieut. Lord, to do.*

The Morning after our Arrival, we killed two large Kangarroos, with Mr. Mountgarret's Dogs. Mr. Mountgarret[64] *is Surgeon to the Settlement.*

[f137] *On Wednesday, the 15th of February, the Ocean came to an Anchor in Risden*

Cove, and the next Morning the Governor, attended by his Officers went on Shore: The Ocean fired twelve Guns as he landed. After examining the Land, Water, and the Situation of the Town, all of which displeased him, he returned on board the Ocean again.

The Town is situated on several Hills, and, on landing, You have to ascend a very steep Hill, before You arrive at it; and the people have to fetch their Water from a considerable distance, where they find it in holes the greatest part of the Year, though in the Rainy Season they have several considerable Runs. The Town, from its high Situation is much exposed to the South Winds, which, descending from a Mountain on the opposite Side of the River, called the Table (which in Winter is covered with Snow) are extremely cold.

The next Morning M^r. Harris was sent in search of a more advantageous place: He returned at Noon, with the information of a fine Run, sufficient to supply the largest Colony with fresh water. On the Banks of the Run are many hundred Acres of good Land, tending towards the Mountain I have before mentioned, on which the Rivulet has its Source. The Cove,[65] *into which the Rivulet*[66] *discharges itself, M^r. Harris informed* [us], *was most advantageous for Shipping, as the largest Vessel might lie within a very few Yards of the Shore. In the middle of the Cove was a small Island,*[67] *on which a Store might be erected, safe from the depredations of the Prisoners; and, M^r. Harris was of opinion, it was in every other respect a desirable place for a Settlement, having the Advantage of being five Miles nearer the Harbour's Mouth than the Risden.*

In the Afternoon the Governor went down to look at the Spot, and returned much pleased with it. His Excellency requested I would go down the next Morning, in one of his Cutters, and examine it, and, on my Return, give him my Opinion of it. I was much delighted with every thing I saw; the Water was beautifully clear and soft; the Land good, and level for a considerable way up; and, in some measure shelted from the cold Southern Winds by high Hills in that direction. The Island I found a charming Object from the Shore, and is large enough for all the Public Stores, and one Sentinel would be sufficient to guard the whole, there being no connection with the Shore, except at low Water, when You may walk from the Island to the Main Land on a Sand Bank.

On Sunday, the 19th of February, the Ocean got down to the Cove, and the next day the Camp Equipage was sent on Shore, and pitched under the direction of Lieut. Lord. On the 22d M^r. Knopwood and myself accompanied the Governor on Shore, and took possession of our Marquees. On the 24th the People on Shore were employed in cutting down Trees to build a Bridge across the Stream. Sunday the 26th a Sermon was preached by the Rev^d. R. Knopwood, pointing out the advantages we were likely to enjoy, and the goodness of God, in at length establishing us in a Land of Plenty.

On the 5th of March, Cap^t. Mertho, the Rev^d. R. Knopwood, M^r. Mountgarret, M^r. Brown, and myself, left the Settlement in two Boats, intending to go up the River as far as our Boats would carry us.[68] *We got a short distance above Herdsman's Cove,*[69] *where we slept. The next day we were stopped by a rapid breaking over large Stones,*[70] *so as to prevent any Boats from proceeding farther. In our way we caught several black Swans, which are most excellent eating.*

After refreshing ourselves with them, seeing nothing to induce one to stay here, and wishing to examine a Rock which [f138] *had attracted my attention in the way up, I returned with M^r. Mountgarret, who was desirous of returning to his Sick. We soon arrived at the Rock, being carried rapidly by the Current, which, at all times, acts down the River, and is so strong in the Rainy Season as to prevent Boats from proceeding the shortest distance against it: Notwithstanding this, the Tide has a*

regular rise and fall at the Sides, though it never sets up the River, or, at least, is never perceptible.
With great difficulty I ascended the Rock to a Hole I had observed to be full of a white Substance. I found it to be delicately-crystallised Alum, of which I collected a quantity, and returned to the Boat, but not without great danger and difficulty. This had detained us so long, that we could not get to Risden that Night: We therefore landed, and made a Fire, round which we slept till next Morning, and got to Mr. Mountgarret's House[71] *to Breakfast.*
On the 9th at five in the Morning, I again, in company with Messrs, Harris, Collins, and Mountgarret, and several Men to carry Luggage, left Risden for the Coal River,[72] *at the back of Frederick Henry Bay. We arrived there at one in the Afternoon, after a most fatiguing walk of about 12 Miles. I procured many Specimens of Coal, which I found in great abundance, and tolerably good, but full of Cubic Pyrites, fossil Wood, &c. This Coal may, at some future Period be very beneficial to the Colony. The Stratum was not more than 6 feet in breadth, and its dip was considerable. We got part of the way back the same Night, and slept at a Hole of Water, after supping off a fine Duck, shot by Mr. Collins, and, early the next Morning, returned to Risden.*
After Dinner I left that Settlement, and on my arrival at Sullivan's Cove, saw the Pilgrim Schooner drop Anchor; and soon found she had Capt. Bowen on board, which Gentleman had left Sydney in the Integrity Sloop, and had been at Port Philip, soon after leaving which the Sloop's Rudder was lost in a Gale of Wind; but fortunately had fallen in with an American Whaler, with the Pilgrim as a Tender. Capt. Bowen had engaged with the Master of the Whaler to bring him here, for the purpose of giving up the Settlement at Risden to Governor Collins, and then to return with him to Sidney: for which he was to receive £200. The Ship and Sloop were in Kent's Bay, Furneaux's Isles, which lie off the East Entrance of Bass's Straits.
On Monday the 12th of March Mr. Brown and myself left the Camp (attended by three Men) for the Table Mountain,[73] *taking with us four days Provision; and, after crossing many Hills, arrived at the Foot (as nearly as we could guess, there being no evident Foot to it, as the Secondary Hills*[74] *lie on its sides) about 4 o'Clock in the Afternoon. On one of the Hills we crossed in our way, a piece of crystallised Jasper was put into my hand: However, we could not stop at that time.*
At the Foot of the Mount, we found a small Hole of good Water, surrounded by Fern Trees of the most beautiful kind; many of them 14 or 15 feet high, with leaves, of 8 or 9 feet long, hanging gracefully from the Top on all sides. The Body, or Trunk of the Tree is covered with a silken brown Moss, and the whole together has a most enchanting appearance. In the same Valley were a great number of Sasafras Trees (different, however, from the Wood used in England,) which likewise have a fine appearance. On the Sides of the Mountain are some of the largest Trees in the World, called by our People at Sydney Blue Gum Trees: But the largest Tree I have seen is of that kind called Stringy Bark. On this Night we slept in the hollow of one, which hollow measured eleven feet in diameter; this is but a small tree; one near the Camp measures 44 feet round, breast [f139] *high; and Mr. Brown, a Gentleman in whom the utmost confidence may be placed, informed me, he had seen a Tree lying on the Earth, large enough for a Coach and Six to be driven along it; and it measured upwards of 70 feet in circumference. The Trees in this Country are all streight, and not branched out till near the Top; so that a first rate Man of War might have Masts all of one piece: But to return to the Mountain.*
After sleeping in the Tree all night, in the Morning, early, we began to ascend. About eleven, after a most fatiguing and dangerous Progress of 6 Hours, during the whole of which we were fighting with the Underwood, or pulling ourselves from one huge block

of Stone to another; cold, and faint, we arrived at the Top, and found ourselves in a heavy Shower of Snow. The Wind was piercing cold, and every thing had a wretched, comfortless, appearance: No Trees were to be seen here, and the few Shrubs, that we observed thinly scattered over the Spot, were stinted [sic] *in growth, and almost bare of leaves. We remained on the Top three Hours, and then began to descend, and arrived at our Tree just before dark.*

We slept here that night; and early the next Morning (the 14th) we again began to ascend the Mountain, of which I shall now give a more particular Account. Its height I could not ascertain as we could get no base, and had no Barometer. On leaving the Tree we began to ascend a Secondary Hill, leaning on the Table. It was for some way up composed of an Argillaceous Stone, having numerous impressions of Marine Shells, &c. on it; But I have never seen the smallest remains of Terrestrial Animals, or plants, in this Stone.[75] *As I proceeded up, the Shells became more scarce, and I found numerous water-worn Pebbles imbedded in it.*

We next came to a body of Sand Stone, some thin pieces of which I detached, and found to be flexible in a slight degree; they were unfortunately broken in our way down. This Sand Stone continued for a considerable way, but we could find no Animal Remains in it. On leaving this we arrived at the Primitive Stone, of which all the Mounts of that nature, I have yet seen in Van Diemen's Land, are composed: It consists of Quartz and Hornblend [Granitell][76] *of a dark olive-green colour; the Hornblend is the least considerable quantity of the Mass; and, where it has been exposed to the Weather, is of a Bronze colour. We found this Substance lying in immense Masses, of from three to fifty feet in length, and from two to ten feet in breadth; one on the other, as if they had been thrown thus, by some great power, towards the Top. They were on their Ends, one on the other, similar to the Basalts of Ireland,*[77] *and, at the Top, we found them piled regularly in joints; but at the juncture, the upper and under pieces had lost their solid Angles thus.* [Here in the MS are sketched part of one such column of dolerite and a tetrahedral fragment (Humphrey's triangular 'Angles') spalled from the column where two adjacent columnar-joint surfaces and a transverse joint intersect.]

Many of the Angles I found lying not far from the Blocks from which they came, they were triangular, as I have figured them. Cape Pillar, and Cape Basalt, are composed of this kind of Stone; and I have not yet been able to detect [f140] *any Granite in Van Diemen's Land; but it is probably to be met with on the North Coast of that Island, in Bass's Straits, as Wilson's Promontory, on the South Coast of New South Wales: the Promontory Isles lying off it; Curt's* [Curtis] *Isles; Hogan's Group; Kent's Group; and Furneaux's Isles, off the North Coast of Van Diemen's Land, are composed of that kind of Substance. These Isles, which lie in the Mouth of the Straits, at the East End, seem to point out, that, at some former Period, Van Diemen's Land was connected with, and formed part of New Holland. At the Western Entrance of the Straits, Cape Albany Otway,*[78] *King's Isle, the pyramid, Black Rock, Albatros Isle, Hunter's Isles, Three Hummock Isles, &c. point out a similar connection from one to the other: What the last mentioned places are composed of I know not, not having been near enough to them to determine; but should Cape Portland, and the Swan Isles off it, at the North East end of Van Diemen's Land be found to consist of Granite, it will go a great way towards confirming my Opinion, that Van Diemen's Land, and New South Wales, were formerly one Isle, or Continent; and the Land that once filled the place where the Strait now is, has been torn away by the Swell of the Western Ocean, which Ocean is daily gaining on the West Coast of New Holland, and from time in immemorial has fallen on it.*

During my short Stay at Port Philip, I had repeated opportunities of observing the

Encroachments of the Sea, on the narrow Neck of Land which divides that Port from the Western Ocean: Not only the soft and soluble parts were taken away, but, likewise, the solid Sand Stone, and Limestone, in a most remarkable manner; for, whenever a small Stone had by any accident fallen into a Hole, out of which it could not be easily washed, and yet had room sufficient to move in, I found, after it had been in this situation for any length of time, both hole and Stone perfectly round, which was occasioned by the motion the Stone received from the falling Surge. On the Sea Shore were thousands of holes, formed in this manner, and they are daily increasing in number and size: Some were as large as an ordinary sized Room. An unfortunate Prisoner was drowned in one of these Holes, from imprudently going too near it, when the surge was coming in: He was nearly dashed to pieces in the Bason, and quite dead, before any Assistance could be rendered him. This happened since I left Port Philip.

But I find myself a long way from the Mountain again. Its Summit is an extensive plain, on which no less than five Rivers have their Sources. From the South Side of the Mount we could see a large River, which we supposed to be the Huon: It appeared to be about 12 Miles from the Table; but, as my time is short, I cannot enter into details in this Letter. We got down to our Tree that Night, and, next day returned to the Camp.

Shortly after M^r. Brown and I attempted to reach the Source of the Derwent; at which time we were twelve Days[79] *in the Woods, and were driven back by want of Food. After following its Course upwards of 80 Miles, we left it among high Mountains, not more than 10 Yards in breadth, but one foot deep. On this Journey I collected many good Minerals, most of which were thrown away by the People I had with me, to lighten their Loads.*

Our next Journey was to the River Huon, over the Table Mountain. After great difficulty we reached the River, and traced it much higher than any who had been before us. It is a charming Stream, with much good Ground on its Banks, and Timber of an immense [f141] *size. The lowest part of it, we were at, was about a quarter of a Mile in breadth, and had three Islands*[80] *of considerable size in the middle. The Water was here perfectly fresh.*

It being impossible to return by the way we came, up the South Side of the Mountain, we were forced to steer for Storm Bay Passage, which, after suffering much from want of Water and Rest, we succeeded in reaching, and returned to Camp after an absence of sixteen days, almost worn out.

In the beginning of our Journey we were five days and nights without Sleep, owing to heavy Rains, and not being able to find among the Rocks we were travelling over, any single one large enough to make a bed of.

I found but few Minerals, as You will see by the inclosed List. The principal of my Discoveries is the Green Garnet in its Matrix, and on the Surface of Pitch Stone, and included in it.

Cap^t. Rands[81] *of the Alexander Whaler arrived here two days since (2d August 1804): He left his Ship in Adventure Bay. He has been at Sydney, and says, that a Packet from England had arrived there, with Orders to the Governor to form a Settlement at Port Dalrymple; and that Colonel Paterson*[82] *is gone, with 50 of the New South Wales Corps, and a number of Prisoners to the Port; and that Norfolk Island is given up. I do not think Port Dalrymple will answer for a Settlement: It is much inferior to this Place.*

I must inform You that Lieut. Lord and I have built a small House; the <u>first</u> of <u>Hobart Town</u>;[83] *we have received, however, much assistance from the Governor, who has kindly given us Nails, Locks, Glass, Paint, a Fire Stove; pitch and Tar for the Top,* *and Men to help; with an Acre of Ground, which is much to have in the Town. Our Cottage consists of four Rooms, in one of which I have my Apparatus; one I have lent to M^r. Sladden, and his Lady, who lately arrived from Port Philip, after a very long Passage; the third Lieut. Lord sleeps in, and the other is a Sitting Room. It has, however, cost us about £50, notwithstanding the help we have had. We have been offered more Money for it, and, in one Year's time it will be worth five times that Sum. We have likewise purchased five Dogs, which will kill about 1000lb weight of Kangarroo a Week; for these Dogs we have given £25; but I must tell You, the Governor has contracted to give us 6^d per Pound for as much as we can give him. We have only two of our Dogs at present, but, after the Ocean sails, we shall have the others. Those we have supply us with fresh Meat <u>every day</u>; and we have exchanged 400lb with Cap^t. Mertho for Flour. The Skins are worth 4 Shillings each in this Country, to make Ladies Shoes. You see, therefore, I shall make Money; but to do it I fear I must distress You.*

5 August 1804. 8 in the Even^g.

I was up very late last Night, and packed up all my Minerals, &c, as the Ocean sails Tomorrow; and had pursued Writing all this day; but had not been long in Bed, before I was taken very ill, and it was not till a short time ago that I could sit up in Bed. I believe I have caught Cold, as the Marquee is damp, there having been lately much Rain. I am at this time better, and by Morning, I have no doubt, I shall be well. News is this moment brought me of the arrival of the Lady Barlow, which came from India, with Cattle for Governor King, who has sent them here, viz. 239 Cows, several Bulls, 6 Oxen, 4 Mares, a Stallion, & 3 Horses. — Governor King has likewise sent One Year's Provision and One Year's Cloathing for the People.
I have just learned from Lieut. Sladden, who had been with the Governor, that there is a Box on board the [f142] *Lady Barlow for me: This is distressing, as I am afraid I cannot have it (though in the River) before the Ocean sails.*

6 August. 11 in the Morning

Learning last Night from Cap^t. Mertho, that he should not sail before Tuesday Morning, I left off Writing. This Morning, I am much better, but by no means well. There is little hopes of getting my Box before the Ocean Sails, as the Wind is foul for Ships to come up the River.
Have you received a small Box of Land Shells from Teneriffe; and one from Rio de Janeiro. By my Friend M^r. Bromley, Surgeon of the Calcutta I sent you a Box of Shells and Minerals; but the two Boxes I now send You of Port Philip Shells, and Minerals from this Country, will, I flatter myself give you great pleasure. My Minerals will, I trust, be found valuable, as they are good Specimens, and many of them new. I pride myself more on them than the Shells, though the latter will be most productive to You. But what distresses me, is, that I am under the necessity of drawing on You for a large Sum, knowing, as I do, what must be Your Situation, in consequence of the War. I would not have done it, but from the great Gains I shall hereafter receive from this first Expense. The Dogs will pay themselves in one Month more than double, as they will kill at least 500lb of Kangarroo per Week, and the Governor, as I said before, has contracted with us for it at Sixpence per Pound. We have, besides, 20 Fowls; a Goat

and Kid; Sow and pigs, and a Goose; together with a House, and an Acre of Land, which, from their Situation in the Town, will always be a property. I have drawn on You two Bills, one to Capt. John Mertho, for £12.6.6, the other to Jacob Mountgarret Esqr. for £43.12.6, both payable at 30 Days Sight. The Things I have sent will partly reimburse You, and inclosed is the Governor's Certificate [*A Copy of this see page* 143. — G.H.], *by which You will recieve my Pay, and a List of the Government Collection.*[84] *Those Minerals I have sent You are referred by numbers to this List. I hope You will be able to pay the Bills when presented: as, should they be returned, I shall lose my Credit, and the Esteem of the Officers, as no one is more contemptible in their eyes, than he who would give a bad Bill, as they term it.*

I have received great kindness from the Governor, who has repeatedly told me that I should have any thing the Store afforded, if I would only mention what it was. His Excellency has never refused me any thing I asked of him, which, in this respect makes me comfortable. When I was ill, yesterday even, I received a very kind Note from him, which concludes "I shall, at all times, be happy, not only to aid Your Public Researches, but also to contribute to Your personal Comfort".

Mr. Accum has not sent a Chimney of the length as ordered (12 feet), and I have not more than three feet; and have been under the necessity of applying to the Governor for Tin to complete it, which his Excellency has given me, though it impoverished the Store, as there is but little.[85] *Mr. Accum has sent no variety of Glasses; the Retorts are all of one kind, and not one of them tubulated. The Crucibles are all of the common sort, not one long, or with a Cover. No evaporating Dishes, and, in short, the worst chosen Assortment I ever saw. Pray desire him to give You a Copy of the Bill of the Apparatus, with the Prices he sent to Mr. Sullivan.*[86]

[f143] *I have received my Books, in good Condition, from the Governor; and only wish I could afford to continue Nicholson's Journal.*[87] *I am greatly in want of Geological Books, such as a Translation of Werner's Works;*[88] *or any other good Work of that kind. I wish to have a good Treatise on Pottery, and the Art of Glass-Making; I mean the mechanical part. I have also received from the Governor a small Pocket Compass, but am much in want of a good Telescope.*

No one can have any Idea of the Infamy of the People of the Colony (the Prisoners I mean) who has not witnessed it: Nothing but Flogging and Stealing, though I have not lost any thing of consequence, from having the best Servant in the Place. His Name is Robert Kennedy. He has been a Servant of Sir G.P. Turner, and Sir John Dryden; and came to this Country for buying a Watch, knowing it to be Stolen. He says he had it of a Man, whom he could not afterwards find. Most of the Officers have suffered by their Servants, but myself. My other Servant, Joshua Thatcher, is a good hard-working Man: The Governor gave him to me as a particular Favour. Thatcher was strongly recommended to him. I expect, however, to have the number of my Servants increased, as soon as I have my Farm of 100 Acres; and I look for it shortly.

The Weather is in Winter very Cold; the Table Mountain is at this time covered with Snow; and I have suffered greatly from Cold and Rain, which latter falls very heavy in the Wet Season; and a Marquee is but a poor protection from it. I have frequently slept with the Water a considerable depth (6 inches) under my Bed; but this is nothing to being out all night in the Rain, after a fatiguing Day's March: Your Fire will not burn, and if it would you could not approach it for the Steam of Your Cloaths. I have been out five succeeding rainy Nights, two out of the five as we were travelling over small Rocks; I believe two more would have killed us, as we could get no Rest, after travelling hard all day. I find that since I have been in Van Diemen's Land, I have slept, or been upwards of forty Nights in the Woods. You may judge I have not been idle.

Two Russian Ships,[89] *on discovery, are expected here daily, and the Governor has received Orders to assist them to the utmost of his power.*
I am in want of Wedgwood's Pyrometer,[90] *and a pair of pocket Pistols and Shot.*

8th August 1804.

I have received from the Governor Your Letters of the 4th and 9th October, and 16th November 1803. The Experiment did not arrive at Port Jackson with the Coromandel, by which Your Letters and Box came, and had not arrived when the Lady Barlow left that Place. No one can judge my joy, when the Governor's Servant put the Letters into my hands, and I saw Your Hand-writing in the Address. I congratulate Miss During and my Brother George[91] *on their Escape; but tell them I am accustomed to Gales of Wind, and have been two or three times in danger of Shipwreck, particularly in the Francis Schooner. When that Vessel arrived at Port Jackson, she was put into Dock, when, on stripping off the Copper Sheathing, they found Holes large enough for men to get through. She is mentioned in Governor Collins's Work*[92] *as condemned, at the time he was before in New South Wales.*
It is my Intention, should health permit, to attempt crossing Van Diemen's Land, from this place to Port Dalrymple; especially when there is a Settlement at that Place. The distance is nearly 200 Miles. I have spoken to Governor Collins respecting it; when he said, he greatly wished it, but [f144] *expressed his fears for my safety; and said he could be glad if another Party should start from Port Dalrymple at the time; but as it* [is] *very uncertain whether we should meet, I do not think that will detain me.*
I have just time to add that I have received my Box, that I have written to Governor Paterson, and have given the Parcell and Letter for him, which came in the Box, and also my Letter to Mr. Brown, who goes to Sydney in the Ocean, which sails at day-light. My Illness was similar to that my Aunt Forster[93] *had, at the time I left England, dreadfully sick all day and night and nothing would remain on my Stomach; but I am to day quite recovered.*

Received per the Ocean, Capt. Mertho, 11th Sept. 1805 [G.H.]

Hobart Town, River Derwent
Van Diemen's Land
19th August 1804

As the Lady Barlow will leave the River in a few days,[94] *and as Capt. Mertho intended staying at Sydney a Month or Six Weeks to refit, I seize the opportunity of again writing to You, thinking it probable this Letter may find him there.*
From Capt. McAsgill, of the Lady Barlow, Lieut. Lord and myself, as one Concern, have together purchased One Cow and Calf at £45, and eight Sheep, at £5 per head, making in all £85 Stock, in which purchase we have been kindly assisted by the Governor. This Acquisition, if we are fortunate, will produce a Stock worth four times that Sum in two Years. Mr. Mountgarret asked £70 for a Cow and Calf, by no means so good as ours, and the Governor purchased them of him. We have also bought a large quantity of Corn; India, and other sorts: And the Governor has purchased 120 Gallons of Rum, at 12 s/ per Gallon, which he has kindly offered to the Civil and

Military Officers; so we can have any quantity of this, repaying the Store in a given time. The established price at which it is to be paid away for Labour, is One Guinea per Gallon, but we can make four times that of it. We shall take some, but will be careful how we get in Debt: It is better to make Trial with a small Stock first.
The following is a List of Stock, belonging to Lieut. Lord, and myself, One Cow, and Female Calf; Eight Ewe Sheep; one Goat and Female Kid; two Sows and two Sow pigs; 15 Fowls, and one Goose. Five Dogs, worth in this Country £50; These Dogs supply our Table with Kangarroo every day, which is most excellent eating, not unlike good Beef, but without fat. We shall shortly supply the Governor with a large quantity weekly, to issue to the Prisoners.
Every thing in the Colony has the most favourable Appearance. Two Ships, the Lady Barlow, and the Alexander whaler, are laying off the Settlement. Houses are increasing in number very fast: Ours, which the Governor has named the House in the Wood, from its distance from Town, is now surrounded by the Frames of Houses. Horses are trotting about, and Sheep and Cows are every where to be seen: In Short, the Settlement is in a very flourishing State, and more independent than Sydney was after four or five Years.
Lieut. Lord is first Cousin to Sir Hugh Owen, of Wales, and has a Brother, a Counsellor, in Lincoln's Inn. [f145] *It was necessary for me to join some one, who would look after the Stock in my Absence in the Country, and Lieut. Lord is prudent and steady.*
The Lady Barlow will probably go to England from Port Jackson, if she should, you will most likely receive the Boxes from her.

Copy of the Governor's Certificate mentioned page 141. [G.H.]

These are to Certify that Mr. A.W.H. Humphrey, Mineralogist of the Colony at this Place, has been since the Date of his Commission, and is at present in the Execution of his Office.

Given under my Hand, Hobart Town,
River Derwent, this 4th August 1804.

David Collins
Lt. Governor

NOTES

Abbreviations used: *ADB* — *Australian Dictionary of Biography* (Melbourne); *DNB* — *Dictionary of National Biography* (Oxford); *DSB* — *Dictionary of Scientific Biography* (New York: Scribner); *HRA* — *Historical Records of Australia* (Sydney); *Hist. Rec. N.S.W.* — *Historical Records of New South Wales* (Sydney).

1 *Hist. Rec. N.S.W.* (V: xxvii) gives 29 April 1803.

2 *Calcutta* and *Ocean* both anchored Santa Cruz roads, Teneriffe, 16 May 1803 (*Hist. Rec. N.S.W.* V: 171).

3 *Calcutta* reached Rio 29 June 1803. The trouble among settlers on the *Ocean* (Pateshall, 1980: 50) is not mentioned by Humphrey.

4 São Sebastião do Rio de Janeiro, the full name of the city. See also the accounts by Knopwood (Nicholls, 1977: 10-12), Pateshall (1980: 45-50) and Harris (British Library, Add. MS 45156 ff1-5, 43-54).

5 John Timothy Swainson, amateur naturalist and collector. For many years secretary to the Board of Customs in London and later collector of customs, Liverpool. Died at Elm Grove, near Liverpool, 23 September 1824, aged 67. His son, William — (*DNB*) — is mentioned in the text p. 109.

6 John Cary [1754?-1835], engraver and mapseller in London. Associated with his brother William [1759-1825] — (*DNB*) — in the manufacture of globes (Close, 1926: 36).

7 This da Costa has not been identified. The absence of comment suggests he was not related to E.M. da Costa, sometime friend and collaborator of Humphrey's father. That E.M. da Costa's family, however, had links with Brazil is shown by the note (*Gentleman's Mag.*, 1812, 82 (1): 143) on Hippolyto da Costa [1774-1823], then editor of the *Correia Braziliense* in London.

8 William Nicholson [1753-1815] — (*DNB*). His *Introduction to Natural Philosophy* was first published London 1782; later editions 1787, 1790, 1796 and 1805.

9 A goniometer. Arnould Carangeot [1742-1806] — (*DSB*) — devised and demonstrated the first such instrument (a contact goniometer) at Paris 1782. The reflecting goniometer of William Hyde Wollaston [1766-1828] — (*DNB*] — was a later development (1809). Carangeot's invention arose from a project in which Jean-Baptiste Louis Romé de l'Isle [1736-1790] — (*DSB*) — commissioned the engraver François-Louis Swebach Desfontaines [fl. 1765-1792] to produce terra cotta models of crystal forms. Sets of 438 such models, to match illustrations in Romé de l'Isle's *Cristallographie* (1783), were on sale in Paris by late 1782.

10 Fredrick [Friedrich] Christian Accum [1769-1838] — (*DNB*).

11 Edward Foord Bromley [1777-1836]. The statement in *ADB* (I: 155) that Bromley first came to Australia in 1816 is plainly incorrect.

12 In fact 7 October 1803 (*Hist. Rec. N.S.W.* V: 247); *Calcutta* arrived 9 October (*Hist. Rec. N.S.W.* V: 232).

13 On 31 July 1803, according to Knopwood (Nicholls, 1977: 15).

14 Daniel Woodriff [1756-1842] — (*ADB*).

15 Sullivan Bay (38° 21′ S; 144° 46′ E), near The Sisters, just east of the present Sorrento. For contemporary charts see those of Harris (British Library, Add. MS 45156 f12) and Tuckey (photographic copies in State Library of Victoria, from the original in the British Library).

16 John Mertho, master of the *Ocean*, chartered from Messrs Hurrys of Newcastle-upon-Tyne.

17 David Collins [1756-1810] — (*ADB*).

18 The place is marked at British Library, Add. MS 45156 ff12-13.

19 Robert Knopwood [1763-1838] — (*ADB*).

20 Jacques-Louis, comte de Bournon [1751-1825] — (*DSB*).

21 George Prideaux Robert Harris [1775-1810] — (*ADB*). Humphrey, in fact, did not join the excursion.

22 Cf. Vallance, 1975: 18.

23 Santa Cruz, at the eastern entrance to the bay of Rio de Janeiro.

24 To Port Phillip, between Point Lonsdale and Point Nepean. The tidal race there is known as the Rip.

25 William Collins [1760?-1819] — (*ADB*).

26 Leonard Fosbrook [fl.1803-1814] — (*ADB*).

27 William Sladden [fl.1793-1814] — (*HRA* (III) I: 796).

28 Edward Lord [1781-1859] — (*ADB*).

29 James Kingston Tuckey [1776-1816]. See Tuckey, 1818: xlvii-lx.

30 *HRA* (III) I: 30.

31 Matthew Bowden [1779?-1814] — (*ADB*).

32 James Michael Johnson. He left the colony, October 1807 (*HRA* (III) I: 393).

33 James McCulloch. Returned to England on *Calcutta* 1804.

34 Edward White. Attached to *Calcutta*.

35 Harris in a letter 11 November 1803 (British Library, Add. MS 45156 ff9-10) remarked: '*At Breakfast the mess is divided to suit convenience — I breakfast* . . . [with] *my Friends, Humphry the Mineralogist & Lts. Lord & Johnston of the Marines — We also drink tea & sup together when we can shoot a few small birds to eat.*'

36 Robert Kennedy (or Cannady). See *HRA* (III) I: 796.

37 Sir Alexander Crichton [1763-1856] — (*DNB*).

38 Deal Island (39° 29′ S; 147° 21′ E).

39 See also Brown's remarks (Vallance and Moore, 1981).

40 Robert Brown [1773-1858] — (*ADB*).

41 James Symons. See *HRA* (I) V: 808.

42 Thomas Clark(e) [1756?-1828] — (*ADB*).

43 On the eastern shore of Port Dalrymple, somewhere between Low Head and the present Georgetown.

44 Now, York Cove, at Georgetown.

45 On a voyage to Sydney, H.M.S. *Guardian* struck an iceberg in the Southern Ocean, 23 December 1789. By a remarkable effort the vessel was brought to Table Bay, Cape of Good Hope, where it was beached and finally abandoned (*New London Mag.*, 1790, 6 (5): 222-4; *Hist. Rec. N.S.W.* 1 (2): 310-11). The article on Clark(e) in *ADB* makes no mention of the disaster.

46 Probably the hill now called The Buffalo; Clark(e) places the hill north of Outer (York) Cove.

47 The distance (12 miles) appears to be exaggerated; the high point reached may have been part of the Asbestos Range or perhaps Flowers Hill.

48 In 1798 Flinders and Bass explored the River Tamar as far as the bend just below Cimitiere Point.

49 Cataract Gorge, Launceston.

50 Appears to be in the vicinity of the present Nelsons Shoal.

51 Egg Island, near Hillwood.

52 At the mouth of the Supply River, on the western shore of Supply Bay, Port Dalrymple.

53 The chart has not been found; according to Stancombe (1966) the inscription is still visible on what he calls dolorite (= dolerite).

54 Opposite York Cove, Port Dalrymple. The island is now linked to the shore.

55 *HRA* (III) I: 53.

56 A hill of granite near the southeastern shore of Port Phillip; named in 1802 by John Murray.

57 William I'Anson [1779-1811] — (*HRA* (III) I: 782).

58 William Hopley [fl.1795-1815] — (*ADB*).

59 John Bowen [1780-1827] — (*ADB*).

60 Probably off the present Lauderdale (about 42° 55′ S; 147° 29′E.

61 Humphrey exaggerates; the distance was about 13 miles. Others at the time knew better. Harris, troubled by ophthalmia and unable to travel, estimated 'abt. 12 or 14 miles' over difficult country (British Library, Add. MS 45156 ff14-15), Knopwood (Nicholls, 1977: 42) thought 14 or 15 miles and Collins (*HRA* (III) I: 222) not more than 15 miles.

62 The Derwent.

63 William Moore [fl.1796-1810] — (*HRA* (III) I: 794-5).

64 Jacob Mountgarrett [1773?-1828] — (*ADB*).

65 Sullivan Cove. See note 86.

66 Hobart Rivulet.

67 Hunter's Island; it has since lost its identity.

68 See also Nicholls, 1977: 45-6.

69 At the confluence of the Derwent and Jordan rivers.

70 About the present New Norfolk.

71 At Risdon; for the position of Mountgarrett's house see map facing p. 48 in Walker (1914).

72 The Coal River enters Pitt Water below Richmond; the principal occurrences of coal lie upstream of Richmond but none has proved to be of great value.

73 Now Mount Wellington (1270 m), 8 km WSW of Hobart.

74 Secondary here may mean subsidiary but as Humphrey elsewhere refers to the dolerite (his *Granitell*) as Primitive it is arguable he intended a geological sense, that is, to imply the hills consisted of what would now be termed broadly late Palaeozoic to Mesozoic rocks. Brown also called these hills Secondary (Vallance and Moore, 1981).

75 Humphrey's (and Brown's) geological observations here are discussed by Vallance and Moore (1981).

76 Granitell (granitelle, granitello), a vaguely-defined petrographic term now obsolete but about 1800

used for binary granular rocks, one of the two mineral phases of which is quartz. Humphrey shows awareness of terminology but what he called quartz is plagioclase; his 'Hornblend' is pyroxene.

77 For instance at The Giant's Causeway in Co. Antrim.

78 The original name of what is now Cape Otway, on the coast of Victoria. The localities next listed by Humphrey all lie off the NW corner of Tasmania.

78 Humphrey exaggerates. Knopwood (Nicholls, 1977: 48) noted departure of the party at 9 a.m. 27 March 1804 and its return in the early afternoon of the 9th day, 5 April.

80 Egg Islands, downstream from the present Huonville.

81 Robert Rhodes; he left Sydney 4 July 1804 (*HRA* (I) V: 122).

82 William Paterson [1755-1810) — (*ADB*).

83 *ADB* (I: 127) assigns credit for building the house to Lord alone.

84 This obviously-important document has not been found, nor has the original provided for the government.

85 Collins (*Hist. Rec. N.S.W.* V: 342-3) also complained about the quality and incompleteness of stores.

86 Presumably John Sullivan [1749-1828], under secretary for war and the colonies 1801-5 (*HRA* (I) III: 785). Sullivan Bay at Port Phillip and Sullivan Cove, Hobart, were named in his honour.

87 *Journal of Natural Philosophy, Chemistry and the Arts . . .* , a notable scientific serial, published London 1797-1815. See also note 8.

88 Abraham Gottlob Werner [1749-1817] — (*DSB*). Although his ideas were already widely-known in Britain, none of Werner's books had been published in English translation when Humphrey made the request.

89 The expected visit (*HRA* (I) IV: 306) of the ships *Neva* and *Nadezhda* did not, in fact, take place.

90 Josiah Wedgwood [1730-1795] — (*DNB*). His pyrometers depended on the property of clay to shrink as it is heated.

91 George (III) Humphrey [1789?-1831]; Miss During has not been identified.

92 D. Collins: *An Account of the English Colony in New South Wales, . . . ,* vol. II (1802), p. 330, refers to the *Francis* in 1801 as 'nearly worn out'.

93 Elizabeth Forster [1735?-1816].

94 The *Lady Barlow* (Capt. M'Askill) sailed 22 August 1804 and reached Sydney on 2 September (*Sydney Gazette*, 9 September 1804) where, on 16 October, she sank at her moorings. The vessel was raised and sailed for England 21 January 1805 only to be seized by the East India Company on her arrival in the Thames (*HRA* (I) V: 661, 705, 711). Mail must have been transferred in Sydney to the *Ocean* which sailed 3 October 1804 for England by way of China.

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CONTENTS:

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PROCEEDINGS
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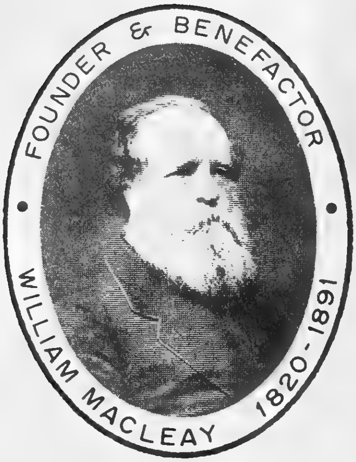

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[1] resigned 17 September 1980
[2] appointed 18 June 1980
[3] resigned 18 June 1980

Cover motif: Mature megasporangiate cone of *Macrozamia communis*, south coast, New South Wales
Sketch by Len Hay, after *Proc. Linn. Soc. N.S.W.* 65, 1940, Pl. XV-8a (where described as *M. spiralis*)

PROCEEDINGS
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The Ascidians of the Reef Flats of Fiji

PATRICIA KOTT

KOTT, P., The ascidians of the reef flats of Fiji. *Proc. Linn. Soc. N.S.W.* 105 (3), (1980) 1981: 147-212

This first account of the ascidians of Fiji is based on collections from the fringing reefs of Viti Levu, the island of Yakuve, and the Great Astrolabe Reef. Records confirm the wide range of the Indo-west Pacific ascidian fauna. Many species parameters are newly defined and scanning electron microscopy has contributed to the definition of species in the family Didemnidae that comprise half of the sixty species recorded. Five new species are described.

Patricia Kott (Dr P. Mather), Queensland Museum, Brisbane, Australia 4006;
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INTRODUCTION

The collections on which this report is based are principally from the fringing reefs along the southern and eastern coasts of Viti Levu, the main island of Fiji, and from Yakuve and the Great Astrolabe Reef. Fiji has not previously been surveyed for this group of organisms. Most of the species recorded are from cryptic habitats under stones and boulders, and in crevices in the reef flat, but algal-bearing species (Kott, 1980) have been taken from the open reef flat. The cryptic species comprise a relatively small proportion of the reef flat ascidian biomass, being far outnumbered by the prolific algae-bearing didemnid species. Deeper subtidal habitats have not been sampled. The records confirm the wide geographical range of species in the tropical Indo-west Pacific (Kott, 1974, 1980) and only very few species are endemic to Fiji. For many of the species these records constitute the first since they were originally taken by the Siboga Expedition in 1900 (Sluiter, 1904, 1909).

This report refers only briefly to the 13 species of plant cell-bearing Didemnidae that occur prolifically in Fiji, but have been discussed more fully by Kott (1980). *Didemnum molle, Lissoclinum patellum, Trididemnum strigosum* and *T. nubilum* are newly recorded from Fiji.

There are five new species described. This does not necessarily reflect a high degree of endemism in the Fijian fauna. It is an indication of the extent to which the ascidian fauna of the Indo-west Pacific region is not understood and the parameters of species not defined. Scanning electron microscopy of spicules has contributed to the definition of species in the family Didemnidae, to which 34 of the 60 species recorded belong.

The following abbreviations are used in the account that follows: AMNH, American Museum of Natural History; BM, British Museum (Natural History); QM, Queensland Museum; ZMA, Zoological Museum of Amsterdam. Where colours of the living specimens have been matched with standards from Ridgeway (1886) they are stated in quotation marks.

SYSTEMATIC DESCRIPTIONS

Order APLOUSOBRANCHIA

Family HOLOZOIDAE

Distaplia vallii Herdman, 1886

Figs 1-3

Distaplia vallii Herdman, 1886, p. 128.
Holozoa vallii: Van Name, 1918, p. 140.
?Leptobotrylloides dubium Oka, 1927, p. 607.
?Distaplia dubia: Tokioka, 1953a, p. 206; 1954b, p. 82.
?Distaplia japonica Tokioka, 1951, p. 169.

Distribution

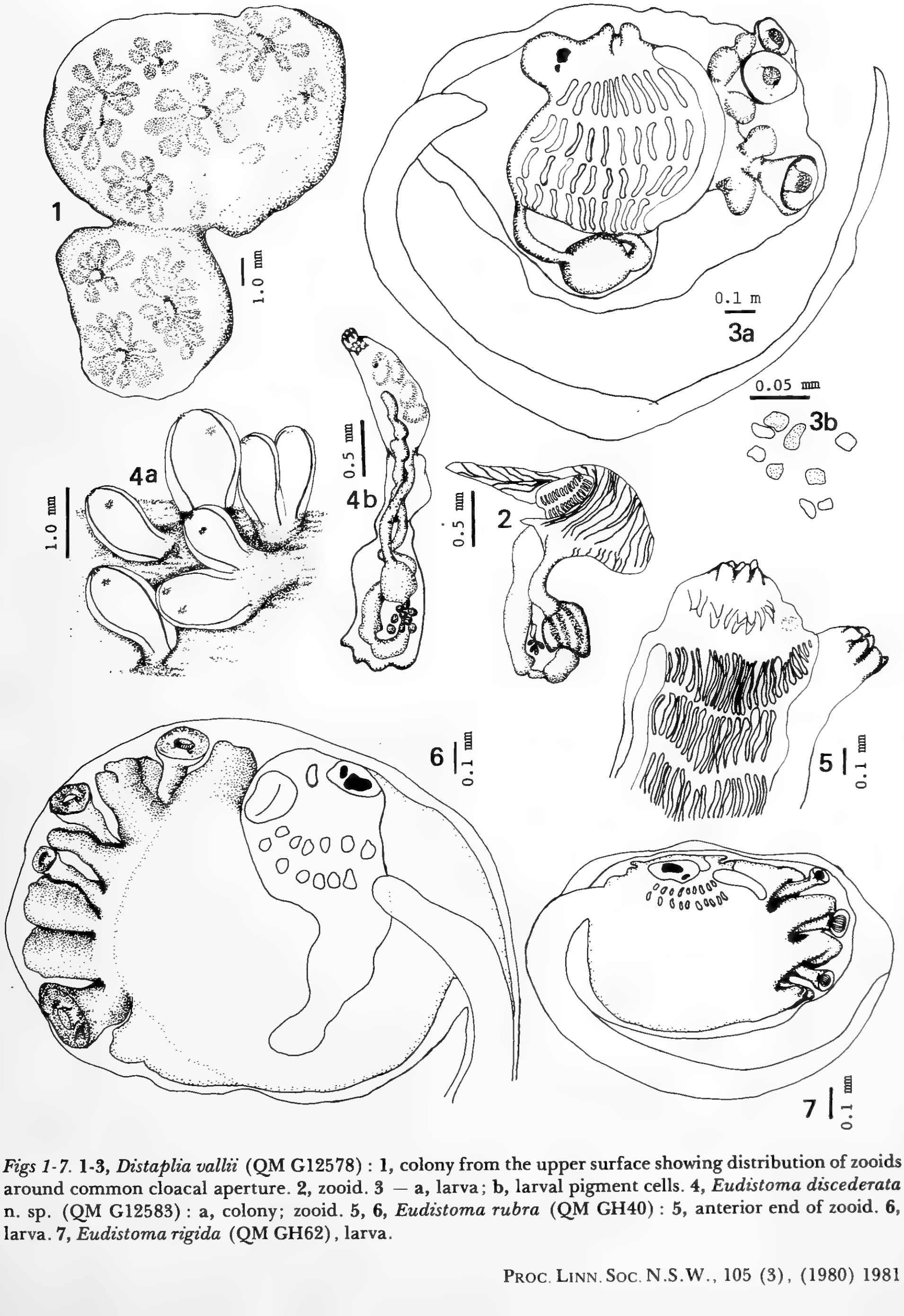
New Records: Fiji — Viti Levu: Malevu, July 1979, LWM, QM G12578; Tai Levu, July 1979, LWM, QM G12591.
Previously Recorded: Morocco — Herdman, 1886. Philippines — Herdman, 1886; Van Name, 1918. ?Japan (Honshu) — Oka, 1927; Tokioka, 1951, 1953a, 1954b.
Depth range: 0-64.4 m.

Description

Colony: The living colonies are two-toned, purple and pinkish-mauve. In preservative they are blue with white zooids, greyish green, or rose coloured. The specimens in this collection are flattened cushions with 3 to 10 round to oval systems of up to 15 zooids. The test is fibrous and spongy.
Zooids: The distapliid thorax, with its wide atrial aperture produced into a large muscular languet, has conspicuous longitudinal muscles, some of which break into small branches across the endostyle, and some extend into the short 6-lobed branchial siphon. There are 4 rows of 25 stigmata, each row crossed by a fine parastigmatic vessel. The abdomen is relatively small with fine longitudinal gastric folds. There is a group of small ♂ follicles in the gut loop. There is a large gastro-intestinal reservoir in the loop of the gut.
Larvae: Single larvae are present in the brood pouch of the specimens from Malevu. They are large, 1.6 mm long. The larval test appears spongy as in the adult colony. This is due to large slightly irregular vesicles which, in the preserved material, are blue or green and sometimes appear to contain darker granules. These obscure the developing embryo.

The larva has the usual 3 triradiate adhesive organs with short thick stalks, swollen into paired rounded prominences at the base of each epidermal cup. These stalks arise from the thick frontal stalk of the embryo. The oozooid is large, occupying the central part of the larval trunk and there is a relatively extensive portion of the larval trunk posterior to the developing oozooid.
Remarks: Herdman's specimens from the Philippines, and from the Mediterranean are distinctly stalked, while the present specimens are sessile cushions, fixed by the whole extent of their flattened base. Other specimens from the Philippines 'exhibit great variation in the form of the colony ranging from distinctly capitate colonies raised on a short but more or less distinct neck, to irregular rounded masses and even flattened incrusting forms' (Van Name, 1918, p. 140). The test in these specimens is spongy and fibrous as in the present colonies. This condition of the test, however, is found in other species of this genus. Species recorded from Japanese waters, *D. dubia* (Oka, 1927) (see Tokioka, 1967), *D. coronata* Tokioka, 1955a, *D. systematica* Tokioka, 1958 and *D. miyose* Tokioka, 1962, are closely related. They all have a similarly spongy test, parastigmatic vessels, gonads contained in the abdomen rather than in a posterior abdominal extension and fine longitudinal folds in the stomach. *Distaplia coronata, D. systematica* and *D. miyose* have only one system in each cormidium. Variations in the orientation of thoracic musculature (which Tokioka has primarily used to distinguish the species) may only be apparent and result from

differences in contraction. The colour of these formalin-preserved colonies is greyish green as are some of the present colonies. The larva of *D. coronata* is known and is identical with those of the present specimens, with a similarly spongy test. It is possible that these species are synonymous with *D. dubia,* which has a similar range in Japanese waters, and includes capitate specimens with single systems (see Tokioka, 1953a)



Figs 1-7. **1-3,** *Distaplia vallii* (QM G12578) : **1,** colony from the upper surface showing distribution of zooids around common cloacal aperture. **2,** zooid. **3** — **a,** larva; **b,** larval pigment cells. **4,** *Eudistoma discederata* n. sp. (QM G12583) : a, colony; zooid. **5, 6,** *Eudistoma rubra* (QM GH40) : **5,** anterior end of zooid. **6,** larva. **7,** *Eudistoma rigida* (QM GH62), larva.

Distaplia dubia displays the same range in colony form and pigmentation as the present specimens and no characteristic is known that can be used to distinguish these highly variable species.

Family POLYCITORIDAE

Eudistoma discederata n. sp.

Fig. 4

Distribution

Type Location: Fiji — Viti Levu: Laucala Bay, experimental mussel raft, with *Symplegma viride,* July 1979, Holotype, QM G12583; Sand Bank Reef, underside of rubble side of channel, July 1980, Paratype, QM GH46.

Description

Colony: The colony is very irregular and only 6 mm thick. There is a spreading basal mass, about 1 cm in maximum extent. The thoraces, each encased in its own separate layer of test, arise densely from the surface of the basal mass of the colony. The test is transparent, gelatinous and soft.

Zooids: These are characteristic of the genus, with 6 rounded lobes fringing each of the apertures. The thorax and abdomen are of approximately equal length. About 12 longitudinal thoracic muscles extend along the length of the thorax and continue in a band on either side of the abdomen. The transverse thoracic musculature is well spaced. There are 3 rows of 6 long rectangular stigmata.

The short stomach is in the posterior third of the abdomen. Gonads of the usual form are present in the loop of the gut, with a large one-egg ovary to the right of the ♂ follicles.

Larvae: Up to 5 embryos present in the peribranchial cavity. Well-developed larvae are 0.4 mm long, with a large ocellus and an otolith, 3 median adhesive organs, 4 pairs of ectodermal ampullae and the tail wound three-quarters of the distance around the trunk.

Remarks: This is the first known species of this genus in which the thoraces are free of the common test. It is unlikely that it is a primitive character, indicating any affinity with species in the family Clavelinidae (in which partial separation of the zooids often occurs). The zooid is characteristic of the genus *Eudistoma* and displays no unique characters except the small number of stigmata in each row. The larvae are especially small but otherwise quite characteristic of the genus.

Eudistoma rubra Tokioka, 1954

Figs 5, 6

Eudistoma rubra Tokioka, 1954, p. 252; 1967, p. 117.

Distribution

New Records: Fiji — Viti Levu: Mumbualau, reef flat close inshore at the base of shallow crevices in surface of the reef below LWM, July 1980, QM GH40.

Previously Recorded: Japan (Tokara Is.) — Tokioka, 1954a. Gilbert Is. — Tokioka, 1967.

Description

Colony: Rounded translucent heads are supported on short thick stalks (about 1.5 cm long and up to 2 cm in diameter) that arise from a thick basal mat. In the living specimens the heads are expanded and the separation between adjacent heads is not apparent to the naked eye so that the colony appears to be a large hemispherical mass (up to 6 cm diameter), translucent and pale cloudy pink. The orange colour in the musculature of the zooids is diffused by the cloudy translucent test to create the

apparent pink colour of the colony. In preservative the head collapses to little more than the diameter of the stalk. The zooids lie parallel to one another in the preserved material, but in life they diverge anteriorly to open all over the surface of the colony. The basal test contains oval faecal pellets.
Zooids: The zooids are long (up to 3 cm when expanded) and very thin. The thorax is only about one quarter of the length of the long, narrow abdomen. They are not arranged in systems. The apertures have 6 well-developed pointed lobes and the anterior lobe of the atrial aperture is often enlarged. Longitudinal muscles extend along the centre of each lobe to its pointed tip. There are circular sphincter muscles around each short siphon. Fifteen longitudinal muscle bands on the thorax lie superficial to a continuous coat of fine circular muscles. The longitudinal muscles extend in wide bands along both sides of the abdomen. There are 3 rows of stigmata. In the second and third rows there are 10 stigmata. In the anterior row, an additional 6 stigmata extend anteriorly, oriented at an angle to the mid-dorsal line (see Tokioka, 1954a, p. 253, fig. 2). The oesophagus is very long, expanding to the oval, smooth stomach in the posterior one third of the abdomen.
Larvae: There are up to 2 (never more) larvae in the peribranchial cavity. The trunk is 0.7 mm long. The anterior border of the trunk is produced into solid, dorso-ventrally flattened pad-like ampullae, 2 between adjacent adhesive organs. In one larva the central adhesive organ appears to have subdivided, the duplicate extending between the dorsal pair of pads. The stalked adhesive organs contain a small central mass of adhesive cells and a circular epidermal cup. There is an otolith and an ocellus.
Remarks: The specimens conform exactly to Tokioka's (1954a) description in all respects except for the coat of circular muscles that is present in these specimens. The colour and form of the colonies, the longitudinal musculature, the number of brooded embryos and the characteristic additional stigmata in the anterior row are identical. The larvae in the present specimens are better developed than Tokioka's and this may be the reason for their larger size. The larva is similar to that of *Eudistoma elongata* from eastern Australia (Kott, 1957b).

Eudistoma arenacea (Sluiter, 1909)

Polycitor arenaceus Sluiter, 1909, p. 13.
?Eudistoma arenosum Kott, 1957b, p. 73.

Distribution
New Records: Fiji — Viti Levu: Sandbank Reef, LWM June 1980, QM GH87; Mumbualau, LWM July 1980, QM GH89.
Previously Recorded: ?Western Australia (Rottnest Is.) — Kott, 1957b. Indonesia — Sluiter, 1909.

Description
Colony: The colonies are oval, soft and sandy cushions about 2 cm long and up to 0.5 cm thick. The test is glassy but filled with sand and faecal pellets in moderate density. Some, but not all of the zooids are arranged in circular systems.
Zooids: The atrial siphon is longer than the branchial siphon. The circular sphincter muscle is only moderately developed on both siphons. There are 15 longitudinal muscles on the thorax extending along both sides of the abdomen and a continuous coat of circular muscles. The three rows of stigmata each have 20 stigmata. The oesophagus is long, the stomach in the posterior third of the abdomen.
Larvae: Larvae were not present in these specimens.
Remarks: The species is distinguished from *E. pyriforme* and *E. ovatum,* both sand-containing tropical species of *Eudistoma,* by the straight gut loop, without twists or

loops (see Hastings, 1931). There are no particular characteristics of either the zooid or the colony except the tendency to form systems.

Eudistoma rigida Tokioka, 1955

Fig. 7

Eudistoma rigida Tokioka, 1955b, p. 50.

Distribution

New Records: Fiji — Viti Levu: Makaluva, LWM July 1980, QM GH62; Sandbank Reef (Laucala Bay), LWM July 1980, QM GH100.
Previously Recorded: Palau Is. — Tokioka, 1955b.

Description

Colony: The colonies form smooth fleshy cushions up to 4 cm in maximum extent and 1 cm thick. In preservative they are dark grey, owing to clouds of minute black pigment cells in the surface test. These become less dense toward the base of the colony. Zooids are white. They are arranged in circles with the atrial openings in an inner concentric circle. There are some oval faecal pellets and some sand scattered sparsely in the test. The colour of the living colony from Fiji has not been recorded. Specimens from the Great Barrier Reef (Heron Is.) are yellow, orange, or geen and yellow.

Zooids: The contracted zooids are about 2 mm long. The branchial and atrial lobes are conspicuous and rounded. The atrial siphon is long and muscular. About 20 longitudinal thoracic muscles continue onto the abdomen where they extend in one wide band along each side. There are 15 stigmata in each of the three rows. The abdomen is much contracted in these specimens.

Larvae: There are two large larvae in the peribranchial cavity. The larval trunk is 0.6 mm long and the tail is wound half way around it. There is an otolith and ocellus. Three adhesive organs in the mid-line are separated by wide median ampullae.

Remarks: In the preserved material the dense grey colour of the surface layers of test, shading to translucent light grey, together with the circular arrangement of the zooids and the virtual absence of sand in these fleshy colonies are characteristic.

Eudistoma vitiata n. sp.

Figs 8, 9

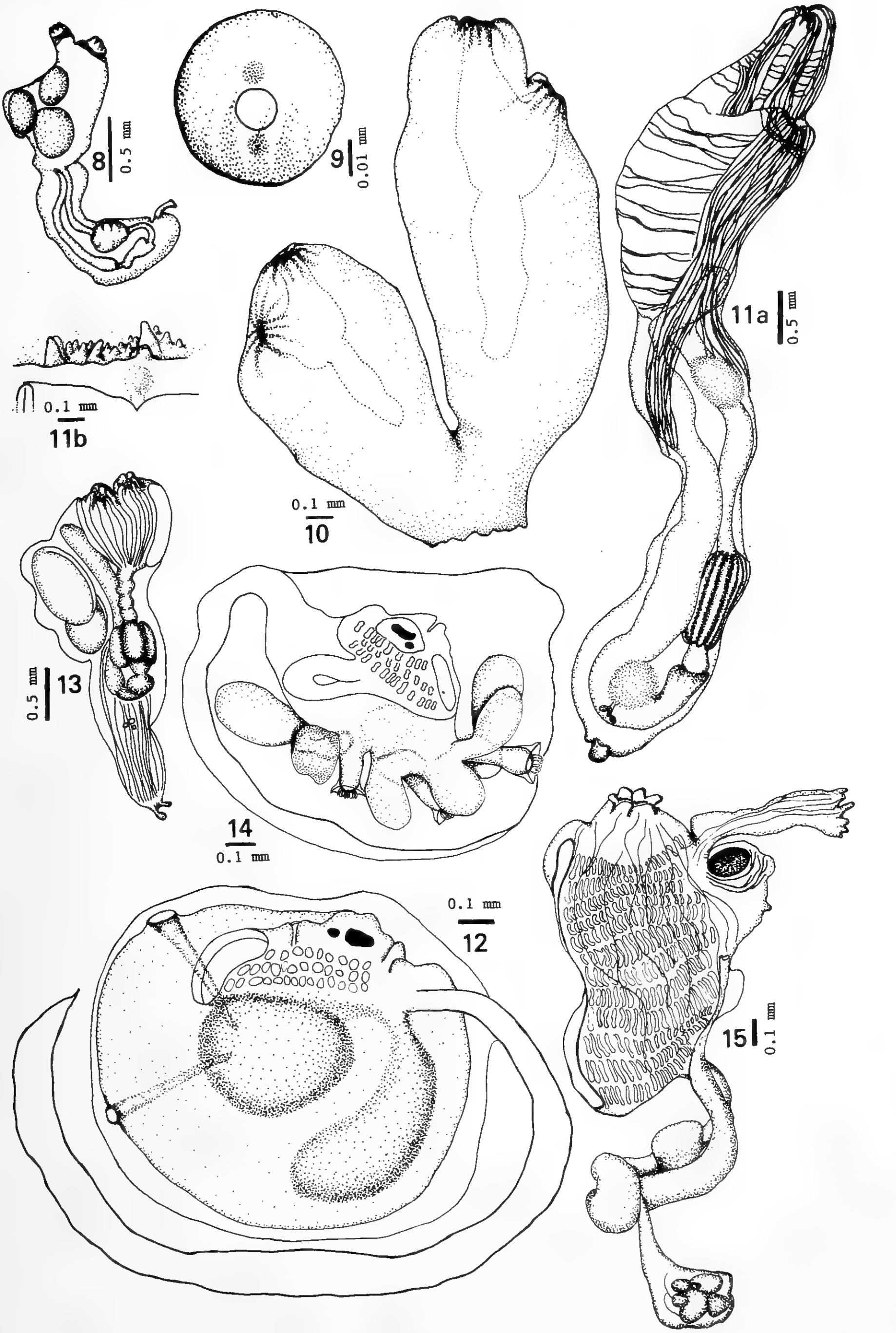
Distribution

Type Location: Fiji — Viti Levu, July 1979: Makaluva, LWM, Holotype QM G124711; Suva Barrier Reef, LWM, Paratype QM G12616.

Description

Colony: The colonies are small irregular cushions, up to 1 cm in length, sometimes with small clavate lobes rising from the surface. The test is translucent, gelatinous, and contains clumps of large (0.05 mm diameter) spherical green cells that are found throughout the test, but are especially around the zooids. These green cells are sometimes contained in what appears to be a spherical cyst from which they are readily liberated by tearing open the wall of the cyst. They may be protozoan. Faecal pellets are also contained in the test.

Zooids: The zooids open independently and are not arranged in systems. In the living colony they are pinkish orange but are colourless in preservative. They are 2 to 3 mm long. There is a conspicuous atrial siphon but the branchial opening is almost sessile. Short sphincter muscles are present around both siphons. About 15 longitudinal thoracic muscles extend along both sides of the abdomen. There are about 15 stigmata in each of the three rows. The abdomen is only slightly larger than the thorax. The rounded stomach is present posteriorly and there is a distinct mid-intestine in the loop



Figs 8-15. **8, 9,** *Eudistoma vitiata* n. sp. (QM G12471) : **8,** zooid. **9,** spherical green cell removed from test. **10-12,** *Euherdmania digitata* (QM G12470) : **10,** part of a colony. **11,** — **a,** zooid; **b,** branchial tentacles. **12,** larva. **13, 14,** *Pseudodistoma aurea* (QM GH106) : **13,** zooid. **14,** larva. **15,** *Polyclinum sundaicum* (QM G12611), zooid.

of the gut. There are up to 3 embryos in the peribranchial cavity.
Larvae: The trunk is large (0.7 mm) in relation to the size of the thorax. Larvae have an ocellus and an otolith and are of the usual form for this genus. There are large median ectodermal ampullae alternating with the adhesive organs. The 3 adhesive organs have long stalks, wide shallow ectodermal cups and a central rather flat-topped circular platform of adhesive cells.
Remarks: The zooids of the genus *Eudistoma* present few characters that can be used to distinguish the species, and neither the zooid nor the larva of this species is unique in any way. The form of the colony is variable and the small flat-topped lobes that arise from a flat mat are found in many other species. The green spherical cells that are found in these colonies are distinctive, however, and distinguish them from other *Eudistoma* spp. which have different test inclusions, distributed in different parts of the colony. It is assumed that these green cells do constitute a specific character, as there are no other foreign inclusions in the test. The species resembles colonies of as yet unidentified material taken from similar habitats in the Great Barrier Reef.

Cystodytes dellechiajei (Della Valle, 1877)

Distoma dellechiajiae Della Valle, 1877, p. 40.
Cystodytes dellachiajei: Kott, 1972a, p. 11 and synonymy.

Distribution

New Records: Fiji — Viti Levu: Tai Levu, July 1979, LWM, QM G12576; Suva Barrier Reef, July 1980, LWM, QM GH118.
Previously Recorded: The species is pan-tropical, with a latitudinal range from Patagonia and Maria Is., Tasmania, in the south, to the Mediterranean and the Azores (see Kott, 1972a).

Description

Small sessile dirty beige cushions in which the white capsules of spicules around the zooids are clearly evident. The colonies and their zooids are identical with those previously described, although purple pigmented test that has been recorded for some colonies (Kott, 1972a) has not yet been observed in specimens from Fiji.
Remarks: Cystodytes philippinensis Herdman (see Tokioka, 1950) is the only other species of this genus known from the Indo-west Pacific. It is distinguished by its spheroidal spicules.

Family POLYCITORIDAE
Subfamily EUHERDMANIINAE
Euherdmania digitata Millar, 1963
Figs 10-12

Euherdmania digitata Millar, 1963, p. 698. Tokioka, 1967, p. 58.
Clavelina dentatosiphonis Millar, 1975, p. 211.

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, LWM, July 1979, QM G12470, July 1980, QM G12868; Makaluva Reef, LWM, July 1979, QM G12469; Sandbank Reef, under rubble at side of western channel, July 1980, QM G12867.
Previously Recorded: N.W. Australia — Millar, 1963. Coral Sea — Millar, 1975. Palau Is. — Tokioka, 1967.
Depth Range: 0-100 m. The Fijian specimens were all under rubble.

Description

Colony: Colonies consist of club-shaped vertical lobes about 1 to 2 cm long, joined basally for up to half of their length and with narrow horizontal basal stolons that often extend for a considerable distance on the substrate. Each lobe contains a single zooid opening on the upper rounded free end of the lobe. The terminal half of each lobe is pale pink, glassy and smooth in life, but the preserved material is collapsed and translucent. The test of the basal part of the lobe is firm and translucent forming a stalk that is often long and narrow.

Zooids: There is a terminal branchial siphon and an atrial siphon anterodorsally. Both siphons are fairly long, each with a conspicuous sphincter muscle around the base. The apertures are protected by 6 accessory lobes. The borders of these lobes are turned inwards, and in these specimens they are smooth rather than dentate. The dorsal lobe of the branchial apertures is large, occupying the whole of the dorsal side of the opening but the lobes around the atrial aperture are all of equal size. There is a velum inside the siphons at the base of the accessory lobes that is also divided into 6 rounded lobes and may be homologous with the border of openings in other species, for it appears that the protective, accessory lobes are produced forwards from the body wall around the periphery of the apertures. There is a dense layer of fine circular muscle bands over the thorax continuing onto the siphons. A conspicuous broad longitudinal band extends along the dorsal border of the body from the atrial siphon to the posterior end of the thorax where it divides to pass around to join a ventral abdominal band of longitudinal muscle. Two conspicuous ventral bands of muscle extend in the thoracic body wall either side of the mid-line and are also continuous with the ventral abdominal band. There are several additional bands of longitudinal muscle extending along the siphons from each accessory lobe that fan out over the thorax. The muscles terminate abruptly at the posterior end of the zooid. The neural gland forms a conspicuous swelling in the pharynx, at the anterior end of the dorsal lamina. The neural duct extends forward for a short distance to a simple opening on a small papilla that projects into the lumen of the gut at the base of the short curved branchial tentacles and just anterior to the straight prepharyngeal groove. The branchial tentacles are in 3 rows. The dorsal lamina is represented by pointed languets. There are 16 rows of 20 stigmata with a wide membrane between successive rows. The oesophagus is long. The stomach is cylindrical when the abdomen is contracted but is pear-shaped when extended. The wide cardiac end of the stomach is about half way down the abdomen. The stomach is yellow in preservative and has 12 parallel longitudinal external folds. There is a duodenal area demarcated from the intestine toward the posterior end of the abdomen and a posterior stomach that is often obscured. The present specimens confirm that the corrugated tube referred to by Millar (1975) is the stomach.

The relative proportions of parts of the zooid are often distorted by contraction. However there is also great variation in the length of the posterior abdomen that may be effected by resorption following sexual reproduction. The posterior abdomen of the specimens from the Palau Is. (Tokioka, 1967), have long posterior abdomina, although only a few scattered ♂ follicles were detected in the anterior part and the heart is present two-thirds of the distance down the posterior abdomen. Specimens from N.W. Australia (Millar, 1963) have less attenuated posterior abdomina. In the present specimens and in the type specimens of *Clavelina dentatosiphonis* Millar, 1975, from the Coral Sea, a distinct posterior abdomen is not present. No gonads were reported for Millar's specimens, but in the Fijian material mature ova and developing embryos are serially arranged in the oviduct, beginning their development at the posterior end of the abdomen. Up to two tailed larvae are present anteriorly in the peribranchial cavity. Fertilization is at the base of the oviduct. Only very few lobed ♂ follicles are occasionally present behind the ovary, to the right of the pole of the gut loop in the present specimens. These are similar to the ♂ follicles described by Millar (1963) and Tokioka (1967).

Blood corpuscles are present in the U-shaped heart posterior to the gut loop. Trophocytes suggestive of subsequent abdominal strobilation are also present along the abdominal body wall. The posterior end of the zooid ends in a rounded knob surrounded by a crown of rounded swellings identical with the condition described by Tokioka (1967, fig. 18e) for this species.

Larvae: Up to 7 developing embryos are present in the oviduct. Well-developed larvae, present in the peribranchial cavity, are especially large, with the larval trunk about 1 mm long. The tail is wound only half way round the body, and there is an ocellus and an otolith. There are two adhesive organs in the mid line covered by the tail where it is wound around the larva. They are long tubes invaginated into the larval trunk from the ectoderm. They are obscured by the yolk(?) material in the larval trunk and can be displayed only by dissection of the larva. This type of adhesive organ is known in other species of *Euherdmania,* viz. *E. claviformis* (Ritter) (see Trason, 1957) and *E. vitrea* Millar, 1961. It also occurs in the genus *Pycnoclavella,* viz. *P. aurilucens* Garstang (see Berrill, 1950), *P. diminuta* (Kott), (see Kott, 1972b), *P. detorta* (Sluiter) (see Millar, 1975) and *P. stanleyi* (Berrill and Abbott) (see Trason, 1963).

Remarks: The species resembles the eastern Pacific *Euherdmania claviformis* (Ritter) (see Van Name, 1945, and Berrill, 1935) and the West African species *E. solida* Millar, 1953 and *E. rodei* Pérès, 1949 in its short posterior abdomen, the several rows of branchial tentacles, the long oesophagus, the long folded stomach, the ventral orientation of the branchial siphon and irregularities in the size of the siphonal lobes (the largest being present dorsally), the unusual arrangement of body muscles in dorsal and ventral bands (possibly associated with specialization of the siphonal lobes), the fertilization of eggs at the base of the oviduct. The form of the larva and its adhesive organs are the same as those of *E. vitrea* and *E. claviformis* (Trason, 1957; Millar, 1961). The species are separated by differences in the number of stomach folds, and rows of stigmata, and in the colonies. *Euherdmania australis* Kott (1957b; 1972b) apparently has other affinities and appears not to be directly related to the other species in this genus.

There is no doubt regarding the identity of the present species with *Stomozoa dentatosiphonis.* Although the denticulations on the siphonal lobes are more pronounced in the Coral Sea specimens this, together with the condition of the posterior abdomen are apparently variable characters in this species and possibly in this genus.

A related species, *Stomozoa murrayi* Kott, 1957a (from the Red Sea), the Brazilian Shelf (Millar, 1977) and from South Africa (<*Clavelina roseola:* Millar, 1962) is the type species of the genus *Stomozoa.* It differs from the present species principally in the form of the colony and in the better development of the siphonal lobes. As in *E. vitrea* the zooids are embedded. Millar (1977) has already drawn attention to the similarity of *E. vitrea* and *Clavelina gigantea* Van Name from Florida (?>*E. morgani* Millar and Goodbody, 1974, from the West Indies). Both these species are distinguished from *Stomozoa murrayi* only by their post-abdominal gonads as in *E. digitata* this may be variable, since *C. gigantea*: Tokioka, 1967 (Gulf of Mexico) has abdominal gonads. Thus *E. vitrea, C. gigantea, E. morgani, S. murrayi* and *C. roseola* may indeed be conspecific and *Stomozoa* is more than likely a synonym of *Euherdmania.*

Phylogenetic affinities of *Euherdmania* are unresolved. A relationship between *Euherdmania* and *Pycnoclavella* is based on the form of the peculiar larval adhesive organs. Trason (1957) has argued that this suggests an independent origin from a cionid-type ancestor, rather than an affinity with either the Polyclinidae or the

Clavelinidae (see Van Name, 1945; Millar, 1977). However, although the blastozooids of *Pycnoclavella* form in the terminal ampullae of the stolonic vessel as in Clavelinidae, in *Euherdmania* they form by abdominal strobilation as in Polyclinidae and these facts suggest relationships with the Clavelinidae and the Polyclinidae respectively that are no less tenuous than those based on the larval adhesive organs.

Pseudodistoma aurea (Brewin, 1957)

Figs 13, 14

Sigillinaria aurea Brewin, 1957, p. 577.

Distribution

New Records: Fiji — Great Astrolabe Reef: Dravuni, July 1980, LWM, QM GH106.
Previously Recorded: New Zealand (North Auckland) — Brewin, 1957.

Description

Colony: The living colony is a low cushion about 1 cm in greatest extent. It is clear and transparent, 'indian yellow' in colour, with the zooids clearly visible through the test. The colony loses some of its colour in preservative.

Zooids: The zooids open separately to the exterior. They measure about 3 mm when contracted. Six rounded lobes fringe both of the short, anteriorly-oriented siphons. Twelve bands of longitudinal muscles on each side of the thorax continue along each side of the abdomen. There are about 20 stigmata in each of the three rows. The oesophagus is fairly long. The stomach with 4 rounded folds is present in the posterior part of the abdomen and there is a posterior stomach in the pole of the gut loop. There is a small ovary in the anterior part of the short posterior abdomen but the ♂ follicles are expended.

Larvae: Two large embryos, incubating in the oviduct, project from the postero-dorsal corner of the thorax. Mature larvae are sometimes found isolated in the test, the brood pouch having separated from the thorax of the zooid. The larval trunk is 0.6 mm long. The tail is wound half of the way around the trunk. The larvae are of the polycitorid-type with 3 median adhesive organs alternating with median ampullae. Lateral ampullae are present on either side of the base of the median ampullae.

Remarks: The clear test, the colour, the thorax with two anteriorly directed short siphons, the long oesophagus and the large larvae are all identical with those described for the New Zealand specimens.

Ritterella proliferus (Oka, 1933)

Distoma proliferum Oka, 1953, p. 436.
Polycitor proliferus: Tokioka, 1953a, p. 204 and synonymy.
Ritterella proliferus: Kott, 1973, p. 245.
Ritterella dispar Kott, 1957b, p. 102; 1963, p. 78.

Distribution

New Records: Fiji — Great Astrolabe Reef: Yakuve, July 1980, LWM, QM GH102. Lord Howe Is. — QM GH12001.
Previously Recorded: On the northeastern Australian coast this is a common species, high in the intertidal region from Botany Bay on the coast of N.S.W. and on the Great Barrier Reef.

Description

Colony: The colonies form small white cushions up to 1 cm in diameter, flat topped and narrowing to a sessile base. There is sand in the basal test but it becomes more sparse toward the upper surface, where it is absent altogether. The living colonies are pinkish white and translucent, with a bluish iridescent tinge. The zooids are visible through the test as orange points which cause the pink tinge in the colony.

Zooids: The zooids open separately to the surface by two 6 lobed apertures. The thorax has 9 or 10 longitudinal muscle bands that extend along both sides of the abdomen. There are 5 rows of about 16 stigmata. The oesophagus is fairly long. The stomach, with 8 longitudinal folds, is present at the posterior end of the abdomen. Gonads are present in a short posterior abdomen.
Larvae: There are up to two large embryos in the peribranchial cavity (Kott, 1957b).
Remarks: This common species is characterized by the bluish translucent tinge in the white test, and by its small cushion-like colonies. Six rows of stigmata have been recorded for Japanese specimens that are identical in all other respects with those from Australia and the mid-Pacific.

Polyclinum sundaicum (Sluiter, 1909)

Fig. 15

Glossophorum sundaicum Sluiter, 1909, p. 97.
Polyclinum tsutsuii Tokioka, 1954a, p. 240; 1967, p. 47.

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, July 1979, LWM, QM G12611; Makaluva, July 1979, LWM, QM G12612; Sand Bank Reef, July 1980, LWM, QM GH88.
Previously Recorded: Indonesia — Sluiter, 1909. Philippine, Palau and Gilbert Is. — Tokioka, 1967. Japan — Tokioka, 1954a.

Description

Colony: The colonies are about 5 mm thick, rounded, soft and gelatinous, fixed basally, the upper surface convex. They extend up to 2 cm in diameter. The outer surface is sandy, but internally the test is transparent, colourless and very soft indeed. Sand is absent only from the zooid openings. There are up to 15 circular systems.
Zooids: Thoraces are delicate and transparent with a large conspicuous atrial tongue that is sometimes pointed but more often ending in a wide straight, but pectinate free end. Thoracic musculature is fine consisting of about 8 longitudinal bands and many fine circular fibres around the apertures. The longitudinal bands do not appear to extend the full length of the thorax, although this may depend on their differential contraction. The muscle fibres in the atrial tongue extend parallel to one another along its length. The atrial opening is posterior to the atrial tongue and is usually produced forwards as is usual in this genus. There is a minute papilla from the body wall just posterior to this aperture. The thorax is large with 12 rows of 20 longish oval stigmata. The horizontal membranes between these rows are broken into conspicuous flattened tongue-shaped papillae opposite each of the stigmata. The abdomen is relatively small. The gut loop is fairly long, flexed ventrally at right angles to the long axis of the zooid, and bent to the right and dorsally at the pole of the loop. The stomach is rounded and smooth, about half way along the proximal limb of the gut loop. The anus opens anterior to the brood pouch. It is usually conspicuously bidentate but in some zooids there are up to 5 rounded lobes.

The small sac-like posterior abdomen, with spherical eggs scattered amongst the smaller pear-shaped ♂ follicles, is joined to the concave or dorsal side of the distal end of the abdomen.

There is usually a conspicuous brood pouch, formed by the swollen distal portion of the oviduct, which bends back on itself before it opens into the atrial cavity from the outer wall of the right peribranchial cavity at about the level of the 7th row of stigmata. Up to 6 embryos are present in the brood pouch, the best developed anteriorly and ventrally. In many zooids well-developed embryos are found free in the peribranchial cavity.

Larvae: Larvae are small. The trunk is 0.57 mm long, and the tail is wound about 3/4 of the way around it. There are three adhesive organs in the mid line with very shallow ectodermal cups. Rounded median ampullae are present between the adhesive organs, and paired lateral ampullae are present on either side of the anterior end of the trunk. Ectodermal vesicles are also present on either side of the mid line postero-ventrally and antero-dorsally.

Remarks: The present colonies are identical with many of those described by Sluiter (1909, from Station 58) and Tokioka (1954, larger colonies with many systems). There are no small colonies consisting of only a single system in the present collection. The species shares its large flattened branchial papillae (that Sluiter, 1909, regarded as characteristic of the genus *Glossophorum*) with *P. constellatum* and *P. vasculosum* (see Tokioka, 1967), but it is distinguished by its simple circular systems and the number of long rows of stigmata. The larvae do not have the thick granular test of *Polyclinum vasculosum* (see Tokioka, 1961). The external sand encrustation appears also to be a variable character that is certainly affected by the age, and possibly by the habitat of the species. *Polyclinum saturnium* (see Tokioka, 1962) also shares many characters with the present species but is distinguished by its very long posterior abdominal neck and short thoracic musculature.

The larvae of all species of *Polyclinum* are very similar. They are all small and have very shallow adhesive organs, and usually postero-ventral and antero-dorsal groups of ectodermal vesicles that separate from posterior extensions of the lateral ridge either side of the mid-line. Most of the larvae also have paired lateral ectodermal ampullae either side of the median ampullae that alternate with the suckers. Larvae of some species of *Synoicum* have similar characters, but the subdivision of anterior ampullae into vesicles that generally occurs in *Aplidium* and *Synoicum* has not been observed in *Polyclinum* (see Kott, 1963). Note should be taken of the very marked similarity between zooids of *Sidneioides* spp. and *Polyclinum* spp. The atrial aperture and tongue, the general structure of the thorax, abdomen and posterior abdomen, the small papilla beneath the atrial aperture and the larvae are similar in both genera. The thoracic ovary of *S. japonense* (see Millar, 1975) is in the same position as the brood pouch in the present species. Although the former characters may indicate some phylogenetic affinity, the latter is associated with the shortening of the oviduct that lies to the right of the mid line in the thorax.

Synoicum kuranui Brewin, 1950

Synoicum kuranui Brewin, 1950, p. 355, Millar, 1960, p. 49. Kott, 1963, p. 88.
?Synoicum ?clavatum: Millar, 1975, p. 255.

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, July 1980, LWM, QM GH97.
Previously Recorded: Queensland (Heron Is.) — Kott, 1963. New Zealand (Great Barrier Is., off North Cape) — Brewin, 1950; Millar, 1960.

Description

Colony: The colonies consist of sandy, solid, basal test with the surface divided into separate shallow lobes, each invested with sand in the lower part but quite naked terminally where the test is translucent. The colonies are about 1 cm high.

Zooids: The zooids are 'crimson' in preservative. They are small, with a long, thread-like posterior abdomen. There is an undivided atrial lip from the upper border of the opening. The thorax has about 6 longitudinal muscles on each side that extend along the ventral border of the abdomen, causing it to curl up when contracted. There are 10 rows of about 15 stigmata. The stomach is smooth.

Remarks: In this genus, the zooids show little variation in their morphology, and species are notoriously difficult to identify. The colony is identical with that described by Millar (1975) as *S. ?clavatum*. However the latter species (see Tokioka, 1954c) is larger, there are more rows of stigmata and the rounded heads have narrow stalks, rather than the broad cylindrical lobes of the present colonies, and of Millar's specimens. Although Millar's (1960) specimens of *S. kuranui* were larger than the present colonies, the type specimens are of the same order of size as the Fijian material and other characters, including the 'crimson' colour are the same.

The records suggest that the species is a tropical component of the New Zealand fauna.

Aplidium depressum Sluiter, 1909

Aplidium depressum Sluiter, 1909, p. 102. Van Name, 1918, p. 167. Kott, 1963, p. 95. Millar, 1975, p. 245.

Distribution

New Records: Fiji — Great Astrolabe Reef: Dravuni, July 1980, LWM, QM GH86.
Previously Recorded: Philippines — Van Name, 1918; Millar, 1975. Indonesia — Sluiter, 1909. Central Queensland (Bundaberg) — Kott, 1963.

Description

Colony: The colonies form small, rather flat investing sheets about 3 mm thick. The test is colourless and translucent and in preservative the buff zooids are clearly seen through it. The surface is smooth, but the base of the colony is very irregular, extending into the interstices of the irregular coralline substrate, making it very difficult to remove. In the preserved colony the zooids are withdrawn deeply into the basal test.
Zooids: The small and short zooids (less than 1 mm) have about 8 rows of about 8 stigmata. There are 12 longitudinal stomach folds. The atrial opening is not protected by a lip.
Remarks: Although the present specimens have more rows of stigmata than are previously recorded for this species, the absence of an atrial lip and the flat translucent colonies are regarded as diagnostic.

Family DIDEMNIDAE

The taxonomy of the family Didemnidae has been given special attention. It has been notoriously difficult, owing to the small size and consequent simplication of the zooids. In general, the size and shape of the thorax and of the retractor muscle are subject to such variation owing to contraction of the muscles, that precise measurements are meaningless. The point from the posterior end of the thorax or from along the oesophagus that the retractor muscle is free from the rest of the zooid is also variable and a consequence of the state of contraction of the musculature. The length of the distal part of the oesophagus (beyond the point where the retractor muscle is free of the body wall) and the shape and structure of the rest of the abdomen are not so affected, and consequently present more reliable characters that have been given more emphasis in this study. The study of the living specimens, previously not possible where expedition and other museum collections form the basis for most of the works on this and other families of the Ascidiacea, has been only of limited use in determining species parameters owing to similarity of colonies and wide and considerable overlap of colour range in most of the species. The form and distribution of the pigment cells and pigment that is visible in freshly preserved material, however, has been found to be a reliable character in the determination of some of the species. Confidence in the use of this character will be based on the data that are available regarding the characteristics and behaviour of the pigments in preservative over extended periods. Little information is available at present.

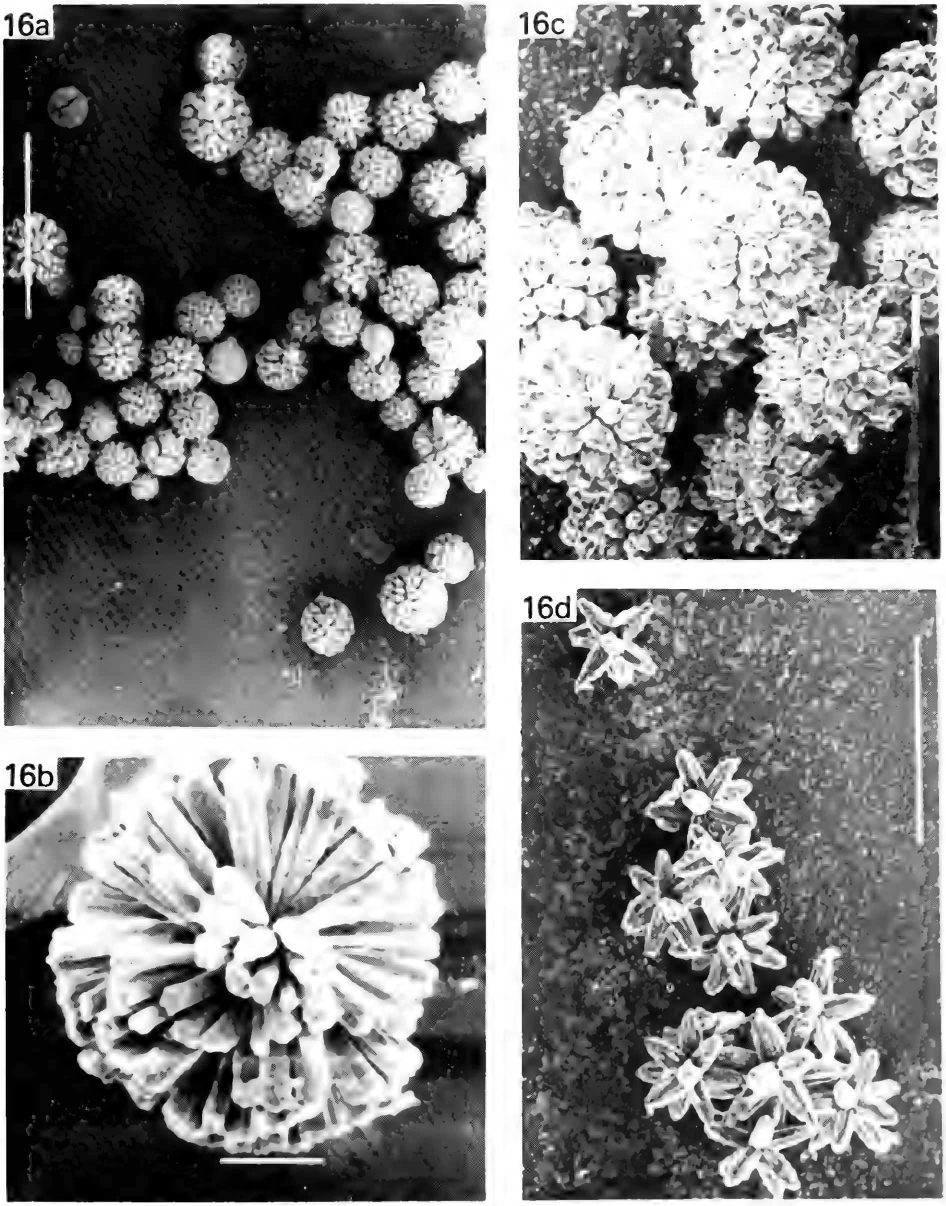


Fig. 16. **a, b,** *Didemnum albopunctatum* (ZMA TU433.2) spherical spicules varying in size, with loose flat ended rays, 0.01-0.04 mm (scales **a**, 0.05 mm, **b**, 0.001 mm); **c,** *Didemnum chartaceum* (ZMA TU437) stellate spicules with many short conical or rounded rays, 0.01-0.03 mm (scale 0.005 mm); **d,** *Didemnum cuculliferum* (QM G12594) stellate spicules with few, very long parallel-sided rays, 0.02-0.04 mm (scale 0.05 mm).

Examination of the calcareous spicules of species of the Didemnidae, by scanning electron microscopy, has revealed complexity and diversity in their structure that was not recognized previously and that are beyond the resolution of the light microscope. The relationships of the different types of spicules, and the significance of their structural variations are not fully understood. In some cases it is possible that spicules lose rays which are later regenerated (see *Didemnum digestum, D. sphaericum* and *Leptoclinides* spp.). Nevertheless, it is clear that the details of the structure and, within certain limits, the size of the spicules are genetically determined and are important taxonomic characters.

Certain species of the family Didemnidae are associated with prokaryotic plant cells of the genus *Prochloron* Lewin, 1977. The species of this group of the Didemnidae in which the association is obligatory have been discussed in detail by Kott (1980). Additional information on those that are now known to occur in Fiji (Table 2) is set out below. Details of records are given only where the species has not previously been recorded from the location referred to. The species *Trididemnum cerebriforme* which apparently has a non-obligatory association with plant cells often present on the surface of the colony is also discussed below.

Didemnum albopunctatum Sluiter, 1909
Figs 16a, b; 20

Didemnum albopunctatum Sluiter, 1909, p. 58 (part, specimens from Sts 89 and 231)

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, LWM, July 1979, QM G12591.
Previously Recorded: Indonesia — Sluiter, 1909.

Description

In addition to the newly-recorded material the following specimens have been examined: *Didemnum albopunctatum* Sluiter, 1909, St. 231, Lectotype, ZMA TU433.2; St. 89, Paralectotype ZMA TU433.4; St. 273, Paralectotype ZMA TU433.1 (<*Didemnum* sp.?); St. 144, Paralectotype, ZMA TU433.3 (<*Didemnum* sp.?). Lectotype and paralectotypes designated by Van der Spoel (1969).

Colony: Fijian colonies are irregular and very thin and elongate. In life they are purple, with contrasting white around the borders and over the anterior end of each zooid, and sometimes around the cloacal apertures where the superficial layer of bladder cells mixed with pigment cells is thin allowing the spicules to show through. The colour is brown in preservative. There are 3 or 4 large open cloacal apertures along the surface of the colonies.

The cloacal cavity is primarily thoracic, the basal test is thin and the abdomina are curved up alongside the thoraces, and project up into the common cloaca. The spicules are 0.01-0.04 mm, spherical, with dense flat-ended parallel-sided rays and are present throughout the test. They are sometimes absent from around the border of the cloacal apertures. The pigment cells are small and spherical to oval.

Zooids: These are evenly spaced and quite dense. They are brown in preservative with minute pigment cells in the body wall. There are 6 pointed branchial lobes, and the atrial aperture is wide exposing the mid-dorsal part of the branchial sac. There is a conspicuous muscular atrial lip in the centre of the upper border of the opening, and fine longitudinal thoracic bands. The thorax is only about 0.5 mm long. There is a fairly short to medium-length retractor muscle from the posterior end of the thorax into which the usual fibres from between the rows of stigmata and from the outer body wall extend. There is a shallow lateral organ on each side of the endostyle opposite the third row of stigmata. There are 10 elongate stigmata per row. The oesophageal neck is fairly long and bends ventrally, the abdomen lying at right angles to the vertical axis of the zooid. The distal part of the gut loop is also curved upwards. It is not twisted, however, as it is in *D. chartaceum* (see Hastings, 1931) which also has the abdomen alongside the thorax. There is conspicuous glandular material, forming a deep V in the loop of the gut. Mature gonads are not present in either the Fijian or Indonesian material.

Remarks: These soft thin colonies with quite extensive cloacal cavities, heavily pigmented, possibly always purple when living and with white circular areas over the zooids and around the borders of the colony where the pigment is missing, are very characteristic. The Fijian colonies do not differ from the Siboga material (Sluiter, 1909) in any way. The V of glandular material in the gut loop is also present in *D. cuculliferum* (see below), which is sometimes (but not always) of a purple colour. The latter species also has a similar rather long gut loop and a similarly placed lateral organ. It lacks an atrial lip, however, has fewer stigmata in each row, a long retractor muscle, characteristic surface papillae and unique spicules that distinguish it. *Didemnum edmondsoni* Eldrege, 1977, from Hawaii, resembles *D. albopunctatum* in many characters, especially in its pigmentation. The presence of some stellate spicules distinguishes it.

Polysyncraton recurvatum (Sluiter, 1909) and *Didemnum chartaceum* Sluiter, 1909, also have spherical spicules and the gut loop bent up level with the thorax. They both lack the pigment cells of the present species. Further, *P. recurvatum* does not have an atrial lip, has the divided ♂ follicle characteristic of the genus, and has characteristic white cells in the buff body wall. *Didemnum chartaceum* has an atrial lip and medium length retractor muscle similar to those of the present species but it has a more conspicuous superficial bladder cell layer, a less distinctive colour pattern, has stellate spicules that are absent from the central test and the thoracic cloacal cavity is very shallow.

The specimens of *D. albopunctatum* Sluiter from Siboga stations 273 and 144 are large, hard investing colonies. Superficially the pigmentation of the preserved specimens is similar to that of the present specimen, but some larger pigment cells are present, the cloacal cavity is more restricted and the spicules are distinctly stellate. They are colonies of apparently undescribed species and are not conspecific. One (ZMA 433.3, St. 144) is probably conspecific with *D. jedanensis:* Hastings, 1931, from Low Is. (BM 1930.12.17.66). *D. jedanensis* Sluiter, 1909 (ZMA 454.3, St. 303) however, is a species of the genus *Polysyncraton.*

Didemnum chartaceum Sluiter, 1909
Figs 16c; 21

Didemnum chartaceum Sluiter, 1909, p. 57.
Didemnum chartaceum: Hastings, 1931, p. 97.

Distribution

New Records: Fiji — Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH55.
Previously Recorded: Indonesia — Sluiter, 1909. Great Barrier Reef (Low Isles) — Hastings, 1931.

Description

In addition to the newly-recorded material the following specimens have been examined: *Didemnum chartaceum* Sluiter, 1909, St. 50, Syntypes, ZMA TU437; Hastings, 1931, St. XVI, BM 1930.12.17.45.

Colony: The colonies form investing sheets, as in the holotype. The living specimens are 'orpiment orange'. In preservative the zooids are orange at first but the colour gradually fades and the test and zooids are grey in the holotype. Pigment cells are minute and the pigment appears to be diffused through the colony. There is a superficial layer of bladder cells and beneath this a single layer of spicules at the level of the branchial siphons. Two or three spicules are also present in the tips of the branchial lobes. Only very sparse spicules are present in the base of the colony and they are otherwise absent from the remainder of the test. There is a thoracic common cloacal cavity. The surface layer of test is very thin indeed, accommodating only the superficial bladder cell layer and the layer of spicules. Each thorax crosses the cloacal cavity in a separate test sheath. The abdomina of the zooids are embedded in the soft basal test. The cloacal apertures, with spicule-free borders, are randomly distributed on the surface of the colony.

The spicules are large, up to 0.06 mm. The majority have numerous short conical pointed rays, but spherical spicules with blunt-ended rays are also present.

Zooids: The zooids are of moderate size. The branchial lobes are not deeply incised. The atrial aperture is wide and its anterior border is produced into a long forked lip, although this may sometimes be quite short and inconspicuous. There are concave oval lateral organs packed with spicules on each side of the endostyle. There is a moderately long retractor muscle from the posterior end of the thorax near the neck of the zooid. The branchial sac has 8 stigmata in each of the 4 rows. The gut loop is simple and vertical. There were no gonads in the Fijian colonies. However, the Low Isles colony has 6½ coils of the vas deferens around a single ♂ follicle. The abdomen is bent up alongside the thorax in the Low Isles specimen (Hastings, 1931) only when the colony is compressed.

Remarks: The species can be identified in the field by its bright colour. The atrial tongue is distinctive, as are the large stellate and globular spicules.

Didemnum cuculliferum (Sluiter, 1909)
Figs 16d; 22a, b

Diplosomoides cuculliferum Sluiter, 1909, p. 90.
Didemnum nekozita Tokioka, 1967, p. 67.
?Didemnum moseleyi: Eldredge, 1967, p. 210 (part).

Distribution

New Records: Fiji — Viti Levu: Makaluva, July 1979, QM G12594; Suva Barrier Reef, July 1979, QM G12593; ?Mumbualau, July 1980, QM GH56. Palau Is. — QM G12678.

Previously Recorded: Indonesia — Sluiter, 1909. Palau Is. and Philippine Is. — Tokioka, 1967. Eniwetok — Eldredge, 1967.

Description

In addition to the newly-recorded material the following specimen was examined: *Diplosomoides cuculliferum* Sluiter, Holotype ZMA TU 490.

Colony: The colonies are small usually irregular cushions to large irregular investing sheets, all about 3 mm thick and usually soft to the touch. There are often a large number of small colonies growing close together, their borders contiguous. This may be the result of lobulation. The living colonies are 'auricula purple', 'scarlet', 'poppy red', 'geranium red', 'flesh colour', 'salmon colour' and 'vinaceous buff' with white where the branchial apertures open to the surface. In preservative they are always white. The borders of the colony are always rounded. The surface test is produced into pointed papillae with a 6-lobed branchial aperture at the base or on the side of the wide base of one of these papillae. There is a superficial layer of bladder cells mixed with small pigment cells that rapidly fade in preservative. Spicules are present throughout the test beneath the bladder cell layer. The spicules interrupt the bladder cell layer over the anterior ends of the zooids and extend into the pointed papillae that project from the surface of the test. The branchial lobes are outlined with spicules

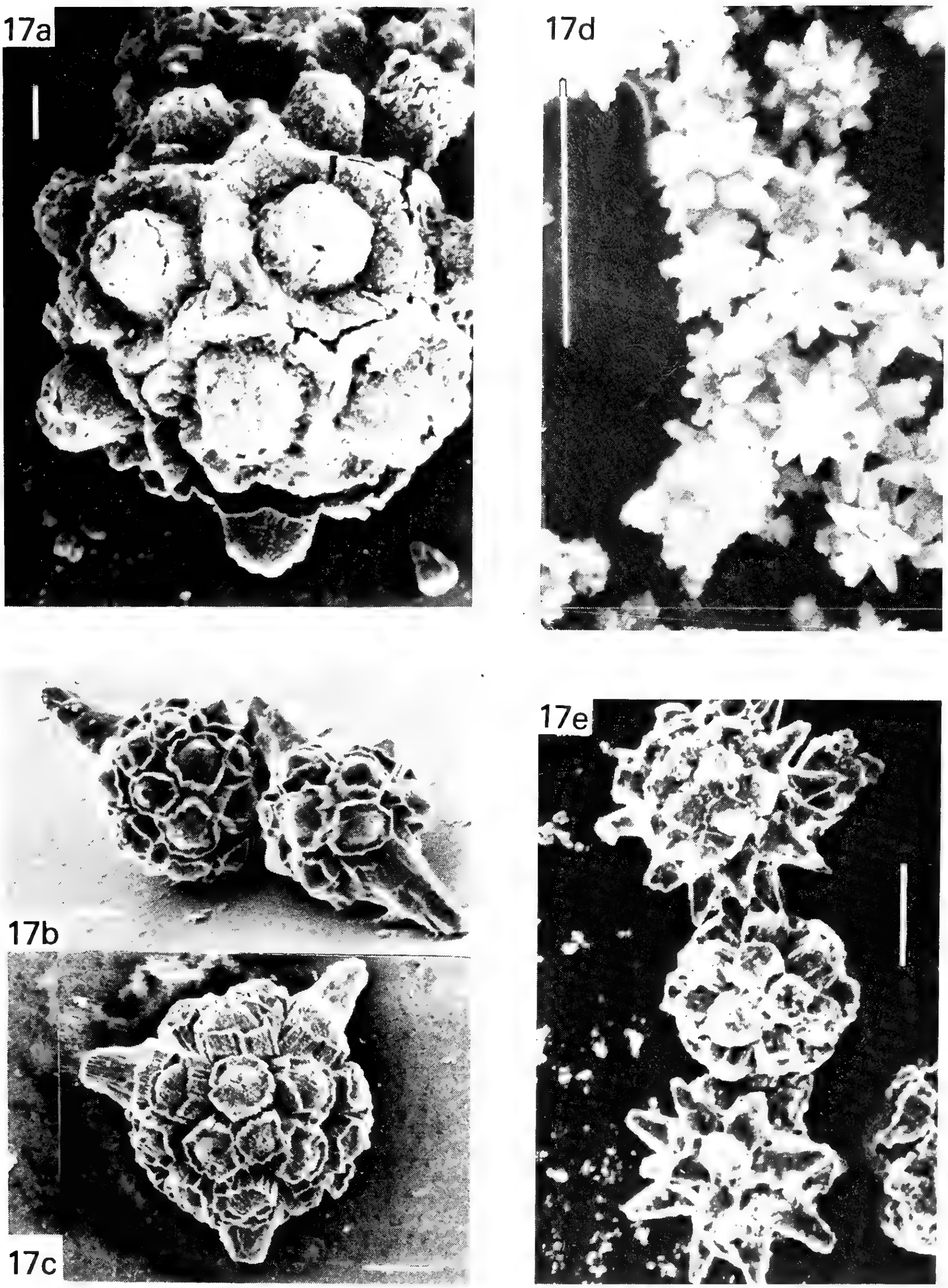


Fig. 17. **a, b, c,** *Didemnum digestum* stellate spicules with conical rays often missing, extending from the centre of basal concavities, 0.02-0.05 mm (**a,** ZMA TU442.2 scale 0.005 mm; **b, c,** QM G12614 scale 0.01 mm; **d,** *Didemnum granulatum* (QM G12589) stellate spicules with long pointed rays, 0.02-0.03 mm (scale 0.05 mm), **e,** *Didemnum moseleyi* (QM G12586) stellate spicules with a variable number of rounded or conical rays, 0.02-0.05 mm (scale 0.001 mm).

where they open to the surface on the pointed papillae. The spicules are distinctive, with a total of only 6-8 long pointed rays. They are 0.02-0.06 mm in diameter between the distal points of the rays. The cloacal cavity is thoracic, and spacious, the surface test being relatively thin. This results in the soft feel of the colonies. The basal test enclosing abdomina and larvae, is relatively thick, but the abdominal portions of zooids often protrude into the thoracic cavity in clumps. In the specimens from Mumbualau (QM GH56), there are no surface papillae, and the common cloaca extends posterior to the zooids, the basal test being especially thin. The posterior abdominal cloacal cavity is traversed by the basal test connectives that support clumps of zooids at the surface.

Zooids: These are about 1 mm long. They are orange when freshly preserved but this colour rapidly fades. The branchial aperture is on a short siphon with a distinct circular sphincter muscle. The atrial aperture is a wide opening exposing a large part of the dorsal section of the branchial sac. There is a very long slender retractor muscle from the proximal part of the oesophageal neck extending well posterior to the end of the abdomen. There are 4 rows of 6 elongate stigmata. There is a small outwardly projecting lateral organ at the level of the third row of stigmata. The proximal part of the abdomen is more or less vertical although the distal section of the gut loop is bent upwards. There are 8½ coils of the vas deferens around the large pyriform ♂ gland. There is a dense mass of glandular tissue in the loop of the gut that appears to be associated with the gastro-intestinal gland. It forms a rather diffuse curved plate and in section appears as the two elongate glands described by Tokioka (1967) and that were referred to as elongate ♂ follicles by Sluiter (1909).

Larvae: Immature embryos are present in the basal test in Fijian material (QM G12593-4). Tokioka reports that the larvae are similar to those of *D. moseleyi.* This could not be confirmed in the present specimens, which have a swollen area anteriorly, to the left of the coiled tail, where two adhesive organs appear to be developing.

Remarks: The spicules and colony of this species together with its relatively large zooid, long slender retractor muscle, long curved gut loop and pyriform testes with numerous coils of the vas deferens are distinctive.

Eldredge (1967) includes papillate specimens with tetrahedal spicules, long retractor muscle and a large number of vas deferens coils in *D. moseleyi.* These are very possibly colonies of the present species.

The similarity between this species and *D. sphaericum* is discussed below.

Didemnum digestum Sluiter, 1909
Figs 17a-c; 23

Didemnum digestum Sluiter, 1909, (part, not specimen from St. 315).

Distribution

New Records: Fiji — Viti Levu: Laucala Bay, 10 m, sandy, July 1979, QM G12614.
Previously Recorded: Indonesia — Sluiter, 1909.

Description

In addition to the newly recorded material the following specimens have been examined: *Didemnum digestum* Sluiter, 1909, St. 127, Paralectotype, ZMA TU442.2; St. 315, Paralectotype ZMA TU442.1 (<*Didemnum* sp?), (Van der Spoel, 1969).

Colony: The Fijian colony is an investing sheet only 1 mm thick. The living specimens are apricot, but preserved specimens are white. There is a conspicuous superficial layer of bladder cells, and beneath this the spicules are dense throughout the thickness of the colony. Only the branchial apertures with associated spicules project up through the bladder cell layer and appear as evenly spaced, white dots in the surface. There is a shallow thoracic cloacal cavity.

The spicules are stellate, but the rays are often missing. Scanning electron micrographs show that in the majority of spicules the terminal portion of each ray is rounded and arises from the centre of a wider base that is irregularly hexagonal in section. The terminal portion of the ray is often very short and surrounded by a projecting outer part of the basal section in which it is supported. However in some of the rays on each spicule the terminal section is long and pointed. These longer rays often arise from either side of the spicules, or there are up to 5 in the one equatorial plane around the spicules. The central portion of the spicules, to the edge of the basal part of the rays, is 0.02-0.03 mm in diameter. The length of the distal part of the rays, however, is from 0.005 to 0.015 mm, so the largest dimension of the spicule from tip of the rays is from 0.02 to 0.06 mm. There are also stellate spicules with almost parallel-sided rays, without basal sections.

Zooids: These are evenly distributed in the test and are small, the thorax being only 0.3 mm long. The abdomen, embedded in the basal test, lies horizontally at right angles to the long axis of the thorax. The branchial siphon is fairly long to accommodate the superficial layer of bladder cells. The atrial opening is wide. There is a short but thick retractor muscle projecting posteriorly from the posterior end of the thorax in line with the long axis of the zooid. There are only 4 oval stigmata in each of the four rows. The single ♂ follicle is rather flat with 6½ coils of the vas deferens around it. There are vascular processes from the abdomen.

Remarks: Polysyncraton recurvatum (Sluiter) and *D. albopunctatum* Sluiter have small zooids and abdomina bent at right angles to the thorax. The present species is distinguished by its long branchial siphons, unique spicules, lesser number of smaller stigmata in each row, and the lack of pigment in the surface of the colony.

The paralectotype specimens from Station 127 (ZMA TU442.2) are investing sheets, in contrast with the present small colonies. They have surface furrows where the surface test is depressed over the cloacal cavities that surround a circle of zooids. These are not present in the smaller Fijian colony where the cloacal system does not appear to have reached its full development. The spicules in the Fijian specimens also have far more rays broken off than in the paratype that was examined.

Sluiter (1909) thought the specimen from Siboga Station 315 (ZMA TU442.1) was conspecific with this species. However the spicules are large with many acutely-pointed rays. It also has a very much smaller thorax, and is distinct from the present species, despite the similarity of the cloacal system and the general appearance of the colony.

There is a striking similarity between this species and *Didemnum sphaericum,* based on the small zooid and the form of the spicules. The spicules of *D. digestum* are larger and the testis follicle is flatter. The colonies are investing sheets, and are thinner, with abdomen at an angle to the zooid and the bladder cell layer is more conspicuous than in *D. sphaericum*.

Didemnum granulatum Tokioka, 1954
Figs 17d; 24

Didemnum moseleyi f. *granulatum* Tokioka, 1954a, p. 244; 1967, p. 67.
Didemnum pele Eldredge, 1967, p. 197.
?Didemnum moseleyi: Kott, 1972a, p. 19; 1972b, p. 17; Eldredge, 1967, p. 210 (part).

Distribution

New Records: Fiji — Viti Levu: Tai-levu, LWM, July 1979, QM G12592; Suva

Barrier Reef, LWM, July 1979, QM G12589, G12590; July 1980, QM GH133. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH73, 129; Yakuve, LWM, July 1980, QM GH69.

Previously Recorded: Palau Is. — Tokioka, 1967. Japan (Tokara Is.) — Tokioka, 1954a. Hawaii (Oahu, 120 m) — Eldredge, 1967. ?Palmyra, Ifaluk Atoll — Eldredge, 1967. Circum-Australian — Kott, 1972a, b.

Description

Colony: Living colonies are 'vermilion', 'poppy red', 'geranium red', 'cadmium orange', 'vinaceous buff' and 'salmon colour'. They are thin and investing, and of variable size. The colonies are brittle with densely packed spicules. There is no superficial bladder cell layer. Very small brownish-orange pigment cells are mixed with the spicules in the surface layer of test. Small evenly-spaced spicule-filled papillae usually protrude from the surface of the colony between the branchial openings. Lobes of the branchial openings are lined with one or two rows of spicules. The apertures may be depressed into the surface of the test and often the test over the ventral branchial lobe may be enlarged to form a papilla protecting the aperture. The common cloacal cavities are thoracic but quite extensive and become deeper around clumps of zooids. Elongate to round common cloacal apertures are sessile. The spicules are less dense in the test around the cloacal apertures, but sometimes there are ribs of dense spicules in the roof of the cloacal cavity surrounding these apertures (as described by Tokioka, 1967). Flat oval spicule-filled projections from halfway along the free edges of each separate thoracic test sheath are associated with the lateral organs of the zooids.

The spicules are conspicuously stellate, 0.02-0.03 mm in diameter with 5-7 long almost parallel-sided but pointed rays in optical transverse section.

Zooids: These are buff, with brown-yellow pigment cells when freshly preserved but they quickly fade. The branchial aperture has 6 conspicuous lobes and the atrial opening is wide, exposing most of the dorsal part of the branchial sac. Four fine thoracic muscles are sometimes conspicuous on the thorax. There is a short to medium length retractor muscle that is free from the middle of the oesophageal neck. There are four rows of 6 stigmata. When the zooid is extended the stigmata are seen to be narrow and elongate in the anterior rows, but become progressively shorter toward the posterior end of the thorax. The fourth row, at the posterior end of the thorax, is inconspicuous, can only be observed in the extended zooid or by careful dissection and has very short oval stigmata. The oesophageal neck is long and vertical. Posterior to the stomach the gut loop is bent upwards. There is a small posterior stomach and a duodenal constriction. There are 6½ coils of the vas deferens around the outer half of the single rather flattened ♂ follicle. Mature ♂ follicles and well-developed eggs are present in all colonies.

Larvae: These are present in basal test in some colonies (QM G12590). They are of the usual didemnid type, about 0.7 mm long with 3 median adhesive organs, 4 pairs of lateral ectodermal ampullae, an otolith and an ocellus. The larva described by Eldredge is immature and the separation between the lateral ampullae on each side is not complete.

Remarks: The present species has undoubtedly been confused with *D. moseleyi*. Its long-armed and dense stellate spicules, absence of bladder cell layer, double gut loop, medium length retractor from the oesophageal neck, and very short posterior row of stigmata are together distinctive. The spicules resemble those of *D. viride* Herdman, 1906, from Ceylon (see Kott, 1980).

The synonymy of many of the specimens of *D. moselyi:* Eldredge, 1967, is proposed on the basis of the long, pointed rays of the spicules, the origin of the retractor muscle from the oesophageal neck, both of which resemble *D. granulatum* rather than *D. moseleyi* (Herdman).

Didemnum molle (Herdman, 1886)

Diplosomoides molle Herdman, 1886, p. 310.
Didemnum molle: Kott 1980, p. 2 and synonymy.

New Records: Mumbualau, on sea grass, LWM, July, 1980.
Remarks: The species has a wide range in the Indo-west-Pacific and has been recorded from a wide range of habitats (Tokioka, 1967). Although it occurs commonly on coral substrates at other locations, its occurrence in Fiji appears to be restricted and this is the only record.

Didemnum moseleyi (Herdman, 1886)
Figs 17e; 25

Leptoclinum moseleyi Herdman, 1886, p. 272.
Leptoclinum incanum Herdman, 1899, p. 90. Herdman and Riddell, 1913, p. 888.
Didemnum moseleyi: Sluiter, 1909, p. 45; 1913, p. 74. Van Name, 1918, p. 151. Tokioka, 1949, p. 43; 1953a, p. 185; 1954a, p. 243; 1955a, p. 212; 1955b, p. 44; 1961, p. 106; 1967, p. 65; 1970, p. 52; Kott, 1957, p. 136; 1962, p. 328.
Not *Didemnum moseleyi:* Kott, 1972a, p. 19; 1972b, p. 17 (?<*D. granulatum*); 1976, p. 65. Eldredge, 1967, p. 210 (?<*D. granulatum* and *D. cuculliferum*).
?Didemnum grande: Van Name, 1918, p. 151 (part, No. 7 and 15).

Distribution
New Records: Fiji — Viti Levu: Tai Levu, LWM, July 1979, QM G12586; Laucala Bay, 10 m, QM G12498; Mumbualau, LWM, July 1980, QM GH130; Suva Barrier Reef, LWM, July 1980, QM GH 74, 132. Great Astrolabe Reef: Yakuve, LWM, July 1980, QM GH67, 69, 131. Great Barrier Reef — Green I., August 1978, LWM, QM G12497.
Previously Recorded: Japan — Tokioka, 1949, 1953a. Japan (Tokara Is.) — Tokioka, 1954a. Gulf of Suez — Kott, 1957a. Philippines — Herdman, 1886; Van Name, 1918; Tokioka, 1967, 1970. Palau Is. — Tokioka, 1955b, 1967. Noumea — Tokioka, 1961. Circum-Australia — Kott, 1962. Indonesia — Sluiter, 1909, 1913; Tokioka, 1955a. A common and ubiquitous Indo — west Pacific species.

Description:
Colony: Colonies are irregular and investing thin sheets of varying size. In life they are 'orange chrome', 'poppy red', 'light saturn red', 'flesh coloured', 'maize yellow', often with white spicules showing around the borders and cloacal apertures where the pigment is absent. The preserved specimens are white and pinkish-apricot with clear apricot or brownish or colourless zooids. The zooids are evenly spaced, surrounded by a thoracic common cloaca. There is a superficial layer of bladder cells, mixed with minute pigment cells and spicules. This results in the frothy appearance of the superficial layer of the test. The pigment cells are especially small and the pigment appears to be more diffuse than in other species. There may be accumulations of spicules in the surface and often spicule-filled papillae project from the surface on some parts of the colony. The spicules are dense throughout the remainder of the test. Spicules fill, but do not outline, the branchial lobes where they open to the surface. The basal test beneath the common cloacal apertures is often produced upwards to form a plug in the opening.

The spicules are 0.02-0.05 mm. They are stellate and of two types, with either 7-11 broad conical rays, or more numerous parallel-sided rays with rounded ends.
Zooids: The thorax is about 0.5 mm, with the usual 6-lobed branchial aperture. The lateral organ projects from the margin of the wide atrial aperture. A short retractor

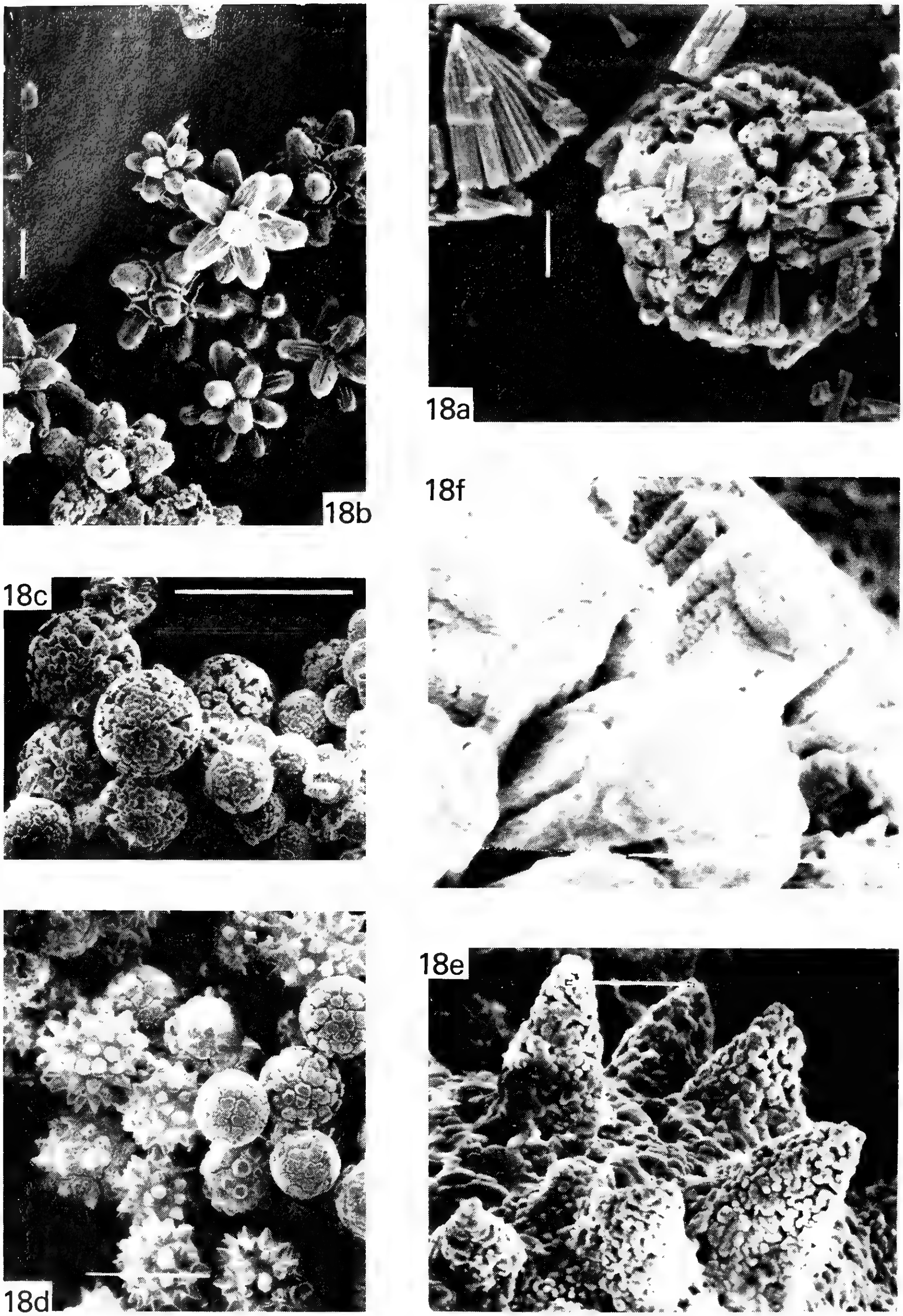


Fig. 18. **a,** *Didemnum proliferum* (QM G12577) spherical spicules with loose flat-ended rays, 0.01-0.03 mm (scale 0.005 mm); **b,** *Didemnum sphaericum* (QM GH127) stellate spicules with straight rays and with rays from centre of basal concavity, 0.015-0.03 mm (scale 0.005 mm); **c,** *Polysyncraton recurvatum* (QM GH105) spherical spicules with flat-ended rays, 0.01-0.04 mm (scale 0.05 mm); **d-f,** *Polysyncraton doboense* (QM GH143) stellate and some spherical spicules, crystalline structure obscure, 0.03-0.04 mm (scales **d,** 0.05 mm; **e, f,** 0.005 mm).

muscle from the posterior end of the thorax extends no more than the length of the oesophagus. There are 4 rows of 6 stigmata. The proximal part of the gut loop is vertical but the pole of the loop is sharply flexed upwards. The gut is conspicuously divided into a post-stomach, a duodenal area and a rectum which is markedly enlarged proximally. There are 6½ coils of the vas deferens around the single rather flattened ♂ follicle.

Larvae: There were no larvae present in these specimens. They are known to be of the characteristic didemnid type with 3 median adhesive organs and paired lateral ampullae.

Remarks: There has been undoubted confusion in defining this ubiquitous species owing to the absence of conspicuously unique characters. However, the two types of spicules, each with different types of rays, together with the superficial bladder cell layer, into which the spicules extend, the short retractor muscle from the posterior end of the thorax and the predominantly vertical gut loop with a sharply flexed pole and its conspicuous subdivisions together with the flattened testis follicle help to distinguish it. The stellate spicules have shorter, thicker and less acutely pointed and more numerous rays than those of the closely related *D. granulatum*.

Van Name (1918) has drawn attention to the similarity between zooids of this species and of specimens he had assigned to *D. grande*. The type and size range of the spicules are also identical.

Didemnum proliferum n. sp.
Figs 18a; 26

Didemnum candidum: Hastings, 1931, p. 94 (part: shore specimens with 'burr-like' spicules).

Didemnum candidum: Tokioka, 1967, p. 62 (part: specimens with single ♂ follicles and spherical spicules).

?Didemnum candidum: Eldredge, 1967, p. 213 (part: specimens with numerous blunt rays).

?Didemnum candidum: Tokioka, 1955b, p. 46.

Distribution

New Records: Fiji — Viti Levu: Vuda Point, LWM, July 1979, Holotype QM G12577; Suva Barrier Reef, LWM, July 1980, QM GH66, 70, 71; Sandbank Reef, June 1980, QM GH54. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH76. Palau Is., QM G12677.

Previously Recorded: Great Barrier Reef (Low Is.) — Hastings, 1931. Gilbert Is. — Tokioka, 1967. ?Palmyra, Eniwetok — Eldredge, 1967. ?Palau Is. — Tokioka, 1955b.

Description

Colonies: Colonies vary from extensive investing sheets to small rounded cushions (QM G12577) which occur in large numbers and have probably resulted from lobulation. Colonies are never more than 2 mm thick. The living colonies are 'pinkish-buff', 'flesh colour', 'vinaceous buff', 'salmon colour', 'flesh colour', 'poppy red' and 'scarlet'. In preservative colonies are almost white. The test is densely packed with spicules and there is no superficial bladder cell layer. The surface of the colony is hard owing to the presence of spicules near the surface. There are minute pigment cells mixed with surface spicules but these are absent from other parts of the colony and fade rapidly in preservative. Pigment is absent from the borders of the colony and around the branchial and common cloacal apertures. Orange pigment persists in lacunae in the basal test for a time.

The colonies are firm and hard. The common cloacal cavity is very shallow (about 0.1 mm deep) and thoracic. The basal test occupies more than half the thickness of the colony. The surface test is also relatively thick and firm.

The spicules are from 0.01 to 0.03 mm, spherical, with numerous, tightly packed, parallel-sided flat-ended rays.

Zooids: These are translucent and orange in fresh material but rapidly fade in preservative. The branchial aperture is 6-lobed and the atrial aperture a wide opening exposing the dorsal part of the branchial sac. There are fine muscle fibres in the thorax and a medium length retractor muscle from the posterior end of the thorax reaching to the middle of the abdomen. There are 4 rows of about 6-8 stigmata.

The abdomen is relatively large (only slightly less than 1 mm). The distal part of the gut loop is flexed only at a slight angle to the vertical oesophagus and stomach. There are only 4½ coils of the vas deferens around the large, spherical ♂ follicle.

Larvae: Larvae are present in the small colonies from Vuda Point. They are of the typical didemnid type. The trunk is 0.5 mm long, and the tail wound the whole way around it. There are 4 pairs of lateral ampullae each side of the 3 adhesive organs, and an ocellus and otolith.

Remarks: The species is characterized by the spherical spicules, limited common cloaca, and relatively few spirals of the vas deferens. It is clear that many specimens of this species have formerly been ascribed to *D. candidum* Savigny. The characters of that species are confused and have included specimens with spicules having many pointed rays, or with a mixture of pointed and blunt-rayed spicules, or with spherical spicules. Van Name (1945) suggested that variation in size and shape of the spicules was associated with the calcareous content of the water and the rigidity of the substrate. This proposition cannot be substantiated and it appears that Van Name's description of investing sheet-like colonies that he referred to *D. candidum* is multispecific and very likely includes specimens of *D. psammatodes* (with faecal pellets), *D. moseleyi* (with orange zooids and two sorts of spicules, see above), *D. granulatum* (with fewer conical rays on the stellate spicules), as well as specimens that may be more accurately referred to *D. candidum* Savigny, which have a greater number of vas deferens coils (8) and spicules with numerous rays both pointed and rounded. Van Name (1945) does not appear to have included specimens with exclusively spherical spicules (as in the present species); nor specimens with exclusively stellate many-rayed spicules that Tokioka (1967) assigned to *D. candidum.* Specimens in which there are exclusively spherical spicules (as in the present species) are included in *D. candidum* by Tokioka (1967) and may be a synonym.

Didemnum candidum: Eldredge, 1967, may also refer to a range of species. His diagnosis refers to specimens with 'numerous blunted rays', (questionably synonymized with the present species). In fig. 16 (Eldredge, 1967, p. 216), however, a many rayed stellate spicules described as 'typical' is similar to one type that has been described for *D. candidum* but is not found in the present species.

The presence of spherical spicules in the Gilbert Is. material (Tokioka, 1969) suggests synonymy of specimens with single ♂ follicles with the present species. Those specimens with two ♂ follicles however may be *Polysyncraton recurvatum,* as is possible for Eldredge's (1967) specimens of *D. grande* from Eniwetok and Palmyra (see *P. recurvatum* below).

The colour of the living colonies of *D. proliferum* falls within the same range as other species of this genus, especially *D. moseleyi,* which has the same minute pigment cells and rather diffuse pigment. The small probably lobulated colonies are known for other species (e.g. *Didemnum dispersum* Sluiter, 1909; *D. fraternum* Sluiter, 1909) but invariably there are other characteristics that distinguish the species. The spicules resemble those of *Polysyncraton recurvatum* but are slightly smaller.

Didemnum psammatodes (Sluiter, 1895)

Leptoclinum psammatodes, Sluiter, 1895, p. 11; 1905, p. 20.
Hypurgon skeati Sollas, 1903, p. 729. Herdman, 1906, p. 337.
Didemnum psammatodes Sluiter, 1909, p. 46; 1913, p. 75. Michaelsen, 1919, p. 14 (part: vars. *guinense, skeati)*; 1920, p. 22 (part: vars. *skeati, typicum)*. Hastings, 1931, p. 95. Kott, 1962; p. 326 (part: var. *skeati)*. Eldredge, 1967, p. 200.
Didemnum ? psammatodes: Millar, 1956, p. 922.
Hypurgon fuscum Oka, 1931a, p. 287.
Didemnum fuscum: Tokioka, 1953a, p. 192.
Not *Didemnum fuscum* Sluiter, 1909, p. 52.
Didemnum dorotubu Tokioka, 1967, p. 74.

Distribution
New Records: Fiji — Viti Levu: Laucala Bay, experimental mussel raft, July 1979. Great Barrier Reef: Green Is., QM G12496.
Previously Recorded: Indonesia — Sluiter, 1895, 1909, 1913; Sollas, 1903. Sri Lanka — Herdman, 1906. Red Sea, Suez — Sluiter, 1905; Michaelsen, 1920; Kott, 1957a. East African Coast — Michaelsen, 1920; Millar, 1956. Australia (Victoria, Queensland, Torres Strait) — Hastings, 1931; Kott, 1962. Ifaluk Atoll — Eldredge, 1967. Philippines — Tokioka, 1967. China — Tokioka, 1967. Japan — Oka, 1931a; Tokioka, 1953a.

Description
Colonies: These form extensive investing sheets, sometimes swollen into lobes. They are mud- or sand-coloured, depending on the composition of the oval faecal bodies crowded in the test. It is clear from these specimens that these bodies are derived from the particles that are available in the environment although it is not established whether or not they are faecal material or particles absorbed directly into the test from the environment. There are small groups of minute spicules in the test surrounding the branchial apertures. The cloacal canals are shallow and thoracic.
Zooids: These are small and conform in this and other characters with earlier descriptions.
Remarks: Colonies of this species are usually very extensive and are clearly most successful in the competition for space. Generally the species is found where there is no fast current and where there is settlement of very fine particulate matter. The colonies in which the oval test inclusions do occur have a wide Indo-west Pacific range and are sufficiently constant in this and other characters to suggest that specific rank is justified. Therefore those forms that have formerly been regarded as conspecific (see Eldredge, 1967), but which do not contain these inclusions in the test, have not been included in the synonymy set out above.

Didemnum sphaericum Tokioka, 1967
Figs 18b; 27

Didemnum sphaericum Tokioka, 1967, p. 70.

Distribution
New Records: Fiji — Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH127, 128.
Previously Recorded: Palau Is. — Tokioka, 1967.

Description
Colony: The colonies are rather regular circular or oval plates, with rounded borders,

up to 1 cm in diameter but less than 3 mm thick. In life they are 'poppy red' or 'salmon colour'. In preservative the red pigment is present in small cells mixed with spicules in the superficial layer of test. The pigment is absent from an area around each branchial opening. In the Fijian specimens the pigment persists for some time in the preserved material although it is gradually lost. The branchial lobes are lined with spicules. The common cloacal cavity is thoracic and each thorax is enclosed in its own test sheath. The spicules are stellate mostly 0.015-0.03 mm in diameter. Some have 5 to 7 long, almost cylindrical rather blunt-tipped rays in optical section. In others, the rays are shorter, and are supported in basal concavities of greater diameter. The spicules are rather dense throughout the test. The surface layer of test is moderately thin and the basal layer of test is thick.

Zooids: The zooids are orange in preservative and contain spherical pigment cells. They are small, only about 0.6 mm in total length. The atrial aperture is wide exposing the dorsal part of the branchial sac. There is a moderately long retractor muscle that is free from the proximal part of the oesophagus. It extends for most of the length of the abdomen. The gut loop is almost vertical in the thick basal test and the gut loop is flexed upwards only slightly. The stomach is small and there are no apparent subdivisions of the intestine. There is a large testis follicle, pointed on its outer side where the vas deferens begins to spiral and rounded on the side against the gut loop. There are 6½ spirals of the vas deferens.

Remarks: It is likely that the spherical shape of the colonies from the Palau Is. is a result of the limited area for attachment on their algal substrate. The flatter plate-like Fijian colonies are on flat coralline rubble surfaces. It is not known whether the spicules of the Palau Is. specimens included the type with bipartite rays but in all other respects they are identical with those from Fiji. The small zooid size, the length of the retractor muscle, the shape of the testis follicle and the number of vas deferens coils are identical with the structure described by Tokioka. A pointed testis follicle is also present in *Didemnum cuculliferum* but the species differ in other respects. Tokioka's specimens, although they had been in preservative for a long time, retained some colour in the pigment cells. The Fijian specimens appear to have retained their colour in preservative for longer than other species. The close relationship between this species and *D. digestum* is discussed above (see *D. digestum*).

Polysyncraton recurvatum (Sluiter, 1909)
Figs 18c; 28

Didemnum recurvatum Sluiter, 1909, p. 51.
Didemnum ?recurvatum: Millar, 1975, p. 233.
Polysyncraton schillingi Michaelsen, 1920, p. 17.
?Didemnum grande: Van Name, 1918, p. 148; Eldredge, 1967, p. 191.
?Didemnum candidum: Tokioka, 1967, p. 62 (part).

Distribution

New Records: Fiji — Viti Levu: Deuba, on *Laurencia,* September 1979, QM GH58; Serua, LWM, July 1979, QM G12587; Makaluva, LWM, July 1980, QM GH104; Mumbualau, LWM, July 1980, QM GH105; Sandbank Reef, LWM, July 1980, QM GH90; Malevu, LWM, July 1980, QM GH14; Suva Barrier Reef, LWM, July 1980, QM G12588. Great Astrolabe Reef: Yakuve, LWM, July 1980, QM GH101.

This species is the common red to pinkish didemnid found on the underside of rubble, high in the intertidal region on all the Fijian reefs.

Previous Records: Tanzania (Mikinadi Bay) — Michaelsen, 1920. Indonesia — Sluiter, 1909; Millar, 1975. ?Philippines — Van Name, 1918. Eniwetok, Palmyra — Eldredge, 1967. Gilbert Is. — Tokioka, 1967.

Description

In addition to the specimens newly recorded, the following specimen has been examined: *Didemnum recurvatum* ZMA TU474, Holotype, Station 250, Sluiter, 1909.

Colony: The colonies are small and oval or rounded, or they form larger investing sheets up to 3 cm in maximum extent, with spreading white borders. The smaller colonies have central common cloacal apertures and some appear to be lobulating. In life the colonies are 'scarlet', 'poppy red', 'salmon colour', 'flesh colour' and 'vinaceous buff'. The colour may vary in the one colony, but more often each is one uniform colour. The colour differences are caused by varying densities of pigment cells. In preservative the colonies are always the same dirty, brownish-white colour owing to the dark 'hazel' coloured pigment cells scattered mainly in the superficial layer of bladder cells. Elsewhere, spicules are dense throughout the test. In this species the red pigment of the living colonies changes to brown in preservative, and is not lost from the colony. The thoracic cloacal cavity is of variable depth. Both the upper and basal layers of test are relatively thick (0.2 mm and 0.5 mm, respectively) and firm. The thoraces of zooids usually cross the cloacal cavity separately although sometimes there are clumps where surface and basal test is continuous around a group of zooids. In preserved colonies the branchial apertures are conspicuous as dark points or star-shaped openings interrupting the otherwise dense spicules. When zooids are contracted and withdrawn from the surface the position of each aperture is marked by a dimple in the otherwise smooth surface. Common cloacal apertures are wide sessile openings with less dense spicules around their borders. The spicules are spherical, with numerous flat-ended parallel-sided rays 0.01-0.04 mm in diameter.

Zooids: The zooids are large, up to 1.5 mm long. In preservative they are an opaque dark buff colour with brown and white cells in the body wall. The white opaque cells persist and are very characteristic. There are 10 stigmata in each of the four rows. A circular lateral organ projects from the body wall on each side of the endostyle and opposite the third row of stigmata. There is a long narrow neck, about one third of the body length, between the thorax and the distal part of the abdomen which is bent at right angles to the long axis of the zooid. A retractor muscle of medium and variable length extends from the proximal end of the oesophageal neck and sometimes extends to overlap the distal part of the gut loop where it is bent at right angles to the vertical oesophagus. The gut loop is long and the lumen of the gut quite narrow. Divisions of the gut posterior to the stomach are not conspicuous. The testis is divided into two to four lobes and the vas deferens winds around them 4½ times. No gonads were present in colonies collected in September 1979.

Larvae: Larvae are present in the basal test of colonies collected in July 1980. The large trunk is 0.87 mm long and the tail is wound half way around it. There are 4 cylindrical ampullae along the lateral line on each side of the 3 small median adhesive organs which are set close together.

Remarks: The post mortem colour of this species is distinctive. Living specimens cannot be readily separated from *D. moseleyi, D. granulatum, D. cuculliferum, D. sphaericum* and *D. proliferum,* all of which have the same range of colours in life. The spicules can be used to distinguish the species from all except *D. proliferum* which has similar spicules in the same size range. Colonies of *D. proliferum,* are harder than those of the present species and have a more restricted common cloaca. Sometimes the surface test of the present species is raised into slight swellings where clumps of zooids underlie it, thus providing a further distinction that may be useful in the field. Tokioka (1967) has questionably synonymized his *D. candidum* with this species, and Millar (1975) discussed the possibility that *D. grande:* Van Name, 1918, was synonymous. The possibility that *D. grande:* Eldredge, 1967, some specimens of *D. candidum:* Tokioka, 1967, from the Gilbert Is. and some of the specimens assigned to *D. grande* by Van Name (1918) are synonyms of the present species should not be overlooked, since the cloacal cavities, spicules, branchial sacs, gut loop and colonies and their pigmentation are the same and frequently there are no more than two ♂ follicles in zooids of the present species.

The holotype, ZMA TU474, agrees with those in the present Fijian collections in all respects except that the retractor muscle was not distinguished. Sluiter's holotype does have two ♂ follicles as in Millar's (1975) material (Fijian specimens have 2-4 ♂ follicles).

Millar (1975, p. 235) has observed that 'Sluiter (1907) alone described 25 new species (of Didemnidae) but without clearly distinguishing them'. Nevertheless, without seeing the type specimen of *D. recurvatum* Sluiter, and without the information that it did contain two ♂ follicles, he had tentatively (but accurately) assigned his specimens to this species. This must be a testimonial to the accuracy of Sluiter's seemingly ambiguous descriptions and his (Millar's) capacity to observe and interpret this difficult group. The species is distinguished by its spherical spicules, absence of an atrial tongue, small number of ♂ follicles, the long, narrow gut loop, the number of vas deferens spirals and the opaque zooids with white corpuscles that persist in preservative.

In view of its common occurrence and wide geographical range it is surprising that there are not more records of this species.

Polysyncraton doboense (Sluiter, 1913)
Figs 18d-f; 29

Polysyncraton doboense Sluiter, 1913, p. 77.

Distribution

New Record: Fiji — Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH143.
Previously Recorded: Aru Is. — Sluiter, 1913.

Description

Colony: Only a fragment of a colony (about 2 cm in length) is available. It is 3.0 mm thick and is solid with very firm test. Its colour in life was 'poppy red'. In preservative it is white with small dark pigment cells scattered amongst the spicules in the surface of the colony, and in reservoirs in the thick basal test. The common cloacal cavity is shallow, at thoracic level. The surface test is very thin. Spicules are dense throughout the test and there is no superficial layer of bladder cells. Spicules fill, but do not outline, the 6 branchial lobes. There are faint fine straight lines in the superficial layer of test that divide the surface into irregular diamond-shaped areas with branchial apertures more or less in the centre of each of these areas. These lines are visible only because they interrupt the densely packed spicules. They may therefore be vessels in the superficial test. They are no more than 0.05 mm in diameter, and are reminiscent of similar markings in *Lissoclinum patellum* (see Kott, 1977).

The spicules up to about 0.04 mm diameter, have about 15 short, conical, pointed rays projecting from a central sphere. Some spherical spicules with blunt-ended rays are generally of lesser diameter and may have been developed from the stellate forms by loss of the pointed rays. The stellate spicules do not vary very much in diameter. Scanning electron micrographs do not show the same crystalline structure in the spicules rays as is usual.

Zooids: The zooids are each embedded in a layer of test that is surrounded by the cloacal cavity. They are about 1.5 mm long, from branchial aperture to the pyloric end of the stomach, and the gut loop, distal to the stomach is curved almost horizontally to the left. The branchial aperture has 6 pointed lobes and is on a short siphon with conspicuous circular sphincter muscles. There are also fine longitudinal thoracic muscles. The atrial opening is extensive, and there is a long, forked lip from the upper border of the opening. There are 8 long rectangular stigmata in each row. The oesophageal neck is rather long and a solid but only moderately long retractor muscle is free from mid-oesophageal level. The stomach is relatively small and pyriform. The voluminous gut loop curves upwards to the left but there is no extra upward flexure in the distal part of the loop. The testis is large and divided into two follicles. The vas deferens spirals around these 6½ times.

Remarks: The specimen agrees with Sluiter's (1913) description in every aspect except that it has two rather than four testis follicles. Variations of this magnitude occur in the genus, and may do in this species. In view of the similarity in other characters it seems appropriate to assign the specimen to Sluiter's species.

The species is distinguished from *P. recurvatum* by the very firm texture of its colony, larger spicules, very large atrial lip, absence of white corpuscles in the zooid, mid-oesophageal origin of the retractor muscle and voluminous gut (in contrast with the narrow diameter and longer loop of the gut in *P. recurvatum)*.

Leptoclinides madara Tokioka, 1953
Fig. 30

Leptoclinides madara Tokioka, 1953a, p. 200.
Leptoclinides rufus: Eldredge, 1967, p. 220.
Leptoclinides marmoratus: Millar, 1975, p. 235 (part: specimens from Koh Mesan — Koh Chuen and Banda, fig. 24).

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, LWM, July 1979, QM G12459.
Previously Recorded: Japan (Sagami Bay) — Tokioka, 1953. Indonesia — Millar, 1975. Hawaii — Eldredge, 1967. Intertidal to 50 m.

Description

Colonies: Two large colonies, one solid black and one brick-red were found adjacent to one another. In preservative (4% formalin) the black colour is lost and the colony becomes translucent with faint orange pigmentation in the surface test. The brick-red specimen has retained more of its colour in preservative and is a light, translucent orange-red. The pigment cells were found to be more densely arranged in the brick-red colony that retained more of its colour. No other difference between the two colonies was detected. The pigment cells are present in the superficial bladder cell layer. They are large, ribbon-like, fusiform, branched, or irregularly pyriform, up to 0.007 mm in width and 0.07 mm in greatest extent. They are filled with spherical granular particles. There is a layer of spicules below the bladder cell layer, extending through it to the surface around the branchial siphons which appear at the surface as white dots. The spicules and the pigment cells become more sparse toward the base of the colony and are absent altogether below the common cloacal cavity. There are large spherical patches of black or reddish pigment in the surface of the basal test (below the cloacal cavity) in some parts of the colony. The spicules are also absent from around the borders of the large, conspicuous, and apparently almost sessile common cloacal apertures.

The spicules are large and stellate, from about 0.04 to 0.07 mm with 8-12 sharply-pointed rays in optical section.

Zooids: The zooids are about 2 mm long. The relaxed thorax is larger than the abdomen. The branchial aperture has 6 well-defined lobes. The atrial siphon is long and extends posteriorly from the posterior third of the dorsal surface. There are long

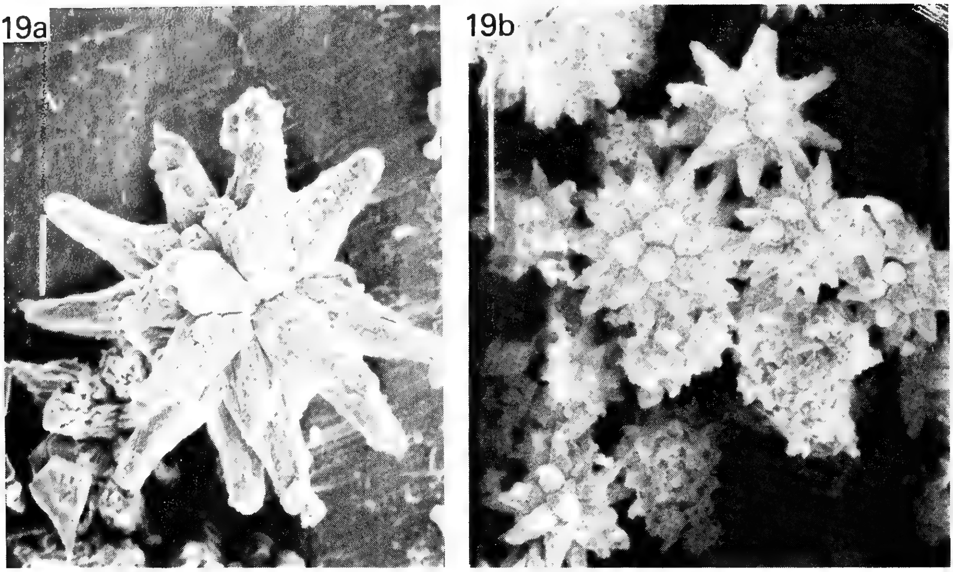


Fig. 19. **a**, *Leptoclinides ocellatus* (QM GH61) stellate spicules with long attenuated rays, 0.03-0.05 mm (scale 0.005 mm); **b**, *Leptoclinides rufus* (QM G12575) stellate spicules with variable numbers of conical rays, some with basal concavities, 0.02-0.05 mm (scale 0.05 mm).

circular sphincters around both apertures. The atrial sphincter is around the distal half of the siphon. When the zooid is contracted the walls of the siphon extend into bilateral pouches just behind the sphincter muscle. There are 8 longitudinal thoracic muscles on each side. A circular to transversely oval lateral organ is depressed into the body wall opposite the middle of the third row of stigmata. There are 8 elongate oval stigmata in each of the four rows. The gut forms a simple elongate loop, although the rectum may be bent over into the proximal part of the atrial siphon. There is a conspicuous gastro-intestinal gland. A rosette of 4 or 5 radiating ♂ follicles is covered by 6 coils of the vas deferens.

Larvae: Neither testes nor ova are mature in the present colonies. Millar (1975) has reported embryos 0.45 to 0.55 mm with 3 adhesive organs, single dorsal and ventral ampullae and 3 pairs of broad lateral ampullae. Although Eldredge (1967) records 4 pairs of lateral ampullae his fig. 17c shows a well developed larva of 0.725 mm with the same adhesive apparatus as in Millar's specimens.

Remarks: The species is characterized by its large and variably shaped pigment cells, very large spicules, relatively small number of ♂ follicles and long atrial siphon with sphincter muscle and pouches.

The colour of the preserved colonies ranges from white with blue markings (Tokioka, 1967), warm grey to deep blue black (Millar, 1975) and tan, sometimes with orange streaks (Eldredge, 1967). Generally the pigment is not evenly distributed, although the even colour of the present colonies in life suggests that sometimes irregularities may result from uneven loss of pigment from preserved specimens. Apparently there is also some variation in the distribution of spicules, which in some of the Hawaiian specimens (Eldredge, 1967) have obscured the bladder cell layer, although in all other specimens they are confined to a layer beneath the bladder cells or are occasionally absent (Eldredge, 1967).

The larvae have more ectodermal ampullae than those of *L. rufus* (see Kott, 1962) and *L. marmoratus*: Millar, 1975, from Jolo (?<*L. rufus*).

Leptoclinides ocellatus (Sluiter, 1909)
Figs 19a; 31

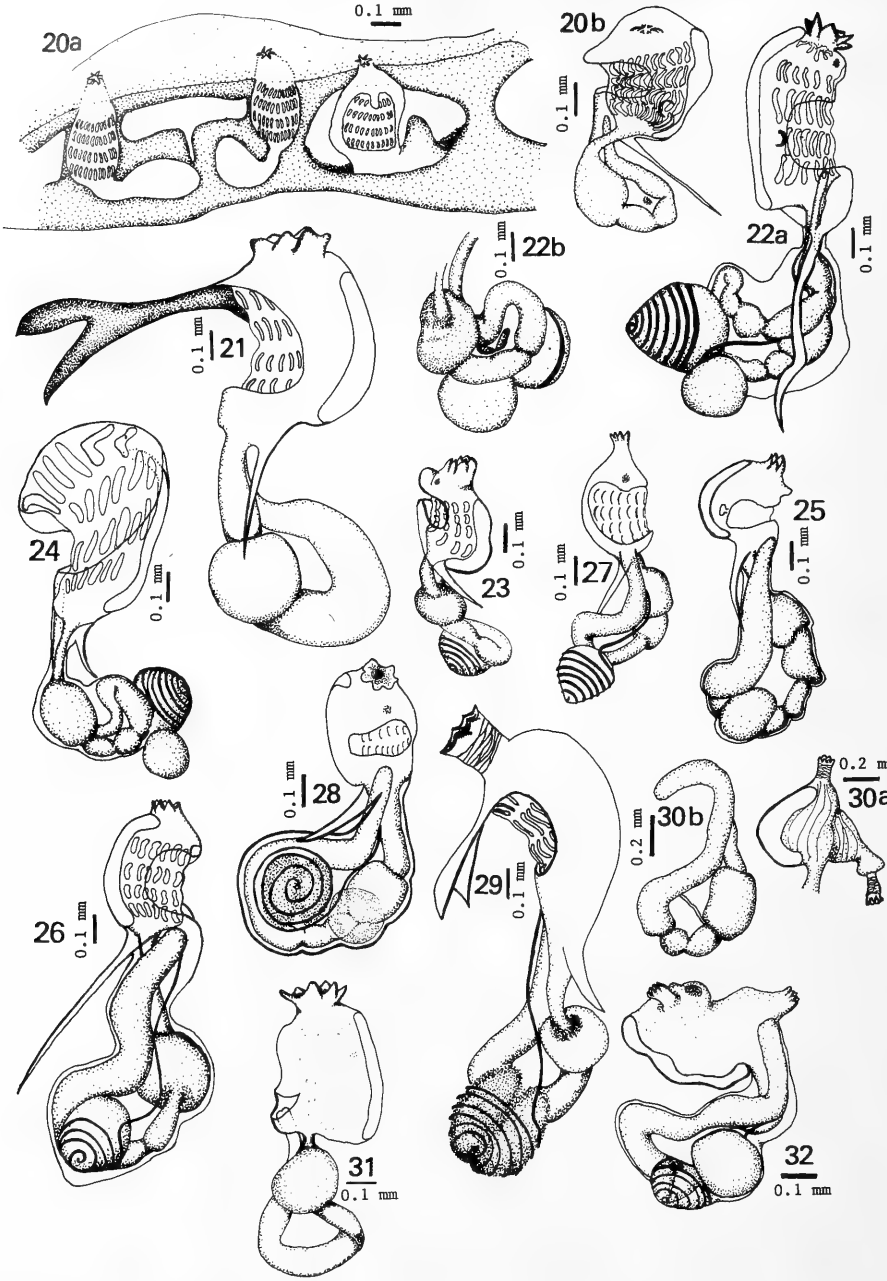
Polysyncraton ocellatum Sluiter, 1909, p. 73.

Distribution
New Records: Fiji — Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH61.
Previously Recorded: Indonesia — Sluiter, 1909.

Description
Colony: The colony is extensive. The surface is uneven, marked by furrows and rounded prominences, up to 5 mm thick at their highest point. The test is firm, tough and gelatinous. There is a thick superficial layer of bladder cells above a layer of spicules, at the level of, and interrupted by, the branchial siphons so that the zooids, which are brown in preservative, are seen from the surface as brown dots interrupting the white spicules. There are large spherical brown globules randomly distributed in the bladder cell layer that are about the same diameter (about 0.3 mm) as the circular areas over the zooids. The living colony was a greenish black sheet stretched over a rocky substrate.

Common cloacal cavities with spicule-free borders are present in the centre of each rounded swelling of the surface of the colony. The zooids lie horizontally in the surface test, their atrial apertures opening directly into the large cloacal cavity that occupies the centre of each rounded swelling. Only very rarely do test connectives cross the cavity to anchor surface to basal test. More often the cavities are uninterrupted, the surface and basal test being connected only around the periphery of the cavity. The basal test is usually paper thin below the cloacal cavity but becomes thicker around its periphery and beneath any test connectives that cross it. A layer of bladder cells is also present in the floor of the cloacal cavity, where the basal test becomes thicker. Spicules are sparse around the zooids, in the roof of the cloacal cavity and in the basal test. They are moderately dense only in the surface test beneath the bladder cell layer and in test connectives. They are large (0.03-0.05 mm diameter) stellate, with 7-9 long, narrow and pointed rays in optical section. Spicules do not outline either the branchial lobes or atrial aperture. The distal half of each ray appears attenuated and narrows rather abruptly from the basal section. This attenuated distal half of the rays is often sheared off the base, leaving a flat-topped stump.
Zooids: These are about 1.2 mm long. The branchial lobes are conspicuous and pointed. The atrial aperture, from the posterior part of the thorax, is two-lipped and does not appear to have the cylindrical siphon characteristic of most species of this genus. The two lips may be withdrawn to expose much of the branchial sac and the distal portion of the rectum and the two-lipped anal opening.

About 10 fine muscle bands extend along the thorax. There are 12 stigmata in each of the four rows. The oesophagus is short, the gut loop distal to the stomach is wide and bent upwards. A mass of glandular vesicles is present around the intestine and proximal part of the rectum. There are no gonads developed in these zooids.
Remarks: Although gonads are not developed in these specimens, the development of the common cloacal cavity and orientation of the zooids to it is characteristic of the genus. The specimen has been assigned to *L. ocellatus* on the basis of similarities in the outer appearance of the colony, the large globular dark masses in the superficial layer, the size and form of the zooids and their musculature and branchial sacs. However, the spicules of the present specimen are vastly different from those described for the



Figs 20-32. **20,** *Didemnum albopunctatum* (QM G12591) : **a,** cross section of colony showing zooids and cloacal cavity; **b,** zooid. **21,** *Didemnum chartaceum* (QM GH55), zooid. **22,** *Didemnum cuculliferum* (QM G12594) : **a,** zooid; **b,** gut loop with gonads and glandular body. **23,** *Didemnum digestum* (QM G12614), zooid. **24,** *Didemnum granulatum* (QM G12586), zooid. **25,** *Didemnum moseleyi* (QM G12589), zooid. **26,** *Didemnum proliferum* (QM G12577), zooid. **27,** *Didemnum sphaericum* (QM GH127), zooid. **28,** *Polysyncraton recurvatum* (QM GH90), zooid. **29,** *Polysyncraton doboense* (QM GH143), zooid. **30,** *Leptoclinides madara* (QM G12459) : **a,** thorax; **b,** gut. **31,** *Leptoclinides ocellatus* (QM GH61), zooid. **32,** *Leptoclinides rufus* (QM G12615), zooid.

Indonesian material and the specimens may be found not to be conspecific when additional material can be examined.

Leptoclinides reticulatus (Sluiter, 1909)

Didemnum reticulatum Sluiter, 1909, p. 60; 1913, p. 74.
Leptoclinides reticulatus: Hastings, 1931, p. 92. Kott, 1962, p. 285; 1972a, p. 18; 1972b, p. 180.
Didemnoides tigrinum Oka, 1927, p. 498..
Leptoclinides tigrinum: Tokioka, 1953b, p. 2; 1954c, p. 70.

Distribution

New Records: Fiji — Great Astrolabe Reef; Dravuni, LWM, July 1980, QM GH63.
Previously Recorded: Japan (Honshu) — Oka, 1927; Tokioka, 1953b, 1954c. Australia (Low Is., Great Barrier Reef) — Hastings, 1931. Circum Australia — Kott, 1972a, b. Indonesia — Sluiter, 1909.

The records suggest that this species has a wide latitudinal range to the north and to the south of the equator.

Description

Colony: The colonies form solid sheets that are streaked with black and yellow pigment patches. One of the colonies was 'indian yellow' when living, but in preservative has the usual fusiform and branched, finely tapering, black pigment cells in addition to the patches of yellow-orange pigment in spherical and oval cells. The pigment cells are present amongst the superficial bladder cells and the single layer of stellate spicules at the level of the branchial siphons. The spicules are very sparse in the remainder of the test. The zooids are often horizontal above the extensive cloacal cavity.

Zooids: The zooids open directly into the common cloacal cavity by a posteriorly-directed atrial siphon. They are of the usual form with about 10 stigmata in each row. They are actively budding in the Fijian specimens and no gonads were seen.

Remarks: The spindle-shaped, often branched pigment cells distinguish this species from *L. rufus* (with oval pigment cells) and *L. madara* (with ribbon-like pigment cells). Its black and yellowish markings are distinctive. It is a common species in temperate as well as tropical waters.

Leptoclinides rufus (Sluiter, 1909)
Figs 19b; 32

Polysyncraton rufum Sluiter, 1909, p. 72.
Leptoclinides rufus: Tokioka, 1952, p. 92. Kott, 1962, p. 286.
Not *Leptoclinides rufus:* Eldredge, 1967, p. 220. (<*L. madara,* above).
Leptoclinides lissus Hastings, 1931, p. 93. Millar, 1963, p. 704.
?*Leptoclinides marmoratus:* Millar, 1975, p. 235 (part: specimens from Jolo Is., fig. 25).

Distribution

New Records: Fiji — Viti Levu, July, 1979: Makaluva, LWM, QM G12575; Suva Barrier Reef, LWM, QM G12615.
Previous Records: Indonesia — Sluiter, 1909; Tokioka, 1952. Queensland — Hastings, 1931; Kott, 1962. N.S.W. — Millar, 1963. Phillipines — Millar, 1975.

Description

Colony: The colonies in the present collection were, in life, cream-brown. The preserved specimens are translucent and slightly orange, especially around the borders of the colonies where small spherical pigment cells are found more densely. There is a superficial layer of pigment cells and spicules are found beneath this layer. The spicules are from 0.02 to 0.05 mm in diameter with 7-9 conical pointed rays in optical section. The distal part of the ray in some of the spicules is supported in a basal section of greater diameter. The common cloacal apertures are large and oval.

Zooids: These are colourless in the preserved specimens. There are 6 branchial lobes with a fairly long muscular sphincter around the siphon. The atrial siphon projects posteriorly, but is rather short and its sphincter is not conspicuous. There are about 8 longitudinal thoracic muscles. The shallow lateral organ is opposite the third row of stigmata. The gut forms a simple vertical loop. Only 3 ♂ follicles could be detected in these specimens. The vas deferens spirals 6 times.

Larvae: No mature gonads or larvae present in these colonies. Previous records are of a larval trunk 0.7-0.8 mm long (Kott, 1962, Millar, 1975). There are only 3 pairs of ectodermal ampullae.

Remarks: This species is distinguished from others by its spherical pigment cells. Its lesser number of larval ampullae, shorter atrial siphon and smaller spicules also distinguish it from the closely related *Leptoclinides madara*. *Leptoclinides reticulatus* (see Kott, 1962) has even smaller spicules, and 4 pairs of larval ampullae.

Eldredge (1967) and Millar (1975) have not separated most of the Indo-west Pacific *Leptoclinides* spp. from one another. Although the colour of both living and preserved specimens and the distribution of the spicules appears to be highly variable, the size of the spicules and the form of the pigment cells appear to provide reliable specific characters.

Trididemnum discrepans (Sluiter, 1909)
Figs 35, 36

Leptoclinum discrepans Sluiter, 1909, p. 77.
Didemnopsis jolense Van Name, 1918, p. 147.
Trididemnum savignii var. *jolense:* Tokioka, 1967, p. 82.

Distribution

New Records: Fiji — Viti Levu: Malevu, July 1979, QM G12475-7; July 1980, QM G12922. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH121. Great Barrier Reef — Green Is., on *Zostera,* August 1979, LWM, QM G12477.

Previous Records: Indonesia — Sluiter, 1909. Philippine Is. — Van Name, 1918; Tokioka, 1967. Palau Is., Gilbert Is. — Tokioka, 1967. Florida — Tokioka, 1967.

Description

Colony: The present colonies are 0.5-2.0 cm in diameter and about 0.5 cm high, regularly hemispherical or slightly irregular and lobed (QM G12477), and sessile. The rounded surface is uppermost. The test is firm, translucent, beige to black, varying with the density of black pigment in elongate or branching long narrow pigment bodies that fit in the interstices between the very large bladder cells that occupy most of the test. The pigment bodies are made up of small spherical or irregular particles that appear to be joined together into strands. There are also minute clear morulae scattered through the test. There are no calcareous spicules. There are two to three sessile open cloacal apertures on the upper border of the colony that are made more conspicuous by dense pigment in the surrounding test. Zooids are relatively sparse, but evenly spaced and open all around the upper surface. Common cloacal canals are thoracic.

Zooids: These are about 1.5 mm long. There is some dark pigment in the anterior part of the body wall, that extends posteriorly along either side of the dorsal and ventral mid-lines. The thorax and oesophageal neck together represent about half of

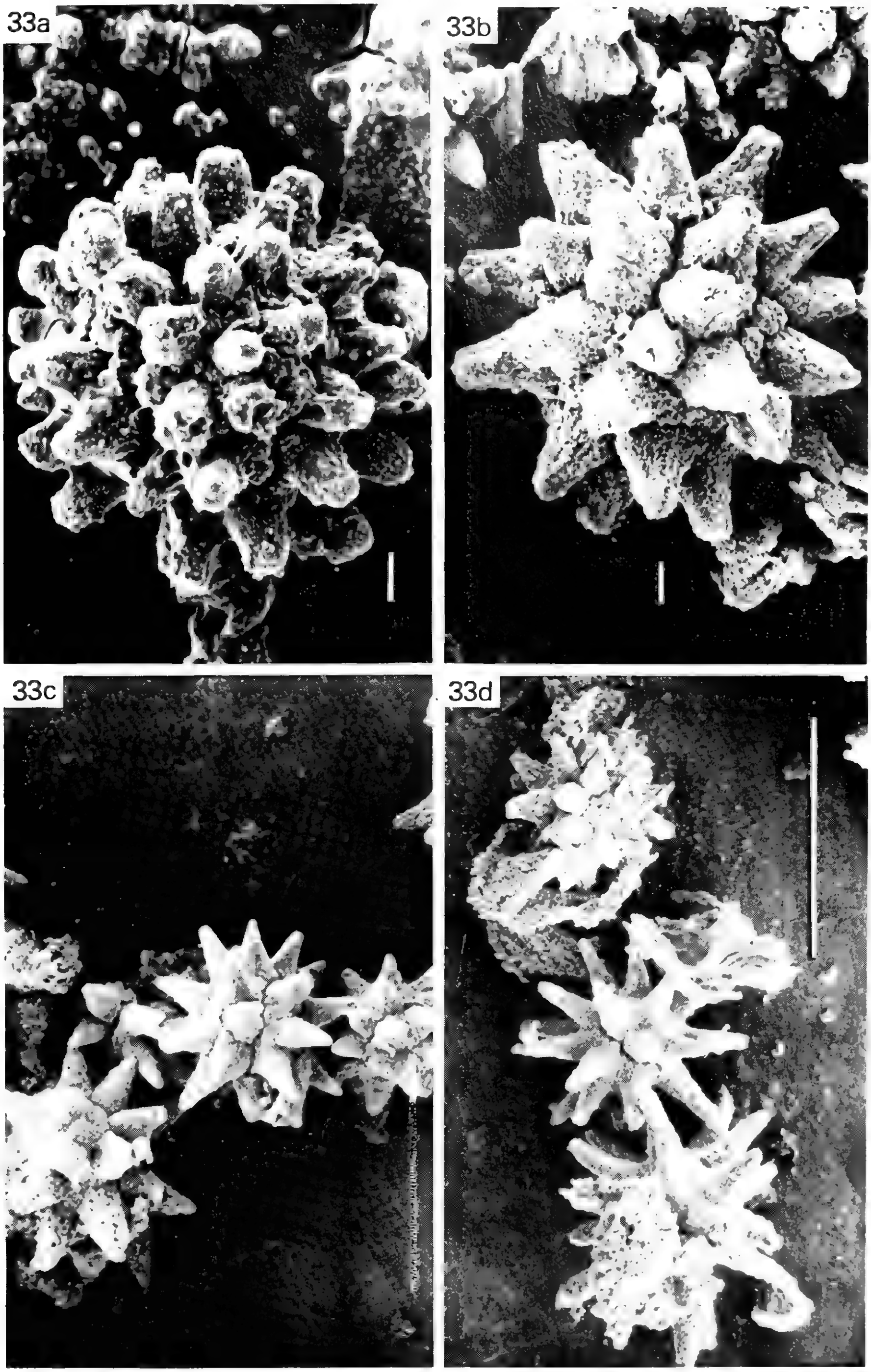


Fig. 33. **a,b,** *Trididemnum savignii* (QM G12618) stellate spicules with numerous short conical rays, 0.04-0.97 mm (scale 0.005 mm) **c, d,** *Trididemnum cerebriforme* (QM G12574) stellate spicules with long pointed rays, 0.03-0.05 mm (Scales **c,** 0.005 mm; **d,** 0.05 mm).

the zooid length and the abdomen the remainder. The branchial lobes are rounded, on a very short siphon. A short horizontally-directed atrial siphon extends from the middle of the dorsum. There are 3 rows of 10 stigmata, which become shorter at the dorsal and ventral end of each row. A medium to long retractor muscle extends from the proximal part of the oesophageal neck to one- to two-thirds of the length of the abdomen. The gut loop is vertical and open at the pole. There are 6½ coils of the vas deferens around the undivided ♂ follicle.

Larvae: These are present in the Fijian colonies. They are large (about 1.3 mm), with 4 paired lateral ampullae, 3 median adhesive organs, an otolith and ocellus. The larval test appears frothy and contains the very large bladder cells that are characteristic of the adult colony.

Remarks: The bladder cells, pigment cells, morula bodies, and the relatively large abdomen of the present species are distinctive. The species does resemble aspicular colonies of *T. savignii,* with similar pigment bodies. The rounded shape of the colony and the larger zooids and pigment cells and bladder cells distinguish it.

Trididemnum savignii (Herdman, 1886)

Figs 33a, b; 37

Didemnum savignii Herdman, 1886, p. 261. Van Name, 1902, p. 358.

Trididemnum savignii: Van Name, 1921, p. 314; 1924, p. 23; 1930, p. 428; 1945, p. 100. Hastings, 1931, p. 91. Pérès, 1949, p. 184; 1951, p. 1056. Tokioka, 1953a, p. 197; 1962a, p. 3. ?Eldredge, 1967, p. 178.

Not *Trididemnum savignii:* Kott, 1966, p. 285; 1975, p. 9.Tokioka, 1967, p. 80 (< *T. cerebriforme,* see below).

Trididemnum planum Sluiter, 1909, p. 42.

Trididemnum natalense Michaelsen, 1920, p. 3. Hastings, 1931, p. 92. Kott, 1962, p. 278.

Distribution

New Records: Fiji — Viti Levu: Malevu, LWM, July 1979, QM G12618. Deuba, LWM, September 1979, QM GH57. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH99.

Previous Records: Atlantic — Herdman, 1886; Pérès, 1949, 1951; Van Name, 1902, 1921, 1924, 1930, 1945; Berrill, 1932. West Indian Ocean — Michaelsen, 1920. Japan — Tokioka, 1953a, 1962a. Hawaii — Eldredge, 1967. Australia (Queensland) — Hastings, 1931: Kott, 1962; (South Australia) — Kott, 1962, 1975; (Western Australia) — Kott, 1962.

Description

Colony: The living colonies are smooth-surfaced, dark-pigmented and gelatinous. The preserved colonies are grey or grey-brown. There is a superficial layer of bladder cells. Irregular fusiform or oval pigment cells are present in the thoracic layer of test where there are also occasional patches of spicules. There is a distinct layer of spicules in the upper part of the basal test, lining the floor of the thoracic cloacal cavity. Spicules are absent from the remainder of the basal test. They are large (0.04-0.07 mm diameter) with 9-14 conical pointed or rounded rays in optical section.

Zooids: The zooids with contracted thorax are slightly more than 1 mm long, the thorax and abdomen of more or less equal length. They are opaque, with dark brown pigment in the body wall, especially anteriorly. There is often, but not always, an endostylar pigment cap. There are 6 distinct branchial lobes. The atrial aperture is on a very short siphon from the middle of the thorax. There is a short to medium-length retractor muscle from the posterior end of the thorax. There are about 8 stigmata in each of the three rows.

The gut loop is curved ventrally, and there are 7½ coils of the vas deferens around the single ♂ follicle.

Larvae: These are not present in the Fijian material (see Kott, 1962).

Remarks: There remains confusion regarding the characters of this species and the closely related *T. cerebriforme* which has similar zooids. The smooth surface, flat colony, thoracic cloacal cavity, the darkly pigmented test, the absence of a distinct and continuous layer of spicules in the test above the zooids and the presence of a distinct layer of spicules in the floor of the cloacal cavity appear to distinguish the Fijian and Australian specimens from *T. cerebriforme.* There are also some differences in the spicules (see *T. cerebriforme* below).

Specimens from Hawaii (Eldredge, 1967) and Japan (Tokioka, 1953a) are unusual in this species. Although their cloacal cavities are thoracic, the colour of the colonies, and the distribution of the spicules (especially those at the surface of the colony that are in a continuous layer and form rounded swellings over the top of the zooids) are more reminiscent of *T. cerebriforme* than of the present species. *T. savignii:* Tokioka, 1967, from various mid-Pacific locations, is possibly *T. cerebriforme* (see below).

No reliable distinguishing characters have been identified to separate the west Indian Ocean *T. natalense* from the present species in either the Atlantic or Pacific Oceans. The number of stigmata, coils of the vas deferens, density and distribution of spicules are all variable and all populations appear to have overlapping ranges of these variable characters. There is also some variation in the length of the retractor muscle which is sometimes twice the length of the thorax (Michaelsen, 1920), about the same length as the thorax (QM G12618), or very much less than the length of the thorax (see Pérès, 1949; Eldredge, 1967; Tokioka, 1953a). In all these specimens, the origin of the retractor muscle is from the posterior end of the thorax. Only in the West Indian populations (Van Name, 1921, 1945) does the retractor muscle originate from half way down the oesophageal neck. This may indicate some isolation of populations but does not at this stage appear to justify a separate specific rank for populations in the western Atlantic.

Trididemnum cerebriforme Hartmeyer, 1913
Figs 33c, d; 38

Trididemnum cerebriforme Hartmeyer, 1913, p. 139. Michaelsen, 1924, p. 341. Millar, 1955, p. 178; 1962, p. 170. Kott, 1962, p. 275; 1972c, p. 247; 1972d, p. 47; 1975, p. 10; 1976, p. 64.

Not *Trididemnum cerebriforme:* Kott, 1972b, p. 178.

Not *Trididemnum savignii:* Tokioka, 1967 (part: ?not Japanese colonies).

Trididemnum luderitzi: Kott, 1957a, p. 139. ?Michaelsen, 1930, p. 506.

Distribution

New Records: Fiji — Viti Levu: Makaluva, LWM, July 1979, QM G12574; Sandbank Reef, June 1980, QM GH6. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH64, 72, 75.

Previously Recorded: New Zealand — Michaelsen, 1924. South Africa — Hartmeyer, 1913; Millar, 1955, 1962a. Southern Arabia — Kott, 1957a. Circum-Australia — Kott, 1962, 1972c, 1972d, 1975, 1976. Philippine Is., Palau Is., Mariana Is., Hawaii — Tokioka, 1967.

Description

Colony: An irregular rather brittle colony, translucent and whitish, often covered with, or with patches of green (prokaryotic?) cells on the surface. Living colonies may be white or 'straw yellow' or green depending on the distribution of these green cells. One colony is 'chrome yellow' with diffuse pigment in the bladder cell layer. Zooid openings are evenly spaced over the surface. Around the borders of the colony furrows tend to separate the surface into lobes. There is a thin superficial layer of bladder cells. Beneath this there is a continuous layer of spicules which form a swelling over the anterior end of each zooid. Spicules are present more sparsely in the remainder of the test and decrease in density toward the base of the colony. The spicules are large (0.03-0.05 mm) with 7-9 pointed rays in optical section. The common cloacal cavity is primarily posterior abdominal, extensive and the basal test is rather thin. Common cloacal apertures are conspicuous.

Zooids: These are slightly less than 1 mm long and contain black-brown pigment in the body wall, especially over the abdomen and around the anterior part of the thorax. There is an endostylar pigment cap. Zooids have 8-10 stigmata and 6½-8½ coils of the vas deferens. The branchial siphon is well developed with a long circular sphincter muscle and 6 distinct branchial lobes. The atrial siphon is also long, from the posterior third of the thorax. There is a short to medium length retractor muscle from the posterior end of the thorax that extends only part of the distance down the abdomen. Larvae are present in colonies from Sandbank Reef in June 1979 (QM GH6).

Remarks: The species is distinguished from *T. savignii* by the posterior abdominal cloacal cavity, the distribution of pigment and spicules, and by the slightly smaller spicules with fewer rays that are present in *T. cerebriforme.* The complicated anastomosing and folding of the colony that is observed in many specimens has not developed in the present small colonies. The milky white appearance of the colonies, the posterior abdominal cloacal cavity, the size of the spicules, their form and their distribution all indicate that specimens of *T. savignii:* Tokioka, 1967, from the mid-Pacific are synonymous with the present species. The larger Japanese colonies which Tokioka (1967) believes to be conspecific do not appear to belong to either of these species.

In *Trididemnum luderitzi* Michaelsen, 1919, from West Africa the cloacal cavities extend posterior to the zooids as in the present colonies and the spicules and spicule distribution are similar. It is distinguished by its smaller zooids and the smaller number of stigmata in each row (see Michaelsen, 1919). *Trididemnum lüderitzi:* Michaelsen, 1930, from Western Australia, with 8 stigmata in each row, may be synonymous with the present species.

The association with plant cells appears to be a non-obligatory one, unlike other species of the family (Kott, 1980) in which these cells are always present. Unlike the present species, the eastern Pacific and Atlantic species *Trididemnum solidum* has a very thick surface layer of plant cells (see Lewin and Cheng, 1975) that may also be an obligatory associatory.

Trididemnum clinides Kott, 1977

Trididemnum clinides: Kott, 1977, p. 617; 1980, p. 5.

New Records: Malevu, behind *Sargassum* zone on reef crest, June 1980, QM GH17; under cascades July 1980, QM GH13. Namanda, under cascades, July 1980, QM G12872. Mumbaulau, LWM, July 1980, QM GH144. Great Astrolabe Reef (Dravuni), LWM, July 1980, QM GH91.

Remarks: The soft colonies previously described have been taken from the western fringing reefs where they are found enmeshed in the algal mat under the cascades.

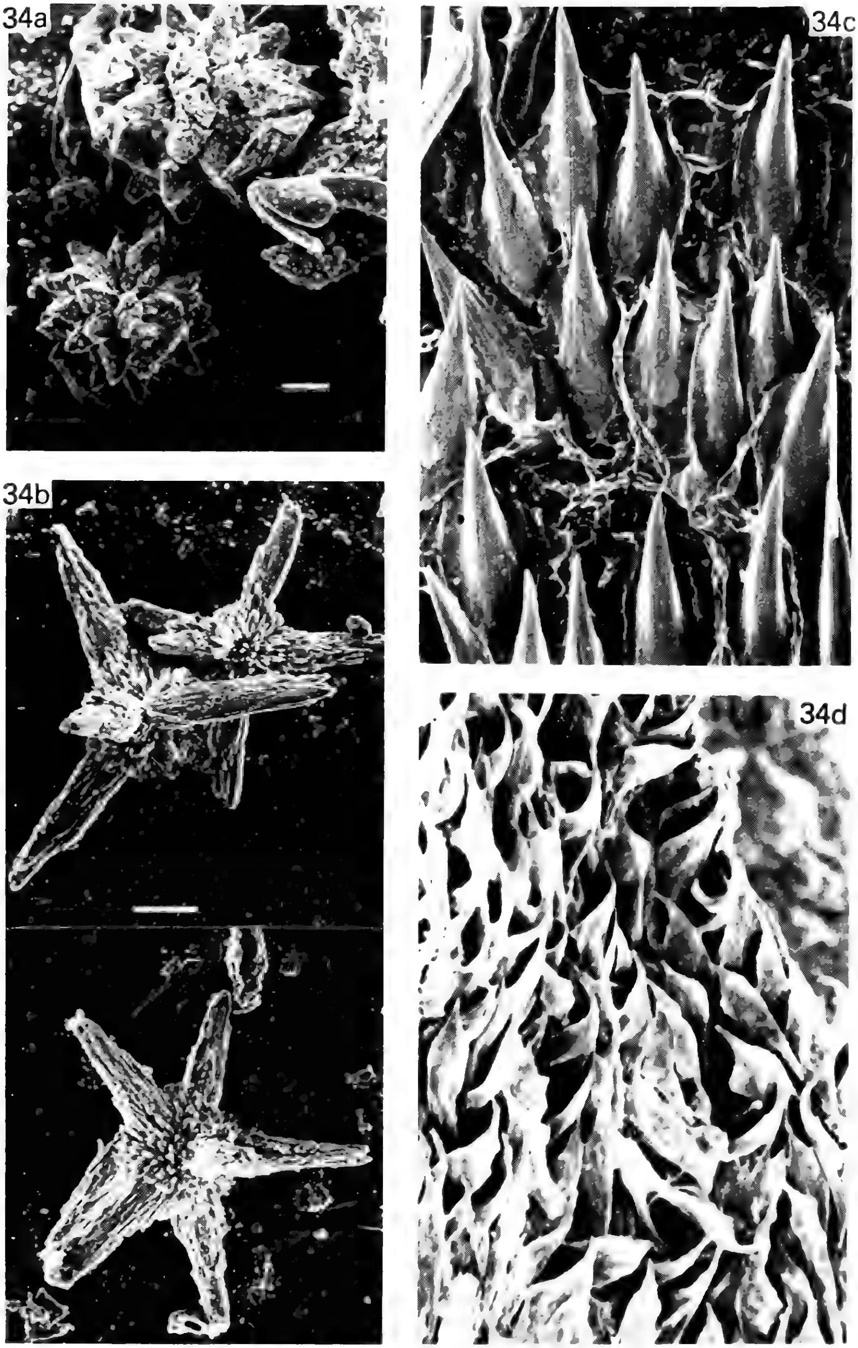


Fig. 34. **a**, *Trididemnum spiculatum* (QM G12585) stellate spicules with numerous short conical rays, 0.02-0.03 mm (scale 0.005 mm); **b**, *Echinoclinum pacificensis* (QM G12584) spicules with four to five long pointed rays, maximum length of rays 0.03 mm (scale 0.005 mm); **c**, *Pyura sacciformis* (QM G12716) branchial spines (scale 0.05 mm); **d**, *Microcosmus exasperatus* (QM G12701) branchial spines (scale 0.01 mm).

Larger (up to 2 cm long), firmer colonies were taken at Mumbualau and the Great Astrolabe Reef. In life these colonies are 'blackish slate'. Freshly preserved material is green, but quickly fades to white as the plant cells, embedded in the test, lose their colour. The slate colour is caused by black pigment that is contained in large rounded reservoirs in the basal test in the preserved material.

The retractor muscle is of variable length. It always arises from the posterior end of the thorax, and is often very short, but may sometimes extend the whole length of the very small abdomen with its short oesophagus.

Trididemnum cyclops Michaelsen, 1921

Trididemnum cyclops Michaelsen, 1921, p. 19: Kott, 1980, p. 10 and synonymy.

Records: This small species is usually present in rather cryptic habitats over the reef flats. It was less common in July 1980 than it had been the previous year.

Trididemnum paracyclops Kott, 1980

Trididemnum paracyclops Kott, 1980, p. 12 and synonymy.

New Records: Mumbualau, LWM, July 1980, QM GH5. Suva Barrier Reef, LWM, July 1980, QM G12912. Makaluva, LWM, July 1980, QM G12911 (with larvae). Namanda, LWM, July 1980, QM G12910. Malevu, LWM, June 1980, QM GH7; July 1980, QM G12913. Great Astrolabe Reef (Dravuni), LWM, July 1980, QM G12908 (with larvae), G12909.

Remarks: Large investing sheets of this species were conspicuous over wide areas of the reef flats, lining pools and in other non-cryptic locations. The black pigment outlining the edge of the colony in the living specimens is quite distinctive.

Trididemnum nubilum Kott, 1980

Trididemnum nubilum Kott, 1980. p. 9.

New Record: Sandbank Reef, LWM, June 1980, QM G12927.

Remarks: This Fijian record represents the first outside the Philippines for this small inconspicuous species. However it has also been taken recently from Lizard Is. (June 1980, coll. PK). It differs from *T. strigosum* principally in its smaller many-rayed spicules (up to 0.05 mm diameter) and very long retractor muscle.

Trididemnum strigosum Kott, 1980

Trididemnum strigosum Kott, 1980. p. 8.

New Records: Malevu, behind *Sargassum* zone on reef crest, June 1980, QM GH18; Great Astrolabe Reef (Dravuni), LWM, July 1980, QM GH84.

Remarks: These records are the first from Fiji of this species thought to be an endemic Philippine species. It has embedded plant cells, a small zooid (0.6 mm), an incised atrial aperture and a stalked projecting lateral organ. It is distinguished from *T. nubilum* principally by its large spicules (0.05-0.08 mm diameter) with few (7) conical rays. The spicules are not quite so dense in the Fijian specimens as had been previously reported (Kott, 1980).

Trididemnum spiculatum Kott, 1962

Figs 34a; 39

Trididemnum spiculatum Kott, 1962, p. 281 (part: specimens from Rottnest Is. and Wreck Bay).

Distribution

New Records: Fiji-Viti Levu: Laucala Bay, experimental mussel raft, July 1979, QM G12585.

Previous records: Western Australia, Tasmania — Kott, 1962.

Description

In addition to the Fijian colony the following material has been examined. *Trididemnum spiculatum* Kott, 1962: Holotype, AM Y1626; Paratype, AM Y1628; Paratype, AM Y1630.

Colonies: The living colony is white and forms a large thin investing sheet. The anterior end of each zooid slightly projects from the surface, and the thin superficial layer of bladder cells becomes even thinner over each zooid. Zooids are evenly distributed. The cloacal cavity is thoracic. Spicules are absent from the border of the cloacal apertures. They are present in a thin layer below the bladder cell layer and again in the base of the common cloacal cavity but there are no spicules present in the rather thick basal test. Spicules outline the test over the branchial lobes. The spicules are 0.02 to 0.03 mm, with about 12 conical rays in optical section. The distal pointed section of each ray is relatively short and is supported in a pentagonal basal part that is of greater diameter. There is no pigment present in these colonies.

Zooids: These are about 1.25 mm long. There is a distinct branchial sphincter and 6 minute, pointed, branchial lobes. The atrial aperture is an incut opening exposing the mid-dorsal part of the branchial sac. The retractor muscle is about half the length of the abdomen. There are 3 rows of 6 stigmata. The vas deferens coils 6½ times around the single ♂ follicle.

Remarks: The distribution of spicules in this species is reminiscent of other species of *Trididemnum* (including *T. cerebriforme* and *T. savignii*). The species is distinguished by its incut atrial aperture, small spicules, and absence of pigmentation. The specimen from Heron Is. reported to have plant cells (Kott, 1962) was wrongly identified with this species. On examination that specimen (AM Y1627) is found to be a specimen of *Trididemnum paracyclops* Kott, 1980.

The recorded distribution is puzzling and the possibility that more than a single species is involved should not be overlooked.

Lissoclinum bistratum (Sluiter, 1905)

Didemnum bistratum Sluiter, 1905, p. 18.
Lissoclinum bistratum: Kott, 1980. p. 16 and synonymy.

New Records: Ba, open reef flat, LWM, July 1980, QM GH15. The species is common at all locations around Viti Levu throughout the year.

Remarks: The colonies from this station have dense spicules in the surface test and patches of carotenoid pigment that are seen as pink patches over the white spicules. The colonies are found on the open reef flat, in a habitat more commonly exploited by *Lissoclinum voeltzkowi.* Kott (1980) has referred to the reduction in density of plant cells in the surface of *L. voeltzkowi* where the colony is shaded. The dense layer of spicules in the surface of these colonies of *L. bistratum* and more commonly in *L. voeltzkowi* appears to be associated with protection of the plant cells from the direct light of the open reef flat.

Similar populations of *L. bistratum* have been observed on the open reef flat at Lizard Is. in the Great Barrier Reef.

Larvae were present in July 1979 and 1980. They were not present in May or June 1980.

Lissoclinum patellum (Gottschaldt, 1898)

Didemnoides patella Gottschaldt, 1898, p. 653.
Lissoclinum patellum: Kott, 1980, p. 18 and synonymy.

New Record: Suva Barrier Reef, LWM, July 1980, QM G12918.

Remarks: The species has not previously been taken from Fiji. It is not a normal component of the reef flat fauna and is more often found in deeper water. Only a single small colony is represented by this record.

Lissoclinum punctatum Kott, 1977

Lissoclinum punctatum Kott, 1977, p. 620; Kott, 1980, p. 20.

Records: The species occurs at all locations around Viti Levu and on the Great Astrolabe Reef.
Remarks: It is very inconspicuous, occupying cryptic habitats amongst weed and binding rubble. Records are available for July 1979, and June and July 1980. The mature larva of this species is not known.

Lissoclinum voeltzkowi (Michaelsen, 1920)

Didemnum voeltzkowi Michaelsen, 1921, p. 54.
Lissoclinum voeltzkowi: Kott, 1980, p. 13 and synonymy.

Records: The species is always present and common at most locations around Viti Levu in very extensive populations over the reef flat, often exposed at low tides.
Remarks: Larvae were present in July 1979 and June and July 1980, but were absent in May 1979 when the colonies appeared to be actively lobulating.

On the vast sandy reef flat at Mumbualau there are patches of this species growing on the higher contours that are exposed for slightly longer periods at low tide. It is possible that, when covered by the tide, more light falling on these high points than on other parts of the otherwise level reef flat may attract larvae to settle there, for it seems unlikely that an advantage is associated with their longer exposure at low tide. Colonies from many locations are often found overlapping one another's borders and it is always an upper border that overlaps the colony above it. It is not known whether this is a result of growth or actual movement of the colonies, although, again, this could be a response to light.

Diplosoma listerianum (Milne Edwards, 1842)

Leptoclinum listerianum Milne Edwards, 1841, p. 295. Berrill, 1950, p. 125 and synonymy.
Diplosoma listerianum: Millar, 1955, p. 174. Rowe, 1966, p. 458 and synonymy.
Didemnum gelatinosum Milne Edwards, 1841, p. 295. Berrill, 1950, p. 122 and synonymy.
Diplosoma rayneri MacDonald, 1859, p. 373. Kott, 1976, p. 72.
Leptoclinum rayneri: Kott, 1962, p. 305; 1966, p. 290.
Diplosoma macdonaldi Herdman, 1886, p. 315. Eldredge, 1967, p. 231, and synonymy.
Leptoclinum mitsukurii: Tokioka, 1967, p. 100.

Distribution

New Records: Fiji-Viti Levu: Suva Barrier Reef, LWM, July 1979, QM G12489; Sandbank Reef, July 1980; Votua-lai-lai, July 1980. Great Astrolabe Reef: Dravuni, July 1980, QM GH80.
Previously Recorded: Records of this species and its synonyms are from the tropical western and eastern Atlantic, the eastern (California, Vancouver Is.) mid and western Pacific (including Japan, New Zealand, eastern Australia), South Australia, south-western Australia, South Africa, Mediterranean, English Channel, North Sea (see Eldredge, 1967; Rowe, 1966).

Description

Colony: The species forms characteristically thin sheets, sometimes extending over considerable areas like a grey slime that breaks up very readily when attempts are made to remove it from the substrate. The test is usually grey and transparent. The colony is identifiable as an ascidian only by the darkly pigmented zooids embedded in it. The common cloacal cavity is extensive, the zooids present in the test strands that extend between the thin basal and surface test. There are minute (0.015 mm in maximum diameter) morulae that resemble small spicules, sparsely distributed in the test strands but not in the surface or basal test. When magnified they are seen to be clusters of translucent spheres (Eldredge, 1967). In the tropics opaque colonies that are tan with streaks of grey and white occur. In preservative the colours are lost. In these colonies the morulae are found in dense clouds in the surface as well as in the test strands.

Zooids: Zooids have the usual dark pigment in the body wall, especially anteriorly and around the abdomen. Beneath this pigment the gut wall is yellow in the preserved specimen. There is a small black pigment spot just posterior to the dorsal ganglion.

Remarks: The type species of the genus *Diplosoma* was described in some detail by MacDonald *(D. rayneri* MacDonald, 1859). Rowe (1966) described a neotype for *D. listerianum* (Milne Edwards, 1841) and confirmed the synonymy of Pacific and Atlantic species with it. Its thin, almost mucus-like test, morulae, pigmented zooid and extensive cloacal cavity are distinctive.

Diplosoma multipapillata Kott, 1980

Diplosoma multipapillata Kott, 1980, p. 29.

New Records: Malevu, under cascades: September 1979, QM G12920; November 1979, QM G12904; December 1979, QM G12900; April 1980, QM G12902; May 1980, QM G12863, behind *Sargassum* zone reef crest, June 1980, QM GH16; under cascades, July, 1980, QM G901; Votualailai, under cascades July 1980, QM G12864; Namanda, under cascades, July 1980, G12869.

The new records indicate that this species is probably confined to the cascades along the riverine reef crests of the southwestern fringing reefs wherever these are bisected by a river channel. Where the river empties onto the reef, close inshore, there is a wide embayment cut in the reef and the moat between the reef and shore drains into this embayment. *D. multipapillata* is not found under the cascades emptying into this inshore bay. It is found on the reef rim, under the cascades, further out from the shore, where the river channel is narrow and receives the drainage from the reef flat rather than the inshore moat. The species also extends for a short distance around onto the surf zone of the seaward face of the reef. However its range along the seaward reef crest is interrupted by the *Sargassum* zone which ocurs on the seaward slope of these reefs.

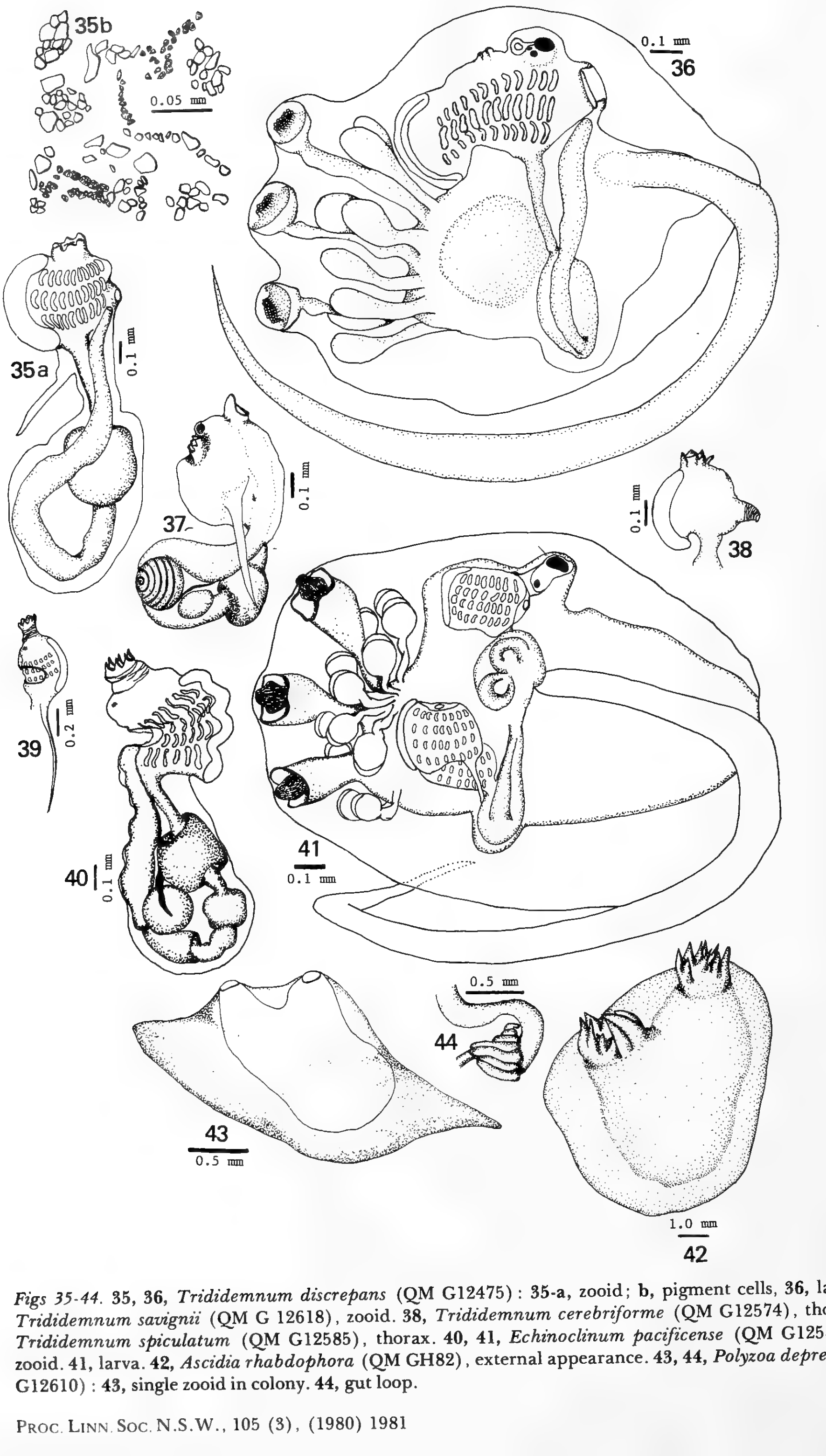
Specimens collected in September at Malevu did not have larvae, but in those collected in June and July the larvae were plentiful.

Diplosoma similis (Sluiter, 1909)

Leptoclinum simile Sluiter, 1909, p. 77.
Diplosoma similis: Kott, 1980, p. 26, and synonymy.

Records: The species is especially common near the reef edge at all locations in the surf zone. Here it encrusts the under surfaces of the reef canopy and grows amongst the deep rubble. The sheeting colonies can be seen encroaching through the spaces in the surface of the reef.

Remarks: The species is distinguished from *Diplosoma virens* by its simple cloacal space and a shorter retractor muscle from the posterior end of the thorax. The



Figs 35-44. **35, 36,** *Trididemnum discrepans* (QM G12475) : **35-a,** zooid; **b,** pigment cells, **36,** larva. **37,** *Trididemnum savignii* (QM G 12618), zooid. **38,** *Trididemnum cerebriforme* (QM G12574), thorax. **39,** *Trididemnum spiculatum* (QM G12585), thorax. **40, 41,** *Echinoclinum pacificense* (QM G12584) : **40,** zooid. **41,** larva. **42,** *Ascidia rhabdophora* (QM GH82), external appearance. **43, 44,** *Polyzoa depressa* (QM G12610) : **43,** single zooid in colony. **44,** gut loop.

distinction between the larva and that of *D. virens,* based on the number of ectodermal ampullae (Kott, 1980) has been found to be unreliable. Larvae have been found with 3 pairs of ectodermal ampullae (June 1980, Tagaque, QM G12915, and July 1980, Suva Barrier Reef, QM GH65) and with 4 pairs of ampullae (July 1980 Mumbualau QM G12916). Although Kott (1980) believed that 4 pairs of ampullae were characteristic of *D. midori,* the specimens from Mumbualau are in all other respects identical with *D. similis.*

The colonies from Tagaque with 3 larval ampullae are polygonal, and about 2 cm in diameter, resembling larger colonies of *D. virens* or *D. midori.* These are in other respects identical with *D. similis.* They therefore have affinities with *D. similis* and *D. midori,* and suggest that *D. midori* may be synonymous with *D. similis.*

Diplosoma virens (Hartmeyer, 1909)

Leptoclinum virens Hartmeyer, 1909, p. 1456.
Diplosoma virens: Kott 1980, p. 22, and synonymy.

Records: Massive populations of small colonies were common over much of the reef flat at all locations around Viti Levu in July 1979. In July 1980 small aggregations were found on the south-western fringing reefs, but in general, the species was much less common on the reef flats. It is possible that the reef flat populations (together with those of *T. cyclops)* were affected by the cyclone and cyclonic rains that had occurred in the previous month. One population of large (up to 2 cm), flat colonies was found at about 3 m at Mumbualau, July 1980 (QM G12895).

Remarks: There is considerable variation in the size and appearance of colonies of this species. Those from Mumbualau (QM G12895) encrusting a branch of *Acropora)* are larger than the small oval specimens so common on the reef flat. The species is distinguished by the complexity of thoracic cloacal canals and by the long retractor muscle that is free from about halfway down the long oesophagus. Kott (1980) suggested that the number of larval ampullae could be used to distinguish *Diplosoma* species. The varying number of larval ampullae found in Fijian material collected in 1979-1980 clearly indicate that this is not a reliable specific character. There is also variation in the number of adhesive organs.

Larvae were taken in colonies from Malevu and Votualailai in November 1979 and July 1980 (QM G12897, 12866, 12878). They have 2 to 3 pairs of ectodermal ampullae, or sometimes 2 and 3 on respective sides of the adhesive organs. Occasionally there are 4 or 5 adhesive organs in the midline instead of the usual 3. Colonies were also taken in September (QM G12876), December (QM G12875) 1979, and February (QM G12898), March (QM G12879), June (QM G12877) 1980 that generally have mature ♂ and ♀ gonads but that do not contain larvae.

Echinoclinum pacificense n. sp.

Figs 34b; 40, 41

?Echinoclinum verrilli: Tokioka, 1958, p. 315.

Distribution

New Records: Fiji-Viti Levu: Suva Barrier Reef, LWM, July 1979, Holotype QM G12584; Makaluva, Paratype, QM G12463. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH59. Great Barrier Reef — Heron Is., LWM, QM G9467.
Previously Recorded: ?Japan (Sagami Bay) — Tokioka, 1958.

Description

Colony: Colonies are small and investing with rounded borders, up to 2 cm in greatest extent and 2 to 3 mm thick. In life they are faintly yellow and translucent and in preservative the faint yellowish colour is still present. There are small white points in the surface where spicules fill the test where it covers the branchial lobes. The zooids are seen through the test as white flecks owing to a capsule of sparse spicules around each zooid. There is a fairly even layer of spicules in the superficial layer of test, but elsewhere the spicules are very sparse. The characteristic spicules have 3 to 5 pointed rays and there is 0.03 to 0.04 mm between the tips of the rays.

A characteristic of this and other related species (see below, Remarks) is the extremely soft test. The colony is very easily torn during or after collection. Separation of the superficial layer of test also occurs very easily and may be an artefact associated with violent contraction of the zooids into the centre of the colony. The cloacal cavities consist of long canals at thoracic level which open into an extensive posterior abdominal space.

Zooids: The zooids with contracted thorax are about 1.5 mm long. There is a very strong branchial sphincter. The 6 branchial lobes are thin and pointed. The atrial opening is incut, exposing the mid dorsal part of the branchial sac. There are about 6 strong longitudinal thoracic muscles. There are 6 elongate, rectangular stigmata in each row. The gut forms a simple vertical, or slightly curved loop. The stomach, duodenal swelling and mid intestine are distinct. The single ♂ follicle is a rather flattened sphere with the duct extending straight anteriorly from the middle of its outer surface. It is not hooked around the posterior border of the gland.

Larvae: Eggs and embryos at all stages of development are present in the test below the zooids, and in the basal test, especially around the borders of the colony around the posterior abdominal cavity. The trunk is large, 1.2 mm long, and the tail is relatively short, extending only about one third of the distance around the trunk. The larva has an ocellus and an otolith, and there are two blastozooids that develop from the oesophageal region of the oozoid. The 3 median adhesive organs have stout stalks and deep ectodermal cups around the deep solid adhesive cones. There are 6 pairs of lateral ampullae. As these mature their stalk narrows. The terminal portion remains swollen and spherical (balloon-like) with very flat epithelial cells and a small hyaline cap on its outer surface. There are small particulate inclusions in the larval test, but these are very much smaller than the inclusions (spicules?) that in *E. verrilli;* Kott, 1972a, obscure the structure of the larva.

Remarks: The spicules of this species are of similar form to those described for other species of this genus, formerly all referred to as synonyms of *E. verrilli* Van Name, 1902. Specimens of *E. verrilli* from the Western Atlantic (Van Name, 1902: Gulf of Mexico AMNH 471, 494; Florida AMNH 484) have been examined. The Atlantic species differs from the present species in its firm gelatinous test, with zooids in double rows along either side of deep canals in deep narrow furrows around circular zooid-free areas of test that form rounded swellings on the surface. The zooids are smaller than those of the present species (1 mm long), and the spicules are larger (0.07 mm between tips of rays). Although Van Name (1945, p. 116) indicates that there were 'probably nearly a dozen (stigmata) in a row on each side', only 4 or 5 stigmata were present in the specimens examined. The larva has only 4 pairs of ectodermal ampullae and a long tail wound one and a half times around the small larval trunk (0.6 mm long).

Echinoclinum verrilli: Kott, 1972a, from South Australia is distinct from both the Atlantic species and *E. pacificense,* having 14 pairs of larval ampullae. Its colony, zooid and larval size resemble those of the present species. The affinities of specimens from West Africa (Millar, 1953) and the Tasmanian coast (Kott, 1962) remain in doubt.

The generic status of the group of species is also in doubt. Eldredge (1967) has suggested that the genus *Echinoclinum* is not distinct from *Lissoclinum*. The larvae with their blastozooids and numerous modified lateral ampullae do resemble those of species of *Lissoclinum,* and certainly the presence of tetrahedal spicules does not preclude an affinity with any didemnid genus, including *Lissoclinum*. However the separation of the genera *Echinoclinum* and *Lissoclinum* is based on differences in the origin and course of the vas deferens. In the latter is is hooked around the posterior border of the male gland from its ventral surface, while in the present genus it originates from the middle of the dorsal surface and extends straight forwards. Van Name (1945) has described testes follicles in which the vas deferens extends in a groove around the follicle from its ventral surface. This requires confirmation.

Echinoclinum triangulum Sluiter (see Kott, 1980) resembles the present species in its very soft colonies, sheaths of rather unusual spicules around each zooid, and straight vas deferens. It differs from other species of *Echinoclinum* (and of *Lissoclinum)* in the absence of larval blastozooids (Millar, 1975). It is also separated from other species of *Echinoclinum* by the form of the spicules and the presence of symbiotic plant cells in the test (Kott, 1980). The form of the larval ampullae is not clear from Millar's description and those with spherical tips and squamous epithelial cells may be characteristic of the *'verrilli'* group of species rather than a generic characteristic.

Order PHLEBOBRANCHIA
Family PEROPHORIDAE
Perophora formosana (Oka, 1931)

Ecteinascidia formosana Oka, 1931b, p. 173.
Perophora formosana: Tokioka, 1953a, p. 218.
Perophora bermudiensis Berrill, 1931, p. 78. Van Name, 1945, p. 167 and synonymy. Pérès, 1949, p. 190. Tokioka, 1950, p. 125. Kott, 1952, p. 315; 1964, p. 147. Vasseur, 1966, p. 149
Perophora orientalis Ärnbäck-Christie-Linde, 1935, p. 6.

Distribution
New Records: Fiji-Levu: Makaluva, LWM, July 1979, QM G12468; Sandbank Reef, LWM, July 1980, QM G12938.
Previously Recorded: Tropical western and eastern Atlantic — see Van Name, 1945; Pérès, 1949. Malagasy — Vasseur, 1966. Palau Is. — Tokioka, 1950. New South Wales — Kott, 1952. Queensland (Moreton Bay) — Kott, 1964. Japan — Oka, 1931; Ärnbäck-Christie-Linde, 1935; Tokioka, 1953a.

Description
Colony: Living specimens are seen as small yellow bubbles, up to 3 mm in diameter on the under surface of rocks at low tide. In preservative the zooids are transparent. Short stalks from the postero-ventral aspect of the body attach it to anastomosing basal stolons.
Zooids: The conspicuous body musculature extends from across the dorsal surface behind the atrial siphon and transversely and obliquely across the body to the ventral border. There are 5 rows of 15 stigmata, and 12 internal longitudinal branchial vessels. The single compact ♂ gland in the loop of the gut is diagnostic.
Remarks: The relatively limited number of records of this small inconspicuous species is probably the result of a cryptic habitat, under rocks, and the fact that it is difficult to remove undamaged from the substrate. Its distribution will very likely be found to be pantropical.

Ecteinascidia nexa Sluiter, 1904

Ecteinascidia nexa Sluiter, 1904, p. 11.

Distribution
New Records: Fiji — Viti Levu: Suva Barrier Reef, on the under side of rubble, LWM, July 1980, QM G12938. Great Barrier Reef: Heron Is. — unpublished records.
Previously Recorded: Indonesia — Sluiter, 1904. North-east Queensland (Hervey Bay) — Kott, 1966.

Description
External appearance: The species forms a mat of small (about 0.5 cm) almost spherical yellowish bubbles. The zooids are fixed along almost their whole ventral or ventro-lateral surface to basal stolons which form a network on the substrate. They are also joined to adjacent zooids by narrow test connectives. Both apertures are sessile, and directed upwards. The atrial aperture is half-way along the dorsal surface.
Internal structure: There are 17 rows of about 20 stigmata with 15 internal longitudinal vessels on each side. Short longitudinal muscles radiate only a limited distance from the apertures and represent the only conspicuous musculature. The dorsal lamina is represented by antero-posteriorly flattened pointed languets without any connecting membrane between them. The smooth stomach is almost spherical. The intestine forms a wide loop and the rectum extends forwards for only a short distance to the atrial aperture. The testis follicles are very small and form an arc distal to a small group of ova.
Remarks: Although seldom recorded, this is a common species under rocks along the north-eastern coast of Australia and probably throughout the Indo-west Pacific. It is probable that it rarely appears undamaged in collections as its prostrate growth makes it very difficult to scrape off the substrate. The connectives joining the test of adjacent zooids comprise the only distinction from *E. tortugensis* Plough and Jones (see Van Name, 1945). These test connectives, the smooth stomach and the flattened languets of the dorsal lamina are diagnostic.

Family RHODOSOMATIDAE
Subfamily CORELLINAE
Corella japonica Herdman, 1882

Corella japonica Herdman, 1882, p. 190. Tokioka, 1953a, p. 231 and synonymy; 1967, p. 148. Vasseur, 1967b, p. 132. Tokioka and Nishikawa, 1975, p. 332. Millar, 1975, p. 266. Nishikawa and Tokioka, 1976, p. 392.

Distribution
New Records: Fiji — Viti Levu: July 1979, Suva Barrier Reef, LWM, QM G12007.
Previously Recorded: Japan — Herdman, 1882; Hartmeyer, 1906; Tokioka, 1953a, 1967; Tokioka and Nishikawa, 1975; Millar, 1975; Nishikawa and Tokioka, 1976. Hong Kong — Herdman, 1882. Noumea — Vasseur, 1967b.

Description
Inconspicuous glassy individual from 5 to 10 mm long, fixed by a large part of the right side to under surfaces.
Remarks: These specimens appear to be juveniles. The species is most often recorded from Japan but it very likely has a wider range than its present records suggest. It is distinguished from the tropical eastern Atlantic *C. minuta* and the temperate Antarctic *C. eumyota* by its conspicuous muscle bands crossing the dorsal line in the intersiphonal region.

Family ASCIDIIDAE

Ascidia rhabdophora Sluiter, 1904
Fig. 42

Ascidia rhabdophora Sluiter, 1904, p. 45. Tokioka, 1953a, 220.

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, LWM, July 1979, QM GH117; Makaluva, LWM, July 1979, QM GH146. Great Astrolabe Reef: Dravuni, LWM, July 1979, QM GH82. Great Barrier Reef — unpublished records.

Previously recorded: Indonesia — Sluiter, 1904. Japan — Tokioka, 1953a.

Description

External appearance: The individuals are small (1 cm long), almost circular, laterally flattened and fixed to the substrate by almost the whole of the left side. The branchial aperture is terminal and the atrial aperture one third to half the distance along the dorsal border. Forward projecting, pointed, hollow test papillae (up to 2 mm long) crowd around the sessile apertures and corresponding projections of the body wall are accommodated in the hollow of each papilla. As the individual grows these papillae become less conspicuous and relatively shorter. The remainder of the test may be translucent or glassy and sometimes it is smooth but it may be rough and uneven, with rounded swellings on the surface or minute pointed papillae may be present all over the right side.

Internal structure: There are short radiating muscles from both apertures. These extend half way across the right side of the animal but on the left they extend only a very short distance from the apertures. In preserved material there is some yellowish pigment in the branchial tentacles. A comma-shaped opening of the neural gland is present in the prebranchial area and there is not the usual peritubercular area projecting posteriorly along the mid line. The dorsal lamina is a wide membrane with strong ribs on the left. It is continuous anteriorly to a line level with the prebranchial groove. Here, in its anterior extent, it is separated into two lamellae by a deep median groove. The branchial sac has the usual papillae projecting inwards from the internal longitudinal vessels at their junction with transverse and parastigmatic vessels. There are also distinct but sometimes minute intermediate papillae between the primary papillae in most parts of the branchial sac.

The gut forms a fairly narrow deeply-curved loop, the rectum extending forwards almost parallel with the ascending limb of the primary loop. The stomach, across the posterior end of the left side of the body, is short and almost spherical. Internally it is divided into 4 longitudinal glandular areas. The proximal part of the ovary, in the pole of the gut loop is very much branched. The distal part curves around inside the gut loop and extends anteriorly parallel to the rectum to open alongside the smooth anal opening.

Remarks: The species is distinguished by the absence of the peritubercular area, the presence of intermediate papillae, the comma-shaped opening of the neural duct. It closely resembles *A. bisulca:* Millar, 1975, but is distinguished by its dorsal tubercle. Like the Japanese specimen (Tokioka, 1953a) the Fijian specimens lack the calcareous spicules that Sluiter (1904) had observed in the inner layer of test. Tokioka (1953a) believes these to be foreign bodies.

Ascidia melanostoma Sluiter, 1885

Ascidia melanostoma Sluiter 1885, p. 172; 1904, p. 30.

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, July 1979, QM G12700; July

1980, QM GH119.
Previously Recorded: Indonesia — Sluiter, 1885, 1904.

Description

External appearance: Glassy, translucent with black pigment in the test, branchial sac, and especially in the anterior part of the body and in distinct stripes in the siphonal linings. There are 9 stripes in the branchial siphon. There are conspicuous pigment spots (possibly light sensitive) at the apex of the lobes around the apertures. The branchial aperture is terminal. The atrial aperture, from one half to two thirds of the way along the dorsal surface is on a short siphon that is sometimes turned posteriorly. Specimens are from 2 to 4 cm long, about 2 cm wide.

Internal structure: There is a fairly open irregular mesh-work of muscles on the right side of the body. These are reorganized into short parallel bands extending across the ventral border. On the left side of the body the musculature is confined to longitudinal bands radiating down as far as the gut loop. The branchial tentacles are crowded, and the very narrow prepharyngeal area is papillated. There is a shallow peritubercular area and the dorsal tubercle has a simple circular or U-shaped opening. The dorsal ganglion is a short distance behind the dorsal tubercle, about half way between the tubercle and the base of the atrial siphon. Anteriorly, for one sixth of its length or less, the lamina is a double membrane. It is strongly ribbed on both sides along its whole length, each rib extending from the border of the membrane to form a regular fringe of distinct tongue-like projections. The branchial sac has about 6 stigmata in each mesh. The branchial papillae are round with a slight swelling on the dorsal side. There are no intermediate papillae. The gut forms a narrow double loop. The secondary loop is very deep. The anal border is bilabiate. The specimens have mature ♂ and ♀ gonads, the vas deferens and oviduct being filled with genital products. Long branches of the ovary obscure the ♂ follicles, and extend over most of the mesial surface of the gut loop and gonoducts. They also extend through the pole of the gut loop and spread over its lateral side.

Remarks: The shape of the body, the branchial sac, the body musculature and the shallow prepharyngeal region are similar to those of *Ascidia gemmata.* Kott (1972a) has ascribed specimens with the dorsal lamina a single membrane for the whole of its length to *A. gemmata.* However, Tokioka (1950) shows a double membrane anteriorly for specimens that are the scarlet colour that he regards as characteristic of that species (Tokioka, 1950, 1952). The colour of the living specimens, therefore, appears to be the only reliable character that can be used to distinguish *A. gemmata* from the present species. Further studies on variation in pigmentation of living material are essential to establish the relationships of these species.

Suborder STOLIDOBRANCHIA
Family STYELIDAE
Subfamily POLYZOINAE
Polyzoa depressa (Oka 1926)
Figs 43, 44

Dictyostyela depressa Oka, 1926, p. 348.
Polyzoa sagamiana Tokioka, 1953a, p. 245. Kott, 1964, p. 131.

Distribution

New Records: Fiji — Viti Levu: Suva Barrier Reef, LWM, July 1979, QM G12610; Laucala Bay, 10 m July 1979, QM G12613.
Previously Recorded: Japan — Oka, 1926; Tokioka, 1953a. Great Barrier Reef (Heron Is.) — Kott, 1964.

Description

External appearance: The species consists of small hemispherical or oval individuals firmly fixed to the substrate by the ventro-lateral (right) surface. The maximum size of the zooids is 3 mm. The test is transparent and fairly thin, but tough, and the bright red body wall shows through. The test spreads out over the surface beyond the zooid. Stolons join adjacent zooids but the test also spreads out from these, as well as around the zooid to form an almost continuous basement membrane. The branchial aperture is toward one end of the upper surface and the atrial aperture is in the centre of the upper surface (dorso-lateral left side of the body). The apertures are sessile and have smooth rims when extended.

Internal structure: There is diffuse musculature in the body wall. A few short longitudinal bands radiate from each siphon. There are 8 internal longitudinal vessels on each side of the branchial sac and 8 rows of about 30 stigmata, each crossed by a parastigmatic vessel. The stomach is pyriform, narrow at the cardiac end, with 12 oblique folds. There is a short curved caecum in the loop of the gut, which lies along the longitudinal axis of the zooid to the left of the endostyle at the outer margin. The rectum extends dorsally and anteriorly toward the atrial aperture. There are 3 gonads in the body wall, just to the left of the endostyle, each consisting of a single ♂ follicle underneath the ovary with a short oviduct directed antero-dorsally. There are up to 5 larvae in the antero-ventral part of the peribranchial cavity to the left of the endostyle.

Larvae: These have an almost spherical trunk, and a short stout tail that is only slightly longer than the trunk. There is a single pigmented sense organ and three anterior adhesive organs arranged in a close triangle. There are no ectodermal ampullae.

Remarks: Specimens from Sagami Bay and Heron Is. (QM G4951) have up to 11 rows of stigmata. The latter have gonads with 2 ♂ follicles on both sides of the endostyle. The number of gonads and rows of stigmata in Oka's specimens is not known. Specimens from Heron Is. (Kott, 1964) have 6 gonads on the right side of the endostyle and 4 on the left toward the middle of the body but these are not mature and the number of ♂ follicles was not determined. These specimens have 8 rows of stigmata. The number of internal longitudinal vessels, the presence of parastigmatic vessels, the size and form of the zooids, and the structure of the gut are the same in all specimens. The number of ♂ follicles and the gonad position and numbers appear to vary with the orientation of the body and the stage of sexual maturity it has reached and do not appear to constitute a specific distinction. In due course it is likely that this inconspicuous species will be found to have a wide range in the Indo-west Pacific.

The species has a superficial resemblance to *Polyandrocarpa imthurni* (Herdman) and the closely related *P. latericius* (Sluiter), both of which have a similar geographic range to that of the present species. They are distinguished however by the presence of the 4 branchial folds that are characteristic of *Polyandrocarpa*.

Symplegma oceania Tokioka, 1961

Symplegma oceania Tokioka, 1961, p. 114.

Symplegma viride: Michaelsen, 1904, p. 50; 1918, p. 39; 1919, p. 101. Michaelsen and Hartmeyer, 1928, p. 358. Kott, 1952, p. 253; 1964, p. 129; 1975, p. 11; 1976, p. 74. Millar, 1966, p. 368. Plante and Vasseur, 1966, p. 149: Vasseur, 1967a, p. 111. Tokioka, 1967, p. 162. Kawamura and Nakauchi, 1976, p. 4.

Symplegma aff. *viride:* Tokioka and Nishikawa, 1975, p. 334.

Diandrocarpa brakenhielmi Michaelsen, 1904, p. 50. Herdman, 1906, p. 331.

Not *Symplegma viride:* Van Name, 1945, p. 232 (part, Atlantic records).

Distribution

New Records: Fiji — Viti Levu: July 1979, Laucala Bay, experimental mussel raft; Makaluva, July 1980, LWM, QM GH 147.

Previously Recorded: Circum-Australia — Kott, 1952, 1964, 1972c, 1976; Millar, 1966. Noumea — Tokioka, 1961. Palau Is., Thailand, China — Tokioka, 1967; Tokioka and Nishikawa, 1975. Sri Lanka — Herdman, 1906. Indian Ocean — Michaelsen, 1904, 1918, 1919; Michaelsen and Hartmeyer, 1928; Vasseur, 1967a; Plante and Vasseur, 1966.

Description

External appearance: Colonies form the usual large investing sheets that overgrow other sessile organisms and, in the present location, compete for space with *Didemnum psammatodes*. Habitats are often muddy, with fine sediments. The Fijian populations are a mixture of orange-red and pale creamish-lemon colonies.

Remarks: The species is common around the Australian coast. Specimens from a range of locations on the central Queensland coast (QM G4939, 4938, 4942, 4941) have 8 to 14 rows of stigmata and 10 to 16 stomach folds. The arrangement of the gastro-intestinal duct and vessels is extremely variable and includes the arrangements described by Tokioka for *S. oceania* and for *S. viride*. The single or branched duct extends from a variable level between the middle and base of the outer convex side of the gastric caecum (which may be curved or almost straight) to the descending limb of the primary gut loop. Single or branched vessels also extend from the tip of the caecum to the ascending limb of the primary gut loop (distal to the stomach) where they ramify over the intestinal wall. These vessels and ducts associated with the caecum are very delicate, embedded in the membranes of the body wall that cover the gut loop.

The species is distinguished from the Atlantic species *S. viride* Herdman principally by the fact that the zooids of *S. viride* have protostigmata, which are suppressed in the Pacific species; and the mode of test vessel formation is different in the Atlantic species (Kawamura and Nakauchi, 1976). Other Pacific species, *Symplegma reptans* Oka (see Tokioka, 1951), *S. connectens* Tokioka (1949b, 1953) and *S. japonica* Tokioka (1962), can be distinguished from *S. oceania* by the absence of ampullae in the larvae of the two former species, the absence of a gastric caecum in *S. connectens* and the large number of stomach folds (17 to 20) in *S. japonica*.

Subfamily BOTRYLLINAE

Botrylloides tyreum Herdman, 1886

Botrylloides purpureum: Herdman, 1886, p. 41.

Botrylloides tyreum Herdman, 1886, p. 344, 381, nom. nov. Gottschaldt, 1898, p. 642. Sluiter, 1904, p. 101. Van Name, 1918 p. 111. Tokioka, 1967, p. 111. Millar, 1975, p. 280. Kott and Goodbody, 1981.

?Botrylloides violaceus marginatus: Tokioka, 1967, p. 160.

?Botrylloides violaceus: Tokioka, 1967, p. 158 and synonym.

?Botrylloides nigrum: Kott, 1952, p. 257; 1972c, p. 238; 1976, p. 74.

Distribution

New Records: Fiji — Viti Levu: Sand Bank Reef, LWM, July 1980, QM GH111. Great Astrolabe Reef: Dravuni, LWM, July 1980, QM GH107, 109.

Previously Recorded: Philippines — Herdman, 1886; Van Name, 1918. Palau Is. — Tokioka, 1967. Indonesia — Sluiter, 1904. Eastern and western Australia — Kott, 1952, 1972c, 1973. Japan — Tokioka, 1949a, 1951, 1953b, 1967.

Description

Colony: The Fijian colonies are all thin and investing and sometimes extensive. The zooids are always in double rows sometimes widely spaced and sometimes crowded, with conspicuous elongate terminal ampullae of blood vessels between the rows, and around the periphery of the colony. These preserved specimens are always dark purplish-brown. The pigment is in small cells in the zooids and in the terminal ampullae. The test between the zooid systems is translucent and raised above the level of the zooids in the preserved material. There are dramatic differences in the colour of the living colonies which are orange and buff, buff and yellow, black and white, 'orpiment orange' and black and white, or 'heliotrope' and 'purple'. The white, orange or yellow pigment outlines the atrial languet and the regular and repeated fine pattern varies according to the orientation and contraction of the atrial languet.

Zooids: The relaxed zooids are about 2 mm long. They are upright in the test. The branchial aperture is sessile and smooth-rimmed. The atrial aperture is wide, often exposing most of the branchial sac. Its upper rim is sometimes produced into a lip. There are 12 rows of stigmata with about 14 in each row. The gut loop lies across the posterior end of the left side of the branchial sac. The stomach is pear-shaped and wider at the pyloric end where the 9 longitudinal folds become more pronounced and where there is a small caecum. The caecum varies in length to some extent and is rounded terminally but it is never curved. There is a vascular connective between the caecum and the intestine. The stomach is an orange colour in the preserved specimens. There is a narrow duodenal area between the stomach and a voluminous mid-intestine with thin walls which is present in the pole of the gut loop. There is a slight constriction between the mid-intestine and the intestine. A rosette of 6 or 7 branched ♂ follicles is present on each side of the body in some colonies. The left testis is outside the gut loop and the right testis is in a corresponding position on the opposite side of the body. Small vegetatively produced juveniles in the test posterior to the zooids have a small rounded atrial aperture.

Remarks: The specimens are identical with those previously described from the Philippines (Herdman, 1886; Van Name, 1945; and Millar, 1975). The specimens from the Palau Is. assigned to *B. violaceus marginatus* by Tokioka (1967) also appear to be conspecific with the present specimens and those from the Philippines. *Botrylloides tyreum:* Tokioka, 1967, from the Palau Is., however, has larger zooids, more stigmata in each row, more stomach folds and different proportions of the gut, and is a doubtful synonym. *Botrylloides violaceus* Oka may also be conspecific since although the number of stomach folds and rows of stigmata exceed those of the present specimens (Tokioka, 1967), other specimens from Japan assigned to this species are identical in these characters (see Tokioka, 1949a, 1951, 1953b), although the characteristic pear-shape of the stomach is not always reported for this Japanese species. *Botrylloides nigrum:* Kott, 1952-76, from Australia has the same pear-shaped stomach but often has larger zooids and more rows of stigmata and stomach folds. Its relationship to the present species and to *B. violaceus* requires investigation.

Tokioka (1967) has suggested synonymy of *B. leachii* (Savigny) with *B. violaceus.* However although the zooids are similar the colonies of the two species are quite distinct.

Subfamily STYELINAE

Cnemidocarpa areolata (Heller, 1878)

Styela areolata Heller, 1878, p. 26; Herdman, 1906, p. 316; Van Name, 1918, p. 87. Tokioka, 1950, p. 145. Kott, 1964, p. 138; 1966, p. 297. Vasseur, 1967b, p. 139.
Cnemidocarpa areolata: Tokioka, 1953a, p. 254; 1953b, p. 14; 1954a, p. 261; 1954b, p. 85; 1959, p. 229; 1961, p. 126; 1962, p. 17; 1967, p. 181.
Cnemidocarpa valborgi Hartmeyer, 1919, p. 35.

Cnemidocarpa irma Michaelsen and Hartmeyer, 1928, p. 388. Hastings, 1931, p. 72. Kott, 1952, p. 217. Millar, 1963, p. 728.

Distribution

New Records: Fiji — Viti Levu: Tai Levu, LWM, July 1979, QM G12683; Suva Barrier Reef, LWM, July 1979, QM G12005; Makaluva, LWM, July 1979, QM G12582. Great Astrolabe Reef: Dravuni, July 1980, QM GH149.

Previously Recorded: Western Australia — Hartmeyer, 1919; Michaelsen and Hartmeyer, 1928; Kott, 1952; Millar, 1963. Queensland — Hastings, 1931; Kott, 1964. Northern Australia — Kott, 1966. Sri Lanka — Heller, 1878; Herdman, 1906. Noumea, Palau Is. — Tokioka, 1950, 1961; Vasseur, 1967b. Philippines — Van Name, 1918. Mariana Is. — Tokioka, 1967. Japan — Tokioka, 1953a, 1953b, 1954a, 1954b, 1959, 1962.

Description

External appearance: Individuals are egg-shaped. They are leathery, orange-chrome in life with dark stripes in the siphons. In preservative they are brown-orange with very irregular surface test, up to 3 cm long, about 1½ cm high and 2 cm broad, dorso-ventrally flattened. They are fixed by the ventral surface and the test here is sometimes irregularly produced. The sessile branchial aperture is terminal, and the atrial aperture, about one third of the body length along the dorsal surface, is also sessile. When the individual is contracted and the surface of the test thrown up into irregular swellings and furrows the closed apertures are especially inconspicuous.

Internal structure: The simple branchial tentacles are fairly long, with a wide posterior flange on each. There is a narrow prepharyngeal area that expands dorsally into a fairly shallow peritubercular area with the dorsal tubercle filling its posterior angle. The opening of the neural duct is a U-shaped slit with the right horn turned in. The branchial folds are fairly high and overlap one another slightly in the contracted specimen. There are about 18 vessels on the folds and 6 between. The oesophagus is fairly short. The stomach is short and pear shaped with internal longitudinal glandular folds. There is a fairly long gut loop of moderate width extending around the postero-ventral curve of the left side of the body and the rectum extends forwards at a wide obtuse angle to the gut loop to form the secondary loop. The anus is bordered with small rounded lobes. A double row of about 8 tall endocarps, sometimes branched, is enclosed in the primary gut loop. Other endocarps are on the body wall between the gonads. Gonads are present in specimens from Dravuni (July 1980). There are two gonads on the left, the posterior one curving anterior to the pole of the primary gut loop. On the right there are three gonads around the ventral half of the body and converging toward the atrial aperture.

Remarks: The specimens collected in 1979 are juveniles and resemble *Polycarpa longiformis* which has similar endocarps on the body wall and in the loop of the gut. The dark stripes in the siphons, the thick body wall that is not closely adherent to the test and the absence of long finger-like anal lobes distinguish the present species.

Polycarpa pedunculata Heller, 1878

Polycarpa pedunculata Heller, 1878, p. 106; Kott, 1972a, p. 35 and synonymy.

Distribution

New Records: Fiji — Viti Levu: Toberua, 2-4 m, July 1980, QM GH78. Great Astrolabe Reef: Dravuni, 1-2 m, July 1980, QM GH85; Yakuve, 1-2 m, July 1980, QM GH79.

Previously Recorded: The species has been recorded from eastern, western and southern Australia, and from New Caledonia (see Kott, 1972a). There are unpublished records from the north-eastern coast of Australia, Lizard Is., and off Townsville. It is a common benthic species.

Description

External appearance: Specimens collected from Fiji are always large, up to 12 cm long and 5 cm deep (dorso-ventrally). They are laterally flattened when collapsed in preservative but the living specimens are more cylindrical. In life they are brown externally, and the internal siphonal lining is light grey to blue. The siphonal lining is conspicuous, and otherwise the brown external test camouflages the animal. The branchial aperture is wide and terminal, but is turned ventrally and posteriorly. The atrial aperture is on a short siphon one third of the distance down the dorsal surface. The body is fixed to the substrate posteriorly and is usually sessile. The test here is very thick, however, and is sometimes produced into a thick stalk.

Internal structure: The body wall is very muscular with an almost continuous layer of outer circular fibres and an internal layer of less developed longitudinal muscles. Spherical vesicles that are black when the animal is preserved interrupt the muscle bands, and also occur in the pharynx and in the ectodermal lining of the outer wall of the peribranchial cavity. The body wall is closely adherent to the test. The dorsal tubercle is large and triangular completely filling the peritubercular space. The opening of the neural gland is interrupted and convoluted. The branchial sac has thick longitudinal vessels that are especially close together on the low folds.

The gut loop is relatively small, and oriented across the posterior part of the left side of the body at right angles to its long axis. The long stomach, with parallel internal glandular folds, occupies most of the proximal limb of the gut loop. The gut loop encloses the usual circular endocarp. The rectum turns anteriorly to the atrial opening. The anus is fringed by about 20 lobes. The gonads are numerous and deeply embedded in the body wall.

Remarks: The deeply embedded gonads, complicated dorsal tubercle, and large size of these specimens, indicate that they are of some age. It is likely that some of the variations described (Kott, 1972a) for this species represent more juvenile individuals.

Family PYURIDAE
Pyura sacciformis (von Drasche, 1884)
Fig. 34

Cynthia sacciformis von Drasche, 1884, p. 376.
Pyura sacciformis: Tokioka, 1967, p. 197.
Cynthia sanderi Traustedt and Weltner, 1894, p. 11.
Halocynthia sanderi: Hartmeyer, 1906, p. 5.
Pyura sanderi: Tokioka, 1953a, p. 275. Rho, 1966a, p. 6; 1966b, p. 7; 1968, p. 11; 1971, p. 20; 1975, p. 24.
Pyura aspersa Tokioka, 1949a, p. 10.
Pyura masuii Tokioka, 1949b, p. 57.
?*Pyura michaelseni* Oka, 1906, p. 46. Tokioka, 1954, p. 90 and synonymy. Kott, 1964, p. 140.

Distribution

New Records: Fiji — Viti Levu: Makaluva, LWM, July 1979, QM G12579.

Previously Recorded: With the exception of a single doubtful record from the Great Barrier Reef (Heron Is.) all previous records are from Japan and Korea.

Description

External appearance: The single specimen is 4 cm long, and very irregular. The test is

TABLE 1
Distribution of Non-Plant Bearing Ascidians Occurring at Fiji

Species \ Location	Tropical																Temperate						
	W. Atlantic	E. Atlantic	W. Indian O.	Red Sea Gulf of Suez	Sri Lanka	NW. Aust.	G.B.R. & N.E. Aust.	Indonesia	Philippines	Tokara Is.	Palau Is.	Noumea	Gilbert Is.	Fiji	Mid Pacific	Hawaii	Japan	N.Z.	Aust.	Africa	Mediterranean	English Channel N. Sea	E. Pacific
D. listerianum	X	X				X	X	?		X				X	X	X	X	X	X	X	X	X	X
C. dellachiajei	X	X	X	X	X	X	X				X			X				X	X		X		X
H. momus	X	X	X	X	X	X	X	X	X		X			X	X		X		X	X			
T. savignii	X	X	X			X	X							X		?			X				
P. formosana	X	X	X				X			X	X			X			X						
T. discrepans	?							X	X		X		X	X									
D. psammatodes			X	X	X		X	X	X					X	X		X		X				
S. oceania			X		X	X	X				X	X		X									
P. recurvatum			X					X	?				?	X	?								
T. cerebriforme				X			X		X		X			X	X	X		X	X	X			
D. moseleyi				X		X	X	X	X	X	X	X		X					X				
C. areolata					X	X	X		X	X	X	X		X	X								
L. reticulatus						X	X	X						X			X		X				
D. granulatum						X	X			X	X			X		X			X				
E. digitata						X					X			X									
T. spiculatum						X								X					X				
E. arenacea						X		X						X									
E. digitata						X	X				X			X									
P. pedunculata							X	X				X		X					X				
B. tyreum							X	X	X		?			X			?		?				
M. exasperatus							X							X					X				
S. kuranui							X							X				X					
D. proliferum							X				?		?	X	?								

	Tropical																Temperate						
Species / Location	W. Atlantic	E. Atlantic	W. Indian O.	Red Sea Gulf of Suez	Sri Lanka	NW. Aust.	G.B.R. & N.E. Aust.	Indonesia	Philippines	Tokara Is.	Palau Is.	Noumea	Gilbert Is.	Fiji	Mid Pacific	Hawaii	Japan	N.Z.	Aust.	Africa	Mediterranean	English Channel N. Sea	E. Pacific
D. cuculliferum							X	X	X		X			X	X								
L. rufus							X	X	X					X									
E. pacificense							X							X			X						
P. sacciformis							?							X			X						
P. depressa							X							X			X						
A. depressum							X	X	X					X									
D. chartaceum							X	X						X									
R. proliferus							X			X				X									
E. nexa							X	X						X									
A. rhabdophora							X	X						X									
L. madara								X						X		X	X						
P. sundaicum								X	X	X	X		X	X									
D. digestum								X						X									
D. recurvatum								X						X									
A. melanostoma								X						X									
P. doboense								X						X									
D. albopunctatum								X						X									
L. ocellatus								X						X									
D. vallii									X					X			X						
E. rubra										X			X	X									
D. sphaericum											X			X	X								
E. rigida											X			X									
C. japonica												X		X			X						
P. aurea														X		X		X					

thin but leathery. There are two concentric circles of lobes that surround the apertures, the inner circle fringing the rim of the openings. There are spines on the outer surface of the inner lobes, and on the rough nodose lobes of the outer circle. The minute pointed spines on the aperture lobes are only 0.05 to 0.07 mm long.

The test is red or carmine deep between the lobes and in the inner lining of the siphons. The apertures are both on short siphons and are fairly close together.

Internal structure: The dorsal tubercle is at the base of the tentacles, to the right of and well removed from the anterior end of the dorsal lamina. The opening is fairly complicated and branched, the terminal end of each branch slightly coiled. The branchial tentacles are almost simple pinnate, secondary branches being small and tertiary branches minute. There are 7 overlapping branchial folds on the left and 6 on the right. The gut loop is narrow and curved, and there is a single gonad in the gut loop and in a corresponding position on the opposite side of the body. The gonads are broken up into a varied number of lobes along each side of the central duct.

Remarks: The horny curved spicules in the body (see Tokioka, 1967) were not observed in this specimen. The irregularity of the body helps to conceal it, despite the red colour in the anterior part of the test. Further collecting should demonstrate continuity between the widely separated locations from which the species has been reported.

Microcosmus exasperatus Heller, 1878

Fig. 34d

Microcosmus exasperatus Heller, 1878, p. 99, Tokioka, 1952, p. 130. Van Name, 1945, p. 346 (? and synonyms from Atlantic locations). Vasseur, 1967b, p. 142.

Microcosmus exasperatus typicus: Michaelsen, 1908, p., 272.

Microcosmus variegatus Heller, 1878, p. 100.

Microcosmus miniatus: Van Name, 1902, p. 396 and synonymy.

Microcosmus claudicans australis: Michaelsen and Hartmeyer, 1928, p. 402. Kott, 1952, p. 288.

Microcosmus australis: Millar, 1963, p. 741. Kott, 1966, p. 373; 1972d, p. 53; 1976, p. 85.

Distribution

New Records: Fiji — Viti Levu: LWM, Suva Barrier Reef, July 1979, QM G12701.

Previously Recorded: West-Indies — Heller, 1878; Traustedt, 1882; Michaelsen, 1908; Van Name, 1902. East Africa — Michaelsen, 1908. New Caledonia — Vasseur, 1967b. Formosa — Michaelsen, 1908. Northern Australia — Kott, 1952, 1966, 1972d; Tokioka, 1952. Western Port Bay (Victoria) — Kott, 1976.

Description

In addition to the newly recorded material, the following specimens from the West Indies have been examined: *M. exasperatus,* Kingston, Jamaica, QM GH154.

External appearance: The single specimen is juvenile, 5 mm in diameter, with a short conical terminal branchial siphon and subterminal atrial siphon. The body is almost spherical, brownish-purple, and smooth. The test is fairly thin but tough, with a pearly glistening internal lining.

Internal structure: The lining of the siphons has red stripes. Just inside the opening there are minute scales with median points, about 0.03 mm long. The branchial tentacles are branched, but not bushy. The dorsal tubercle has a simple U-shaped opening with the horns turned in. There are 7 branchial folds on the left and 6 on the right. The folds vary in width, and the widest has about 109 longitudinal vessels of variable thickness. The gut forms a long narrow loop around the ventral part of the left side. Gonads are not developed.

TABLE 2
Distribution of Plant-Bearing Didemnid Ascidians Occurring off Fiji

Species	Zanzibar 5°S	Malagasy 20°S	Red Sea 20°N	Sri Lanka 8°N	Indonesia 10°S	Darwin N. Australia 10°S	Cockburn Sd W. Australia 32°S	Great Barrier Reef 10 to 24°S	Mooloolaba S.E. Queensland 28°S	Borneo 0°	Philippines 10°N	Tokara Is. 30°N	Okinawa 26°N	Palau Is. 10°N	Eniwetok 10°N	Marshall Is. 10°N	Hawaii 20°N	Gilbert Is. 0°	Line Is. 0°	Fiji 20°S	Tonga 23°S
D. molle	X	X			X	X	X	X			X		X	X						X	
T. cyclops		X	X			X		X			X				X			X		X	
L. voeltzkowi		X						X												X	
L. bistratum			X		X	X		X	X			X		X						X	X
D. virens				X	X	X		X			X					X		X		X	
D. similis					X			X			X				X	X	X		X	X	
L. patellum					X		X	X		X				X						X	
T. clinides								X			X				X					X	
L. punctatum								X												X	
T. paracyclops								X												X	
T. nubilum								X			X									X	
T. strigosum											X									X	

Remarks: Although the number of branchial folds in this juvenile specimen is less than that recorded for this species, the pointed scale-like siphonal spines are identical with those present in specimens of *M. exasperatus* from the West Indies. These spines distinguish the species from the closely related *M. squamiger* (cup-shaped scales, 0.03 mm) and *M. australis* (longer narrow pointed spines, 0.05 mm) (see Kott and Goodbody, 1981).

Herdmania momus (Savigny, 1816)

Cynthia momus Savigny, 1816, p. 143.
Herdmania momus: Kott, 1972a, p. 41 and synonymy; 1972b, p. 189; 1976, p. 84.

Distribution

New Records: Small specimens of this species occur in cryptic habitats at all locations on the fringing reefs of Viti Levu.
Previously Recorded: This is probably the most commonly occurring ascidian species at all locations over a wide pan-tropical range in the Indian, the Pacific and the Atlantic Oceans. It occurs in the Red Sea, extends into temperate waters around the southern coasts of the Australian and the African continents. It occurs in most tropical Pacific locations including Hawaii.

Description

Small individuals of this species are almost spherical, with short siphons diverging from one another. The specimens are pink and translucent in life but become white in preservative. The barbed spines that occur in the test, the body wall and the branchial sac are characteristic and unique to this monotypic genus.

BIOGEOGRAPHY
Tables 1, 2

Apart from the three species presently recorded only from Fiji*, all but 6 of the species discussed above are also recorded from either the Philippines (20 species), Indonesia (28 species) or northern tropical Australia including the Great Barrier Reef (42 species), and many have been taken at more than one or at all of these locations. The records reflect the intensity of collecting at these locations, but also indicate that for ascidians, the region from Japan in the north to Torres Strait, along the length of the Great Barrier Reef and east to Fiji comprises the west-Pacific marine region. Half of the species extend into the Indian Ocean generally as far as the West Indian Ocean, and of these several also extend further east to Hawaii. This group of 17 species with an extended distribution in the Indo-west Pacific includes five species that are pantropical, occurring in the Atlantic as well as the Indian and Pacific Oceans. It is of interest that those species with the widest longitudinal range have also the widest latitudinal range and of the tropical species are the ones that are found to occur most often in temperate waters. Apart from endemic species, *Pseudodistoma aurea* recorded only from Fiji and the North Island of New Zealand has the most restricted range.

This pattern of distribution suggests that the capacity of the species to maintain gene flow over a wide geographic range affects the pattern of its distribution to a greater extent than environmental factors such as temperature and substrate.

Tokioka (1950, 1955, 1961, 1967) has recorded a total of 72 species from the central-west Pacific, 35 of which have not yet been recorded from Fiji. It should also

* *Eudistoma discederata* n. sp., *E. vitiata,* n. sp. and *Diplosoma multipapillata* Kott.

be noted that there are no representatives of the families Clavelinidae or Diazonidae and a few phlebobranch or stolidobranch species in the present collections from the reef flats. Undoubtedly further collecting at greater depths will disclose that many, if not all, of these species and many others also occur in Fiji. Probably the list of Fijian ascidians will eventually exceed 100 species.

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A Review of Early Carboniferous Stratigraphy and Correlations in the northern Tamworth Belt, New South Wales

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MORY, A. J. A review of Early Carboniferous stratigraphy and correlations in the *northern Tamworth Belt, New South Wales. Proc. Linn. Soc. N.S.W.* 105 (3). (1980) 1981: 213-236.

In reviewing the Early Carboniferous stratigraphy of the northern Tamworth Belt two stratigraphic units are amended. First, in the vicinity of Caroda, the Eungai Mudstone of McKelvey and White (1964) is regarded as a junior partial synonym of the Mandowa Mudstone with the rudite unit between, which they referred to as the Keepit Conglomerate, here recognized as the Kingsland Conglomerate Member (new name). Second, the Tangaratta Formation of White (1964a) is now included within the Goonoo Goonoo Mudstone of Crook (1961).

Correlations based on conodont faunas suggest the following modifications to the correlation offered by Jones and Roberts (1976) for the northern Tamworth Belt: (i) the Mandowa Mudstone ranges into the Carboniferous on the eastern limbs of the Werrie and Belvue Synclines, (ii) the break in sedimentation at the base of the Carboniferous (the Onus Creek Unconformity of White, 1964a) cannot be detected on the eastern limbs of the Werrie and Belvue Syclines, and (iii) the Luton and Namoi Formations have diachronous upper and lower contacts.

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INTRODUCTION

The Tamworth Belt (Harrington, 1974; Korsch, 1977), a NNW-trending structural unit on the western margin of the New England Fold Belt in northern New South Wales, contains rocks ranging in age from Cambrian to Permian (Leitch, 1974; Cawood, 1976). The belt is divided into two by Tertiary basalts forming the Liverpool Ranges and it is the Early Carboniferous succession in the northern half with which this paper is concerned (see Fig. 1).

The Early Carboniferous succession in the northern Tamworth Belt has been the subject of a number of papers since the 1850s; prior to the 1910s, however, this work was largely on fossil faunas from isolated localities with little mention of the relevant stratigraphy (e.g., W. B. Clarke, 1852-53; S. Stutchbury, 1853; L. G. de Koninck, 1876; E. F. Pittman, 1881; G. A. Stonier, 1871-95; R. Etheridge jun., 1887-1921; W. S. Dun, 1891-1920; and H. I. Jensen, 1907).

The first major survey of Carboniferous rocks in New England was that of W. N. Benson (1913-1920) as part of his study on the 'Great Serpentine Belt'. This survey was followed by those of S. W. Carey (1934, 1937) on the Werrie Basin and A. H. Voisey (1934-1942) on parts of the eastern half of the New England Fold Belt. Not until the 1950s did interest in the Carboniferous of the northern Tamworth Belt revive with the work of staff and students from the University of New England at Armidale, especially Engel, 1954; Williams, 1954; Voisey, 1958, 1959, 1964; Voisey and

Williams, 1964; Chappell, 1958, 1961a, 1961b; Crook, 1958; 1961, 1964; Manser, 1959, 1965, 1967, 1968; Campbell and Engel, 1963; Campbell, 1969; McKelvey and White, 1964; McKelvey, 1967, 1968, 1974; and White, 1964a, b, c, 1965, 1966. These investigations were largely lithostratigraphic in nature since most of the available palaeontological information was restricted to the western limbs of the Werrie and Belvue Synclines (Campbell and Engel, 1963; Campbell and McKellar, 1969; Jenkins, 1974; Roberts, 1975) giving little insight into along- and across-strike relationships of stratigraphic units.

This paper stems from a study of the Early Carboniferous conodont biostratigraphy of the northern Tamworth Belt (Mory, 1980), and unless otherwise stated, all conodonts mentioned herein from this region, have been recovered during that investigation. Further details of the conodont faunas are to be the subject of a number of joint papers on the Early Carboniferous conodont biostratigraphy of eastern Australia currently in preparation with Drs T. B. H. Jenkins and D. T. Crane. As Mory (1980) was primarily concerned with the time relations of the various Early Carboniferous lithostratigraphic units, the chronological aspect of these units is here emphasized. One unit, the Mandowa Mudstone (Chappell, 1961), was found to range in age across the Devonian/Carboniferous boundary and is thus a convenient starting point for a review of the Early Carboniferous stratigraphy of the northern Tamworth Belt.

MANDOWA MUDSTONE (Chappell, 1961)

Synonymy: ? Barraba Series, Benson, 1913a, p. 502.
? Barraba Mudstones, Benson, 1915b, p. 577; Voisey, 1958a, p. 209.
in part Manilla Group, Voisey and Williams, 1964, p. 67.
Mandowa Mudstone, Chappell, 1961b, p. 68; White, 1964a, b, c; Voisey, 1964; Manser, 1965; White, 1965; Moore and Roberts, 1976.
Mandowa Mudstone + Keepit Conglomerate + Eungai Mudstone, McKelvey and White, 1964; McKelvey, 1968.

Type Section: Whereas Chappell (1961b, p. 68) designated 'the provisional type section . . . on the western limb of the Klori Anticline immediately south of the Namoi River', he did not describe the nature of the upper boundary of the stratotype nor did he specify its position. Instead he indicated that the Kiah Limestone Member (= Borah Limestone Member herein) 'occurs within or slightly above the Mandowa Mudstone' in the type section. In view of the lenticular nature of the Borah Limestone and the difficulty of tracing a boundary within the poorly exposed associated mudstones at this level away from this section the definition of the type section of the Mandowa Mudstone here follows that of White (1964a, c) rather than Chappell (1961b). White (1964c) indicated that 'the provisional type section' extends approximately 1.5 km west of outcrop of the Borah Limestone Member to the base of the (?)Tulcumba Sandstone. As outcrop between the Borah Limestone and the (?)Tulcumba Sandstone is extremely poor a lectostratotype is desirable. Unfortunately, in the type area on the eastern limb of the Belvue Syncline outcrop is too poor to choose such a section; on the western limb a disconformity at the top of this unit, not detected to the east, makes the western sections similarly unsuitable. The nearest, well-exposed section known to the author through the Mandowa Mudstone is Slaty Gully near 'Burindi', 40 km to the north of Chappell's type section; as the Mandowa is there overlain by the Luton Formation, as opposed to the Tulcumba

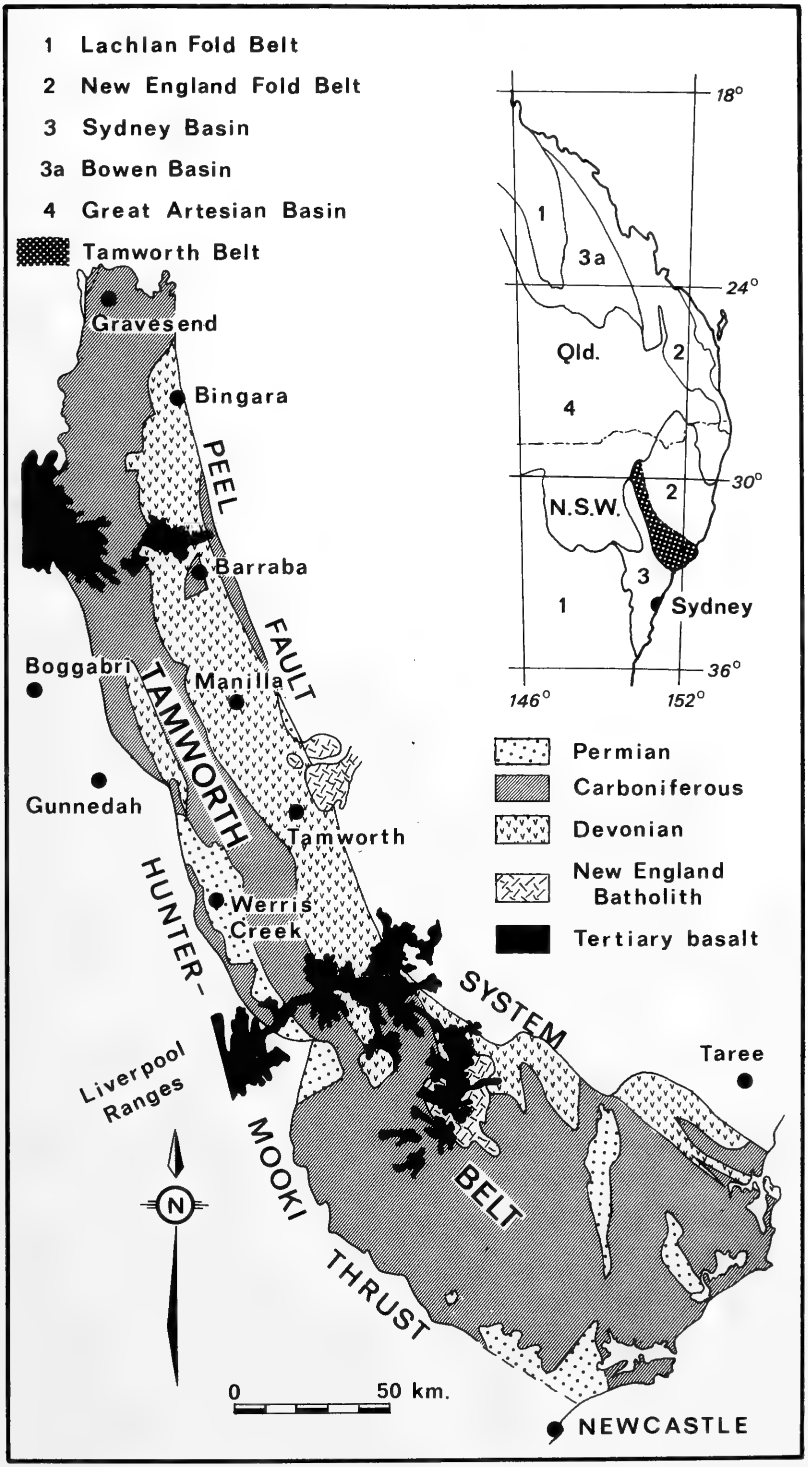

Fig. 1. Geological setting of the Tamworth Belt (after Pogson and Hitchins, 1973, Leitch, 1974).

Sandstone in the Namoi River section, the Slaty Gully section is here designated as a hypostratotype to supplement White's (1964a, c) type section.

Thickness: Approximately 650 m in the type section (White, 1964c) reaching a maximum thickness of over 900 m 85 km to the north near 'Luton'. Near Keepit Dam this unit reaches a maximum of nearly 300 m but in some sections the entire unit has been removed by erosion (Jenkins, 1969).

Lithologies: Massive mudstone beds up to 5 m thick alternating with thinly interbedded siltstones and mudstones which often contain minor sandstone bands generally less than 2 cm thick, and minor lithographic limestone and conglomerate.

Members: Two members within the Mandowa Mudstone are recognized herein; the Borah Limestone (Pickett, 1960) and the Kingsland Conglomerate, previously called the Keepit Conglomerate, in the vicinity of Caroda (McKelvey and White, 1964; McKelvey, 1968).

BORAH LIMESTONE MEMBER (Pickett, 1960)

Synonymy: Borah Limestone, Pickett, 1960, p. 237; Voisey and Williams, 1964; Voisey, 1964.
Kiah Limestone, Crook, 1961, p. 201; Chappell, 1961b, p. 68; White, 1964a, b, c; White, 1965; Manser, 1968.

Type Locality: On the south bank of Borah Creek at G.R. 489 089 (Tarpoly, 9036-IV-N, 2 inches/mile), on the eastern side of the 'Rangari'— Barraba road.

Thickness: 1 m at the type locality but may attain a thickness of up to 5 m.

Lithology: Blue/grey fine grained lithographic limestone often stylo-bedded and with ?authigenic feldspar crystals.

Although the Borah Limestone does not appear in every section of the Mandowa (and Goonoo Goonoo) Mudstones it is one of the most persistent units in the Tamworth Belt having been recognized as far south as 'Timor' near Murrurundi and as far north as 'Yagobie' near Gravesend, a distance of 260 km. The very fine-grained (lithographic) nature of the Borah Limestone, its lateral persistence, and its close association with the upper limit of *Leptophloem australe* (Crook, 1961; Gould, 1975), suggest that not only does it represent a long period of slow sedimentation but perhaps it may be considered as a close approximation to a time-rock unit. Within the Borah Limestone pseudomorphs after triclinic or monoclinic crystals of ?feldspar are locally abundant and have been interpreted as authigenic albite (White, 1965). The formation of authigenic feldspars has been reviewed recently by Kastner and Siever (1979); while these authors indicate that in carbonates albite is far more common than K-feldspar, the composition of the (?) feldspar in the Borah Limestone has not been determined.

Age: Pickett (1960) gave a Wocklumerian age for the limestone based on the supposed phylogenetic affinities of *Cymaclymenia borahensis* Pickett. Conodonts recovered by T. B. H. Jenkins from the Borah Limestone 5½ km north of 'Borah Vale' (at G. R. 423 195 Berrioye 8936-I-N, 2 inches/mile) include *Polygnathus communis communis* (2 specimens), *Bispathodus aculeatus aculeatus* (1) and

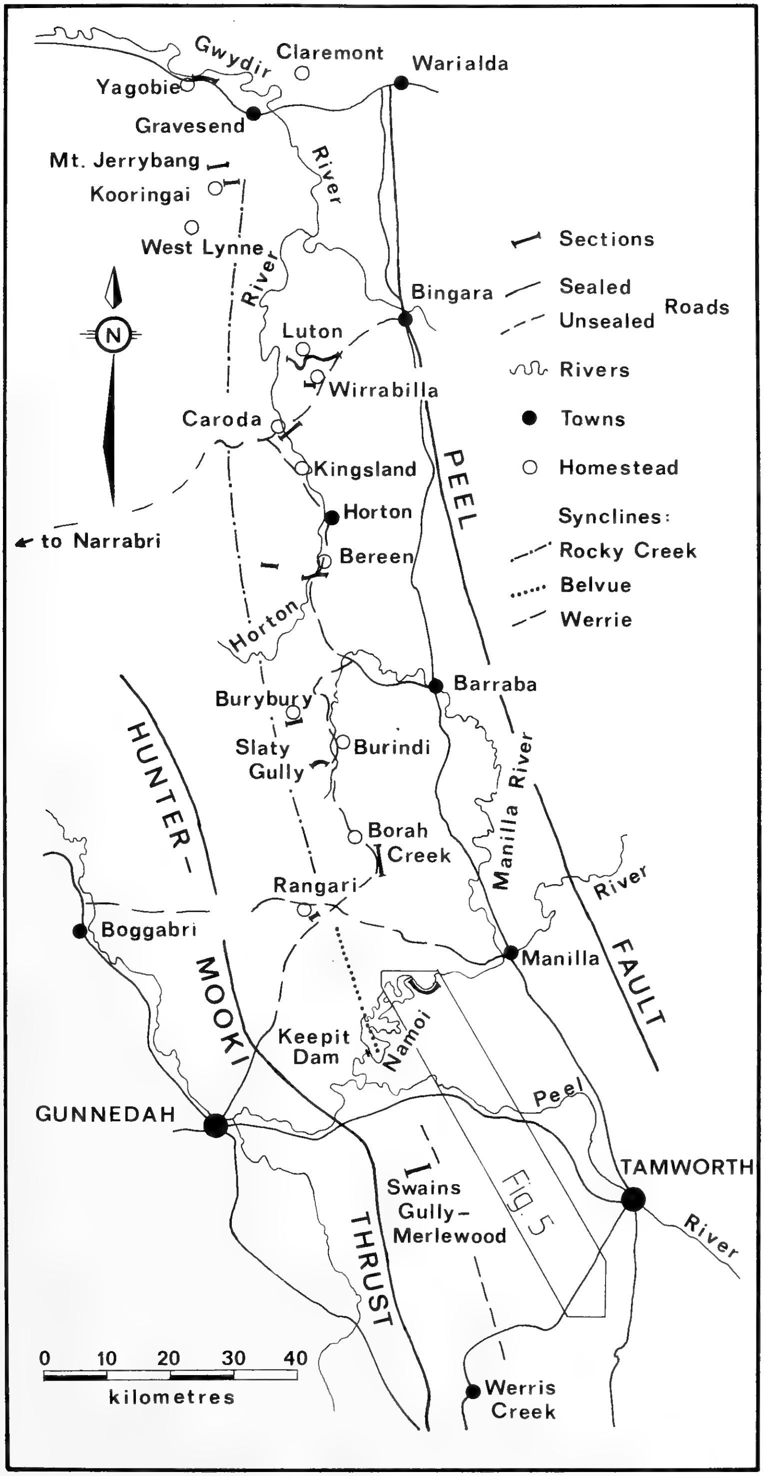

Fig. 2. Location of measured sections in the northern Tamworth Belt (to accompany Figs. 4 and 6).

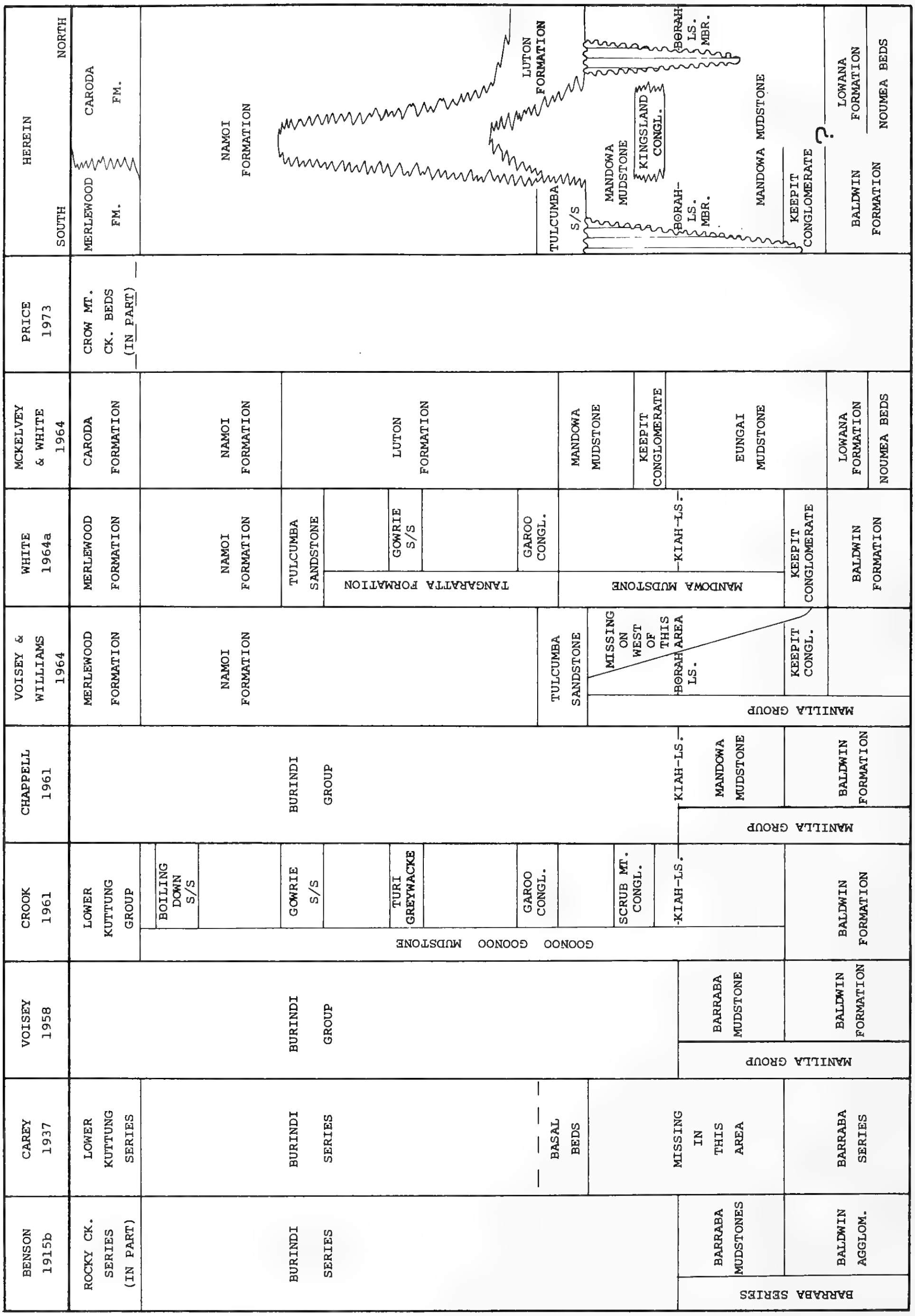

Fig. 3. Correlation of previous stratigraphic nomenclature.

Protognathodus meischneri (1). In the type section of the Mandowa Mudstone *Polygnathus vogesi* (2), and *Palmatolepis gracilis sigmoidalis* (4) were recovered 10 m above the limestone. These conodont species indicate an age within the *costatus* zone (or from the uppermost *Clymenia* Stufe into the *Wocklumeria* Stufe) for the Borah and thus support the age determination of Pickett (1960) based on a single new clymeniid species.

KINGSLAND CONGLOMERATE MEMBER (new name)

Synonymy: Keepit Conglomerate, McKelvey and White, 1964; Russell, 1979, 1980 (in part).

Derivation: After Kingsland Homestead 2 km north of the type section.

Type Section; Road cutting on the Upper Horton-Narrabri road at G.R. 345 766 Eulowrie, 8937-I-N, 2 inches/mile, 1 km NW of the bridge over Noogera Creek.

Thickness: 40 m in the type section, reaching 60 m near 'Wirrabilla', 10 km to the northeast.

Lithologies: Orthoconglomerate, sandstone, siltstone, mudstone and pebbly mudstone overlying massive mudstone with an abrupt or gradational lower contact. The upper contact is at the highest coarse sandstone, conglomerate or pebbly mudstone which is overlain conformably by thinly-bedded mudstones and siltstones with minor sandstone bands.

Age: Siphonodella duplicata, an early Tournaisian conodont species has been recovered from a limestone boulder 6.5 m below the top of this unit in the type section and also 30 m above its top at 'Wirrabilla' 10 km to the northeast. Fragments of *Siphonodella* sp. have also been recovered from a calcareous concretion 20 cm below this unit 3 km southwest of its type section on the southern side of the Horton road. The genus is restricted to the Carboniferous and its presence indicates that the erosional contact at the base of the Kingsland Conglomerate is not the result of a significant break in sedimentation.

Discussion: Previously this member had been identified as the Keepit Conglomerate (McKelvey and White, 1964; McKelvey, 1968) between 'Luton' and 'Bereen', presumably because of its stratigraphic position below a thick mudstone/siltstone sequence (the Mandowa Mudstone), itself below the Luton Formation. However the thick sequence of mudstone and siltstone below this member (the Eungai Mudstone of McKelvey and White, 1964) is not developed in the vicinity of Klori Trig, the type section of the Keepit Conglomerate; there the Keepit Conglomerate overlies strata dominated by argillites but also with arenites, greywackes and conglomerates (the Baldwin Formation). In view of the difficulty in distinguishing the Eungai Mudstone from the Mandowa Mudstone on lithological criteria, and the lack of outcrop of the Keepit Conglomerate between 'Burindi' and the vicinity of 'Kingsland' (a distance of 47 km), it is felt that it is necessary to place the Eungai Mudstone into synonymy with the Mandowa Mudstone and to rename the Carboniferous conglomerate.

Age and Faunas of the Mandowa Mudstone:

The age of the base of the Mandowa Mudstone has so far only been determined in two localities:

1. A thin conglomerate 6 km north of Keepit Dam has yielded the clymeniids

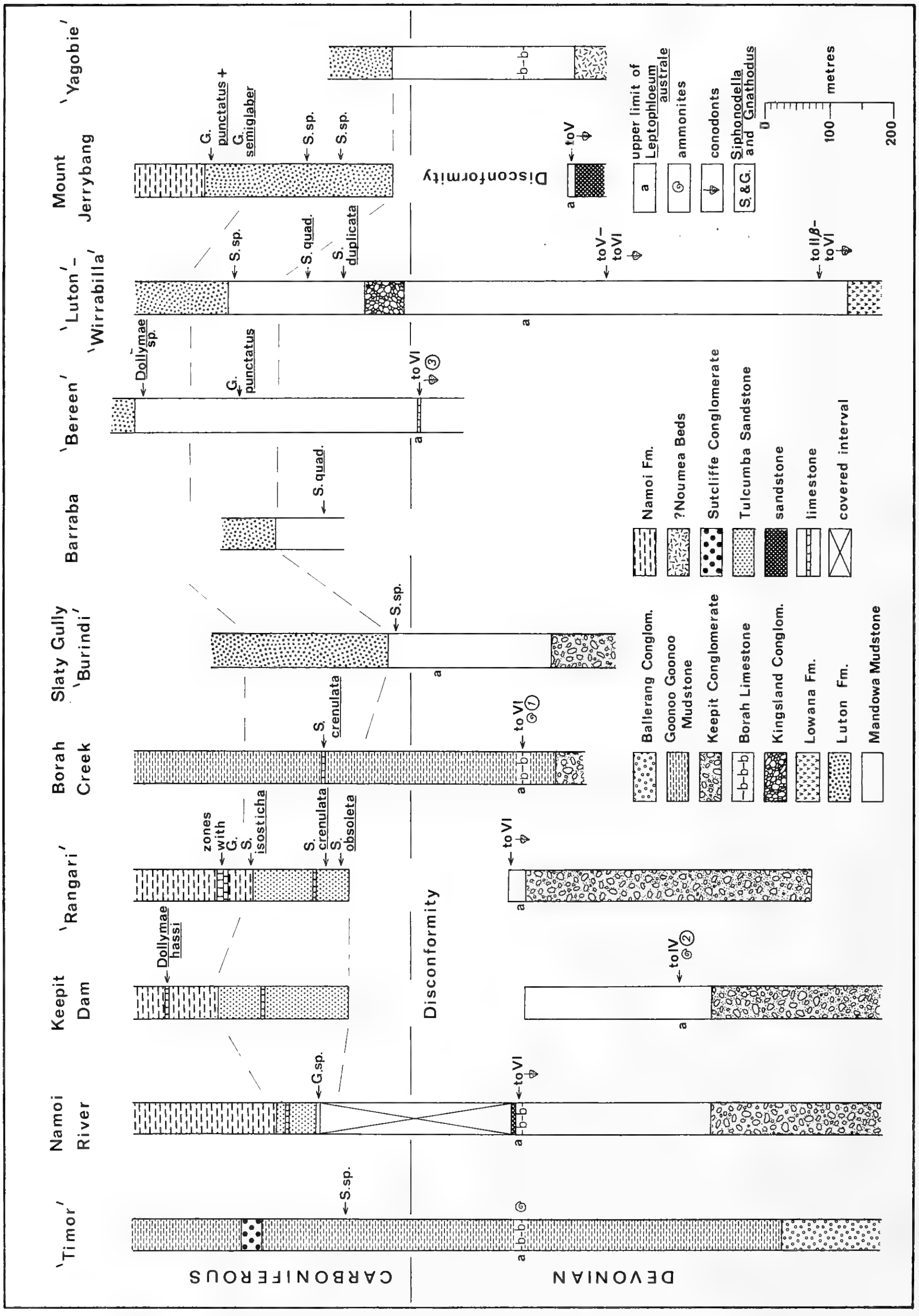

Fig. 4. Correlation of sections spanning the Devonian/Carboniferous boundary in the northern Tamworth Belt. The Timor section is situated 5 km north of the type section of the Goonoo Goonoo Mudstone. Ages indicated by circled numbers are from:
1. Pickett, 1960.
2. Jenkins, 1969.
3. Philip and Jackson, 1970.

?Rectoclymenia, Platyclymenia, and *Genuclymenia* indicating the *Platyclymenia* Stufe of the Famennian stage (toIV, Jenkins, 1969).
2. A decalcified concretion 3 m above the base of the Mandowa at Mount Jerrybang has yielded the conodonts *Polygnathus marginatus* or *praehassi* (1 specimen), *Palmatolepis ?perlobata helmsi* (10), *Palmatolepis gracilis sigmoidalis* (10) and *Drepanodus* sp. (6). This fauna indicates an age from the upper *styriacus* to lower *costatus* conodont zones, i.e. the *Clymenia* Stufe (toV).

In sections where the unit overlying the Mandowa Mudstone rests on a significant erosion surface the youngest faunas in the Mandowa are Famennian (Upper Devonian). In sections where the overlying unit shows a conformable relationship or a minor disconformity is present and the age of the top of the Mandowa can be determined it appears to fall in the Early Carboniferous (see Fig. 4). Unfortunately it is difficult to resolve just how diachronous the upper depositional limit of the Mandowa is, as very few localities yielded faunas from which precise ages can be determined. However at 'Luton' and Slaty Gully conodonts from the zones with *Siphonodella* (Tn1-Tn2) were recovered from this level whereas at 'Bereen' *Dollymae hassi* suggests the presence of the zones with *Gnathodus* (Tn3) at this level.

An important fossil in the Mandowa Mudstone (and its partial correlative, the Goonoo Goonoo Mudstone) is the lycopod *Leptophloem australe.* This fossil is considered not to range to beyond the Devonian in sediments in the New England Fold Belt (Gould, 1975). The few conodont occurrences associated with the lycopod and stratigraphically higher (summarized in Fig. 4), are in agreement with this age limit.

General and Historical Comments:

Between the Peel River and 'Burindi' the Mandowa Mudstone conformably overlies the Keepit Conglomerate. North of 'Bereen' Gap it conformably overlies the Lowana Formation and between Mount Jerrybang and 'Yagobie' the ?Noumea beds (see Fig. 4). Units overlying the Mandowa Mudstone may show a conformable or disconformable relationship. Between 'Merlewood' and 'Rangari' the Tulcumba Sandstone shows a persistently disconformable relationship with the underlying units; in some places the Mandowa Mudstone is missing entirely presumably due to erosion (Jenkins, 1969; White, 1964a, b, c). White (1964a, p. 212) called this break in sedimentation the Onus Creek Unconformity after the creek section of that name south of the Peel River on the eastern limb of the Werrie Syncline; remapping of that area (see Fig. 5), however, suggests that a break in sedimentation can only be recognized on the western limb of the syncline.

At Mount Jerrybang the Mandowa Mudstone, here only 10 m thick, is abruptly overlain by coarse sands of the Carboniferous Luton Formation. The age of the base of the Mandowa Mudstone at this locality (toV) and the disconformable nature of the contact with the overlying Luton show similarities with the Tulcumba/Mandowa contact between Swains Gully and 'Rangari'. These similarities suggest that the break in sedimentation is a continuous feature on the western limb of the Rocky Creek Syncline from 'Rangari' to Mount Jerrybang in spite of the lack of outcrop of rocks of this age between the latter two sections. In all other sections (on the eastern limbs of the Rocky Creek, Belvue and Werrie Synclines) the overlying Tulcumba Sandstone or Luton Formation rests conformably on the Mandowa Mudstone.

W. N. Benson (1913a, p. 502), who first mapped the Devonian and Carboni-

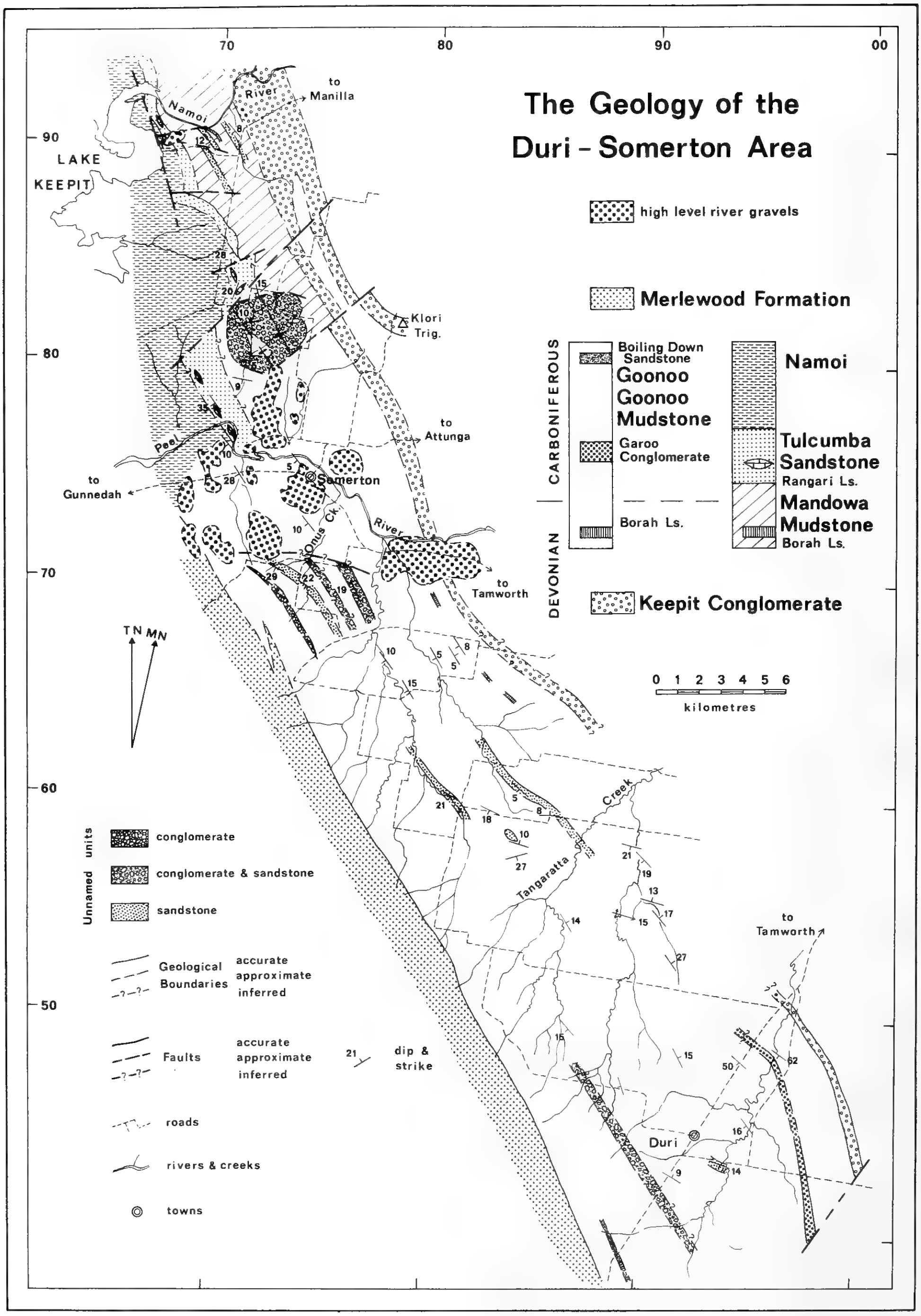

Fig. 5. Geology of the Duri-Somerton area.

ferous rocks north of the Liverpool Ranges, initially used the name Barraba Series to describe the sequence of 'banded shales and mudstones . . . Interbedded with . . . acid or intermediate tuff, . . . conglomerate, . . . tuffaceous agglomerate . . . and lenticles of blue argillaceous limestone'. He later (Benson, 1915b) used the term Barraba Mudstones interchangeably with Barraba Beds and Barraba Shales to mean the same as the Barraba Series of Benson (1913a). As no type section was specified for the Barraba Mudstones it is impossible to determine exactly how this unit correlates with modern subdivisions of the sequence.

Chappell (1961b, p. 68) proposed the Mandowa Mudstone to replace the Barraba Mudstones due to the number of meanings this term has assumed in the past'. However, he did not describe the nature of the upper contact in his type section implying that this boundary was recognized using the criteria employed since Benson (1913a) first defined the Barraba Series. Benson (1913a, p. 502) had said 'Indeed the distinction between the Barraba Series and the [overlying] Burindi Series, lies largely in the absence of *L. australe* (and radiolaria) from the latter'. He later (Benson, 1917a, p. 269) said *'It may be, therefore, that the true base of the Carboniferous System lies at some unrecognisable horizon in the Barraba mudstone. For the purpose of mapping, however, the base of the Burindi beds is the lowest recognisable horizon in the Carboniferous that can be traced'.* These statements suggest that the Barraba/Burindi contact was recognized at different stratigraphic levels in different areas and that the distinction between the two was often palaeontological rather than lithological. For the latter reason Crook (1961) working south of Tamworth grouped the Barraba Mudstones and Burindi Series into one unit, the Goonoo Goonoo Mudstone. As a general rule however the Devonian of the Mandowa Mudstone may be lithologically distinguished from the Carboniferous; the former is characterized by flaggy, thin bedded dark mudstones, siltstones and sandstones whereas the latter possesses massive mudstones and siltstones typically with little sandstone.

GOONOO GOONOO MUDSTONE (Crook, 1961)

Synonymy: Burindi Series + ? Barraba Series, Benson, 1913a, p. 502-3.
? Nundle Series, Benson, 1913b, p. 581; Benson, 1918a, p. 340.
Burindi Series + ? Barraba Mudstones, Benson, 1915b, p. 577; Carey, 1937.
Goonoo Goonoo Mudstone, Crook, 1961, p. 197; Roberts and Oversby, 1974, p. 10.
Namoi Formation + Tulcumba Sandstone + Tangaratta Formation + Mandowa Mudstone, (south of the Peel River on the eastern limb of the Werrie Syncline only), White, 1964a, b, c.
Licount Mudstone + Sutcliffe Conglomerate + Glenlawn Mudstone + Dancing Dicks Conglomerate + Martindale Mudstone, Manser, 1968.

Type Section: Timor Creek and its tributaries from G. R. 184 882 down to Timor Creek and then downstream to the junction with Deep Creek, up Deep Creek to G.R. 133 859 — Isis River, 9137-IV-N, 1:25,000, (Crook, 1961; modified after Manser, 1968).

Thickness: Approximately 2,000 m in the type section (estimate from Manser, 1968).

Lithologies: Olive-green to olive-brown mudstones, frequently with silty bands and small argillaceous limestone lenses; numerous labile arenite and conglomerate units, and one thin bed of lithographic limestone are contained within the mudstones (Crook, 1961, pp. 196-7).

Members: Crook (1961) recognized a number of 'sheet-like but ultimately lenticular' arenite and conglomerate members. In the western region of the area he mapped north of the Liverpool Ranges six members were recognized: the Kiah Limestone (= Borah Limestone herein), Scrub Mountain Conglomerate, Garoo Conglomerate, Turi Greywacke, Gowrie Sandstone and Boiling Down Sandstone (in ascending order). The eastern region is not discussed herein.

Manser (1968) subdivided the type section of the Goonoo Goonoo Mudstone into five formations based on the presence of two conglomerate horizons within the mudstone/siltstone sequence. Since both conglomerates are lenticular and sections exist with no lithological change between mudstone units, doubt as to the validity of the Martindale, Glenlawn and Licount Mudstones was expressed by Roberts and Oversby (1974, p. 11). It is suggested here that these names be regarded as junior partial synonyms of the Goonoo Goonoo Mudstone. The names of the two conglomerate units, the Dancing Dicks and Sutcliffe Conglomerates could, however. be retained for members within the Goonoo Goonoo Mudstone.

Discussion: White (1964a, b, c) in an adjacent area to the north of Crook (1961) recognized the Garoo Conglomerate Member and the Gowrie Sandstone Member of Crook (1961) but placed them within the Tangaratta Formation. In view of the exceptionally poor outcrop in Tangaratta Creek, the provisional type section of this unit (5 m of outcrop over the 6.5 km shown as Tangaratta Formation by White, 1964a, b) a lectostratotype needs to be selected. However, due to the sparse and impersistent nature of outcrop within the entire area shown as Tangaratta Formation by White (1964a, b, c) an accurate determination of the lithological character of this unit cannot be achieved, nor can lateral continuity of members be demonstrated (see Fig. 5). Thus the Tangaratta Formation should be regarded as a junior partial synonym of the Goonoo Goonoo Mudstone.

White (1966, pp. 212-3) also referred to the Tangaratta Formation a sequence of mudstones with three thin conglomerate, pebbly mudstone and sandstone members with erosional basal contacts 6 km northeast of 'Rangari' in Conglomerate Creek, a tributary of Rangira Creek. However, as the stratigraphically lowest conglomerate member lenses out 7 km to the north near 'Borah Vale' (Ian Wakely, 1978, pers. comm.) and the underlying mudstones cannot be distinguished from those above, this section is tentatively referred to the Goonoo Goonoo Mudstone. North of 'Borah Vale' the middle conglomerate has been traced along strike to the base of the Caroda Formation (Ian Wakely, 1978, pers. comm.). The overlying, poorly-exposed, mudstones are here thought to be time equivalents of the lower part of the Caroda Formation.

Age: Within the Goonoo Goonoo Mudstone fossils are rare except at the top of the unit in the Winton Limestone Member (White, 1964a). Conodonts from this limestone belong to the *S. anchoralis* Zone indicating a horizon high in the Tournaisian. The base of the Goonoo Goonoo Mudstone is latest Devonian based on the faunas of the included Borah Limestone.

Conodonts recovered from the base of the sandstone ridge on Priors Hill (G. R. 550 735 Winton, 9035-IV-N, 2 inches/mile) (shown as Garoo Conglomerate at the base of the Tangaratta Formation by White, 1964a, b) include *Gnathodus punctatus* and *Siphonodella* sp. This fauna indicates that this level is at least partly equivalent to the Tulcumba Sandstone at 'Carrol Gap' and 'Rangari' and the base of the Luton Formation in its type section (see Fig. 3). Further work is necessary to determine whether the Goonoo Goonoo Mudstone between 'Rangari' and 'Borah Vale' (best exposed in Conglomerate Creek) ranges into the Visean.

TULCUMBA SANDSTONE (Voisey and Williams, 1964)

Synonymy: Burindi Series, (in part), Lloyd, 1933, p. 31.
Basal beds of the Burindi series, Carey, 1937.
Tulcumba Sandstone, Campbell and Engel, 1963; Voisey and Williams, 1964, p. 68; White, 1964a, b, c (in part); Voisey, 1964, Manser, 1965; Jenkins, 1969; Roberts, 1975; Moore and Roberts, 1976.

Type Section: Swains Gully near 31°01.5′ S 150°28.5′ E, designated by Voisey and Williams (1964).

Thickness: 230 m in the type section thinning to 140 m at 'Rangari'. Overlying the type section of the Mandowa Mudstone is a unit consisting of approximately 60 m of thinly bedded siltstone with rare sandstone and limestone, questionably assigned to the Tulcumba Sandstone (see Fig. 5).

Lithologies: Coarse, cross-stratified feldspathic sandstones, siltstones, conglomerates, dark blue marly mudstones, tuffs and oolitic limestones (Voisey and Williams, 1964, p. 68).

Member: Rangari Limestone (Voisey and Williams, 1964).

Synonymy: Rangari Limestone Member, Campbell and Engel, 1963; Voisey and Williams, 1964, p. 68; White, 1964a, c; Voisey, 1964; Manser, 1965; Jenkins, 1969 (in part); Moore and Roberts, 1976.

Type Locality: Beside the Manilla-Boggabri road 1.7 km east of 'Rangari' at 30°40.3′ S 150° 23.3′ E, designated by Voisey and Williams (1964).

Thickness: 5 m in the type locality thinning southwards, not reaching the type section of the Tulcumba Sandstone in Swains Gully.

Lithologies: Oolitic limestone with minor bioclastic (crinoidal) limestone and limestone conglomerate.

Age: The conodonts *Siphonodella crenulata* and *S.* sp. cf. *S. isosticha* recovered from the Rangari at 'Carrol Gap' (by G. M. Philip, pers. comm.) indicate a mid-Tournaisian age.

General Comments:

The Tulcumba Sandstone crops out on the western limbs of the Werrie and Belvue Synclines over a distance of 58 km from south of 'Merlewood' north to 'Rangari'. It can also be questionably identified to the east of the synclinal axes over a distance of 13 km at and between the Namoi and Peel Rivers (see Fig. 5). On the western limbs the Tulcumba disconformably overlies Devonian units while to the east the ?Tulcumba Sandstone conformably overlies the Mandowa Mudstone (see Fig. 4).

Age: The basal Carboniferous age of the Tulcumba Sandstone was first established by Campbell and Engel (1963) who not only recognized Carboniferous fossils in this unit but also the Devonian lycopod *Leptophloem australe* in the underlying unit.

Brachiopods from the Rangari Limestone and the base of the overlying Namoi Formation at 'Rangari' have been assigned to the *Spirifer sol* and *Schellwienella* cf. *burlingtonensis* Zones respectively and assigned a mid-Tournaisian age (Roberts, 1975). Conodont evidence is in agreement with such an age determination.

Luton Formation (McKelvey and White, 1964)

Synonymy: ?Barraba Series (in part), Benson, 1913a, pl. XX.
?Barraba Mudstones (in part), Benson, 1917b, pl. XIX.
Luton Formation, McKelvey and White, 1964; White, 1965 (in part); McKelvey, 1968.

Type Section: Extends from a point southeast of 'Luton' at G.R. 232 164 (base) (Bangheet, 1:100,000 Geol. Series) northwest to Dry Creek, then downstream to the junction with Pallal Creek and then downstream to the Pallal — Bingara road at G.R. 214 177 (top), (McKelvey and White, 1964; McKelvey, 1968).

Thickness: 560 m in the type section thinning southwards to 340 m near 'Bereen', > 340 m at Slaty Gully, 'Burindi' and 220 m to the northwest at Mount Jerrybang.

Lithologies: Calcareous or arkosic sandstones and siltstones interbedded with thick mudstone sequences, rare limestone and conglomerate (McKelvey and White, 1964).

Discussion: The Luton Formation generally rests conformably on the underlying Mandowa Mudstone; an exception to this rule is the section exposed at Mount Jerrybang (see Fig. 4). The upper contact of the Luton Formation is conformable with the overlying Namoi Formation.

While the Luton Formation encompasses a wide variety of lithologies it is distinguished in the field primarily by the presence of relatively thick sandstone beds which are rare in the underlying Mandowa Mudstone and the overlying Namoi Formation. As most sandstone beds within the Luton are generally less than 6 m thick and as no sequence of beds or single sandstone bed can be recognized in more than one section it seems that the majority of sandstone beds are lenticular. Unfortunately even the thickest sandstone beds are difficult to trace for any great distance due to paucity of outcrop. In short sections with very few sandstone beds it can be difficult, if not impossible, to decide which of the early Carboniferous stratigraphic units is represented.

Near 'Bereen' the Luton Formation is defined by calcareous sandstones at the base and a conglomerate at its upper limit (Hill, 1973). The conglomerate lenses out to the north and two sections west of 'Bereen' are known thereabouts in which no coarse lithologies are present to distinguish the upper limit of the Luton. However sandstone and conglomerate beds north and south of these sections approximately define the position of the Luton/Namoi contact.

Five km south of 'Bereen' a submarine channel approximately 100 m deep and at least 0.6 km wide cuts through mudstones of the Luton Formation (Crook and Powell, 1976). The channel is filled with rhythmically-bedded feldspathic sandstones, siltstones, mudstones and has conglomerate at the base.

Variation in the Luton Formation is such that the only sections to show overall similarities to the type section are those between the Elcombe and Peel Faults south from Warialda (McKelvey, 1967). In those sections thick homogeneous coarse sandstones often with erosive lower contacts (proximal turbidites) are not uncommon but are usually less than 3 m thick with mudstone and siltstone dominating to the extent that coarser lithologies are often excluded in sections up to 100 m thick. Since sandstone beds which characterize the Luton Formation are lenticular and often rare it could be expected that both the upper and lower contacts of the Luton Formation are somewhat diachronous. The variation in lithology between sections assigned to the Luton, and the distance between well-exposed sections (up to 30 km), between which outcrop is minimal, are such that some doubt exists as to the validity of this formation as a mappable unit away from the type area.

Age: Campbell and McKellar (1969) reported the early Tournaisian *Tulcumbella tenuistriata* Zone from the Luton Formation. Subsequently Roberts (1975) gave the location of the fauna as the base of the Luton Formation in the type section. Roberts (1975) also reported brachiopods from the Luton Formation at Mount Jerrybang showing an affinity with the late Tournaisian *Schellwienella* cf. *burlingtonensis* Zone. To date no other macrofaunal localities within the Luton have been described.

Below the type section of the Luton Formation fragments of *Siphonodella* sp. have been recovered at the top of the Mandowa Mudstone whereas to the south at 'Bereen', *Dollymae* sp. has been recovered 14 m below the Luton (see Fig. 4). This genus has previously been reported only from Tournaisian conodont zones younger than those with *Siphonodella*. Where conodonts have been recovered elsewhere, it appears that the base of the Luton is Carboniferous although faunas are sparse and cannot be assigned to specific zones.

In the type section *Dollymae hassi* has been recovered 50 m below the top of the Luton Formation. This species has a short range in Belgium but as associated gnathodids in N.S.W. are rare, it cannot here be confidently assigned to a narrower range than the *Gnathodus punctatus, G. semiglaber* and *G.* sp. *A.* Zones of Jenkins (1974). A fauna from the *anchoralis* Zone occurs at the top of the Luton Formation near 'Claremont' 10 km NE of Gravesend, whereas at Mount Jerrybang 10 km SSW of Gravesend conodonts from limestone blocks in a conglomerate close to the top of the Luton have yielded a fauna from the *G. semiglaber* Zone.

NAMOI FORMATION (Voisey and Williams, 1964)

Synonymy: Burindi Series (in part), Benson, 1913-1920; Lloyd, 1933, p. 91; Carey, 1937.
Lower Burindi Series (in part), Carey and Browne, 1938.
Burindi Group (in part), Voisey, 1958; Chappell, 1961.
Namoi Formation, Campbell and Engel, 1963; Voisey and Williams, 1964, pp. 69-70; McKelvey and White, 1964; Voisey, 1964; White, 1965; Manser, 1965; McKelvey, 1968; Roberts, 1975; Moore and Roberts, 1976.
Namoi Formation (= Goonoo Goonoo Mudstone south of Peel River on east limb of Werrie Syncline), White, 1964a, b, c.

Type Section: Swains Gully from 30° 02.2′ S 150° 33.6′ E (base) to 30° 02.3′ S 150° 34.5′ E (top) (designated by Voisey and Williams, 1964). Benson (1917a, p. 265) gave the 'type locality' of the Burindi 'Mudstones' as 'near Portion 106, Parish of Burindi'. This locality (near the upper limit of Hellholes Creek west of 'Burindi') corresponds to the upper part of the Namoi Formation but is cut by a major NNW trending fault (White, 1965).

Thickness: 690 m in the type section (Voisey and Williams, 1964), approximately 500 m on the west side of the Belvue Syncline near Keepit Dam. Due to structural complications the thickness of the Namoi can be determined only approximately north

of Keepit. In Slaty Gully near Caroda the Namoi is more than 1000 m thick while near Mount Jerrybang it is approximately 1,200 m thick.
Lithologies: Olive-green to olive-brown siltstones and mudstones with rare sandstones, limestones, conglomerate and pebbly sandstone.

Member: Pallal Conglomerate (McKelvey, 1968).
Synonymy: Pallal Conglomerate Member, McKelvey, 1968.
Type Section: No section was specifically designated as the type by McKelvey (1968) but he mentions only one section near 'Pallal' (at G.R. 203 164 Bangheet, 1:100,000 Geol. Series) which is here taken to be the type section.
Thickness: Up to 66 m.
Lithologies: Cross-bedded coarse sandstone, lensoidal conglomerate and siltstone.
Age: An age has not yet been determined from within this unit but its stratigraphic position, approximately 300 m below a fauna with *Polygnathus bischoffi* and well above a fauna with *Dollymae hassi,* suggests assignment to the *anchoralis* Zone.

General Comments:

The Namoi Formation is the most persistently outcropping unit in the Tamworth Belt. It can be recognized from 'Royston' south of Swains Gully to Gravesend, a distance of 180 km. The Namoi has a conformable contact with the underlying Tulcumba Sandstone between 'Royston' and 'Rangari' and with the Luton Formation north from 'Burindi'. Between 'Rangari' and 'Burindi' the Namoi Formation cannot be lithologically distinguished from older mudstones and siltstones.

The upper contact of the Namoi with the Merlewood and Caroda Formations varies from gradational to erosional. Erosional contacts have been reported from the western limb of the Werrie Syncline south of 'Merlewood' (Moore and Roberts, 1976) and the eastern limb (Crook *in* Campbell, 1969). West of 'Burindi' several sections offering good exposure of this boundary show a variation from gradational to abrupt contacts and suggest that the erosional contacts cannot represent major breaks in sedimentation.

Generally the Namoi Formation consists of a monotonous sequence of olive-green to olive-brown fossiliferous and unfossiliferous fine siltstones and mudstones with minor sandstone beds. However, unnamed coarse polymictic orthoconglomerates with well-rounded pebbles cut through these fine-grained sediments in a number of sections. These conglomerates are lenticular and are restricted in distribution to small areas near 'Rangari' and the type section; away from these areas conglomerate is rarely found in this unit.

Age: Roberts (1975, p. 8) designated the Swains Gully Section as the reference section of the *Spirifer sol* and *Schellwienella* cf. *burlingtonensis* brachiopod Zones. He thus assigns a mid to late Tournaisian age to the Namoi Formation. Conodont evidence for the age of the top of the underlying formations and the base of the Namoi Formation has been discussed previously (see Luton Formation and Tulcumba Sandstone herein).

At the top of the Namoi Formation conodonts from the *S. anchoralis* Zone have been recovered in the type area. Near 'Burybury' (west of Barraba) *Doliognathus latus* and *Gnathodus* sp. nov. (characterized by a parapet on the inner side ornamented with transverse ridges and a smooth outer platform) has been recovered at this level 100 m above a fauna typical of the *S. anchoralis* Zone. This fauna is younger than those with *S. anchoralis* but as it is not present in either the type Tournaisian or the type Visean in Belgium it is difficult to assign this fauna to either series. Further north near 'Luton' *Polygnathus bischoffi* and *Patrognathus* sp. have been recovered near the top of the Namoi while near Mount Jerrybang *P. bischoffi* occurs with *Mestognathus beckmanni* suggesting an early Visean age.

MERLEWOOD FORMATION (Voisey and Williams, 1964)

Synonymy: Kuttung Series (in part I), Benson, Dun and Browne, 1920.
Lower Kuttung Series, Carey, 1937.
Lower Kuttung Group, Crook, 1961.
Merlewood Formation, Voisey and Williams, 1964, p. 70; White, 1964a; Voisey, 1964; Manser, 1965; Roberts, 1975; Moore and Roberts, 1976.

Type Section: Voisey and Williams (1964) designated the Merlewood section of Carey (1937, p. 351) as the type. This section runs almost east-west close to the junction of Portions 9 and 61, Parish of Babinboon in an unnamed tributary of Swains Gully immediately north of 'Merlewood' at 31°3′ S, 150°34.5′ E.

Thickness: 1,300 m in the type section:

Lithologies: Coarse, pink to buff lithic sandstone, commonly cross stratified with scour and fill structures, lensoidal polymictic conglomerate, magnetite sandstone, silty mudstone and pyroxene andesite flows.

Members: Voisey and Williams (1964, pp. 70-71) named six members within the Merlewood Formation. These had all been previously recognized by Carey (1937) who described them using informal names. Of these members the Hill 60 Member is the only one which has received subsequent recognition. That member has since been incorporated into the Kyndalyn Mudstone Member (Moore and Roberts, 1976).

KYNDALYN MUDSTONE MEMBER (Moore and Roberts, 1976)

Synonymy: Oolitic grits and conglomerates, Carey, 1937.
Hill 60 Member, Voisey and Williams, 1964; White, 1964b; Roberts, 1975.
Kyndalyn Mudstone Member, Moore and Roberts, 1976.

Type Section: Donnellys Springs Creek from G.R. 591 594 to G.R. 595 595 (Winton, 9035-IV-N, 2 inches/mile) (Moore and Roberts, 1976).

Thickness: 170 m in the type section, thinning away from this section.

Lithologies: Interbedded mudstone, siltstone and minor lithic sandstone in the type section with oolitic limestone, oolitic limestone conglomerate and polymictic conglomerate also present away from the type section (Moore and Roberts, 1976).

The Merlewood Formation has been recognized in the Belvue Syncline 40 km north of the type section and southwards as far as the northern edge of the Liverpool Ranges

75 km to the south. This formation generally has a gradational lower contact but a local erosional contact with the Goonoo Goonoo Mudstone has been reported by Crook (*in* Campbell, 1969) and with the Namoi Formation by Moore and Roberts (1976).

The Coepolly Conglomerate, Voisey and Williams (1964), abruptly overlies the Merlewood Formation. Jones *et al.* (1973) show a break in sedimentation at this level based on the correlation of the Coepolly Conglomerate with the Spion Kop Conglomerate (McKelvey and White, 1964).

Age: Marine fossils have so far been found only in the Kyndalyn Mudstone Member. Based on the occurrence of brachiopods from the *Gigantoproductus tenuirugosus* Subzone of the *Delepinea aspinosa* Zone of Roberts (1975), Jones and Roberts (1976) assigned a middle Late Visean (V3b) age to this level. Only two conodont species have been recovered from this unit (*Patrognathus* sp. and *Rhachistognathus* cf. *muricatus*). Although both species are present in oolitic limestones in the Caroda Formation to the north the ranges of these species are not sufficiently well established to suggest a correlation between the fossiliferous layers based on conodont evidence.

CARODA FORMATION (McKelvey and White, 1964)

Synonymy: Rocky Creek Series (in part), Benson, 1913-1917.
Caroda Formation, McKelvey and White, 1964; White, 1965; McKelvey, 1967; McKelvey, 1968.

Type Section: No location for the type section has been published. The name derives from Caroda Post Office west of Bingara, and the sections in that vicinity are meant to make up the type (McKelvey, 1967). While the section (east and west from the bridge over the Horton River) is folded and faulted, it is possible to put together a composite section due to the repetition of a persistent oolitic limestone horizon.

Thickness: About 650 m around Caroda Post Office, appears to maintain this thickness along strike although most sections are structurally complex. On the western limb of the Rocky Creek Syncline a complete section 320 m thick is found in the vicinity of 'West Lynne'.

Lithologies: Cross-bedded sandstones, lenticular orthoconglomerates with minor cross-bedded oolitic limestone and calcareous and magnetite sandstones.

Comments: The Caroda Formation crops out over a distance of 120 km from 5 km north of 'Rangari' to Gravesend. It is lithologically very similar to, and appears to be an approximate time-equivalent of the Merlewood Formation. The Caroda Formation conformably overlies the Namoi Formation, although often abruptly, and is disconformably overlain by the Spion Kop Conglomerate (White, 1965). The Caroda Formation contains paralic and terrestrial sandstone and conglomerate at the base overlain by marine sediments, chiefly sandstone and limestone, which are in turn abruptly overlain by fluvial sandstone, conglomerate and shale. Locally thin dirty coal seams and purple shales (up to 3 m thick) are developed in the uppermost and lowermost parts of the Caroda.

Age: Roberts (1975) indicates that at least part of the Caroda Formation lies within the *Gigantoproductus tenuirugosus* Subzone of the *Delepinea aspinosa* Zone (as does the Kyndalyn Mudstone Member). The location of the fossils used for this age determination is most probably the oolitic limestone next to the bridge over the Horton River near Caroda Post Office. Roberts correlates this zone with the middle portion of the upper Visean of Belgium (i.e. V3b). Conodonts recovered from this level include *Mestognathus bipluti, Gnathodus girtyi collinsoni* and *Cavusgnathus* sp. and suggest a Late Visean (V3c) age.

CROW MOUNTAIN CREEK BEDS (Price, 1973)

Synonymy: Burindi Series (in part), Benson, 1913-1917.
Burindi Group (in part), Voisey, 1958; Chappell, 1961.
Crow Mountain Creek Beds, Price, 1973, p. 204.

Type Section: A type section has not been designated due to relatively intense deformation although a representative section through the unit was described at Crow Mountain Creek (Price, 1973, p. 205).

Thickness: A thickness cannot be determined for this unit due to the intense deformation.

Lithologies: Basal massive mudstones with conglomerate, sandstone, siltstone and limestone; in the upper part, sandstone, conglomerate, siliceous mudstone and pyroclastics.

Comments: This unit has been subdivided into two units by Simandjuntak (1977). The basal unit has marine fossils and conglomerate with a volcanic clastic assemblage. The upper unit appears to be non-marine with conglomerates containing abundant clasts of radiolarian jasper derived from the Woolomin beds to the east (Price, 1973). Although Simandjuntak's two units appear to be conformable, their original relationship to the surrounding rocks cannot be determined as they lie within a fault-bounded block.

Age: Brachiopods from the fossiliferous horizons, identified by K. S. W. Campbell (*in* Simandjuntak, 1977) indicate that the lower part of the Crow Mountain Creek Beds belongs to either the *Orthetes australis* or *Delepinea aspinosa* Zones. Rare isolated occurrences of *Gnathodus? reversus, Cavusgnathus* sp. and *Patrognathus* sp. suggest that this unit spans the interval from early to late Visean.

CORRELATION WITHIN THE NORTHERN TAMWORTH BELT

Correlation of the principal sections in the northern Tamworth Belt is indicated in Fig. 6. The correlation shown is based entirely on conodont faunas since brachiopod zones proposed by Roberts (1975) are either much broader, covering up to 6 conodont zones in the case of the *S.* cf. *burlingtonensis* Zone, or have a limited established distribution, as with the *T. tenuistriata* and *S. sol* Zones. Previous correlations within the Tamworth Belt (Jones *et al.,* 1973; Roberts, 1975, fig. 11 — refigured by Jones and Roberts 1976, fig. 3) have been based largely on brachiopod faunas with ammonoids and conodonts providing ages in terms of European stages. Correlations within the northern Tamworth Belt by these authors are largely restricted to the consideration of two composite sections which covered (1) the Werrie and Belvue Synclines and (2) the Rocky Creek Syncline. The former was composed of the Swains Gully and 'Rangari' sections while the latter referred to the type sections of the Luton and Caroda Formations (and the intervening Namoi Formation) near Caroda, with

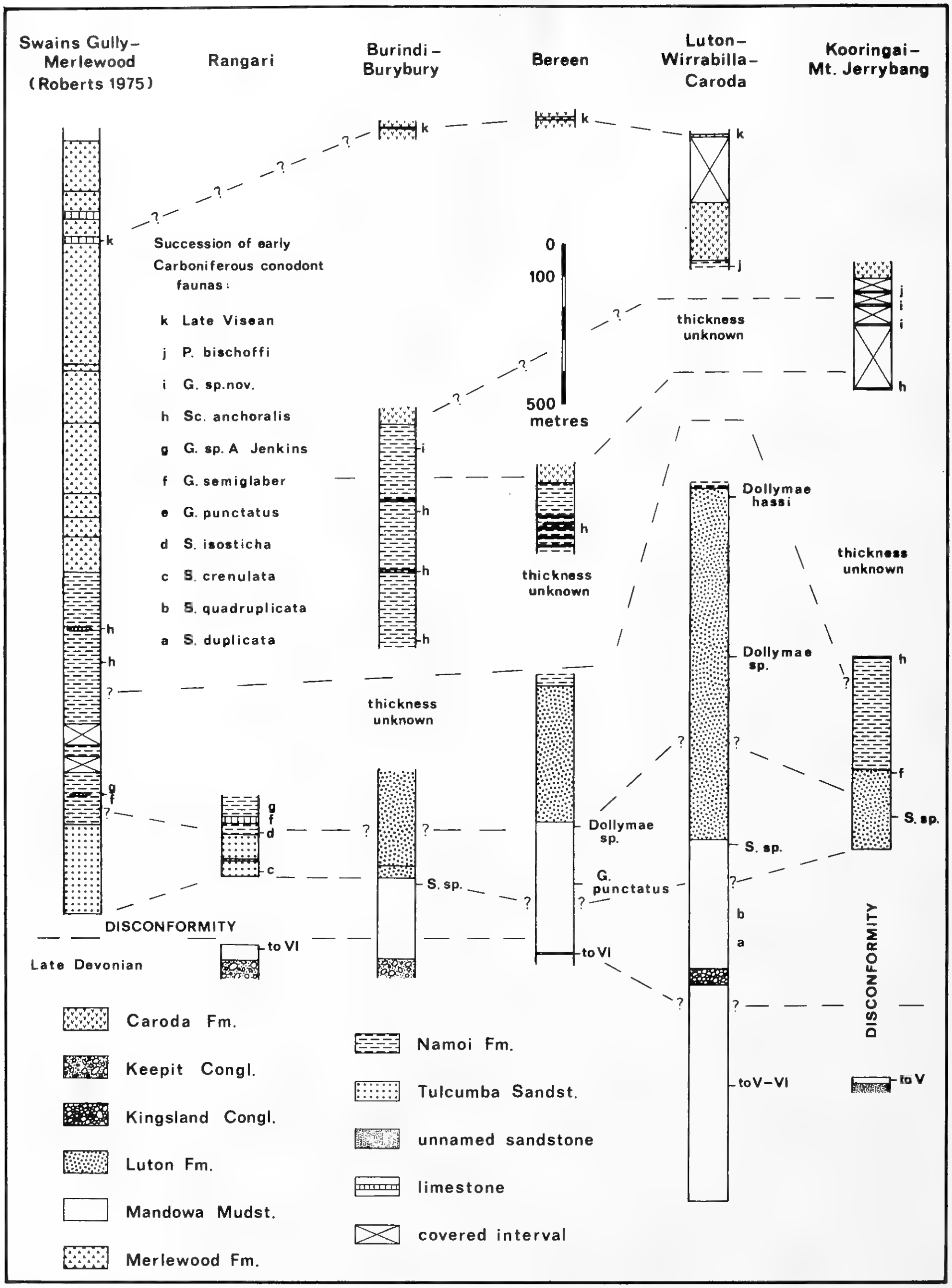

Fig. 6. Correlation of principal sections in the Early Carboniferous of the northern Tamworth Belt.

spot ages from 'Bereen' (Philip and Jackson, 1970) and Mount Jerrybang (Roberts, 1975). Although Roberts (1975) clarified a number of points concerning the correlation given by Jones *et al.* (1973), conodont and lithological evidence suggest the following additional modifications to the correlation offered by these authors:

(1) The Mandowa Mudstone ranges up into the Carboniferous on the eastern limbs of the Werrie, Belvue and Rocky Creek Synclines. The Wocklumerian age determined by Philip and Jackson (1970) is from a limestone in this unit rather than from the overlying Luton Formation (Hill, 1973; Gould, 1975, p. 455).

(2) There is little or no evidence for a break in sedimentation at the base of the Luton Formation except at Mount Jerrybang. Furthermore the Mandowa/Luton contact appears to be diachronous as indicated by the presence of *Dollymae* sp. at this level at 'Bereen' and *Siphonodella* sp. at 'Luton'.

(3) The top of the Luton Formation (and base of the overlying Namoi Formation) is diachronous as suggested by the presence of an *anchoralis* fauna at this level at 'Claremont', *G. semiglaber* at Mount Jerrybang and *Dollymae hassi* in the type section.

(4) The top of the Namoi Formation becomes younger to the north; the *anchoralis* Zone is found at this level south of 'Burybury' while younger faunas are found at 'Burybury' and to the north. A significant break in sedimentation at this level is unlikely as a gradational contact with the overlying Caroda and Merlewood Formations has been observed in a large number of sections.

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The final-instar Larvae of two Anomaloninae (Hymenoptera: Ichneumonidae) from Australia

J. R. T. SHORT

SHORT, J. R. T. The final-instar larvae of two Anomaloninae (Hymenoptera: Ichneumonidae) from Australia. *Proc. Linn. Soc. N.S.W.* 105 (3), (1980) 1981: 237-240.

The final-instar larvae of two Anomaloninae from Australia are figured. The taxonomic characters of the known final-instar larvae of *Anomalon* are discussed. Information from the final-instar larva of *Habronyx (Austranomalon) pammi* Gauld is used to construct a larval key to three subgenera of *Habronyx*.

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INTRODUCTION

Gauld's (1976b) revision of Australian Anomaloninae has been used to identify the adults of two reared Australian species of particular interest. The final-instar larva has not been described for any species of *Anomalon* from Australia; further, the final-instar larvae of the two Nearctic specimens of *Anomalon* described in Short (1978) were from material that could not be identified to species level. The species of the exclusively Australian subgenus *Austranomalon* gives information for distinguishing the known final-instar larvae of the subgenera of *Habronyx*. I have followed Gauld (1976a, b) on the name for this subfamily. The name Anomalinae has been in wide use, at least in Britain and North America (Townes, 1971).

MATERIAL AND METHODS

Anomalon morleyi Gauld ♀ emerged 13.ix.1974 from larva of *Pterohelaeus* sp. (Tenebrionidae), host collected as larva 10.ix.1974, Queensland, 20 km south of Jondaryan, P. Allsopp, Department of Primary Industries, Qld.
Habronyx (Austranomalon) pammi Gauld ♀ from pupa of *Mnesampela privata* (Guenée) (Geometridae), N.S.W., Windeyer, 1975, J. F. Read, N.S.W. Department of Agriculture.

The methods of making slide preparations from the exuviae of final-instar larvae are given in Short (1978:4). Terminology, and its basis in comparative morphology, is given in Short (1952). The scale line for both specimens represents 0.1 mm. The slide preparations will be deposited in the above institutions.

DISCUSSION

The larval characters of the Anomaloninae are outlined in Short (1978:96, 97). The species discussed, as in other Anomaloninae, spin only a flimsy cocoon within the host.

Anomalon, which is known from all zoogeographic regions, and the related Nearctic and Neotropic *Neogreeneia,* are isolated genera of Anomaloninae.

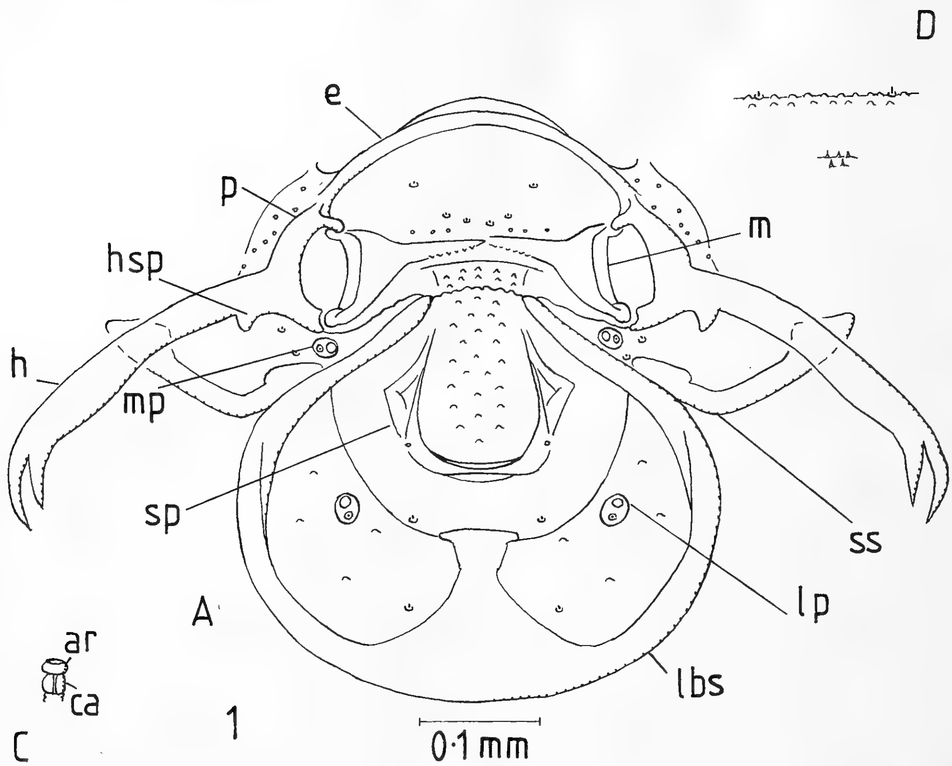

Fig. 1. Anomalon morleyi Gauld.

Anomalon is unusual in the subfamily in parasitizing the larvae of soil-dwelling Coleoptera; the biology of *Neogreeneia* is unknown. Other Anomaloninae parasitize Lepidoptera. The adults of the two Nearctic specimens of *Anomalon* figured in Short (1978) could not be determined to species. As many as ten species have been confused under the name of *A. ejuncidum* Say (Carlson, 1979). The mandible only of a final-instar larva of *Anomalon* sp. is figured by Gauld (1976a: 115). Mr Gauld has advised me (in litt.) that this specimen was from the Mediterranean region. It is therefore valuable to have this Australian *Anomalon morleyi* Gauld (Fig. 1) identified to species level. Mr Gauld has confirmed the identification. Material of known final-instar larvae of *Anomalon* is remarkable in showing very uniform characters. All possess the distinctive mandible (m) with teeth on only the ventral surface of the blade. All show a reduced hypostomal spur (hsp). The labial sclerite (lbs) is similar in its rounded form with a dorsal projection from the mid-ventral region. The maxillary (mp) and labial (lp) palps are similar in showing one round sensillum and a reduced seta.

The genus *Habronyx* is a rather unsatisfactory heterogeneous assemblage of species that exhibit few common adult characters (Gauld, 1976b). The genus has an almost worldwide distribution and Gauld (1976a) recognizes four subgenera. *Habronyx (Camposcopus) nigricornis* (Wesmael) (Short 1978, fig. 635) is very similar to *H. (Austranomalon) pammi* Gauld (Fig. 2) on larval characters, even to the grouping of sensilla on a raised area of the labrum (1). *H. (Habronyx) pyretorus?* (Cameron) figured by Gauld (1976a:115) differs markedly in larval characters from the first two subgenera.

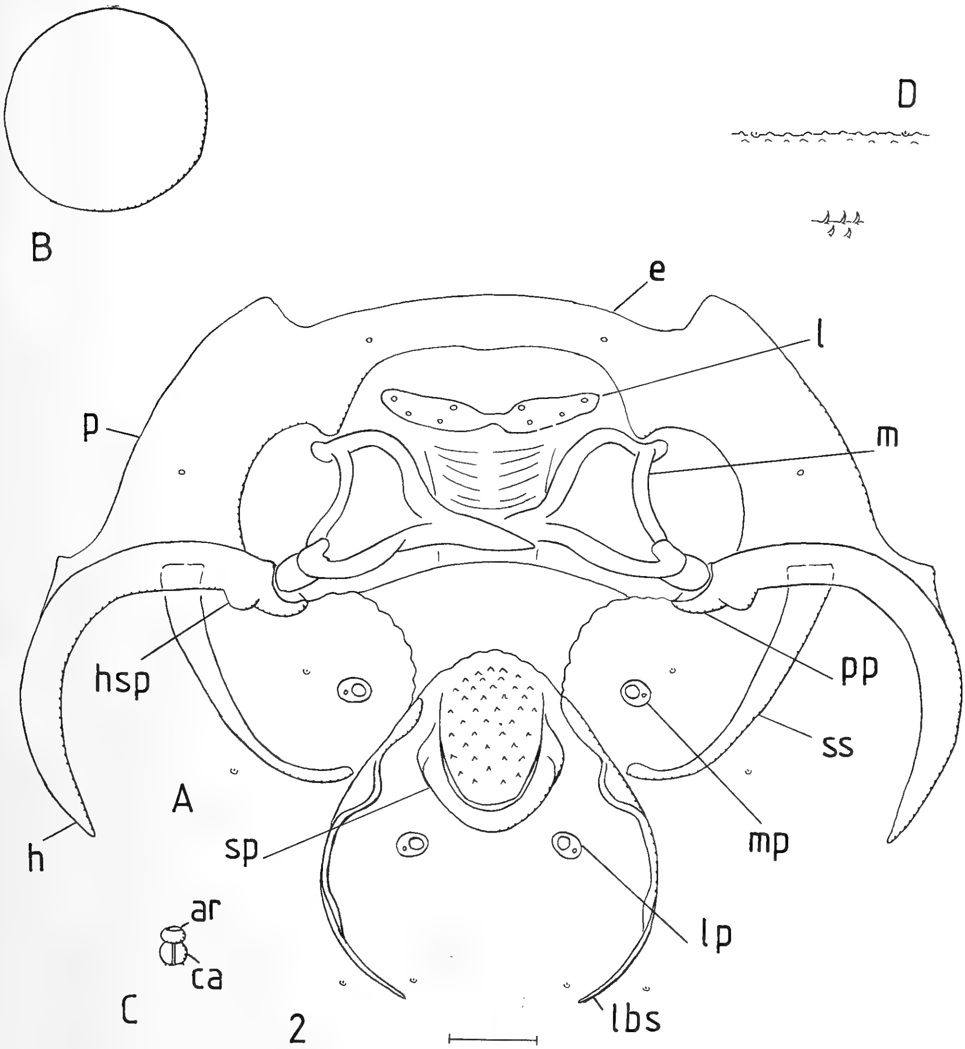

Fig. 2. Habronyx (Austranomalon) pammi Gauld. **A,** Head sclerites anterior view; **B,** Antenna; **C,** Mesothoracic spiracle; **D,** General surface of cuticle and spines at posterior end of body.

ABBREVIATIONS

ar atrium of spiracle; ca closing apparatus of spiracle; e epistoma; h hypostoma; hsp hypostomal spur; l labrum; m mandible; mp maxillary palp; lbs labial sclerite; lp labial palp; p pleurostoma; pp posterior pleurostomal process; sp silk press; ss stipital sclerite.

Larval key to three subgenera of *Habronyx*.

1. Epistoma conspicuously broad with depth of median part two thirds of length of mandible; median two thirds of length of hypostoma conspicuously broad with depth about equal to length of stipital sclerite .... subgenus *Habronyx*

   Epistoma and hypostoma not of this form 2
2. Lateral end of hypostoma enclosed by a lightly sclerotized area; ventral part of

labial sclerite unsclerotized for part equal in length to distance between posterior pleurostomal processes .... subgenus *Camposcopus*

Lateral end of hypostoma not enclosed by lightly sclerotized area; ventral part of labial sclerite (Fig. 2, lbs) with length of unsclerotized part about one half distance between posterior pleurostomal processes (pp) ....
subgenus *Austranomalon*.

Acknowledgements

I thank the Australian Research Grants Committee for financial support and the Departments of Primary Industries of Queensland and of Agriculture of N.S.W. for permission to study material.

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Type Specimens in the Macleay Museum, University of Sydney
VIII. Insects: Beetles (Insecta: Coleoptera)

E. B. BRITTON and P. J. STANBURY

BRITTON, E. B., & STANBURY, P. J. Type specimens in the Macleay Museum, University of Sydney. VIII. Insects: beetles (Insecta: Coleoptera). *Proc. Linn. Soc. N.S.W.* 105 (4), (1980) 1981: 241-293.

This paper, the first of a series on the insects, describes the transfer, on permanent loan, of 5619 type specimens, representing 2907 species of Coleoptera, from the Macleay Museum to the Australian National Insect Collection in Canberra. The types of Coleoptera are listed and their origin and status are discussed.

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INTRODUCTION

The Macleay Museum at the University of Sydney contains a comprehensive zoological collection, comprised, in the main, of those collections given to the University by Sir William Macleay in 1888, some three years before his death. These collections contain many types. Lists of the recognized types of fish (Stanbury 1969a), reptiles (Goldman, Hill and Stanbury, 1969), birds (Stanbury 1969b), mammals (Stanbury, 1969c), decapod crustaceans (Griffin and Stanbury, 1970) and molluscs (Ponder and Stanbury, 1972) have been published. In addition a paper (Whitley and Stanbury, 1976) discusses the identification of a Johansson orthopteran type dated 1756, and a preliminary list of insect types (Hahn, 1962) has been issued by the Macleay Museum in duplicated form.

The Macleay insect collections have been estimated to contain about one million specimens (Anderson, 1965) — although the total is now thought to be less — housed in 936 cabinet drawers, largely untouched since the days of Sir William Macleay and his curator, George Masters.

As the result of an agreement between the Professor of Biological Sciences, Professor L. C. Birch, and the Chief Curator of the Australian National Insect Collection, all insect type specimens so far recognizable in the Macleay Museum Collection have been transferred to the Australian National Insect Collection in Canberra.

THE TRANSFER

The transfer of type specimens of insects was initiated in 1969 by a suggestion from the Curator of the Macleay Museum (P.J.S.) to the Professor of Biological Sciences at the University of Sydney, Professor L. C. Birch, who wrote to the Chief Curator of the Australian National Insect Collection, Canberra. Professor Birch considered it appropriate that this scientifically-valuable material should be housed in the National Collection where it could be adequately cared for and indicated that this could be done by transferring it on permanent loan. The point was made that the specimens, where necessary, should be remounted for safe preservation and that this should be done under the supervision of competent taxonomists. On 16th May 1969 it was agreed that the transfer of type material should be made to the ANIC on a 'permanent loan' basis. This would imply that transferred material could in principle be recalled, and that specimens could not be given away, but ANIC staff would have authority to lend specimens and could exercise discretion in remounting specimens. It was further agreed that ANIC staff would prepare and publish a full list of the types and that in addition to types, material transferred should include 'specimens from classical sites now destroyed, specimens of rare species, specimens from critical localities, and material that formed the basis of monographic works.'

Before any specimens were removed from the collection every drawer and storebox of insect specimens in the Macleay Museum (936 in all) was photographed by the Department of Photographic Illustration of the University of Sydney. One copy of the set of photographic prints (25 cm x 18 cm) is stored in the Macleay Museum and one in the Australian National Insect Collection.

The coleopteran type material was extracted from the Macleay Collection and its type status determined by one of us (EBB). As each specimen was removed its image on the corresponding photograph was ringed in ink and labelled with its specific name. Specimens were pinned in order of removal in stout wooden storage boxes. The removal of the boxes to Canberra was arranged and carried out by Mr M. S. Upton, Manager of the Australian National Insect Collection. In Canberra the label 'On permanent loan from the Macleay Museum, University of Sydney' was affixed to every specimen and the species were transferred each to a separate unit tray and housed in steel cabinets. Stainless steel pins were used to replace pins that had corroded. This was especially necessary in the case of types of Curculionidae-Amycterinae in the Ferguson Collection.

The delicate work of repinning specimens, the reorganization of the card catalogue and the final typing of the alphabetical list of the coleopteran species was undertaken voluntarily by Joyce Britton. Stefan Misko carried out the responsible and time-consuming work of labelling, transferring to trays and the final organization and incorporation of the coleopteran material into the Australian National Insect Collection.

THE ORIGIN AND STATUS OF THE TYPES OF COLEOPTERA IN THE MACLEAY COLLECTION

The number of specimens of Coleoptera transferred to the Australian National Collection stands at 5619, representing 2907 species. The types include 584 holotypes, 94 allotypes, 36 lectotypes, 2077 syntypes (of 853 species), 1980 paratypes (of 1035 species), 65 paralectotypes (of 35 species). In addition there were 783 tototypes representing 364 species.

Included are types of species described by W. S. Macleay, W. J. Macleay, A. M. Lea, E. W. Ferguson, T. Sloane, R. L. King, J. Thomson, T. Blackburn, H. J. Carter, M. Cameron, E. Donovan, G. C. Champion, P. B. Carne, W. Kirby, A. Raffray, F. H. Uther Baker, E. B. Britton, W. T. Armstrong, E. Brown, R. Charpentier and O. E. Jansen. There are in addition, topotypes of species described by J. S. Baly, E. P. Pascoe, F. De Brême, A. S. Olliff, L. J. Reiche, F. Bates, H. W. Bates, F. Laporte de Castelnau and A. White.

The precise status as types of specimens as old as those in the Macleay Museum is often difficult to determine. It has appeared reasonable to us to accept as types specimens labelled as species described by W. J. Macleay and bearing the the type locality. Where such species are represented by a single specimen we have accepted and labelled this as the holotype. Where there is more than one specimen we have labelled these as syntypes. Some specimens, e.g. those of species described by Lea, bear the author's labels 'Type' and 'Cotype'. These have been accepted here as the equivalents of 'Holotype' and 'Paratype' and labelled accordingly although Lea did not designate types in his published descriptions. Strict interpretation of the International Code of Zoological Nomenclature will require that these 'Holotypes' should be designated as lectotypes when opportunity offers.

With regard to the species described by Pascoe, Castelnau, Olliff and Sloane, however, there are difficulties. The species described by Pascoe are almost all represented by unique 'types' in the British Museum, but the specimens of these species in the Macleay Collection are labelled with the type localities, and it is known that Pascoe received his material from Masters. Pascoe (1870:445) wrote:

> 'I am indebted for a great many of the species to my valued correspondent Mr George Masters of Sydney, and it is a great advantage that these were accompanied by their exact localities.'

Macleay or Masters either (a) sorted their material into species and sent one or more specimens of each to Pascoe in London, who described the species and returned the name for the remaining series of each species in Sydney, or (b) sent all specimens to Pascoe who retained one of each species and returned the remainder with the name. If (a) then the Macleay Collection specimens are not syntypes, whereas if (b) occurred then they are syntypes. Blackburn and Lea clearly treated the Macleay Museum specimens of Pascoe species as having the significance of types. Blackburn (1893:301) states:

> 'I have to acknowledge with much gratitude the extremely valuable assistance I am receiving in the preparation of the articles on Erirhininae and other Curculionidae by the co-operation of George Masters Esq . . . who is allowing me to examine his collection of authentic types of Mr Pascoe's genera.'

Lea (1898:449) wrote:

> 'For the gift or loan of specimens from various parts of Australia I have to thank . . . in particular Mr George Masters. The latter gentleman has supplied me with specimens (which might almost be regarded as cotypes) of a number of species described by Mr Pascoe.'

A similar uncertainty presents itself with regard to the specimens of Castelnau species labelled with the type locality. These are treated here as topotypes but it is noteworthy that none of the Castelnau species represented in the Macleay collection is also in the National Museum of Victoria, where the bulk of the Castelnau collection is deposited. This suggests that the specimens of Castelnau species in the Macleay Collection may be of more than the topotypic status granted them here.

The Macleay Collection includes a number of species of Carabidae described by T. G. Sloane. These are of special importance because the original Sloane Collection, which contained most of the type material, suffered considerable damage before it was acquired by the CSIRO and moved to Canberra. Some specimens in the Macleay Collection and identified and labelled by Sloane are found to represent species of which the type in the Sloane collection is destroyed. These specimens must therefore assume much of the value of types until such times as neotypes may be designated.

Olliff was a member of the staff of the Australian Museum (1885-1890) so that it is to be expected that most of his types are to be found there. Nevertheless, it is possible that parts of the type series were acquired by Macleay. Unless additional evidence is available these specimens are treated here as 'topotypes' but they are clearly of considerable taxonomic importance, being contemporary specimens, almost certainly identified by the author of the species.

It is quite possible, indeed likely, that types of other species may yet be recognized in the Macleay Museum collection, especially among the extensive exotic collection which was brought to Australia in 1825 by Alexander Macleay. These specimens, however, lack data and identification labels and any types could therefore be recognized only from original drawings or descriptions of individual peculiarities and with evidence of purchase by Alexander Macleay in annotated catalogues of auction sales of insect collections in the early 19th century.

THE LIST OF COLEOPTERA TYPES

The types are listed in alphabetical order of specific name, together with original genus, family, type locality, number of specimens, and kind of type.

CATALOGUE OF TYPES OF COLEOPTERA TRANSFERRED ON PERMANENT LOAN FROM THE MACLEAY MUSEUM TO THE AUSTRALIAN NATIONAL INSECT COLLECTION, CANBERRA

Abbreviations Used in the List

A = allotype: H = holotype; L = lectotype; P = paratype;
PL = paralectotype; S = syntype; T = topotype;
"Macleay" = W. J. Macleay

Specific Name	Original Genus	Family	Type Locality	Types
abaceta Lea 1923	*Monolepta*	Chrysomelidae	Dorrigo, NSW	2 P
abdominalis Lea 1921	*Dasytes*	Melyridae	Yilgarn, WA	2 P
abdominalis Lea 1915	*Edusa*	Chrysomelidae	NSW	2 P
aberrans Lea 1907	*Crepidomenus*	Elateridae	Tas	1 P
aberrans Lea 1899	*Melanterius*	Curculionidae	Rockhampton, Q	H
aberrans Macleay 1872	*Anthicus (Macratria)*	Anthicidae	Gayndah, Q	4 S
aberrans Macleay 1865	*Talaurinus*	Curculionidae	Vic	2 S
abjectus Lea 1915	*Agetinus*	Chrysomelidae	Galston, NSW	2 P
abnormalis Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
abnormis Macleay 1873	*Anoplognathus*	Scarabaeidae	Southern parts of Queensland, Wide Bay	H, A
abruptus Pascoe 1882	*Atelicus*	Curculionidae	Tas	2 T
absonus Lea 1904	*Loxopleurus*	Chrysomelidae	Kiama, NSW	2 P
abundans Lea 1910	*Acacicis*	Curculionidae	Hobart, Tas	2 P
abundans Lea 1922	*Anthicus*	Anthicidae	Cairns district, Q	2 P
abundans Lea 1923	*Monolepta*	Chrysomelidae	Adelaide, SA	4 P
abundans Lea 1915	*Phagonophana*	Scydmaenidae	Tas	2 P
abundans Lea 1925	*Platysoma*	Histeridae	Lord Howe I.	3 P
abundans Lea 1928	*Tapinocis*	Curculionidae	Lord Howe I.	2 P
abundans Lea 1917	*Xylophilus*	Aderidae	Lord Howe I.	2 P
acaciae Lea 1916	*Chrysomela*	Chrysomelidae	SA	1 P
acaciae Lea 1910	*Phloeopthorus*	Curculionidae	Hobart, Tas	2 P
acaciae Lea 1917	*Xylophilus*	Aderidae	Tas	2 P
acacaei Pascoe 1873	*Hypera*	Curculionidae	Gayndah, Q	2 T
acanthomera Lea 1915	*Lepidocolaspis*	Chrysomelidae	Cairns district, Q	2 P
acentetus Lea 1904	*Loxopleurus*	Chrysomelidae	Tas	2 P
acromialis Ferguson 1912	*Talaurinus*	Curculionidae	Q	H
aculeatus Ferguson 1921	*Hyborrhynchus*	Curculionidae	WA	H
acuminata Pascoe 1870	*Evas*	Curculionidae	King George Sound, WA	2 T
acuminatus Macleay 1865	*Sclerorinus*	Curculionidae	SA	2 S
acuticeps Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	2 S
acuticollis Macleay 1887	*Pterohelaeus*	Tenebrionidae	Endeavour R., Q	H
acutipennis Ferguson 1913	*Talaurinus*	Curculionidae	Vic	H
adelaidae Macleay 1873	*Arthropterus*	Carabidae	SA	H
adelaidae Macleay 1866	*Sclerorinus*	Curculionidae	SA	4 S
adeps Olliff 1886	*Ptinus*	Ptinidae	Morpeth, NSW	2 T

Specific Name	Original Genus	Family	Type Locality	Types
adusta Pascoe 1860	*Leperina*	Trogossitidae	Vic	2 S
aenea Fabricius 1792	*Lamprima*	Lucanidae	Norfolk I.	2 T
aenea Macleay 1873	*Cymindis (Anomotarus)*	Carabidae	Monaro, NSW	3 S
aeneus Macleay 1873	*Scopodes*	Carabidae	Gayndah, Q	4 S
aequalis Lea 1904	*Balaninus*	Curculionidae	Cairns, Q	H
aequalis Sloane 1893	*Talaurinus*	Curculionidae	Central Australia	H, A
aequata King 1865	*Bryaxis (Eupines)*	Pselaphidae	Elizabeth Bay, Sydney, NSW	H
aerata Lea 1915	*Tomyris*	Chrysomelidae	Sydney, NSW	1 P
aericollis Pascoe 1869	*Cardiothorax*	Tenebrionidae	NSW	1 P
aesalon Pascoe 1870	*Polyphrades*	Curculionidae	King George Sound, WA	2 T
affine Macleay 1864	*Carenum*	Carabidae	NSW	H
affinis W. S. Macleay 1821	*Scarabaeus (Gymnopleurus)*	Scarabaeidae	Senegal (Africa)	H
alata Castelnau 1869	*Nepharis*	Cucujidae	King George Sound, WA	2 S
alaticornis Ferguson 1914	*Talaurinus*	Curculionidae	NSW	H, A
alatus Macleay 1888	*Trox*	Trogidae	King George Sound, WA	L
albatus Lea 1924	*Dryophilodes*	Anobiidae	SA	2 P
albifasciatus Lea 1909	*Menios*	Curculionidae	Endeavour R., Q	1 P
albifrons Lea 1907	*Sympediosoma*	Curculionidae	Endeavour R., Q	1 P
albigutta Lea 1906	*Baris*	Curculionidae	Cairns, Q	H
alboguttatus Macleay 1888	*Lacon*	Elateridae	King Sound, WA	L, 2 PL
albohirtus Macleay 1863	*Liparetrus*	Scarabaeidae	Port Denison, Q	H
albolineata Macleay 1888	*Cicindela*	Carabidae	King Sound, WA	2 S
albopicta Lea	*Baris*	Curculionidae	Q	H
alboscutellaris Lea 1911	*Poropterus*	Curculionidae	Tas	2 P
albovillosa Macleay 1888	*Lagria*	Lagriidae	Q, Mossman R.	2 S
albovittatus Ferguson 1914	*Sclerorinus*	Curculionidae	Eucla, WA	H, A
albus Lea 1913	*Microberosiris*	Curculionidae	SA	2 P
alcyone Lea 1915	*Rhyparida*	Chrysomelidae	Port Darwin, NT	2 P
algarum Pascoe 1870	*Aphela*	Curculionidae	King George Sound, WA	3 T
alleni Lea 1910	*Eurychirus*	Curculionidae	Cairns, Q	2 P
alleni Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	1 P
alleni Lea 1908	*Stenocorynus*	Curculionidae	Cairns, Q	2 P
allynensis Carter 1926	*Helmis*	Helminthidae	Allyn R., NSW	2 S
alphabetica Lea 1917	*Mordella*	Mordellidae	Cairns district, Q	2 P
alphabetica Lea 1925	*Orchesia*	Melandryidae	Tas	2 P
alphabetica Lea 1917	*Oxyops*	Curculionidae	Oodnadatta, SA	1 P
alphabeticus Lea 1920	*Ditropidus*	Chrysomelidae	SA	2 P
alpicola Ferguson 1915	*Acantholophus*	Curculionidae	NSW	H, 1 P
alpicola Ferguson 1915 (1914)	*Sclerorinus*	Curculionidae	Vic	H, A, 2P
alternans Castelnau 1867	*Eudema (Craspedophorus, Epicosmus)*	Carabidae	Rockhampton, Q	2 T
alternans Macleay 1872	*Lacon*	Elateridae	Gayndah, Q	1 P
alternans Macleay 1865	*Talaurinus*	Curculionidae	Clyde R., NSW	H
alternans W. S. Macleay 1827	*Trox*	Trogidae	"New Holland"	H
alternans Pascoe 1870	*Phloeoglymma*	Curculionidae	Rope's Creek, NSW	2 T
alternata Carter 1929	*Phoracantha*	Cerambycidae	NSW	H
alternata Lea 1923	*Pedaria*	Scarabaeidae	Groote Eylandt, NT	2 P
alternata, var of *biceps* Lea 1903	*Phyllocharis*	Chrysomelidae	Brisbane, Q	H
alternata Lea 1908	*Telephorus*	Cantharidae	King Sound, WA	3 P
alternatus Macleay 1865	*Talaurinus*	Curculionidae	New Holland	H
alternus Macleay 1865	*Sclerorinus*	Curculionidae	Wagga Wagga, NSW	H
amaroides Pascoe 1862	*Chariotheca (Apterotheca)*	Tenebrionidae	Lizard I., Q	4 T
ambiguum Macleay 1865	*Carenum*	Carabidae	King George Sound, WA	3 S
ambiguus Macleay 1865	*Talaurinus*	Curculionidae	Darling Downs, Q	H
ambiguus Sloane 1890	*Laccocenus*	Carabidae	Dunoon, Richmond R., NSW	H
amethystina Lea 1903	*Calomela*	Chrysomelidae	Geraldton, WA	1 P
ammophilus Lea 1909	*Mandalotus*	Curculionidae	Sydney, NSW	2 P
amphibia Pascoe 1870	*Scymena*	Tenebrionidae	King George Sound, WA	3 T
ampliatus Macleay 1887	*Xylobanus*	Lycidae	Barron R., Q	H
amplicollis Ferguson 1909	*Phalidura*	Curculionidae	Q	H, A
amplicollis var A Lea 1906	*Misophrice*	Curculionidae	Tas	2 P
amplipenne Macleay 1871	*Bembidium (Tachys)*	Carabidae	Gayndah, Q	2 S
amplipenne Macleay 1873	*Platylytron*	Carabidae	King George Sound, WA	3 S
amplipennis Ferguson 1909	*Psalidura*	Curculionidae	Darling Downs, Q	H

Specific Name	Original Genus	Family	Type Locality	Types
amplipennis Lea 1925	*Ellopia*	Chrysomelidae	Ben Lomond, NSW	2 P
amplipennis Lea 1915	*Misophrice*	Curculionidae	Adelaide, SA	1 P
amplipennis Lea 1925	*Rhamphus*	Curculionidae	SA	1 P
amplipennis Lea 1915	*Scydmaenus*	Scydmaenidae	NSW	1 P
amplipennis Macleay 1871	*Districhothorax (Amblytelus)*	Carabidae	Wide Bay, Q	2 S
amplipes Raffray 1901	*Eupinoda*	Pselaphidae	King George Sound, WA	1 T
amycteroides Ferguson 1914	*Sclerorinus*	Curculionidae	Portland, Vic	H, A, 2 P
amycteroides Macleay 1865	*Acantholophus*	Curculionidae	King George Sound, WA	4 S
analis Macleay 1871	*Adelotopus*	Carabidae	Gayndah, Q	1 S
analis Macleay 1871	*Quedius*	Staphylinidae	Gayndah, Q	2 S
anchomenoides Macleay 1871	*Badister (= Microferonia)*	Carabidae	Gayndah, Q	2 S
angasi Macleay 1865	*Acantholophus*	Curculionidae	SA	H
angasi Macleay 1865	*Sclerorinus*	Curculionidae	SA	2 S
angasi Pascoe 1863	*Symphyletes*	Cerambycidae	SA	2 T
angophorae Lea 1906	*Baris*	Curculionidae	NSW	2 P
angularis Ferguson 1912	*Talaurinus*	Curculionidae	Q	H, A
angularis Lea 1908	*Euryporopterus*	Curculionidae	NSW	1 P
angularis Macleay 1866	*Cubicorrhynchus*	Curculionidae	Swan R., WA	2 S
angulata Olliff 1889	*Howea*	Cerambycidae	Lord Howe I.	1 T
angulatus Carter 1939	*Limonius*	Elateridae	Mt Irvine, NSW	2 P
angulatus Macleay 1873	*Arthropterus*	Carabidae	Rockhampton, Q	2 S
angulatus Macleay 1886	*Liparetrus*	Scarabaeidae	Sydney, NSW	2 S
angulicollis Macleay 1871	*Paederus*	Staphylinidae	Gayndah, Q	4 S
angulicorne Macleay 1873	*Bolboceras*	Geotrupidae	Port Curtis, Q	L, 1 PL
angusta Lea 1917	*Seraptia*	Seraptiidae	Tas	1 P
angustata Macleay 1887	*Hybrenia*	Alleculidae	Cairns, Q	H
angustatus Lea 1917	*Belus*	Curculionidae	Strathalbyn, Bull I., SA	2 P
angustatus Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	4 S
angustibasis Lea 1921	*Neocarphurus*	Melyridae	Cairns district, Q	2 P
angusticeps Macleay 1886	*Diphucephala*	Scarabaeidae	NSW	H
angusticollis Carter 1906	*Cardiothorax*	Tenebrionidae	NSW	3 S
angusticollis Ferguson 1915	*Acantholophus*	Curculionidae	Vic	H, 3 P
angusticollis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	H
angusticollis Macleay 1888	*Casnonia (Clarencia)*	Carabidae	King Sound, WA	3 S
angusticollis Macleay 1864	*Xanthophoea*	Carabidae	Port Denison, Q	2 S
angusticornis Macleay 1871	*Arthropterus*	Carabidae	Gayndah, Q	3 S
angustior Ferguson 1916	*Sclerorinus*	Curculionidae	WA	H, 2 P
angustior Macleay 1871	*Cyclothorax (Abacetus)*	Carabidae	Gayndah, Q	2 S
angustipennis Macleay 1871	*Notonomus*	Carabidae	Gayndah, Q	1 S
angustipictus Lea 1911	*Mandalotus*	Curculionidae	Stanley, Tas	4 P
angustulus Macleay 1887	*Trichalus*	Lycidae	Cairns, Q	H
angustulus Macleay 1888	*Rhytisternus*	Carabidae	King Sound, WA	2 S
angustus Ferguson 1865	*Talaurinus*	Curculionidae	Vic	H, A, 2 P
angustus Lea 1914	*Cyllorhamphus*	Curculionidae	Q	2 P
angustus Lea 1911	*Prypnus*	Curculionidae	Mt Victoria, NSW	2 P
angustus Macleay 1865	*Sclerorinus*	Curculionidae	Lower Murrumbidgee, NSW	H
anomala Carter 1925	*Seirotrana*	Tenebrionidae	Barrington, NSW	2 S
anomogastra Lea 1915	*Colaspoides*	Chysomelidae	Q	H
anopla Lea 1908	*Tentegia*	Curculionidae	Darling River, NSW	2 P
antennalis Lea 1923	*Monolepta*	Chrysomelidae	Groote Eylandt, NT	2 P
anthracinum Macleay 1864	*Carenum*	Carabidae	SA	4 S
anthracinus Macleay 1873	*Promecoderus*	Carabidae	Lower Murrumbidgee, NSW	2 S
anthrocoides Ferguson 1921	*Talaurinus*	Curculionidae	Vic	H, A, 1 P
aphodioides Macleay 1864	*Cheiragra*	Scarabaeidae	NSW	4 S
apicale Macleay 1871	*Cryptobium*	Staphylinidae	Gayndah, Q	4 S
apicalis King 1869	*Anthicus*	Anthicidae	Port Denison, Q	2 T
apicalis Lea 1911	*Bubaris*	Curculionidae	Port Denison, Q	3 P
apicalis Macleay 1865	*Acantholophus*	Curculionidae	SA	2 S
apicalis Macleay 1864	*Adelotopus*	Carabidae	Port Denison, Q	4 S
apicalis Macleay 1888	*Cisseis*	Buprestidae	King Sound, WA	2 S
apicalis Macleay 1873	*Eleale*	Cleridae	Gayndah district, Q	2 S
apicalis Macleay 1864	*Phyllotocus*	Scarabaeidae	Port Denison, Q	2 S
apicalis Macleay 1865	*Sclerorinus*	Curculionidae	NSW	H
apicalis Macleay 1887	*Selenurus*	Cantharidae	Mossman R., Q	H

Specific Name	Original Genus	Family	Type Locality	Types
apicalis Sloane 1896	*Clivina*	Carabidae	WA	3 T
apicollis Lea 1915	*Tomyris*	Chrysomelidae	SA	1 P
apicicornis Lea 1921	*Helcogaster*	Melyridae	Mt Lofty, SA	3 P
apicifusca Lea 1917	*Copidita*	Oedemeridae	Cairns, Q	1 P
apicihirtus Ferguson 1912	*Talaurinus*	Curculionidae	Q	H
apicipennis Lea 1895	*Mecynotarsus*	Anthicidae	Tamworth, NSW	1 T
apicirufus Lea 1904	*Cadmus*	Chrysomelidae	SA	2 S
appendiculatus Lea 1904	*Cryptocephalus*	Chrysomelidae	Lane Cove, NSW	2 P
appropinquans Lea 1915	*Scydmaenus*	Scydmaenidae	WA	2 P
approximata Ferguson 1909	*Phalidura*	Curculionidae	Vic	H
approximatus Macleay 1865	*Acantholophus*	Curculionidae	Vic	2 S
apterus Olliff 1889	*Telephorus*	Cantharidae	Lord Howe I.	2 T
aratus Pascoe 1866	*Cardiothorax*	Tenebrionidae	Pine Mountain, Q	2 T
araucariae Lea 1929	*Brachycilibe*	Tenebrionidae	Norfolk I.	1 P
arboricola Carter 1911	*Adelium*	Tenebrionidae	NSW	2 P
arboricola Ferguson 1923	*Mythites*	Curculionidae	Mt Tambourine, Q	H. 1P
arciferus Lea 1907	*Mandalotus*	Curculionidae	Tas	1 P
arenosus Macleay 1866	*Sclerorinus*	Curculionidae	Flinders Range, SA	H, A
argus Pascoe 1867	*Rhytiphora (Depsages)*	Cerambycidae	Rockhampton, Q	4 T
arida Lea 1917	*Psyllioides*	Chrysomelidae	Ooldea, SA	1 P
arida Pascoe 1862	*Mycerinopsis*	Cerambycidae	Lizard I., Q	3 T
aridus Blackburn 1895	*Liparetrus*	Scarabaeidae	Lake Callabonna, SA	2 P
argus Lea 1905	*Aonychus*	Curculionidae	WA	2 P
armata Thomson 1879	*Stigmodera*	Buprestidae	NSW	1 P
armaticeps Macleay 1871	*Scitala*	Scarabaeidae	Gayndah, Q	1 S
armatus Lea 1921	*Ditropidus*	Chrysomelidae	King George Sound, WA	3 P
armicollis Lea 1915	*Eudela*	Curculionidae	Warrior I., Q	2 P
armicollis Lea 1908	*Laius*	Melyridae	Darling River, NSW	1 P
armigerum Macleay 1873	*Bolboceras*	Geotrupidae	Rockhampton, Q	L
armipectus Lea 1909	*Mandalotus*	Curculionidae	NSW	2 P
armipennis Lea 1910	*Aoplocnemis*	Curculionidae	Vic	2 P
armipennis Lea 1927	*Storeus*	Curculionidae	Endeavour R., Q	1 P
arrowi Lea 1911	*Lipothyrea*	Curculionidae	Q	1 P
arthuri Sloane 1889	*Notonomus*	Carabidae	Mt Wilson, NSW	2 T
aruspex Pascoe 1866	*Blepegenes*	Tenebrionidae	Illawarra, NSW	4 T
ashi Lea 1917	*Myllocerus*	Curculionidae	Ooldea, SA	2 P
asper Macleay 1886	*Liparetrus*	Scarabaeidae	NSW	L, 3 PL
asper Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	4 S
asper Macleay	*Sclerorinus*	Curculionidae	SA	H, A
asper Pascoe 1870	*Iphisiaxus*	Curculionidae	King George Sound, WA	2 T
asperatus Macleay 1888	*Trox*	Trogidae	King Sound, WA	L, 1 P
aspericollis Blackburn 1889	*Heteronyx*	Scarabaeidae	Wagga Wagga, NSW	H
asperipes Pascoe 1870	*Saragus*	Tenebrionidae	Port Lincoln, SA	1 T
asperrimus Macleay 1888	*Trox*	Trogidae	King Sound, WA	L, 1 P
asphaltinus Thompson 1968	*Catasarcus*	Curculionidae	WA	2 P
assimilis Carter 1928	*Hesthesis*	Cerambycidae	NSW	H, A, 2 P
assimilis Ferguson 1909	*Psalidura*	Curculionidae	NSW	H, A
assimilis Macleay 1888	*Haplaner*	Carabidae	King Sound, WA	H
assimilis Macleay 1886	*Liparetrus*	Scarabaeidae	NSW	H
assimilis Macleay 1864	*Phyllotocus*	Scarabaeidae	SA	4 S
assimilis Macleay 1863	*Schizorhina (Cacochroa, Lyraphora)*	Scarabaeidae	Port Denison, Q	H
astri Lea 1925	*Apion*	Curculionidae	Murray R., SA	1 P
ater Lea 1909	*Balanophorus*	Melyridae	SA	H
ater Macleay 1869 (1871)	*Abacetus*	Carabidae	Gayndah, Q	4 S
ater Macleay 1871	*Cyphosoma (Cratogaster, Tibarisus)*	Carabidae	Gayndah, Q	3 S
ater Macleay 1886	*Liparetrus*	Scarabaeidae	SA	H
ater Macleay 1864	*Saprinus*	Histeridae	Port Denison, Q	4 S
ater Macleay 1887	*Xylobanus*	Lycidae	Cairns district, Q	2 S
aterrime Macleay 1872	*Mordella (Tomoxia)*	Mordellidae	Gayndah, Q	2 S
aterrimum Macleay 1873	*Helluosoma (Helluonidius)*	Carabidae	Cape York, Q	2 S
aterrimus Ferguson 1915	*Sclerorinus*	Curculionidae	NSW	H, 1 P

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aterrimus Lea 1910	*Auletes*	Curculionidae	Sydney, NSW	2 P
aterrimus Lea 1904	*Brachycaulus*	Chrysomelidae	Cleveland Bay, Q	H
aterrimus Macleay 1871	*Carpophilus*	Nitidulidae	Gayndah, Q	2 S
atra Lea 1921	*Atyphella*	Lampyridae	National Park, Q	2 P
atra Lea 1915	*Rhyparida*	Chrysomelidae	Charters Towers, Q	2 P
atra Macleay 1863	*Cheiragra*	Scarabaeidae	Illawarra, NSW	H
atriceps Carter 1915	*Aethyssius*	Alleculidae	Port Denison, Q	2 P
atriceps Macleay 1871	*Bembidium (Tachys)*	Carabidae	Gayndah, Q	4 S
atriceps Macleay 1871	*Bryaxis*	Pselaphidae	Gayndah, Q	4 S
atriceps Macleay 1864	*Liparetrus*	Scarabaeidae	Port Denison, Gayndah, Q	L, 1 PL
atriceps Macleay 1871	*Trichus (Lecanomerus)*	Carabidae	Gayndah, Q	3 S
atriceps Macleay 1873	*Conurus (Coproporus)*	Staphylinidae	Gayndah, Q	4 S
atrichia Lea 1915	*Edusa*	Chrysomelidae	Sydney, NSW	H
atricolor Macleay 1888	*Lacon*	Elateridae	Barrior Range, WA	L
atricornis Lea 1909	*Metriorrhynchus*	Lycidae	Cairns, Q	2 S
atricornis Lea 1921	*Telephorus*	Cantharidae	Mt Tambourine, Q	2 P
atripennis Macleay 1887	*Xylobanus*	Lycidae	Cairns, (Barron R.), Q	6 S
atronitens Lea 1917	*Mordellistena*	Mordellidae	Cairns district, Q	1 P
atronitens Macleay 1863	*Carenum*	Carabidae	SA	H
atronitidus W. S. Macleay 1821	*Scarabaeus (Gymnopleurus)*	Scarabaeidae	Greece	2 S
atrophus Lea 1915	*Scydmaenus*	Scydmaenidae	WA	2 P
atroviride Sloane 1894	*Homalosoma (Trichosternus)*	Carabidae	Inverell, NSW	2 S
atro-viridis Macleay 1887	*Encyalesthus (Cholipus)*	Tenebrionidae	Cairns, Q	2 S
atrum Castelnau 1868	*Helluosoma*	Carabidae	Rockhampton, Q	1 T
atrum Macleay 1887	*Gigadema (Ametroglossus)*	Carabidae	Russell R., Q	H
atyphella Olliff 1886	*Homalota*	Staphylinidae	Sydney, NSW	3 T
auchmeresthes Lea 1926	*Mandalotus*	Curculionidae	Eccleston, NSW	4 P
aulocophoroides Lea 1917	*Laius*	Melyridae	WA	3 P
auratus Macleay 1871	*Scopodes*	Carabidae	Gayndah, Q	4 S
aureomaculatus Ferguson 1915	*Cubicorrhynchus*	Curculionidae	Cue, WA	H, A
aureotincta Macleay 1887	*Pelecotomoides*	Rhipiphoridae	Cairns district, Mossman R., Q	2 S
aureus Carter 1906	*Cardiothorax*	Tenebrionidae	NSW	1 P
auricollis Castelnau 1867	*Leiradira*	Carabidae	Clarence R., NSW	6 T
auricomus Blackburn 1889	*Heteronyx*	Scarabaeidae	Darling R., NSW	2 S
auricomus Lea 1911	*Tyromorphus*	Pselaphidae	Tas	4 P
auriculatus Ferguson 1916	*Cubicorrhynchus*	Curculionidae	Tenterfield, NSW; Dalveen, Q	H, A, 3 P
aurifer Lea 1904	*Cryptocephalus*	Chrysomelidae	Sydney, NSW	2 S
aurifer Lea 1927	*Storeus*	Curculionidae	Fiji, Taveuni	2 P
aurita Ferguson 1915	*Brachymycterus*	Curculionidae	WA	H, 3 P
aurita Pascoe 1869	*Mithippia*	Tenebrionidae	SA	1 T
auronotata Lea 1917	*Mordella*	Mordellidae	Cairns district, Q	4 P
australasiae Blackburn 1892	*Donacia*	Chrysomelidae	Endeavour R., Q	2 T
australasiae Lea 1910	*Apion*	Curculionidae	SA	4 P
australasiae Lea 1910	*Homalota*	Staphylinidae	Vic	2 P
australiae Lea 1906	*Baris*	Curculionidae	NSW	3 P
australiae Lea 1923	*Pitnus*	Ptinidae	WA	2 P
australiae Lea 1912	*Sagola*	Pselaphidae	NSW	2 P
australiae Lea 1921	*Thallis*	Erotylidae	Belltrees, NSW	2 P
australicus Sloane 1896	*Tachys*	Carabidae	Tweed R., NSW	2 P
australis Castelnau 1867	*Apotomus*	Carabidae	Melbourne, Vic	2 T
australis King 1865	*Georyssus*	Georyssidae	Parramatta, NSW	2 T
australis King 1862	*Lutochrus*	Helminthidae	Parramatta R., NSW	2 T
australis Macleay 1871	*Abraeus*	Histeridae	Gayndah, Q	4 S
australis Macleay 1871	*Philonthus*	Staphylinidae	Gayndah, Q	1 S
australis Macleay 1887	*Languria*	Languriidae	Cairns, Q	4 S
australis Macleay 1871	*Polystichus*	Carabidae	Rockhampton, Q	H
australis Macleay 1888	*Trachys (Habroloma)*	Buprestidae	King Sound, WA	3 S
australis Wallace 1868	*Lomaptera*	Scarabaeidae	Lizard I., Q	1 T
azureipennis Macleay 1886	*Diphucephala*	Scarabaeidae	Victoria R., NT	2 S

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badius Macleay 1888	*Liparetrus*	Scarabaeidae	King Sound, WA	4 S
badius Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	H
balanirostris Lea 1906	*Myctides*	Curculionidae	Endeavour R., Q	3 P
banksiae W. S. Macleay 1827	*Carpophagus*	Chrysomelidae	NSW	2 S, 1 T
barbatus King 1863	*Mesoplatus (Batrisus)*	Pselaphidae	Parramatta, NSW	1 T
barnardi Macleay 1887	*Conopterum*	Carabidae	Dawson R., Q	H
barnardi Macleay 1886	*Diphucephala*	Scarabaeidae	Dawson R., Q	2 S
barnardi Macleay 1888	*Philoscaphus*	Carabidae	Dawson R., Q	H
barossae Carter 1936	*Brycopia*	Tenebrionidae	SA	1 P
barreti Carter 1926	*Helmis*	Helminthidae	NSW	2 P
basalis Macleay 1872	*Cylidrus*	Cleridae	Gayndah, Q	4 S
basalis Macleay 1871	*Hydroporus (Bidessus)*	Dytiscidae	Gayndah, Q	2 S
basalis Macleay 1866	*Tetracha (Megacephala)*	Carabidae	Port Denison, Q	4 S
basicollis Lea 1911	*Myllocerus*	Curculionidae	between Charters Towers and Hughenden, Q	2 P
basicollis Lea 1919	*Pseudoheteronyx*	Scarabaeidae	Q	1 P
basiflavus Lea 1908	*Metriorrhynchus*	Lycidae	Barron R., Q	2 P
basipennis Lea 1913	*Exithius*	Curculionidae	Tas	2 P
basirostris Lea 1906	*Baris*	Curculionidae	Q	1 P
basirostris Lea 1914	*Polyphrades*	Curculionidae	Melville I., NT	2 P
basiventris Lea 1915	*Geloptera*	Chrysomelidae	Endeavour R., Q	2 S
basizonis Lea 1904	*Cryptocephalus*	Chrysomelidae	Cairns, Q	2 S
bassi Sloane 1902	*Notonomus*	Carabidae	Yarragon, Vic	1 S
bathursti Pascoe 1866	*Symphyletes*	Cerambycidae	SA	2 T
besti Ferguson 1921	*Sclerorinus*	Curculionidae	Portland, Vic	H, A, 2P
besti Sloane 1901	*Morphnos (Teropha)*	Carabidae	Grampian Mts, Vic	2 P
biarctus Carter 1939	*Melanoxanthus*	Elateridae	Cairns, Q	H, 1 P
bicarinata Lea 1915	*Colaspoides*	Chrysomelidae	Richmond R., NSW	2 P
biceps Lea 1903	*Phyllocharis*	Chrysomelidae	Brisbane, Q	H, 1 P
bicolor Carter 1914	*Adelium*	Tenebrionidae	Tambourine Mt, Q	3 S
bicolor Carter 1914	*Platycilibe*	Tenebrionidae	Q	1 P
bicolor Castelnau 1868	*Silphomorpha*	Carabidae	Rockhampton, Q	1 T
bicolor Lea 1911	*Hoplocossonus*	Curculionidae	Port Denison, Q	2 P
bicolor Sloane 1896	*Clivina*	Carabidae	WA	3 T
bicolor Sloane 1899	*Thenarotes (Lecanomerus)*	Carabidae	Mordialloc, Vic	1 P
bicornis Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	2 S
bicornutum Macleay 1887	*Conopterum*	Carabidae	Endeavour R., Q	H
bicornutus Macleay 1863	*Hyborrhynchus*	Curculionidae	Port Lincoln, SA	2 S
bidentatus Lea 1899	*Melanterius*	Curculionidae	WA	2 P
bidentimedia Lea 1915	*Geloptera*	Chrysomelidae	Endeavour R., Q	H
bifasciata Lea 1910	*Agametis*	Curculionidae	Cairns, Q	2 P
bifasciata Macleay 1887	*Episcaphula*	Erotylidae	Russell R., Q	2 S
bifasciatus Macleay 1871	*Hydroporus (Hyphydrus)*	Dytiscidae	Gayndah, Q	4 S
bifasciculatus Lea 1912	*Scydmaenus*	Scydmaenidae	Vic	2 P
bifoveata Lea 1927	*Emplesis*	Curculionidae	Sydney, NSW	3 P
bifoveiceps Lea 1912	*Batrisodes*	Pselaphidae	Brisbane, Q	4 P
bifurcatus Lea 1908	*Iptergonus*	Curculionidae	Q	2 P
biguttata Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	4 S
biimpressa Lea 1915	*Trypocolaspis*	Chrysomelidae	Cairns district, Q	2 P
bilineatus Pascoe 1885	*Isotrogus*	Curculionidae	Cape York, Q	2 T
bilobus Lea 1898	*Laemosaccus*	Curculionidae	Cairns, Q	2 P
bimaculatum Macleay 1864	*Scaphidium*	Scaphidiidae	Port Denison, Q	L, PL
bimaculatus Lea 1921	*Aphanocephalus*	Corylophidae	Mackay, Q	2 P
bimaculatus Lea 1922	*Erotendomychus*	Endomychidae	Dividing Range, Vic	2 P
bimaculatus Macleay 1888	*Acupalpus*	Carabidae	King Sound, WA	H
bimaculatus Macleay 1864	*Adelotopus*	Carabidae	Port Denison, Q	2 S
bimaculatus Macleay 1864	*Caelodes (Liparochrus)*	Scarabaeidae	Port Denison, Q	3 S
bimaculatus Macleay 1864	*Chlaenius*	Carabidae	Port Denison, Q	H
binodosus Pascoe 1870	*Zymans*	Curculionidae	Wide Bay, Q	2 T
binotatus Lea 1920	*Coenobius*	Chrysomelidae	Sydney, NSW	2 P
biordinatus Macleay 1866	*Sclerorinus*	Curculionidae	Yorke Peninsula, SA	H

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bipunctata W. S. Macleay 1819	*Chasmodia (Lagochile)*	Scarabaeidae	Brazil	2 S
bipunctatum Macleay 1863	*Carenum (Eutoma)*	Carabidae	Port Denison, Q	2 S
bipunctatus Macleay 1865	*Euryscaphus*	Carabidae	SA	H
bipustulatus Macleay 1871	*Bembidium*	Carabidae	Gayndah, Q	6 S
bisignatus Pascoe 1874	*Acalles*	Curculionidae	Gayndah, Q	1 T
bisinuatus Macleay 1873	*Arthropterus*	Carabidae	Lane Cove, NSW	H
bispinosus Macleay 1872	*Bostrychus*	Bostrychidae	Gayndah, Q	4 S
bistriatum Macleay 1871	*Bembidium (Tachys)*	Carabidae	Gayndah, Q	6 S
bituberculata Lea 1911	*Fergusoniella (Fergusonia)*	Curculionidae	Swan R., WA	1 P
bituberculatus Macleay 1886	*Liparetrus*	Scarabaeidae	SA	4 S
bivittata Lea 1909	*Eniopea*	Curculionidae	NSW	2 P
bivitticollis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	H*
bizonata Macleay 1887	*Thallis*	Erotylidae	Cairns, Q	2 S
bizonata Macleay 1873	*Zonitis*	Meloidae	Gayndah, Wide Bay, Q	4 S
blackburni Carter 1926	*Notoceratus*	Tenebrionidae	NSW	1 P
blackburni Ferguson 1914	*Sclerorinus*	Curculionidae	SA	1 P
blackburni Lea 1895	*Carphurus*	Melyridae	Adelaide, SA	1 P
blackburni Lea 1911	*Eristus*	Curculionidae	Hobart, Tas	2 P
blackburni Lea 1916	*Geomela*	Chrysomelidae	Windsor, NSW	4 P
blackburni Lea 1907	*Mandalotus*	Curculionidae	Stonor, Tas	2 P
blackburni Macleay 1888	*Saragus*	Tenebrionidae	SA	3 S
blackburni Sloane 1896	*Clivina*	Carabidae	SA	1 S
blackburni Sloane 1890	*Promecoderus*	Carabidae	Port Lincoln, SA	1 T
blackmorei Lea 1907	*Mandalotus*	Curculionidae	NSW	2 P
blanda Lea 1917	*Mordella*	Mordellidae	Wide Bay, Q	H
bonellii W. S. Macleay 1821	*Scarabaeus*	Scarabaeidae	Cape of Good Hope, South Africa	H
bostocki Castelnau 1867	*Geoscaptus (Scarites)*	Carabidae	Nicol Bay, WA	1 T
boviei Lea 1911	*Ecrizothis*	Curculionidae	Vic	2 P
brêmei Macleay 1872	*Pterohelaeus*	Tenebrionidae	Gayndah, Q	4 S
brevicauda Ferguson 1914	*Psalidura*	Curculionidae	Dalby, Q	H, A
breviceps King 1869	*Articerus*	Pselaphidae	Ropes Creek, NSW	1 T
brevicollis Blackburn 1889	*Heteronyx*	Scarabaeidae	NSW	2 S
brevicollis Lea 1921	*Ditropidus*	Chrysomelidae	Cairns district, Q	2 P
brevicollis Lea 1907	*Lemidia*	Cleridae	King Sound, Albany, Vasse, Rottnest I., WA	4 P
brevicollis Macleay 1873	*Arthropterus*	Carabidae	NSW	2 S
brevicornis Cameron 1927	*Sternotropa*	Staphylinidae	Fiji	2 P
brevicornis Ferguson 1915	*Acantholophus*	Curculionidae	Vic	H, 1 P
brevicornis Lea 1894	*Tomoderus*	Anthicidae	SA	2 P
breviformis Ferguson 1909	*Psalidura*	Curculionidae	Glen Innes, NSW	H, 1 P
brevior Ferguson 1914 var. of *maculipennis* Lea	*Talaurinus*	Curculionidae	Eucla, WA; SA	H, A, 1 P
brevipenne Macleay 1887	*Eutoma (Carenum)*	Carabidae	Moreton Bay, Q	H
brevipennis Macleay 1888	*Adelotopus*	Carabidae	King Sound, WA	2 S
brevipes Lea 1915	*Hyparinus*	Curculionidae	Cairns, Q	1 P
brevipilis Lea 1915	*Scelodonta*	Chrysomelidae	Cairns district, Endeavour R., Q	2 P
brevipilis Lea 1915	*Scydmaenus*	Scydmaenidae	Mt Wellington, Waratah, Tas	2 P
brevirostris Lea 1908	*Pantoreites*	Curculionidae	Vic	2 P
brevirostris Lea 1908	*Polyphrades*	Curculionidae	WA	2 P
brevirostris Lea 1913	*Tyrtaeosus*	Curculionidae	Cairns district, Q	1 P
brevis Lea 1919	*Neosalpingus*	Salpingidae	Cairns, Q	1 P
brevis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	1 P
bribiensis Lea 1921	*Mordella*	Mordellidae	Bribie I., Q	1 P
brisbanensis Castelnau 1868 (1867)	*Veradia*	Carabidae	Brisbane, Q	2 T
broadhursti Lea 1896	*Pterohelaeus*	Tenebrionidae	Houtman's Abrolhos, WA	2 S
browni Ferguson 1915	*Acantholophus*	Curculionidae	WA	H, 1 P
browni Ferguson 1915	*Sclerorinus*	Curculionidae	Yalgoo, WA	H, A
browni Lea 1916	*Leptops*	Curculionidae	Cue, WA	2 P
browni W. S. Macleay 1819 var. of *manicatus* Swartz	*Anoplognathus (Repsimus)*	Scarabaeidae	"Australasia"	2 S
browni Sloane 1913	*Cicindela*	Carabidae	WA	1 S

* Label present, specimen missing.

Specific Name	Original Genus	Family	Type Locality	Types
brunneipennis Macleay 1871	*Odontotonyx*	Scarabaeidae	Gayndah, Q	H
brunneipennis Macleay 1871	*Oxytelus*	Staphylinidae	Gayndah, Q	2 S
brunnipenne Macleay 1871	*Bembidium (Tachys)*	Carabidae	Gayndah, Q	2 S
brunnipennis Macleay 1888	*Saragus*	Tenebrionidae	King Sound, WA	4 S
bryophagus Lea 1907	*Mandalotus*	Curculionidae	Hobart, Tas	2 P
bryophila Lea 1911	*Rhybaxis*	Pselaphidae	Mt Wellington, New Norfolk, Tas	2 P
bryophilus Lea 1911	*Microchaetes*	Byrrhidae	Waratah, Tas	1 P
bubaroides Ferguson 1914	*Talaurinus*	Curculionidae	SA	H
buprestoides Sloane 1896	*Tachys*	Carabidae	King Sound, WA	4 P
burmeisteri Macleay 1886	*Liparetrus (Automolus)*	Scarabaeidae	Illawarra, NSW	L, 1 PL
burnettensis Macleay 1871	*Leperina*	Trogossitidae	Gayndah, Q	1 S
bursaria Lea 1914	*Microvalgus*	Scarabaeidae	NSW, Vic, Tas	2 P
cacus Macleay 1863	*Geoscaptus (Scarites)*	Carabidae	Port Denison, Q	2 S
caeruleipennis Lea 1920	*Ditropidus*	Chrysomelidae	WA	2 P
caeruleipennis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	1 P
calcaratum Macleay 1873	*Brithysternum*	Carabidae	Peak Downs, Q	4 S
calcaratus Lea 1908	*Hypattalus*	Melyridae	Sydney, NSW	3 P
calcaratus Macleay 1865	*Cubicorrhynchus*	Curculionidae	SA	4 S
calcaratus Macleay 1871	*Merodontus (Platyphymatia)*	Scarabaeidae	Gayndah, Q	2 S
calcaratus Pascoe 1875	*Titurius*	Cerambycidae	Ropes Creek, NSW	2 T
caliginosa Pascoe 1872	*Rhinaria*	Curculionidae	Bombala, NSW	2 T
calomeloides Lea 1904	*Cadmus*	Chrysomelidae	Gunning, NSW	2 P
calopasa Lea 1917	*Mordella*	Mordellidae	Cairns district, Q	2 P
caloptera Lea 1917	*Mordella*	Mordellidae	Cairns district, Q	1 P
calvulum Olliff 1889	*Hopatrum*	Tenebrionidae	Lord Howe I.	4 T
calypso Blackburn 1889 (1888)	*Paropsis (Pyrgo)*	Chrysomelidae	Dalmorton, NSW	2 P
camdenensis Macleay 1865	*Talaurinus*	Curculionidae	Camden, NSW	2 S
camelus Pascoe 1873	*Tychraeus*	Curculionidae	Tas	2 T
campestre Macleay 1865	*Carenum*	Carabidae	Lower Murrumbidgee, NSW	2 S
canalicornis Lea 1909	*Myllocerus*	Curculionidae	WA	2 P
canaliculatum Carter 1908	*Adelium*	Tenebrionidae	NSW	1 P
cancellata Ferguson 1909	*Psalidura*	Curculionidae	Yarrow Creek, NSW	H, A
cancellata Lea 1908	*Hyocis*	Tenebrionidae	Vic	2 P
canei Carne 1957	*Adoryphorus*	Scarabaeidae	Burrawang, NSW	1 P
canescens Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
caperatus Pascoe 1869	*Atryphodes (Cardiothorax)*	Tenebrionidae	Hunter R., NSW	2 T
capillatus Macleay 1888	*Heteronyx*	Scarabaeidae	Barrier Range, WA	H
capillatus Macleay 1886	*Liparetrus*	Scarabaeidae	King George Sound, WA	4 S
capreolus Pascoe 1867	*Symphyletes*	Cerambycidae	Rockhampton, Q	2 T
capucinus Pascoe 1870	*Exithius*	Curculionidae	Tas	3 T
cara Lea 1917	*Haplonycha*	Scarabaeidae	SA	2 P
cardinalis Donovan 1841	*Hyperantha*	Buprestidae	Brazil	H
carimatifrons Ferguson 1914	*Talaurinus*	Curculionidae	SA	H, A, 1 P
carinata Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	3 S
carinaticeps Lea 1909	*Catasarcus*	Curculionidae	Esperance Bay, WA	1 P
carinatior Ferguson 1915	*Talaurinus*	Curculionidae	NSW	H
carinatus Ferguson 1914	*Talaurinus*	Curculionidae	Vic	H, A
carinatus King 1864	*Heterognathus*	Scydmaenidae	Parramatta, NSW	1 T
carinatus Lea 1904	*Myllocerus*	Curculionidae	King Sound, WA	3 P
carinatus Macleay 1864	*Carenum (Philoscaphus)*	Carabidae	Wingelo, Bungendore, NSW	3 S
carpentaria Ferguson 1912	*Talaurinus*	Curculionidae	Q	H
carpentaria Macleay 1873	*Bolboceras*	Geotrupidae	Q	2S
carteri Ferguson 1923	*Bubaris*	Curculionidae	Dalveen, Q	H, A, 1 P
carteri Ferguson 1909	*Psalidura*	Curculionidae	Kosciusko, NSW	H, A
carteri Ferguson 1915	*Sclerorinus*	Curculionidae	Bridgetown, WA	H, A
carteri Ferguson 1913	*Talaurinus*	Curculionidae	NSW	H
carteri Sloane 1907	*Notonomus*	Carabidae	Kosciusko, NSW	1 P
carus Lea 1902	*Perissops*	Curculionidae	Endeavour R., Q	2 P
castaneipennis Macleay 1871	*Valgus*	Scarabaeidae	Gayndah, Q	2 S
castaneipennis Macleay 1888	*Rhopaea*	Scarabaeidae	WA	H

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castaneus Lea 1921	*Circopes*	Nitidulidae	Q	2 P
castaneus Lea 1920	*Limnichus*	Limnichidae	Mt Tambourine, Q	2 P
castaneus Macleay 1871	*Heteronyx*	Scarabaeidae	Gayndah, Q	2 S
castaneus Macleay 1871	*Silvanus*	Silvanidae	Gayndah, Q	H
castelnaui Lea 1911	*Leptops*	Curculionidae	Rockhampton, Q	1 P
castelnaui Macleay 1888	*Darodilia*	Carabidae	King Sound, WA	2 S
castigatus Lea 1904	*Loxopleurus*	Chrysomelidae	Sydney, NSW	2 S
castor Lea 1911	*Euplectops*	Pselaphidae	Tas	2 S
castor Lea 1909	*Myllocerus*	Curculionidae	Brisbane, Q	2 P
castor Lea 1902	*Tyrtaeosus*	Curculionidae	Endeavour R., Q	2 P
castor Pascoe 1866	*Helaeus*	Tenebrionidae	SA	1 T
casuarinae Lea 1915	*Micraonychus*	Curculionidae	NSW	2 P
caudata Carter 1937	*Phormesa*	Colydiidae	Adelaide, SA	2 P
caudata Macleay 1865	*Psalidura*	Curculionidae	Darling Downs, Q	2 S
caviceps Macleay 1866	*Talaurinus*	Curculionidae	Port Lincoln, SA	4 S
cavicolle Macleay 1873	*Bolboceras*	Geotrupidae	SA	L♂ + 1♂ 2 ♀ PL
cavicollis Lea 1912	*Chlamydopsis*	Histeridae	Sydney, NSW	H
cavicornis Lea 1908	*Laius*	Melyridae	Inglewood, Q	3 P
caviventris Lea 1923	*Monolepta*	Chrysomelidae	Groote Eylandt, NT	2 P
cellaris Pascoe 1873	*Dysostines*	Curculionidae	Sydney, NSW	1 T
centralis Macleay 1887	*Metriorrhynchus*	Lycidae	Cairns, Q	2 S
centralis Macleay 1888	*Silphomorpha*	Carabidae	King Sound, WA	2 S
centurio Pascoe 1866	*Sybra*	Cerambycidae	Illawarra, NSW	3 T
cereus Macleay 1887	*Pterohelaeus*	Tenebrionidae	WA	H
chalcea Lea 1915	*Edusa*	Chrysomelidae	Rockhampton, Q	2 P
chalcopterus Olliff 1887	*Mysolius*	Staphylinidae	Cairns, Mulgrave R., Q	3 T
chalybeipennis Macleay 1873	*Philonthus*	Staphylinidae	Gayndah, Q	4 S
chaudoiri Castelnau 1867	*Catascopus*	Carabidae	Clarence R., NSW	2 T
chaudoiri Castelnau 1868	*Mystropomus*	Carabidae	Clarence R., NSW	2 T
chaudoiri Macleay 1887	*Carenidium*	Carabidae	Endeavour R., Q	H
chaudoiri Macleay 1869	*Carenum*	Carabidae	SA	H
chaudoiri Macleay 1873	*Coptocarpus*	Carabidae	Clarence R., NSW	L
chaunoderus Lea 1925	*Myllocerus*	Curculionidae	Groote Eylandt, NT	3 P
chlaenioides Macleay 1888	*Chlaenioidius (Poecilus)*	Carabidae	King Sound, WA	2 S
chrysideus Pascoe 1885	*Myllocerus*	Curculionidae	Q	1P
cicatricosa Lea 1907	*Lemidia*	Cleridae	NSW	2 P
cicatricosa Pascoe 1871	*Leptops*	Curculionidae	Wide Bay, Q	2 T
cinctum Macleay 1873	*Lachnoderma*	Carabidae	Clarence R., NSW	2 S
cinerascens Lea 1906	*Leptops*	Curculionidae	Hunter R., NSW	2 P
cingulatus Macleay 1871	*Myrmecocephalus*	Staphylinidae	Gayndah,Q	2 S
cingulatus Macleay 1871	*Paederus*	Staphylinidae	Gayndah, Q	4 S
cinnamomea Macleay 1862	*Stigmodera*	Buprestidae	Port Denison, Q	H
clarus Lea 1904	*Cryptocephalus*	Chrysomelidae	WA	2 S
clarus Lea 1915	*Scydmaenus*	Scydmaenidae	Tas	2 P
clathratus Macleay 1888	*Saragus*	Tenebrionidae	Fitzroy Downs, Q	H
clavicornis Ferguson 1912	*Talaurinus*	Curculionidae	NSW	H
cleistostoma Lea 1910	*Tretothorax*	Tenebrionidae	Q	1 P
clypealis Lea 1924	*Heteronyx*	Scarabaeidae	Tas	H
coccinelloides Lea 1920	*Elaphodes*	Chrysomelidae	Hunter R., NSW	1 P
coelestis Lea 1903	*Calomela*	Chrysomelidae	Port Denison, Q	2 P
coelioxys Lea 1917	*Mordellistena*	Mordellidae	NSW	1 P
coenosus Lea 1899	*Metriorrhynchus*	Lycidae	Sydney, Galston; Gosford, NSW	2 T
coerulea Champion 1894	*Ectyche*	Tenebrionidae	Baudin I., WA	1 S
coeruleipennis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	1 P
collaceratus Lea 1905	*Bleptocis*	Curculionidae	NSW	H
collaris Lea 1914	*Polyphrades*	Curculionidae	Batchelor, NT	1 P
collaris Macleay 1886	*Liparetrus*	Scarabaeidae	SA	H
collossus Pascoe 1870	*Leptops*	Curculionidae	Champion Bay, WA	2 T
columbinus Carter 1939	*Melanoxanthus*	Elateridae	Cairns, Q	H, 1 P
comatus Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
comes Sloane 1898	*Euthenaris*	Carabidae	Darling Ranges, WA	2 T
commodum Pascoe 1869	*Adelium*	Tenebrionidae	Tas	2 T
communis Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L, 1 PL
commutabilis Lea 1915	*Rhyparida*	Chrysomelidae	Q	2 P

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compactus Lea 1908	*Elleschodes*	Curculionidae	NSW	1 P
compositus Lea 1904	*Cryptocephalus*	Chrysomelidae	Gayndah, Q	2 S
compositus Lea 1907	*Mecistocerus*	Curculionidae	Cape York, Q	7 P
compta Lea 1903	*Pseudotepperia*	Curculionidae	WA	H
comptus Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	2P
concaviceps Lea 1917	*Oxacis*	Oedemeridae	Fortescue R., WA	2 P
concavirostris Lea	*Rhinaria*	Curculionidae	Port Denison, Q	2 P
concinnus Lea 1908	*Elleschus*	Curculionidae	Forest Reef, NSW	1 P
concolor King 1869	*Anthicus*	Anthicidae	Parramatta, NSW	2 T
concolor Macleay 1871	*Nitidula*	Nitidulidae	Gayndah, Q	4 S
concolor Macleay 1887	*Palaestrida*	Meloidae	Russell R., Q	H
concolor W. S. Macleay 1827	*Stenoderus*	Cerambycidae	Tas	4 S
concolor Sloane 1893	*Euryscaphus*	Carabidae	Fowler's Bay, SA	A (♀)
confusus Ferguson 1914	*Talaurinus*	Curculionidae	NSW	H, A
confusus Macleay 1872	*Pterohelaeus*	Tenebrionidae	Gayndah, Q	3 S
confusus Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
congener Olliff 1885	*Silvanus*	Silvanidae	SA	1 T
congestum Lea 1910	*Apion*	Curculionidae	Port Denison, Q	2 P
conicicornis Lea 1911	*Euplectops*	Pselaphidae	Mt Wellington, Hobart, Tas	2 P
conifer Lea 1910	*Onesorus*	Curculionidae	WA	2 P
conjungens Lea 1925	*Platysoma*	Histeridae	NSW, Q	2 P
conloni Lea 1907 (1908)	*Perperus*	Curculionidae	King I., Tas	2 P
conspecta Lea 1917	*Mordella*	Mordellidae	Q	1 P
conspersus Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
conspiciendus Lea 1904	*Cryptocephalus*	Chrysomelidae	NSW	1 P
conspiciendus Lea 1912	*Exithius*	Curculionidae	Tas	1 P
conspicua Olliff 1886	*Leperina*	Trogossitidae	Lizard I., Q	4 T
conspicuus Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	4 S
constricticeps Sloane 1896	*Pyrrhotachys (Perileptus)*	Carabidae	Tamworth, NSW	4 P
constricticornis Lea 1910	*Articerus*	Pselaphidae	Murrurundi, NSW	H
constrictus Macleay 1872	*Anthicus*	Anthicidae	Gayndah, Q	2 S
contaminatus Grouvelle 1877	*Laemophlaeus*	Cucujidae	Wide Bay, Q	2 T
conterminus Olliff 1885	*Laemophlaeus*	Cucujidae	Wide Bay, Q	1 T
convexa Macleay 1872	*Cistela*	Alleculidae	Gayndah, Q,	1 S
convexicollis Lea 1904	*Cryptocephalus*	Chrysomelidae	Berrima, NSW	2 S
convexicollis Macleay 1888	*Saragus*	Tenebrionidae	Port Augusta, SA	3 S
convexior Macleay 1886	*Liparetrus*	Scarabaeidae	SA	L, PL
convexiusculum Macleay 1872	*Adelium*	Tenebrionidae	Gayndah, Q	2 S
convexiusculum Macleay 1871	*Platysoma*	Histeridae	Gayndah, Q	4 S
convexiusculus Macleay 1866	*Acantholophus*	Curculionidae	Shelley's Flat, NSW	H, A
convexiusculus Macleay 1871	*Carpophilus*	Nitidulidae	Gayndah, Q	2 S
convexiusculus Macleay 1871	*Gyrinus*	Gyrinidae	NSW, Q	2 S
convexiusculus Macleay 1871	*Harpalus (Gnathaphanus)*	Carabidae	Gayndah, Q	H
convexiusculus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Murrumbidgee (Wagga), NSW	2 S
convexum Macleay 1871	*Bembidium (Tachys)*	Carabidae	Gayndah, Q	8 P
convexus Castelnau 1865	*Coptocarpus*	Carabidae	King George Sound, WA	T
convexus Lea 1910	*Lissotes*	Lucanidae	Tas	1 P
convexus Macleay 1864	*Craspedophorus (Eudema)*	Carabidae	Port Denison, Q	2 S
convexus Sloane 1899	*Meonis*	Carabidae	Blue Mts, NSW	1 P
convexus Sloane 1893	*Sclerorinus*	Curculionidae	McDonnell Ranges, Central Australia	H
cooki Macleay 1886	*Liparetrus (Automolius)*	Scarabaeidae	Endeavour R., Q	H
coracina Macleay 1871	*Tachyusa (Calodera)*	Staphylinidae	Gayndah, Q	4 S
cordicollis Pascoe 1869	*Cardiothorax*	Tenebrionidae	Q	2 T
cordicollis Sloane 1899	*Cyclothorax (Mecyclothorax)*	Carabidae	Urana, NSW	2 S
cordipenne Sloane 1897	*Carenum*	Carabidae	NW district, Vic	2 T (hind body only)
coriaceus Lea 1920	*Ditropidus*	Chrysomelidae	Geraldton, WA	2 P
cornigerum Macleay 1873	*Bolboceras*	Geotrupidae	Swan R., WA	L♂ 1♂ 2♀ PL

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cornutum Macleay 1888	*Bolboceras*	Geotrupidae	Barrier Range, WA	L♂ 1♂ 2♀ PL
cornutus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Wide Bay, Q	4 S
corpulentus Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	H
corticalis Lea 1924	*Dorcatoma*	Anobiidae	Pillworta, SA	1 P
corticalis Lea 1908	*Pseudapries*	Curculionidae	Cairns, Q	2 P
corticalis Lea 1913	*Tapinocis*	Curculionidae	Hobart, Tas	1 P
corynophylloides Carne 1957	*Neodasygnathus*	Scarabaeidae	NSW	3 P
costalis Macleay 1873	*Philoscaphus*	Carabidae	Nicol Bay, WA	3 S
costata Lea 1919	*Euclarkia*	Colydiidae	Swan R., WA	3 P
costata Macleay 1871	*Ditoma*	Colydiidae	Gayndah, Q	2 S
costata Macleay 1872	*Melobasis*	Buprestidae	Gayndah, Q	L + 3 PL
costata Pascoe 1863	*Penthea*	Cerambycidae	King Sound, WA	2 T
costatus King 1869	*Nepharis*	Colydiidae	Liverpool, NSW	1 T
costatus Macleay 1871	*Microchaetes*	Byrrhidae	Gayndah, Q	3 S
costatus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Darwin, NT	4 S
costicollis Lea 1909	*Metriorrhynchus*	Lycidae	Cairns, Q	H
costipennis Ferguson 1914	*Psalidura*	Curculionidae	Brisbane, Q	H, A
costipennis Ferguson 1912	*Talaurinus*	Curculionidae	Vic	H
costirostris Lea 1907 (1908)	*Perperus*	Curculionidae	King I., Tas	2 P
cowardense Blackburn 1894	*Hopatrum (Gonocephalum)*	Tenebrionidae	Coward Springs, nr Lake Eyre, SA	1 T
coxalis Lea 1913	*Tyrtaeosellus*	Curculionidae	Cairns district, Q	1 P
coxi Ferguson 1923	*Mythites*	Curculionidae	Eccleston, NSW	H, 1 P
coxi Macleay 1865	*Psalidura*	Curculionidae	Mudgee (Dabee), NSW	4 S
c — purpureus Lea 1914	*Laius*	Melyridae	Cairns, Q	2 P
crabroides Carter 1928	*Hesthesis*	Cerambycidae	Q	H, A
crassiceps Macleay 1871	*Cymindis*	Carabidae	Moreton Bay, Q	H
crassicornis Bates 1873	*Spiloscapha*	Tenebrionidae	NSW	2 S
crassicornis Lea 1895	*Heteromastix*	Cantharidae	Cairns, Q	4 P
crassicornis Macleay 1888	*Cicindela*	Carabidae	King Sound, WA	H
crassidens Macleay 1865	*Acantholophus*	Curculionidae	King Sound, WA	4 S
crassipes Lea 1915	*Phagonophana*	Scydmaenidae	Tas	2 P
crassipes Sloane 1898	*Gnathoxys*	Carabidae	Rottnest I., WA	1 S
crassipes Sloane 1904	*Morio*	Carabidae	Kuranda, Q	1 T
crassirostris Lea 1906	*Leptops*	Curculionidae	Port Denison, Q	1 P
crassiusculus Macleay 1866	*Hyborrhynchus*	Curculionidae	King George Sound, WA	1 S
crawshawi Ferguson 1923	*Aedriodes*	Curculionidae	Jandokot, WA	H, A, 11 P
crawshawi Ferguson 1921	*Sclerorrhinella*	Curculionidae	WA	H, 1 P
crenaticollis Macleay 1865	*Acantholophus*	Curculionidae	NSW	H
crenaticollis Macleay 1864	*Scaraphites*	Carabidae	SA	H
crenatipennis Macleay 1871	*Ammoecius*	Scarabaeidae	Gayndah, Q	2 S
crenicolle Pascoe 1869	*Seirotrana*	Tenebrionidae	Mts of Victoria, Vic	4 T
crenulata Macleay 1885	*Homolamprima*	Lucanidae	Clarence River, NSW	H
crenulatus Ferguson 1912	*Talaurinus*	Curculionidae	NSW	H
crenulatus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Darwin, NT	H
crenulatus Macleay 1888	*Pterostichus*	Carabidae	King Sound, WA	1 S
crenulatus Macleay 1888	*Saragus*	Tenebrionidae	Port Denison, Q	2 S
crenulicollis Bates 1880	*Atryphodes (Cardiothorax)*	Tenebrionidae	Endeavour R., Q	1 T
cretata Pascoe 1859	*Rhytiphora*	Cerambycidae	Moreton Bay, Q	2 T
cribriceps Lea 1923	*Monolepta*	Chrysomelidae	Strahan, Tas	2 P
cribricollis Lea 1928	*Idotasia*	Curculionidae	Fiji	2 P
cribripennis Lea 1920	*Ditropidus*	Chrysomelidae	Swan R., WA	2 P
criniger Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
crinita Pascoe 1872	*Agriochaeta*	Curculionidae	Gayndah, Q	1 T
cristata Lea 1911	*Fergusonia*	Curculionidae	Sydney, NSW	2 P
cristatus Pascoe 1875	*Hebecerus*	Cerambycidae	Gayndah, Q	4 T
cristatus Pascoe 1870	*Protopalus*	Curculionidae	Q	2 T
croesus Lea 1915	*Agetinus*	Chrysomelidae	King George Sound, WA	H
cruciata Pascoe 1875	*Corrhenes*	Cerambycidae	Gayndah, Q	2 T
cruciatus W. S. Macleay 1827	*Clerus*	Cleridae	Australia	H
cruciger Macleay 1888	*Onthophagus*	Scarabaeidae	WA	2 S
crucigera Macleay 1863	*Tetracha*	Carabidae	Port Denison, Q	2 S
crucigera Pascoe 1910	*Odosyllis*	Curculionidae	New Guinea	1 P
cucullata Macleay 1887	*Emenadia*	Rhipiphoridae	Cairns, Q	3 S
cultrata Ferguson 1914	*Psalidura*	Curculionidae	Vic	H, A

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cuneicaudata Ferguson 1914	*Psalidura*	Curculionidae	Q	1 P (♀)
cuniculus Macleay 1864	*Onthophagus*	Scarabaeidae	Northern parts of NSW & Q	2 S
cuneiformis Olliff 1886	*Dabra*	Staphylinidae	King George Sound, WA	2 T
cuprea Macleay 1886	*Diphucephala*	Scarabaeidae	Rockhampton, Q	2 S
cupreipennis Macleay 1871	*Stenus*	Staphylinidae	Gayndah, Q	♂L + 3♀ PL
cupreomicans Ferguson 1921	*Acantholophus*	Curculionidae	WA	H
cupreoniger Lea 1912	*Ptinus*	Ptinidae	Stanley, Tas	2 P
cupripenne Macleay 1863	*Carenum*	Carabidae	King George Sound, WA	2 S
cupripes Lea 1903	*Stethomela*	Chrysomelidae	Cairns, Q	1 P
cursitans Macleay 1863	*Distipsidera*	Carabidae	Clarence R., NSW	2 S
curticollis Sloane 1896	*Tachys*	Carabidae	Tweed River, NSW	1 P
curtulus Olliff 1889	*Meneristes*	Tenebrionidae	Lord Howe I.	4 T
curvifasciata Lea 1910	*Allelidea*	Cleridae	WA	1 P
curvipes Ferguson 1915	*Cubicorrhynchus*	Curculionidae	Geraldton, WA	4 P
curvipes Lea 1913	*Decilans*	Curculionidae	Ardrossan, SA	2 P
curvipes Sloane 1920	*Promecoderus*	Carabidae	Tas	1 S
cuvieri W. S. Macleay 1821	*Scarabaeus*	Scarabaeidae	Senegal	H
cyanea Castelnau 1868	*Helluosoma (Helluonidius)*	Carabidae	Rockhampton, Q	2 T*
cyanea Macleay 1872	*Lagria*	Lagriidae	Gayndah, Q	4 S
cyaneipennis Macleay 1871	*Leptacinus (Metaponcus)*	Staphylinidae	Gayndah, Q	2 S
cyaneum Castelnau 1867	*Helluosoma*	Carabidae	Rockhampton, Q	2 T
cyaneocinctus Macleay 1871	*Notonomus*	Carabidae	Gayndah, Q	1 S
cyaneus Macleay 1872	*Atractus (Neoatractus)*	Alleculidae	Gayndah, Q	4 S
cyaneus Pascoe 1870	*Omolipus*	Tenebrionidae	King George Sound, WA	2 T
cyanipenne Macleay 1869	*Carenum*	Carabidae	SA	4 S
cylindrica Carter 1937	**Bitoma*	Colydiidae	Illawarra, NSW & Q	2 P
cylindrica Macleay 1863	*Megacephala*	Carabidae	Peak Downs, Q	2 S
cylindricollis Macleay 1873	*Arthropterus*	Carabidae	Rockhampton, Q	H
cylindricornis Lea 1910	*Articerus*	Pselaphidae	Portland, Vic	2 P
cylindricus Macleay 1872	*Bostrychus*	Bostrychidae	Gayndah, Q	4 S
cylindricus Macleay 1888	*Bubastes*	Buprestidae	King Sound, WA	H
cylindricus Macleay 1871	*Sunius*	Staphylinidae	Gayndah, Q	2 S
cylindrirostre Lea 1910	*Apion*	Curculionidae	SA	1 P
cynethiodes Pascoe 1885	*Zena*	Curculionidae	Celebes	1 P
dallasi Pascoe 1869	*Rhytiphora*	Cerambycidae	Champion Bay, WA	1 T
damastes Macleay 1863	*Geoscaptus*	Carabidae	Murrumbidgee, NSW	2 S
dameli Macleay 1869	*Carenidium*	Carabidae	Cape York, Q	H
dameli Macleay 1873	*Gigadema*	Carabidae	Cape York, Q	H
dameli Macleay 1873	*Mecynognathus*	Carabidae	Cape York, Q	2 S
dameli Macleay 1865	*Talaurinus (Dicherotropis)*	Curculionidae	King George Sound, WA	4 S
dardanus W. S. Macleay 1819	*Phanaeus*	Scarabaeidae	"Brazilia"	H
darlingense Macleay 1887	*Carenidium*	Carabidae	Bourke, NSW	H
darlingensis Blackburn 1889	*Heteronyx*	Scarabaeidae	Darling R., NSW	2 S**
darlingensis Ferguson 1912 var. of *variegatus* Macleay	*Talaurinus*	Curculionidae	Darling R., NSW	H, A
darlingensis Macleay 1873	*Arthropterus*	Carabidae	Darling R., NSW	H
darwini Blackburn 1889	*Heteronyx*	Scarabaeidae	NT	1 S
darwini Sloane 1909	*Cicindela*	Carabidae	Port Denison, Q	1 S
darwiniense Macleay 1878	*Carenum*	Carabidae	Darwin, NT	H
darwiniensis Macleay 1887	*Pterohelaeus*	Tenebrionidae	Port Darwin, NT	H
daveyi Ferguson 1921	*Sclerorinus*	Curculionidae	Portland, Vic	H, A, 2 P
deauratus Macleay 1872	*Agrilus*	Buprestidae	Gayndah (Wide Bay), Q	2 S
debilis Blackburn 1890	*Clivina*	Carabidae	SA	1 P
decemmaculata Lea 1903 (1902)	*Phyllocharis*	Chrysomelidae	Wide Bay, Q	2 S
decipiens Lea 1908	*Eleschus*	Curculionidae	WA	2 P
decipiens Lea 1912	*Gerallus*	Pselaphidae	Vic	1 P
decipiens Lea 1910	*Lamitema*	Curculionidae	Cairns, Q	2 P

* Hind bodies only.

** One marked "Type" by Lea.

Specific Name	Original Genus	Family	Type Locality	Types
decipiens Lea 1910	*Merimnetes*	Curculionidae	Mt Wellington, Tas	2 P
decipiens Lea 1915	*Micraonychus*	Curculionidae	Hobart, Tas	2 P
decipiens Lea 1913	*Pezichus*	Curculionidae	Cairns district, Q	1 P
decipiens Pascoe 1863	*Symphyletes*	Cerambycidae	SA	2 T
decorticata Macleay 1863	*Schizorhina (Camilla)*	Scarabaeidae	Port Denison, Q	8 S
decorum Sloane 1888	*Carenum*	Carabidae	Coonamble district, NSW	1 P
delicatulus Lea 1895	*Anthicus*	Anthicidae	WA	1 P
delicatulus Lea 1904	*Balaninus*	Curculionidae	WA	H
delicatulus Lea 1904	*Schizosternus*	Chrysomelidae	Rockhampton, Q	2 S
denisoni Lea 1894	*Anthicus*	Anthicidae	Tarcutta, NSW	6 P
denisoni King 1869	*Anthicus*	Anthicidae	Port Denison, Q	2 S
denisoni King 1869	*Formicans*	Anthicidae	Port Denison, Q	2 S
dentatus Blackburn 1895	*Eophileurus*	Scarabaeidae	Endeavour R., Port Denison, Q	2 T
denticollis Macleay 1865	*Acantholophus*	Curculionidae	Kurrajong, NSW	2 S
denticollis Macleay 1864	*Scopodes*	Carabidae	Port Denison, Q	3 S
denticollis Pascoe 1867	*Phaeapete*	Cerambycidae	Rockhampton, Q	2 T
dentipes Lea 1921	*Metriorrhynchus*	Lycidae	Coen R., Q	H
dentiventris Lea 1915	*Scydmaenus*	Scydmaenidae	Tas, NSW	1 P
depressiuscula Macleay 1872	*Cistela (Nocar)*	Alleculidae	Gayndah, Q	3 S
depressiusculus Macleay 1887	*Pterohelaeus*	Tenebrionidae	SA	2 S
depressus Lea 1915	*Scydmaenus*	Scydmaenidae	SA	6 P
depressus Macleay 1873	*Arthropterus*	Carabidae	Tweed R., NSW	H
depressus Wollaston 1873	*Aphanocorynes*	Curculionidae	King George Sound, WA	2 S
derbyensis Macleay 1888	*Helaeus*	Tenebrionidae	Derby, WA	2 S
desectus Macleay 1871	*Onthophagus*	Scarabaeidae	Rockhampton, Q	2 S
desiderabilis Lea 1906	*Ipsichora*	Curculionidae	Q	2 P
deuqueti Carter 1927	*Stigmodera*	Buprestidae	Armidale, NSW	1 P
devia Lea 1906	*Baris*	Curculionidae	Q	2 P
devexus Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	H
digglesi Macleay 1869	*Eutoma (Carenum)*	Carabidae	Moreton Bay, Q	3 S
digglesi Macleay 1873	*Carenum*	Carabidae	Brisbane, Q	2 S
dilaticollis Macleay 1863	*Sclerorinus*	Curculionidae	Vic	3 S
dilaticollis Macleay 1888	*Trox*	Trogidae	King Sound, WA	L, 1 P
dilutior Blackburn 1896	*Monolepta*	Chrysomelidae	Cairns, Q	2 P
dimidiata Macleay 1872	*Cisseis*	Buprestidae	Gayndah, Q	4 S
dimidiata Macleay 1888	*Sarothrocrepis*	Carabidae	King Sound, WA	H
diminutivus Lea 1909	*Metriorrhynchus*	Lycidae	Cairns, Q	H
discicollis Lea 1916	*Uracanthus*	Cerambycidae	SA	1 P
discolor Pascoe 1871	*Simocrysa*	Cerambycidae	King George Sound, WA	2 T
discoidalis Macleay 1864	*Liparetrus*	Scarabaeidae	Port Denison, Q	H
discorimosus Sloane 1902	*Notonomus*	Carabidae	Tweed R., NSW	1 P
discorufa Lea 1903	*Stethomela*	Chrysomelidae	Cairns, Q	7 S
dispar Lea 1915	*Edusa*	Chrysomelidae	Darling Range, WA	1 P
dispar Lea 1907	*Mecistocerus*	Curculionidae	Cape York, Q	4 P
dispar Macleay 1873	*Anoplognathus*	Scarabaeidae	NSW	H
dispar Macleay 1869	*Carenum*	Carabidae	SA	3 S
dispersus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Lower Murrumbidgee, NSW	2 S
distinctum Macleay 1864	*Toxicum*	Tenebrionidae	Gayndah, Q	2 S
distinctus Lea 1913	*Agathicis*	Curculionidae	Q	1 P
distortus Lea 1904	*Cryptocephalus*	Chrysomelidae	Brisbane, Q	1 P
distortus Lea 1909	*Heteromastix*	Cantharidae	Sydney, NSW	H
distributa Lea 1915	*Tomyris*	Chrysomelidae	Blue Mts, NSW	1 P
divaricatus Macleay 1871	*Onthophagus*	Scarabaeidae	Gayndah, Q	2 S
divaricatus Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
dives Lea 1899	*Neozeneudes*	Curculionidae	Illawarra, NSW	4 P
dixoni Ferguson 1915	*Acantholophus*	Curculionidae	Vic	H, 1 P
dixoni Ferguson 1915	*Sclerorinus*	Curculionidae	Vic	H, A, 2P
doddi Sloane 1905	*Cicindela*	Carabidae	Kuranda, Q	2 T
dolichoderes Lea 1925	*Philonthus*	Staphylinidae	Lord Howe I.	2 P
dolichognathus Lea 1920	*Polyachus*	Chrysomelidae	SA	2 P
dominorum King 1864	*Bryaxis*	Pselaphidae	Clyde R., NSW	1 T
doriae Pascoe 1885	*Zygara*	Curculionidae	New Guinea	2 P
dorsalis Pascoe 1873	*Axides*	Curculionidae	Sydney, NSW	2 T
dorsalis W. S. Macleay 1827	*Epithora*	Cerambycidae	NSW	4 S
dorsalis Macleay 1873	*Promecoderus*	Carabidae	Murrumbidgee, NSW	2 S
draco W. S. Macleay 1827	*Amycterus*	Curculionidae	WA	2 S

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dubia Lea 1914	*Misophrice*	Curculionidae	Dalby, Q	2 P
dubia Lea 1900	*Oreda*	Curculionidae	NSW	H
dubius Lea 1911	*Mesoplatus*	Pselaphidae	WA	2 P
dubius Macleay 1871	*Philophloeus*	Carabidae	Wide Bay, Q	2 S
dubius Macleay 1865	*Talaurinus*	Curculionidae	Darling Downs, Q	H
duboulaye Bates 1873	*Amarygmimus*	Tenebrionidae	Champion Bay, WA	1 T
dulcis Carter 1939	*Paracardiophorus*	Elateridae	SA	1 P
dumbrelli Lea 1895	*Paraphanes*	Tenebrionidae	Lane Cove, NSW	2 S
dumosus Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	4 S
duplicata Lea 1909	*Timareta*	Curculionidae	National Park, NSW	2 P
duplicatus Lea 1911	*Mechistocerus*	Curculionidae	Cape York, Q	1 P
durus Lea 1909	*Catasarcus*	Curculionidae	Mt Barker, WA	1 P
ebenina Lea 1929	*Araucaricola*	Tenebrionidae	Norfolk I.	2 P
ebeninus Macleay 1886	*Liparetrus*	Scarabaeidae	King George Sound, WA	2 S
echidna Macleay 1865	*Acantholophus*	Curculionidae	Blue Mts, NSW	3 S
echidna W. S. Macleay 1827	*Chrysolopus (Leptopius)*	Curculionidae	New Holland	2 S
echinata Pascoe 1865	*Aromagis*	Curculionidae	NSW	2 T
echinata Lea	*Hibberticola*	Curculionidae	SA	2 P
ectatommae Lea 1910	*Scydmaenus*	Scydmaenidae	Tas	2 P
ectromoides Sloane 1896	*Tachys*	Carabidae	Donnybrook, WA	H
edenensis Ferguson 1914 var. of *mira*	*Psalidura*	Curculionidae	Eden, NSW	H
edentulus W. S. Macleay 1827	*Passalus (Aulacocyclus)*	Passalidae	Australia	H
effulgens Lea 1909	*Euops*	Curculionidae	SA	2 S
egens Lea 1907	*Mecistocerus*	Curculionidae	Cairns, Q	H
egenus Olliff 1886	*Ptinus*	Ptinidae	Lane Cove, NSW	3 T
elata Pascoe 1873	*Licinoma*	Tenebrionidae	Gayndah, Q	4 T
elderi Sloane 1893	*Sclerorinus*	Curculionidae	Everard Range, SA	2 S
eleanora Carter 1925	*Chromomaea*	Alleculidae	NSW	2 S
electrica King 1862	*Bryaxis*	Pselaphidae	Parramatta, NSW	3 T
elegans Lea 1895	*Formicomus*	Anthicidae	WA	2 P
elegans Lea 1904	*Leptops*	Curculionidae	Endeavour R., Q	2 P
elegans Lea 1911	*Rhinaria*	Curculionidae	Brisbane, Q	2 P
elegans Macleay 1864	*Carenum*	Carabidae	Victoria River, NT	H
elegantula Castelnau 1867	*Feronia (Steropus)*	Carabidae	King George Sound, WA	1 T
elegantula Lea 1915	*Colaspoides*	Chrysomelidae	Cairns district, Q	2 P
elizabethae King 1863	*Bryaxis (Eupines)*	Pselaphidae	Sydney, NSW	3 T
ellipticus Lea 1908	*Elleschodes*	Curculionidae	NSW	1 P
ellipticus Pascoe 1871	*Poropterus*	Curculionidae	Illawarra (Kiama) NSW	2 T
elongata Carter 1864	*Briseis*	Buprestidae	Rockhampton, Q	1 PL
elongata Macleay 1872	*Allecula*	Alleculidae	Gayndah, Q	1 S
elongata Sloane 1898	*Xanthophaea*	Carabidae	Rottnest I., WA	1 P
elongatula Macleay 1872	*Eleale*	Cleridae	Gayndah, Q	3 S
elongatula Macleay 1887	*Mordella*	Mordellidae	Cairns district, Mossman R., Q	4 S
elongatula Macleay 1873	*Rhizopertha*	Bostrychidae	Gayndah, Q	4 S
elongatula Macleay 1873	*Stigmodera*	Buprestidae	Gayndah, Q	2 S
elongatulus Macleay 1888	*Adelotopus*	Carabidae	King Sound, WA	2 S
elongatulus Macleay 1888	*Ammoecius*	Scarabaeidae	King Sound, WA	3 S
elongatulus Macleay 1871	*Arthropterus*	Carabidae	Gayndah, (Burnett R.) Q	2 S
elongatulus Macleay 1871	*Copelatus*	Dytiscidae	Gayndah, Q	3 S
elongatulus Macleay 1871	*Dolicaon*	Staphylinidae	Gayndah, Q	3 S
elongatulus Macleay 1871	*Philhydrus*	Hydrophilidae	Gayndah, Q	5 S
elongatulus Macleay 1887	*Platyphanes*	Tenebrionidae	Cairns, Q	H
elongatulus Macleay 1872	*Nyctozoilus (Styrus)*	Tenebrionidae	Gayndah, Q	2 S
elongatus Carter 1926	*Docalis*	Tenebrionidae	King George Sound, WA	2 S
elongatus Carter & Zeck 1929	*Stetholus*	Helminthidae	Gresford, NSW	1 P
elongatus Lea 1910	*Notoplatypus*	Curculionidae	NSW	4 P
elongatus Lea 1910	*Orthoporopterus*	Curculionidae	Port Denison, Q	H
elongatus Macleay 1887	*Metriorrhynchus*	Lycidae	Barron R., Q	2 S
elongatus Macleay 1873	*Nyctozoilus*	Tenebrionidae	Gayndah, Q	2 S
elongatus Macleay 1873	*Pterohelaeus*	Tenebrionidae	Gayndah, Q	4 S
elumbis Lea 1909	*Pseudapries*	Curculionidae	Endeavour R., Q	2 P
eluta Lea 1915	*Geloptera*	Chrysomelidae	Port Denison, Q	2 S

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emarginatus Macleay 1887	*Onthophagus*	Scarabaeidae	Cairns, Q	4 S
emblematicus Lea 1902	*Critomerus*	Curculionidae	Cairns, Q	6 P
emblematicus Lea 1908	*Polyphrades*	Curculionidae	WA	2 P
eminens Olliff 1886	*Ptinus*	Ptinidae	King George Sound, WA	7 T
encephalus Pascoe 1869	*Cardiothorax*	Tenebrionidae	Rockhampton, Q	1 T
enixum Olliff 1886	*Conosoma*	Staphylinidae	Piper's Flats, NSW	4 T
eques Castelnau 1867	*Notonomus*	Carabidae	Illawarra, NSW	2 T
erineus Pascoe 1863	*Exocentrus*	Cerambycidae	Port Denison, Q	4 S
eritima Olliff 1886	*Calodera*	Staphylinidae	Wagga Wagga, NSW	2 T
erosum W. S. Macleay 1855	*Callidium (Pytheus)*	Cerambycidae	WA	H
erythrodes Lea 1917	*Copidita*	Oedemeridae	Swan R., WA	2 P
erythrogaster Lea 1929	*Rhizobius*	Coccinellidae	Norfolk I.	2 P
eucalypti Lea 1908	*Elleschodes*	Curculionidae	King I., Tas	2 P
eucalypti Lea 1920	*Orchesia*	Melandryidae	Tas	2 P
eucerus Lea 1921	*Metriorrhynchus*	Lycidae	Darwin, NT	1 P
eustictus Pascoe 1869	*Orphanistes*	Curculionidae	Rockhampton, Q	2 T
eutermiphilus Lea 1921	*Palorus*	Tenebrionidae	Townsville, Q	3 T
evanida Pascoe 1872	*Idotasia*	Curculionidae	Wide Bay, Q	3 T
excavatus Pascoe 1885	*Cossonus*	Curculionidae	Somerset, Q	2 P
excavipectus Lea 1910	*Articerus*	Pselaphidae	Vic, SA	1 P
excisicollis Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	2 S
excisilatera Sloane 1897	*Tetracha*	Carabidae	Barrow Creek, NT	1 S
excursus Pascoe 1870	*Tetralophus*	Curculionidae	SA	2 T
exilis Macleay 1865	*Sclerorinus*	Curculionidae	Murrumbidgee, NSW	4 S
exilis Lea 1915	*Tomyris*	Chrysomelidae	Tas	1 P
eximia Sloane 1896	*Clivina*	Carabidae	WA	1 S, 1 T
eximius Macleay 1866	*Cubicorrhynchus*	Curculionidae	Stirling Range, WA	H
exoleta Lea 1917	*Tomoxia*	Mordellidae	WA	2 S
exophthalmus Lea 1898	*Ceocephalus*	Brenthidae	Cairns, Q	2 P
exulans Pascoe 1866	*Saragus*	Tenebrionidae	Lord Howe I.	2 T
eyrensis Blackburn 1876	*Laius*	Melyridae	Basin of Lake Eyre, SA	1 S
fagi Lea 1910	*Merimnetes*	Curculionidae	Hobart, Tas	2 P
fairmairei Macleay 1888	*Cryptodus*	Scarabaeidae	WA	H
falciformis Macleay 1865	*Psalidura*	Curculionidae	Mudgee (Tambaroora), NSW	2 S
famelica Lea 1899	*Lybaeba*	Curculionidae	SA	2 P
familiaris Olliff 1886	*Diphobia*	Ptinidae	SA	6 T
farinosa Pascoe 1871	*Oxyops*	Curculionidae	King George Sound, WA	1 T
farinosus Pascoe 1863	*Symphyletes*	Cerambycidae	Sydney, NSW	2 T
fasciata Lea 1909	*Pachyura*	Curculionidae	Mt Lofty, SA; NSW	2 P
fasciata Macleay 1872	*Eleale*	Cleridae	Gayndah, Q	2 S
fasciata Macleay 1871	*Sarothrocrepis*	Carabidae	Gayndah, Q	4 S
fasciata Macleay 1888	*Trigonothops*	Carabidae	King Sound, WA	4 S
fasciata Sloane 1898	*Agonochila*	Carabidae	Swan R., WA	3 P
fasciatus Ferguson 1921	*Anascoptes*	Curculionidae	Mt Barker, WA	H
fascicularis Macleay 1871	*Microchaetes*	Byrrhidae	Gayndah, Q	4 S
fasciculata Macleay 1863	*Cetonia*	Scarabaeidae	Illawarra, NSW	H
fasciculatus Lea 1906	*Leptops*	Curculionidae	Cairns, Q	2 P
fasciculatus Lea 1928	*Microcryptorhynchus*	Curculionidae	Lord Howe I.	2 P
fasciolatus Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L
fasciolatus Macleay 1887	*Scopodes*	Carabidae	Cairns district, Q	4 S
felix Sloane 1896	*Clivina*	Carabidae	Port Denison, Q	1 S
felix Sloane 1888	*Paliscaphus (Carenum)*	Carabidae	Darling R., NSW	1 S
femorata Carter 1915	*Hybrenia*	Alleculidae	Q	2 P
fera Pascoe 1870	*Leptops*	Curculionidae	Wide Bay, Q	2 T
fergusoni Carter 1937	*Talaurinus*	Curculionidae	Q	1 P
feronioides Pascoe 1866	*Nyctobates*	Tenebrionidae	Blue Mts, NSW	4 T
fervidus Blackburn 1892	*Heteronyx*	Scarabaeidae	Murchison district, WA	4 S
ficus Lea 1903	*Phyllocharis*	Chrysomelidae	Moreton Bay, Q	2 S
fijiana Cameron 1927	*Atheta*	Staphylinidae	Fiji	1 P
filamentarius Lea 1917	*Laius*	Melyridae	Emerald, Q	1 P
filicis Lea 1929	*Rhizobius*	Coccinellidae	Lord Howe I.	2 P
fimbricollis Lea 1914	*Campanostiphilus*	Tenebrionidae	WA	1 P
fimbricollis Lea 1915	*Scydmaenus*	Scydmaenidae	Tas	1 P
fissiceps Macleay 1888	*Maechidius*	Scarabaeidae	King Sound, WA	2 S

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fissiceps Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	4 S
fitzroyense Macleay 1888	*Zuphium*	Carabidae	Barrier Range, King Sound WA	H
fitzroyensis Macleay 1888	*Oodes*	Carabidae	Barrier Range, WA	H
flabellicornis Macleay 1887	*Palaestrida*	Meloidae	Q	2 S
flava Lea 1925	*Neorupilia*	Chrysomelidae	Hobart, Tas	1 P
flaveolus Ferguson 1914	*Talaurinus*	Curculionidae	Eucla, WA	1 S
flavescens Ferguson 1914	*Psalidura*	Curculionidae	Eucla, WA	H, A
flavicans Macleay 1887	*Mordella (Mordelistena)*	Mordellidae	Q	2 S
flavicolle Macleay 1871	*Necterosoma*	Dytiscidae	Gayndah, Q	2 S
flavicollis Macleay 1872	*Luciola*	Lampyridae	Gayndah (Wide Bay), Q	2 S
flavicollis Macleay 1888	*Silphomorpha*	Carabidae	Barrier Range, WA	H
flavicornis Macleay 1887	*Allecula*	Alleculidae	Cairns, Q	2 S
flavifrons Blackburn 1889	*Scymnus*	Coccinellidae	Norfolk I.	4 T
flavipalpis Macleay 1864	*Harpalus (Diaphoromerus)*	Carabidae	Port Denison, Q	2 S
flavipennis Baly 1871	*Dubulaia*	Chrysomelidae	WA	1 T
flavipennis Lea 1917	*Liparetrus*	Scarabaeidae	SA	2 P
flavipennis Macleay 1887	*Platydesmus (Pteroplatydesmus)*	Scarabaeidae	Cairns, Q	2 S
flavipennis Macleay 1872	*Telephorus*	Cantharidae	Gayndah, Q	2 S
flavipes Lea 1920	*Ditropidus*	Chrysomelidae	Leigh Creek, SA	2 P
flavipes Lea 1908	*Laius*	Melyridae	SA	4 P
flavipes Macleay 1888 (*macleayi* Blackburn nec Thomson)	*Abacetus*	Carabidae	King Sound, WA	2 S
flavipes Macleay 1887	*Atractus*	Alleculidae	Q	H
flavipes Macleay 1887	*Distipsidera*	Carabidae	Q	4 S
flavoapicalis Lea 1910	*Eupines*	Pselaphidae	NSW	1 P
flavoapicalis Lea 1923	*Onthophagus*	Scarabaeidae	Geraldton, WA	1 P
flavoapicalis Lea 1915	*Scydmaenus*	Scydmaenidae	NSW	2 P
flavocinctus Blackburn 1887	*Lecanomerus*	Carabidae	Swan R., WA	2 P
flavofasciata Lea 1921	*Episcaphula*	Erotylidae	Q	2 P
flavolatera Lea 1915	*Rhyparida*	Chrysomelidae	WA	2 P
flavolaterus Lea 1926	*Scymnus*	Coccinellidae	Mt Wellington, Tas	2 P
flavomaculata Lea 1909	*Euops*	Curculionidae	Cairns, Q	2 P
flavomaculata Macleay 1887	*Popillia (Mimadoretus)*	Scarabaeidae	Barron R., Q	4 S
flavonotatus Lea 1913	*Cratomerocis*	Curculionidae	Kuranda, Q	1 P
flavonotatus Lea 1913	*Tyrtaeosus*	Curculionidae	Cairns, Q	2 P
flavopictus Carter 1939	*Hypnoidus*	Elateridae	NSW	2 S
flavopictus Lea 1908	*Laius*	Melyridae	SA	2 S
flavosetosa Ferguson 1914	*Psalidura*	Curculionidae	Vic	H, 1 P
flavosignata Macleay 1863	*Stigmodera*	Buprestidae	Rockhampton, Q	H
flavosignatus Carter 1939	*Melanoxanthus*	Elateridae	Wide Bay, Q	H
flavovaria Ferguson 1909	*Psalidura*	Curculionidae	SA	H
flavovittata Pascoe 1870	*Esmelina*	Curculionidae	Blue Mts, NSW	2 T
flavus Lea 1919	*Pseudohydrobius*	Hydrophilidae	Wentworth Falls, NSW	2 S
fletcheri Sloane 1902	*Notonomus*	Carabidae	Sydney, NSW	1 S
floccosum Pascoe 1870	*Saragus (Encara)*	Tenebrionidae	Wide Bay, Q	5 T
foliatus Macleay 1887	*Metriorrhynchus*	Lycidae	Mossman R. (Cairns district), Q	2 S
forficulata Macleay 1865	*Psalidura*	Curculionidae	Rockhampton, Q	2 S
formicicola King 1869	*Byzenia (Chlamydopsis)*	Histeridae	Liverpool, NSW	1 T
formicicola Lea 1895	*Lagria*	Lagriidae	Monaro, NSW	2 T
formicinus Macleay 1873	*Tmesiphorus*	Pselaphidae	Mundarlo, NSW	8 S
fortis Sloane 1890	*Nuridius*	Carabidae	Maryborough, Q	2 T
fossor Lea 1909	*Carphurus*	Melyridae	WA	2 S
foveata Macleay 1865	*Psalidura*	Curculionidae	NE Australia	2 S
foveatus Macleay 1866	*Gnathoxys*	Carabidae	Swan R., WA	H
foveatus Macleay 1865	*Talaurinus*	Curculionidae	NE Coast, New Holland	H
foveiceps Lea 1909	*Myllocerus*	Curculionidae	WA	1 P
foveiceps Macleay 1863	*Ceratoglossa (Clivina)*	Carabidae	Richmond R., NSW	3 S
foveicollis Lea 1911 (1912)	*Rybaxis*	Pselaphidae	Tamworth, NSW	1 P
foveicollis Macleay 1873	*Arthropterus*	Carabidae	Sydney, NSW	H

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foveicollis Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L
foveicollis Olliff 1886	*Diplocotes*	Ptinidae	NSW	1 T
foveipenne Macleay 1873	*Carenum (Laccopterum)*	Carabidae	SA	2 S
foveipennis Ferguson 1912	*Talaurinus*	Curculionidae	Q	H
foveipennis Lea 1910	*Mythites*	Curculionidae	Blue Mts, NSW	1 P
foveipennis Macleay 1871	*Argutor*	Carabidae	Gayndah, Q	1 S
foveipennis Pascoe 1872	*Poropterus*	Curculionidae	Illawarra, NSW	2 T
foveipennis Pascoe 1872	*Rhinaria*	Curculionidae	Bombala, NSW	2 T
foveiventris Lea 1923	*Monolepta*	Chrysomelidae	Parachilna, SA	2 P
foveiventris Lea 1911	*Pselaphus*	Pselaphidae	Mt Wellington, Hobart, Waratah, Tas	2 P
foveogranulatus Ferguson 1912	*Talaurinus*	Curculionidae	WA	H
foveolatum Macleay 1888	*Carenum (Calliscapterus)*	Carabidae	King Sound, WA	2 S
foveolatum Macleay 1864	*Laccopterum (Carenum)*	Carabidae	NE Australia	H
foveolatus Ferguson 1923	*Aedriodes*	Curculionidae	WA	H
fragilis Lea 1923	*Monolepta*	Chrysomelidae	Pinjarrah, WA	2 P
francilloni Kirby 1818	*Gnathium*	Meloidae	Georgia, USA	H
frater Lea 1898	*Laemosaccus*	Curculionidae	Mudgee, NSW	1 P
frater Lea 1910	*Mythites*	Curculionidae	Coonabarabran, NSW	7 P
fraterculus Lea 1906	*Leptops*	Curculionidae	Rockhampton, Q	1 P
fraterna Olliff 1886	*Leperina*	Trogossitidae	Salt R., WA	4 T
frenchi Ferguson 1914	*Psalidura*	Curculionidae	Rockhampton, Q	H, A
frenchi Sloane 1896	*Clivina*	Carabidae	Lake Callabonna, SA	1 P
froggatti Macleay 1887	*Cicindela*	Carabidae	Cairns, Q	2 S
froggatti Macleay 1888	*Diaphoromerus*	Carabidae	Barrier Range (nr King Sound), WA	H
froggatti Macleay 1887	*Episcaphula*	Erotylidae	King Sound, WA	2 S
froggatti Macleay 1888	*Eudalia*	Carabidae	Barrier Range (King Sound), WA	1 S
froggatti Macleay 1888	*Gigadema*	Carabidae	Barrier Range (King Sound), WA	H
froggatti Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	2 S
froggatti Macleay 1888	*Lacon*	Elateridae	Barrier Range, WA	L
froggatti Macleay 1888	*Maechidius*	Scarabaeidae	King Sound, WA	H
froggatti Macleay 1887	*Onthophagus*	Scarabaeidae	Cairns, Q	2 S
froggatti Macleay 1888	*Oodes*	Carabidae	King Sound, WA	2 S
froggatti Macleay 1888	*Philophloeus*	Carabidae	King Sound, WA	2 S
froggatti Macleay 1888	*Rhytisternus (Omascus)*	Carabidae	King Sound, WA	2 S
froggatti Macleay 1888	*Silphomorpha*	Carabidae	King Sound, WA	H
froggatti Macleay 1887	*Telephorus*	Cantharidae	Cairns district (Mossman R.), Q	4 S
froggatti Sloane 1896	*Tachys*	Carabidae	WA	5 S
frontale Macleay 1865	*Carenum*	Carabidae	Wallaroo, SA	H
frontalis Macleay 1871	*Limnichus*	Byrrhidae	Gayndah, Q	2 S
frontalis Thompson 1962	*Catasarcus*	Curculionidae	WA	2 P
fugax Olliff 1889	*Lestignathus*	Carabidae	Lord Howe I.	2 S
fugitiva Lea 1926	*Adimonia*	Chrysomelidae	Port Denison, Q	1 P
fugitiva Lea 1915	*Tomyris*	Chrysomelidae	NSW	H
fugitivus Lea 1914	*Myllocerus*	Curculionidae	Tennant Creek, NT	2 P
fulgens Macleay 1863	*Cetonia*	Scarabaeidae	Rockhampton, Q	2 S
fulgidicollis Macleay 1888	*Cisseis*	Buprestidae	WA	2 S
fuligineus Lea 1913	*Roptoperus*	Curculionidae	Mt Wellington, Tas	2 P
fulvescens Pascoe 1863	*Symphyletes*	Cerambycidae	Port Denison, Q	4 T
fulviventris Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
fulvohirtus Macleay 1871	*Liparetrus*	Scarabaeidae	Gayndah, Q	4 S
fumata Lea 1929	*Mesotretis*	Tenebrionidae	Norfolk I.	2 P
fumosus Lea 1909	*Tychreus*	Curculionidae	Cairns, Q	1 P
fumosus Macleay 1887	*Xylobanus*	Lycidae	Cairns, Q	1 P
fungicola Olliff 1886	*Polylobus*	Staphylinidae	Elizabeth Bay, Sydney, NSW	5 T
furcatus Macleay 1865	*Hyborrhyncus*	Curculionidae	King George Sound, WA	2 S
furcatus Macleay 1864 (n. nov. *furcaticeps* Masters)	*Onthophagus*	Scarabaeidae	Port Denison, Q	3 S
fuscicornis Raffray 1900	*Eupines*	Pselaphidae	NSW	2 P

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fuscitarsis Lea 1904	*Loxopleurus*	Chrysomelidae	Swan R., WA	2 P
fuscus Macleay 1872	*Selenopalpus*	Oedemeridae	Gayndah, Q	2 S
fuscus Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
gagates Lea 1921	*Ditropidus*	Chrysomelidae	Jenolan, NSW	1 P
gagaticeps Macleay 1888	*Liparetrus*	Scarabaeidae	King George Sound, WA	2 S
gagatinum Macleay 1864	*Carenum (Carenidium, Conopterum)*	Carabidae	SA	3 S
gascoynensis Baker 1971	*Notonophes*	Curculionidae	WA	1 P
gawleri King 1869	*Anthicus*	Anthicidae	SA	2 T
gayndahense Macleay 1871	*Bolboceras*	Geotrupidae	Gayndah, Q	3 S
gayndahense Macleay 1871	*Omalium*	Staphylinidae	Gayndah, Q	1 S
gayndahensis Macleay 1871	*Harpalus (Gnathaphanus)*	Carabidae	Gayndah, Q	1 S
gayndahensis Macleay 1871	*Hydrophilus*	Hydrophilidae	Gayndah, Q	2 S
gayndahensis Macleay 1872	*Hypaulax*	Tenebrionidae	Gayndah, Q	2 S
gayndahensis Macleay 1872	*Lacon*	Elateridae	Gayndah, Q	2 PL
gayndahensis Macleay 1871	*Leperina*	Trogossitidae	Gayndah, Q	2 S
gayndahensis Macleay 1871	*Saprinus*	Histeridae	Gayndah, Q	4 S
gayndahensis Macleay 1871	*Stenus*	Staphylinidae	Gayndah, Q	L, + PL
geminatus Lea 1927	*Barretthydrus*	Dytiscidae	NSW	2 P
geminatus Macleay 1871	*Aphodius (Pedaria)*	Scarabaeidae	Gayndah, Q	2 S
geninatus Macleay 1888	*Saragus*	Tenebrionidae	Upper Hunter, NSW	H
geniale Pascoe 1869	*Adelium*	Tenebrionidae	Clarence R., NSW	1 T
georgei Carter 1910	*Helaeus*	Tenebrionidae	WA	H
germari Macleay 1886	*Liparetrus*	Scarabaeidae	SA	3 S
germari Macleay 1865	*Sclerorinus*	Curculionidae	Port Lincoln, SA	4 S
gerstackeri Macleay 1872	*Trigonodera (Pelecotomoides)*	Rhipiphoridae	Gayndah, Q	2 S
geryon Macleay 1863	*Geoscaptus (Scarites)*	Carabidae	Darling R., NSW	2 S
gibbicollis Macleay 1872	*Rhizopertha*	Bostrychidae	Gayndah, Q	4 S
gigas Castelnau 1867	*Dicrochile*	Carabidae	Rockhampton, Q	1T
gigas Castelnau 1867	*Scaraphites*	Carabidae	Nicol Bay, WA	1T
gigas Macleay 1887	*Episcaphula*	Erotylidae	Cairns, Q	2 S
gilesi Carter 1910	*Helaeus*	Tenebrionidae	WA	2 P
gilesi Ferguson 1914	*Pseudonotonophes*	Curculionidae	WA	H
glaber Lea 1911	*Prypnus*	Curculionidae	SA	1 P
glaber Macleay 1887	*Chartopteryx*	Tenebrionidae	Mossman R., Q	2 S
glaber Macleay 1887	*Pterohelaeus*	Tenebrionidae	Darling R., NSW	2 S
glaberrimum Macleay 1865	*Carenum (Eutoma)*	Carabidae	NSW	H
glabra Lea 1906	*Baris*	Curculionidae	Q	1 P
glabricollis Macleay 1887	*Isodon*	Scarabaeidae	Mulgrave R., Q	H
glabripennis Macleay 1886	*Liparetrus*	Scarabaeidae	Melbourne, Vic	2 S
gladiator Lea 1906	*Leptops*	Curculionidae	Manning R., NSW	2 P
globiceps Lea 1922	*Anthicus*	Anthicidae	Cairns district, Q	2 P
globicollis Lea 1911	*Cubicorrhynchus*	Curculionidae	Albury, NSW	3 P
globicollis Lea 1906	*Leptops*	Curculionidae	Darling Downs, NSW	1 P
globosus Macleay 1871	*Trinodes*	Dermestidae	Gayndah, Q	1 S
globosus Pascoe 1870	*Salcus*	Curculionidae	Cape York, Q	2 T
globulicollis Macleay 1888	*Casnonia (Myrmecodemus)*	Carabidae	Barrier Range, WA	H
globuliferum Lea 1923	*Hyperomma*	Staphylinidae	Vic, NSW	2 P
globuliformis Macleay 1864	*Bolboceras*	Geotrupidae	Port Denison, Q	L♀ + 1 PL♀
globuliformis Macleay 1888	*Liparochrus*	Scarabaeidae	King George Sound, WA	2 S
globulus Macleay 1887	*Epilissus*	Scarabaeidae	Cairns, Q	L + PL
globulus Macleay 1886	*Liparetrus*	Scarabaeidae	Juntawang, NSW	3 S
gloriosa Lea 1906	*Misophrice*	Curculionidae	Tas	2 P
gloriosus Lea 1912	*Ptinus*	Ptinidae	Swan R., WA	2 P
glossatus Lea 1921	*Ditropidus*	Chrysomelidae	Port Lincoln, SA	1 P
goudiei Ferguson 1915	*Sclerorinus*	Curculionidae	Vic	H, A
gracilicornis Lea 1915	*Tomyris*	Chrysomelidae	SA	1 P
gracilis Lea 1909	*Metriorrhynchus*	Lycidae	Endeavour R., Q	H
gracilis Macleay 1872	*Neocuris*	Buprestidae	Gayndah, Q	2 S
grandiceps Macleay 1871	*Pinophilus*	Staphylinidae	Gayndah, Q	2 S

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grandis Carter 1926	*Lyphia*	Tenebrionidae	Endeavour R., Q	2 S
grandis Ferguson 1909	*Psalidura*	Curculionidae	Daandine, Q	H, A
grandis Lea 1909	*Rhinaria*	Curculionidae	Sydney, NSW	2 P
grandis Macleay 1864	*Helluo (Gigadema)*	Carabidae	Port Denison, Q	2 S
grandis Macleay 1872	*Omolipus*	Tenebrionidae	Gayndah, Q	3 S
granicollis Lea 1911	*Timareta*	Curculionidae	Swan R., WA	2 P
granulatus Ferguson 1915	*Acherres*	Curculionidae	SA	1 P
granulatus Ferguson 1915	*Talaurinus*	Curculionidae	SA	4 P
granulatus Lea 1909	*Catasarcus*	Curculionidae	Geraldton, WA	1 P
granulatus Lea 1915	*Empolis*	Curculionidae	NSW	2 P
granulatus Macleay 1872	*Lacon*	Elateridae	Gayndah, Q	5 PL
granulatus Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	2 S
granuliger Macleay 1887	*Pterohelaeus*	Tenebrionidae	Murrumbidgee, NSW	2 S
gravicollis Macleay 1866	*Acantholophus*	Curculionidae	Port Lincoln, SA	2 S
gravidus Blackburn 1905	*Liparetrus*	Scarabaeidae	WA	1 S
griffithi Lea 1915	*Edusa*	Chrysomelidae	WA	1 P
griffithi Lea 1915	*Misophrice*	Curculionidae	Adelaide, SA	2 P
griffithi Lea 1908	*Oxyops*	Curculionidae	Q	1 P
griffithi Lea 1915	*Scydmaenus*	Scydmaenidae	SA	1 P
grisea Lea 1927	*Emplesis*	Curculionidae	Lucindale, SA	2 P
griseus Macleay 1865	*Talaurinus*	Curculionidae	Rockhampton, Q	H
guerini Macleay 1872	*Calochromus*	Lycidae	Gayndah, Q	2 S
gulielmi Olliff 1889	*Saragus*	Tenebrionidae	Lord Howe I.	4 T
gulosus King 1864	*Scydmaenus*	Scydmaenidae	Sydney, Parramatta, Camden, NSW	4 T
guttulata Pascoe 1865	*Corrhenes*	Cerambycidae	Port Denison, Q	2 T
gymnosterna Lea 1917	*Scraptia*	Scraptiidae	Cairns district, Q	2 P
habitans Sloane 1889	*Sarticus*	Carabidae	Mulwala, NSW	2 T
hackeri Lea 1921	*Helcogaster*	Melyridae	Bribie I., Brisbane, Q	3 P
hackeri Lea 1910	*Laius*	Melyridae	Q	2 P
hackeri Lea 1915	*Lamprolina*	Chrysomelidae	Q	2 P
hackeri Lea 1907	*Lemidia*	Cleridae	Q	2 P
haemorrhoidalis Lea 1915	*Colaspoides*	Chrysomelidae	Kurrajong, NSW	2 P
haemorrhoidalis Macleay 1871	*Philonthus (Hesperus)*	Staphylinidae	Gayndah, Q	1 S
halmaturina Ferguson 1915	*Melanegis*	Curculionidae	Kangaroo I., SA	2 P
halmaturinus Ferguson 1915	*Acantholophus*	Curculionidae	Kangaroo I., SA	2 P
halmaturinus Ferguson 1914	*Talaurinus*	Curculionidae	Kangaroo I., SA	2 P
halmaturinus Lea 1925	*Acritus*	Histeridae	SA	2 P
halticoides Lea 1915	*Rhyparida*	Chrysomelidae	Nelson (Blackburn), Vic	2 P
hamatilis Macleay 1887	*Mordella*	Mordellidae	Cairns, Q	2 S
hardcastlei Carter 1911	*Nyctozoilus*	Tenebrionidae	Q	4 P
hardcastlei Lea 1911	*Myllocerus*	Curculionidae	Cunnamulla, Q	2 P
harrisoni Carter 1926	*Athemistus*	Cerambycidae	NSW	H,1 P
harrisoni Carter 1936	*Brycopia*	Tenebrionidae	Barrington, NSW	H
harrisoni Carter 1925	*Cardiothorax*	Tenebrionidae	NSW	H
helmsi Blackburn 1892	*Dasytes*	Melyridae	SA	2 P
helmsi Ferguson 1914	*Psalidura*	Curculionidae	Benalla, Vic	H, A
helmsi Sloane 1890	*Drimostoma (Teraphis)*	Carabidae	Dunoon, Richmond R., NSW	H
helmsi Sloane 1893	*Talaurinus*	Curculionidae	SA	H, A
henryi Britton 1957	*Haplopsis*	Scarabaeidae	Cairns, Q	H
herbivorus Lea 1925	*Myllocerus*	Curculionidae	Connexion I., NT	2 P
hercules Ferguson 1915	*Molochtus*	Curculionidae	WA	H, A, 1 P
heros Pascoe 1867	*Aridus*	Cerambycidae	Cape York, Q	1 T
hesperi King 1869	*Anthicus*	Anthicidae	SA	3 T
hieroglyphicus Lea 1911	*Laemosaccus*	Curculionidae	Blue Mts, NSW	1 P
hilaris Lea 1903	*Phyllocharis*	Chrysomelidae	Cairns, Q	H, 1 P
hilaris Olliff 1889	*Wyseolus (Colpodes)*	Carabidae	Lord Howe I.	2 T
hippocrates W. S. Macleay 1821	*Pachysoma*	Scarabaeidae	Cape of Good Hope, S. Africa	2 S
hippopus Macleay 1888	*Bolboceras*	Geotrupidae	Barrier Range, WA	L♂ + 1♂ PL
hirsuta Lea 1911	*Rybaxis*	Pselaphidae	Tas	2 P
hirsuta Macleay 1864	*Acrogenys*	Carabidae	Port Denison, Q	3 S

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hirta Macleay 1871	*Bryaxis (Batrisodes)*	Pselaphidae	Gayndah, Q	3 S
hirticeps Lea 1912	*Eupinoda*	Pselaphidae	NSW	H
hirticeps Macleay 1871	*Schizorhina (Chondropyga, (Pseudoclithria)*	Scarabaeidae	Gayndah, Q	6 S
hirticornis Lea 1913	*Protopalus*	Curculionidae	Cairns district, Q	1 P
hirtipennis Macleay 1887	*Egestria*	Anthicidae	Russell R., Q	1 S
hirtipes Macleay 1887	*Metriorrhynchus*	Lycidae	Mossman R., Q	H
hirtipes Macleay 1864	*Scaraphites*	Carabidae	SA	2 S
hirtipes Macleay 1864	*Silphodes (Phaeochrous)*	Scarabaeidae	Port Denison, Q	4 S
hirtus Macleay 1873	*Arthropterus*	Carabidae	Monaro, NSW	3 S
hirtus Macleay 1873	*Batrisodes*	Pselaphidae	Gayndah, Q	3 S
hirtus Macleay 1887	*Pterohelaeus*	Tenebrionidae	NSW	4 S
hispidus Macleay 1886	*Liparetrus*	Scarabaeidae	NSW	4 S
hoblerae Lea 1915	*Apion*	Curculionidae	Dalby, Q	2 P
hobleri Lea 1911	*Misophrice*	Curculionidae	Dalby, Q	2 P
holosericeus Macleay 1871	*Heteronyx*	Scarabaeidae	Gayndah, Q	2 S
hoplosternus Lea 1929	*Myllocerus*	Curculionidae	Stewart R., Q	2 P
hoplostetha Lea 1922	*Thallis*	Erotylidae	Galston, NSW	2 P
hopsoni Ferguson 1921	*Psalidura*	Curculionidae	NSW	H, A
horni Lea 1910	*Tychius*	Curculionidae	Forest Reefs, NSW	2 P
horridus Lea 1904	*Leptops*	Curculionidae	Cairns, Q	1 P
horridus Macleay 1865	*Sclerorinus*	Curculionidae	SA	4 S
hortensis King 1862	*Bryaxis (Rybaxis)*	Pselaphidae	Parramatta, NSW	2 T
hortensis Lea 1922	*Mecynotarsus*	Anthicidae	Swan R., WA	2 P
hottentotus W. S. Macleay 1821	*Scarabaeus*	Scarabaeidae	Cape of Good Hope, S. Africa	H
howei Thomson 1864	*Arimaspes (Cnemoplites)*	Cerambycidae	Lord Howe I.	2 T
howensis Lea 1915	*Colaspoides*	Chrysomelidae	Lord Howe I.	2 S
howensis Lea 1928	*Microcryptorhynchus*	Curculionidae	Lord Howe I.	2 P
howensis Lea 1929	*Trachyscelis*	Tenebrionidae	Lord Howe I.	2 P
howitti Macleay 1865	*Acantholophus*	Curculionidae	Vic	H
howitti Macleay 1873	*Arthropterus*	Carabidae	Vic	H
howitti Macleay 1865	*Psalidura*	Curculionidae	Melbourne, Vic	4 S
howitti Macleay 1865	*Sclerorinus*	Curculionidae	Vic	2 S
howitti Macleay 1863	*Talaurinus*	Curculionidae	Vic	2 S
howitti Pascoe 1869	*Apasis*	Tenebrionidae	Vic	2 T
howitti Pascoe 1867	*Athemistus*	Cerambycidae	Illawarra, NSW	2 T
howitti Pascoe 1869	*Cardiothorax*	Tenebrionidae	Illawarra, NSW	2 T
humanus W. S. Macleay 1821	*Scarabaeus (Gymnopleurus)*	Scarabaeidae	Cape of Good Hope, S. Africa	H
humeralis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns district, Q	2 P
humeralis Macleay 1865	*Acantholophus*	Curculionidae	Swan R., WA	2 S
humeralis Macleay 1873	*Arthropterus*	Carabidae	Dabee, NSW	H
humeralis Macleay 1886	*Diphucephala*	Scarabaeidae	Illawarra, NSW	H
humeralis Macleay 1864	*Gnathoxys*	Carabidae	SA	H
humeralis Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	3 S
humeralis Macleay 1888	*Plochionus (Trigonothops)*	Carabidae	King Sound, WA	H
humeralis Macleay 1863	*Megacephala (Tetracha)*	Carabidae	Port Denison, Q	3 S
hunteriensis Castelnau 1867	*Notonomus*	Carabidae	Hunter R., NSW	2 T
hunteriensis Macleay 1873	*Promecoderus*	Carabidae	Hunter R., NSW	H
hystricosus Lea 1908	*Deretiosus*	Curculionidae	Cairns, Q	H
hystricosus Lea 1927	*Storeus*	Curculionidae	Cairns, Q	H
hystrix Ferguson 1915	*Talaurinus*	Curculionidae	Vic	H, A, 2 P
ianthinipennis Lea 1903 (1902)	*Phyllocharis*	Chrysomelidae	Cape York, Q	2 S
igneus W. S. Macleay 1833	*Phanaeus*	Scarabaeidae	N. America	2 S
ignita Lea 1903	*Augomela*	Chrysomelidae	Illawarra, NSW	2 S
ignota Lea 1895	*Mordella*	Mordellidae	NSW	2 P
ignota Macleay 1886	*Diphucephala*	Scarabaeidae	NSW	H
illactabilis Lea 1923	*Ataenius*	Scarabaeidae	Fortescue R., WA	2 P

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illawarrae Macleay 1873	*Cymindis (Anomotarus)*	Carabidae	Illawarra, NSW	2 S
illidgei Ferguson 1916	*Cubicorrhynchus*	Curculionidae	Q	H
illidgei Ferguson 1912	*Talaurinus*	Curculionidae	Brisbane, Q	H
imitator Lea 1910	*Auletes*	Curculionidae	SA	2 P
imitator Sloane 1897	*Neocarenum (Carenum)*	Carabidae	Wimmera District, Vic	H
immaculatus King 1869	*Anthicus*	Anthicidae	SA	1 S
immaturus Lea 1898	*Telephorus*	Cantharidae	WA	4 P
impar Macleay 1863	*Schizorhina (Tapinoschema)*	Scarabaeidae	Gayndah, Q	2 S
imperator Lea 1921	*Helcogaster*	Melyridae	SA	2 P
imperiale Sloane 1894	*Homolosoma*	Carabidae	Moreton Bay, Q	H
imponderosus Lea 1911	*Lixus*	Curculionidae	NSW	2 P
impressiceps Lea 1915	*Edusa*	Chrysomelidae	Jenolan, NSW	1 P
impressicollis Macleay 1886	*Liparetrus*	Scarabaeidae	NSW	H
impressicollis Macleay 1863	*Stigmodera*	Buprestidae	Manning R., NSW	2 S
impressicollis Macleay 1865	*Talaurinus*	Curculionidae	Vic	2 S
impressifrons King 1865	*Bythinus*	Pselaphidae	Clyde R., NSW	1 T
impressifrons Macleay 1871	*Oxytelus*	Staphylinidae	Gayndah, Q	2 S
impunctata Haag – Rutenberg 1878	*Hypocilibe (Onosterrhus)*	Tenebrionidae	Peak Downs, Q	1 T
impuncticollis Lea 1909	*Euops*	Curculionidae	Cairns, Q	H
imulus Olliff 1886	*Ptinus*	Ptinidae	King George Sound, WA	3 T
inaequalipennis Castlenau 1867	*Harpalus (Diaphoromerus)*	Carabidae	King George Sound, WA	2 T
inaequalipennis Lea 1925	*Quedius*	Staphylinidae	NSW	1 P
incana Macleay 1888	*Chrysobothris*	Buprestidae	Barrier Range, WA	2 S
incana Macleay 1863	*Cetonia (Clithria)*	Scarabaeidae	Rockhampton, Port Denison, Q	2 S
incanescens Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	4 S
incanus Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	2 S
incerta Blackburn 1893	*Microdonacia (Eumolpinae teste* Monros 1958)	Chrysomelidae	Vic	1 T
incerticornis Lea 1912	*Scydmaenus*	Scydmaenidae	Sydney, NSW	1 P
incertus Macleay 1865	*Talaurinus*	Curculionidae	Rockhampton, Q	2 S
incisipes Lea 1922	*Timareta*	Curculionidae	Franklin I., SA	2 P
incisus Pascoe 1869	*Saragus*	Tenebrionidae	Mudgee, NSW	2 T
incivilis Pascoe 1863	*Sybra*	Cerambycidae	Port Denison, Q	2 T
incoctus Lea 1904	*Cryptocephalus*	Chrysomelidae	Mackay, Q	1 P
inconspicua Lea 1921	*Luciola*	Lampyridae	Q	2 P
inconspicua Pascoe 1866	*Neissa*	Cerambycidae	SA	1 T
inconspicua Sloane 1896	*Clivina*	Carabidae	WA	2 S
inconspicuus Ferguson 1912	*Talaurinus*	Curculionidae	Q	H, A
inconspicuus Lea 1927	*Gonipterus*	Curculionidae	Gympie, Q	2 P
inconspicuus Macleay 1887	*Cheiroplatys*	Scarabaeidae	Cairns, Q	L
inconstans Lea 191	*Auletes*	Curculionidae	Tas	2 P
inconstans Lea 1908	*Belus*	Curculionidae	Q	1 P
inconstans Lea 1909	*Elleschodes*	Curculionidae	WA	2 P
inconstans Lea 1911	*Eristes*	Curculionidae	Mt. Wellington, Tas	2 P
inconstans Lea 1904	*Loxopleurus*	Chrysomelidae	SA	4 P
inconstans Lea 1911	*Misophrice*	Curculionidae	Cairns district, Q	2 P
inconstans Lea 1911	*Sclerorinus*	Curculionidae	Mt. Kosciusko, NSW	1 P
inconstans Lea 1908	*Telephorus*	Cantharidae	Clarence River, NSW	7 P
inconstans Lea 1909	*Timareta*	Curculionidae	Tas	2 P
incornutum Macleay 1887	*Conopterum*	Carabidae	Richmond R., NSW	H
incornutus Macleay 1871	*Onthophagus*	Scarabaeidae	Gayndah, Q	3 S
incultus Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L, 1 PL
incurvus Lea 1909	*Myllocerus*	Curculionidae	WA	2 P
indigens Pascoe 1885	*Cossonus*	Curculionidae	Somerset, Q	2 P
indistincta Lea 1911	*Eupines*	Pselaphidae	Tas	1 P
indistinctus Lea 1921	*Ditropidus*	Chrysomelidae	SA	1 P
ineditum Macleay 1869	*Carenum*	Carabidae	SA	H
inermis Lea 1913	*Diethusa*	Curculionidae	Murray Bridge, SA	2 P
inermis Lea 1915	*Lycosura*	Curculionidae	WA	2 P

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inermis Macleay 1871	*Onthophagus*	Scarabaeidae	Gayndah, Q	3 S
inflaticollis Lea 1926	*Auletes*	Curculionidae	SA	1 P
inflatus Lea 1910	*Neomerimnetes*	Curculionidae	Gympie, Q	1 P
infuscata Armstrong 1953	*Pseudomicrocara*	Helodidae	King George Sound, WA	2 P
infuscaticornis Lea 1910	*Polylobus*	Staphylinidae	Vic, NSW	2 P
ingens Macleay 1888	*Bolboceras*	Geotrupidae	King Sound, WA	H
innubis Lea 1912	*Eupines*	Pselaphidae	NSW	2 P
inornata Ferguson 1915	*Sclerorinus*	Curculionidae	Vic	2 P
inornatus Lea 1895	*Anthicus*	Anthicidae	WA	2 P
inornatus Macleay 1873	*Promecoderus*	Carabidae	Monaro, NSW	2 S
insignicornis Lea 1921	*Helcogaster*	Melyridae	Mt. Tambourine, Q	2 P
insignicornis Lea 1921	*Metriorrhynchus*	Lycidae	Gordonvale, Cairns, Q	1 P
insignior Blackburn 1904	*Aphodius*	Scarabaeidae	Swan R., WA	2 T
insignis Ferguson 1914	*Macramycterus*	Curculionidae	WA	H, A
insignis Lea 1910	*Euhackeria*	Curculionidae	NSW	1 P
insignis Lea 1917	*Liparetrus*	Scarabaeidae	WA	1 P
insignis Pascoe 1870	*Axionicus*	Curculionidae	Gayndah, Q	2 T
insignis Sloane 1890	*Helluo*	Carabidae	Darling R., NSW	3 T
insignita Elston 1919	*Diethusa*	Curculionidae	SA	2 P
insignitus Macleay 1864	*Gnathoxys*	Carabidae	King George Sound, WA	5 S
insolitus Carter 1939	*Melanoxanthus*	Elateridae	Q	H, 1 P
insuavis Olliff 1886	*Aleochara*	Staphylinidae	Monaro, NSW	2 T
insulanum Olliff 1887	*Hopatrum (Gonocephalum)*	Tenebrionidae	Norfolk I.	2 T
insularis Lea 1908 (1907) var of *westwoodi* Pascoe	*Achthosus*	Tenebrionidae	King I., Tas	2 P
insularis Lea 1919	*Anodontonyx*	Scarabaeidae	Stradbroke I., Q	2 P
insularis Lea 1916	*Diphucephala*	Scarabaeidae	Stradbroke I., Q	2 P
insularis Lea 1908 (1907)	*Hypattalus*	Melyridae	King I., Tas	1 P
insularis Lea 1907 var of *ruficornis* Champion	*Menephilus*	Tenebrionidae	King I., Tas	1 S
insularis Lea 1927	*Notiosomus*	Curculionidae	Norfolk I.	2 P
insularis Macleay 1885	*Lamprima*	Lucanidae	Lord Howe I.	4 S
insulicola Lea 1920	*Coenobius*	Chrysomelidae	Pelsart I., WA	2 P
integriceps Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	3 S
intercalaris Pascoe 1867	*Atyporus*	Cerambycidae	Cape York, Q	1 T
intercoxalis Lea 1916	*Chrysomela*	Chrysomelidae	Cairns, Q	2 P
intercoxalis Lea 1915	*Geloptera*	Chrysomelidae	Endeavour R., Q	2 P
intergricollis Lea 1923	*Ataenius*	Scarabaeidae	Cunnamulla, Q	2 P
interioris Macleay 1888	*Helaeus*	Tenebrionidae	Darling R., NSW	2 S
interioris Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
intermedia Ferguson 1914	*Psalidura*	Curculionidae	Stanthorpe, Q	H, A
intermedia Lea 1895	*Macratria*	Anthicidae	Cairns, Q	1 P
intermedia Sloane 1894	*Megacephala*	Carabidae	King George Sound, WA	4 S
intermedius Macleay 1865	*Scaraphites*	Carabidae	Illawarra, NSW	2 S
intermixta Lea 1928	*Cisowhitea*	Curculionidae	SA	2 P
intermixta Lea 1909	*Timareta*	Curculionidae	Ulverstone, Tas	2 P
interoculare Lea 1926	*Apion*	Curculionidae	Cairns district, Q	2 P
interocularis Lea 1911	*Mandalotus*	Curculionidae	Stanley, Tas	4 P
interrupta Lea 1918	*Mesolita*	Cerambycidae	Q	2 P
interruptum Macleay 1865	*Carenum*	Carabidae	NSW	4 S
interruptus Lea 1906	*Leptops*	Curculionidae	W. interior, SA	2 P
interruptus Macleay 1873	*Promecoderus*	Carabidae	Clarence R., NSW	H
interstitialis Lea 1913	*Camptorrhinus*	Curculionidae	Kuranda, Q	1 P
interstitialis Lea 1910	*Hylesinus*	Curculionidae	Cairns, Q	2 P
interstitialis Macleay 1864	*Harpalus (Gnathaphanus)*	Carabidae	Port Denison, Q	2 S
inusitatus Lea 1907	*Mandalotus*	Curculionidae	Stonor, Tas	2 P
involutus Macleay 1871	*Hygrotrophus*	Hydrophilidae	Gayndah, Q	4 S
iridescens Macleay 1863	*Phyllotocus*	Scarabaeidae	Sydney, NSW	4 S
irrasa Ferguson 1914	*Psalidura*	Curculionidae	Howell, NSW	H
irrasa Lea 1924	*Dorcatoma*	Anobiidae	WA	1 P
irrasa Lea 1915	*Tomyris*	Chrysomelidae	Clyde R., NSW	H
irrasus Lea 1911	*Mandalotus*	Curculionidae	NSW	2 P
irregularis Macleay 1871	*Copelatus*	Dytiscidae	Gayndah, Q	4 S
irroratus Macleay 1866	*Acantholophus*	Curculionidae	Port Lincoln, SA	2 S

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jacksoniensis Macleay 1865	*Scarites (Geoscaptus)*	Carabidae	Sydney, NSW	3 S
johnstoni Sloane 1907	*Notonomus*	Carabidae	Barrington R., NSW	1 S
jonesi Lea 1917	*Essolithna*	Curculionidae	Ooldea, SA	2 P
jucundus Carter 1939	*Melanoxanthus*	Elateridae	Port Denison, Q	1 P
jurinei W. S. Macleay 1819	*Euchlora*	Scarabaeidae	Java	H
juvencus Lea 1915	*Agetinus*	Chrysomelidae	Capel R., WA	1 P
kentiae Lea 1925	*Heterothops*	Staphylinidae	Lord Howe I.	4 P
kentiae Lea 1925	*Paromalus*	Histeridae	Lord Howe I.	1 P
kershawi Lea 1907 (1908)	*Aleochara*	Staphylinidae	King I., Tas	1 P
kershawi Sloane 1902	*Notonomus*	Carabidae	Otway Range, Vic	1 P
kingense Blackburn 1907	*Cercyon*	Hydrophilidae	King I., Tas	2 T
kingi King 1864	*Phagonophana*	Scydmaenidae	NSW, Q	3 T
kingi Lea 1910	*Glyptoma*	Staphylinidae	NSW, Vic	2 P
kingi Lea 1911	*Rytus*	Pselaphidae	NSW	2 P
kingi Macleay 1871	*Arthropterus*	Carabidae	Gayndah (Burnett R.), Q	1 S
kingi Macleay 1869	*Carenum*	Carabidae	Liverpool Plains, NSW	H
kingi W. S. Macleay 1827	*Coccinella (Egleis)*	Coccinellidae	Australia	H
kingi Macleay 1872	*Formicomus*	Anthicidae	Gayndah, Q	4 S
kingi Macleay 1871	*Georyssus*	Georyssidae	Gayndah, Q	4 S
kingi Macleay 1872	*Mecynotarsus*	Anthicidae	Gayndah, Q	4 S
kingi W. S. Macleay 1827	*Megamerus*	Chrysomelidae	WA	2 S
kingi Macleay 1864	*Phyllotocus*	Scarabaeidae	NSW	2 S
kingi Macleay 1871	*Scydmaenus*	Scydmaenidae	Gayndah, Q	3 S
kingi Macleay 1871	*Tmesiphorus*	Pselaphidae	Gayndah, Q	5 S
kirbyi W. S. Macleay 1827	*Talaurinus*	Curculionidae	New Holland	H
klugi W. S. Macleay 1827	*Chrysomela (Phyllocharis)*	Chrysomelidae	Australia	H
koebelei Lea 1910	*Ficicis*	Curculionidae	Barron Falls, Q	1 P
kosciuskianus Sloane 1902	*Notonomus*	Carabidae	Mt Kosciusko, NSW	2 T
kosciuskoana Ferguson 1909	*Psalidura*	Curculionidae	Jindabyne, NSW	H, 1 P
kreffti Macleay 1865	*Acantholophus*	Curculionidae	Peak Downs, Q	2 S
krefti Castelnau 1887	*Harpalus (Hypharpax)*	Carabidae	Port Denison, Q	2 T
kreuslerae Macleay 1869	*Carenidium (Conopterum)*	Carabidae	SA	H
kreuslerae Macleay 1886	*Liparetrus*	Scarabaeidae	SA	4 S
kreusleri King 1866	*Ctenistes*	Pselaphidae	SA	3 T
kreusleri King 1869	*Mecynotarsus*	Anthicidae	SA	3 T
lacordairei Macleay 1873	*Encara*	Tenebrionidae	Illawarra (Kiama), NSW	4 S
lacunosum Macleay 1873	*Bolboceras*	Geotrupidae	Sydney, NSW	L
lacunosum Macleay 1887	*Laccopterum (Carenum)*	Carabidae	Coonabarabran, NSW	4 S
lacunosus Macleay 1865	*Talaurinus*	Curculionidae	Manning R., NSW	H
lacustre Macleay 1873	*Carenidium*	Carabidae	Wagga Wagga, NSW	H
laeta Lea 1913	*Idotasia*	Curculionidae	Q	1 P
laevatus Macleay 1886	*Liparetrus*	Scarabaeidae	Gayndah, Q	2 S
laeviceps Sloane 1899	*Simodontus*	Carabidae	Junee, NSW	2 T
laeviceps Macleay 1864	*Pachauchenius (Gnathaphanus)*	Carabidae	Port Denison, Q	4 S
laevicostatus Macleay 1888	*Saragus*	Tenebrionidae	SA	4 S
laevigatum Macleay 1864	*Carenum*	Carabidae	SA	4 S
laevigatus Macleay 1888	*Pterostichus (Loxandrus)*	Carabidae	King Sound, WA	H
laevipenne Macleay 1863	*Carenum*	Carabidae	King George Sound, WA	6 S
laevis Castelnau 1868	*Silphomorpha*	Carabidae	Port Denison, Q	3 T
laevis Macleay 1888	*Adelotopus*	Carabidae	King Sound, WA	H
laevis Macleay 1883	*Poecilus (Rhytisternus)*	Carabidae	Port Darwin, NT	4 S
laevis Macleay 1888	*Saragus*	Tenebrionidae	Interior, NSW	H
laevis Pascoe 1869	*Omolipus*	Tenebrionidae	Cape York, NQ	2 T
laevius Macleay 1872	*Stigmatium*	Cleridae	Gayndah, Q	1 S

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laminatus Lea 1900	*Derbyia*	Curculionidae	WA	H
laminatus Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	4 S
lanaticollis Macleay 1888	*Liparetrus*	Scarabaeidae	Barrier Range, WA	H
lanosus Pascoe 1870	*Chimades*	Curculionidae	NSW	2 T
lapidosa W. S. Macleay 1827	*Buprestis (Cisseis)*	Buprestidae	New Holland	H
larinus Lea 1904	*Cryptocephalus*	Chrysomelidae	Hunter River, NSW	1 P
lata Lea 1914 (1915)	*Coatesia*	Scydmaenidae	NSW	2 P
lata Lea 1925	*Ellopia*	Chrysomelidae	Bourke, NSW	1 P
latebricola Lea 1926	*Mandalotus*	Curculionidae	Ferntree Gully, Vic	2 P
latebricola Lea 1910	*Termophila*	Staphylinidae	Galston, NSW	2 P
latens Lea 1914	*Mandalotus*	Curculionidae	Mt Tambourine, Q	1 P
laterale Macleay 1865	*Carenum*	Carabidae	Australia	H
lateralis Lea 1903	*Stethomela*	Chrysomelidae	Cairns, Q	2 S
lateralis Macleay 1887	*Ananca (Sessinia)*	Oedemeridae	Cairns, Q	2 S
lateralis Macleay 1886	*Diphucephala*	Scarabaeidae	NSW	H
lateralis Pascoe 1882	*Orthorrhinus*	Curculionidae	Lord Howe I.	2 T
lateralis Sloane 1889	*Notonomus*	Carabidae	Mt Wilson, NSW	2 P
latericollis Lea 1924	*Secretipes*	Ptinidae	Q	2 P
lateroalbus Lea 1928	*Deretiosus*	Curculionidae	Fiji	2 P
lateroapicalis Lea 1920	*Ditropidus*	Chrysomelidae	Forest Reefs, NSW; West Tamar, Tas	2 P
laticeps Lea 1907	*Lemidia*	Cleridae	Brisbane, Q	H
laticeps Macleay 1871	*Prostomis (Mimemodes)*	Cucujidae	Gayndah, Q	6 S
laticeps Macleay 1885	*Rhyssonotus*	Lucanidae	Australia	H
laticeps Olliff 1885	*Ancyrona*	Trogossitidae	NSW	2 T
latericollis Lea 1926	*Ataenius*	Scarabaeidae	Groote Eylandt, NT	2 P
latericollis Lea 1915	*Geloptera*	Chrysomelidae	Endeavour R., Q	2 P
laticollis Lea 1911 (1912)	*Batrisodes*	Pselaphidae	NSW	H
laticollis Lea 1909	*Heteromastix*	Cantharidae	Cairns, Q	2 S
laticollis Lea 1906	*Leptops*	Curculionidae	Q	H
laticollis Macleay 1887	*Hybrenia*	Alleculidae	Cairns, Q	H
laticollis Macleay 1866	*Scaraphites*	Carabidae	NT	H
laticollis Macleay 1888	*Silphomorpha*	Carabidae	King Sound, WA	H
laticollis Pascoe 1866	*Illacuris*	Curculionidae	Pine Mt, Q	2 T
laticorne Macleay 1873	*Bolboceras*	Geotrupidae	SA	L♂ + 1♂ 2♀ PL
latior Carter 1926	*Uloma*	Tenebrionidae	Kurrajong, NSW	H, 1 P
latipennis Lea 1912	*Chlamydopsis*	Histeridae	WA	H
latipennis Lea 1924	*Dryophilodes*	Anobiidae	Swan R., WA	2 P
latipennis Lea 1907	*Nechyrus*	Curculionidae	Clarence R., NSW	1 P
latipennis Lea 1910	*Phagonophana*	Scydmaenidae	Bridgetown, WA	2 P
latipennis Lea 1910	*Prosayleus*	Curculionidae	Swan R., WA	2 P
latipennis Macleay 1864	*Odacantha (Eudalia)*	Carabidae	Port Denison, Q	2 S
latipennis Macleay 1863	*Scaraphites*	Carabidae	King George Sound, WA	4 S
latirostris Pascoe 1873	*Psepholax*	Curculionidae	Illawarra, NSW	1 T
lativittis Carter 1939	*Melanoxanthus*	Elateridae	Q	2 S
latreillei W. S. Macleay 1819	*Lamprima*	Lucanidae	Sydney, NSW	3 S
latum Carter 1910	*Encara*	Tenebrionidae	WA	H
latus Ferguson 1915	*Acherres*	Curculionidae	WA	2 P
latus Lea 1908	*Polyphrades*	Curculionidae	Cairns, Q	1 P
lauta Macleay 1888	*Melobasis*	Buprestidae	King Sound, WA	L + 3 PL
leachi W. S. Macleay 1819	*Paxillus*	Passalidae	Brazil	L, 2 PL
leai Blackburn 1894	*Candezea (Monolepta)*	Chrysomelidae	NSW	2 P
leai Britton 1957	*Cheiragra*	Scarabaeidae	Cairns, Q; NSW	6 P
leai Carter 1924	*Bubastes*	Buprestidae	WA	1 P
leai Carter 1924	*Ethon*	Buprestidae	Nuriootpa, SA	1 P
leai Ferguson 1915	*Psalidura*	Curculionidae	Vic	1 P
leai Ferguson 1915	*Talaurinus*	Curculionidae	WA	1 P
leai Sloane 1898	*Amblytelus*	Carabidae	Rottnest I., WA	2 P
leai Sloane 1897	*Carenidium (Conopterum)*	Carabidae	Gerraldton ("Champion Bay district"), WA	H
leai Sloane 1905	*Cicindela*	Carabidae	Endeavour R., Q	2 S
leai Sloane 1896	*Clivina*	Carabidae	Pine Mt., Q	1 P

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leai Sloane 1902	*Notonomus*	Carabidae	Blue Mts, NSW	2 P
leai Sloane 1898	*Simodontus*	Carabidae	Champion Bay, WA	1 P
lecideosus Pascoe 1870	*Proxyrus*	Curculionidae	Champion Bay, WA	2 T
legitimus Lea 1907	*Nechyrus*	Curculionidae	NSW	H
leichardti Macleay 1865	*Amycterus*	Curculionidae	Lynd R., North Australia	H
lemmus Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	1 S
leonina W. S. Macleay 1838	*Cetonia (Conostethus)*	Scarabaeidae	"Caffraria", S. Africa	H
lepidopterus Schreibers 1802	*Tragocerus*	Cerambycidae	NSW	1 T
lepidopygus Lea 1917	*Liparetrus*	Scarabaeidae	WA	2 P
lethargicus Olliff 1889	*Cossonus*	Curculionidae	Lord Howe I.	4 S
leucosticta Kirby 1818	*Cisseis*	Buprestidae	Sydney, NSW	5 T
levicostatus Macleay 1888	*Saragus*	Tenebrionidae	SA	4S
licinoides Macleay 1864	*Stomatocoelus (= Dicrochile)*	Carabidae	Port Denison, Q	H
licinoides Kirby 1818	*Adelium*	Tenebrionidae	Tas	2 T
lignarius Olliff 1885	*Rhysodes*	Rhysodidae	Lambing Flat, NSW	1 T
lilliputanum Carter 1937	*Platydema*	Tenebrionidae	SA	1 P
lilliputanus Macleay 1888	*Oodes*	Carabidae	King Sound, WA	2 S
limbatus Macleay 1888	*Rhytisternus*	Carabidae	King Sound, WA	2 S
limbatus Pascoe 1871	*Catastygnus*	Curculionidae	Port Denison, Q	2 T
lindense Blackburn 1891	*Adelium*	Tenebrionidae	Port Lincoln, SA	2 T
lineare Pascoe 1864	*Itheum*	Cerambycidae	SA	2 T
linearis Macleay 1888	*Adelotopus*	Carabidae	King Sound, WA	2 S
lineatellus Macleay 1888	*Lacon*	Elateridae	Barrier Range, WA	L, 1 PL
lineatus King 1862	*Pselaphus*	Pselaphidae	Parramatta, NSW; Vic; SA	4 T
lineatus Pascoe 1873	*Evas*	Curculionidae	Gayndah, Q	2 T
liosomoides Pascoe 1870	*Psaldus*	Curculionidae	King George Sound, WA	2 T
liragerus Sloane 1902	*Notonomus*	Carabidae	NSW	3 P
litoralis Lea 1908	*Conlonia*	Curculionidae	King I., Tas	2 P
litoralis Lea 1907	*Copidita*	Oedemeridae	King I., Tas	2 P
litoralis Lea 1911	*Eupines*	Pselaphidae	Clifton, NSW	3 P
litoralis Lea 1911	*Perperus*	Curculionidae	Hobart, Tas	2 P
litoralis Pascoe 1875	*Phycosecis*	Phycosecidae	King George Sound, WA	2 T
littorale Macleay 1887	*Conopterum*	Carabidae	Richmond R., NSW	H
liturata Macleay 1888	*Sarothrocrepis*	Carabidae	King Sound, WA	2 S
lividus Lea 1925	*Acritus*	Histeridae	Lord Howe I.; SA	2 P
lobicollis Macleay 1887	*Onthophagus*	Scarabaeidae	Cairns, Q	2 S
loculiferus Lea 1913	*Exithius*	Curculionidae	Tas	1 P
longicolle Macleay 1888	*Helluosoma*	Carabidae	King Sound, WA	H
longicollis Macleay 1871	*Morio*	Carabidae	Gayndah, Q	4 S
longicollis Macleay 1864	*Cymindis (Xanthophaea)*	Carabidae	Port Denison, Q	H
longicollis Pascoe 1871	*Phacodes*	Cerambycidae	Wide Bay, Q	2 T
longicornis Macleay 1871	*Placonotus (Laemophloeus)*	Cucujidae	Gayndah, Q	2 S
longicornis Macleay 1887	*Xylobanus*	Lycidae	Q	2 S
longipennis Macleay 1888	*Adelotopus*	Carabidae	King Sound, WA	2 S
longipennis Macleay 1873	*Anoplognathus*	Scarabaeidae	Petersham, NSW	H
longipennis Pascoe 1872	*Polyphrades*	Curculionidae	SA	2 T
longipes Ferguson 1912	*Talaurinus*	Curculionidae	NSW	H
longipes Lea 1909	*Carphurus*	Melyridae	WA	H
longirostris Lea 1899	*Neomelanterius*	Curculionidae	Pine Mt, Q	H
longirostris Lea 1908	*Pantoreites*	Curculionidae	SA	3 P
longirostris Lea 1910	*Phaunaeus*	Curculionidae	Cairns, Q	2 P
longus Macleay 1865	*Sclerorinus*	Curculionidae	SA	4 S
luciae Carter 1928	*Athemistus*	Cerambycidae	Barrington Tops, NSW	H, A
lucidum Macleay 1888	*Temnoplectron*	Scarabaeidae	King Sound, WA	2 S
lucidus Macleay 1887	*Carenoscaphus*	Carabidae	Dawson R., Q	H
lucidus Macleay 1888	*Heteronychus*	Scarabaeidae	King Sound, WA	2 S
luctuosa Pascoe 1862	*Zygocera (Disterna)*	Cerambycidae	Lizard I., Q	1 T
luctuosus Pascoe 1872	*Aonychus*	Curculionidae	WA	2 T
luctuosus Pascoe 1863	*Lychrosis*	Cerambycidae	Port Denison, Q	2 T
lugubris Lea 1904	*Loxopleurus*	Chrysomelidae	Kiama, NSW	2 P
lunatica King 1863	*Rybaxis*	Pselaphidae	Parramatta, NSW	1 T
lurida Macleay 1864	*Cheiragra*	Scarabaeidae	Kurrajong, NSW	2 S

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luridicollis Macleay 1872	*Malachius (Heteromastix)*	Cantharidae	Gayndah, Q	1 S
luridipennis Macleay 1871	*Hydraena (Ochthebius)*	Hydraenidae	Gayndah, Q	L + 5 PL
luridipennis Macleay 1871	*Leptacinus*	Staphylinidae	Gayndah, Q	3 S
luridipennis Macleay 1886	*Liparetrus*	Scarabaeidae	WA	5 S
luridus King 1869	*Anthicus*	Anthicidae	Port Denison, Q	2 T
luridus Macleay 1871	*Hydrobaticus*	Hydrophilidae	Gayndah, Q	2 S
lutea Macleay 1872	*Zonitis*	Meloidae	Gayndah, Q	2 S
luteipennis Macleay 1872	*Rhipiphorus (Emenadia)*	Rhipiphoridae	Gayndah, Q	1 S
lychnus Olliff 1889	*Atyphella*	Lampyridae	Blue Mts, NSW	2 T
macilenta Sloane 1894	*Darodilia*	Carabidae	Darling R., NSW	1 P
macilentus Lea 1915	*Cossonus*	Curculionidae	Cairns, Q	2 P
macleayi Bates 1871	*Eudalia*	Carabidae	Monaro, NSW	4 T
macleayi Brême 1842	*Helaeus*	Tenebrionidae	King George Sound, WA	2 T
macleayi Carter 1924	*Agrilus*	Buprestidae	Cairns, Q	H
macleayi Carter 1923	*Melobasis*	Buprestidae	Port Darwin, NT	2 P
macleayi Carter 1926	*Nyctozoilus*	Tenebrionidae	NSW	H
macleayi Carter 1926	*Platydema*	Tenebrionidae	Kuranda, Q	2 S
macleayi Carter 1926	*Ulomoides*	Tenebrionidae	WA	2 S
macleayi Castelnau 1868	*Pamborus*	Carabidae	Clarence R., NSW	2 T
macleayi Donovan 1805	*Cerapterus*	Carabidae	Australia	H
macleayi Donovan 1825	*Conognatha*	Buprestidae	Brazil	H
macleayi King 1869	*Anthicus*	Anthicidae	Illawarra, NSW	2 T
macleayi King 1864	*Heterognathus*	Scydmaenidae	Illawarra, NSW	1 T
macleayi King 1863	*Tmesiphorus*	Pselaphidae	Illawarra; Parramatta, NSW	2 P
macleayi Lea 1915	*Alittus*	Chrysomelidae	Port Denison, Q; NSW	2 P
macleayi Lea 1895	*Balanophorus*	Melyridae	King Sound, WA	2 S
macleayi Lea 1909	*Heteromastix*	Cantharidae	Cairns, Q	H
macleayi Lea 1906	*Ipsichora*	Curculionidae	NSW	2 P
macleayi Lea 1910	*Mecopus*	Curculionidae	Endeavour R., Q	1 P
macleayi Lea 1911 (1912)	*Rybaxis*	Pselaphidae	Richmond R., NSW	3 P
macleayi Lea 1896	*Stereoderus*	Curculionidae	Cairns, Q	2 P
macleayi Montrouzier 1860	*Onthobium*	Scarabaeidae	New Caledonia	1 S
macleayi Olliff 1887	*Actinus*	Staphylinidae	Cairns, Q	4 T
macleayi Olliff 1885	*Brontes*	Cucujidae	Richmond R., NSW	1 T
macleayi Pascoe 1866	*Byrsax*	Tenebrionidae	Manning R., NSW	2 T
macleayi Pascoe 1864	*Catypnes*	Cerambycidae	Richmond R., NSW	1 T
macleayi Pascoe 1866	*Sympetes*	Tenebrionidae	King George Sound, WA	2 T
macleayi Pascoe 1863	*Typhocesis*	Cerambycidae	Port Denison, Q	1 T
macleayi Sloane 1896	*Clivina*	Carabidae	NT	1 S
macleayi Sloane 1907	*Mochtherus*	Carabidae	Cairns, Q	2 S
macleayi Sloane 1899	*Pediomorphus*	Carabidae	King Sound, WA	2 S
macleayi Sloane 1894	*Pheropsophus*	Carabidae	King Sound, WA	4 S
macleayi Sloane 1889	*Sarticus*	Carabidae	Coonabarabran, NSW	2 T
macleayi Sloane 1896	*Tachys*	Carabidae	King Sound, WA	4 P
macrocephalus Ferguson 1912	*Peritalaurinus*	Curculionidae	WA	H
macrocephalus Lea 1912	*Batrisodes*	Pselaphidae	Gayndah, Wide Bay, Q	3 P
macrocephalus Lea 1920	*Ditropidus*	Chrysomelidae	WA	2 P
maculata Carter 1926	*Helmis*	Helminthidae	NSW	2 P
maculata Lea 1904	*Matesia*	Curculionidae	King Sound, WA	2 P
maculatus Lea 1922	*Mecynotarsus*	Anthicidae	Hobart, Tas	2 P
maculatus Macleay 1865	*Cubicorrhynchus*	Curculionidae	Murrumbidgee, NSW	2 S
maculatus Macleay 1865	*Hyborrhynchus*	Curculionidae	King George Sound, WA	2 S
maculatus Macleay 1871	*Stenus*	Staphylinidae	Gayndah, Q	4 PL
maculatus Macleay 1865	*Talaurinus*	Curculionidae	New Holland	2 S
maculiceps Macleay 1871	*Philhydrus*	Hydrophilidae	Gayndah, Q	6 S
maculicollis Lea 1910	*Cubicorrhynchus*	Curculionidae	SA; Vic	3 P
maculipennis Lea 1911	*Talaurinus*	Curculionidae	Coolgardie, Bardoc, WA	3 P
maculipennis Macleay 1871	*Adelotopus*	Carabidae	Gayndah, Q	1 S
maculiventris Armstrong 1953	*Pseudomicrocara*	Helodidae	Vic	1 P
maculiventris Macleay 1863	*Stigmodera*	Buprestidae	Q	H
maculosus Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L♂, PL ♀

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maculosus W. S. Macleay 1821	*Scarabaeus (Gymnopleurus)*	Scarabaeidae	India	2 S
maechidioides Macleay 1886	*Liparetrus (Automolius)*	Scarabaeidae	Pipers Flats, NSW	2 S
magnificum Macleay 1887	*Eutoma (Carenum)*	Carabidae	Peak Downs, Q	H
major Blackburn 1892	*Seirotrana*	Tenebrionidae	Tamworth, NSW	2 T
major Lea 1908	*Decilaus*	Curculionidae	King I., Tas	2 P
major Lea 1895	*Helcogaster*	Melyridae	WA	3 P
major Lea 1905	*Pantoreites*	Curculionidae	Vic	1 P
majorinus Lea 1913	*Tyrtaeosus*	Curculionidae	Cairns, Q	2 P
mandibularis Macleay 1871	*Bledius*	Staphylinidae	Gayndah, Q	3 S
mandibularis Macleay 1885	*Neolamprima*	Lucanidae	Herbert R., Q	2 S
mandibularis Sloane 1899	*Simodontus*	Carabidae	Mulwala, NSW	1 S
marginalis Lea 1919	*Maechidinus*	Scarabaeidae	King George Sound, WA	2 P
marginatus Blackburn 1889	*Heteronyx*	Scarabaeidae	Endeavour R., Q	5 S
marginatus Macleay 1888	*Haplaner*	Carabidae	King Sound, WA	4 S
marginatus Macleay 1864	*Phyllotocus*	Scarabaeidae	Sydney, NSW	4 S
marginicollis Lea 1917	*Cacochroa*	Scarabaeidae	Cape York, Q	1 P
marginicollis Macleay 1872	*Metriorrhynchus*	Lycidae	Gayndah, Q	1 S
marginipennis Macleay 1871	*Homothes*	Carabidae	Gayndah, Q	1 S
marginipennis Macleay 1864	*Phyllotocus*	Scarabaeidae	NSW	2 S
marginipennis Macleay 1863	*Schizorrhina (Trichaulax)*	Scarabaeidae	Port Denison, Q	2 S
maritima Lea 1917	*Copidita*	Oedemeridae	Ulverstone, Tas	2 P
maritima Lea 1911	*Sediantha*	Curculionidae	WA	2 P
marmorata Macleay 1887	*Pelecotomoides*	Rhipiphoridae	Cairns, Q	2 S
marmorata Lea 1903	*Phyllocharis*	Chrysomelidae	Richmond R., NSW	2 S
marmoratus Lea 1914	*Polyphrades*	Curculionidae	Murray Bridge, SA	2 P
marmoratus Lea 1924	*Pronus*	Ptinidae	Norfolk I	2 P
marmoratus Lea 1904	*Schizosternus*	Chrysomelidae	SA	H
marmoratus Macleay 1871	*Philhydrus*	Hydrophilidae	Gayndah, Q	1 S
marmorea Pascoe 1870	*Metacymia*	Curculionidae	King George Sound, WA	1 T
masculina Lea 1927	*Emplisis*	Curculionidae	Fortescue R., WA	2 P
mastersi Blackburn 1897	*Penthea*	Cerambycidae	WA	1 T
mastersi Carter 1909	*Byallius*	Tenebrionidae	NSW	2 S
mastersi Carter 1910	*Saragus*	Tenebrionidae	WA	H
mastersi Castelnau 1867	*Sarticus (Feronia)*	Carabidae	Port Lincoln, SA	2 T
mastersi Castelnau 1868	*Zuphium*	Carabidae	Rope's Creek, NSW	1 T
mastersi King 1869	*Formicomus*	Anthicidae	SA	1 T
mastersi Lea 1910	*Articerus*	Pselaphidae	SA	H
mastersi Lea 1908	*Calochromus*	Lycidae	NSW	1 P
mastersi Lea 1907	*Lemidia*	Cleridae	Cairns, Q	2 P
mastersi Lea 1895	*Mordella*	Mordellidae	Rope's Creek, NSW	2 P
mastersi Lea 1911	*Myllocerus*	Curculionidae	WA	2 P
mastersi Lea 1915	*Scydmaenus*	Scydmaenidae	NSW	3 P
mastersi Macleay 1866	*Acantholophus*	Curculionidae	Stirling Range, WA	3 S
mastersi Macleay 1871	*Acupalpus (Lecanomerus)*	Carabidae	Gayndah, Q	2 S
mastersi Macleay 1871	*Adelotopus*	Carabidae	Gayndah, Q	1 S
mastersi Macleay 1872	*Allecula*	Alleculidae	Gayndah, Q	2 S
mastersi Macleay 1872	*Apellatus*	Alleculidae	Q	H
mastersi Macleay 1872	*Astraeus*	Buprestidae	Gayndah, Q	1 S
mastersi Macleay 1872	*Balanophorus*	Melyridae	Gayndah, Q	5 S
mastersi Macleay 1871	*Bothrideres*	Colydiidae	Gayndah, Q	2 S
mastersi Macleay 1871	*Canthonosoma*	Scarabaeidae	Gayndah, Q	4 S
mastersi Macleay 1873	*Calloodes*	Scarabaeidae	Port Denison, Cleveland Bay, Q	2 S
mastersi Macleay 1872	*Cardiothorax (Atryphodes)*	Tenebrionidae	Gayndah, Q	1 S
mastersi Macleay 1872	*Chartopteryx*	Tenebrionidae	Gayndah, Q	1 S
mastersi Macleay 1872	*Chromomaea*	Alleculidae	Gayndah, (Wide Bay), Q	2 S
mastersi Macleay 1872	*Chrysobothris*	Buprestidae	Gayndah, Q	1 S
mastersi Macleay 1872	*Clerus*	Cleridae	Gayndah, Q	4 S
mastersi Macleay 1871	*Cryptobium*	Staphylinidae	Gayndah, Q	4 S
mastersi Macleay 1871	*Cyclonotum*	Hydrophilidae	Gayndah, Q	4 S
mastersi Macleay 1871	*Dasygnathus*	Scarabaeidae	Gayndah, Q	2 S

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mastersi Macleay 1886	*Diphucephala*	Scarabaeidae	King George Sound, WA	4 S
mastersi Macleay 1871	*Distipsidera*	Carabidae	Wide Bay, Q	H
mastersi Macleay 1871	*Drypta*	Carabidae	Gayndah, Q	4 S
mastersi Macleay 1871	*Eucalypticola (Coptodera)*	Carabidae	Gayndah, Q	4 S
mastersi Macleay 1871	*Heterocerus*	Heteroceridae	Gayndah, Q	2 S
mastersi Macleay 1871	*Hololepta*	Histeridae	Gayndah, Q	3 S
mastersi Macleay 1866	*Hyborrhynchus*	Curculionidae	Port Lincoln, SA	2 S
mastersi Macleay 1871	*Hydatotrephis*	Hydrophilidae	Gayndah, Q	2 S
mastersi Macleay 1871	*Hydroporus (Bidesus)*	Dytiscidae	Gayndah, Q	4 S
mastersi Macleay 1872	*Laius*	Melyridae	Gayndah, Q	6 S
mastersi Macleay 1872	*Lemodes*	Anthicidae	Gayndah, Q	1 S
mastersi Macleay 1886	*Liparetrus*	Scarabaeidae	Salt R., King George Sound, WA	4 S
mastersi Macleay 1872	*Mychestes*	Tenebrionidae	Gayndah, Q	2 T
mastersi Macleay 1872	*Neocuris*	Buprestidae	Gayndah, Q	2 S
mastersi Macleay 1872	*Nyctozoilus*	Tenebrionidae	Gayndah, Q	2 S
mastersi Macleay 1872	*Ommatophorus*	Alleculidae	Gayndah, Q	5 S
mastersi Macleay 1871	*Onthophagus*	Scarabaeidae	Gayndah, Q	2 S
mastersi Macleay 1872	*Opatrum (Gonocephalum)*	Tenebrionidae	Gayndah, Q	2 S
mastersi Macleay 1871	*Philoscaphus*	Carabidae	Gayndah, Q	4 S
mastersi Macleay 1871	*Pinobius*	Staphylinidae	Gayndah, Q	2 S
mastersi Macleay 1871	*Pinophilus*	Staphylinidae	Gayndah, Q	1 S
mastersi Macleay 1871	*Agabus (Platynectes)*	Dytiscidae	Gayndah, Q	3 S
mastersi Macleay 1873	*Promecoderus*	Carabidae	Monaro, NSW	2 S
mastersi Macleay 1865	*Psalidura*	Curculionidae	Ipswich, Q	2 S
mastersi Macleay 1872	*Pseudhelops (Coripera)*	Tenebrionidae	Gayndah, Q	1 S
mastersi Macleay 1871	*Rhytisternus (Omaseus)*	Carabidae	Gayndah, Q	4 S
mastersi Macleay 1871	*Saprinus*	Histeridae	Gayndah, Q	2 S
mastersi Macleay 1871	*Sarothrocrepis*	Carabidae	Gayndah, Q	2 S
mastersi Macleay 1871	*Schizorrhina*	Scarabaeidae	Gayndah, Q	2 S
mastersi Macleay 1866	*Sclerorinus*	Curculionidae	Flinders Range, SA	2 S
mastersi Macleay 1872	*Selenopalpus*	Oedemeridae	Gayndah, Q	2 S
mastersi Macleay 1864	*Silphomorpha*	Carabidae	Port Denison, Q	2 S
mastersi Macleay 1872	*Stigmatium*	Cleridae	Gayndah, Q	1 S
mastersi Macleay 1872	*Stigmodera*	Buprestidae	Gayndah, Q	2 S
mastersi Macleay 1872	*Strongylium*	Tenebrionidae	Gayndah, Q	2 S
mastersi Macleay 1865	*Talaurinus*	Curculionidae	Rope's Creek, NSW	2 S
mastersi Macleay 1872	*Telephorus*	Cantharidae	Gayndah, Q	4 S
mastersi Macleay 1872	*Trigmodera (Pelecotomoides)*	Rhipiphoridae	Gayndah, Q	2 S
mastersi Macleay 1871	*Tyrus (Tyromorphus)*	Pselaphidae	Gayndah, Q	4 S
mastersi Pascoe 1871	*Cherrus*	Curculionidae	King George Sound, WA	2 T
mastersi Pascoe 1870	*Helaeus*	Tenebrionidae	Salt R., WA	2 T
mastersi Pascoe 1870	*Mecistocerus*	Curculionidae	Illawarra, NSW	4 T
mastersi Pascoe 1873	*Oxyops*	Curculionidae	Rope's Creek, NSW	2 T
mastersi Pascoe 1873	*Psepholax*	Curculionidae	Wide Bay, Q	2 T
mastersi Pascoe 1870	*Seirotrana*	Tenebrionidae	Gayndah, Q	2 T
mastersi Pascoe 1875	*Tryphocharia*	Cerambycidae	Vic	1 T
mastersi Pascoe 1871	*Zygocera*	Cerambycidae	Wide Bay, Q	2 T
mastersi Sloane 1894	*Bembidium*	Carabidae	Sydney, NSW	2 P
mastersi Sloane 1896	*Clivina*	Carabidae	Darwin, NT	H
mastersi Sloane 1903	*Epiosmus (Craspedophorus)*	Carabidae	Neighbourhood of Sydney, NSW	2 T
maximus Macleay 1865	*Cubicorrhynchus*	Curculionidae	Swan R., WA	H
medioalbus Lea 1915	*Phaunaeus*	Curculionidae	Endeavour R., Q	1 P
mediocris Lea 1904	*Cryptocephalus*	Chrysomelidae	Endeavour R., Q	1 P
medioflava Lea 1924	*Aulacophora*	Chrysomelidae	Cairns district, Q	3 P
mediofusca Lea 1914	*Essolithna*	Curculionidae	Alexandria, NT	1 P
mediomaculatus Lea 1913	*Metyrculus*	Curculionidae	Cooktown, Q	1 P
mediorufa Lea 1915	*Rhyparida*	Chrysomelidae	Coen R., Q	1 P

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mediovittata Lea 1915	*Rhyparida*	Chrysomelidae	Derby (W. D. Dodd), WA	1 P
megacephalus Lea 1925	*Leptacinus*	Staphylinidae	Lord Howe I	2 P
megalongensis Ferguson 1912	*Talaurinus*	Curculionidae	NSW	H
megalops Lea 1902	*Balanophorus*	Melyridae	Otford, NSW	H
megalops Lea 1917	*Euctenia*	Rhipiphoridae	Mullewa, WA	1 P
megalops Lea 1925	*Rhamphus*	Curculionidae	SA	1 P
melaena W.S. Macleay 1838	*Cetonia (Oxythyraea, Leucocelis)*	Scarabaeidae	Cape of Good Hope, S. Africa	2 S
melaleucae Lea 1917	*Liparetrus*	Scarabaeidae	SA	2 P
melancholica Lea 1921	*Thallis*	Erotylidae	Galston, NSW	2 P
melancholicus Lea 1911	*Poropterus*	Curculionidae	Hobart, Tas	1 P
melanocephalus Lea 1921	*Heteromastix*	Cantharidae	Bribie I., Q	2 P
melanopus Lea 1904	*Cryptocephalus*	Chrysomelidae	WA	H
melanosticta Pascoe 1875	*Penthea*	Cerambycidae	Nicol Bay, WA	2 T
melasoma Lea 1917	*Tomoxia*	Mordellidae	Cairns, Q	1 P
meleagris Pascoe 1870	*Orthorrhinus*	Curculionidae	Wide Bay, Q	2 T
meleoides Pascoe 1872	*Demyrsus*	Curculionidae	Sydney, NSW	2 T
m — elevatus Lea 1911	*Talaurinus*	Curculionidae	Blackheath, NSW	1 P
melvillense Lea 1926	*Apion*	Curculionidae	Melville I., NT	2 P
melvillensis Lea 1919	*Adoretus*	Scarabaeidae	Melville I., NT	1 P
meridianus Carter 1926	*Mesomorphus*	Tenebrionidae	Port Lincoln, SA	1 S
meridionalis Lea 1907	*Lemidia*	Cleridae	SA	3 S
mesosternalis Lea 1906	*Ipsichora*	Curculionidae	Q	2 P
metallica Carter 1936	*Pedaria*	Scarabaeidae	Clarence R., NSW	H
metallica Lea 1915	*Edusa*	Chrysomelidae	Kewell, Vic	2 P
metallicus Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	2 S
metallicus Lea 1920	*Ditropidus*	Chrysomelidae	Sheffield, Tas	2 P
metasternalis Lea 1917	*Mordella*	Mordellidae	Cairns district, Q	2 P
metasternalis Lea 1911 (1912)	*Rybaxis*	Pselaphidae	Rope's Creek, NSW	1 P
micans Blackburn 1889	*Alittus*	Chrysomelidae	NT	2 P
micans Lea 1903	*Lamprolina*	Chrysomelidae	Cairns, Q	H
micans Macleay 1864	*Odacantha (Casnonia)*	Carabidae	Port Denison, Q	3 S
micans Macleay 1886	*Liparetrus*	Scarabaeidae	Endeavour River, Q	H
microcalla Lea 1915	*Geloptera*	Chrysomelidae	Port Denison, Q	2 S
microps Lea 1911	*Titinia*	Curculionidae	Gayndah, Q	2 P
microscopica Lea 1906	*Baris*	Curculionidae	WA	2 P
microscopica Lea 1920	*Scraptia*	Scraptiidae	WA	2 P
microscopicum Lea 1910	*Apion*	Curculionidae	Tas	2 P
microscopicus Lea 1904	*Loxopleurus*	Chrysomelidae	WA	2 P
microscopicus Lea 1925	*Rhamphus*	Curculionidae	WA	1 P
microtrichopterus Lea 1923	*Ataenius*	Scarabaeidae	Cunnamulla, Q	2 P
miliaris Ferguson 1913	*Talaurinus*	Curculionidae	NSW	H, A
mimicus Lea 1917	*Belus*	Curculionidae	Mt Lofty Range, SA	2 P
mimicus Lea 1914	*Cyllorhamphus*	Curculionidae	NSW	1 P
miniaticollis Macleay 1887	*Xylobanus*	Lycidae	Barron R., Q	H
miniatus Macleay 1887	*Cladophorus*	Lycidae	Barron R., Q	2 S
miniatus Pascoe 1872	*Atelicus*	Curculionidae	Moreton Bay, Q	2 T
minima Lea 1915	*Geloptera*	Chrysomelidae	Cairns district, Q	3 P
minima Macleay 1886	*Diphucephala*	Scarabaeidae	Kurrajong, NSW	H
minima Macleay 1885	*Lamprima*	Lucanidae	SA	H
minima Macleay 1864	*Sarothrocrepis (Agonochila)*	Carabidae	Port Denison, Q	3 S
minimus Lea 1927	*Storeus*	Curculionidae	Taveuni, Fiji	2 P
minimus Pascoe 1869	*Pterohelaeus*	Tenebrionidae	Coopers Creek, SA	4 T
minor Ferguson 1915	*Cubicorrhynchus*	Curculionidae	WA	H, A
minor Lea 1921	*Metriorrhynchus*	Lycidae	Brisbane, Q	3 P
minor Lea 1908	*Stenocorynus*	Curculionidae	Endeavour R., Q	1 P
minor Lea 1913 var. of *spencei* Waterhouse	*Sympiezoscelus*	Curculionidae	Dorrigo, NSW	2 P
minuscula Lea 1923	*Monolepta*	Chrysomelidae	Mt. Tambourine, Q	2 P
minuscula Lea 1915	*Rhyparida*	Chrysomelidae	Cairns district, Q	2 P
minusculus Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	2 P
minusculus Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	H
minuta Lea 1908	*Orchesia*	Melandryidae	Tas	2 P
minuta Lea 1907	*Rodwayia*	Limulodidae	Tas	4 P

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minutus Castelnau 1868	*Amblygnathus*	Carabidae	King George Sound, WA	1 T
minutus Lea 1915	*Cleptor*	Chrysomelidae	King George Sound, WA	1 P
minutus Lea 1920	*Ditropidus*	Chrysomelidae	Tas	4 P
mira Lea 1912	*Daveyia*	Pselaphidae	Geelong, Vic	2 P
mira Lea 1911	*Eupines*	Pselaphidae	Swan R., WA	2 P
mirabilis Lea 1911	*Myllocerus*	Curculionidae	WA	2 P
miracula Lea 1915	*Geloptera*	Chrysomelidae	Cairns district, Q	2 P
mirus Lea 1919	*Leanymus*	Pselaphidae	Cairns district, Q	2 P
miscella Pascoe 1863	*Niphona (Prosoplus, Micracatha)*	Cerambycidae	Port Denison, Q	2 T
mitchelli Macleay 1886	*Liparetrus*	Scarabaeidae	Victoria R., NT	H
mitchelli Macleay 1865	*Talaurinus*	Curculionidae	Victoria R., NT	H
mitchelli Sloane 1894	*Tachys*	Carabidae	Urana,NSW	3 S
mitificus Lea 1904	*Loxopleurus*	Chrysomelidae	Newcastle, NSW	2 S
mixta Lea 1917	*Haplonycha*	Scarabaeidae	Murray R., Crecy, Grunthal, SA	1 P
mixtus Lea 1904	*Loxopleurus*	Chrysomelidae	King George Sound, WA	2 S
molesta Olliff 1886	*Homalota*	Staphylinidae	Sydney, NSW	4 T
mollis Lea 1908	*Decilaus*	Curculionidae	King I., Tas	1 P
monarensis Sloane 1889	*Sarticus*	Carabidae	Monaro, NSW	3 T
monilicorne Macleay 1872	*Adelium*	Tenebrionidae	Gayndah, Q	1 S
monilicornis Sloane 1896	*Clivina*	Carabidae	Port Denison, Q	3 S
moniliferus Pascoe 1866	*Helaeus*	Tenebrionidae	SA	2 T
monilis King 1869	*Anthicus*	Anthicidae	Port Lincoln, SA	1 T
monstrosa Pascoe 1868	*Orcopazia*	Tenebrionidae	Illawarra, NSW	2 T
montana Carter 1928	*Hesthesis*	Cerambycidae	Mt Kosciusko, NSW	H, A
montana Castelnau 1868	*Celanida*	Carabidae	Vic	1 T
montanus Ferguson 1923	*Mythites*	Curculionidae	Blue Mts, NSW	H, A, 2P
montanus Ferguson 1913 var. of *foveatus* Macleay	*Talaurinus*	Curculionidae	NSW	H, A
montanus King 1864	*Elmis*	Helminthidae	Illawarra, NSW	4 T
montanus Lea 1911	*Haplonyx*	Curculionidae	Mt Kosciusko, NSW	2 P
montanus Lea 1919	*Macrohelodes*	Helodidae	Mt Wellington, Tas	1 P
montanus Lea 1910	*Merimnetes*	Curculionidae	Summit of Mt Wellington, Tas	2 P
montanus Macleay 1873	*Anoplognathus*	Scarabaeidae	Monaro,NSW	H, A
monticola Ferguson 1909	*Psalidura*	Curculionidae	Buffalo Mts, Vic	H, A
montivaga Olliff 1889	*Idotasia* (now *Ampagia*)	Curculionidae	Lord Howe I.	3 S
moratus Pascoe 1863	*Symphyletes*	Cerambycidae	Port Denison, Q	1 T
morio Pascoe 1873	*Diathetes*	Curculionidae	Cape York, Q	3 T
morio Pascoe 1869	*Tanylypa*	Tenebrionidae	Tas	2 T
morioformis Macleay 1876	*Miscelus*	Carabidae	New Guinea	H
mossmani Macleay 1887	*Telephorus*	Cantharidae	Mossman R., Q	H
mucidus Lea 1910	*Haplonyx*	Curculionidae	WA	2 P
mucronatum Macleay 1866	*Carenum (Conopterum)*	Carabidae	SA	H
mucronatus Ferguson 1923	*Aedriodes*	Curculionidae	WA	H
mucronatus Macleay 1887	*Colpodes*	Carabidae	Cairns (Mossman R.), Q	H
mucronatus Macleay 1865	*Sclerorinus*	Curculionidae	Vic	H
mucronipennis Ferguson 1914	*Sclerorinus*	Curculionidae	Vic	2 P
muelleri Macleay 1885	*Lamprima (Phalacrognathus)*	Lucanidae	North Australia	H
multicarinata Lea 1915	*Trypocolaspis*	Chrysomelidae	Mt Tambourine, Q	2 P
multicolor Lea 1915	*Cleptor*	Chrysomelidae	Q	2 P
multimaculatus Lea 1928	*Mechistocerus*	Curculionidae	Q	2 P
multimaculatus Lea 1924	*Trypopites*	Anobiidae	Tas	1 P
multinodosus Lea 1906	*Leptops*	Curculionidae	Tilba Tilba, NSW	1 P
multipunctatus Macleay 1888	*Diaphoromerus (Gnathaphanus)*	Carabidae	King Sound,WA	3 S
mulwalensis Sloane 1899	*Tachys*	Carabidae	Mulwala, NSW	1 P
munda Lea 1902	*Queenslandica*	Curculionidae	Cape York, Q	2 P
munitis Pascoe 1863	*Symphyletes*	Cerambycidae	NSW	2 T
murchisoni Blackburn 1892	*Onthophagus*	Scarabaeidae	Murchison district, WA	2 T
murchisoni Ferguson 1921 var. of *tatei* Blackburn	*Acantholophus*	Curculionidae	WA	H, A, 2P
murex Thompson 1968	*Catasarcus*	Curculionidae	WA	3 P

Specific Name	Original Genus	Family	Type Locality	Types
muriceus Ferguson 1915	*Amorphorrhinus*	Curculionidae	WA	H
murrayi Lea 1923	*Mandalotus*	Curculionidae	Pearson I., SA	2 P
murrayi Macleay 1871	*Brachypeplus*	Nitidulidae	Gayndah, Q	2 S
murrumbidgense Macleay 1865	*Carenum*	Carabidae	Murrumbidgee, NSW	5 S
murrumbidgensis Macleay 1865	*Gnathoxys*	Carabidae	Murrumbidgee, NSW	H
murrumbidgensis Macleay 1865	*Talaurinus*	Curculionidae	Murrumbidgee, NSW	2 S
muscivorus Lea 1909	*Mandalotus*	Curculionidae	Waratah, Tas	2 P
musculus Pascoe 1872	*Poropterus (Exithius)*	Curculionidae	Tas	2 T
muticus Macleay 1861	*Onthophagus*	Scarabaeidae	Port Denison, Q	2 S
myrmecophilum Lea 1905	*Tribolium*	Tenebrionidae	Birchip, Vic	1 S
myrteus King 1869	*Anthicus*	Anthicidae	NSW	4 T
mythitoides Ferguson 1913	*Talaurinus*	Curculionidae	Coonabarabran, NSW	H
naevia Olliff 1888	*Dysthaeta*	Cerambycidae	Norfolk I.	3 T
namoyensis Sloane 1894	*Prosopogmus*	Carabidae	Namoi R., NSW	1 P
nana Sloane 1896	*Clivina*	Carabidae	Tamworth, NSW	1 P
nanus Ferguson 1921	*Acantholophus*	Curculionidae	NSW	H, 4 P
navicularis Pascoe 1869	*Euthyrrhinus*	Curculionidae	King George Sound, WA	2 T
nebulosa Lea 1911	*Eniopea*	Curculionidae	Swan R., WA	1 P
nebulosus Kirby 1818	*Rhyssonotus*	Lucanidae	NSW	2 T
nebulosus Macleay 1864	*Anoplognathus*	Scarabaeidae	Rockhampton, Q	H, A
nebulosus Macleay 1871	*Hydroporus (Chostonectes)*	Dytiscidae	Gayndah, Q	4 S
neglectus Ferguson 1914	*Sclerorinus*	Curculionidae	SA	H, A
neglectus Lea 1908	*Stenocorynus*	Curculionidae	Rockhampton, Q	2 P
neglectus Pascoe 1863	*Symphyletes*	Cerambycidae	NSW	2 T
neophyta Pascoe 1869	*Adelium*	Tenebrionidae	Vic	2 T
nicholsoni Carter 1926	*Helmis*	Helminthidae	NSW	H, A
nicholsoni Carter 1926	*Nyctozoilus*	Tenebrionidae	NSW	H
nidicola Lea 1928	*Glaucopela*	Curculionidae	Ooldea, SA	2 P
nigella Sloane 1906 var. of *leai* Sloane	*Cicindela*	Carabidae	Coen, Q	3 S
niger Castelnau 1868	*Meonis*	Carabidae	Clarence R., NSW	2 T
niger Lea 1919	*Anodontonyx*	Scarabaeidae	Tas	2 P
niger Lea 1909	*Helcogaster*	Melyridae	SA	H
niger Macleay 1871	*Cychramus*	Nitidulidae	Gayndah, Q	4 S
niger Sloane 1899	*Eudalia*	Carabidae	Mulwala, NSW	2 T
niger Macleay 1871	*Tibarisus (Cratogaster, Cyphosoma)*	Carabidae	Gayndah, Q	2 S
nigerrima Macleay 1873	*Adotela*	Carabidae	Percy Islands, N.E. Coast	H
nigerrimum Macleay 1865	*Carenum*	Carabidae	SA	4 S
nigra Lea 1903	*Calomela*	Chrysomelidae	Rockhampton, Q	2 S
nigra Macleay 1872	*Anthaxia*	Buprestidae	Gayndah, Q	2 S
nigra Macleay 1888	*Trachys*	Buprestidae	Barrier Range, King Sound, WA	H
nigrans Macleay 1888	*Diaphoromerus*	Carabidae	King Sound, WA	H
nigrans Macleay 1887	*Mordella*	Mordellidae	Q	*
nigrans Macleay 1871	*Schizorrhina*	Scarabaeidae	Gayndah, Q	5 S
nigrescens Macleay 1888	*Lacon*	Elateridae	Barrior Range, WA	L
nigricans Macleay 1871	*Anthrenus*	Dermestidae	Gayndah, Q	3 S
nigriceps Lea 1909	*Helcogaster*	Melyridae	Nowra, NSW	H
nigriclavus Lea 1920	*Aspidiphorus*	Byrrhidae	Cairns, Q	2 P
nigricollis Lea 1894	*Dromaeolus*	Eucnemidae	Lane Cove, NSW	2 P
nigricollis Macleay 1864	*Trigonothops*	Carabidae	Port Denison, Q	4 S
nigricornis Lea 1903	*Calomela*	Chrysomelidae	Forest Reefs, NSW	1 P
nigricornis Macleay 1873	*Arthropterus*	Carabidae	Wide Bay, Q	H
nigrina Macleay 1864	*Cicindela*	Carabidae	Port Denison, Q	2 S
nigrinus Macleay 1871	*Valgus (Microvalgus)*	Scarabaeidae	Gayndah, Q	2 S
nigripennis Lea 1903	*Calomela*	Chrysomelidae	Rockhampton, Q	2 S
nigripennis Macleay 1888	*Cisseis*	Buprestidae	WA	H
nigripennis Macleay 1885	*Lamprima*	Lucanidae	Australia	H
nigripennis Macleay 1887	*Palaestrida*	Meloidae	Cairns, Q	2 S

* Missing in Macleay Museum.

Specific Name	Original Genus	Family	Type Locality	Types
nigripes Lea 1906	*Misophrice*	Curculionidae	Tas	2 P
nigripes Macleay 1872	*Metriorrhynchus*	Lycidae	Gayndah, Q	2 S
nigrirostris Lea 1915	*Micraonychus*	Curculionidae	Hobart, Tas	2 P
nigriventris Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
nigriventris Pascoe 1873	*Rhinoncus*	Curculionidae	Gayndah, Q	2 T
nigrohirtus Macleay 1886	*Liparetrus*	Scarabaeidae	Q	2 S
nigrolateralis Lea 1917	*Pelecotomoides*	Rhipiphoridae	Cairns district, Q	2 P
nigromaculatus Lea 1913	*Tyrtaeosus*	Curculionidae	Cairns, Q	1 P
nigropunctatus Lea 1906	*Leptops*	Curculionidae	Narromine, Wellington, NSW	4 P
nigrosuffusus Carter 1939	*Paracardiophorus*	Elateridae	Bogan R., NSW	1 P
nigrosuturale Lea 1910	*Apion*	Curculionidae	WA	2 P
nigroterminale Lea 1915	*Apion*	Curculionidae	Sydney, NSW	1 P
nigroterminalis Lea 1908	*Telephorus*	Cantharidae	Port Denison, Q	2 P
nigrovaria Lea 1907	*Lemidia*	Cleridae	King I., Tas	1 P
nigrovaria W. S. Macleay 1827	*Podontia*	Chrysomelidae	Australia	3 S
nigrovarius Lea 1914	*Myllocerus*	Curculionidae	Coen R., Q	2 P
nigrovarius Lea 1909	*Omorophius*	Curculionidae	Swan R., WA	2 P
nigrovarius Lea 1908 (1907)	*Rhizobius*	Coccinellidae	King I., Tas	2 P
nigrovittatus Lea 1908	*Metriorrhynchus*	Lycidae	Blue Mts., NSW	H, 1 P
nigrum Carter 1905	*Encara*	Tenebrionidae	Moruya, NSW	2 T
niphonoides Pascoe 1863	*Hebecerus*	Cerambycidae	Port Denison, Q	2 T
nitens Macleay 1886	*Diphucephala*	Scarabaeidae	Endeavour R., Q	2 S
nitescens Macleay 1869	*Carenum*	Carabidae	Salt Lake, Hummock Range, SA	H*
nitida Lea 1910	*Dabra*	Staphylinidae	Vic	3 P
nitida Pascoe 1869	*Licinoma*	Tenebrionidae	Mt Macedon, Vic	3 T
nitidicollis Macleay 1886	*Diphucephala*	Scarabaeidae	Illawarra, NSW	3 S
nitidior Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
nitidipennis Macleay 1886	*Liparetrus*	Scarabaeidae	SA	H
nitidipennis Macleay 1871	*Platynus (Loxandrus)*	Carabidae	Gayndah, Q	1 S
nitidissimus Pascoe 1869	*Pterohelaeus*	Tenebrionidae	SA	2 T
nitidiusculus Macleay 1887	*Pterohelaeus*	Tenebrionidae	SA	2 S
nitidiventris Lea 1916	*Leptops*	Curculionidae	WA	2 P
nitidivirgatus Lea 1915	*Agetinus*	Chrysomelidae	Swan R., WA	2 P
nitiduloides Carter 1908	*Pterohelaeus*	Tenebrionidae	Blue Mts., NSW	2 S
nitidulus Macleay 1873	*Sitophagus (Isaphes)*	Tenebrionidae	Gayndah, Q	2 S
nitidulus Macleay 1871	*Sternolophus*	Hydrophilidae	Gayndah, Q	4 S
nitidus Macleay 1887	*Paraphanes*	Tenebrionidae	Q	2 S
nivea Pascoe 1870	*Alphitopis*	Curculionidae	King George Sound, WA	2 T
niveonotata Lea 1906	*Baris*	Curculionidae	WA	2 P
niveopictus Lea 1909	*Balaninus*	Curculionidae	Q	1 P
niveosparsa Armstrong 1941	*Neothrenus*	Dermestidae	Lane Cove, NSW	2 P
niveovittatus Ferguson 1912	*Talaurinus*	Curculionidae	Q	H, A, 2 P
nobile Macleay 1888	*Eudema (Craspedophorus, Epicosmus)*	Carabidae	King Sound, WA	2 S
nociva Lea 1909	*Desiantha*	Curculionidae	Vic	2 P
noctivagus Lea 1923	*Astenus*	Staphylinidae	Sydney, NSW	1 P
noctivagus Lea 1920	*Byrrhinus*	Limnichidae	Cairns district, Q	3 P
noctuabundus Lea 1914	*Rhizobius*	Coccinellidae	Murray R., SA	2 P
nodicollis Lea 1904	*Leptops*	Curculionidae	Cairns, Q	4 P
nodicollis Lea 1907	*Mandalotus*	Curculionidae	Gayndah, Q	2 P
nodicollis Macleay 1888	*Trox*	Trogidae	WA	L, 1 PL
nodipennis Lea 1909	*Timareta*	Curculionidae	King George Sound, WA	4 P
nodosus Ferguson 1923	*Euomus*	Curculionidae	WA	H
nodosus Ferguson 1923 var. of *basalis* Boisduval	*Mythites*	Curculionidae	Yalgoo, Cue, WA	H, 1 P
nodulosus Carter 1910	*Pterohelaeus*	Tenebrionidae	Roper R., NT	H
nodulosus Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
norfolcensis Lea 1915	*Colaspoides*	Chrysomelidae	Norfolk I.	2 T
norfolcensis Lea 1928	*Microcryptorhynchus*	Curculionidae	Norfolk I.	4 P
norfolcensis Lea 1929 var. of *flavifrons* Blackburn	*Scymnus*	Coccinellidae	Norfolk I.	4 P

* Hind body only.

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norfolcensis Lea 1913	*Sympiezoscelus*	Curculionidae	Norfolk I.	2 P
nosodermoides Pascoe 1870	*Seirotrana*	Tenebrionidae	Wide Bay, Q	4 T
notabilis Pascoe 1865	*Aesiotes*	Curculionidae	Pine Mt., Q	2 T
notabilis Macleay 1888	*Mordella*	Mordellidae	Cairns district, Mossman R., Q	2 S
notabilis Macleay 1888	*Sarothrocrepis*	Carabidae	King Sound, WA	3 S
notaticollis Carter 1916	*Stigmodera*	Buprestidae	Berrima, NSW	H, 1 P
notus Olliff 1886	*Polylobus*	Staphylinidae	Sydney, NSW	2 T
novemnotatus King 1864	*Elmis*	Helminthidae	Parramatta, NSW	2 T
nutans Macleay 1871	*Hygrotrophus*	Hydrophilidae	Gayndah, Q	2 S
obesus Macleay 1863	*Euryscaphus (Scaraphites)*	Carabidae	NSW	H
obesus Olliff 1886	*Polylobus*	Staphylinidae	Sydney, NSW	2 T
obliqua Lea 1927	*Emplesis*	Curculionidae	Lucindale, SA; Launceston, Tas	2 P
obliquifasciatus King 1869	*Formicomus*	Anthicidae	NSW	2 T
obliterata Sloane 1896	*Clivina*	Carabidae	Mulwala, NSW	1 T
obliteratus Ferguson 1923	*Amorphorrhinus*	Curculionidae	Muswellbrook, NSW	H, 1 P
obliteratus Ferguson 1921	*Anascoptes*	Curculionidae	WA	H
obliteratus Ferguson 1923 var. of *basalis* Boisduval	*Mythites*	Curculionidae	WA	H
obliteratus Macleay 1888	*Pterohelaeus*	Tenebrionidae	Peak Downs, Q	H
obliteratus Macleay 1865	*Sclerorinus*	Curculionidae	Vic	H
oblonga Lea 1906	*Baris*	Curculionidae	WA	2 P
oblongatus Ferguson 1915	*Sclerorinus*	Curculionidae	Vic	2 P
oblongicollis Macleay 1888	*Cicindela*	Carabidae	Barrier Range, WA	H
oblongipennis Lea 1920	*Ditropidus*	Chrysomelidae	Launceston, Tas; Forest Reefs, Tas	4 P
oblongum Macleay 1864	*Carenum*	Carabidae	SA	H
oblongus Lea 1912	*Austrectopsis*	Curculionidae	Cairns, Q	1 P
oblongus Lea 1903	*Elaphodes*	Chrysomelidae	Thursday I., Q	2 P
obscura Macleay 1872	*Anthaxia*	Buprestidae	Wide Bay (Gayndah), Q	4 S
obscura Macleay 1886	*Diphucephala*	Scarabaeidae	NSW	2 S
obscura Macleay 1872	*Melobasis*	Buprestidae	Gayndah, Q	5 S
obscuripenne Macleay 1887	*Homalosoma (Trichosternus)*	Carabidae	Mossman R. (Cairns district), Q	4 S
obscuripennis Lea 1917	*Neosalpingus*	Pythidae	NSW	1 P
obscuripennis Macleay 1887	*Mordella (Mordelistena)*	Mordellidae	Cairns, Q	H
obscuripes Lea 1915	*Trypocolaspis*	Chrysomelidae	Cairns, Q	1 P
obscurum Macleay 1865	*Carenum*	Carabidae	NSW	H
obscurus Lea 1926	*Auletes*	Curculionidae	Goolwa, SA	2 P
obscurus Macleay 1871	*Ammoecius (Ataenius)*	Scarabaeidae	Gayndah, Q	4 S
obscurus Macleay 1871	*Catops (Choleva)*	Anisotomidae	Gayndah, Q	4 S
obscurus Macleay 1886	*Liparetrus*	Scarabaeidae	SA	H
obscurus Reiche 1842	*Gnathoxys*	Carabidae	Swan R., WA	2 T
obsoleta Macleay 1886	*Diphucephala*	Scarabaeidae	NSW	3 S
obsoleta Macleay 1888	*Silphomorpha*	Carabidae	King Sound, WA	H
obsoletus Ferguson 1914	*Macramycterus*	Curculionidae	WA	H
obtusa Sloane 1920	*Nemaglossa (Lecanomerus)*	Carabidae	Tas	1 P
occidentale Macleay 1888	*Temnoplectron*	Scarabaeidae	King Sound, WA	2 S
occidentalis Lea 1925	*Acritus*	Histeridae	WA	2 P
occidentalis Lea 1917	*Epacticus*	Curculionidae	Geraldton, WA	2 P
occidentalis Lea 1907	*Rodwayia*	Limulodidae	WA	2 P
occidentalis Lea 1912	*Roptoperus*	Curculionidae	Rottnest I., WA	1 P
occidentalis Macleay 1888	*Ammoecius*	Scarabaeidae	King Sound, WA	2 S
occidentalis Macleay 1888	*Aphanisticus*	Buprestidae	Barrier Range, WA	H
occidentalis Macleay 1888	*Cheiroplatys*	Scarabaeidae	King Sound, WA	2 S
occidentalis Macleay 1888	*Cyphosoma (Cratogaster)*	Carabidae	King Sound, WA	2 S
occidentalis Macleay 1886	*Liparetrus*	Scarabaeidae	King George Sound, WA	2 S
occidentalis Macleay 1888	*Simodontus*	Carabidae	King Sound, WA	2 S
occidentalis Sloane 1898	*Lecanomerus*	Carabidae	Pinjarrah, WA	2 P

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occultum Macleay 1871	*Carenum*	Carabidae	Gayndah, Q	3 S
ocellata Macleay 1863	*Schizorrhina (Lyraphora)*	Scarabaeidae	Port Denison, Q	2 S
ocellata Pascoe 1869	*Coripera*	Tenebrionidae	Mt. Macedon, Vic	5 T
ochreonotatus Lea 1913	*Perissops*	Curculionidae	Cairns district, Q	2 P
octoarticulata Lea 1896	*Mastersinella*	Curculionidae	Q	1 P
octosignatus Carter 1939	*Paracardiophorus*	Elateridae	SA	2 S
ocularis Carter 1925	*Ceratognathus*	Lucanidae	Barrington Tops, NSW	3 P
odewahni Macleay 1873	*Anoplognathus*	Scarabaeidae	SA	3 S
odewahni Macleay 1873	*Arthropterus*	Carabidae	SA	H
odewahni Pascoe 1866	*Cossyphus*	Tenebrionidae	Singleton, NSW	4 T
olivaceus Macleay 1873	*Promecoderus*	Carabidae	Piper's Flats, NSW	3 S
olivaceus Macleay 1871	*Stenus*	Staphylinidae	Gayndah, Q	4 P
olivieri Lea 1915	*Atyphella*	Lampyridae	Cairns, Little Mulgrave R., Q	4 P
oodiformis Macleay 1871	*Argutor (Simodontus, Prosopogmus)*	Carabidae	Gayndah, Q	2 S
opaca Lea 1917	*Haplonycha*	Scarabaeidae	SA	1 P
opaciceps Lea 1921	*Ditropidus*	Chrysomelidae	Bribie I., Q	2 P
opacicollis Macleay 1872	*Amarygmus (Chalcopterus)*	Tenebrionidae	Gayndah, Q	2 S
opacicollis Macleay 1872	*Cardiothorax (Atryphodes)*	Tenebrionidae	Gayndah, Q	2 S
opacicollis Macleay 1872	*Hypaulax*	Tenebrionidae	Gayndah, Q	2 S
opacicollis Macleay 1886	*Liparetrus*	Scarabaeidae	King George Sound, WA	2 S
opacipennis Macleay 1888	*Hypharpax*	Carabidae	King Sound, WA	H
opacipennis Macleay 1888	*Saragus*	Tenebrionidae	Derby, WA	2 S
opacistriatus Sloane 1902	*Notonomus*	Carabidae	Cairns, Q	3 S
opacula Bates 1874	*Hypaulax*	Tenebrionidae	Rockhampton, Q	2 T
opacum Macleay 1869	*Carenum*	Carabidae	Clarence R., NSW	2 S
opacus Macleay 1888	*Diaphoromerus*	Carabidae	King Sound, WA	4 S
opatroides Macleay 1887	*Pterohelaeus*	Tenebrionidae	Clyde R., NSW	2 S
orbicollis Sloane 1904	*Rhysopleura*	Carabidae	Kuranda, Q	1 S
orbiculatus Lea 1910	*Haplonyx (Aolles)*	Curculionidae	SA	1 P
ordinatum Macleay 1869	*Carenum*	Carabidae	SA	6 S
ordinatus Carter 1937	*Mychestes*	Tenebrionidae	Little Mulgrave R. Q	1 P
ordinatus Macleay 1886	*Liparetrus*	Scarabaeidae	SA (interior)	H
orientalis Armstrong 1953	*Pseudomicrocara*	Helodidae	Sydney, NSW	1 P
orientalis Carter 1924	*Notobubastes*	Buprestidae	Dawson R., Q	H, 1 P
orientalis Lea 1915	*Geloptera*	Chrysomelidae	Galston, NSW	2 P (and var 2 P)
orientalis Lea 1907	*Rodwayia*	Limulodidae	NSW; Tas	2 P
ornata Macleay 1888	*Silphomorpha*	Carabidae	Barrier Range, WA	2 S (hind bodies only)
ornata Macleay 1888	*Trigonothops*	Carabidae	King Sound, WA	H
ornatus Macleay 1888	*Acupalpus*	Carabidae	King Sound, WA	2 S
orthodoxus Olliff 1887	*Xantholinus*	Staphylinidae	Sydney, NSW	1 T
ovalis Macleay 1873	*Saragus*	Tenebrionidae	Gayndah, Q	4 S
ovalis Sloane 1899	*Psilonothus (Amblystomus)*	Carabidae	Urana, NSW	2 P
ovalisticta Lea 1927	*Emplesis*	Curculionidae	Atherton, Q	2 P
ovalisticta Macleay 1887	*Mordella*	Mordellidae	Cairns, Q	H
ovata Lea 1907	*Rodwayia*	Limulodidae	Tas	1 P
ovata Pascoe 1869	*Melytra*	Tenebrionidae	Tas	3 T
ovatum Macleay 1871	*Bembidium*	Carabidae	Gayndah, Q	6 S
ovatus Macleay 1886	*Liparetrus*	Scarabaeidae	WA	H
ovensensis Carter 1909	*Byallius*	Tenebrionidae	Bright, Vic	2 P
ovicollis Macleay 1873	*Arthropterus*	Carabidae	SA	2 S
pachycera Lea 1923	*Monolepta*	Chrysomelidae	Mt. Lofty, SA	2 P
pacificus Olliff 1887	*Hesperus*	Staphylinidae	Lord Howe I.	4 T
pacificus Sloane 1888	*Scaraphites*	Carabidae	Eucla, WA	2 T
pallens Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	2 P
palliatus Macleay 1864	*Phyllotocus*	Scarabaeidae	NSW	2 S
pallida Carter 1915	*Hybrenia*	Alleculidae	Q	1 P

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pallida Lea 1907	*Lemidia*	Cleridae	Sydney, NSW	2 P
pallida Macleay 1864	*Cheiragra*	Scarabaeidae	Parramatta, NSW	5 S
pallida Macleay 1871	*Sarothrocrepis*	Carabidae	Gayndah, Q	2 S
pallida Macleay 1872	*Zonitis*	Meloidae	Cairns, Q	H
pallidicollis Macleay 1864	*Trigonothops*	Carabidae	Port Denison, Q	3 S
pallidicornis Lea 1911	*Eristus*	Curculionidae	Mt. Barker, WA	2 P
pallidior Macleay 1888	*Trigonothops*	Carabidae	King Sound, WA	4 S
pallidipennis Lea 1894	*Rhinosimus*	Pythidae	Illawarra, NSW	1 P
pallidipennis Macleay 1871	*Homalota (Polylobus)*	Staphylinidae	Gayndah, Q	2 S
pallidipennis Macleay 1864	*Macrothops*	Scarabaeidae	Victoria R., NT	H
pallidipes Carter 1926	*Helmis*	Helminthidae	NSW	H
pallidiventris Lea 1915	*Edusa*	Chrysomelidae	SA	1 P
pallidula Macleay 1888	*Scitala (Liparetrus)*	Scarabaeidae	WA	L + 1 PL
pallidus Macleay 1888	*Helaeus*	Tenebrionidae	SA	2 S
pallidus Macleay 1871	*Liparetrus*	Scarabaeidae	Gayndah, Q	3 S
pallipes Lea 1915	*Geloptera*	Chrysomelidae	Cairns district, Q	1 P
palpalis Blackburn 1895	*Colpochila*	Scarabaeidae	Callabonna, SA	1 P
palpalis Macleay 1872	*Apellatus*	Alleculidae	Gayndah, Q	1 S
palustris Sloane 1910	*Lachnothorax (Deipyrus, Casnonia)*	Carabidae	Cairns, Q	2 T
panagaeicolle Macleay 1872	*Adelium*	Tenebrionidae	Gayndah, Q	3 S
panduriformis Ferguson 1912	*Talaurinus*	Curculionidae	Q	H, A
papuensis Macleay 1876	*Harpalus*	Carabidae	Hall Sound, New Guinea	3 S
papuensis Macleay 1876	*Lebia*	Carabidae	Hall Sound, New Guinea	H
paradoxus Lea 1914	*Platypterocis*	Curculionidae	SA	2 P
paradoxus W. S. Macleay 1819	*Cryptodus*	Scarabaeidae	NSW	H
parallelicornis Macleay 1887	*Onthophagus*	Scarabaeidae	Cairns, Q	2 S
parallelus Armstrong 1941	*Neoanthrenus*	Dermestidae	Lane Cove, NSW	4 P
parallelus Lea 1895	*Helcogaster*	Melyridae	King George Sound, WA	2 P
parallelus Macleay 1871	*Hydrochus*	Hydrochidae	Gayndah, Q	4 S
parilis Lea 1903	*Calomela*	Chrysomelidae	Armidale, NSW	2 T
parva Macleay 1887	*Distipsidera*	Carabidae	Cairns, Q	4 S
parvicornis Lea 1906	*Leptops*	Curculionidae	Flinders Range, SA	2 P
parvicornis Lea 1911	*Perperus*	Curculionidae	Hobart, Tas	2 P
parvidens Lea 1899	*Melanterius*	Curculionidae	Port Curtis, Q	2 P
parvidens Lea 1911	*Rybaxis*	Pselaphidae	Mt. Wellington, Tas	2 P
parvula Deuquet 1956	*Stigmodera (Castiarina)*	Buprestidae	NSW	2 P
parvulum Macleay 1872	*Adelium*	Tenebrionidae	Gayndah, Q	1 S
parvulum Macleay 1873	*Carenum*	Carabidae	Murrurundi, NSW	H
parvulum Macleay 1888	*Eudema (Craspedophorus, Epicosmus)*	Carabidae	King Sound, WA	4 S
parvulus Ferguson 1921	*Acantholophus*	Curculionidae	NSW	H
parvulus Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	7 S
parvulus Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L, 1 PL
parvulus Macleay 1871	*Liparetrus*	Scarabaeidae	Gayndah, Q	3 S
parvulus Macleay 1871	*Maechidius*	Scarabaeidae	Gayndah, Q	1 S
parvulus Macleay 1872	*Menephilus*	Tenebrionidae	Gayndah, Q	4 S
parvulus Macleay 1873	*Promecoderus*	Carabidae	Upper Murrumbidgee, NSW	2 S
parvulus Macleay 1865	*Sclerorinus*	Curculionidae	SA	3 S
parvus Lea 1910	*Lissotes*	Lucanidae	Hobart, Tas	2 P
parvus W. S. Macleay 1821	*Scarabaeus (Gymnopleurus)*	Scarabaeidae	India	H
pascoei F. Bates 1868	*Chromomoea*	Alleculidae	Q	2 T
pascoei Macleay 1872	*Allecula*	Alleculidae	Gayndah, Q	2 S
pascoei Macleay 1871	*Bothrideres*	Colydiidae	Gayndah, Q	2 S
pascoei Macleay 1871	*Deretraphus*	Colydiidae	Gayndah, Q	1 S
pascoei Macleay 1887	*Distipsidera*	Carabidae	Cairns, Q	4 S
pascoei Macleay 1872	*Metistete*	Alleculidae	Gayndah, Q	2 S
pascoei Macleay 1872	*Platydema*	Tenebrionidae	Gayndah, Q	4 S
pascoei Macleay 1872	*Promethis*	Tenebrionidae	Gayndah, Q	4 S
pascoei Macleay 1872	*Pterohelaeus*	Tenebrionidae	Gayndah, Q	3 S

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pascoei Macleay 1888	*Saragus*	Tenebrionidae	Port Augusta, SA	2 S
patruelis Pascoe 1885	*Orthorrhinus*	Curculionidae	New Guinea	2 P
pectoralis Lea 1899	*Melanterius*	Curculionidae	SA	1 P
pedunculata Lea 1915	*Phagonophana*	Scydmaenidae	Clarence R.; Sydney, NSW	2 P
pencillatus Macleay 1865	*Talaurinus*	Curculionidae	Tas	2 S
perarmatus Lea 1929	*Myllocerus*	Curculionidae	Magnetic I., Q	2 P
peregrina Pascoe 1866	*Ceropria*	Tenebrionidae	NSW	2 T
perissus Britton 1957	*Anthotocus*	Scarabaeidae	Richmond R., NSW	4 P
perlata Ferguson 1909	*Psalidura*	Curculionidae	Eucla, WA	H, A
perlatus Lea 1904	*Cadmus*	Chrysomelidae	Sydney, NSW	H
perpilosus Macleay 1871	*Onthophagus*	Scarabaeidae	Gayndah, Q	2 S
perplexus Ferguson 1915	*Talaurinus*	Curculionidae	Vic	H, A, 2 P
phanophila Lea 1923	*Monolepta*	Chrysomelidae	Cairns, Q	1 P
phanophilus Lea 1923	*Monoplistes*	Scarabaeidae	Gordonvale, Cairns, Q	2 P
phylarchus Sloane 1899	*Pterostichus (Cratoferonia)*	Carabidae	Bellinger R., NSW	1 S
phymatodes Lea 1906	*Leptops*	Curculionidae	Cairns, Q	2 P
piceoniger Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	H
piccosetosus Macleay 1865	*Cubicorrhynchus*	Curculionidae	Yass, NSW	2 S
piceus King 1865	*Tyrus*	Pselaphidae	Sydney, NSW	1 T
picipennis Macleay 1871	*Eulebia*	Carabidae	Wide Bay, Q	1 S
picipennis Macleay 1888	*Isodon*	Scarabaeidae	King Sound, WA	H
picipes Macleay 1873	*Arthropterus*	Carabidae	South country, nr. Yass, NSW	H
picipes Macleay 1864	*Harpalus (Gnathaphanus)*	Carabidae	Port Denison, Q	H
picipes Macleay 1871	*Heteronychus*	Scarabaeidae	Gayndah, Q	17 S
picta Castelnau 1868	*Silphomorpha*	Carabidae	Port Denison, Q	1 T
picta Pascoe 1869	*Dinoria*	Tenebrionidae	Tas	4 T
picta Pascoe 1863	*Penthea (Corrhenes)*	Cerambycidae	SA	2 T
picticollis Lea 1921	*Cychramus*	Nitidulidae	Brisbane, Q	2 P
picticornis Lea 1915	*Colaspoides*	Chrysomelidae	Brisbane, Q	1 P
picticornis Lea 1915	*Tomyris*	Chrysomelidae	Warren R., WA	1 P
pictus Lea 1910	*Mecopus*	Curculionidae	Cairns, Q	2 P
piliger W. S. Macleay 1827	*Acanthocinus (Symphyletes)*	Cerambycidae	Australia	H
piliger W. S. Macleay 1827	*Probatodes*	Cerambycidae	Hobart, Tas	2 S
pilipennis Macleay 1871	*Carpophilus*	Nitidulidae	Gayndah, Q	2 S
pilistriatus Lea 1908	*Ephrycinus*	Curculionidae	Lord Howe I.	2 P
pilosella Pascoe 1869	*Brycopia*	Tenebrionidae	Vic	4 T
pilosipennis Lea 1913	*Neocarphurus*	Melyridae	Narromine, NSW	1 P
pilosus Ferguson 1915	*Acherres*	Curculionidae	Cue, WA	H, 2 P
pilosus Macleay 1871	*Liparetrus*	Scarabaeidae	Gayndah, Q	1 S
pilularius Macleay 1866	*Sclerorinus*	Curculionidae	Flinders Range, SA	4 S
pilulifer Lea 1916	*Leptops*	Curculionidae	WA	1 P
pinguis Blackburn 1890	*Heteronyx*	Scarabaeidae	NSW	H
pini Lea 1911	*Car*	Curculionidae	WA	2 P
pisciformis Carter 1916	*Castiarina*	Buprestidae	SA	2 S
pisoniae Lea 1921	*Carphurus*	Melyridae	Cairns district, Q	3 P
pisoniae Lea 1923	*Panelus*	Scarabaeidae	Cairns district, Q	2 P
pithecius Pascoe 1879	*Mythites*	Curculionidae	Monaro, NSW	2 T
placidus Lea 1908	*Elleschodes*	Curculionidae	WA	2 P
plagiatus Macleay 1876	*Phloeodromius*	Carabidae	Hall Sound, New Guinea	H
planiceps Macleay 1871	*Platysoma*	Histeridae	Gayndah, Q	1 S
planicollis Macleay 1872	*Allecula*	Alleculidae	Gayndah, Q	2 S
planicollis Macleay 1871	*Isomalus (Eleusis)*	Staphylinidae	Gayndah, Q	1 S
planipenne Macleay 1873	*Carenum*	Carabidae	Port Wakefield, SA	4 A
planipennis Macleay 1878	*Coptocarpus*	Carabidae	Port Darwin, NT	3 S
planipennis Macleay 1871	*Platynus (Colpodes)*	Carabidae	Gayndah, Q	2 S
planipennis Macleay 1871	*Harpalus (Gnathaphanus)*	Carabidae	Gayndah, Q	2 S
platygaster Lea 1908	*Luciola*	Lampyridae	Cairns, Q	3 S
plebejus Carter 1915	*Apellatus*	Alleculidae	Murray R., SA.	1 P
plicigerun Pascoe 1869	*Adelium*	Tenebrionidae	Port Denison, Q	2 T
plumbeus Lea 1898	*Syarbis*	Curculionidae	NSW	2 P
poeciloderma Lea 1915	*Colaspoides*	Chrysomelidae	NSW	2 P

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polita King 1863	*Bryaxis (Eupines)*	Pselaphidae	Parramatta, NSW	2 T
polita Macleay 1871	*Silphomorpha*	Carabidae	Gayndah, Q	1 S
politicollis Bates 1879	*Cardiothorax*	Tenebrionidae	Hunter R., NSW	2 T
politulum Macleay 1871	*Carenum*	Carabidae	Gayndah, Q	1 S
politulum Macleay 1871	*Gigadema*	Carabidae	Gayndah, Q	2 S
politulum Macleay 1871	*Lathrobium*	Staphylinidae	Gayndah, Q	2 S
politulum Macleay 1887	*Temnoplectron*	Scarabaeidae	Cairns, Q	4 S
politulus Macleay 1888	*Liparochrus (Antiochrus)*	Scarabaeidae	King Sound, WA	H
politum Macleay 1871	*Scaphisoma*	Scaphidiidae	Gayndah, Q	L + PL
politus King 1865	*Elmis (Austrolimnius)*	Helminthidae	Parramatta R., NSW	3 T
politus Lea 1906	*Gymnobaris*	Curculionidae	Q	1 P
politus Macleay 1888	*Diaphoromerus*	Carabidae	King Sound, WA	2 S
pollux Lea 1904	*Loxopleurus*	Chrysomelidae	Tas	2 P
polymorpha Lea 1915	*Rhyparida*	Chrysomelidae	Vic	1 P
polyphyllus W. S. Macleay 1827	*Passalus*	Passalidae	'New Holland'	H
porcatulus Macleay 1888	*Diaphoromerus*	Carabidae	King Sound, WA	2 S
porcatum Macleay 1887	*Steganomma*	Carabidae	Russell R., nr Cairns, Q	H
porcatus Lea 1908	*Syarbis*	Curculionidae	WA	1 P
porosa Lea 1915	*Geloptera*	Chrysomelidae	Gosford, NSW	2 P
porrigineus Pascoe 1872	*Poropterus*	Curculionidae	Vic	2 T
postcoxalis Lea 1926	*Mandalotus*	Curculionidae	Gippsland, Vic	3 P
posthumeralis Lea 1915	*Edusa*	Chrysomelidae	Sydney, NSW	2 P
posticalis Ferguson 1915	*Talaurinus*	Curculionidae	Coramba, NSW	H
posticalis Lea 1903	*Queenslandica*	Curculionidae	Lizard I., Q	4 P
posticalis Macleay 1866	*Acantholophus*	Curculionidae	Stirling Range, WA	H, 2 P
posticalis Macleay 1887	*Cladophorus (Metriorrhynchus)*	Lycidae	Barron R., Q	2 S
potamophilus Lea 1921	*Aphanocephalus*	Corylophidae	WA	2 P
prasina Macleay 1886	*Diphucephala*	Scarabaeidae	Bargo (Picton), NSW	4 S
prasinus Macleay 1873	*Calloodes*	Scarabaeidae	North Australia	2 S
pretiosa Lea 1911	*Lybaeba*	Curculionidae	Vic	2 P
princeps King 1864	*Heterognathus*	Scydmaenidae	Parramatta, NSW	2 T
prionoides Thomson 1864	*Dioclides*	Cerambycidae	Salt R., WA	2 T
procerum Olliff 1890	*Ceresium*	Cerambycidae	Lord Howe I.	1 T
procerus Olliff 1889	*Cossonus (Aphanocorynes)*	Curculionidae	Lord Howe I.	2 S
prodigus Macleay 1866	*Hyborrhynchus*	Curculionidae	King George Sound, WA	2 S
promptus Harold 1869	*Onthophagus*	Scarabaeidae	Cape York, Q	2 T
propinqua Carter 1916	*Stigmodera*	Buprestidae	SA	H
propinquum Macleay 1869	*Carenum*	Carabidae	Liverpool Plains, NSW	H
propinquus Macleay 1872	*Anthicus*	Anthicidae	Gayndah, Q	2 S
propinquus Macleay 1886	*Liparetrus*	Scarabaeidae	Port Denison, Q	H
propinquus Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	2 S
proxima Pascoe 1869	*Seirotrana*	Tenebrionidae	Vic	2 T
prypnoides Ferguson 1912	*Talaurinus*	Curculionidae	SA	H, A, 1P
pubescens Carter 1939	*Limonius*	Elateridae	Mt Tambourine, Q	2 P
pubescens Lea 1911	*Bubaris*	Curculionidae	NSW	6 P
pubescens Lea 1920	*Ditropidus*	Chrysomelidae	Leigh Creek, SA	3 P
pubescens Lea 1922	*Gcoendomychus*	Endomychidae	Lord Howe I.	2 P
pubescens Macleay 1886	*Diphucephala*	Scarabaeidae	Q	H
pubescens Macleay 1871	*Heteronyx*	Scarabaeidae	Gayndah, Q	1 S
pubiventris Pascoe 1862	*Symphyletes*	Cerambycidae	SA	2 T
pudicum Olliff 1889	*Ostoma*	Trogossitidae	Lord Howe I.	2 T
pulcher King 1869	*Anthicus*	Anthicidae	Gawler, SA	3 T
pulcher Lea 1915	*Chrysophoracis*	Chrysomelidae	Tas	1 P
pulchra Brown 1869	*Megacephala (Tetracha)*	Carabidae	Champion Bay, WA	1 T
pulchra Macleay 1871	*Schizorrhina*	Scarabaeidae	Gayndah, Q	5 S
pulchripennis Lea 1897	*Syarbis*	Curculionidae	WA	2 P
pulchrivaria Lea 1917	*Lagria*	Lagriidae	NSW	1 P
pulverulenta Macleay 1887	*Mordella*	Mordellidae	Cairns, Q	2 S
pulverulentus Macleay 1865 var. *prosternalis* Ferguson	*Talaurinus*	Curculionidae	Q	3 P

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punctatissima Lea 1915	*Geloptera*	Chrysomelidae	Cairns, Q	H
punctatissima Macleay 1888	*Silphomorpha*	Carabidae	King Sound, WA	H
punctatus King 1865	*Cyathiger*	Pselaphidae	Petersham; Blue Mts, NSW	2 T
punctatus Lea 1910	*Lissotes*	Lucanidae	Tas	2 P
punctatus Sloane 1894	*Cyclothorax (Mecyclothorax)*	Carabidae	Urana, NSW	2 P
puncticolle Macleay 1873	*Bolboceras*	Geotrupidae	SA	L♂ + 2♂ 1♀ PL
puncticolle Macleay 1864	*Carenum*	Carabidae	SA	H
puncticollis Carter 1910	*Pterohelaeus*	Tenebrionidae	WA	H
puncticollis Lea 1909	*Timareta*	Curculionidae	Tas	2 P
puncticollis Macleay 1873	*Arthropterus*	Carabidae	Liverpool Plains, NSW	H
puncticollis Macleay 1888	*Haplaner (Hypharpax)*	Carabidae	King Sound, WA	4 S
puncticollis Macleay 1873	*Promecoderus*	Carabidae	Monaro, NSW	H
puncticollis Macleay 1871	*Stenus*	Staphylinidae	Gayndah, Q	2 P
punctifera Macleay 1872	*Seirotrana*	Tenebrionidae	Gayndah, Q	4 S
punctifrons Lea 1903	*Calomela*	Chrysomelidae	Rockhampton, Q	2 S
punctilatera Lea 1924	*Dorcatoma*	Anobiidae	Lord Howe I.	1 P
punctipenne Macleay 1871	*Scaphidium*	Scaphidiidae	NSW	L
punctipennis Carter 1926	*Athemistus*	Cerambycidae	Barrington Tops, NSW	H
punctipennis Lea 1910	*Auletes*	Curculionidae	Illawarra, NSW	1 P
punctipennis Lea 1909	*Helcogaster*	Melyridae	Cairns, Q	2 S
punctipennis Lea 1912	*Notocalviceps*	Curculionidae	Q	H
punctipennis Macleay 1872	*Chalcopterus (Amarygmus)*	Tenebrionidae	Gayndah, Q	1 S
punctipennis Macleay 1871	*Cyclothorax (Mecyclothorax)*	Carabidae	Gayndah, Q	1 S
punctipennis Macleay 1873	*Gnathoxys*	Carabidae	SA	2 S
punctipennis Macleay 1887	*Pterohelaeus*	Tenebrionidae	Cape York, Q	2 S
punctirostris Lea 1908	*Belus*	Belidae	SA	2 P
punctivarius Lea 1921	*Ditropidus*	Chrysomelidae	Hobart, Tas	2 P
punctulata Blackburn 1889	*Rhyparida*	Chrysomelidae	SA (north)	1 P
punctulatum Macleay 1864	*Carenum*	Carabidae	Byalla, NSW	H
punctulatum Macleay 1887	*Eutoma*	Carabidae	Dawson R., Q	2 S
punctum W. S. Macleay 1827	*Oedemera (Sessinia)*	Oedemeridae	New Holland	H
purpurascens Macleay 1888	*Anthaxia (Anilara)*	Buprestidae	King Sound, WA	H (missing)
purpurea Lea 1915	*Cleorina*	Chrysomelidae	Cairns district, Q	2 P
purpureicollis Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	3 S
purpureipennis Bates 1873	*Metisopus*	Tenebrionidae	Norfolk I.	4 T
purpureipennis Lea 1921	*Carphurus*	Melyridae	Q	1 P
purpureipennis Lea 1916	*Stethomela*	Chrysomelidae	Coen R., Q	1 P
purpureipennis Macleay 1887	*Lagria*	Lagriidae	Mulgrave R., Q	2 S
purpureipennis Macleay 1871	*Notonomus*	Carabidae	Gayndah, Q	2 S
purpureitarsis Macleay 1886	*Diphucephala*	Scarabaeidae	NSW	H
purpureomarginatum Macleay 1887	*Carenum*	Carabidae	Coonabarabran, NSW	4 S
purpureotincta Macleay 1888	*Cisseis*	Buprestidae	WA	H
purpureotinctus Lea 1904	*Cryptocephalus*	Chrysomelidae	Kurrajong, NSW	2 P
pusillus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Barron R., Q	2 S
pygidialis Lea 1917	*Mordella*	Mordellidae	Illawarra, Sydney, NSW	3 P
pygmaea Macleay 1864	*Cheiragra*	Scarabaeidae	NSW	2 S
pygmaeum Macleay 1871	*Cyclonotum*	Hydrophilidae	Gayndah, Q	3 S
pygmaeum Macleay 1888	*Temnoplectron (Lepanus)*	Scarabaeidae	King Sound, WA	2 S
pygmaeus Carter 1906	*Cardiothorax*	Tenebrionidae	NSW	2 S
pygmaeus Carter 1926	*Hypaulax*	Tenebrionidae	Darwin, NT	H, 1 P
pygmaeus Carter 1939	*Limonius*	Elateridae	SA	2 S
pygmaeus Lea 1908	*Microcryptorhynchus*	Curculionidae	King I., Tas	2 P
pygmaeus Macleay 1888	*Oodes*	Carabidae	King Sound, WA	2 S
pyriferus Lea 1910	*Dialeptopus*	Curculionidae	SA	1 P
pyrrha Olliff 1886	*Calodera*	Staphylinidae	Hunter R., NSW	1 T

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quadraticollis Ferguson 1915	*Cubicorrhynchus*	Curculionidae	Mt Lofty, SA	2 P
quadratipennis Macleay 1888	*Abacetus*	Carabidae	King Sound, WA	2 S
quadratus Carter 1910	*Sympetes*	Tenebrionidae	Shark Bay, WA	1 S
quadricolor Lea 1926	*Apion*	Curculionidae	Darwin, NT	2 P
quadricolor Lea 1907	*Lemidia*	Cleridae	NSW	H
quadriguttata Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	2 S
quadrimaculata Lea 1917	*Mordella*	Mordellidae	NSW	3 S
quadrimaculata Macleay 1864	*Silphomorpha*	Carabidae	Port Denison, Q	4 S
quadrimaculatus Macleay 1888	*Acupalpus*	Carabidae	King Sound, WA	4 S
quadriplagiatus Carter 1926	*Helmis*	Helminthidae	Vic	1 P
quadripunctatum Macleay 1863	*Carenum*	Carabidae	Port Denison, Q	4 S
quadrisignata Castelnau 1868	*Silphomorpha*	Carabidae	SA	3 T
quadrituberculata Lea 1911	*Rybaxis*	Pselaphidae	Tas	2 T
quatuordecimmaculata Macleay 1872	*Mordella*	Mordellidae	Gayndah (Wide Bay), Q	2 S
queenslandica Sloane 1909	*Cicindela*	Carabidae	Cairns, Q	1 P
queenslandica Sloane 1896	*Clivina*	Carabidae	Darling Downs, Q	1 P
queenslandicus Ferguson 1915	*Sclerorinus*	Curculionidae	Q	3 P
queenslandicus Sloane 1902	*Notonomus*	Carabidae	Q	1 P
quinquenotatus Lea 1921	*Stenotarsus*	Endomychidae	Sydney, NSW	1 P
quintana Lea 1911	*Eupines*	Pselaphidae	Tas	2 P
raffrayi Lea 1910	*Articerus*	Pselaphidae	WA	2 P
rainbowi Sloane 1902	*Notonomus*	Carabidae	Mt Kosciusko, NSW	2 T
ramsayi Olliff 1885	*Laemophlaeus*	Cucujidae	Wide Bay, Q	1 T
rara Lea 1915	*Colaspoides*	Chrysomelidae	SA	H
rayneri Macleay 1864	*Callodes*	Scarabaeidae	Port Denison, Q	2 S
rayneri Macleay 1865	*Talaurinus*	Curculionidae	West Coast, New Holland	H
rectangulare Macleay 1864	*Carenum*	Carabidae	SA	2 S
rectangularis Macleay 1864	*Bothrideres*	Colydiidae	Port Denison, Q	2 S
recticarinatus Lea 1926	*Mandalotus*	Curculionidae	Myponga, SA	2 P
recticollis Macleay 1888	*Haplaner*	Carabidae	King Sound, WA	H
rectifasciatus Lea 1895	*Anthicus*	Anthicidae	Fitzroy I., Q	2 P
rectipes Ferguson 1916	*Cubicorrhynchus*	Curculionidae	Cue, WA	H, 2 P
regalis Olliff 1887	*Colonia*	Staphylinidae	Richmond R., NSW	2 T
regius King 1869	*Articerus*	Pselaphidae	Liverpool, NSW	1 T
regularis Lea 1906	*Leptops*	Curculionidae	Darling R., NSW	1 P
regularis Macleay 1872	*Homotrysis*	Alleculidae	Gayndah, Q	1 S
regularis Sloane 1893	*Talaurinus*	Curculionidae	SA	H, A
reichei Castelnau 1868	*Prosopogmus*	Carabidae	Kiama, NSW	2 T
repandum Pascoe 1869	*Seirotrana*	Tenebrionidae	Q	2 T
resplendens Castelnau 1867	*Notonomus*	Carabidae	Merimbula, NSW	2 T
reticulatus Bates 1872	*Nyctozoilus*	Tenebrionidae	Monaro, NSW	H, 1 P
rhaebocnema Lea 1915	*Geloptera*	Chrysomelidae	WA	H
rhinoceros Macleay 1864	*Bolboceras*	Geotrupidae	Port Denison, Q	L♂ + 1♀ PL
rhipidius W. S. Macleay 1827	*Lycus (Metriorrhynchus)*	Lycidae	Australia	H
rhizophagus Lea 1914	*Leptops*	Curculionidae	Wirrabara, WA	1 P
rhizophagus Lea 1923	*Rhyssemus*	Scarabaeidae	Swan R.; Vasse R., WA	2 P
rhyncoliformis Wollaston 1873	*Pentamimus*	Curculionidae	King George Sound, WA	1 P
rhyticephalus Lea 1908	*Helcogaster*	Melyridae	NSW	2 P
richmondia Macleay 1886	*Diphucephala*	Scarabaeidae	Richmond R., NSW	4 S
riverinae Macleay 1873	*Arthropterus*	Carabidae	Murrumbidgee, NSW	H
riverinae Macleay 1865	*Carenum (Conopterum)*	Carabidae	Lower Murrumbidgee (= R. Murray), Mulwala, NSW	3 S
riverinae Macleay 1873	*Coptocarpus*	Carabidae	Murrumbidgee, NSW	2 S
riverinae Macleay 1873	*Promecoderus*	Carabidae	Lower Murrumbidgee, NSW	2 S
riverinae Macleay 1887	*Pterohelaeus*	Tenebrionidae	Murrumbidgee, NSW	2 S
riverinae Macleay 1865	*Sclerorinus*	Curculionidae	Lower Murrumbidgee, NSW	3 S
riverinae Macleay 1865	*Talaurinus*	Curculionidae	Lower Murrumbidgee, NSW	2 S
riverinae Sloane 1894	*Bembidium*	Carabidae	Urana, NSW	2 P
riverinae Sloane 1896	*Clivina*	Carabidae	Urana, NSW	2 P
rivulare Lea 1926	*Apion*	Curculionidae	Derby, WA	2 P
rivularis Lea 1920	*Ditropidus*	Chrysomelidae	Vasse R., WA	1 P
rivularis Lea 1915	*Scydmaenus*	Scydmaenidae	NSW; Vic	3 P

Specific Name	Original Genus	Family	Type Locality	Types
robustus Lea 1915	*Heterognathus*	Scydmaenidae	Mulgrave R., Q	1 P
rockhamptonensis Castelnau 1867	*Eudema (Epicosmus, Craspedophorus)*	Carabidae	Rockhampton, Q	1 T
rockhamptonensis Castelnau 1868	*Silphomorpha*	Carabidae	Rockhampton, Q	1 T
rockhamptonensis Macleay 1873	*Arthropterus*	Carabidae	Rockhampton, Q	H
roei Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	2 S
rostralis Lea 1906	*Leptops*	Curculionidae	Wide Bay, Q	2 P
rostrata Macleay 1864	*Macrothops*	Scarabaeidae	King George Sound, WA	5 S
rotundata Lea 1910	*Cassythicola*	Curculionidae	Geraldton, WA	2 P
rotundicollis Ferguson 1916	*Moluchtus*	Curculionidae	Onslow, Ashburton R., WA	H, A, 2P
rotundicollis Macleay 1871	*Scopaeus*	Staphylinidae	Gayndah, Q	2 S
rotundiformis Macleay 1886	*Liparetrus*	Scarabaeidae	King George Sound, WA	2 S
rotundipennis Macleay 1886	*Liparetrus*	Scarabaeidae	SA	4 S
rubefactus Macleay 1866	*Liparetrus*	Scarabaeidae	King George Sound, WA	H
rubescens Macleay 1888	*Lacon*	Elateridae	Barrier Range, WA	L, 1 PL
rubescens Macleay 1888	*Onthophagus*	Scarabaeidae	King Sound, WA	4 S
rubicunda Macleay 1887	*Egestria*	Anthicidae	Cairns, Q	H
rubicunda Macleay 1871	*Pria*	Nitidulidae	Gayndah, Q	2 S
rubicundulus Macleay 1888	*Lacon*	Elateridae	King Sound, WA	L
rubicundulus Macleay 1871	*Onthophagus*	Scarabaeidae	Gayndah, Q	5 S
rubicundum Macleay 1871	*Bembidium (Tachys)*	Carabidae	Gayndah, Q	4 S
rubicundus Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	2 S
rubicundus Macleay 1864	*Liparetrus*	Scarabaeidae	Port Denison, Q	3 S
rubiginosus Macleay 1873	*Anoplognathus*	Scarabaeidae	New England, NSW	2 S
rubriceps Macleay 1887	*Telephorus*	Cantharidae	Cairns district (Mossman R.), Q	2 S
rubrimaculatus Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	3 S
rubromarginata Théry 1922	*Metaxymorpha*	Buprestidae	'? Patria' (Q)	H
rudis Macleay 1888	*Saragus*	Tenebrionidae	Mudgee, NSW	4 S
rudis Macleay 1865	*Talaurinus*	Curculionidae	NSW	2 S
rufescens F. Bates 1868	*Licymnius (Chromomoea)*	Alleculidae	NSW	2 S
rufescens Macleay 1887	*Demetrias*	Carabidae	Cairns district, Q	4 S
ruficeps Lea 1919	*Odontonyx*	Scarabaeidae	Hunter R., NSW	H
ruficeps Macleay 1887	*Lagria*	Lagriidae	Q	2 S
ruficeps Macleay 1871	*Lecanomerus*	Carabidae	Gayndah, Q	2 S
ruficollis Macleay 1872	*Atractus (Neoatractus)*	Alleculidae	Gayndah, Q	4 S
ruficollis Macleay 1864	*Cheiragra*	Scarabaeidae	NSW	9 S
ruficollis Macleay 1864	*Phyllotocus*	Scarabaeidae	NSW	2 S
ruficollis Sloane 1898	*Agonochila*	Carabidae	Mt Barker, WA	3 P
ruficornis Lea 1908	*Belus*	Curculionidae	Q	1 P
rufilabris Lea 1915	*Edusa*	Chrysomelidae	WA	2 S
rufilabris Macleay 1871	*Trechus (Perigona)*	Carabidae	Gayndah, Q	4 S
rufimanus Lea 1908	*Elleschodes*	Curculionidae	NSW	2 P
rufimanus Lea 1908	*Magdalis*	Curculionidae	King I., Tas	2 P
rufimanus Lea 1928	*Microcryptorhynchus*	Curculionidae	Norfolk I.	2 P
rufipalpis Macleay 1871	*Conurus (Conosoma)*	Staphylinidae	Gayndah, Q	3 S
rufipennis Macleay 1864	*Liparetrus*	Scarabaeidae	Port Denison, Q	4 S
rufipes Blackburn 1896	*Talaurinus*	Curculionidae	Central Australia	1 P
rufipes Macleay 1872	*Amarygmus (Chalcopterus)*	Tenebrionidae	Gayndah, Q	2 S
rufipes Macleay 1872	*Microphyes*	Tenebrionidae	Gayndah, Q	3 S
rufipes Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	2 S
rufitincta Macleay 1886	*Euryonia (Glycyphana)*	Scarabaeidae	Port Moresby, NG	2 S
rufiventris Macleay 1887	*Telephorus*	Cantharidae	Cairns district (Mossman R.), Q	2 S
rufobrunneus Lea 1928	*Haplonyx*	Curculionidae	SA	1 P
rufolineata Macleay 1865	*Psalidura*	Curculionidae	Hunter R., NSW	2 S
rufomarginata Macleay 1871	*Silphomorpha*	Carabidae	Gayndah, Q	3 S
rufopiceus Macleay 1888	*Heteronyx*	Scarabaeidae	Barrier Range, WA	6 S

Specific Name	Original Genus	Family	Type Locality	Types
rufopiceus Macleay 1888	*Lacon*	Elateridae	Barrier Range, WA	L, 2 PL
rufosignatus Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	4 S
rufoterminalis Lea 1904	*Cryptocephalus*	Chrysomelidae	Yass, NSW	1 P
rufus Blackburn 1892	*Liparochrus*	Scarabaeidae	Murchison R., WA	1 P
rugiceps Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	4 S
rugicollis Carter 1915	*Hybrenia*	Alleculidae	NSW	1 P
rugicollis Macleay 1888	*Ammoecius*	Scarabaeidae	King Sound, WA	2 S
rugicollis Macleay 1865	*Sclerorinus*	Curculionidae	SA	H
rugicollis Macleay 1865	*Talaurinus*	Curculionidae	Singleton, NSW	H
rugosicolle Macleay 1872	*Adelium*	Tenebrionidae	Gayndah, Q	2 S
rugosipennis Macleay 1871	*Heteronyx*	Scarabaeidae	Gayndah, Q	1 S
rugosipennis Macleay 1888	*Saragus*	Tenebrionidae	Monaro, NSW	4 S
rugosulum Macleay 1869	*Neocarenum*	Carabidae	Salt Lake, Hummock Ridge, SA	H
rugosus Ferguson 1923	*Mythites*	Curculionidae	NSW	H, A, 1P
rugosus Kirby 1818	*Onthophagus*	Scarabaeidae	NSW; SA	2 T
rugosus Macleay 1865	*Hyborrhynchus*	Curculionidae	King George Sound, WA	2 S
rugosus Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
rugosus Macleay 1865	*Talaurinus*	Curculionidae	New Holland	2 S
rutilans Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	2 P
sabulosa Lea 1931	*Achopera*	Curculionidae	King I., Tas	2 P
sabulosus Lea 1907	*Mandalotus*	Curculionidae	Swansea, Tas	2 P
salebrosum Macleay 1871	*Carenum (Laccopterum)*	Carabidae	Gayndah, Q	4 S
salebrosus Macleay 1886	*Liparetrus*	Scarabaeidae	SA; Vic; NSW	4 S
salebrosus Macleay 1888	*Onthophagus*	Scarabaeidae	King George Sound, WA	H
salebrosus Macleay 1865	*Talaurinus*	Curculionidae	New Holland	2 S
satelles Blackburn 1893	*Calomela*	Chrysomelidae	Fraser Range, WA	2 P
satyrus Pascoe 1873	*Poropterus*	Curculionidae	Tas	2 T
saundersi Macleay 1888	*Chrysodema (Chalcophora)*	Buprestidae	King Sound, WA	4 S
savagei Lea 1917	*Maechidius*	Scarabaeidae	SA	1 P
scaber Macleay 1865	*Talaurinus*	Curculionidae	Swan R., WA	H
scabiosus Lea 1904	*Cryptocephalus*	Chrysomelidae	SA	H
scaphirostris Ferguson 1915	*Acantholophus*	Curculionidae	WA	H
scapularis Ferguson 1912	*Talaurinus*	Curculionidae	Dawson R., Q	1 P
scapularis Macleay 1863	*Megacephala (Tetracha)*	Carabidae	Port Denison, Q	2 S
scitulum Macleay 1863	*Carenum*	Carabidae	Moreton Bay, Q	H
sciurus Pascoe 1870	*Syarbis*	Curculionidae	Nicol Bay, WA	2 T
scrobiculata Lea 1908	*Wiburdia*	Curculionidae	NSW	1 P
sculptipennis Castelnau 1867	*Harpalus (Diaphoromerus)*	Carabidae	King George Sound, WA	2 T
sculpturatus Sloane 1894	*Lestianthus (Lithastrotus)*	Carabidae	Rope's Creek, NSW	4 T
scutatus Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	2 S
scutellare Pascoe 1869	*Adelium*	Tenebrionidae	Darling Downs, Q	2 T
scutellaris Lea 1915	*Alittus*	Chrysomelidae	Stewart R., Q	2 P
scutellaris Macleay 1873	*Arthropterus*	Carabidae	South Country, NSW	H
scutellaris Macleay 1864	*Phyllotocus*	Scarabaeidae	Sydney, NSW	4 S
scutellaris Pascoe 1871	*Catastygnus*	Curculionidae	Wide Bay, Q	1 T
scutellatus Lea 1895	*Anthicus*	Anthicidae	WA	4 P
securigera W. S. Macleay 1827	*Cistela*	Alleculidae	Australia	H
sellatus Ferguson 1921	*Acantholophus*	Curculionidae	NSW	2 S
sellatus Pascoe 1873	*Tychreus*	Curculionidae	NSW	2 T
semicalvus Lea 1917	*Pseudoryctes*	Scarabaeidae	Ooldea, SA	1 P
semicoecus Macleay 1888	*Ammoecius*	Scarabaeidae	WA	2 S
semicornutus Macleay 1871	*Ammoecius (Ataenius)*	Scarabaeidae	Gayndah, Q	3 S
semicostatus Macleay 1871	*Trox*	Trogidae	Gayndah, Q	3 S
semicrudus Lea 1920	*Ditropidus*	Chrysomelidae	Vic	1 P
semiflava Lea 1923	*Monolepta*	Chrysomelidae	Bribie I., Q	2 P
semimetallicus Lea 1923	*Onthophagus*	Scarabaeidae	Q	1 P
seminiger Lea 1915	*Scydmaenus*	Scydmaenidae	Vic; NSW; Tas	5 P
seminudus Lea 1911	*Haplonyx*	Curculionidae	Q	1 P

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semiopaca Lea 1917	*Haplonycha*	Scarabaeidae	SA	1 P
semiopacus Lea 1910	*Polylobus*	Staphylinidae	Tas, Huon R.	2 P
semiporosus Lea 1908	*Melanterius*	Curculionidae	Q	2 P
semipunctatus Lea 1917	*Anthicus*	Anthicidae	Geraldton, WA	1 P
semiruber Carter 1939	*Melanoxanthus*	Elateridae	Cairns, Q	H
semirufirostris Lea 1915	*Aphanocorynes*	Curculionidae	WA	2 P
semistriata Lea 1915	*Geloptera*	Chrysomelidae	Cairns, Q	H
semiviolacea Castelnau 1867	*Cerotalis*	Carabidae	Port Lincoln, SA	2 T
semiviridis Sloane 1906	*Cicindela*	Carabidae	Coen, Q	1 T
semivittatus Macleay 1888	*Plochionus (Phloeocarabus)*	Carabidae	King Sound, WA	H
sepidioides Macleay 1865	*Cubicorrhynchus*	Curculionidae	Murrumbidgee, NSW	2 S
seposita Olliff 1885	*Leperina*	Trogossitidae	King George Sound, WA	2 T
septemcavus W. S. Macleay 1827	*Lycus (Metriorrhynchus)*	Lycidae	Australia	H
septemcostatus Carter 1910	*Pterohelaeus*	Tenebrionidae	Camooweal, Q	2 P
septentrionale Macleay 1887	*Carenidium (Conopterum)*	Carabidae	Peak Downs, Q	H
septentrionalis Ferguson 1912	*Talaurinus*	Curculionidae	Q	H, A
sericans Lea 1917	*Mordella*	Mordellidae	Ardrossan, SA	1 P
sericea Lea 1915	*Edusa*	Chrysomelidae	WA	1 P
sericea Macleay 1885 var. of *latreillei*	*Lamprima*	Lucanidae	Herbert R., Q	2 S
sericeipennis Lea 1919	*Cheiragra*	Scarabaeidae	Q	2 P
sericeipennis Macleay 1886	*Liparetrus*	Scarabaeidae	NSW	H
sericeus Macleay 1871	*Liparetrus*	Scarabaeidae	Gayndah, Q	1 PL
sericeus Macleay 1871	*Phyllotocus*	Scarabaeidae	Gayndah, Q	2 S
sericeus Macleay 1871	*Scopodes*	Carabidae	Gayndah, Q	2 S
sericipennis Macleay 1888	*Diaphoromerus*	Carabidae	King Sound, WA	H
serraticollis Macleay 1865	*Acantholophus*	Curculionidae	Wingelo, NSW	H
serraticornis Macleay 1887	*Metriorrhynchus*	Lycidae	Mossman R., Q	H
serraticornis Macleay 1887	*Pelecotomoides*	Rhipiphoridae	Cairns, Q	H
serratipes Ferguson 1916	*Cubicorrhynchus*	Curculionidae	WA	H
serricollis Lea 1926	*Hydrochus*	Hydrochidae	East Tamar, Tas	2 P
seticollis Lea 1919	*Pseudoheteronyx*	Scarabaeidae	NSW	2 P
seticollis Macleay 1871	*Morio*	Carabidae	Gayndah, Q	4 S
seticollis Sloane 1896	*Tachys*	Carabidae	King Sound, WA	5 P
setifera Lea 1915	*Geloptera*	Chrysomelidae	Cairns district, Q	2 P
setipennis Lea 1923	*Candezea*	Chrysomelidae	National Park, NSW	3 P
setosus Ferguson 1916	*Cubicorrhynchus*	Curculionidae	Onslow, WA	H, A, 2 P
setosus Lea 1904	*Polyphrades*	Curculionidae	WA	4 P
sexfoveatus Macleay 1888	*Scopodes*	Carabidae	Barrier Range, WA	2 S
sexguttata Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
sexpunctatum Macleay 1869	*Carenum*	Carabidae	Lower Murrumbidgee (= R. Murray), NSW	H
sexpunctatus Macleay 1888	*Diaphoromerus*	Carabidae	King Sound, WA	2 S
sexspilota Lea 1907	*Lemidia*	Cleridae	NSW	H
silaceus Pascoe 1871	*Cherrus (Leptops)*	Curculionidae	King George Sound, WA	2 T
silenus Westwood 1842	*Scaraphites*	Carabidae	Swan R., WA	1 T
similis Lea 1915	*Colaspoides*	Chrysomelidae	Brisbane, Q	2 P
similis Lea 1913	*Mechistocerus*	Curculionidae	Q	2 P
similis Macleay	*Stenus*	Staphylinidae	Gayndah, Q	2 S
simillimus Charpentier 1968	*Heterocerus*	Heteroceridae	WA	4 P
simillimus Macleay 1886	*Liparetrus*	Scarabaeidae	SA	3 S
simillimus Macleay 1865	*Talaurinus*	Curculionidae	Merimbula, NSW	H
simius Blackburn 1889	*Heteronyx*	Scarabaeidae	NSW	H
simplex Lea 1908	*Oxyops*	Curculionidae	Q	1 P
simpliciceps Lea 1908	*Helcogaster*	Melyridae	Kurrajong, NSW	1 P
simplicipennis Lea 1911	*Cherrus*	Curculionidae	Adelaide, Clifton, SA	2 P
simplicitarsis Carne 1958	*Amblyterus*	Scarabaeidae	Clarence R., NSW	H
simsoni Lea 1911	*Cossonus*	Curculionidae	Beaconsfield, Tas	2 P
simsoni Lea 1907	*Lemidia*	Cleridae	Tas	2 P
simulans Sloane 1896	*Clivina*	Carabidae	Urana, NSW	2 S
simulator Ferguson 1915	*Acantholophus*	Curculionidae	Kangaroo I., SA	3 P
simulator Lea 1907	*Mandalotus*	Curculionidae	NSW	1 P
sinuaticollis Carter 1911	*Apasis*	Tenebrionidae	NSW	1 P

Specific Name	Original Genus	Family	Type Locality	Types
sinuaticollis Macleay 1887	*Pterohelaeus*	Tenebrionidae	Cape York, Q	H
sloanei Ferguson 1909	*Psalidura*	Curculionidae	NSW	H, A
sloanei Ferguson 1921	*Sclerorinus*	Curculionidae	NSW	H, A, 2 P
smithi W. S. Macleay 1838	*Ceratorrhina*	Scarabaeidae	Delagoa Bay, South Africa	2 S
smithi W. S. Macleay 1838	*Orthopterus (Arthropterus)*	Carabidae	South Africa	H
sobrinus Ferguson 1913	*Talaurinus*	Curculionidae	Q	H, 1 P
sobrinus Lea 1910	*Mecopus*	Curculionidae	Richmond R., NSW	1 P
sobrinus Lea 1911	*Neomerimnetes*	Curculionidae	Wide Bay, Q	2 P
socialis Pascoe 1869	*Barytipha*	Tenebrionidae	Vic	2 T
sodalis Olliff 1886	*Polylobus*	Staphylinidae	Sydney, NSW	4 T
solida Pascoe 1863	*Penthea*	Cerambycidae	Clarence R., NSW	2 T
solidus Blackburn 1889	*Heteronyx*	Scarabaeidae	SA	H
solidus Carne 1957	*Cheiroplatys*	Scarabaeidae	Clyde R., NSW	A ♀ P ♂
solidus Sloane 1893	*Talaurinus*	Curculionidae	Q	H, 1 P
solitus Lea 1921	*Ditropidus*	Chrysomelidae	Quorn, SA	2 P
sordidus Ferguson 1921	*Acantholophus*	Curculionidae	Vic	2 S
sordidus Ferguson 1916	*Cubicorrhynchus*	Curculionidae	Jindabyne, NSW	H, A
sordidus Lea 1908	*Hypattalus*	Melyridae	SA	2 P
sordidus Macleay 1865	*Sclerorinus*	Curculionidae	SA	1 S
sororia Lea 1906	*Baris*	Curculionidae	Q	2 P
soror Lea 1914	*Misophrice*	Curculionidae	Pt. Lincoln, SA	2 P
soror Lea 1915	*Tomyris*	Chrysomelidae	Mt. Wellington, Tas	2 P
spaldingi Macleay 1878	*Carenidium (Conopterum)*	Carabidae	Port Darwin, NT	H*
sparsus Ferguson 1916	*Cubicorrhynchus*	Curculionidae	Darling Ranges, WA	H, A
speciosa Pascoe 1863	*Silphomorpha*	Carabidae	Gayndah, Q	4 T
speciosus Sloane 1888	*Calliscapterus*	Carabidae	Gascoigne R., WA	1 T
spencei Armstrong 1953	*Macrocyphon*	Helodidae	Sydney, NSW	1 P
spenceri Ferguson 1914 var. of *convexus*	*Sclerorinus*	Curculionidae	NW of SA	H, A, 1 P
spenceri Sloane 1896	*Tachys*	Carabidae	King Sound, WA	2 P
spicata Olliff 1889	*Platydema*	Tenebrionidae	Lord Howe I.	4 S
spilota W. S. Macleay 1821	*Scarabaeus (Gymnopleurus)*	Scarabaeidae	India	H
spinicollis Macleay 1866	*Cubicorrhynchus*	Curculionidae	Magadup, WA	2 S
spinicollis W. S. Macleay 1827	*Prionus (Agrianome)*	Cerambycidae	NSW	2 S
spinicollis Macleay 1887	*Pterohelaeus*	Tenebrionidae	Endeavour, Q	H
spinifer Macleay 1865	*Acantholophus*	Curculionidae	Vic	H
spiniger Ferguson 1914	*Talaurinus*	Curculionidae	SA	1 P
spinipennis Lea 1907	*Lemidia*	Cleridae	NSW	H
spinosa Carter 1939	*Melobasis*	Buprestidae	Q	H, 1 P
spinosus Macleay 1865	*Acantholophus*	Curculionidae	King George Sound, WA	4 S
spinosus Macleay 1865	*Talaurinus*	Curculionidae	King George Sound, WA	4 S
spissus Lea 1920	*Coenobius*	Chrysomelidae	Sydney, NSW	1 P
splendens Macleay 1872	*Curis*	Buprestidae	Gayndah, Q	2 S
splendens W. S. Macleay 1827	*Notoclea*	Chrysomelidae	Australia	H
splendidum Macleay 1863	*Carenum (Eutoma)*	Carabidae	King George Sound, WA	4 S
squalidus Macleay 1865	*Acantholophus*	Curculionidae	Merimbula, NSW	2 S
squalidus Macleay 1872	*Cestrinus (Adelodemus)*	Tenebrionidae	Gayndah, Q	2 S
squalidus Macleay 1887	*Merodontus (Amphistomus)*	Scarabaeidae	Cairns, Q	2 S
squalidus Macleay 1887	*Pterohelaeus*	Tenebrionidae	Q	2 S
squalidus Macleay 1865	*Sclerorinus*	Curculionidae	Lambing Flat, NSW	2 S
squamibunda Pascoe 1870	*Eleagna*	Curculionidae	Port Augusta, SA	1 T
squamibundus Lea 1911	*Mandalotus*	Curculionidae	Port Denison, Q	2 P
squamiger Macleay 1886	*Liparetrus*	Scarabaeidae	SA	2 S
squamigera Macleay 1865	*Psalidura*	Curculionidae	New Holland	H
squamipennis Lea 1904	*Decilaus*	Curculionidae	Gayndah, Q	2 P
squamiventris Lea 1913	*Gygaeus*	Curculionidae	Cairns district, Q	1 P
squamiventris Lea 1906	*Misophrice*	Curculionidae	Vic	2 P

*Pin bears a printed label 'Dawson River, Q' but stands over label '*Carenidium spaldingi* Macl. Port Darwin'. No other identified specimen exists.

Specific Name	Original Genus	Family	Type Locality	Types
squamosus Carter 1911	*Onosterrhus*	Tenebrionidae	NSW	2 P
squamosus Lea 1906	*Leptops*	Curculionidae	Clarence R., NSW	2 P
squamosus Lea 1908	*Onesorus*	Curculionidae	Onslow, WA	4 P
squamosus Macleay 1865	*Acantholophus*	Curculionidae	Vic	H
squamosus Macleay 1872	*Apatelus*	Tenebrionidae	Gayndah, Q	1 S
squamosus Macleay 1865	*Talaurinus*	Curculionidae	Murrumbidgee, NSW	2 S
squamosus Macleay 1871	*Trox*	Trogidae	Gayndah, Q	3 S
squamosus Pascoe 1869	*Helaeus*	Tenebrionidae	Darling R., NSW	2 T
squiresensis Blackburn 1902	*Dasytes*	Melyridae	Mt. Squires, WA	2 P
stenocerus Lea 1904	*Cryptocephalus*	Chrysomelidae	Rockhampton, Q	2 S
stephensi Macleay 1865	*Illaphanus*	Carabidae	Illawarra (Wollongong), NSW	2 S
sterculiae Pascoe 1873	*Zeneudes*	Curculionidae	Gayndah, Q	2 T
sternalis Blackburn 1912	*Stethaspis*	Scarabaeidae	Mt. Buffalo, Vic	1 P
sterrha Olliff 1889	*Nyctobates*	Tenebrionidae	Lord Howe I.	4 T
stigma Pascoe 1873	*Lobotrachelus*	Curculionidae	Gayndah, Q	2 T
stigmaticus Pascoe 1870	*Cryptorrhynchus*	Curculionidae	Q	1 T
stilbum Lea 1910	*Apion*	Curculionidae	Otford, NSW	2 P
storeoides Lea 1902	*Bothynacrum*	Curculionidae	Endeavour R., Q	1 P
strabonus Lea 1899	*Melanterius*	Curculionidae	King George Sound, WA	2 P
straminea Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
striatipennis Lea 1915	*Geloptera*	Chrysomelidae	Cairns district, Q	1 P
striatipennis Macleay 1886	*Liparetrus*	Scarabaeidae	Piper's Flat, NSW	H
striatipennis Macleay 1888	*Saragus*	Tenebrionidae	Monaro, NSW	2 S
striatipennis Macleay 1888	*Silphomorpha*	Carabidae	King Sound, WA	2 S
striatopunctata Macleay 1887	*Decialma*	Tenebrionidae	Q	2 S
striatopunctatum Macleay 1865	*Carenum*	Carabidae	Daly Waters, NT	H
striatopunctulatum Macleay 1865	*Carenum*	Carabidae	Murrumbidgee, NSW	H
striatus Lea 1905	*Aonychus*	Curculionidae	WA	6 P
striatus Lea 1913	*Decilaus*	Curculionidae	Mt. Wellington, Tas	2 P
striatus Macleay 1872	*Amarygmus*	Tenebrionidae	Gayndah, Q	1 S
strigata Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
strigiceps Lea 1911	*Cherrus*	Curculionidae	SA	2 P
strigicollis Carter 1937	*Metopiestes*	Colydiidae	Sydney, NSW	H
strigicollis Ferguson 1915	*Cubicorrhynchus*	Curculionidae	Nathalia, Vic	H, 1 P
strigicollis Lea 1910	*Diplocotes*	Ptiniidae	SA	H
striolatum Macleay 1871	*Bembidium*	Carabidae	Gayndah, Q	6 S
stuarti Macleay 1865	*Sclerorinus*	Curculionidae	Central Australia	H
stuarti Sloane 1895	*Rhytisternus*	Carabidae	Lake Callabonna, SA	1 P
sturmi W. S. Macleay 1821	*Scarabaeus*	Scarabaeidae	S. Europe	2 S
suavis Lea 1915	*Colaspoides*	Chrysomelidae	Q	2 P
subaenea Harold 1877	*Coptodactyla*	Scarabaeidae	Cape York, Q	1 T
subaeraria Lea 1924	*Paropsis*	Chrysomelidae	Somerset, Q	1 P
subampliatus Macleay 1873	*Arthropterus*	Carabidae	Monaro district, NSW	2 S
subapterus Lea 1911	*Myllocerus*	Curculionidae	WA	4 P
subcaerulea Lea 1908	*Eniopea*	Curculionidae	King I., Tas	1 P
subcarinatus Ferguson 1916	*Sclerorinus*	Curculionidae	NSW	H, A, 1 P
subcarinatus Macleay 1864	*Trox*	Trogidae	Port Denison, Q	L
subcingulatus Macleay 1871	*Philonthus*	Staphylinidae	Gayndah, Q	1 S
subcostata Macleay 1865	*Psalidura*	Curculionidae	Parramatta, NSW	2 S
subcostatum Macleay 1865	*Carenum*	Carabidae	Clarence R., NSW	3 S
subcostatus Macleay 1864	*Chlaenius*	Carabidae	Port Denison, Q	2 S
subcostatus Macleay 1871	*Cryptodus*	Scarabaeidae	Gayndah, Q	1 S
subcostatus Macleay 1865	*Sclerorinus*	Curculionidae	Wingelo, NSW	2 S
subcyaneum Macleay 1869	*Carenum*	Carabidae	SA	2 S
subcylindricornis Lea 1919	*Articerus*	Pselaphidae	WA	2 P
subcylindricus Lea 1924	*Dryophilodes*	Anobiidae	Myponga, SA	2 P
subcylindricus Macleay 1873	*Arthropterus*	Carabidae	Bogalong, nr. Yass, NSW	2 S
subdepressum Carter 1908	*Adelium*	Tenebrionidae	NSW	1 P
subdepressum Macleay 1873	*Platysoma*	Histeridae	Gayndah, Q	1 S
subellipticus Lea 1921	*Dasytes*	Melyridae	Bribie I., Q	2 P
subfasciatus Pascoe 1870	*Imaliodes*	Curculionidae	Illawarra, NSW	1 T
subfuscus Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	2 S
subglaber Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	H
subhumeralis Lea 1924	*Pronus*	Ptinidae	Lord Howe I.	1 P
sublaevigata Ferguson 1909	*Psalidura*	Curculionidae	NSW	H, A
sublaevis Macleay 1888	*Eudalia (Dicraspeda)*	Carabidae	Barrier Range (King Sound), WA	2 S

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sublaevis Macleay 1887	*Hybrenia*	Alleculidae	Cairns, Q	H
sublaminata Lea 1906	*Baris*	Curculionidae	Q	1 P
sublineatus Lea 1911	*Prosayleus*	Curculionidae	Forest Reefs, NSW	2 P
submaculatus Lea 1904	*Balaninus*	Curculionidae	Kiama, NSW	H
submetallicum Macleay 1869	*Neocarenum*	Carabidae	Gayndah, Q	3 S
submetallicus Macleay 1864	*Gnathoxys*	Carabidae	SA	H
subopaca Lea 1906	*Baris*	Curculionidae	NSW	2 P
subopacum Lea 1910	*Apion*	Curculionidae	Chillagoe, Q	2 P
subopacus Lea 1913	*Tyrtaeosus*	Curculionidae	Cairns, Q	2 P
subopacus Macleay 1871	*Adelotopus*	Carabidae	Gayndah, Q	2 S
subparallela Champion 1894	*Hyocis*	Tenebrionidae	Swan R., WA	2 T
subporcatulum Macleay 1865	*Carenum*	Carabidae	Wide Bay, Q	2 S
subquadratum Macleay 1865	*Carenum*	Carabidae	SA	H
subrugulosum Macleay 1865	*Carenum*	Carabidae	'New Holland'	H
subsericeus Macleay 1888	*Haplaner*	Carabidae	King Sound, WA	H
subsquamosus Macleay 1886	*Liparetrus*	Scarabaeidae	Port Darwin, NT	H
substriata Castelnau 1867	*Cerotalis*	Carabidae	King George Sound, WA	2 T
substriatulum Macleay 1865	*Carenum (Eutoma)*	Carabidae	Richmond R., NSW	H
substrigosus Ferguson 1915	*Cubicorrhynchus*	Curculionidae	SA	2 P
subsuturalis Lea 1907	*Lemidia*	Cleridae	Hobart, Tas	1 P
subsuturalis Lea 1908	*Belus*	Belidae	Cairns, Q	1 P
subtilis Macleay 1888	*Lacon*	Elateridae	King George Sound, WA	L
subtridentatus Ferguson 1921	*Acantholophus*	Curculionidae	NSW	H
subvariabilis Lea 1927	*Misophrice*	Curculionidae	Ooldea, SA	3 P
subviride Macleay 1871	*Bembidium*	Carabidae	Gayndah, Q	6 S
subvittata Macleay 1887	*Hybrenia*	Alleculidae	Cairns, Q	2 S
subvittata Macleay 1887	*Mordella*	Mordellidae	Russell R., Q	H
subvittatus Ferguson 1912	*Talaurinus*	Curculionidae	Q	H, A, 1 P
subvittatus Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	H
sulcaticeps Sloane 1897	*Carenum*	Carabidae	Nullarbor Plain, WA	1 S
sulcatulus Macleay 1888	*Poecilus (Chlaenioidius)*	Carabidae	King Sound, WA	H
sulcatulus Macleay 1888	*Diaphoromerus*	Carabidae	Barrier Range (nr King Sound), WA	H
sulcatus Macleay 1878	*Coronocanthus (Sarticus)*	Carabidae	Port Denison, Q	4 S
sulcatus Macleay 1864	*Helluo (Gigadema)*	Carabidae	Port Denison, Q	H
sulciceps Lea 1908	*Helcogaster*	Melyridae	NSW	H
sulcicollis Sloane 1896	*Clivina*	Carabidae	WA	2 S
sulcipennis Ferguson 1909	*Psalidura*	Curculionidae	NSW	H, A
sulcipennis Macleay 1872	*Notograptus*	Buprestidae	Gayndah, Q	5 S
sulcipennis Macleay 1887	*Platydesmus (Pteroplatydesmus)*	Scarabaeidae	Mossman R., Q	H
sulciventris Ferguson 1912	*Talaurinus*	Curculionidae	Q	H
superans Pascoe 1862	*Tryphocharia*	Cerambycidae	Tas	2 T
superbas Castelnau 1867	*Homalosoma (Trichosternus)*	Carabidae	Hunter R., NSW	2 T
suturalis Lea 1910	*Temialma*	Curculionidae	Endeavour R., Q	2 P
suturalis Macleay 1871	*Agonochila*	Carabidae	Gayndah, Q	4 S
suturalis Macleay 1873	*Bothrideres*	Colydiidae	Gayndah, Q	2 S
suturalis Macleay 1888	*Stenolophus*	Carabidae	King Sound, WA	H
swanseaensis Lea 1909	*Timareta*	Curculionidae	Swansea, Tas	2 P
sweeri Macleay 1873	*Bolboceras*	Geotrupidae	Sweers I., Q	L
sydneyensis Sloane 1896	*Clivina*	Carabidae	Sydney district, NSW	2 P
sylvicola Blackburn 1894	*Licinoma*	Tenebrionidae	Forest Reefs, NSW	2 T
tabellicornis Macleay 1864	*Onthophagus*	Scarabaeidae	Port Denison, Q	H
taeniata Pascoe 1871	*Egestria*	Anthicidae	Rockhampton, Q	2 T
tantilla Lea 1915	*Tomyris*	Chrysomelidae	Darling Ranges, WA	1 P
tarsalis Lea 1915	*Colaspoides*	Chrysomelidae	Cairns district, Q	2 P
tarsalis Lea 1911	*Eupines*	Pselaphidae	Tas	2 P
tasmanicum Lea 1910	*Apion*	Curculionidae	Tas	4 P
tasmanicus Bates 1878	*Scopodes*	Carabidae	Tas	3 T
tasmaniensis Lea 1911	*Acantholophus*	Curculionidae	Hobart, Tas	3 P

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tasmaniensis Lea 1910	*Polylobus*	Staphylinidae	Hobart; Launceston, Tas	4 P
tasmaniensis Lea 1908	*Roptoperus*	Curculionidae	King I., Tas	4 P
taurus Ferguson 1914	*Notonophes*	Curculionidae	WA	L, 1 PL
taylori Ferguson 1915	*Psalidura*	Curculionidae	NSW	H, A
taylori Sloane 1903	*Notonomus*	Carabidae	Oberon, NSW	1 T
tectus Lea 1902	*Protopalus*	Curculionidae	Cairns, Q	2 P
tenebricosus Ferguson 1912	*Talaurinus*	Curculionidae	Vic	H, A
tenebricosus Lea 1904	*Cryptocephalus*	Chrysomelidae	Ipswich, Q	2 S
tennantensis Ferguson 1915	*Acantholophus*	Curculionidae	Tennant Creek, NT	2 P
tenuicollis Macleay 1888	*Cicindela*	Carabidae	Barrier Range, WA	4 S
tenuicornis Lea 1916	*Calomela*	Chrysomelidae	Cue, WA	1 P
tenuicornis Lea 1915	*Scydmaenus*	Scydmaenidae	Tas	1 P
tenuirostris Lea 1911	*Elleschodes*	Curculionidae	Tas	2 P
tenuis Lea 1911	*Eniopea*	Curculionidae	WA	3 P
tenuis Lea 1899	*Melanterius*	Curculionidae	WA	H
tenuis Lea 1912	*Polylobus*	Staphylinidae	Tas	3 P
tenuis Lea 1915	*Rhyparida*	Chrysomelidae	Cairns district, Q	2 P
tenuistriata Bates 1874	*Hypaulax*	Tenebrionidae	NSW	1 S
tenuistriata Lea 1906	*Baris*	Curculionidae	Q	2 P
tenuistriatum Lea 1910	*Apion*	Curculionidae	NSW	2 P
terminalis Lea 1910	*Lixus*	Curculionidae	Cairns, Q	2 P
terminata Pascoe 1863	*Atimua*	Cerambycidae	Port Denison, Q	2 T
termitophila Lea 1910	*Episcaphula*	Erotylidae	Darnley I., Q	2 P
terreus Pascoe 1870	*Imaliodes*	Curculionidae	Wide Bay, Q	2 T
tersus Lea 1915	*Cleptor*	Chrysomelidae	WA	H
tessellatus Macleay 1864	*Gnathoxys*	Carabidae	Parramatta, NSW	H
testaceicollis Macleay 1887	*Cladophorus (Xylobanus)*	Lycidae	Q	3 S
testaceipennis Macleay 1888	*Colpochila (Haplonycha)*	Scarabaeidae	King George Sound, WA	H
tetraspilota Lea 1915	*Rhyparida*	Chrysomelidae	Cairns, Q	H
tetrastictoptera Lea 1924	*Aulacophora*	Chrysomelidae	Roper R., NT	4 P
tetricus Pascoe 1874	*Poropterus*	Curculionidae	Gayndah, Q	2 T
textilis Pascoe 1871	*Catastygnus*	Curculionidae	Lizard I., Q	2 T
thoracicus Lea 1894	*Dromoeolus*	Eucnemidae	Lane Cove, NSW	2 P
thymaloides Macleay 1888	*Pterohelaeus*	Tenebrionidae	SA	4 S
tibialis Carne 1957	*Trissodon*	Scarabaeidae	SA	1 P
tibialis Ferguson 1914	*Chriotyphus*	Curculionidae	Onslow, WA	H, A
tibialis Ferguson 1914	*Macramycterus*	Curculionidae	WA	H
tibialis Ferguson 1923	*Aedriodes*	Curculionidae	Cunderdin, WA	H, 1 P
tibialis Lea 1916	*Augomela*	Chrysomelidae	Coen R., Cape York, Q	2 P
tibialis Lea 1927	*Emplesis*	Curculionidae	Strahan, Tas	2 P
tibialis Lea 1915	*Geloptera*	Chrysomelidae	Cairns, Q	2 P
tibialis Lea 1921	*Heteromastix*	Cantharidae	Dorrigo, Tweed R., NSW	2 P
tibialis Lea 1917	*Mordellistena*	Mordellidae	Sydney, NSW	1 P
tibialis Lea 1911	*Prypnus*	Curculionidae	Venus Bay, SA	2 P
tibialis Lea 1908	*Sellechus*	Curculionidae	NSW	2 P
tibialis Macleay 1863	*Cetonia*	Scarabaeidae	Port Denison, Q	2 S
tibialis Sloane 1893	*Molochtus*	Curculionidae	Fraser Range, WA	H
tigrina Carter 1935	*Elodes*	Helodidae	Kosciusko, NSW	H, A
timidus Arrow 1909	*Liparochrus*	Scarabaeidae	Northern Australia, Alexandria	3 P
titania Carter 1916	*Stigmodera*	Buprestidae	Endeavour R., Q	H, 1 P
torquatus Pascoe 1875	*Symphyletes*	Cerambycidae	Gayndah, Q	3 T
torrida Janson 1874	*Dilochrosis*	Scarabaeidae	Nicol Bay, WA	H
tortipes Lea 1912	*Tentegia*	Curculionidae	Port Denison, Q	H
tragocephalus Ferguson 1863	*Acantholophus*	Curculionidae	WA	H, 1 P
tranquillus Lea 1920	*Ditropidus*	Chrysomelidae	Como, NSW	1 P
transitus Macleay 1865	*Acantholophus*	Curculionidae	Swan R., WA	2 S
transversicollis Macleay 1888	*Heteronyx*	Scarabaeidae	King Sound, WA	H
trepidus Pascoe 1885	*Myllocerus*	Curculionidae	Cape York, Q	2 T
triangulifera Lea 1915	*Rhyparida*	Chrysomelidae	Cairns district, Q	2 P
trianguliferus Lea 1913	*Tyrtaeosus*	Curculionidae	Cairns, Q	2 P
tribulus Macleay 1866	*Acantholophus*	Curculionidae	SA	H
tricarinata Macleay 1863	*Stigmodera*	Buprestidae	Rockhampton, Q	2 S
tricolor Lea 1915	*Eucolaspis*	Chrysomelidae	Mt Tambourine, Q	1 P
tricolor Lea 1911	*Lybaeba*	Curculionidae	NSW	1 P
tricolor Lea 1895	*Selenurus*	Cantharidae	Blackheath, NSW	2 P

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tricolor Lea 1922	*Thallis*	Erotylidae	Dorrigo, NSW	2 P
tridentatus Macleay 1871	*Liparetrus*	Scarabaeidae	Q	2 S
trifasciata Lea 1911	*Lybaeba*	Curculionidae	Vic	2 P
trifasciatus Lea 1909	*Haplonyx (Aolles)*	Curculionidae	SA	2 P
trifidus Blackburn 1895	*Pseudoryctes (Cryptoryctes)*	Scarabaeidae	Darling R., Q	2 T
triguttata Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	4 S
trilineatus Lea 1904	*Schizosternus*	Chrysomelidae	NSW	H
trimaculatus Armstrong 1943	*Anthrenocerus*	Dermestidae	SA	1 P
trisinuatus Lea 1921	*Helcogaster*	Melyridae	Cairns district, Q	2 P
trivirgatus Lea 1913	*Decilaus*	Curculionidae	Mt Tambourine, Q	2 P
trivitticollis Lea 1923	*Monolepta*	Chrysomelidae	Hastings R., NSW	2 P
troglodytes Lea 1914	*Idacarabus*	Carabidae	Tas	1 P
tropica Lea 1915	*Rhyparida*	Chrysomelidae	Cairns district, Q	2 P
tropicale Macleay 1887	*Carenidium (Conopterum)*	Carabidae	Endeavour R., Q	H
tropicus Lea 1925	*Acritus*	Histeridae	Q	2 P
tropicus Lea 1921	*Ditropidus*	Chrysomelidae	WA	4 P
tropicus Lea 1908	*Helcogaster*	Melyridae	Cairns, Q	H
tropicus Lea 1911	*Laemosaccus*	Curculionidae	Cape York, Q	2 P
truncaticornis Macleay 1865	*Acantholophus*	Curculionidae	Newcastle, NSW	H
truncatus Sloane 1898	*Philophloeus*	Carabidae	Mt Barker, WA	1 T
t — squameus Lea 1906	*Leptops*	Curculionidae	Cairns, Q	2 P
tuberculata Lea 1915	*Diethusa*	Curculionidae	NSW	1 P
tuberculatus Ferguson 1923	*Amorphorrhinus*	Curculionidae	SA	H, 2 P
tuberculatus Lea 1920	*Michrochaetes*	Byrrhidae	Gawler, SA	2 P
tuberculatus Lea 1911	*Mythites*	Curculionidae	Vic	6 P
tuberculatus Macleay 1863	*Carenum (Philoscaphus)*	Carabidae	Murrumbidgee, NSW	H
tuberculatus Macleay 1865	*Talaurinus*	Curculionidae	Vic	H
tuberculifera Champion 1894	*Brycopia*	Tenebrionidae	Tas	3 S
tuberculosus Macleay 1865	*Sclerorinus*	Curculionidae	Vic	2 S
tulanus Carne 1957	*Corynophyllus*	Scarabaeidae	Brisbane, Q	1 P
tumulosus Ferguson 1912	*Talaurinus*	Curculionidae	NSW	H
tumulosus Pascoe 1873	*Poropterus*	Curculionidae	SA	2 T
turbidum Lea 1910	*Apion*	Curculionidae	SA	4 P
turneri Ferguson 1914	*Talaurinus*	Curculionidae	NSW	H
turneri Macleay 1873	*Arthropterus*	Carabidae	Lane Cove, nr Sydney, NSW	H
turritus Macleay 1888	*Cavonus*	Scarabaeidae	King Sound, Barrier Range, WA	H
typicus Macleay 1863	*Talaurinus*	Curculionidae	Argyle, NSW	2 S
ubiquitosus Lea 1924	*Dryophilodes*	Anobiidae	Sydney, NSW	2 P
ubiquitosus Lea 1925	*Heterothops*	Staphylinidae	Latrobe, Ulverstone, Tas	2 P
ubiquitosus Macleay 1886	*Liparetrus*	Scarabaeidae	Lake George, NSW	4 S
undosa Macleay 1887	*Mordella*	Mordellidae	Mossman R., Q	H
undulata Pascoe 1866	*Blepiarida*	Curculionidae	Wide Bay, Q	2 T
undulata Pascoe 1859	*Diotima*	Cerambycidae	Wide Bay, Q	2 T
undulatum Macleay 1865	*Carenum (Eutoma)*	Carabidae	Wingelo, NSW	H
undulatus Lea 1911	*Poropterus*	Curculionidae	Vic	1 P
unicolor Masters 1871 (pro *concolor* Macleay 1864 nec Erichson)	*Liparetrus (Automolius)*	Scarabaeidae	Q	5 S
unicolor Macleay 1863	*Schizorhina (Metallesthes)*	Scarabaeidae	King George Sound, WA	H
uniformis Blackburn 1889	*Rhyparida*	Chrysomelidae	NT	2 P
uniformis Lea 1909	*Polyphrades*	Curculionidae	Boorabbin, WA	1 P
uniformis Macleay 1888	*Anthaxia*	Buprestidae	King Sound, WA	H
uniformis Pascoe 1863	*Mycerinopsis*	Cerambycidae	Port Denison, Q	4 T
ursa Lea 1915	*Edusa*	Chrysomelidae	Otford, NSW	3 P
urticarium Pascoe 1873	*Perperus*	Curculionidae	Gayndah, Q	2 T
usitatus Lea 1915	*Scydmaenus*	Scydmaenidae	Stanley, Waratah, Tas	2 P
usitatus Olliff 1886	*Polylobus*	Staphylinidae	Sydney, NSW	2 T

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vacillans Lea 1917	*Oxyops*	Curculionidae	Ooldea, SA	1 P
vagans Lea 1906	*Baris*	Curculionidae	Tas	2 P
vagans Lea 1921	*Circopes*	Nitidulidae	Bribie I., Q	2 P
vagans Lea 1921	*Ditropidus*	Chrysomelidae	Cairns, Q	2 S
vagans Lea 1914	*Microvalgus*	Scarabaeidae	Q; NSW	2 P
vagans Lea 1915	*Rhyparida*	Chrysomelidae	Quorn, SA	2 P
valgus Lea 1909	*Cubicorrhynchus*	Curculionidae	WA	2 P
varia King 1863	*Narcodes*	Pselaphidae	Parramatta, NSW	1 T
variabilis Carter 1939	*Mythites*	Curculionidae	Q	1 P
variabilis Lea 1915	*Antyllis*	Curculionidae	NSW	2 P
variabilis Lea 1917	*Belus*	Curculionidae	Lucindale, SA	2 P
variabilis Lea 1908	*Catastygmus*	Curculionidae	Cairns, Q	2 P
variabilis Lea 1919	*Cheiragra*	Scarabaeidae	Q	4 P
variabilis Lea 1907	*Mandalotus*	Curculionidae	Hobart, Tas	2 P
variabilis Lea 1911	*Rybaxis*	Pselaphidae	Tas	2 P
variabilis Macleay 1863	*Schizorhina (Cacochroa)*	Scarabaeidae	Port Denison, Q	3 S
variabilis Macleay 1887	*Synatractus*	Alleculidae	Cairns district, Q	5 S
variabilis Macleay 1888	*Xanthophaea*	Carabidae	King Sound, WA	7 S
varians Carter 1939	*Paracardiophorus*	Elateridae	Minnie Downs, SA	2 P
varians Lea 1902	*Cupes*	Cupedidae	Sydney, NSW	3 P*
varians Lea 1910	*Ficicis*	Curculionidae	Gosford, NSW	2 P
varicosus Pascoe 1873	*Poropterus*	Curculionidae	Illawarra, NSW	2 T
variegata Lea 1914	*Eutinophaea*	Curculionidae	Q	1 P
variegata Macleay 1871	*Soronia (Neaspis)*	Trogossitidae	Clarence R., NSW	2 S
variegatus Macleay 1865	*Talaurinus*	Curculionidae	Cooper's Creek (= Victoria R.), Q	H
variiceps Lea 1920	*Ditropidus*	Chrysomelidae	Port Lincoln, SA	1 P
variiceps Lea 1929	*Scymnus*	Coccinellidae	Lord Howe I.	2 P
variicollis Lea 1910	*Auletes*	Curculionidae	Mt Wellington, Tas	1 P
variicollis Lea 1907	*Lemidia*	Cleridae	SA	H
variicollis Macleay 1871	*Phyllotocus*	Scarabaeidae	Gayndah, Q	1 S
variipennis Lea 1909	*Auletes*	Curculionidae	Dirk Hartog, Brown Station, WA	1 P
variipennis Lea 1908	*Notosalpingus*	Salpingidae	Tas	1 P
variipes Lea 1908	*Eleschus*	Curculionidae	NSW	2 P
variiventris Lea 1921	*Telephorus*	Cantharidae	Malanda, Q	1 P
variivitta Lea 1925	*Oides*	Chrysomelidae	Coen R., Q	2 P
variolosa Ferguson 1909	*Psalidura*	Curculionidae	Q	H, A
variolosum Macleay 1864	*Laccopterum (Carenum)*	Carabidae	Murrumbidgee, NSW	H
variolosus Macleay 1888	*Tesserodon*	Scarabaeidae	King Sound, WA	H
varius Lea 1914	*Myllocerus*	Curculionidae	Cue, WA	1 P
varus Macleay 1888	*Hypharpax*	Carabidae	King Sound, WA	H
velutina Macleay 1863	*Schizorhina (Platydilosis = Lyraphora)*	Scarabaeidae	Port Denison; Cape York, Q	2 S, 1 T
velutinus W. S. Macleay 1827	*Chalcopterus*	Tenebrionidae	Australia	H
velutinus Macleay 1871	*Homethes*	Carabidae	Gayndah, Q	1 S
ventrale Macleay 1872	*Stigmatium*	Cleridae	Gayndah, Q	2 S
ventralis Lea 1911	*Limoniates*	Pselaphidae	WA	3 P
ventralis Lea 1899	*Melanterius*	Curculionidae	NSW	2 P
veris Olliff 1886	*Apphiana*	Staphylinidae	Sydney, NSW	4 T
vermicollis Ferguson 1912	*Talaurinus*	Curculionidae	NSW	H, 1 P
vermicosa Pascoe 1883	*Leptops*	Curculionidae	Gayndah, Q	2 T
vermiculatus Lea 1911	*Perperus*	Curculionidae	National Park, NSW	1 P
vermiculatus Lea 1912	*Brachyporopterus*	Curculionidae	Clarence R., NSW	1 P
vermiculatus Macleay 1865	*Sclerorinus*	Curculionidae	Braidwood, NSW	H
vernalis King 1863	*Tmesiphorus (Ctenisophus)*	Pselaphidae	Parramatta, NSW	2 T
verrucosa Macleay 1865	*Psalidura*	Curculionidae	New Holland	H
verrucosus Macleay 1865	*Sclerorinus*	Curculionidae	New Holland	H
vertebrale Lea 1910	*Apion*	Curculionidae	NSW	3 P
vertebralis Carter 1923	*Melobasis*	Buprestidae	Q	2 P

* Not conspecific with holotype: 2 *C. youanga* Neboiss, *C. eumana* Neboiss.

Specific Name	Original Genus	Family	Type Locality	Types
verticalis W. S. Macleay 1827	*Laius*	Melyridae	North Australia	H
vestigialis Pascoe 1864	*Symphyletes*	Cerambycidae	SA	4 T
vestita Ferguson 1915	*Psalidura*	Curculionidae	Q	A (♀)
vestitus Macleay 1865 (1866)	*Sclerorinus*	Curculionidae	Flinders Range, SA	4 S
v — fasciata Lea 1895	*Mordella*	Mordellidae	Blackheath, NSW	1 P
vicarius Lea 1904	*Cryptocephalus*	Chrysomelidae	Port Denison, Gayndah, Q	2 S
vicarius Lea 1921	*Ditropidus*	Chrysomelidae	Cairns, Q	2 P
vicarius Pascoe 1869	*Pterohelaeus*	Tenebrionidae	NSW	2 T
vicina Lea 1906	*Misophrice*	Curculionidae	Tas	1 P
vicina Olliff 1886	*Aleochara*	Staphylinidae	King George Sound, WA	1 T
vicinus Sloane 1898	*Homothes*	Carabidae	Mt Barker, WA	1 S
victoriae Macleay 1866	*Talaurinus*	Curculionidae	Vic	2 S
vigilans Lea 1924	*Dryophilodes*	Anobiidae	Forest Reefs, NSW	2 P
villosa Lea 1917	*Haplonycha*	Scarabaeidae	Q	2 P
villosa Lea 1912	*Rybaxis*	Pselaphidae	Sydney, NSW	1 P
villosicollis Macleay 1886	*Liparetrus*	Scarabaeidae	Southern districts of NSW	2 S
villosipennis Lea 1895	*Formicomus*	Anthicidae	Sydney, NSW	1 T
villosus Lea 1911	*Pselaphus*	Pselaphidae	Tas	2 P
villosus Macleay 1888	*Onthophagus*	Scarabaeidae	WA	2 S
violacea Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Gayndah, Q	H
violaceum Macleay 1887	*Conopterum*	Carabidae	Mudgee, NSW	H
violaceum Macleay 1864	*Carenum (Eutoma)*	Carabidae	SA	H
virgata Lea 1907	*Lemidia*	Cleridae	NSW	1 P
viridescens Castelnau 1867	*Homalosoma (Trichosternus)*	Carabidae	Clarence R., NSW	2 T
viridiaeneum Macleay 1888	*Calliscapterus (Carenum)*	Carabidae	King Sound (Barrier Range), WA	H
viridicollis Macleay 1873	*Anoplognathus*	Scarabaeidae	Darling Downs, Q	2 S
viridicollis Macleay 1872	*Eleale*	Cleridae	Gayndah, Q	2 S
viridilatera Lea 1915	*Edusa*	Chrysomelidae	Galston, NSW	1 P
viridimarginatum Macleay 1871	*Carenum*	Carabidae	Gayndah, Q	2 S
viridipenne Macleay 1872	*Adelium*	Tenebrionidae	Gayndah, Q	2 S
viridipennis Lea 1903	*Calomela*	Chrysomelidae	WA	2 P
viridipennis Macleay 1887	*Decialma*	Tenebrionidae	Cairns distr. (Mossman R.), Q	4 S
viridipennis Macleay 1887	*Selenurus*	Cantharidae	Russell R., Q	2 S
viridis Lea 1910	*Merimnetes*	Curculionidae	Mt Kosciusko, NSW	2 P
viridis Macleay 1871	*Adotela (Promecoderus)*	Carabidae	Gayndah, Q	2 S
viridisignata Macleay 1863	*Schizorhina (Chlorobapta)*	Scarabaeidae	King George Sound, WA	2 S
viridisquama Lea 1911	*Eniopea*	Curculionidae	NSW	2 P
viridissimus Macleay 1888	*Carenoscaphus*	Carabidae	King Sound (Barrier Range), WA	2 S
viridivaria Lea 1911	*Hackeria*	Curculionidae	Coen district, Q	2 P
viridiventris Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
vitiensis Lea 1929	*Ampagia*	Curculionidae	Moturiki, Fiji	2 P
vitiensis Lea 1928	*Microcryptorhynchus*	Curculionidae	Viti Levu, Fiji	2 P
vitiosa Pascoe 1870	*Oxyops*	Curculionidae	Wide Bay, Q	2 T
vitreo — maculatus Macleay 1888	*Trox*	Trogidae	WA	L, 1 P
vittatus Macleay 1871	*Philophoeus*	Carabidae	Gayndah, Q	4 S
vittatus Macleay 1887	*Phyllotocus*	Scarabaeidae	Cairns, Q	2 S
vittatus Macleay 1865	*Sclerorinus*	Curculionidae	SA	2 S
vittatus Pascoe 1872	*Stenocorynus*	Curculionidae	Night I., Q	2 T
vitticolle Macleay 1888	*Polystigma*	Scarabaeidae	WA	2 S
vitticollis Ferguson 1914	*Talaurinus*	Curculionidae	Q	H
vitticollis Macleay 1872	*Ananca (Sessinia)*	Oedemeridae	Gayndah, Q	2 S
vitticollis Macleay 1863	*Stigmodera*	Buprestidae	Port Denison, Q	H
vittipenne Macleay 1871	*Necterosoma*	Dytiscidae	Gayndah, Q	4 S
vittipennis Macleay 1887	*Atractus*	Alleculidae	Q	2 S
vitulus Pascoe 1871	*Temnosternus*	Cerambycidae	Wide Bay, Q	2 T
volitans Macleay 1863	*Distipsidera*	Carabidae	Port Denison, Cleveland Bay, Q	3 S
vulgaris Olliff 1889	*Meneristes*	Tenebrionidae	Lord Howe I.	4 T

Specific Name	Original Genus	Family	Type Locality	Types
walteri Macleay 1887	*Onthophagus*	Scarabaeidae	Cairns, Q	2 S
waterhousei Lea 1895	*Mordella*	Mordellidae	Blackheath, NSW	2 P
waterhousei Macleay 1873	*Arthropterus*	Carabidae	SA	2 S
waterhousei Macleay 1864	*Euryscaphus (Scaraphites)*	Carabidae	NT	H
waterhousei Macleay 1865	*Scarites (Geoscaptus)*	Carabidae	Near Adelaide, SA	2 S
waterhousei Macleay 1865	*Sclerorinus*	Curculionidae	SA	4 S
waterhousei Pascoe 1859	*Ozotomerus (Dipieza)*	Scolytidae	Wide Bay, Q	2 T
westwoodii Macleay 1871	*Arthropterus*	Carabidae	Gayndah, Q	1 S
wiburdi Lea 1895	*Mordella*	Mordellidae	Blackheath, NSW	4 P
wilcoxi Castelnau 1867	*Cicindela*	Carabidae	Clarence R., NSW	1 T
wilcoxi Macleay 1865	*Psalidura*	Curculionidae	Clarence R., NSW	2 S
wollastoni White 1857 (1856)	*Blax*	Cerambycidae	Lord Howe I.	2 T
wyanamattae Macleay 1873	*Arthropterus*	Carabidae	Camden, NSW	2 S
xanthorrhoeae Lea 1924	*Secretipes*	Ptinidae	SA	1 P
xanthorrhoeae Lea 1911	*Timareta*	Curculionidae	WA	2 P
xerophilus Lea 1917	*Anthicus*	Anthicidae	Geraldton, WA	2 P
yorkensis Lea 1907	*Sybulus*	Curculionidae	Cape York, Q	1 P
ziczac King 1869	*Mecynotarsus*	Anthicidae	SA	2 T
ziczac Lea 1915	*Edusa*	Chrysomelidae	Forest Reefs, NSW	2 P
ziczac Lea 1909	*Epamaebus*	Curculionidae	Tas	2 P

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Morphology, Distribution and Host Range of the Lucerne Race of *Ditylenchus dipsaci* in New South Wales

R. W. McLEOD

McLEOD, R. W. Morphology, distribution and host range of the lucerne race of *Ditylenchus dipsaci* in New South Wales. *Proc. Linn. Soc. N.S.W.* 105 (4), (1980) 1981: 295-305.

Measurements of *Ditylenchus dipsaci* from *Medicago sativa* (lucerne) from three localities in New South Wales and one in South Australia are given and the morphology of the nematodes described. In surveys of some major lucerne areas in New South Wales, the nematode occurred in 22% of the lucerne crops sampled. Cross inoculation indicated that *D. dipsaci* from *M. sativa* did not reproduce in bulbs of *Narcissus peudonarcissus* (daffodil); *D. dipsaci* from *N. pseudonarcissus* caused some swelling of *M. sativa* seedlings and small numbers were in the seedlings four days after inoculation. Inoculation of seed of 14 different plant species with *D. dipsaci* from lucerne from two locations caused distorted growth of *Allium cepa, Lycopersicon esculentum, M. sativa, Phaseolus vulgaris* and *Pisum sativum*. *D. dipsaci* was recovered from the stems and leaves of these plants 4 weeks after inoculation but not 10 weeks after.

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INTRODUCTION

The stem nematode, *Ditylenchus dipsaci* Huhn) was first reported on lucerne (*Medicago sativa* L.) in Australia by Noble (1925). Subsequently it has become widespread in the Hunter Valley, New South Wales, where first found, and in the Lachlan-Belubula River districts of New South Wales; it is also a problem in South Australia (Dubé, 1975). Despite the economic importance of its main host, the morphology and bionomics of the stem nematode on lucerne in Australia have not been recorded. This paper reports its measurements and morphology and records studies on its incidence in New South Wales and its host range.

MEASUREMENTS AND MORPHOLOGY

Measurements of races of *D. dipsaci* are influenced by host (Goodey, 1941; Barraclough and Blackith, 1962; Blake, 1962; Metlitzky, 1969) and a "Giant Race" is known (Goodey, 1941). Measurements in standard descriptions (Goodey, 1963; Hooper, 1972) are those of Thorne (1945), who studied specimens collected from Fuller's teasel (*Dipsacus sativus* (L.) Honck.), the type host, near Molalla, Oregon, U.S.A. (Thorne, 1961). Thorne (1945) described specimens from teasle, Goodey (1963) and Hooper (1972) also provided brief descriptions of the nematode and Wu (1958; 1960; 1967) studied the reproductive systems of *Ditylenchus* species.

Sixteen females and 16 males of *D. dipsaci* from lucerne plants collected from Wagga Wagga, N.S.W., Whittingham, Scotts Flat (near Singleton) N.S.W. and Langhorne Creek, South Australia were measured (Table 1) and their morphology studied.

TABLE 1

Measurements (means and ranges, n = 16) of *Ditylenchus dipsaci* from lucerne in Australia.

Locality	L (μm)	a	b	c	V	T
Langhorne Creek,	1146	43	6.2	14	79	—
South Australia	980-1274	36-49	5.4-6.9	13-17	76-82	—
	1104	44	6.2	14	—	61
	993-1231	36-51	5.5-7.7	13-16	—	45-74
Scotts Flat,	1264	47	6.4	16	80	—
New South Wales	1153-1410	40-55	5.9-7.1	14-18	69-89	—
	1168	50	5.7	15	—	60
	997-1307	40-58	5.0-7.0	13-16	—	49-67
Whittingham,	1132	44	6.5	14	80	—
New South Wales	1009-1274	38-55	5.5-7.3	11-16	77-83	—
	1142	46	6.1	13	—	61
	1037-1344	38-57	5.1-8.4	15-17	—	53-73
Wagga Wagga,	1324	49	7.1	15	80	—
New South Wales	1165-1448	43-65	6.2-7.6	13-16	74-83	—
	1202	52	6.4	15	—	57
	1086-1354	43-59	4.2-7.1	14-17	—	50-77
U.S.A.*	1000-1300	36-40	6.5-7.1	14-18	80	—
	1000-1300	37-41	6.5-7.3	11-15	—	65-72
England† 48	1305±9	62±5.6	15±1.4	14±2.1	80±1.5	—
23	1252±17	63±11	15±1.7	14±2.1	—	72±16

*Measurements of Thorne (1945), specimens from teasel *(Dipsacus sativus)*, U.S.A.
† Measurements of Blake (1962), specimens from oats *(Avena sativa)*; England.

Morphology

The following description and illustrations (Figs 1, 2, 3) are based on specimens from the four places;

Female: Body tapered anteriorly and posteriorly; tail tapered to a sharply pointed terminus. Lip region lightly sclerotized, smooth in light microscopy but striae apparent in SEM (Fig. 3), slightly flattened, barely offset, 6.9 μm (6-8) wide by 2.8 μm (2-4) (n = 5) high. Amphid openings slit-like (Fig. 3), on lateral lips. Body striae about 1 μm apart. Lateral field with four prominent lines, as in Fig. 1D, phasmids obscure. Spear slender with well defined knobs, 10-12 μm long. Excretory pore 140-160 μm from anterior end opposite middle of basal oesophageal bulb, hemizonid 8-12 μm anterior to excretory pore, 5-6 μm long. Nerve ring at middle of isthmus.

Median oesophageal bulb fusiform, 20 μm (17-26) by 11 μm (10-12) (n = 10). Isthmus narrow, widening posteriorly into clavate basal bulb containing three prominent and two inconspicuous gland nuclei. Basal bulb abuts squarely upon the intestine or overlaps it slightly. Intestine not extending into tail, a distinct rectum leads to anus.

Genital tract prodelphic, extending one third to half body length, ovary outstretched, oocytes in single file along distal third, then two rows changing to single file near proximal end. Oviduct (*sensu* Geraert, 1976) a short tube, 10 μm long, between ovary and spermatheca and consisting of four to six rings of cells, two cells in each ring (Fig. 2A). Spermatheca made up of large cells which become stretched when spermatheca is distended. Prominent quadricolumella behind spermatheca, composed of 4 rows each of 4 large cells (Fig. 2B) and about half as long as

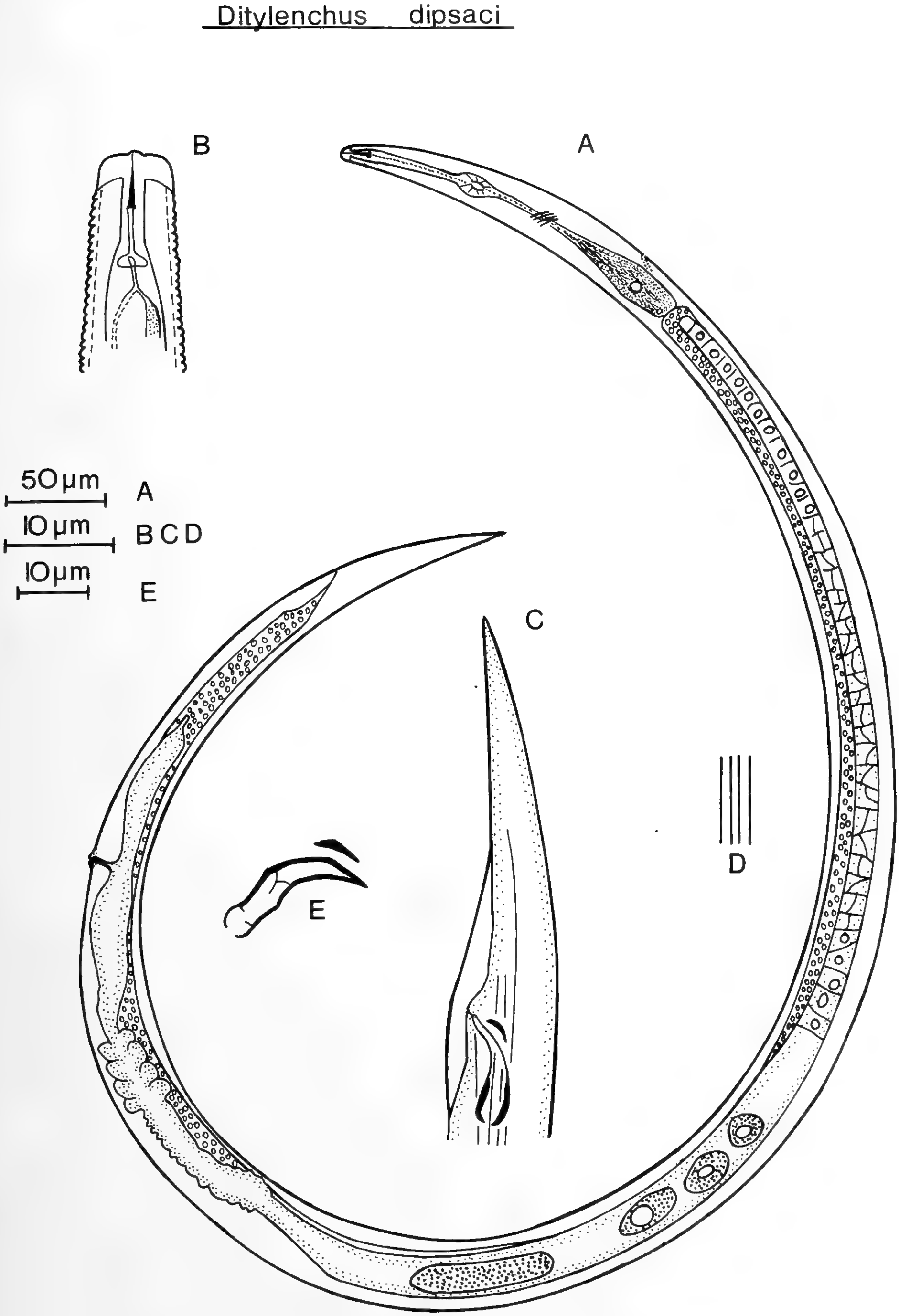

Fig. 1. Ditylenchus dipsaci. A. female, B. anterior end of female, C. male tail, D. lateral field, E. spicule and gubernaculum.

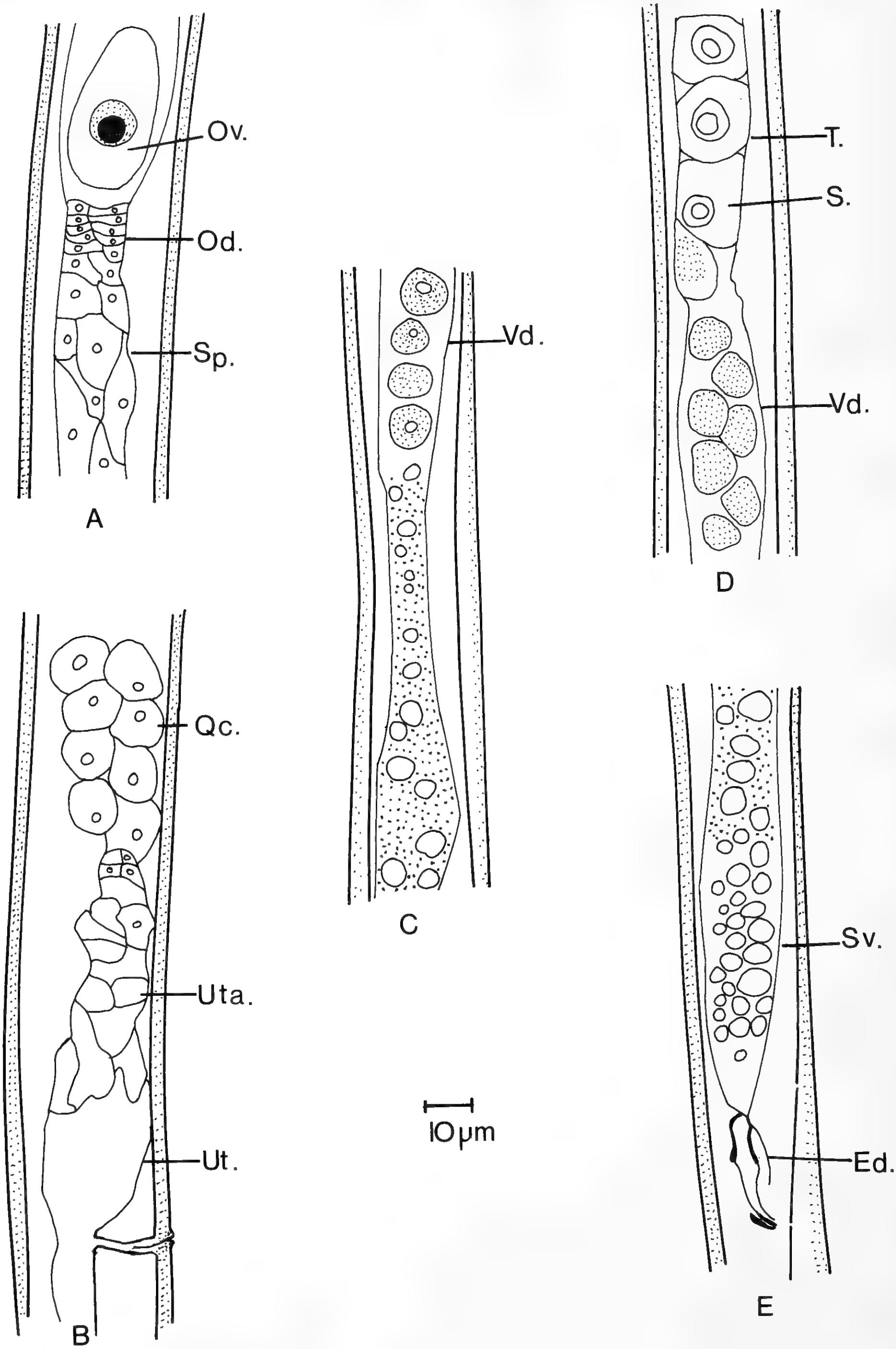

Fig. 2. Reproductive tracts of *Ditylenchus dipsaci*. **A.** proximal end of ovary, **B.** uterus, **C.** proximal end of vas deferens. **D.** proximal end of testis. **E.** proximal end of seminal vesicle. Ov. = ovary; Od. = oviduct; Sp. = spermatheca; Qc. = quadricolumella; Uta. = uterus, anterior part; Ut. = uterus; Vd. = vas deferens; T. = testis; S. = spermatocyte; Sv. = seminal vesicle; Ed. = ejaculatory duct.

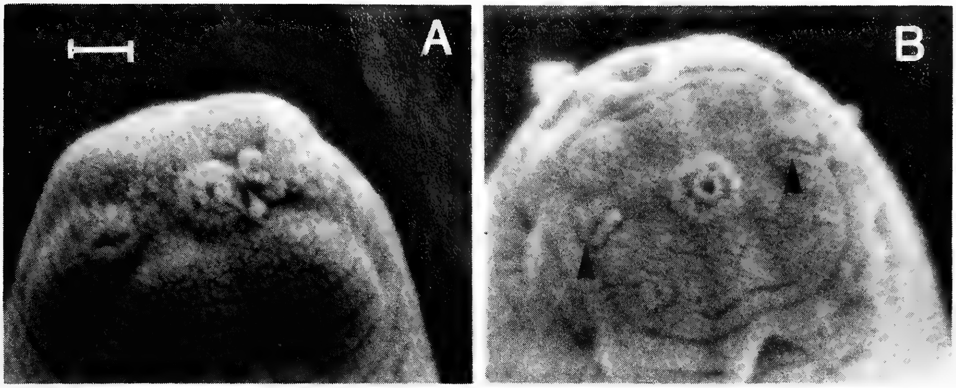

Fig. 3. Scanning electron micrograph of head-on view of *Ditylenchus dipsaci.* **A.** striation of lip region, **B.** amphid openings (arrowed). Bar = 1 μm. Specimens were dried in acetone followed by critical-point drying and coating with gold.

spermatheca (Fig. 1). Uterus with two distinct areas, an anterior slender part with a wall of thick small cells and a wide, thin walled posterior section. Eggs two to three times as long as wide. Minute epiptygmata in distal part of vagina as observed by Natasasmita and De Grisse (1976). Vulva a transverse slit. Posterior uterine sac approximately three anal body widths long, a terminal vestigial posterior ovary composed of two or three cells often present.

Male: Body bow-shaped when relaxed. Lip region flattened, slightly offset, 7.6 μm (7-8) wide by 3 μm (2.5-3.3) high (n = 5). Body tapered anteriorly and posteriorly, tail tapering to a sharply pointed terminus. Excretory pore 110-160 μm from anterior end, hemizonid as in female. Bursa begins in region of anterior one third of spicules and extends three-quarters of tail length.

Testis extends to middle of body, occupying 50% of length of genital tract. Spermatocytes in single row at distal and proximal ends and in two or three rows in the central multiplication region. Vas deferens same width as testis (Fig. 2D), occupying 20% of length of tract. Seminal vesicle (Fig. 2E) a dilated tube occupying about 30% of length of tract. A narrow ejaculatory duct, three quarters to one body width in length, extends posteriorly from the seminal vesicle but its junction with the cloaca could not be seen. Spicules shaped as in Fig. 1E, 21 μm (18-27, n = 48) long; gubernaculum lens shaped.

Distribution in New South Wales

The known distribution of *D. dipsaci* on lucerne in New South Wales (Noble, 1925; Edwards, 1932; Anon., 1949-1978; McLeod, 1979) is shown in Fig. 4.

Lucerne growing districts in New South Wales where *D. dipsaci* had been found were surveyed in the springs of 1976 and 1977. Within each district, crops were sampled at intervals of approximately 10 km and five lucerne crowns were collected at random from each crop sampled. Individual plants were placed in mist (Hooper, 1970) for 48hr to extract the nematodes. Measurements were made of soil pH, conductivity and texture in 1976.

Of the 79 crops sampled 17 (22%) were infested by *D. dipsaci* (Table 2). The pH range in soils where *D. dipsaci* occurred was only slightly more restricted than in soils

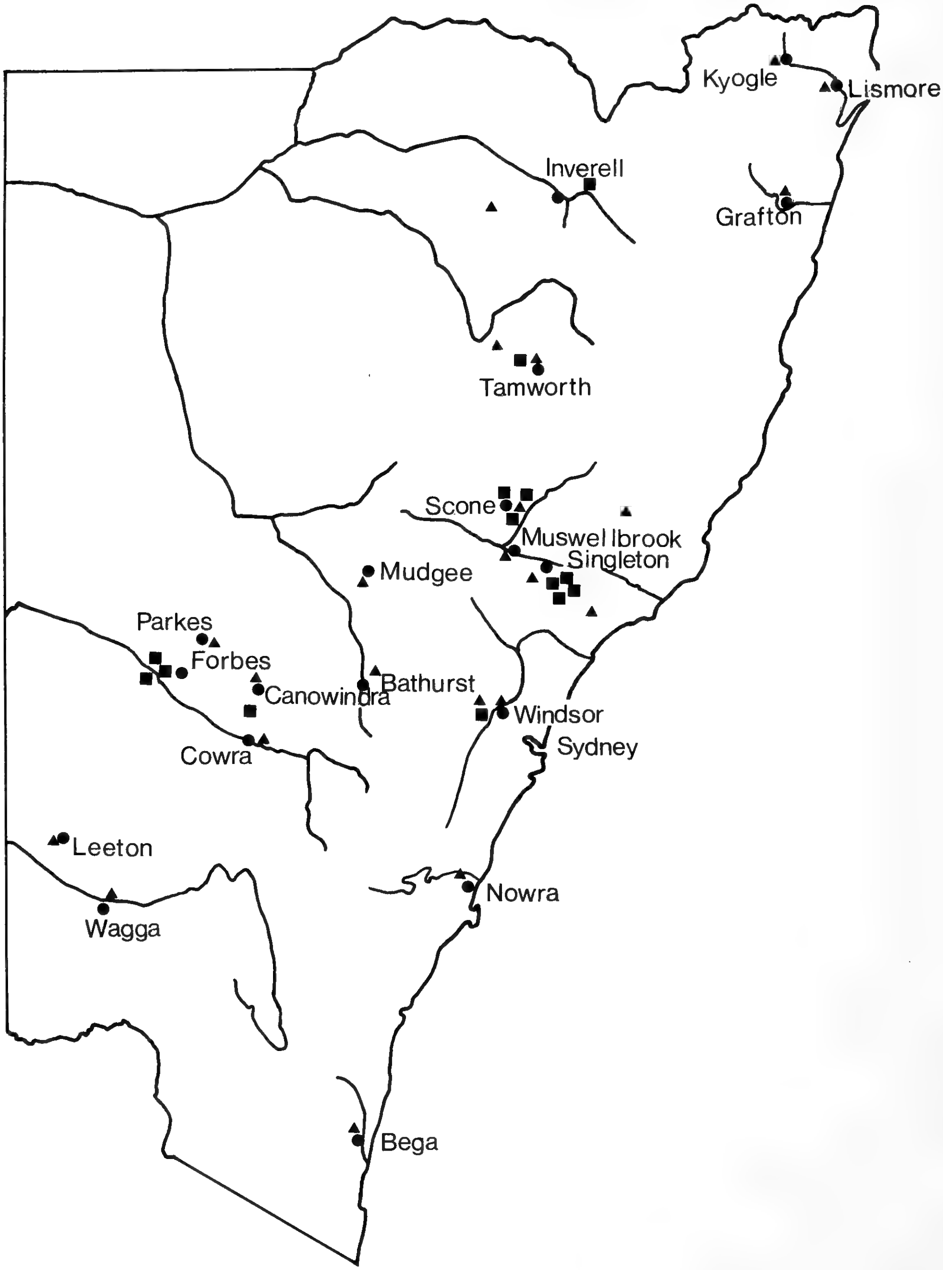

Fig. 4. Eastern part of N.S.W. showing recorded distribution of *Ditylenchus dipsaci* on lucerne in the State.

▲ indicates locality recorded in literature.

■ indicates *D. dipsaci* found in survey.

TABLE 2

Incidence of *Ditylenchus dipsaci* in lucerne crops in selected districts of N.S.W.

District	No. stands sampled	No. with *D. dipsaci*
Singleton (Hunter Valley)	10	4
Scone (Hunter Valley)	12	4
Inverell to Tamworth	23	3
Condobolin to Cowra (Lachlan Valley)	27	4
Richmond to Camden	7	2
Total	79	17 (22%)

apparently free of it while the range in conductivity was almost the same (Table 3). However, all soils where *D. dipsaci* occurred had 25% or more clay (Table 3).

Cross Inoculation of Lucerne and Daffodil Isolates

Attempts were made to inoculate *Narcissus pseudonarcissus* L. (daffodil) by injecting with a syringe *D. dipsaci* from Whittingham lucerne into bulbs. The inoculated bulbs were grown in pots for three months and then chopped and extracted in mist for 48 hr.

To determine whether *D. dipsaci* from daffodil invaded lucerne, 160 germinating lucerne seeds were inoculated with 40/seed *D. dipsaci* from daffodil bulbs from Bowral, N.S.W. and a similar number were inoculated with *D. dipsaci* from lucerne. Four days later the numbers of swollen seedlings were counted and the number of nematodes per seedling in 25 seedlings estimated after staining.

The daffodil bulbs were free of *D. dipsaci* 3 months after inoculation. 33% of lucerne seedlings inoculated with *D. dipsaci* from daffodil became swollen and contained an average of 1.6 nematodes/seedling. *D. dipsaci* from lucerne caused 92% swollen seedlings and there were an average of 30 nematodes/seedling.

TABLE 3

The relation between soil pH, conductivity and texture and the occurrence of *Ditylenchus dipsaci* in lucerne crops in N.S.W.

District	pH		Conductivity (mS/cm)		Texture*	
	Range, *D. dipsaci* absent	Range, *D. dipsaci* present	Range, *D. dipsaci* absent	Range, *D. dipsaci* present	Range, *D. dipsaci* absent	Range, *D. dipsaci* present
Singleton	6.9-7.5 (6)†	6.9-7.3 (4)	0.23-0.31 (6)	0.21-0.26 (4)	CL (6)	CL (4)
Scone	5.7-7.3 (8)	6.7-7.5 (4)	0.18-0.32 (8)	0.13-0.34 (4)	SCL-LMC (8)	LFS-LMC (4)
Inverell to Tamworth	5.6-8.1 (20)	6.7-7.7 (3)	0.11-0.63 (20)	0.18-0.62 (3)	SL-HC (20)	LC-HC (3)

*SL = sandy loam, 10-15% clay content; SCL = sandy clay loam, 20-30% clay; LFS = Loam, fine sandy, 25% clay; CL = clay loam, 30-35% clay; LC = light clay, 35-40% clay; LMC = light medium clay, 40-50% clay; HC = heavy clay, 50% or more clay; (Northcote, 1971).
† Number of samples in this category.

Host Range of Lucerne Race

Hesling (1966) lists 21 races (differing in their host range) of *D. dipsaci*. Interbreeding between certain races has been demonstrated (Webster, 1967; Eriksson, 1974); the crosses may combine host range characteristics of the parents. Some strains, including the lucerne race, have a high degree of reproductive isolation (Eriksson, 1974).

Most observations overseas indicate that, under field conditions, the lucerne strain of *D. dipsaci* does not readily infest other hosts (Brown and Goodey, 1956; Thorne, 1961; Bingefors, 1969). In pot experiments Griffin (1975) showed that a lucerne strain of *D. dipsaci* from the western United States could not reproduce on *Allium cepa* L., *Beta vulgaris* L., *Lycopersicon esculentum* Mill., *Melilotus indica* (L.) All., *Triticum durum* Desf., but stunted, distorted or killed seedlings of these hosts. Sturhan (1975) found that a lucerne strain reproduced to a limited extent on only six of 23 varieties of *Vicia faba* L. whereas other races produced large populations on most varieties. On the other hand, Barker and Sasser (1959) found 14 out of 36 plant species were susceptible or slightly susceptible to two populations of *D. dipsaci* from lucerne from North Carolina.

In Australia *D. dipsaci* has been recorded on *A. cepa* (Cobb, 1891); *Ceratochloa unioloides* HBK. (Edwards, 1932); *Hyacinthus orientalis* L. (Hynes *et al.*, 1941); *Hyacinthus romanus* L. (Anon., 1977); *L. esculentum* (Anon., 1941); *Medicago polymorpha* L., *M. minima* (L.) Bartal. (Edwards, 1932); *M. sativa* (Noble, 1925); *Narcissus jonquilla* L., *N. pseudonarcissus* L. (Noble, 1928); *Phaseolus vulgaris* L. (Wilson, 1942); *Phlox drummondii* Hook. (Hynes *et al.*, 1941); *P. paniculata* L., (Anon., 1941); *Trifolium pratense* L., (Noble *et al.*, 1937); *T. repens* L. (Anon., 1955); *V. faba* (Anon., 1941).

The infested plants of *C. unioloides, M. polymorpha* and *M. minima* were found amongst heavily infested lucerne plants (Edwards, 1932) hence it is probable that they were infested with the same race of nematode as the lucerne.

The aim of this work was to find whether the strain of *D. dipsaci* attacking lucerne in New South Wales has a narrow or a wide host range.

Materials and Methods

Two experiments were done, one with nematodes from Whittingham and the second with nematodes from Scotts Flat. Two lots of seed of plants listed in Table 4 were germinated on filter paper in Petri dishes. Immediately after germination a suspension of adults and larvae of *D. dipsaci* was added to one dish of each host, so as to add 50 nematodes/seed. A 15 cm diameter pot was then planted with five uninfested seeds and another four planted with five infested seeds. Pots were kept covered with plastic sheet for 48 hr after planting to maintain humidity. Growth abnormalities were noted 3 weeks after planting. Ten weeks after inoculation in the first experiment and 4 weeks after in the second experiment, the tops of the ten most affected plants were cut and placed in mist for 48 hr to extract nematodes present.

Results

Results are given in Table 4. The nematodes caused stunting, twisting of the stem and leaf puckering of *L. lycopersicon* (tomato), *P. vulgaris* (French bean) and *Pisum sativum* L. (pea). On *A. cepa* (onion) the symptoms were twisting and tip necrosis of the leaves and many seedlings were killed. Lucerne seedlings showed the typical swelling of the hypocotyl region. Nematodes were recovered from tissues of plants other than lucerne only in the second experiment, when extraction was done 4 weeks after planting.

TABLE 4

Numbers of nematodes in and reactions of plants following inoculation* with *Ditylenchus dipsaci*

Plant	Source of *D. dipsaci*			
	Whittingham		Scotts Flat	
	Reaction	No. *D. dipsaci*‡	Reaction	No. *D. dipsaci*#
Allium cepa				
c. v. Hunter River White	+ †	0	+	270
Avena sativa				
c. v. Acacia	—	0	—	0
c. v. Algerian	—	0	—	0
c. v. Avon	—	0	—	0
Cynodon dactylon	—	0	—	0
Lycopersicon esculentum				
c. v. Grosse Lisse	+	0	+	470
Mathiola incana				
c. v. Giant Perfection	—	0	—	0
Medicago sativa				
c. v. Hunter River	+	570	+	800
Medicago trunculata				
c. v. Cyprus	—	0	—	0
Phaseolus vulgaris				
c. v. Stringless Tender Crop	+	0	+	10
c. v. Blue Lake	+	0	+	220
Pisum sativum				
c. v. Massey Gem	+	0	+	280
Secale cereale				
c. v. Strain 8	—	0	—	0
Trifolium alexandrinum	—	0	—	0
Trifolium pratense				
c.v. Cowgrass	—	0	—	0
Trifolium repens				
c. v. Louisiana	—	0	—	0
Tirolium suberraneum				
c. v. Mount Barker	—	0	—	0

* Germinating seedlings inoculated with 50 *D. dipsaci* to a seedling.
† + indicates stunting of plant or twisting of stem and leaf puckering, or, in *A. cepa,* tip necrosis of leaves and death of seedlings.
‡ Number of nematodes from tops of 10 plants, including any showing abnormal growth, 10 weeks after inoculation.
# Numbers of nematodes from tops of 10 plants, including any showing abnormal growth, 4 weeks after inoculation.

Discussion

Measurements of these Australian lucerne populations are close to those of *D. dipsaci* from the type host (Thorne, 1945) (Table 1). Blake's (1962) specimens of the oat race from oats were much thinner ($a = 62\pm 5.6$ for females and 63 ± 11.3 for males) and had shorter oesophagi ($b = 15\pm 1.4$ for females and 15 ± 1.7 for males). However, Metlitzki (1968, 1969) concluded that measurements and their ratios are useless for separating races within *D. dipsaci* and Hooper and Southey (1978) report that even measurements on the giant race and the oat race overlap.

The structures of the female and male genital tracts are as described for *D. destructor* and *D. dipsaci* by Wu (1958, 1967). Wu (1967) noted that in *D. dipsaci* the spermatheca is longer than the quadricolumella whereas they are of similar length in *D. destructor*. My observations of Australian *D. dipsaci* confirm this.

D. dipsaci was recovered from 22% of crops sampled within known infested districts. It is interesting that Adamova (1975) reports that 6% of plants in 23% of the lucerne growing areas of Czechoslovakia were severely infested. The distribution of *D. dipsaci* appeared not to be restricted by pH or soil conductivity within the ranges examined. In the Netherlands *D. dipsaci* causes severe damage to onions in soils containing 30% or more clay (Seinhorst, 1956). I found *D. dipsaci* only on soils with 25% or more clay. A requirement for heavy soils could explain why economic damage to lucerne in New South Wales occurs mainly in river valleys with heavy alluvial soils.

The results indicate that the *D. dipsaci* attacking *Narcissus* and lucerne in New South Wales are two distinct races, distinguishable by cross-inoculation. Barker and Sasser (1959) could not infest daffodils with *D. dipsaci* from lucerne in the U.S.A. and Webster (1967), in England, found that inoculation of daffodil race with a lucerne race and of lucerne with a daffodil race resulted in invasion but no multiplication or tissue reaction.

Failure to extract nematodes other than from lucerne after 10 weeks suggests that the nematode was unable to persist in those plants which showed growth distortion and contained nematodes 4 weeks after inoculation. It seems unlikely that two nematode strains are involved since they came from localities less than 2 km apart and they caused growth distortion on the same plants. Although it may be possible to demonstrate a wider range than obtained here by using special techniques (Webster, 1967), my results suggest that, under field conditions, the lucerne race of *D. dipsaci* in Australia would reproduce on few plants other than lucerne. It could, however, cause symptoms on and damage to onion, tomato, French bean and pea.

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Pre-Permian Geology of the Bullio Area, New South Wales

ADRIAN C. HUTTON

HUTTON A. C. Pre-Permian geology of the Bullio area, New South Wales. *Proc. Linn. Soc. N.S.W.* 105 (4), (1980) 1981: 307-320.

The oldest rocks in the Bullio area, the Byrnes Creek Formation (new name), comprise folded Ordovician distal flysch. Unconformably overlying this formation are shale, limestone and arenite of the Silurian Karalinga Formation (new name). In Late Silurian or Early Devonian time dacite and rhyodacite flows of the Bindook Complex spread discordantly over the area. This volcanic episode was associated with the emplacement of two granitic bodies — the Jemidee Microgranodiorite and the Mandari Granodiorite. Folding of the Silurian rocks possibly occurred at this time. Erosional remnants of the Permo-Triassic Sydney Basin succession unconformably overlie the older rocks in the eastern part of the area.

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INTRODUCTION

The Bullio area is located 100 km southwest of Sydney (Fig. 1) and includes a sequence of Ordovician and Silurian sedimentary rocks and Devonian volcanic rocks. A microgranodiorite intrudes both the sedimentary sequence and the volcanic rocks and a coarse-grained granodiorite of similar mineralogy intrudes the youngest unit of the Silurian sequence. These early-middle Palaeozoic rocks are unconformably overlain by the Permo-Triassic Sydney Basin succession.

Previous geological investigations in the Bullio area have been confined mostly to investigations of the Permian succession and associated coal and torbanite at Joadja (Wilkinson, 1891; Carne, 1903; Read, 1975; Robinson and Shiels, 1975). Mladek (1954) mapped the area and briefly described the major rock types but did not delineate the Palaeozoic rocks on his map. Editions of the Wollongong 1:250 000 Geological Sheet (Joplin *et al.*, 1952; Rose, 1966) showed the major rock types but gave little descriptive or interpretative geology in accompanying notes. McElroy and Relph (1961) mapped and described the area to the north of Bullio and several studies on the economic geology and petrology of the Bindook Complex in the Yerranderie district, 25 km north of Bullio, have been made (Harper, 1930; Edwards, 1953; Lawrence, 1953; 1965; Keaney, 1970; Jones *et al.*, 1977; Fergusson, 1980).

The aim of the present study was to map the pre-Permian rocks of the area in detail and to describe their petrology and stratigraphy. An interpretation of the structure and tectonic development of the area has also been made.

STRATIGRAPHY

The stratigraphy of the pre-Permian sedimentary and volcanic rocks in the Bullio area has not been delineated previously. Detailed mapping has allowed the recognition of one formation, the Byrnes Creek Formation, comprising the Ordovician strata and a second formation, the Karalinga Formation, comprising the Silurian

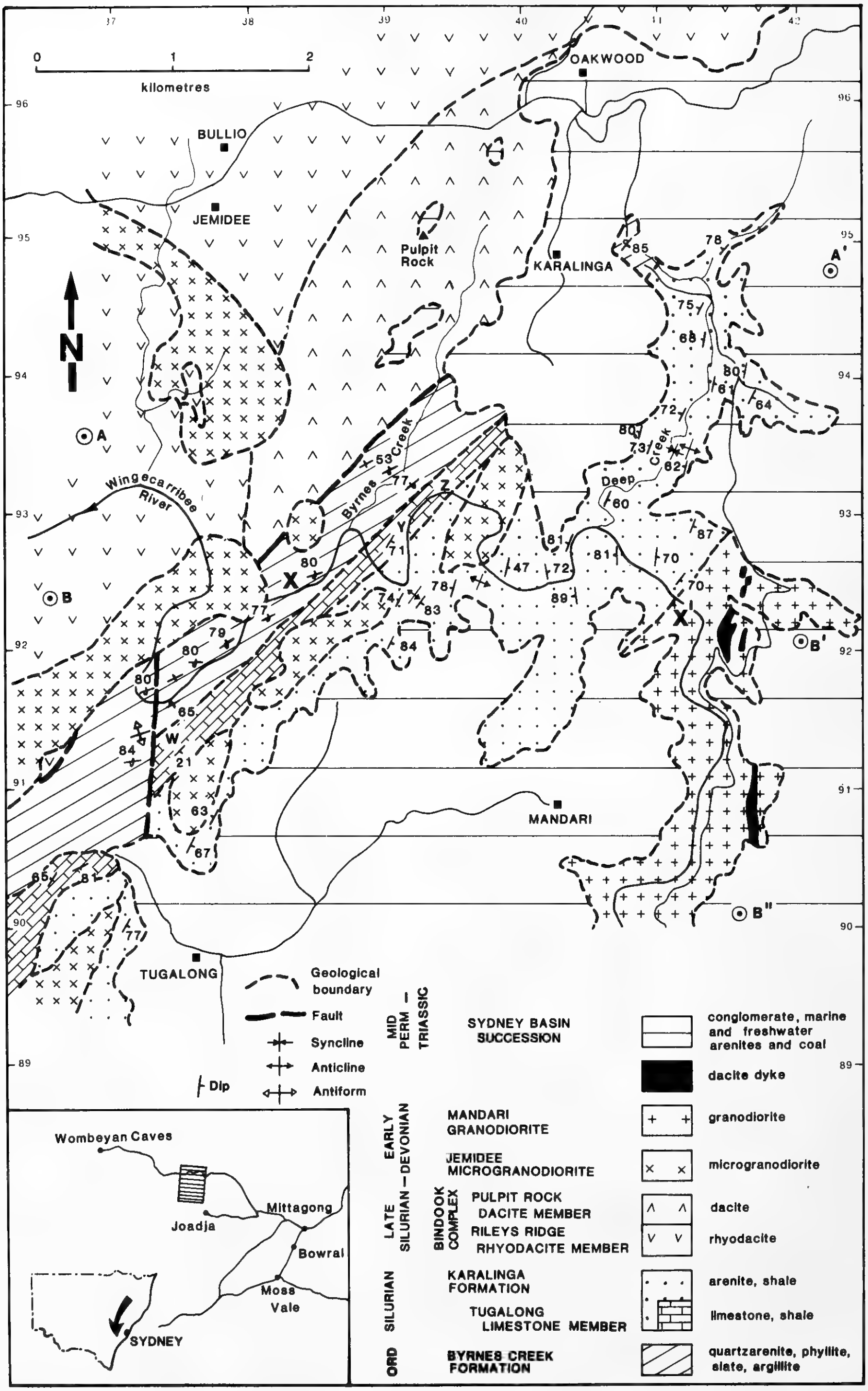

Fig. 1. **Geology of the Bullio area, New South Wales. The grid used is the Australian Map Grid (U.T.M.) and is taken from the Hanworth 8929-III-S and Barrallier 8929-III-N 1 : 25 000 topographic sheets.**

sequence. Lithological variations have allowed informal units to be recognized within both formations (Fig. 2). Two members have been recognized within the Devonian Bindook Complex.

BYRNES CREEK FORMATION *(new name)*

The Byrnes Creek Formation, which has a minimum thickness of 470 m, crops out along the Wingecarribee River and its tributary, Byrnes Creek, after which it is named. Along its western margin the formation is fault bounded, and in the east it is unconformably overlain by Silurian strata. Unfossiliferous, folded, quartz-rich rocks, which range from low-grade regionally metamorphosed quartzarenite to black slate, are the dominant rock types. The type section crosses the Wingecarribee River and is taken from GR374919 to GR374195 on the Hanworth 1:25 000 Topographic Sheet.

An Ordovician age for the Byrnes Creek Formation is suggested on the basis of lithological similarity with the Ordovician Unit B sequences described by Crook *et al.* (1973).

The Byrnes Creek Formation has been subdivided into four informal units.

Unit A (100 + m) is the oldest unit and is a medium-grained quartzarenite which crops out immediately east of the faulted western contact of the Formation.

Unit B (100 m) conformably overlies Unit A and consists of black slate. At the base of this unit, grey quartzarenite laminated on a 0.5 to 5 mm scale and typical of Unit A, is interbedded with the slate.

Unit C (110 m) conformably overlies Unit B and is a well-bedded grey to dark grey fine-grained, partly laminated (1 to 5 mm scale) quartzarenite.

Unit D (160 + m), the youngest unit preserved, conformably overlies Unit C and consists of interbedded grey to brown quartzarenite and shale. The quartzarenite beds range in thickness from less than 50 mm to 300 m and typically show boudinage structure. The shale has a well-developed cleavage parallel to bedding.

Petrography. The quartzarenite of the Byrnes Creek Formation is very well sorted and uniform in both composition and texture. Quartz grains, which constitute up to 90 volume percent and range in size from 0.01 to 0.5 mm, are partially recrystallized along their boundaries. Minor amounts of biotite, zircon, muscovite, tourmaline and garnet are also present. X-ray diffraction studies showed that the fine-grained matrix is composed of quartz, chlorite, illite, iron oxide and minor plagioclase. The absence of sand-sized feldspar grains distinguishes the arenite of the Byrnes Creek Formation from that of the overlying Karalinga Formation.

The shale is composed of illite, quartz and minor chlorite.

Sedimentary Structures. Slump folds with amplitudes from 30 to 50 mm are found in the fine-grained laminated quartzarenite of Units A, C and D.

In Unit B, small-scale (200 to 300 mm) cross-stratified quartzarenite is interbedded with coarser-grained, plane-bedded quartzarenite. Palaeocurrents determined from cross-laminated arenite (seven measurements) and corrected for tectonic tilt (Potter and Pettijohn, 1963) alternated between north-northeast and south. Angular intraclasts of the finer-grained arenite are found at the base of many planar beds. Ripples with internal cross-laminae, intraformational breccias, slump folds, small faults of less than 100 mm throw and load casts are found in Unit C. Graded bedding occurs in Units B and C.

Environment of Deposition. The fine-grained quartzarenite of the Byrnes Creek

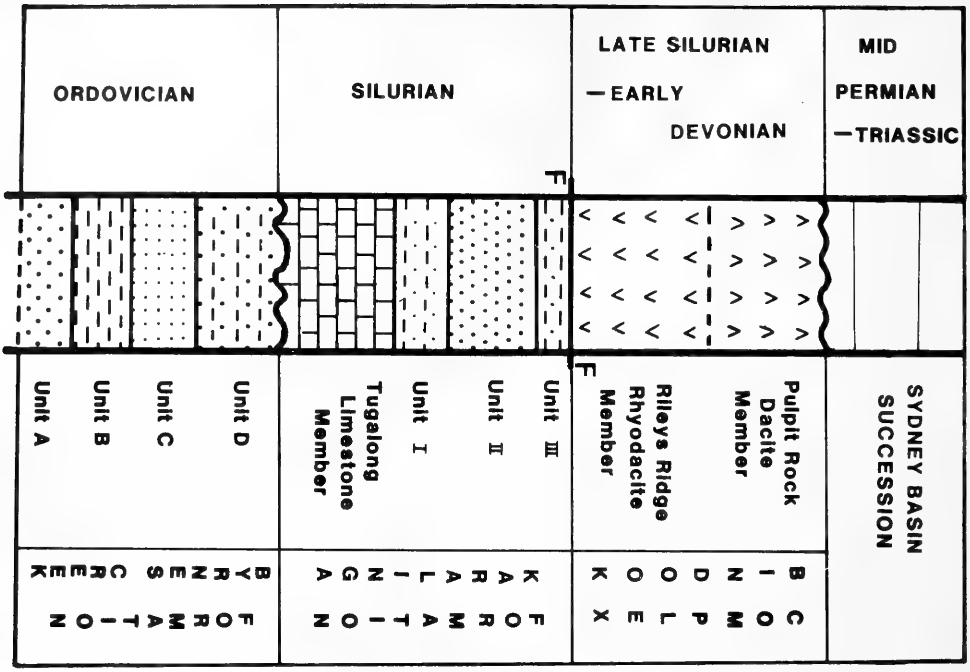

Fig. 2. Idealized stratigraphic section for the Bullio area.

Formation is associated with black slate and this suggests deposition in a moderately deep water, anaerobic, marine environment.

KARALINGA FORMATION *(new name)*

The Karalinga Formation, with a minimum thickness of 550 m, unconformably overlies the Byrnes Creek Formation and is intruded by the Mandari Granodiorite. This formation is named after the property Karalinga, on which the type section crops out (composite type section from GR391929 to GR392924 and from GR400925 to GR403923 on the Hanworth and Barrallier 1:25 000 Topographic Sheets). It has been subdivided into one member and three informal units.

Tugalong Limestone Member (new name). The Tugalong Limestone Member (200 m), named after the property Tugalong, unconformably overlies the Byrnes Creek Formation and comprises a lower, brown to yellowish brown shale, a fossiliferous limestone and an upper, brown shale. The sub-unit boundaries are transitional and the upper shale grades into Unit 1 which conformably overlies it. The type section (GR391929 to GR392926 on the Barrallier 1:25 000 Topographic Sheet) crops out along the Wingecarribee River.

The contact between the Byrnes Creek Formation and the lower shale sub-unit of the Tugalong Limestone Member is not exposed but there is considerable evidence to suggest an unconformable relationship:

(i) the mean strike of the Ordovician arenite is 060° whereas the mean strike of the Tugalong Limestone is 020°;

(ii) at GR914374 the Ordovician strata are steeply dipping to the east whereas the Tugalong Limestone Member dips at 21° to the east; and

TABLE 1

Fossil assemblages found in the Tugalong Limestone Member. Localities are shown on Fig. 1.

Locality W	Locality Y	Locality Z
Coenites sp. indet.	*Heliolites* sp. indet.	*Favosites* sp. indet.
brachiopod fragments	*Tryplasma* sp. indet.	rhynchonellid brachiopods
syringoporoid corals	syringoporoid corals	
crinoid ossicles	crinoid ossicles	
	brachiopod fragments	
	pentamerid brachiopods	

(iii) small-scale cross-bed sets in the Ordovician strata show that they are overturned (i.e. younging to the west) whereas geopetal structures in *Tryplasma* sp. show that the Tugalong Limestone Member is right way up and younging to the east.

Scheibner (1973a) has recognized an angular discordance between overturned Ordovician strata and Silurian sediments at Murruin Creek (30 km northwest of Bullio).

The basal 10 m of the limestone sub-unit consists of shale beds, 50 to 150 mm thick, interbedded with calcareous beds. In northeastern exposures the calcareous beds are reduced to flattened nodules, 100 to 150 mm in diameter, in a clay matrix. The limestone varies in colour from grey to dark grey and is composed of micritic and sparry calcite, terrigenous angular quartz, euhedral cubic pyrite and clay minerals. The shale sub-units are composed of clay minerals (mostly illite), micritic calcite and small amounts of quartz.

The basal 10 m of the limestone sub-unit is richly fossiliferous but only three localities have yielded fossils identifiable to generic level (Table 1) since deformation has compressed most fossils parallel to bedding. Calcareous shells and corals have been partially recrystallized. The fossils suggest a Silurian age for the Tugalong Limestone Member.

Deposition of the Tugalong Limestone Member occurred in a predominantly quiet, neritic environment which experienced periodic influxes of clastic sediment. Disarticulated and fragmented fossils indicate minor turbulence during the deposition of the basal 10 m of limestone.

Unit I (100+ m). The Tugalong Limestone Member grades vertically into an interbedded quartzarenite and shale unit in which the arenite to shale ratio increases upwards. Arenite beds range in thickness from 100 mm to 1.5 m. At GR392924 small-scale cross-bed sets in fine-grained arenite show that this sub-unit faces east. Ripples with internal cross-lamination are found in the shale.

Unit II (150+ m). Fine-grained laminated arenite, interbedded with coarser-grained massive arenite, conformably overlies Unit I. Graded beds, cross-laminated ripples and slump folds occur at several localities.

Unit III (50+ m). The youngest unit comprises interbedded arenite and shale. Arenite beds range in thickness from 10 mm to 1 m and predominate over shale beds which range in thickness from 50 to 500 mm. Asymmetrical linguoidal current-generated ripples (Table 2) with internal cross-laminae commonly occur in the shale. Palaeocurrents (six measurements) flowed towards the north.

Units I, II and III were probably deposited in a higher energy environment and shallower water than the limestone.

Petrography of Clastic Sedimentary Rocks. The arenite is a grey to dark grey indurated quartzarenite composed of subrounded to rounded quartz grains less than

TABLE 2

Ripple parameters for Unit III, Karalinga Formation. (6 readings).

	Wave Length (mm)	Amplitude (mm)	Ripple Index	Ripple Symmetry Index	Straightness Index
Mean	180	17	11.9	3.7	4.6
Range	130-240	10-30	6.0-16.0	3.3-4.3	3.7-5.6

1 mm in diameter. A matrix of illite, chlorite, and fine-grained quartz occurs between the framework grains. Minor amounts of plagioclase and K-feldspar are present. Accessory minerals include tourmaline, zircon and opaque minerals. Illite, chlorite and fine-grained quartz are the main constituents of the shale. Small amounts of feldspar are also present.

BINDOOK COMPLEX

The Bindook Complex consists of acid volcanic rocks and related intrusions which crop out in a meridional belt to the west of Bullio over an area in excess of 750 km^2. Mapping of the eastern edge of the Bindook Complex in the study area has shown that two volcanic phases can be recognized.

Rileys Ridge Rhyodacite Member (new name). The Rileys Ridge Rhyodacite Member, named after a ridge north of Bullio Station, crops out to the west of the Pulpit Rock Dacite Member and extends beyond the boundaries of the mapped area. (Type locality GR388959 on the Barrallier 1:25 000 Topographic Sheet.)

The Rileys Ridge Rhyodacite Member comprises fine-grained, grey porphyritic rhyodacite and minor dacite. Phenocrysts consist of quartz, plagioclase, orthoclase, oxyhornblende and minor amounts of biotite. Plagioclase phenocrysts have cores of andesine-labradorite (An_{38} to An_{54}) and outer rims of oligoclase (An_{20} to An_{25}). Broken phenocrysts and curved twin lamellae are common in plagioclase. β-quartz phenocrysts have large embayments and micro-fractures which are annealed with fine-grained quartz. Hypersthene is the dominant pyroxene and accessory minerals include zircon, chlorite, epidote, and black opaque minerals. Chlorite, clinozoisite and prehnite occur as secondary minerals.

Pulpit Rock Dacite Member (new name). This member crops out over an area of 6 km^2 west of the Byrnes Creek Formation and is named after Pulpit Rock, a large Permian outlier which overlies the dacite at GR393951 (Type locality GR398957 on the Barrallier 1:25 000 Topographic Sheet).

The Pulpit Rock Dacite member is a dark grey, fine-grained porphyritic dacite with minor rhyodacite. The dacite is composed of subhedral to anhedral phenocrysts of plagioclase, embayed β-quartz, hornblende (pleochroic scheme — α = pale green, β = green, γ = dark green to brown) and calcic clinopyroxene set in a fine-grained to aphanitic groundmass of orthoclase, plagioclase, quartz and biotite. Plagioclase with cores of andesine-labradorite (An_{34} to An_{56}) and outer rims of oligoclase (An_{20} to An_{25}) is twinned according to the Carlsbad, pericline and albite laws. Twin lamellae are curved and fractured and many grain boundaries show evidence of fracturing. Accessory minerals include epidote, zircon and opaque minerals. Clinozoisite, prehnite and chlorite occur as secondary minerals.

Rounded to angular clasts of rhyodacite occur in the Pulpit Rock Dacite Member. These clasts may represent volcanic debris incorporated in the dacite during eruption and emplacement. Randomly oriented layering of the groundmass is present in several samples of the rhyodacite.

The dacite of the Pulpit Rock Dacite Member can be distinguished from the rhyodacite of the Rileys Ridge Rhyodacite Member by:
(i) darker colour in hand-specimen;
(ii) absence of hypersthene and oxyhornblende phenocrysts;
(iii) presence of hornblende;
(iv) lower percentage of quartz phenocrysts; and
(v) lower percentage of biotite in the groundmass.
Although the contact between the two volcanic members can be delineated both in the field and by petrographic studies, the stratigraphic relationship between the members has not been determined. At Bungonia, 60 km to the south, hornblende dacite is younger than dacite without hornblende phenocrysts (Carr, Jones and Wright, 1980) and at Yerranderie hornblende dacite occurs stratigraphically above hypersthene dacite (Joplin *et al.*, 1952).

Mode of Emplacement. The Pulpit Rock Dacite and Rileys Ridge Rhyodacite Members are considered to be extrusive for the following reasons:

(i) microscopic flow layering is present in the fine-grained groundmass of both members;
(ii) β-quartz is present in both members;
(iii) both members have fractured plagioclase phenocrysts and the Rileys Ridge Rhyodacite Member has fractured pyroxene phenocrysts;
(iv) rounded fragments of dacitic composition are found in the Pulpit Rock Dacite Member and may represent volcanic ejecta;
(v) the Rileys Ridge Rhyodacite Member contains spherulitic quartz, with an outer rim of radiating quartz crystals, which is similar to textures thought to result from the devitrification of glass shards; and
(vi) at two localities within the Rileys Ridge Rhyodacite Member (GR377928 and GR413965) sub-horizontal layers separated by large joints show textural and colour differences and may represent flows.

Age of the Extrusive Rocks. Although there is no direct evidence for the age of the volcanic rocks in the Bullio area, it is probable that both the Pulpit Rock Dacite Member and the Rileys Ridge Rhyodacite Member were extruded no later than Early to Middle Devonian. Both members are part of the large Bindook Complex which has been correlated with Devonian igneous rocks elsewhere.

At Yerranderie the Bindook Complex and the associated sulphide mineralization have been extensively studied and correlation with several Devonian igneous complexes within New South Wales has been attempted (David, 1950; Joplin *et al.*, 1952). More recently O'Reilly (1972) has suggested a Late Silurian to Early Devonian age for toscanites and dacites along the western margin of the Bindook Complex and Jones *et al.* (1977) have ascribed an Early to Middle Devonian age to ash-flow tuffs and silicic volcanic rocks near Yerranderie. Carr, Jones and Wright (1980) suggested that the Tangerang volcanics at Bungonia, dated at early Devonian, are a correlative of the Bindook Complex.

INTRUSIONS

Two episodes of intrusive activity can be recognized in the Bullio area. These intrusions post-date the Bindook Complex volcanics and were emplaced prior to the deposition of the Mid-Permian Shoalhaven Group of the Sydney Basin sequence.

Jemidee Microgranodiorite (new name). Two large outcrops and five smaller southwest-northeast trending outcrops of the Jemidee Microgranodiorite have been mapped to the south of Bullio and Jemidee Stations (Fig. 1). These intrusions crop out poorly over an area of 4 km^2, and in many localities contacts have been inferred (Fig. 1). The Jemidee Microgranodiorite is named after Jemidee Station and the type locality is GR373949 on the Barrallier 1:25 000 Topographic Sheet.

Where visible most contacts are sharp, irregular and characterized by veins of microgranodiorite which intrude the country rock. At one contact with the Karalinga Formation (GR397297), large blocks (up to 2 m) of sandstone with contorted bedding are found within the microgranodiorite. Elsewhere, smaller irregularly-shaped xenoliths derived from country rock occur along contacts with the Rileys Ridge Rhyodacite Member and the Karalinga Formation. These xenoliths have biotite- and hornblende-rich rims. Pyrite, slickensides and well-developed non-systematic jointing also occur along contacts. Contacts with the Rileys Ridge Rhyodacite Member are characterized by partial recrystallization of the dacite groundmass.

The Jemidee Microgranodiorite is a fine-grained pale grey to green holocrystalline porphyritic microgranodiorite composed of phenocrysts of quartz (up to 10 mm), plagioclase and biotite in a fine-grained groundmass. Plagioclase phenocrysts are zoned with cores of andesine (An_{38} to An_{47}) and more albitic outer rims (An_{20} to An_{25}). Small phenocryts of hornblende (pleochroic scheme — α = pale green, β = green, γ = brown to dark green) can be seen in thin-section. The groundmass comprises quartz, plagioclase, orthoclase and biotite. Accessory minerals include zircon, apatite, epidote and opaque minerals. Clinozoisite and chlorite occur as secondary minerals.

At GR364913 a leucogranitic phase characterized by more quartz and orthoclase and less mafic minerals than the dominant phase, crops out over an area of 500 m^2. Adjacent to this phase (at GR363913) and also cropping out at GR363912 and GR363914 (total outcrop area 1500 m^2) is a foliated coarse-grained granodiorite with a higher percentage of mafic minerals.

The Tugalong Limestone Member has been extensively altered to a coarse- to medium-grained calc-silicate hornfels along the contact with the Jemidee Microgranodiorite. Green hornfels contains abundant colourless to pale green diopside and epidote; grey to pink hornfels has abundant tremolite and grossular garnet; and white hornfels comprises mostly wollastonite and calcite with minor amounts of quartz. Clinozoisite and biotite are found in the diopside-epidote hornfels.

At GR367915 a small outcrop of metamorphosed limestone is found within the Jemidee Microgranodiorite.

Mandari Granodiorite (new name). The Mandari Granodiorite, named after Mandari property, intrudes the Silurian Karalinga Formation and is unconformably overlain by the Mid-Permian Shoalhaven Group. Reconnaissance mapping has shown that this intrusion, which crops out over an area of 2 km^2 in the eastern part of the Bullio area (Fig. 1), extends southeast to Joadja. The type locality is located at GR413920 on the Hanworth 1:25 000 Topographic Sheet. Contacts with the Karalinga Formation are sharp with vein-like masses of finer-grained granodiorite cross-cutting the sedimentary rocks. A 20 m fine-grained hornfels aureole has developed in the Karalinga Formation and contains abundant red-brown biotite, chlorite, quartz with inclusions of biotite, tourmaline and minor muscovite, sericitized plagioclase and pinite.

The Mandari Granodiorite is a coarse-grained, grey, holocrystalline granodiorite with large euhedral crystals of plagioclase (up to 12 mm in length), hornblende and anhedral grains of quartz and orthoclase. Staining with sodium cobaltinitrite and amaranth dye (Norman, 1974) shows that orthoclase is also interstitial to these minerals. Plagioclase has andesine (An_{35} to An_{45}) cores and oligoclase (An_{20}) rims. Dark green to black hornblende (pleochroic scheme — α = pale brown, β = brown and γ = dark brown) has inclusions of apatite, zircon (usually with faint pleochroic haloes) and opaque minerals. Accessory minerals include zircon, apatite and magnetite.

Xenoliths in the Mandari Granodiorite are of two types. Dark, rounded to elongate mafic xenoliths occur randomly distributed throughout the body and range in size from less than 50 mm to over 500 mm. These xenoliths are surrounded by a corona-like zone of large hornblende crystals and contain biotite and K-feldspar in equal amounts with lesser amounts of hornblende and plagioclase. The plagioclase is of similar composition to that in the granodiorite. Irregular elongated quartz-rich sedimentary xenoliths, derived from the country rock, occur near known and inferred contacts and are also randomly scattered throughout the granodiorite.

Numerous pink aplite veins cross-cut the granodiorite and xenoliths. Pegmatites with micrographic texture also occur within the Mandari Granodiorite.

Minor Intrusions. Two large dykes (GR418898 and GR416921) and several smaller dykes of weathered, medium-grained dacite with plagioclase phenocrysts up to 15 mm long, intrude the Mandari Granodiorite. A small intrusion of pink medium-grained porphyritic dacite of less than 200 m^2 outcrop area intrudes the Byrnes Creek Formation at GR372917 but does not appear to be related to the dykes. A distinct foliation has developed and abundant pyrite occurs in this porphyritic dacite near southeastern contact.

GEOCHEMISTRY

Chemical data for samples from the type localities of the Pulpit Rock Dacite Member, the Rileys Ridge Rhyodacite Member, the Jemidee Microgranodiorite and the Mandari Granodiotite were presented in Facer *et al.* (1980; analyses 11-14, table 1). The similarity in chemical data and the spatial relationships of these igneous rocks at Bullio suggests that they are genetically related. The two volcanic phases of the Bindook Complex which crop out in the Bullio district and the two igneous intrusions also have a close chemical affinity with other phases of the Bindook Complex given elsewhere (Joplin, 1943; 1971; David, 1950; Facer *et al.,* 1980; Fergusson, 1980). Chemical data for the two intrusive phases are consistent with those for I-type granites (Chappell and White, 1974; 1976).

AGE OF THE INTRUSIONS

The Jemidee Microgranodiorite intrudes both the Silurian Karalinga Formation and the Rileys Ridge Rhyodacite Member of the Bindook Complex, whereas the Mandari Granodiorite intrudes the youngest sub-unit of the Silurian sequence. Both are unconformably overlain by the Mid-Permian Shoalhaven Group.

Facer *et al.* (1980) have shown that chemical and heat generation data for the

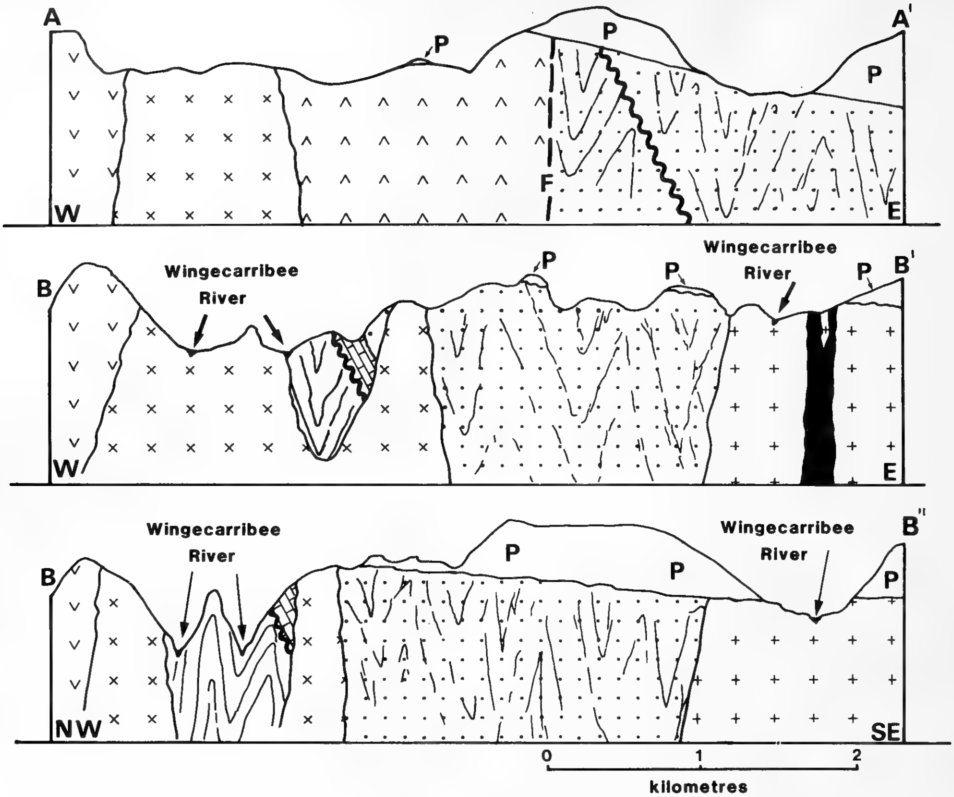

Fig. 3. Geological sections for the Bullio area. P — Permian, Sydney Basin sequence. Location of sections and other symbols are shown on Fig. 1.

four igneous phases at Bullio are consistent with data for other siliceous igneous rocks of Devonian age.

The Wollongong 1:250 000 Geological Map (Rose, 1966) showed the Marulan Batholith and Bindook Complex as southerly and northerly extremities, respectively, of a large north-south trending igneous complex. Chemical data for the igneous rocks of the Bullio area are similar to data for phases of the Marulan Batholith (Jones and Carr, pers. comm., 1980) which has been dated by Carr, Jones and Wright (1980) as Early Devonian (mean K-Ar date — 398M.Y.). A possible genetic relationship between the Marulan Batholith (and associated Tangerang volcanics) and the four igneous phases in the Bullio area is therefore likely. Jones and Carr (1980) suggested a nearly synchronous emplacement for the volcanic rocks and intrusions at Bungonia and similarly a nearly synchronous emplacement of the Jemidee Microgranodiorite, the Mandari Granodiorite and the volcanic rocks of the Bindook Complex is indicated at Bullio. An Early Devonian age is therefore favoured for both intrusions at Bullio.

Structural History

Schematic geological cross-sections showing the major structural features of the Bullio district are given in Figs. 3 and 4.

Folding. Two scales of folding have been recognized in the Byrnes Creek Formation.

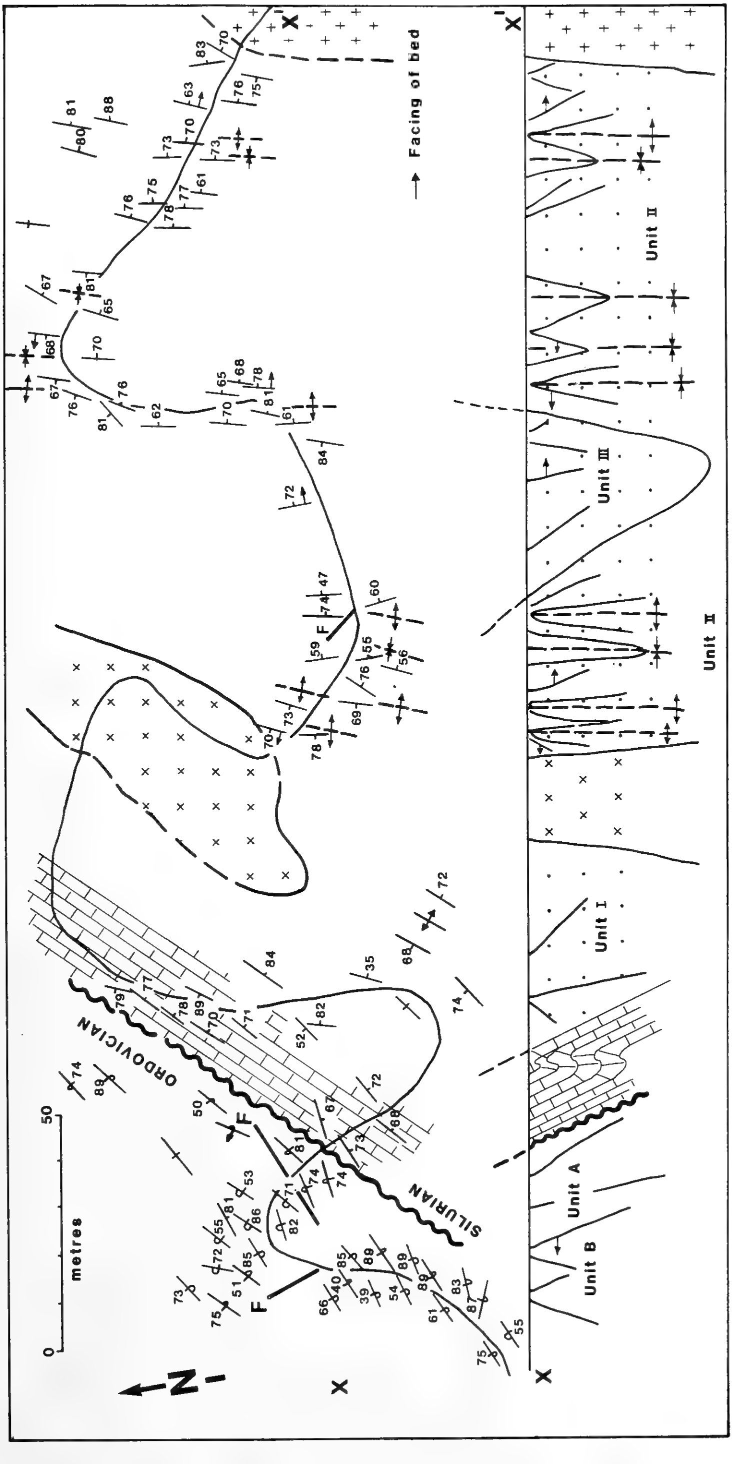

Fig. 4. Fold axes and schematic cross-section along portion of the Wingecarribee River. Locality and symbols are shown on Fig. 1.

Large-scale folding has gently plunging axial planes (for example approximately 10° towards 260° at GR372914) and has been recognized in well exposed outcrops of quartzarenite along the Wingecarribee River. Small-scale folds and small kink folds have developed in the black slates and fine-grained laminated quartzarenites of Units B and C of the Byrnes Creek Formation. These smaller folds plunge steeply and fold axes are not persistent along strike.

Medium- to small-scale tight asymmetrical folds have been recognized in the interbedded arenite and shale of the Karalinga Formation (Fig. 4). In small-scale folds, movement has occurred along strike-slip fault planes in the shale and there is a marked thickening of shale along fold hinges. Open small-scale folds have been recognized in the bedded arenites. Fold axes in both small-scale fold sets plunge to the north and to the south at angles of less than 20°. Both fold styles are thought to be expressions of the same folding event.

Open folds with shallow amplitudes and short wavelengths are found in the Tugalong Limestone Member. Axial plane cleavage, calcite-filled *en echelon* tension gashes and calcite-filled joints have developed in both the shale and limestone of this member. Differences in competence between the Tugalong Limestone Member and rocks of the overlying units can possibly account for the different fold styles that have developed during a single episode of folding.

The steeply-dipping folded Karalinga Formation may represent the western limb of a large syncline.

A well-defined cleavage, subparallel to bedding planes, has developed in the less competent slates and finely laminated quartzarenites of the Byrnes Creek Formation and in shales of Units I and II of the Karalinga Formation. Boudinage structures are found in the quartzarenites of Unit D of the Byrnes Creek Formation.

Faulting. Two large faults have been mapped in the area. A normal fault northwest of Tugalong Station is represented by a marked change in the type of vegetation and a termination of the limestone at GR374914. A second major fault is inferred along the vertical contact between the Byrnes Creek Formation and the Pulpit Rock Dacite Member with pronounced jointing, possibly representing an incipient shear zone, developed in both units. Quartz-filled veins and abundant pyrite are found in the quartzarenite at this contact.

Numerous small cross-cutting faults of up to 4 m lateral movement, are found in bedded quartzarenite (Units A and C) and in interbedded quartzarenite and shale (Unit D) of the Byrnes Creek Formation. Faults of similar dimensions are found in the Karalinga Formation. Those in the Tugalong Limestone Member are associated with calcite filled fracture zones.

Only the major faults are shown in Fig. 1.

Discussion

Deep marine quartz-greywacke spread throughout the southern Lachlan Geosyncline during the Late Ordovician. These sediments (such as Unit B of Crook *et al.,* 1973, and the black shale-slate facies and overlying flysch sequence of Scheibner, 1973b) spread south and east of Yass and accumulated on the Monaro Slope and Basin near an inferred subduction zone on the eastern edge of the Lachlan Pre-Cratonic Province. The Byrnes Creek Formation at Bullio was deposited in a northern extension of this province. Large-scale isoclinal folds in Ordovician strata have been recognized at Bungonia (Carr, Jones, Kantsler *et al.,* 1980) and in the southeastern part of the Lachlan Fold Belt (Late Bolindian to Late Llandoverian: Stauffer and

Rickard, 1966; Crook *et al.*, 1973) and have been attributed to the Benambran Orogeny. The age of the folding in the Ordovician Byrnes Creek Formation at Bullio has not been determined.

At Bullio Early Silurian graptolitic distal flysch strata, such as the "Jerrara Series" (Naylor, 1935; 1936; 1950) have not been recognized and the Karalinga Formation, which was deposited in shallow water, is the earliest Silurian unit. Uplift and erosion of the Byrnes Creek Formation predated the deposition of the Tugalong Limestone Member.

The eruption of calc-alkaline acid volcanics which spread discordantly over the Bullio portion of the Capertee Volcanic Arch during the Late Silurian or Early Devonian was responsible for the emplacement of the Bindook Complex. Volcanism was associated with high level intrusion of granitic rocks of the Mandari Granodiorite and Jemidee Microgranodiorite. These events were of regional extent; similar volcanism and granite have been recognized at Bungonia (Carr, Jones, Kantsler *et al.*, 1980) and at Yerranderie (Jones *et al.*, 1977; Fergusson, 1980).

The age of the major faults in the Bullio area is difficult to establish. Small-scale strike-slip faults, found only in the youngest unit of the Karalinga Formation may have been active during folding. The north-south trending fault near Tugalong Station is, however, younger than the folding in the Karalinga Formation.

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Index

Volume 105

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CONTENTS:

NUMBER 3

NUMBER 4

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