PROCEEDINGS

OF THE

Royal Zoological Society

OF

NEW SOUTH WALES

for the Year 1955-56

Price, 4/-

(Free to all Members and Associates)

Sydney:

Published by the Society, 28 Martin Place

May 8, 1957

Registered at the G.P.O., Sydney, for transmission by post as a periodical

ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES

Established 1879

REGISTERED UNDER THE COMPANIES ACT 1899 (1917)

Patron:

His Excellency Lieutenant-General Sir John Northcott, K.C.M.G., K.C.V.O., C.B.

Vice-Patrons:

Sir Philip Woolcott Game, G.C.V.O., G.B.E., K.C.B., K.C.M.G., D.S.O.
The Right Honourable Sir John Greig Latham, G.C.M.G.

COUNCIL, 1955-56

President: James Roy Kinghorn, F.R.Z.S., C.M.Z.S., F.C.A.S.

Vice-Presidents:

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Emil Herman Zeck, F.R.Z.S.
Aubrey Halloran, O.B.E., B.A., LL.B., F.R.Z.S.

Honorary Secretary: Mrs. Leone Harford.

Honorary Solicitor: Aubrey Halloran, O.B.E., B.A., LL.B., F.R.Z.S.

Honorary Editor: Gilbert Percy Whitley, F.R.Z.S.

Honorary Treasurer: Geoffrey Alan Johnson.

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Lieut.-Col. Henry Burgh
Ernest Jeffrey Gadsden
John Hallstrom
Percy Fincham Harvey
James Allen Keast, M.Sc., M.A., Ph.D.
Anthony Irwin Ormsby, LL.B.
Elizabeth Carington Pope, M.Sc., F.R.Z.S., C.M.Z.S.
Ellis Le Geyt Troughton, F.R.Z.S., C.M.Z.S.
John David Waterhouse
Leonard Webber

OFFICERS (Non-Councillors).

Acting Honorary Treasurer: R. Murnin.

Honorary Auditor: M. S. Davies, F.C.A. (Aust.).

Honorary Librarian: Mrs. P. R. Johnston.

Assistant Honorary Secretary: Miss J. M. Coleman.

OFFICERS OF SECTIONS

Avicultural Section:

Chairman: L. Webber
Hon. Secretary: P. Harvey

Marine Zoological Section:

Chairman: Miss G. Thornley
Hon. Secretary: Mrs. O. Wills

Budgerigar Section:

Chairman: W. Hastings
Hon. Secretary: J. L. Bright

Ornithological Section:

Chairman: E. J. Gadsden
Hon. Secretary: A. R. McGill, F.R.Z.S.

General Section:

Chairman: Miss E. Pope, M.Sc., F.R.Z.S., C.M.Z.S.
Hon. Secretary: Miss B. Dew, B.A.

ROYAL ZOOLOGICAL SOCIETY

OF

NEW SOUTH WALES

The Seventy-sixth Annual Meeting was held at Taronga Zoological Park, Mosman, on Saturday, 28th July, 1956, at 2.30 p.m. Ninety-three members and their friends were present. The Honorary Secretary presented the

76th ANNUAL REPORT

Membership: At the 1st July, 1956, the total Membership of the Sociey was 504, consisting of 1 Endowment Member, 4 Associate Benefactors, 8 Honorary Members, 55 Life Members, 328 Ordinary Members, 72 Associate Members, 16 Life Associate Members, 4 Honorary Associate Members and 16 Junior Members. During the year the Society lost 13 Members by resignation, 7 by death and 39 in terms of Article 9 of the Constitution, a total of 59 Members. The Society has lost an overall Membership since last year of 20 members, 9 of these being Juniors who did not become Full Members or Associates on attaining the age of 16 years.

Among those lost by death were Professor J. D. Stewart, Sir Samuel Hordern and Mr. Samuel Biber. The last mentioned was a sincere conservationist and a keen worker in this field.

Council: During the year 11 Council Meetings were held with an average attendance of 11 members, a decided improvement on the previous year's attendance. Extended leave was granted to Lieut.-Col. Harry Burgh.

Mr. Theodore Cleveland Roughley resigned from the Council after thirty years of valuable service, a record of which has been entered in the Minutes. In terms of Article 26, Mr. John Hallstrom was appointed by Council to fill the vacancy caused by Mr. Roughley's resignation.

Fellowship: The Council was pleased to confirm the recommendation of the Qualifications Committee, that Mr. Norman Chaffer be awarded the Fellowship of the Royal Zoological Society of N.S.W. in recognition of his outstanding work in Natural History photography, especially in the field of Ornithology. On Wednesday March 28th the Council was pleased to accept a further recommendation from the Qualifications Committee that Mr. Michael Stanley Reid Sharland of Tasmania be made a Fellow.

Publications: *The Australian Zoologist* Vol. 12 Part 3 was ready for publication. The *Proceedings* for the year 1954-55 was published on 10th April 1956.

Overseas Exchanges: Our publications are in great demand overseas, so much so that numerous requests for exchange had to be refused; this was done for two reasons: (1) the material offered to us was not printed in English, (2) Subject matter was not zoological or did not have any bearing on Australian Fauna or Flora.

Conferences: Mr. Ellis le Geyt Troughton represented the Society at all meetings and sub-committees of the Fauna Protection Panel.

A Sub-Committee comprising Sir Edward Hallstrom, Messrs. A. I. Ormsby, G. P. Whitley, J. D. Waterhouse and Mrs. L. Harford was formed to investigate the future of the Dee Why Lagoon.

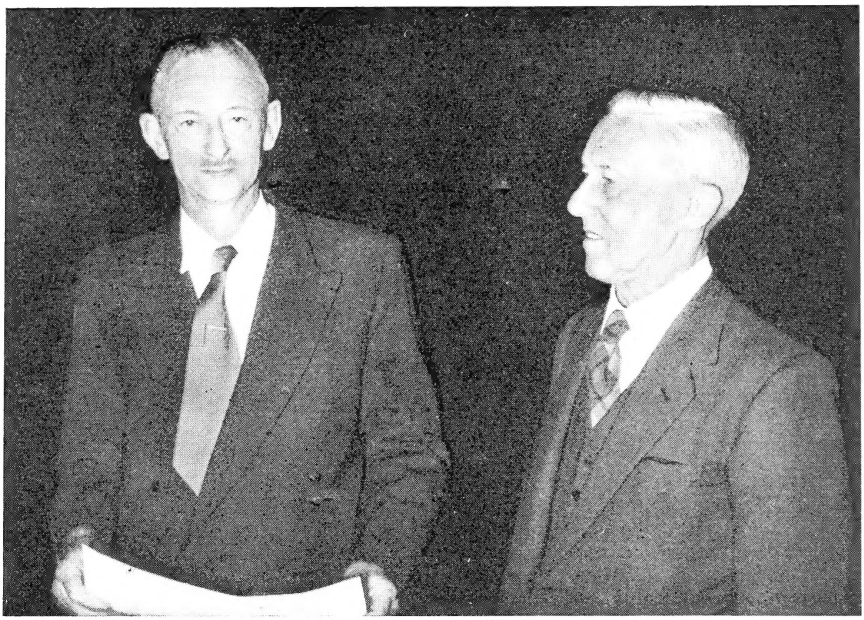
Special Lecture:: At the Australian Museum on Wednesday 21st September a special lecture was given by Mr. Arthur Clarke, B.Sc., F.R.A.S., entitled "Coast of Coral."

Film Night: A Film Night was held in conjunction with the Sydney Scientific Film Society on Monday, 14th November, 1955, at the Wallace Theatre, University of Sydney.

Library: The following books were donated to the Society's Library:—

"A Treasury of New Zealand Fishes," David H. Graham.
"The Marine and Fresh Water Fishes of Ceylon," by Ian S. R. Munro.
"The Mammals of Victoria," C. W. Brazenor.
"Collections of a Century," R. T. M. Prescott.
"Flying Fox and Drifting Sand," Francis Ratcliffe.
"Life of a Scotch Naturalist," Samuel Smiles.
"Cowry Shells of World Seas," Joyce Allan.

We wish to thank the authors and publishers for their generosity.



Mr. Norman Chaffer (left) being awarded the Fellowship of the Society by Mr. E. H. Zeck, a Vice-President.

Ladies' Auxiliary: During the year a 35 mm. Leitz Projector was purchased for the Society and is available for all sectional meetings in the Society's rooms.

Functions held during the year:

Bus trip to Minna Murra Falls, 23rd October, 1955.
Social Evening, I.O.O.F. Hall, 22nd November, 1955.
Launch Trip, Shark Island, 5th May, 1956.

Adoption of the Annual Report was moved by Dr. A. Keast, seconded by Mr. E. Le G. Troughton and carried.

Six retiring Councillors (Messrs. Aubrey Halloran, John Hallstrom, G. A. Johnson, J. R. Kinghorn, E. Le G. Troughton and J. Waterhouse) were re-elected.

Sir Edward Hallstrom, Vice-Patron, referred to the inauguration of the zoological gardens at Moore Park and the work of the Royal Zoological Society in connection with the Moore Park, Maroubra and Taronga sites.

The President welcomed Mr. F. J. Griffiths, Chairman of the Fauna Protection Panel, who spoke on the care and protection of fauna in New South Wales. Adoption of the Balance Sheet for 1955 was moved by Mr. G. A. Johnson, seconded by Mr. E. J. Gadsden, and carried.

Presidential Address: A good deal has been done to advance the interests of the Society during the last six years. Even though many things have been inaugurated during my term of office as your President, nothing had, or could have been, accomplished without the active support of members of Council, executive officers of Sections, and members of this great Zoological Society. You may remember that, on the termination of my first year, at the Annual Meeting, I made certain suggestions that might build up the zoological interests of the Society, and enable it, not only to retain its position as the leading Zoological Society in Australia, but to advance it considerably. Many of the matters concerning internal and domestic reorganisation emanated from executive members. The Sections have been somewhat reorganised within themselves and thereby enjoy greater power, particularly through electing Full Members only to their executive, as required by the rules. Provision has been made for expanding the field of the Society so that any interested body of country members can now form a "Country Branch." During the past few years, Secretaries of Sections have been giving occasional reports to the Council of their activities, thereby making the deliberations of the Council easier. Your President or a deputy has been present at all meetings of Sections and I am pleased with the zoological work being done. A very great and important work among young zoologists is being done by your Secretary, who is to be congratulated on her evening classes in zoology. Several attempts have been made to contact the President of the Royal National Park Trust, to discuss the rebuilding of the Ornithologists' Cabin near the Causeway, but without success. It is suggested that efforts be continued, so that eventually some ornithological survey work of the birds of the Park can be done.

Owing to the fact that several evenings in the General Zoology Section were devoted to instruction by Miss E. Pope on the compilation of scientific papers, and to methods of preparation of scientific drawings by Miss Joyce Allan, there has been a very great improvement in the standard of papers submitted to the Publication Committee, and the Editor must be very happy about that. Mr. Whitley has had a very trying time, as most editors have, and we owe a debt of gratitude to him for his efforts on the Society's behalf.

A List of the Birds of Sydney, recommended to you by me some years ago, has now been completed by Messrs. K. A. Hindwood and A. R. McGill. It is a very great effort, is now before the Council, and will, we hope, be published in the near future. Also ready for press is Lieut.-Col. Fraser's Revision of the Odonata, or dragon-flies.

Your Society has been interested in efforts to secure as a Reserve a small area of Kurrajong Heights known as "Bell Bird Corner." This region has been occupied by Bell Birds, *Manorhina melanophrys*, for longer than the oldest Richmond inhabitant can remember. It is a great tourist attraction, and all cars passing that way stop for a little time for the passengers to hear the tinkling in the trees. It is understood that the landowner intends cutting the land into small building-blocks, and it is suggested that members of this Society should take

steps to prevent this and see if the area cannot be kept in its primitive state as a bird reserve.

Ever rising rents are making it more and more difficult for the Society to function as we would wish. Our income is only about on a par with our rent, and if it were not for subletting portion of our rooms, we would not be able to carry on at all. Because of this, and for the reason that it is desirable that more of our income should be spent on zoology, a keen lookout is being kept for less expensive but equally suitable premises.

It is understood that several matters put before you at the Annual Meeting of 1951 have now been satisfactorily attended to and that others (such as a Handbook of bird ailments, and an annotated Map of the marine collecting-grounds of the Sydney area) are well under way.

The possibility of installing an Insect House at Taronga Zoological Park received very detailed and careful attention, but, mainly because it would necessitate the employment of a full-time entomologist, the scheme was dropped.

On behalf of the Council, the Secretary has been keeping in touch with all known seriously ill members, wishing them a speedy return to health.

To the Ladies' Auxiliary, whose work is known to all of us, we owe much for a better social life, in addition to funds raised for the purchase of projectors and other necessary equipment. It is hoped that the Auxiliary will be able to continue this happy and useful work. I take this opportunity of thanking you all, fellow members of Council, the Honorary Secretary, Treasurer, executive officers of Sections, and members generally. Your advice and support during the six years I have been honoured to occupy the Chair have been very comforting and much appreciated. I sincerely hope you will continue to give the same measure of support to your new President. Only by this manner of support and community effort will the Society continue to advance and spread zoological knowledge. I have great hopes for the future prosperity of this Society.

A vote of thanks to the President was moved by Mr. Aubrey Halloran who praised Mr. J. R. Kinghorn, Sir Edward Hallstrom, Mr. F. J. Griffiths and the Hon. Clive Evatt for their work on behalf of the Society and Sir William McKell for his efforts to ensure the preservation of the Kosciusko State Reserves and Macquarie Marshes as sanctuaries for animals.

OFFICERS FOR THE YEAR 1956-57

President: Mr. E. J. Gadsden.
Vice-Presidents: Messrs. A. Halloran, J. R. Kinghorn, E. H. Zeck and Dr. J. A. Keast.
Honorary Secretary: Mrs. L. Harford.
Honorary Treasurer: Mr. G. A. Johnson.
Honorary Solicitor: Mr. A. Halloran.
Honorary Editor: Mr. G. P. Whitley.
Honorary Librarian: Mrs. P. R. Johnston.
Honorary Auditor: Mr. M. S. Davies.
Assistant Honorary Secretary: Miss J. M. Coleman.
Assistant Honorary Treasurer: Mr. R. Murnin.

ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES

REVENUE ACCOUNT FOR THE YEAR ENDED 30th JUNE, 1956

GENERAL ACCOUNT

	£ s. d.		£ s. d.	£ s. d.
To Office Rent	762 0 0	By Subscriptions		885 12 4
Stationery and Stamps	200 13 0	Rent—Sub-letting	479 10 4	
Telephone	15 5 10	Interest—Bank	25 16 3	
Electricity	18 14 7	Interest—Bonds	38 16 6	
Insurance	14 5 8	Government Grant	50 0 0	
Publication Expenses—General	388 19 4	Sundry Income	. . .	
Publication Expenses—Zoologist	630 10 4	Bequests	51 10 0	
Sundry Expenses	79 3 7			645 13 1
		Excess of Expenditure over Income for the Year ended 30th June, 1956		578 6 11
	£2109 12 4			£2109 12 4

PUBLICATION ACCOUNT

	£ s. d.		£ s. d.
To Surplus of Income over Expenditure for the year ended 30th June, 1956	23 14 4	By Sales—Handbooks	23 14 4
	£23 14 4		£23 14 4

BUILDING FUND

	£ s. d.		£ s. d.	£ s. d.
To Balance Transferred to Building Fund	29 9 5	By Interest—Investments	22 15 0	
		Interest—Bank Account	6 14 8	
				29 9 5
	£29 9 5			£29 9 5

ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES

BALANCE SHEET AS AT 30th JUNE, 1956

LIABILITIES	£ s. d.	£ s. d.
Accumulated Funds:		
Balance as at 30th June, 1955 ..	3715 8 9	
Add surplus for year ended 30th June, 1956—		
Publication Account	23 14 4	
	3739 3 1	
Less Deficiency for year ended 30th June, 1956—		
General Account	578 6 11	
		3160 16 2
Building Fund:		
Balance as at 30th June, 1955 ..	955 16 11	
Add Interest received for year	29 9 8	
		985 6 7
Subscriptions paid in advance ..		181 7 0
Marine Section Fund		60 2 3
		£4387 12 0

ASSETS	£ s. d.	£ s. d.
Furniture and Fittings:		
Office, Lecture Room, Furniture and Equipment at cost	494 7 11	
Library Books at cost	503 4 6	
"Parrot" Paintings at cost	500 0 0	
Projector at cost	54 18 6	
		1552 10 11
Investments at cost:		
Australian Commonwealth inscribed stock	1104 7 6	
Australian Commonwealth Treasury Bonds	100 0 0	
		1204 7 6
Commonwealth Savings Bank Current Account	640 7 0	
Cash in Hand	5 0 0	
		645 7 0
Building Fund Investments:		
Australian Commonwealth Treasury Bonds	700 0 0	
Commonwealth Savings Bank ..	285 6 7	
		985 6 7
		£4387 12 0

AUDITOR'S REPORT TO THE MEMBERS OF THE ROYAL ZOOLOGICAL SOCIETY OF NEW SOUTH WALES

I hereby report that I have audited the books and accounts of the Royal Zoological Society of New South Wales for the year ended 30th June, 1956, and have obtained all the information and explanations I have required, and, in my opinion, the above Balance Sheet exhibits a true and correct view of the state of the Society's affairs as at 30th June, 1956, according to the best of my information and the explanations given to me and as shown by the books of the Society.

I have examined the Register of Members and other records which the Society is required to keep by law or by its Articles and am of the opinion that such records have been properly kept.

SYDNEY, 28th August, 1956.

(Signed) M. S. DAVIES, F.C.A. (Aust.), Hon. Auditor.

REPORTS OF SECTIONS

Avicultural Section

During the past year the Avicultural Section has held the keen interest of many members of the Society by the talks that have been given and the friendly feeling of one aviculturalist to another under the very able chairman Mr. L. Webber.

The attendance at the meetings averaged 15, with 24 members and friends at the August meeting to hear a talk by Dr. A. Lendon of Adelaide on his recent trip to England, Europe and America and of the various Zoos he visited in these countries, none of which he thought came up to our own Taronga Park.

Mr. R. Askoff also gave a talk on aviaries and their construction in Europe and compared the aviaries and conditions of breeding in Europe with those in our own very easy climate in Sydney. Mr. Askoff then entertained members with a film of some Sydney aviaries and a beautiful colour film of Luxemburg, Monte Carlo and Paris.

An unusual lecture for this Section was given by Mr. Johnston of Agricultural Services Ltd. dealing with garden and home pests and the various sprays for their destruction, including the prevention and destruction of mites in the aviary. At the conclusion of his address, in reply to questions, Mr. Johnston was of the opinion the blow-off from garden sprays, if used as recommended, would not be harmful to the inmates of aviaries, nor did he think crop and nursery spraying would have any harmful effect on the wild birds.

Mr. Webber was again asked to give of his vast knowledge of aviculture and he obliged with two very interesting talks, one on Hybrids and the other, "The Beautiful Firetail."

In his talk on Hybrids Mr. Webber dealt with hybrid-breeding in the aviary and in nature among the wild birds.

In the aviary it appears to run in cycles; just previous to World War II a great deal of work was carried out and this fascinating experiment is again attracting the attention of aviculturists, due perhaps to the difficulty of obtaining birds to replace losses over the years. A mating of two different species producing fertile eggs indicates a close relationship between these birds, but matings producing either infertile eggs or sterile young is Nature's method of preventing undesirable hybridisation. In the native state certain hybrids are produced, the most common being in the Birds of Paradise.

Mr. Webber's talk on the Firetail dealt with its natural life in the damp gullies, the trapping and transferring to aviary conditions and the successful breeding of this bird in the aviary.

We are again indebted to the Ornithological Section for a very educational talk by Mr. A. McGill on the Birds of south-western N.S.W. illustrated by Kodachrome transparencies. He told of the type of country, the birds and their nesting habits and the various types of plants from which food is procured.

To the Budgerigar Section we owe our thanks for the talk on colour-breeding so aptly given by Mr. J. Bright in which he explained the traps and pitfalls in breeding the desired colours for the show bench.

In April we had an evening when members brought along Kodachrome slides taken in their aviaries and on excursions through the country and bushland areas and from these it appears there are many budding camera enthusiasts in the Society.

Mr. Chaffer presented his films on the Bower Birds at the May Meeting and in introducing the speaker Mr. J. R. Kinghorn described Mr. Chaffer as the foremost bird photographer in Australia. In his film we saw the Satin Bowerbird in National Park, the Spotted Bowerbird of western N.S.W. and the beautiful Golden Bowerbird of North Queensland.

To all who have so freely given of their time and knowledge this Section extends its sincerest thanks.

Mrs. F. J. Blaxland has again had remarkable success in the breeding of the Scarlet-chested, Hooded and Bourke Parakeets.

The Budgerigar has been used quite successfully in rearing the smaller parrots by members at various times when hens have died or have deserted eggs or young. Mrs. N. Ewings used them to hatch and rear the Peach Face Lovebird, but this involved changing into several nests as they are longer reaching the stage at which they leave the nest.

Mrs. Ewings also reared a Bourke Parakeet under Budgerigars, a story with rather a strange beginning. The young Bourke was deserted by its parents when only a few days old and transferred to its foster-parents. Now the Bourke at hatching is covered with a fine grey down, whilst the Budgerigar is naked, and so to even things up the foster-parents immediately stripped all the down off the young Bourke and then proceeded to feed and rear it to full size and continued to feed it after it had left the nest.

Although many of our local birds open up a big field for scientific and genetic work, members are unable to take suitable breeding pairs from the wild state as they are protected by the Fauna and Flora Protection Act, but have to purchase these same birds from other States, although many are only N.S.W. birds sent interstate by dishonest trappers.

A warm welcome is extended to members and friends to be present at the Avicultural meetings and we will endeavour to help you in the keeping of our feathered friends happy and contented in the aviary.

PERCY F. HARVEY,
Hon. Secretary.

Budgerigah Section

No annual report of this Section's activities has been submitted for publication.

General Zoology Section

The General Zoology Section has enjoyed a happy and successful year during the 1955-56 Session. At the July Meeting it was decided to reduce the number of lecture evenings with a view to improving the general quality of the talks and to devote the remaining meetings to the preparation of a handbook on the natural history of Sydney.

The completed handbook is to be offered to the Council of the Society for consideration as a Society publication. It is felt that a profusely illustrated, well written and attractively printed book could enjoy a wide sale to members of the Royal Zoological Society, tourists, visiting scientists and school children. It is anticipated that this work will occupy Section members for several years to come and afford an opportunity for those with specialised knowledge of obscure groups of animals to record their findings and thus make them available to all—facts and observations which might otherwise be lost. The response

by Section members to this project has been splendid and all have co-operated in the work and joined in the discussions.

Tangible results of this work are set out below and represent a considerable part of the preliminary work: Lists have been prepared for all groups of animals comprising the commoner or more important species found around Sydney. A card catalogue of these animals has been made and sections of it have been distributed to the members best fitted to fill in the detailed information required about each species. These cards are to be returned to the Section in three months' time and then any obvious gaps in the information can be noted and steps be taken to make the necessary observations to fill them in during the 1956-57 Session. The completed card index will then be available to the editor or editors of the booklet.

Meetings in July, August, December, March and May were devoted to work on the handbook. No meeting was held in January, as many members were on holidays. The remaining nights were devoted to talks and discussions as outlined below:

On September 13th, six members contributed talks to a symposium on" Zoological Curiosities." A very varied and enjoyable programme resulted, covering a wide zoological field and provoking good discussions.

At the meeting on October 11th, Dr. D. F. McMichael gave a breezy and interesting account of his experiences while "Shell Collecting in Dixieland, U.S.A." He illustrated his talk with numerous kodachromes.

A joint meeting with the Marine Zoological Section was held on November 8th, when advantage was taken of Mr. A. W. B. Powell's visit to Sydney to have him address the Society on "The Australian Element in the New Zealand Fauna." Mr. Powell was on his way to New Guinea to collect molluscs for the Auckland Museum. An interesting discussion followed his talk.

Visiting Fulbright Scholar from U.S.A., Miss Joan Steinberg, told the February Meeting of the Section about "Collecting Nudibranchs in California, U.S.A." Between kodachromes of these beautiful molluscs, Miss Steinberg showed to fans of John Steinbeck's two classics "Cannery Row" and "Sweet Thursday" pictures of some of the quaint establishments, like the Western Biological and Lee Chong's Store, that figured so prominently in those books.

The talk given on April 10th by Mr. Baughan Wisely, of C.S.I.R.O. Division of Fisheries and Oceanography, on "Exploring in Fiordland, New Zealand" was a highlight of the current session. Mr. Wisely packed a great deal of zoological information about the New Zealand fauna in general, into his more particular account of that wild, wet area of the South Island where Notornis chooses to live. Without benefit of a single illustration, he produced a graphic account of the charms and difficulties of living in this area. Members are now hoping to see Mr. Wisely's kodachromes when they come over from New Zealand.

The Chairman's Address given by Miss Pope on June 12th was entitled "Some peculiarities Exhibited by Peripheral Populations of Marine Animals."

The General Section again arranged and managed a popular lecture for the Society, by Mr. Arthur Clarke, a noted author of science fiction. Mr. Clarke spoke on "Coasts of Coral" and told of his adventures exploring coral reefs and photographing them in colour stills and movies. Three hundred and eight people attended the talk which was held in the lecture hall of the Australian Museum on 21st September. The interest created by this meeting shows the demand that exists for more evenings of this type, where the Society meets as a whole and invites visitors to hear noted speakers.

Average attendance at lectures was 21 and for all meetings of the Section was 16. It is felt that this improvement in attendances justifies the policy of fewer and better lectures in each session. During the year the time of meeting was changed to 7.45 p.m. to enable meetings to close earlier.

The Section greatly appreciates the interest shown in all its activities by the President and various members of the Council who have come to its meetings and takes this opportunity of thanking them.

The following officers were elected at the Annual General Meeting, held on June 12th, for the 1956-57 Sessions:

Chairman: Miss E. Pope.
Vice-Chairman: Mr. J. Waterhouse.
Honorary Secretary: Miss B. Dew.

B. DEW,
Honorary Secretary.

Marine Zoological Section

The month of June finds us at the end of yet another year's activities in the Marine Section, and sets us looking forward to the studies and lectures arranged for 1956-7, also the Publishing Committee's efforts with the "Marine Zoologist."

During the year, the study nights (2nd Thursday in each month), though at times poorly attended, have been of great interest and assistance in "getting to know our shells" and their respective animals. Average attendance has been 12 members, which number we hope will be considerably increased during the coming year.

Attendance at lectures (1st Tuesday in the month), has been much better, an average of 25 members and friends having been maintained.

Due to the lack of favourable tides, we did not organise many field days, but those that were held were most gratifying in numbers of members and friends, who desired to find out what the various reefs and sand flats held for them.

Our sincere thanks are due to the various lecturers and to all those who have assisted in making our year such an enjoyable one, and to our visitors who help to show that our small activities are of general interest to the public. To Members we appeal for full scale attendance and the encouragement of their friends to join this group, which covers such an interesting and beautiful field.

The following is a list of Study nights, Lectures and outings held during the year July 1955 to June 1956.

Lectures.

1955.
July 5: Transparencies of Living Molluscs and Views of Sydney Beaches .. .. F. McCamley
Aug. 2: Old Collectors Known to Me .. .. .. T. Iredale
Sept. 6: Transparencies of a Trip to Nor' West Island L. Woolacott
Oct. 4: Talks by Members.
Nov. 8: Australian Shells in New Zealand .. .. A. Powell
Dec. 6: Origin and Construction of the Molluscs .. G. Thornley
1956.
Feb. 7: A Trip to Lord Howe Island with Aerial Views of Sydney Harbour and Coastline—Transparencies F. McCamley
Mar. 6: Transparencies—Mussels, Malacologists and Museums .. .. D. McMichael
April 3: Paraphernalia Used for Collecting .. .. J. Laseron
May 1: Transparencies—Noumea and Around Australia .. .. J. Keats

June 5: Presidential Address and Election of Officers.

Study Nights.

1955.

July 14: Display of Anomalies from Members' Collections.

Aug. 11: Rare Shells. Comments by Collectors.

Sept. 8: Display and Discussion of Common Puzzling Shells.

Oct. 13: Study Family Limidae—Hedley's List 73-81 ..	J. Laseron
Nov. 10: Volutidae—Generic Division	L. Woolacott
Dec. 8: Common Genera	L. Woolacott

1956.

Jan. 12: Dentaliums, Janthinidae, Neritidae—Hedley's List Nos. 1202-1208, 618-622, 471-475	J. Laseron
Feb. 9: Limpets—Hedley's List No. 480-488	G. Thornley
Mar. 8: Family Strombidae	J. Laseron

April 12: Display by Members.

May 10: Architectonicidae—Hedley's List 1077-1086 ..	J. Laseron
June 14: Naticidae—Hedley's List 687-703	L. Woolacott

Field Days

1955.

Aug. 20: Long Reef.

Nov. 3: Annual Outing—Shark Island.

1956.

Jan. 28: Gunnamatta Bay. Leader: F. McCamley.

Feb. 26: Long Reef.

J. LASERON,
Hon. Secretary.

Ornithological Section

Regular monthly meetings were held during the year. As previously, members of the New South Wales Branch of the Royal Australasian Ornithologists' Union held their meetings, by invitation, with members of the Section. Attendances fluctuated between 39 (minimum) and 61 (maximum) and the average attendance of 47 was most encouraging. A number of informative and well-illustrated addresses were delivered, among which were "The Birds of the Furneaux Islands," by Roy Mackay; "Bird Photography," by Ellis McNamara; "Some Victorian Birds," by Roy P. Cooper; "Overseas Bird Study," by J. E. Roberts; "Wild Life in America," by Dr. Allen Keast; "The Tasmanian R.A.O.U. Congress and Camp-out," by Norman Chaffer; "Birding Unlimited," by S. G. Lane; "Reminiscences of a Bird Photographer," by J. D. Waterhouse; "The History of Falconry," by J. J. Francis; "In Search of a Bird," by K. A. Hindwood; and "A Trip to the Grampians," by W. R. Moore. Mr. Chaffer screened his excellent colour films of birds at the March meeting.

After two years' absence in America Allen Keast was welcomed back in September and congratulated on his having obtained the degree of Doctor of Philosophy at Harvard University. It was also pleasing that the Council of the Royal Zoological Society of New South Wales conferred the title of Fellow on Mr. Norman Chaffer (an active supporter of the Section's activities for many years who received the honour during his term as President of the Royal Australasian Ornithologists' Union) and on Mr. Michael Sharland (who for some years whilst resident in New South Wales was Secretary of the Section and later Chairman). Among the visitors welcomed during the year were Mrs. Hare (Canada), Mr. Laval (England), Dr. Brerton (New England University), Mr. David Condon (United Kingdom Office of Information), Dr. David Griffin (Cambridge University), Mr. and

Mrs. Ward (New Zealand), Mr. Payne (England), Mr. Rod Suthers (America), Mr. Jones (British Museum), Mr. L. Amiet (Queensland) and Messrs. Roy Cooper and David Nicholls (Victoria).

Notable progress in conservation was apparent during the year in the declaration of three new Faunal Reserves, which are under the control of the Fauna Protection Panel. These are the Barren Grounds Faunal Reserve No. 3 (3,600 acres), an elevated heathland plateau in the vicinity of Jamberoo, frequented by such interesting and rare species as the Ground Parrot (*Pezoporus wallicus*) and Eastern Bristle-bird (*Dasyornis brachypterus*); Gurumbi Faunal Reserve No. 4 (375 acres) adjacent to St. George's Basin; and Lion Island Faunal Reserve No. 5 (22 acres) at the mouth of the Hawkesbury River, the breeding place of two species of shearwaters (*Puffinus*) and the Little Penguin (*Eudyptula minor*). In addition an area of 10,240 acres of chiefly mallee country was reserved from sale in September 1955 (No. 77764) for "the preservation of native fauna (Mallee Fowl)" in the Eubalong-Hillston area; also an area of 8,700 acres on the Budderoo Plateau, adjoining the Barren Grounds Faunal Reserve, "reserved from sale for the preservation of flora and fauna" (No. 78178). At the request of various interested organisations a Conservation Conference, arranged and convened by Mr. F. J. Griffiths, Chief Guardian of Fauna, was held on July 2 and continued on November 5, to deal with (a) National Parks and Faunal Reserves, (b) Military Use of National Parks and (c) Ban on the Sale of Wild Flowers.

SECTION OFFICERS FOR THE YEAR 1956-1957

Chairman: Mr. E. J. Gadsden.
Vice-Chairman: Dr. J. A. Keast.
Secretary: Mr. A. R. McGill.
Assistant-Secretary: Mr. F. G. Johnston.
Committee: Messrs. N. Chaffer, A. H. Chisholm, N. C. Fearnley, G. R. Gannon, K. A. Hindwood, W. R. Moore, J. A. Palmer and J. D. Waterhouse.

ARNOLD R. McGILL,
Hon. Secretary.

ORNITHOLOGICAL FIELD REPORT FOR 1955-1956

The year in New South Wales was notable because of almost unprecedented rainfall, not only in many coastal areas but throughout most of the ofttimes dry western parts of the State. At times serious flooding occurred and thus bush-fire risk generally was at a minimum. Because of such favourable conditions, inland water-frequenting birds were noticeably rare in localities near Sydney. Ibises, spoonbills, herons, egrets, ducks and cormorants occurred in much fewer numbers than usual and some species which are normally present appeared to be entirely absent. It was surprising to find the usually large concentrations of cormorants reduced to single birds or small scattered flocks. The Jabiru (*Xenorhynchus asiaticus*) was observed on a few occasions at the Hawkesbury swamps and records were made of the Lotus-bird (*Irediparra gallinacea*), now unfortunately very rare in its haunts near Sydney.

Beach-mortality of sea-birds was meagre compared with that of the previous twelve months. An exception was the Great-winged Petrel (*Pterodroma macroptera*), a species which is only rarely washed up on local beaches. Specimens were found on Cronulla beach and on beaches near Wollongong and there were two instances of stranded birds being found alive—one in Hyde Park, Sydney (by a Council employee), and another in a backyard of a house at West Chatswood and examined by K. A. Hindwood. The most interesting derelict to come ashore was a specimen of the Westland Petrel (*Procellaria*

westlandica), which was found by J. D. Gibson and A. Sefton on Woonona beach. It is the only known specimen to be known to have occurred in Australian waters and this is the first occasion the species has been recorded outside the New Zealand region. On Currarong beach, near Nowra, a fresh specimen of the Brown-headed Petrel (*Pterodroma melanopus*) was found by Gibson and preserved as a study skin. There are only a few records of beach-washed Gould Petrels (*Pterodroma leucoptera*) so a further specimen from Woonona beach (Gibson and Sefton) is of interest. Albatrosses and the Giant Petrel (*Macronectes giganteus*) occurred in good numbers again during the winter and spring at the Malabar sewer outfall, and observations were made, and photographs secured at sea off Bellambi Point, on the feeding habits of the Wandering Albatross (*Diomedea exulans*) and Black-browed Albatrosses (*D. melanophris*) by small parties of observers. The Five Islands also were visited and the nesting habits of the Wedge-tailed Shearwater (*Puffinus pacificus*), White-faced Storm-Petrel (*Pelagodroma marina*), Little Penguin (*Eudyptula minor*), Silver Gull (*Larus novaehollandiae*) and Crested Tern (*Sterna bergii*) were studied.

Occurrences of tropic-birds in coastal New South Wales are rare, but during the twelve months under review there were five records. A White-tailed Tropic-bird (*Phaethon lepturus*) was picked up on Cronulla beach in March (Hindwood, McGill and Wheeler) and a short time previously one was found alive by a passing motorist alongside a road at Bulladelah. The Red-tailed Tropic-bird (*P. rubricaudus*) was seen in flight over the Five Islands (Gibson and Sefton), and one, with clipped wings, was taken from the water at Circular Quay (G. Marshall), the first definite record of the species for the County of Cumberland. Shortly afterwards another was seen in flight at Manly (D. Condon). Many Silver Gulls and Crested Terns were banded on their breeding grounds at the Five Islands and on Montague Island. During the summer and autumn many banded birds were seen and recorded in the Sydney area and various interesting observations were also made at other coastal areas. Some bands returned were from beach derelicts. A most unexpected recovery of a Silver Gull was made near Menindie, on the Darling River, of a bird ringed as a fledgling at Altona, southern Victoria. Wedge-tailed Shearwaters and White-faced Storm-Petrels were also banded at the Five Islands.

Generally migratory waders did not appear in their usual numbers near Sydney. However, the Great Knot (*Calidris tenuirostris*), Broad-billed Sandpiper (*Limicola falcinellus*) and Grey Plover (*Squatarola squatarola*), all rare locally, were observed. On Lake Illawarra tidal-flats the Great Knot, Greenshank (*Tringa nebularia*) and Black-tailed Godwit (*Limosa limosa*) were seen (Gibson and Sefton). The Sooty Oyster-catcher (*Haematopus fuliginosus*) and Pied Oyster-catcher (*H. ostralegus*) were both recorded at Boat Harbour (individual birds), the former for the second known time at that locality and the latter for the first time near Sydney for over 50 years.

The Little Eagle (*Hieraaetus morphnoides*) and three Wedge-tailed Eagles (*Aquila audax*) were observed at Pennant Hills (N. Fearnley). The Crested Hawk (*Aviceda subcristata*) was recorded in the Royal National Park (Fearnley and Salmon), the second known observation of the species for the County. The Raven (*Corvus coronoides*) nested in the Botanic Gardens and three species of Lorikeets—the Scaly-breasted (*Trichoglossus chlorolepidotus*), Rainbow (*T. moluccanus*) and Musk (*Glossopsitta concinna*) were noted feeding on flowering trees at the same locality (E. S. Hoskin). There were some excellent breeding records in the Sydney district, including those of species rarely recorded or not previously known. Eggs examined in a typical sparrow-like nest at Pennant Hills proved to be

those of the Tree Sparrow (*Passer montanus*) although the birds were not seen (N. Fearnley); a nest containing five eggs of the Lewin Water-rail (*Rallus pactoralis*) was located at Dee Why in January (Mrs. V. Rothwell) but the birds proved exceptionally shy; the Little Cuckoo-Shrike (*Coracina robusta*) again nested in a favoured area at Lane Cove (S. G. Lane); a pair of White-eyed Ducks (*Aythya australis*) was found accompanied by seven young, a few days old, at Centennial Park (A. R. McGill); a Brown Quail (*Coturnix australis*) was observed closely as it crossed a road, followed by seven chicks, at Malabar (J. Hobbs); a pair of Grey Goshawks (*Accipiter novaehollandiae*) nested at Engadine Creek (F. G. Johnston); a Collared Sparrowhawk (*Accipiter cirrocephalus*) was found occupying an old nest of a Raven at South-west Arm (A. Brinsley); and three nests of the Pilot-bird (*Pycnoptilus floccosus*) were located during the season in the Royal National Park (Brinsley). Other local records during the year included a number of observations at Botany Bay and Maroubra of the Southern Black-backed Gull (*Larus dominicanus*); a Powerful Owl (*Ninox strenua*) at Pennant Hills (Fearnley) which proved elusive in the thick timber but a dropped feather was later identified at the Australian Museum; a female Blackbird (*Turdus merula*) picked up dead at Vaucluse and forwarded to the Museum, and a pair of Cockatiels (*Leptolophus hollandicus*) at Gymea (J. Francis).

At McMaster's Beach two Oriental Cuckoos (*Cuculus saturatus*) were seen by Captain Hutcheson. An immature Purple-crowned Pigeon (*Ptilinopus superbus*) was killed by lads at Ulladulla and afterwards given to Mr. C. Humphries and eventually made into a study skin by Mr. L. Haines. Mr. Francis observed a pair of Grey Goshawks at Forbes, which locality must be near the western limits of its range. First indication that some immature birds of the Short-tailed Shearwater (*Puffinus tenuirostris*) move up the New South Wales coast on their northern migration was secured in the Bulli area during April by Messrs. Gibson and Sefton. A trip to Lion Island was made by Messrs. McGill and F. Hersey (Fauna Ranger) in April but the indications were that few shearwaters were nesting. The Gould League held an enjoyable Camp-out in the Lake Cargelligo area where observations on such species as the Mallee Fowl (*Leipoa ocellata*) and Pink Cockatoo (*Kakatoe leadbeateri*) caused interest.

Various trips to country areas were undertaken by members. Messrs. Brinsley and Johnston went north-west, but continued rain made progress on the roads beyond Coonamble impossible and observations were mainly limited to that locality where the Little Cuckoo-Shrike was nesting and the Plumed Tree-Duck (*Dendrocygna eytoni*) and Spotted Harrier (*Circus assimilis*) were observed, as well as greater numbers of the Southern Stone-Curlew (*Burhinus magnirostris*) than had been expected. Mr McNamara journeyed to the MacPherson Range and successfully photographed the Olive Whistler (*Pachycephala olivacea*) and Noisy Pitta (*Pitta versicolor*) on the Queensland side of the border. Mr. Hoskin visited the Upper Hunter and secured an interesting list of many species. Messrs. Hindwood, Humphries and Sharland made a trip through the Upper Hunter where observations were made on the Rock Warbler (*Origma solitaria*); then to the Tenterfield area where the Black-throated Finch (*Poephila cincta*) was seen. Mr. M. Goddard had the species building in the area during the past two years (the first time the bird had been known to occur in New South Wales for about 100 years), and about 60 miles west of Tenterfield. Goddard also found the Squatter Pigeon (*Geophaps scripta*) nesting. Messrs. Hindwood, Humphries and Sharland then drove to the coast and camped near the mouth of the Clarence River. There the Mangrove Honeyeater (*Meliphaga fasciogularis*) was found

nesting, the first definite evidence that the species occurred in New South Wales, the Crested Hawk had a nest with young immediately above the camp, the Cattle Egret (*Bubulcus ibis*) was seen in the Ulmarra swamps and one nest was examined, and nests of the Jabiru were seen on two occasions. A. R. McGill paid a visit to the Manning River district in December and among a good list of birds recorded were the Crested Hawk at Kolodong, Bar-shouldered Dove (*Geopelia humeralis*) at Harrington and a few Mangrove Warblers (*Gerygone cantator*) in mangroves at the mouth of the Manning River, this locality being the farthest south the species has yet been recorded.

Some excellent field work during the year in the south-western part of New South Wales was carried out by Constable J. Hobbs, of Finley. Messrs. Lane and McGill journeyed to that area in October and were joined by Hobbs for ten days, finishing the trip with two days in the mallee between Rankin Springs and Griffith. Six days were spent on Bundyulumblah Station as the guest of Mr. Bernie Keays, a keen bird observer. At Moonee Swamp (between Finley and Deniliquin) a number of occupied nests of the Marsh Tern (*Chlidonias hybrida*) was examined; the Black-tailed Native-hen (*Tribonyx ventralis*) was common and nesting in many of the nitre-bushes spread commonly in the flooded area; a party of six Blue-winged Parrots (*Neophema chrysostoma*) was closely observed whilst feeding on the buds of the nitre-bush (or blue-bush); a fine view was obtained of a pair of Painted Snipe (*Rostratula benghalensis*); a nest of the Blue-winged Shoveler (*Anas rhynchotis*) was found placed in low herbage above the water-line and contained eleven eggs; Red-kneed Dotterels (*Erythrogonys cinctus*) and Avocets (*Recurvirostra novaehollandiae*) had young hidden in the grass and gave fine exhibitions of the 'broken-wing' act; and young of the White-headed Stilt (*Himantopus himantopus*) were nearly as large as the parents. On "Bundy" Station the Orange Chat (*Epthianura crocea*) and Australian Dotterel (*Peltohyas australis*) were seen, and the White-winged Wren (*Malurus leuconotus*), Little Quail (*Turnix velox*), Tawny Frogmouth (*Podargus strigoides*), Pied Butcher-bird (*Cracticus nigrogularis*), Rufous Songlark (*Cinclorhamphus mathewsi*) and Ground Cuckoo-Shrike (*Pteropodocys maxima*) were among a large number of birds found nesting there. At Black Swamp the Pink-eared Duck (*Malacorhynchus membranaceus*) and Chestnut Teal (*Anas castanea*) were breeding (the former with eggs and the latter with young) and at nearby Wanganella an immense rookery of the Straw-necked Ibis (*Threskiornis spinicollis*) was located. It comprised many thousands of nests, with eggs and young, together with young of the White Ibis (*T. molucca*) in many nearby nests. The Glossy Ibis (*Plegadis falcinellus*), Brolga (*Grus rubicunda*) and Blue-billed Duck (*Oxyura australis*) were seen in the vicinity and a nest with five eggs of the Musk Duck (*Biziura lobata*) and a nest containing one young of the Little Crow (*Corvus bennetti*) were also examined.

In the mallee bird-life was interesting and the dawn chorus a real thrill. Three nesting mounds of the Mallee Fowl were found and the bird heard calling, a nest with three eggs of the Gilbert Whistler (*Pachycephala inornata*) was located in a low bush (two eggs when found and three when it was photographed a few hours later), and a nest with one young of the Southern Scrub-Robin (*Drymodes brunneopygia*) was seen. The Shy Heath-Wren (*Hylacola cauta*), Chestnut Quail-Thrush (*Cinclosoma castanotum*) and Red-tailed Thornbill (*Acanthiza albiventris*) were fairly common and the Spotted Nightjar (*Eurostopodus guttatus*) was heard calling at night.

Mr. Hobbs has also recorded the Corella (*Kakatoe tenuirostris*) as a breeding bird in a few favoured places near Deniliquin, although nothing appears to have been published on the occurrence of this

species in the State for 50 years. Two further species recorded during the year appear to have not been previously observed in New South Wales—the Dusky (or Black-eared) Miner (*Myzantha melanotis*), which was found near Euston, and the Cape Barren Goose (*Cereopsis novaehollandiae*), which has been reported on sound evidence near Deniliquin during a period of heavy flooding. Among other species observed in the south-west by Hobbs may be mentioned the Grey Falcon (*Falco hypoleucos*), Australian Pratincole (*Glareola isabella*), Redthroat (*Pyrrholaemus brunneus*), Ground Thrush (*Zoothera lunulata*), Masked Owl (*Tyto novaehollandiae*), Plumed Tree-Duck, Freckled Duck (*Stictonetta naevosa*), White-fronted Honeyeater (*Gliciphila albifrons*), Little Bittern (*Ixobrychus minutus*), Gull-billed Tern (*Gelochelidon nilotica*), Black-winged Currawong (*Strepera melanoptera*), Black-capped Sittella (*Neositta pileata*) and Spotted Crake (*Porzana fluminea*). A nest and three eggs of the last-mentioned species were located. On Bundyulumblah, after good rains when most of the salt-bush plain was inundated, a party of 36 Double-banded Dotterels (*Charadrius bicinctus*) was observed during May (a few being in breeding plumage)—a bird rarely recorded away from the coast; also a huge flock of Chestnut-breasted Shelduck (*Casarca tadornoides*) numbering over 1,500 birds

At Rand, in the eastern part of the Riverina, P. A. Bourke recorded a number of unusual visitors, such as the Australian Pratincole, Orange Chat and Marsh Tern. The last-mentioned species bred in good numbers, and nesting observations were also made on the Brolga and Little Crake (*Porzana pusilla*).

ARNOLD R. McGILL.

SYLLABUS OF SECTIONAL MEETINGS FOR 1956-57

Visitors are welcome and members are invited to bring their friends to any of the Society's meetings.

Avicultural Section.

Meets on the fourth Tuesday of each month. Lectures, films, etc.

Budgerigar Section.

Meets on the third Tuesday of each month. Exhibits, discussions.

General Section.

Meets on the second Tuesday of each month. Lectures, Exhibits and practical work in preparing handbooks.

Marine Zoological Section.

Meets on the first Tuesday of each month. Lectures, etc.

Junior Members' Study Group.

Meets on the second Thursday of each month at 7 p.m.
Demonstrations, exhibits, discussions, etc. for those aged 16 or under.

Conchology Study Group.

Meets on the second Thursday of each month at 7.30 p.m.

Ornithological Section.

Meetings, to which Members of the Royal Australasian Ornithologists' Union are invited to be present, are held at 7.45 p.m. on the third Thursday of each month. Syllabus:

1956—

July 19: "Photography in Rain-forests," by Ellis McNamara.
August 16: Film Evening, by David Condon.
September 20: "Life in the Takahe Country, New Zealand," by Boughan Wisely.
October 18: "Bird Migration in Europe," by Dr. David Griffen.
November 15: Expeditions Night.
December 20: "Habitat, Nomadism and Nesting Seasons," by Dr. Allen Keast.

1957—

January 17: "The Birds of New Guinea," by Tom Iredale.
February 21: Film Evening, by Norman Chaffer.
March 21: Members' Night.
Members are invited to bring along Kodachromes for projection; photographs, etc., for exhibition, and ornithological problems for discussion.
April 18: "Breeding Activities of Petrels on the Offshore Islands of New Zealand," by Dr. W. Dawbin.
May 16: The Bird Year About Sydney. Discussion, led by A. R. McGill.
June 20: Annual Meeting, Election of Officers, and Chairman's Address.

A Field Survey of a Koala Population

By J. McNally

Research Officer, Fisheries & Game Department, Victoria.

1. SUMMARY.

This paper concerns the survey of a small (800-1000) population of Koalas, *Phascolarctos cinereus* Goldfuss, confined on French Island, Victoria. Koalas were introduced on to the island fifty to sixty years ago and the number had increased to such a degree that the supply of food trees was diminishing rapidly. It therefore became necessary to move the bulk of the population to suitable localities on the mainland, to save the animals from starvation and possibly the ultimate death of large numbers. In the course of capture and removal, observations were made on general condition, weights, sexes and breeding condition. These are the first recorded ecological observations of a koala population of significant size in Victoria.

2. HABITAT.

The Koalas were located on French Island, which is the largest of a group of islands in Western Port Bay in southern Victoria. The area is 41,300 acres. The only available means of transport with the mainland is by boat. French Island is sparsely populated and has few made roads. Settlers numbering less than 100 are on farms scattered over the island. Tankerton in the south-west and Fairhaven on the west coast are the only towns. The McLeod Training Centre, a penal establishment, is located on the south-east coast.

The vegetation is typical of other similar coastal islands. The eastern end is comparatively open. The centre and western portion is covered with low scrub and associations of eucalypts, including Swamp Gum, *E. ovata*, Messmate, *E. obliqua*, Peppermint, *E. radiata*, Mahogany, *E. botryoides*, and Manna Gum, *E. viminalis*. Ti-tree and bracken scrub is thick on the coast, where pure stands of the stunted coastal Manna Gum *E. viminalis* var. *racemosa*, are also found. The best of these are along the west and south coasts.

Scrub fires are frequent on the island and large burned-out areas were seen on the eastern end. Considerable clearing of scrub and trees has been carried out around farms, but some settlers have retained stands of Manna Gums near the homesteads for shelter.

Koalas are not native to French Island. Information obtained from available records and enquiries indicates that koalas were introduced onto the island early in the twentieth century from Corinella on the mainland. The reason for introduction was apparently to have the animals as a novelty. Precise information on the numbers liberated in the first instance is not available, but the koalas apparently found the new environment suitable and increased considerably in the course of time. One report gives an estimate of 5000 approximately 30 years ago. The same informant states that a settler counted 2,300 animals between Red Bill Creek and Tankerton, a distance of approximately 5 miles on the west coast. Whether these figures are accurate or not, information from a number of sources, mainly early settlers or their

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Plate 1.

A gum tree (*Eucalyptus viminalis*) on French Island, Victoria, showing progressive defoliation by koalas, 5th September, 1954. Six months later the defoliation was almost complete.

Plate 1.

relatives, indicates that the population reached a high level and was subject to fluctuations over the years in accordance with the availability of suitable food trees. Feeding was concentrated on the Manna Gum, *Eucalyptus viminalis*, and whole areas of the island are reported to have been cleared of manna gums which as a result of intensive feeding, became defoliated and died.

Where a large population of koalas is confined on an island it is essential that a balance be maintained between the numbers of animals and the numbers of available food trees, which their highly specialised diet demands. When this balance is upset by a continued increase in the number of koalas and a check in growth of the trees, due to bad seasons or other reasons, then the koalas begin gradually to eliminate the trees. The result is the death by starvation of large numbers of koalas as they cannot escape from the island or live on other available vegetation.

Mass mortality of koalas has occurred on at least one occasion on French Island. The few survivors which formed the beginning of the present population, were so small in number that a proportion of the trees which had been attacked was able to recover and the balance was restored.

The habitat on this island was so suitable that in recent years koalas were removed at intervals by the Government and used to establish the species or supplement existing colonies on other islands in Western Port Bay and elsewhere. Amongst these were Phillip Island, Quail Island, Chinaman Island and Snake Island. All such islands which have been stocked require frequent inspection to ensure that the supply of food-trees continues to be adequate to feed the increasing population. When the numbers of koalas become too high, the surplus must be removed to enable the remainder to survive. These surpluses are liberated at selected areas on the mainland which previously carried koalas and it is expected that this will ultimately result in the partial re-establishment of the koala in Victoria.

3. PRESENT DISTRIBUTION OF KOALAS ON FRENCH ISLAND.

An inspection of the island made between 14-17 April 1954 showed that koalas were scattered throughout the island, but the main concentrations were in the stands of manna gum along the west coast to the north of Tankerton. Small numbers were also found on parts of the north and south coasts.

Individual koalas were found in the small stands of manna gum around farms. Settlers stated that they had known koalas to remain in the trees around the homestead until they had defoliated and killed them. The koalas then moved on to other feeding areas. On the result of this inspection and information supplied by settlers, the total population of koalas on the island was estimated at between 800 and 1,000.

It was clear that the manna gums, particularly on the coast, were again suffering severe defoliation caused by excessive feeding by koalas, and that if no action were taken, the koalas would before long deprive themselves of food-supply and die. Burned carcasses found in patches of burned-out scrub also indicated that the fire risk on the island was a danger to the animals.

In view of the circumstances, it was decided to remove the majority of the koala population from the island. This operation was commenced on 17 August 1954 and continued with intervals until 11th

PLATE 2.

A female koala in a resting attitude, "nursing" two young. This is the female parent and twins (?) referred to in the text.

Plate 2.

October, 1954. The animals were caught by a team of men using poles, ropes and catching-sheets and were crated for transport. The crates were shipped to Hastings, an adjacent town on the mainland, and carried by vehicle to previously selected areas, having an abundant supply of *E. viminalis*, and liberated. Liberation sites and the numbers liberated at each are given in Table 1.

TABLE 1.

DETAILS OF LIBERATIONS.

Locality	Males	Females	Juveniles	Remarks
Mt. Cole State Forest	52	70	39	Situated near Ararat. Liberations made near Mt. Lonach.
Stony Rises	193	208	132	Liberations made at various points between Pirron Yallock and Camperdown.
Totals	245	278	171	Grand Total, 694

The great majority of the animals collected were in excellent condition. No symptoms of disease were noted and pelages appeared very healthy. A small proportion showed signs of deterioration with age. Two animals which had had their fur partially burned in recent fires were noted.

4. COMPOSITION OF POPULATION.

The sample probably represents at least 70-80 per cent of the total population on the island. A careful search of the whole island was made for koalas over a long period and all animals found were captured and removed. A proportion escaped capture however by moving at night into areas previously examined or into the dense scrub and swampy areas. This was later established by an inspection on 1 March 1955, when groups of koalas were seen in areas which had been cleared earlier.

The total sample of 694 animals consisted of 245 males, 278 females and 171 dependent juveniles. The total of the females exceeded the males by 33.

The proportion of parous females was 61.5 per cent of the total females and 72.5 per cent of the adult females. Of the 171 juveniles, 53 were in the pouches and 118 carried on the backs of the females. A small proportion (4) of the pouched young were seen to leave the pouch and return.

The 53 pouched young were not sexed. 116 of those on the back were sexed and showed 56 males and 60 females. One female carried two juveniles of approximately the same age. These were of opposite sex and may have been twins, which are rare in koalas, but it is also possible that the female may have adopted an abandoned juvenile in addition to its own offspring. Koalas are believed to do this occasionally.

5. BODY WEIGHTS OF KOALAS.

All adult koalas were weighed to the nearest quarter of a lb., and the sex and condition recorded. Table 2 shows the distribution of weights by classes of 2 lb. difference. The weight-range for the whole sample is from 7 to 32 lb. This does not include the dependent

PLATE 3.

A juvenile koala re-entering the pouch after having been removed.

Plate 3.

juveniles, i.e. those carried on the back or in the pouch. Where females were carrying young in the pouch, the weight recorded is that of the parent and offspring.

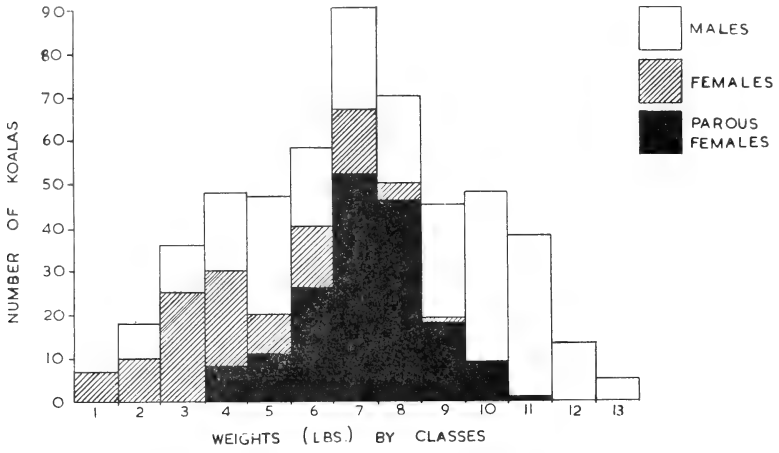

Figure 1.—The distribution of body-weights of a sample of 523 koalas by classes of 2 lb. difference in a weight-range of 7-32 lb.

TABLE 2.

THE WEIGHTS OF 523 KOALAS BY CLASSES OF 2 LB. DIFFERENCE IN A WEIGHT RANGE OF 7-32 LB.

NUMBERS OF KOALAS IN EACH CLASS.

Class	Weight Range	Total Sample	Males	All Females	Parous Females
	lb.	523	245	278	171
1.	7-8	7	—	7	—
2.	9-10	18	8	10	—
3.	11-12	36	11	25	—
4.	13-14	48	18	30	8
5.	15-16	47	27	20	11
6.	17-18	58	18	40	26
7.	19-20	90	23	67	52
8.	21-22	70	20	50	46
9.	23-24	45	26	19	18
10.	25-26	48	39	9	9
11.	27-28	38	37	1	1
12.	29-30	13	13	—	—
13.	31-32	5	5	—	—

These figures show that on the average, the males are heavier than the females. The weight range for the males is from 9 to 32 lb., the average weight being 21 lb. The range for females is from 7 to 28 lb., the average being 17.5 lb. The weight-range for the parous females is from 13 to 28 lb., the average weight being 20 lb. All ten females at the upper limit of the weight-range (25-28 lb.) were parous. This may indicate that the females remain fertile throughout their life-span after reaching maturity, but it must be stated that no senile females were collected.

TABLE 3.

WEIGHTS OF PARENTS AND OFFSPRING.

Males		Females	
Parent	Offspring	Parent	Offspring
20 lb.	2 lb.	21 lb.	2 lb.
20 lb.	1 lb.	21 lb.	2 lb.
24 lb. 4 oz.	(twins?) 2 lb. 4 oz.	—	1 lb. 12 oz.
19 lb.	1 lb. 10 oz.	21 lb.	12 oz.

The weights recorded in Table 3 were those of young taken from the backs of females with the exception of the 12 oz. juvenile which was removed from the pouch. Plate 3 shows a juvenile in the process of re-entering the downward opening pouch.

6. AGING ON THE BASIS OF WEIGHTS.

It is possible by comparing the weights of captive animals with those captured in the native state, to sort the population into approximate age-groups. The parent and twin (?) offspring mentioned above, were placed in the Melbourne Zoological Gardens for observations after capture. The male twin subsequently died, but a record of progressive weights has been made for the female from 24 August 1954 to 24 February 1956, the date of the last weighing.

The probable age of the animal when first weighed was eight months and the weight 1 lb. 12 oz. On 24 February 1956, at the estimated age of twenty-six months, it weighed 12 lb. 15 oz., a gain of 11 lb. 3 oz. over a period of eighteen months. The monthly weights indicate that the growth continued without setbacks. This growth-rate can only give an indication of what might be expected in the native state. All captive animals are hand-fed with selected eucalypt leaves, and it is not possible to say with any certainty, whether the growth-rate in captivity is likely to be greater or less than in the native state.

No parous females observed weighed less than 13 lb. The weights of the captive female given above show that it would reach this weight in the third year of growth. It may be assumed therefore that a proportion of juvenile females reaches maturity at the age of three years.

Competence to reproduce is an obvious indication of maturity in females, but no criterion was applied to the males. It was not possible under the circumstances to make tests of sperm motility on the live animals and even had these been made, the time of the year may have rendered the results uselss in determining maturity.

Some information is available from captive males. A male in its fifth year of growth weighed 17 lb. 6 oz. on 30 May 1954. On 30 January 1956, when nearly six years old, it weighed 19 lb. 8 oz.—a gain of only 2 lb. 2 oz. in nearly two years. The animal appears quite healthy, so that the rapid growth as shown by the juvenile female above, settles down to a much slower rate after the first three years of life.

Captive males are used for breeding purposes in the Lone Pine Sanctuary, Brisbane, when four years old. It is likely therefore that the males mature in the native state in the third or fourth year of growth. In view of the greater weight of the males, it is probable that the weight on reaching maturity is higher than the 13 lb. shown by the females.

7. THE EXTENT OF THE BREEDING SEASON.

The amount of published information on the breeding season and reproduction generally of the koala is small. Those observations

which have been recorded were made on koalas in captivity or on relatively small numbers in the native state.

Asdell (1946) quotes Semon for the statement that the koala is monoestrous annually at the end of October and that the males rut at the same time. A summary of other opinions indicates that the mating period may extend from September to late January in New South Wales and from November to February in Victoria, where the majority of koalas breed in the late spring and summer months.

Troughton (1951) quotes Burnett for the following figures on the reproduction of the koala.

Mating period—early September to late January.
Breed as a rule every second year.
Gestation period—about 35 days.
At birth the length is about $\frac{3}{4}$ in. and the weight about $5\frac{1}{2}$ gr.
First emerges at 6 months—well furred and about 7 in. long.
Uses pouch for about two more months.
Carried by mother until 1 year old.
Fully developed at 4 years and can live for 20 years.

Presumably Burnett bases his contention that the koala normally breeds every second year on the assumption that a female carrying a juvenile in its pouch or on its back would be unlikely to copulate while in that condition. There does not appear to be any obvious anatomical or physiological reason why the koala should not breed every year. If it is monoestrous and monovular and ovulates regularly each season, then the presence of a dependent juvenile would not necessarily prevent mating taking place. The koala is considered by some workers to be ancestrally related to the Ring-tailed Possum *Pseudocheirus laniginosus* and this animal ovulates regularly at least once per year.

It is possible, however, that some physiological mechanism exists which suppresses ovulation in females with dependent young. The koala may present a further example of the delayed pregnancy which some marsupials have been shown to exhibit. The most recent work on this mechanism is that of Sharman (1955) who showed that in the case of the Quokka, *Setonix brachyurus*, if fertilisation takes place while the female is carrying a suckling foetus in the pouch, the resulting embryo remains as a small unimplanted blastocyst for up to five months.

Enquiries made to Mr. A. K. Minchin of Koala Farm, South Australia, and Mr. C. A. M. Reid of the Lone Pine Sanctuary, Brisbane, both of whom have had long experience with breeding koalas in captivity, indicated that the female koala can reproduce once each year. It appears however that a koala which carries its offspring until late in the year may not reproduce until late in the following breeding season. The reproductive period can therefore cover some months each year for the whole population. Apart from Burnett, other observers agree that the koala normally produces one young each year.

Burnett's figure of eight months in the pouch is rather higher than that given from other sources. A total period in the pouch of 5-6 months, the young leaving the pouch and returning after 3-4 months, seems more normal. After finally leaving the pouch, the young koala is carried on the female's back until approximately one year old, when it is capable of leading a free existence.

On the basis of these figures the 53 pouched young of the present sample were not more than six months old and the 118 young on the back were not more than one year old. In the extreme cases therefore the pouched young would have been born in the previous February and those on the back in the previous September. Young in both

conditions were encountered throughout the collecting period. The breeding period in the native state may therefore cover the spring and summer months, with some late and early occurrences.

8. DISCUSSION.

Discussion must necessarily be brief, since no comparable field data to those presented here are available. However, the question of age-determination on live animals and sorting of the population into age-groups is worth considering. Owing to the rigid protection and comparatively restricted distribution of the koala, it is not possible to obtain sufficient dead specimens for laboratory examinations to apply some of the more usual criteria. The removal of surplus populations from island reserves occasionally provides the opportunity of making limited observations on the live animals as in this instance. The only criterion of age applied has been that of body-weight. Assuming that body-weight is an indication of age, it serves to separate juveniles from mature animals. It also follows that the heaviest animals are probably the oldest. It has been stated that the koala may live to 20 years, presumably in captivity, and weight does not appear to be an adequate criterion for sorting the intermediate age groups, without consideration of some other factor or factors at the same time.

It is desirable that further data be collected on the age-grouping and reproductive processes of koalas. Two koala reserves have been established in Victoria at Creswick and Castlemaine. In these the koalas are in the native state on substantial areas of manna gums which are enclosed within a koala-proof fence. Much useful information could be gained by marking these animals with ear tags or by other means and making regular observations on their movements and habits.

9. ACKNOWLEDGMENTS.

The author desires to thank the Zoological Board of Victoria for accommodating, and recording the weights of the juvenile female koala mentioned in the text and for making available the records of other koala weights taken by the Zoological Gardens staff. The help of all who provided information on the koalas of French Island and on animals reared in captivity is also gratefully acknowledged.

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Teaching Zoology

II. Introducing Students to Field Work

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(i) SOME VALUES OF FIELD STUDIES.

Australian Universities are becoming increasingly interested in field aspects of Zoology (see Waring, 1953, Guiler, 1954 and Meyer, 1956); and with the introduction of the new N.S.W. Leaving Certificate syllabus in Biology (New South Wales Department of Education, 1954) field studies are playing a more important role in secondary education (Meyer, 1955a).

Teaching field work is one of the most exciting and stimulating duties of any trained teacher of biology.

Field studies give students opportunities to appreciate the diversity and beauty of animal life while providing basic training in techniques for the study of ecology and behaviour. In the laboratory or the classroom students can only meet relatively few animals, and these in artificial settings, while in the field they may meet hundreds in their natural environments. Apart from these more obvious values, field work gives rich opportunities to enlarge on studies of anatomy, physiology and systematics begun in the classrooms.

Problems encountered in the field provide a challenge to further enquiry and cut across the 'text-book and formalin-bottle' attitude so prevalent in the past. The attitudes of students taken into the field for the first time illustrate this problem-solving approach.

For instance students may find caddis-fly larvae on the rocks at the foot of a small waterfall in a local creek. After some discussion they may then suggest that because of the severe conditions in that place caddis-flies could probably tolerate almost any conditions of water flow and that they could also be found in slowly flowing reedy pools.

They could then collect in these slowly flowing pools and in other parts of the creek and confirm that caddis-flies live in a number of different places. But the "houses" of the insects would be noticeably different in each place—the "house" among the stones in the waterfall would probably be a coiled tube of sand grains, a "house" further up on the face of the fall itself would be built of a triangular silken web and in the slowly flowing pools "houses" may be built of sticks or leaves.

The students may then conclude that while caddis-fly larvae are probably widely distributed in all parts of the creek, the "houses" in each kind of place are different and that these differences probably develop in response to the conditions in each place.

The students should then be ready to discuss further observations and investigations that would strengthen and extend the information. With some help from the group leader they should be able to discuss, for instance, the possibility of experiments to determine the efficiency of the web of *Hydropsyche* for capturing particles of food in streams of various velocities.

These students then, without being consciously aware of the process, would have followed step by step the classical procedure of the scientific method. They would have observed facts (*caddis-fly "houses" in waterfalls*) and built an hypothesis (*that caddis-fly larvae occur in all parts of a stream*). They would have tested this hypothesis

* Part I of this paper appeared in "The Australian Zoologist," XII, 2, 1955, p. 165.

(*by more collecting*) and modified it (*while caddis-flies occur in all types of places their "houses" are different and are adapted to local conditions*). Finally they would have designed experiments to test the modified hypothesis (*Hydropsyche's net varies in efficiency with the rate of flow of the water*).

(ii) A SUGGESTED PROGRAMME.

Beginners in Zoology, either at the secondary or tertiary level, should be given series of field excursions with connecting themes. One series for coastal schools and universities could be "Physiological and Ecological Problems Solved During the Evolution of Marine Animals invading the land via rock platforms and via estuaries, creeks and swamps." In this series a minimum of four excursions would be required—one to each place—a marine rock platform, an estuary, a creek and a swamp. Of course the series could be extended to include various types of each place and also areas of land. But in general large classes and limited time force universities to cut programmes to the minimum. Sydney University for instance is only able to manage excursions to the first three places in this series because of the enormous first year enrolment in Zoology. Secondary schools are usually more fortunate and can undertake more ambitious field programmes.

Other themes can form the basis of other excursion series and these will vary with the type of institution, the facilities available and the calibre and interests of the students.

(iii) EXCURSION PROCEDURE

Excursion procedure for beginners in the field, particularly where large classes are involved, requires careful planning.

As an example the steps involved in an excursion to a freshwater creek are outlined below. This is the method followed by the University of Sydney Zoology School to teach its large first year classes—over 100 students in each field group. Minor aspects would of course be modified for smaller classes or for other places.

Preparatory Teaching.

The excursions are designed as introductions to ecology and before each trip one or two preparatory lectures are given. After an account of the basic ideas of ecology the class is told, in one instance, something of the creek environment and of the plants and animals living there. Components of the environment which may influence the distribution and numbers of organisms are discussed briefly, and some of the adaptations to creek-life are mentioned. These lectures are illustrated by lantern slides which show some of the adaptations possessed by animals living in fast flowing water. Animals with strong clinging legs and claws, with streamlined bodies, with suckers on various parts of their bodies and animals which build protective "houses" and "nets" form a good series.

In these preliminary lectures the students are also instructed in the field problems and assignments that are to be begun on the excursion. These assignments give meaning and theme to the work and are designed to prevent excursions becoming mere outings.

Care is also taken to see that students understand the conservation laws and local regulations, if any, of the place to be visited.

The Excursion.

Organisation of field teaching for large classes requires close co-operation among members of the staff as it is desirable that there should be one teacher for each group of eight to ten students. The students are grouped before going into the field.

Each student brings one improvised dip net, a small camel hair brush for lifting small animals, a hand lens, field notebook, pencil

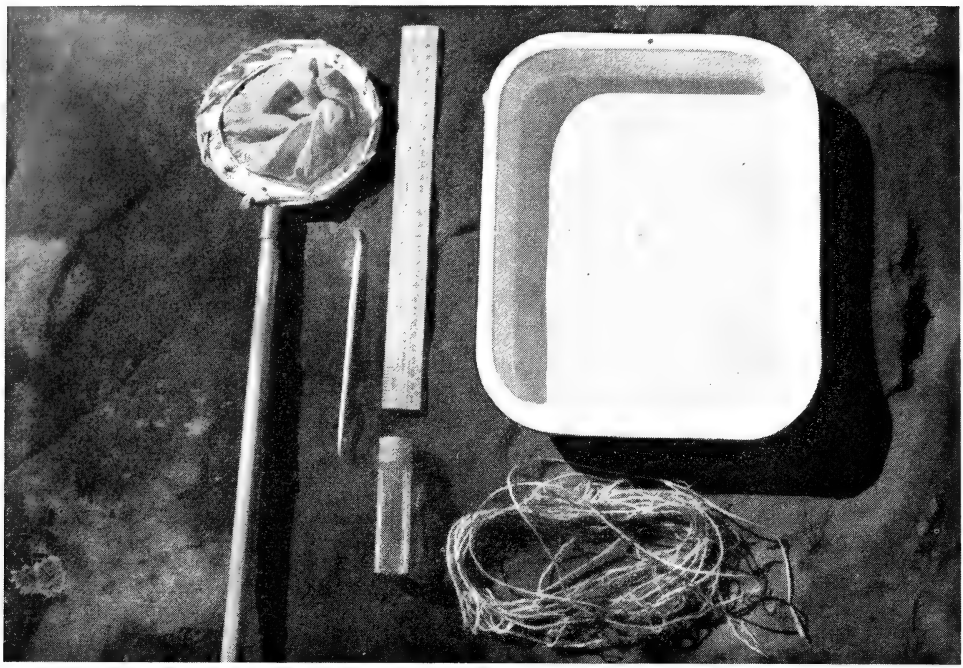

Figure 1. Some of the equipment needed on an excursion to a freshwater creek. The knotted string and the foot-rule are useful for plotting transects across the stream. In addition, students should have hand lenses, note-books and pencils and a field text-book.

(Photograph: E. Slater.)

and field text books. A length of string and a rule or measuring tape are also useful. (Fig. 1.)

Buses are hired to transport students from the University to the creek—McCarr's Creek in the Kuring-gai Chase near Sydney. McCarr's Creek is very suitable for this type of work because it presents varied types of environments such as still pools, small waterfalls, rocky and sandy beds and banks, and plant growth both in the stream and on the banks. Five stations are selected, each station illustraing some special feature of the creek environment, and white dishes, tubes and jars are left at each station.

The excursion itself falls into two parts.

First, each group leader takes his group of students to one of the stations. After about fifteen or twenty minutes of collecting and discussion (figs. 2 and 3) *all* groups move on until each group has

Figure 2. A group leader shows students how to use the dip-net to collect animals on the surface of a pool.

(Photograph: E. Slater.)

visited each station once. Specimens collected are left in the dishes, tubes and jars so that all groups may benefit from the material collected. To stress the need for conservation all private collecting is banned.

An hours' recess allows students to organise the results of the morning's work and to prepare for the assignments and problems set for the afternoon.

The second part of the excursion involves more individual work and less direct supervision than the first part. After careful instructions from group leaders each group moves off to complete the practical assignments. Teachers move from group to group as demonstrators giving help and advice where required but leaving as much as possible to the initiative and ingenuity of the students.

It has been found inadvisable to set more than two or three simple field problems, so that the students are able to cover these thoroughly rather than a large number superficially. The data assembled from the assignments are written directly into field note-books. Suitable problems include drawing a scale profile of the stream bed, marking in the locations of animals and plants, and work can be done towards completing a table summarising such information as the location, respiratory mechanisms, feeding habits and body form of the animals found in the creek.

These problems are completed after the conclusion of the excursions. More theoretical problems based on excursion data, such as building an hypothetical food web for the creek community and integrating the results with other excursion work wait for lecture-room analysis.

Follow-up Teaching.

As soon as possible after the excursion, laboratory and classroom teaching is given. This teaching helps the students with the more theoretical aspects of their assignments and helps them decide how far the original aims of the excursion have been fulfilled. Each student then discusses the results of his problems in a written field report. (Besley and Meyer, 1955.)

(iv) CONCLUSION.

No teacher who has taken a group of students into the field could continue biology teaching without featuring field excursions. Those secondary and tertiary teachers who have not attempted out-of-doors work have the most stimulating form of teaching still to come.

In Sydney University the attitudes of first year students to Zoology have undergone considerable change since the introduction of excursions in 1953. Before, when the course was limited to dissection and microscope work in the laboratory, most students considered the subject rather dull and academic. The second year classes were small (Meyer, 1955 b.). Now, and the new excursion work must claim a major role in the change, these students enjoy the course and the second year enrolment has considerably increased.

In the schools in New South Wales the trend is towards more and more secondary biology and here too pupils are more interested if the teacher uses the field approach.

In terms then of presenting factual knowledge and of building student interest and in more intangible terms such as fostering an appreciation of living things and a love of out-of-doors, the excursion method has few rivals. It should be an integral part of the programme of every biology teacher.

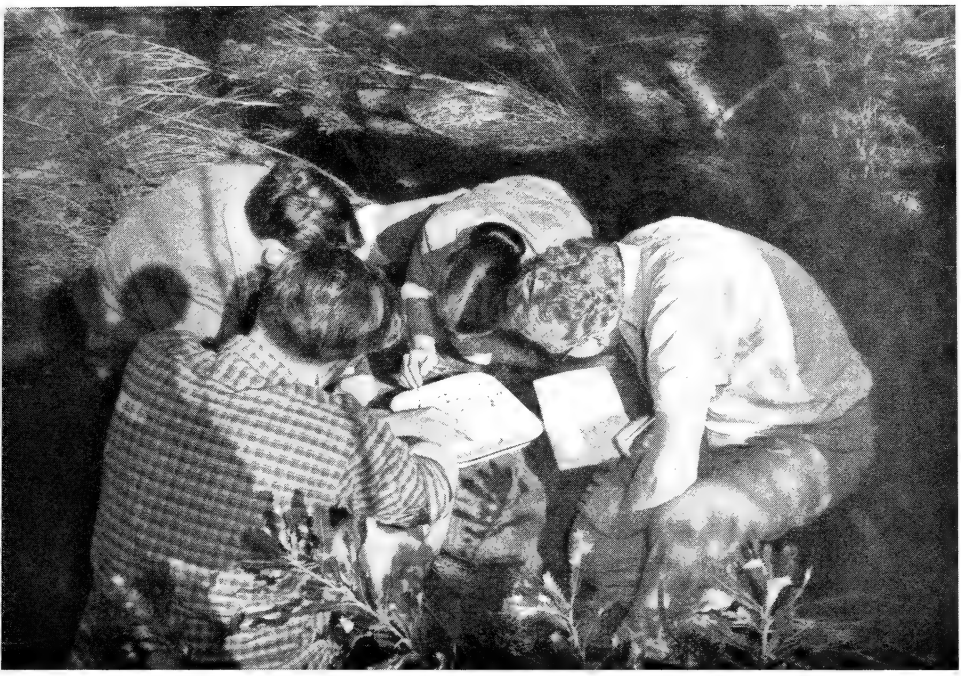

Figure 3. Examining the catch. Note that the shallow white dish provides a contrasting background for small animals which can be lifted out with a brush.

(Photograph: E. Slater.)

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The Main Principles of Diet and Nutrition for Aviary Birds

By Mrs. F. J. Blaxland.

Food includes taken everything into the body which either directly or indirectly enters into the growth or repair of tissues.

There are many substances which do not themselves build tissue or repair waste or even produce energy or activity, yet which are absolutely essential to the continued well-being of the body be it of man or bird.

I will briefly set out the essential elements of a scientific diet under eight main headings: Proteids, Carbohydrates, Hydro-carbons, Water, Nutritive "salts," Vegetable Acids, Fibre and Vitamins.

Proteids or Albumens are the nitrogenous elements of food.

From the study of physiology the protoplasm of the cells of which the body is composed can be built up or repaired only if sufficient proteids are available.

A deficiency of proteids quickly leads to a general impairment of functional activity, however, it is possible for birds as well as man to have an excess of nitrogenous foodstuffs which is liable to cause various metabolic troubles.

Carbohydrates consists for the most part of starches and sugar, but unlike the proteids contain no nitrogen at all and therefore are quite incapable of building a single cell of protoplasm.

They contribute to the maintenance of bodily heat, and the production of energy and, in addition, help to replace the fatty tissues.

Carbohydrates like the Proteids are found in varying quantities in the seeds of most plants.

Excess will usually show an increase in fat which will sooner or later lead to the impairment of the functions of the liver.

Hydrocarbons consist mainly of fats and oils, their work in the body is similar to that of the Carbohydrates.

Many foods, such as Linseed, contain a high proportion of these elements, often fully forty per cent and should be used with care, especially with young birds, and in the warmer seasons. Excess of oily seeds is an ever-present danger.

Canary seed contains only about four per cent of fats, but has over fifty per cent of starchy matters, so that the two seeds are often given as a mixture in order that one may balance the effects of the other.

There is a certain percentage of water in all natural seeds, however dry and hard they are; the higher the percentage of water in a food the less the quantity of other essential constituents and they are seldom nutritious and cannot take the place in any diet of the more solid foods which contain a good percentage of proteids. Green-foods have a very low nutritive value but are of the utmost importance in the diet.

Nutritive Salts include such substances as potash, Soda, lime and Magnesia, all of which are contained in varying proportions in practically all seed and green-foods in common use in the Aviary and are of great importance in the diet.

Vegetable acids are not strictly speaking foods, they play an important part in the preservation of health and a diet is hopelessly incomplete without them.

One of the chief amongst them is Malic Acid which is found in considerable quantities in apples and pears.

Other important acids are citric and tartaric, found mainly in fresh fruit and green-foods, either as free acids or combined with alkalis as alkaline salts.

These when taken into the body undergo a chemical change by forming carbonates and preserving the alkalinity of the blood and other fluids.

As a result of oxidation in the body they provide a small amount of bodily heat and energy. Fibre is contained in varying proportion, particularly in all natural foods; it has no value as a food, but is necessary to stimulate the bowels in their natural functions.

The following will give some idea of the percentages of the essential food-elements contained in some of the common seeds in use in the Aviary.

	Proteids %	Carbo-hydrates %	Hydro-carbons %	Water %	Ash or Minerals %
Canary	14	50	5	14	2.1
Hemp	16	16	30	12	4.3
Millet	16	60	5	13	1.6
Niger	17	15	30	8	7
Maw	18	12	40	14	12.2
Rape	20	10	50	11	3.9
Linseed	25	18	40	—	—

VITAMINS: The story of Vitamins is a most fascinating and interesting one, hundreds of scientific workers have been engaged solving most difficult problems for many years.

It is a very big subject and can only be dealt with in a small way in this article, but I hope to cover enough ground to show how essential Vitamins are in the diet of our birds.

Diseases such as Scurvy, Beri-beri and Rickets now known as Vitamin-deficiency diseases are due to dietary errors which date from about 1601 to 1900.

This was discovered long before the word 'Vitamin' had been heard of.

It was not until 1912 after many experiments had been made that the word Vitamin was introduced by Fink.

Vitamins are found in a large number of unspoiled foods, such as greenstuffs, grains and fruits.

Their fundamental importance in any scheme of feeding can hardly be over emphasised.

In the last few years the knowledge of Vitamins has advanced rapidly, some are produced in nature and some are synthesised.

Vitamin A, the anti-infective Vitamin, keeps the mucous membranes and epithelial linings in the body normal.

Birds need plenty of Vitamin A and large amounts are essential for breeding birds.

The origin of Vitamin A is in the "green things of the land and the sea," Carotene being synthesised by both marine and terrestrial plant life.

There are two separate and distinct forms of Vitamin A, the colourless which is Vitamin A proper and Carotene the yellow colouring matter of carrots and many other natural foodstuffs.

Carotene is generally accompanied also by greenness, so that most green plants are rich in Vitamin A activity, such as spinach, cabbage, lettuce, Brussel sprouts and green peas, certain yellow root vegetables, notably carrots.

The principal sources of Vitamin A as distinct from Carotene are the liver oils of fishes, notably halibut and, to a somewhat less extent, Cod.

Butter and eggs are distinctive in owing their Vitamin A potency partly to Vitamin A itself and partly to Carotene.

Vitamin A is stored in the liver and Carotene is converted in the body into Vitamin A.

Vitamin A is destroyed by light and oxygen, especially when aided by heat.

Rancid fat rarely has any Vitamin A, rancidity being a token that oxidation has occurred.

Milk is a moderately good source of Vitamin A which resides in the butter fat.

All types of bird seed are, unfortunately, deficient in Vitamin A with the exception of rape which may retain some.

Amongst some of the conditions resulting from Vitamin A deficiencies are nutritional roup, poor vision, particularly night blindness, weakness and sterility.

Vitamin B complex contains Thiamin B_1, Riboflavin B_2, Nicotinic Acid B_3, and several other Vitamin factors.

These substances are found in the outer covering of grain and seeds, some are richer in one member of the complex than in others.

The B Vitamins are soluble in water and are not destroyed by moderate cooking.

Thiamin B_1, the anti-beri-beri Vitamin, is concerned with Metabolism, particularly of the central nervous system, it promotes growth and stimulates the appetite, aids digesion and the metabolism of carbohydrates and fats.

Amongst the many natural foods that contain a moderate amount of B_1 are Wheat- barley-, or rice-germ, oatmeal, wholemeal wheat, peas and egg yolk; rape seed contains it in greater quantities than any other item in the canary's diet.

Riboflavin B_2 is essential for the functioning of nerve and other tissue cells, it improves growth and is necessary for good egg production and hatchability.

Riboflavin is a yellow-coloured substance, soluble in water, the existence of which was first noted as long ago as 1879 by an English public analyst, named Wynter Blyth.

The best sources of Riboflavin are milk, yeast, liver, egg-white, green vegetables, it is however present to some extent in almost all foodstuffs, both animal and vegetable.

The growing plant is able to synthesise it.

Nicotinic Acid B_3, the anti-pellagra Vitamin: Nicotinic Acid derives its rather surprising name from the circumstance that it happened to be first prepared in the 1870's by organic chemists in Germany, by chemical breakdown (oxidation) of the alkaloid nicotine, present in tobacco, however, it bears little or no resemblance in its properties, or physiological activities, to nicotine.

Nicotinic Acid promotes health and growth and is essential for the functioning of the gastrointestinal tract and skin.

The foodstuffs richest in Nicotinic Acid include yeast, liver, and most protein foods, e.g. meat, fish, milk, peanuts, whole egg and whole wheat.

At least seven other Vitamins have been discovered during the last ten years, one of the newest is Vitamin K, the blood clotting Vitamin, and within the last few years two new remarkable Vitamins have come to light, Folic Acid and Vitamin B.12, the Anti-anaemia Vitamins.

Folic Acid is present in green leaves.

The history of Vitamin K. began in 1935 when Dr. H. Dam at Copenhagen described a new disease which he observed in chicks when kept on a diet of cereals and yeast. The special feature of the disease was the occurrence of bleeding in different parts of the body. When natural foodstuffs, particularly green leaves, were restored to the diet, the birds recovered.

Vitamin K. is fairly widely distributed in foodstuffs, being present in the fatty portions of various animals and vegetable tissues. Green leaves are especially rich in it, lucerne having often been used as the raw material for its preparation.

Vitamin B_{12}. Pioneer experiments were made in 1926 by physiologists and medical men. It was not until 1947-8 that an unidentified substance in liver, which was needed to regenerate fresh blood-cells in the blood of a patient with pernicious anaemia, was identified and characterised as B_{12}.

It is the only Vitamin so far known which contains Cobalt.

Vitamin C prevents scurvy and is contained in fresh fruits (notably orange juice).

Vegetables form the best practical source of the Anti-scurvy factor.

It was some two or three centuries ago since it was discovered that Scurvy (then so familiar to seamen) could be prevented or cured by the inclusion of green vegetables and small quantities of fruit-juice in the diet.

Birds are said to have the power to manufacture Vitamin C for themselves.

Vitamin D, the Anti-rickets Vitamin. Rickets is prevalent wherever there is little sunlight. In 1890 Dr. T. A. Palm, an English medical man, was the first to advocate the use of sunlight as a therapeutic measure in rickets.

Vitamin D is the most stable of the Vitamins; it is not destroyed by drying or cooking.

Vitamin D is the growth-vitamin, adults either human or avian can live for a long time on a very limited supply without suffering serious injury, but all young growing creatures need large amounts of it.

The amount of ultra-violet light that can fall on the body of a bird in ten minutes' exposure to the sun will manufacture enough Vitamin D to last for one day.

The function of Vitamin D has to do with the metabolism of the minerals, Calcium, and phosphorus.

Its absence from the diet is associated with soft shelled eggs, and malformed bones and teeth.

Vitamin D stands out from other Vitamins in the fact that only very few foods contain appreciable amounts of it.

Cod-liver oil is the old fashioned remedy. The most modern fish-liver oils, such as halibut or shark-liver oils, have the advantage over cod-liver oil as they contain a higher concentration of the Vitamins, therefore the dose is only a few drops.

Cod-liver oil and other fish-liver oils, especially tunny-liver oil and halibut-liver oil, are extremely rich sources of Vitamin D, but most other fats such as vegetable oils and mammalian animal fats and milk have but slight activity, while egg-yolk is relatively good.

Other common foods contain the Vitamin only in small traces.

Hemp-seed and sunflower-seed contain appreciable quantities, these two seeds are also rich in Vitamin E.

Vitamin E. Although this is the reproductive Vitamin all the Vitamins are needed, not only Vitamin E, for normal reproduction.

A characteristic feature about this Vitamin is that, as with Vitamin A, reserves of it can be stored with remarkable efficiency in the body.

Foods containing the best sources of Vitamin E are green leaves and the embryo of seeds (e.g. wheat germ).

There are many other sources of foods which contain Vitamins, but I have endeavoured to restrict my article to the foods necessary for our birds.

Variation in the Australian Whitefaces (Aves, genus *Aphelocephala* Oberholser, 1899)

By Allen Keast.

The three species that make up the endemic Australian genus *Aphelocephala* are small, drab-coloured, inhabitants of the savannahs and deserts of the southern two-thirds of the continent. They do the bulk of their feeding on the ground, sheltering and nesting for the most part in the low bushes that stud the plains. One species, *Aphelocephala leucopsis*,* is general in its habitat requirements (living mainly in savannah and mulga) and is, accordingly, widely-ranging. It is on the coast at several points in the east, in the central south, thence extending in a broad belt across the interior of the southern half of the Continent, to the western seaboard. The other two species, *A. nigrocincta* and *A. castanota*, live in the barren gibber and sandhill deserts (annual rainfall of well below 10 inches per annum over much of the area). The former, discovered in central Australia by the Horn Expedition in 1894, has become better known in recent years with the collection of specimens from localities as far apart as Birdsville, Tanami, and along the Canning Stock Route (see distribution map). *A. castanota*, however, remains one of the real mysteries of Australian ornithology. Though originally described by Gould in 1871 (from near Port Augusta in the south) it was not collected again until 1914, when White found it on the gibber-covered plateaux west of Oodnadatta in northern South Australia. Nothing has been heard of it in recent years. *A. castanota* has at various times been considered an age or seasonal form of *A. nigrocincta* but the evidence is that it is a good species with a very restricted range.

Aphelocephala subsists on a mixed diet of insects and seeds. This applies even to *A. leucopsis* of the better areas. For example, of eight birds collected in south-eastern Australia and New South Wales five contained both seeds and insects, two only seeds, and one only insects. Adaptation in the direction of grain-feeding is presumably all-important to sedentary species colonising the dryer parts of the Australian continent. There is no evidence, in any of the Aphelocephalas, of extensive nomadic movements such as those undertaken by many avian inhabitants of the Australian interior to avoid bad conditions. Apparently the desert populations of *Aphelocephala* do not require surface water for drinking. McGilp (1921), who lived for many years in the arid Lake Frome area of northern South Australia, has stressed this with respect to *A. nigrocincta*. Likewise, the Horn expedition (North and Keartland, 1896) found that the presence or absence of water had no effect on the distribution of *A. leucopsis* in central Australia. Although there is ample evidence that *Aphelocephala* breeds after rain in the dryer areas, like many desert birds, it might be noted that McGilp (1921) records the well-adapted *A. nigrocincta* commencing to breed weeks prior to the breaking of the 1920 drought in the Lake Frome area. Clutch-sizes, moreover, were no smaller than those of the following year (1921) which winter was "the best on record."

The three members of *Aphelocephala* are obviously species of long-standing and, despite the unusual habitats and distribution of the two desert forms, no suggestion can be made as to the circumstances of their speciation. *A. leucopsis* is interesting in that it is broken up into eastern, central, and western races, each partly isolated, by the treeless tracts of sandhill and gibber desert that form the habitat of *A. nigrocincta*. *A. nigrocincta* and *A. pectoralis*, with continuous ranges

* The western *Aphelocephala castaneiventris* of the R.A.O.U. Checklist (1926) is obviously just a geographic form of *A. leucopsis*.

in the most arid part of the continent, are monotypic. Just what the ecological relationships of *A. pectoralis* and *A. nigrocincta* are in those parts of central Australia where they coexist in flocks would be interesting to know. They are similar in over-all size (as judged by wing-length) and in the bill.

Aphelocephala leucopsis (Gould, 1840). Whiteface.

This species ranges across the continent south of the Tropic of Capricorn (most northern specimens: Minilya River, W.A.; McDonnells, S.A.; and Warwick in Queensland). It avoids the denser coastal forests of the southwest (Serventy and Whittell, 1948) and east, though in the latter it does extend across to the seaward side of the coastal ranges in places (viz. west of Sydney, Hunter Valley). At the other extreme the treeless spinifex and gibber deserts are distributional barriers. The habitat is best described as savannah woodland, savannah grassland, mulga, and mallee. *A. leucopsis* is essentially sedentary.

Geographic Variation: The species is broken up into three geographic colour forms, as follows:

(a) Western Australia, *castaneiventris* (Milligan 1903). These birds have dull rufous flanks. Localities: Minilya, Carnarvon, Roeburn, East Murchison, Shark's Bay, Southern Cross, Kalgoorlie.

(b) Central Australia, *whitei* (Mathews 1914). The flanks of this form could best be described as brownish. They tend to be browner above than either the western or eastern forms. Localities: Musgrave Ranges, Everard Ranges, Oodnadatta, Todmorden, Coonga Creek, and Coralbynie and Wertigo Dam in the Gawler Ranges.

(c) Eastern and south-eastern Australia, *leucopsis*. (These birds lack the brownish flanks. Localities: Warwick, Bunya Mountains, Q.; Birdsville, various places in New South Wales, Victorian mallee, south-eastern South Australia, Port Augusta, Lake Dempsey, Gawler Ranges, Coffin Bay, Port Lincoln.

The fact that the Birdsville birds, living under arid conditions similar to those of the central Australian stock, are like the eastern birds supports habitat and distributional evidence that there is an extensive range gap corresponding to the Arunta (Simpson) Desert. Interestingly enough, it is the eastern *leucopsis* colour-type that extends along the south coast, merging into the *whitei* type in the Gawler Ranges. In the western section of the continent *whitei* and *castaneiventris*, are obviously isolated by the vast spinifex-covered Great Sandy Desert. This is supported by the different appearance of the two forms, notwithstanding the similarity of climatic conditions in their two environments, and the fact that within the extensive range of each colour, variation is apparently negligible. Notwithstanding this, there is probably gene flow between the two stocks across the Nullarbor Plain in the far south.

The sexes would appear to be of more or less the same size in *A. leucopsis*. Measurements for specimens labelled male and female in the Australian Museum from western New South Wales (Lachlan River, Bourke), are as follows:

	Wing Length (mm.)	Tail Length (mm.)
Males	58-64 (62)	41-44 (42)
Females	59-64 (62)	38-43 (42)

Comparative geographic measurements for adult males from extremes of the range are as follows:

	Wing Length (mm.)	Tail Length (mm.)
Mid-western Australia (6)..	58-60 (59)	41-44 (43)
Central Australia (6)	59-62 (60)	40-44 (42)
Bunya Mountains (2)	60, 62	42, 43
Victorian Mallee (5)	59-63 (61)	40-44 (42)

Geographic size-differences in *A. leucopsis* are negligible.

The range of *Aphelocephala leucopsis*, distribution of its geographic forms, and vegetation barriers are set out on fig. 1.

Variation in the species may be summed up by saying that isolation apparently has been all-important in its initiation but that, as it is apparently not now complete, and the species has fairly general habitat requirements, current trends are not in the direction of speciation.

I agree with the action of Mathews in relegating his forms "*pallida*," "*missa*" and "*minilya*" to synonymy.

Aphelocephala pectoralis (Gould 1871). Chestnut-breasted Whiteface.

This rare species has been recorded from Port Augusta to west of Oodnadatta (see fig. 2), a circumscribed and restricted range in arid desert country. White states that it is confined to tableland country covered with gibber stones, with small clumps of low bushes, and with a few mulga trees growing along the watercourses.

Mathews (1923) has reviewed evidence as to the status of *A. pectoralis* and nothing further has been learnt since that time.

Geographic Variation: Museum material of this species is scanty and is mostly from the Wantapilla, Indulkana, and Todmorden areas west of Oodnadatta. Measurements are as follows:

	Wing Length (mm.)	Tail Length (mm.)
Males (4)	56-58 (57)	36-39 (37)
Females (4)	54-56 (55)	35-37 (36)

There is no evidence of any geographic variation in *A. pectoralis* and I agree with Mathew's action in subsequently sinking his race "*todmordeni*."

Aphelocaphala nigrocincta (North 1895). Banded Whiteface.

This species has a fairly extensive range through the barren sandhill, claypan, and gibber deserts in the centre of the Continent from Oodnadatta to Birdsville, Barrow Creek, Tanami, and the Canning Stock Route (see crosses on fig. 2 for localities of peripherally-collected specimens). In effect, this species occurs in those parts of the central desert where the mulga habitat of *A. leucopsis* is lacking. In places, however, it occurs where there are trees, vide Barrow Creek (Jarman, 1944).

Geographic Variation: There is no geographic colour-variation in *A. nigrocincta*, specimens from central Australia, Birdsville, and the

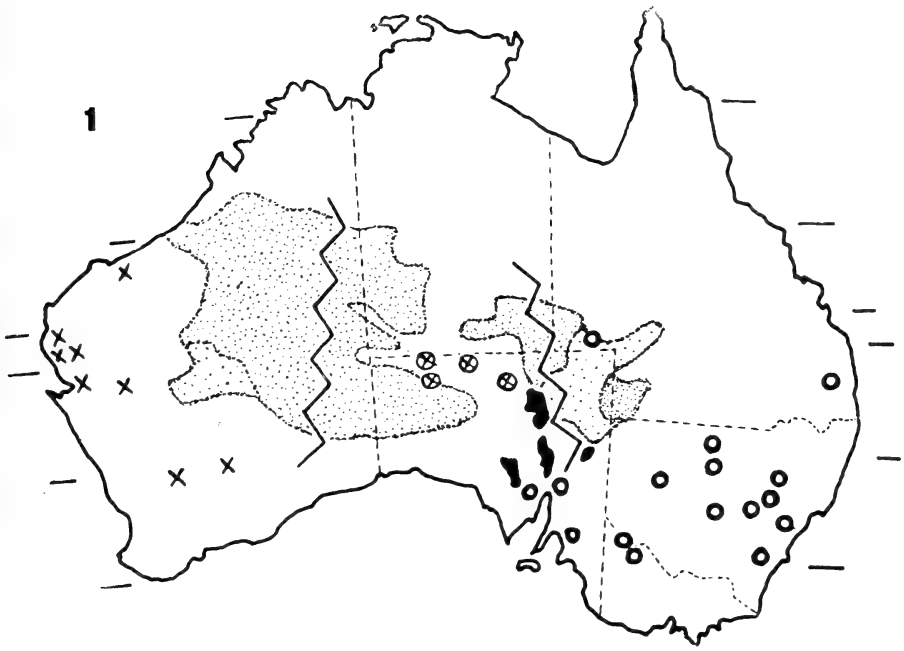
Figure 1. *Aphelocephala leucopsis*. Symbols indicate localities from which specimens of the colour races have been taken:

O *leucopsis*
X inside O *whitei*
X *castaneiventris*

The two areas of sandhill and gibber desert (Arunta and Great Sandy Deserts), distributional barriers to *A. leucopsis*, are shaded. Salt lakes are shown in black.

Figure 2. *Aphelocephala nigrocincta* (large ellipse) ranges through the sandhill and gibber deserts (shaded areas) of the desert centre of the continent. The circles represent locality records, the peripheral ones being numbered 1-7.

Aphelocephala pectoralis (small ellipse) has a restricted range through the barren gibber-covered plateaux of northern South Australia. Symbol "a" represents Gould's original specimen from the Port Augusta area, "b" the area in which White's observations were made.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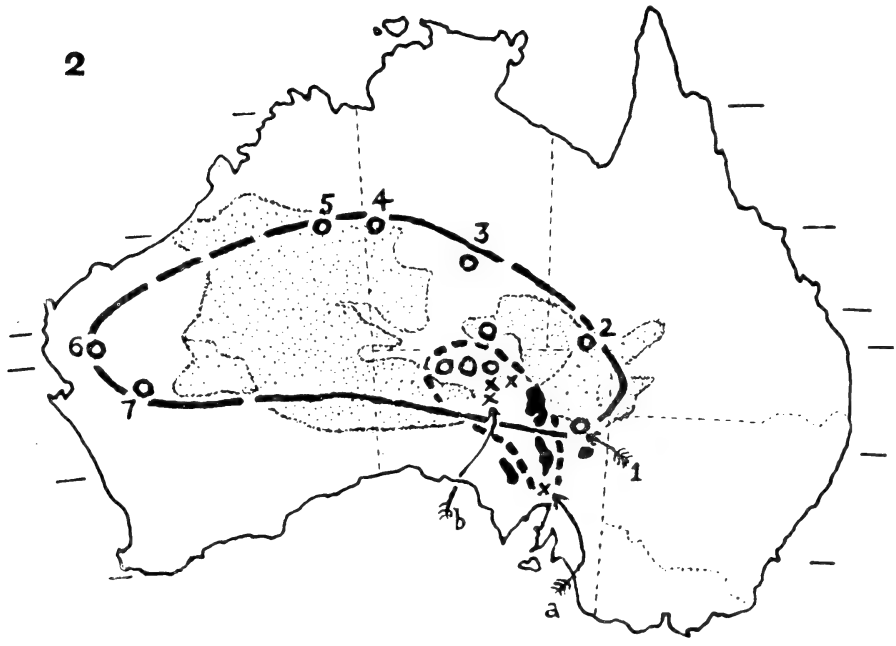
2
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a

Canning Stock Route being similar. Measurements of adult birds from the various localities are as follows:

Males

	Wing Length (mm.)	Tail Length (mm.)
Central Australia (6)	56-59 (57)	36-39 (37)
Canning Stock Route:		
Wells 25 and 48 (2) ..	57, 58	38, 38

Females

Birdsville (1)	58	38
Central Australia (3) ...	53-57 (55)	All 36
Canning Stock Route:		
Wells 25 and 48 (2) ..	56, 59	36, 37

There is no evidence of any geographic size-variation in *A. nigrocincta.*

I agree with the action of Mathews in sinking his race "*tanami*" into synonymy.

SUMMARY.

Of the three species in *Aphelocephala* two are monotypic and one is broken up into three geographic forms. Whilst isolation has apparently been involved in the origin and maintenance of the latter it is not sufficiently complete at the present time for speciation to be occurring.

Aphelocephala is interesting habitat-wise in that two of the species are inhabitants of the arid sandhill and gibber deserts, areas to which only a couple of Australian birds are specialised. *A. leucopsis* provides an example of how the distribution of an interior species, well-adapted to arid conditions but requiring shrubs or low trees, may be broken up by spinifex and sandhill desert.

ACKNOWLEDGMENTS.

I should like to express my thanks to the authorities of the American Museum of Natural History (New York), Australian Museum (Sydney), South Australian Museum (Adelaide), and Western Australian Museum (Perth) for permitting me to examine specimens housed in their institutions.

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Variation in the Bristle-birds (*Dasyornis*)

By Allen Keast, Australian Museum.

The recent rediscovery of the eastern and western forms of the Bristle-bird (*Dasyornis brachypterus*), after an absence of 30-40 years has created widespread interest in these drab inhabitants of the coastal undergrowth. But there is more to *Dasyornis* than its rarity for the two species (*D. brachypterus* and *D. broadbenti*) have a relict distribution that poses a whole series of questions as to climatic and vegetational changes in the south of the Australian Continent. Attention has recently been drawn to this by Chisholm (1951).

The Bristle-birds, so called because of their prominent rictal bristles, are moderate-sized, predominantly brown in colour, and not easy to locate. Each species has an eastern and a western stock, isolated from each other by distances of perhaps 1400 and 2000 miles respectively. Within each they are broken up into a series of populations by discontinuities in the habitat. An interesting facet is that, notwithstanding that the two species are of different size, suggesting that they differ ecologically, they apparently never coexist in a habitat and strictly replace each other geographically. This suggests different habitat requirements, or, possibly persistence of a degree of competition.

It is probable that *Dasyornis* was decreasing in numbers long before white settlement but it is generally accepted that the introduction of feral cats, clearing of the country, and especially its periodic firing are responsible for reducing the stocks to near-extinction in places. Such changes are most severe where the range is restricted and one is forcibly reminded of the melancholy observation of Carter (1923) respecting one of the main localities in southwestern Australia a few years after he had collected birds there: "Where there had been dense impenetrable scrub was mostly bare sand drifts caused by fires made to improve the country for cattle grazing." The situation in the southwest today is that, recently, Buller (1945) obtained the first member of *D. brachypterus* seen for 38 years and that in 1940 Glauert (1945) recorded a bird "probably" *D. broadbenti*, the first to be seen in 34 years. The eastern *D. brachypterus*, with a range embracing the approximate limits of the New South Wales coastline was long held to be extinct but then followed a remarkable series of "rediscoveries" up and down the coast. The first of these was by Marshall (1939) inland from Kiama. Subsequently it has been seen at Mallacoota, near the Victorian border, Kiama (McNamara, 1946; Chaffer, 1954), Dorrigo (Goddard, 1948), Macpherson Range (Robertson, 1944), and on the plateau of the Mount Lindsay area, some fifty miles from the sea (Goddard, 1954). It is probable, of course, that these records are as much due to the species reappearing as to trained observers actively searching for it. In contrast to the other stocks of the genus the Rufous Bristle-bird (*D. broadbenti*) in the coastal scrubs of the Otway Peninsula and western Victoria seems to have remained relatively high since the early days and there have been frequent sightings of it throughout (see Lang, 1946, etc.).

Dasyornis broadbenti (McCoy) 1867. Rufous Bristle-bird.

In the southwest of the continent this species is confined to a narrow strip of coastal country some 60 miles long, from Cape Naturaliste to Cape Leeuwin (Serventy and Whittell, 1948). In the east it extends from the Otways to the Coorong, a sliver of coastal undergrowth some 300 miles in length but that is broken up into pockets. The western and eastern stocks are some 1400 miles apart. I agree with Chaffer (1954) that sight records of the species east of the Otways are probably incorrect. The habitat ranges from coastal dune thickets to undergrowth in timbered gulleys. In the Otways it

would appear at least in part to occupy the ecological niche of the whipbird further east.

Geographic Variation. This has recently been reviewed by Condon (1951) and I am in agreement with his findings that there are three forms:

(a) Western Victoria (*broadbenti*).

(b) Coorong, southeastern South Australia (*whitei* (Mathews) 1912). Specimens in the American Museum of Natural History are paler above than the nominate form, having a light greyish wash over the back, and the top of the head is a dull rufous instead of a dark brownish-chestnut. The side of the head is also paler. The chin and centre of the abdomen are whitish, the throat and chest feathers dark grey edged with white, whereas *broadbenti* is brownish underneath. This description substantially agrees with that of Condon.

Condon has seen a bird from the Glenelg River that appears to be a true intermediate between *broadbenti* and *whitei*.

(c) Southwestern Australia (*litoralis* (Milligan) 1902). This form is characterised by a much brighter rufous head. Condon mentions the "markedly scalloped appearance of the throat and breast" in his specimens. Specimens in the A.M.N.H. from the Coorong, however, also tend to show this feature. Southwestern specimens in the A.M.N.H. have a slightly yellowish wash ventrally but this is lacking in the single specimen in the Australian Museum collection.

Measurements of adult males and females are as follows:—

	Bill Length mm.	*Wing Length* mm.	*Tail Length* mm.
MALES			
Lorne and St. George River (4)	14.5-15.4 (14.9)	92-97 (96)	117-124 (121)
Coorong (3)	14.2-15.1 (14.5)	92-96 (94)	121-128 (124)
Cape Naturaliste (3) ..	13.9-14.4 (14.2)	88-92 (90)	114-124 (118)
FEMALES			
Lorne (2)	14.4, 14.9	90, 97	115, 125
Cape Naturaliste (1) ..	14.2	89	108

The small series of specimens confirms that the southwestern stock is smaller than the eastern ones.

Dasyornis brachypterus (Latham) 1801. Bristle-bird.

The southwestern stock of this species extended, in recorded time, from about Perth to the east of Albany (Serventy and Whittell, 1948). In the east the species extends from the Macphersons on the border of New South Wales and Queensland to Marlo, just over the Victorian border. Measured along the seaboard the two ranges measure about 350 and 700 miles respectively and lie about 2000 miles apart. The species is restricted to the tangled scrub and vegetation associated with creeks and marshes along the seaboard and associated plateaux. Goddard's discovery of it on a plateau near Mount Lindsay, fifty miles from the sea, demonstrates how far inland it goes when there is suitable habitat.

Geographic Variation. The southwestern and eastern forms of *D. brachypterus* are distinctive and under the old scheme of classification were each given the status of species. The western form (*longirostris* Gould 1840) is noticeably the smaller and has a long narrow bill. The top of its head is blackish and it lacks the reddish on the forehead. The wings and rump are, however, distinctly rufous (not seen in the nominate form). The most curious feature of the somewhat sooty back of *longirostris*, however, is that the individual feathers have a pale and glossy tip that reflects the light. The undersurface of *longirostris* is the darker.

Figure 1.—Distribution of the two species of *Dasyornis* in Australia. Eastern and western stocks of *D. broadbenti* (striped) are isolated by some 1400 miles, those of *D. brachypterus* (black areas) by some 2000 miles.

Males from the two stocks measure as follows:—

	Bill Length mm.	*Wing Length* mm.	*Tail Length* mm.
Eastern Australia (5) (mostly Sydney area south to Clyde River)	10.6-11.2 (10.8)	73-78 (75)	105-114 (109)
Southwestern Australia (6)	11.0-11.8 (11.4)	67-72 (70)	78-87 (84)

Three females from New South Wales reflect the larger size of this form. Their wings range from 73-78 mm. in length (mean of 74), whereas two from the southwest have wings measuring 68 and 71 mm.

Since *D. brachypterus* is obviously broken up distributionally into a series of pockets in the east it might be expected that there is geographic variation. Specimens in the Australian Museum from as far apart as the Clyde and Richmond Rivers are similar, however. No skins have been seen from the northern extremity of range, which birds K. A. Hindwood has suggested (on field appearance) are not so small and dull as Sydney birds (see Chaffer, 1954). The Mount Lindsay stock, in particular, would be worth sampling.

Relationships of Dasyornis broadbenti and D. brachypterus.

The two bristle-birds are somewhat similar and one of the chief points of difference is size. Within each there is a small western

and a larger eastern form. Each occupies a generally similar sort of habitat, a fact commented upon by Favaloro (1931) with respect to the Macpherson Range. The writer has similar feelings about the Barren Grounds (N.S.W.) habitat of *D. brachypterus* and that of *D. broadbenti* near Lorne. A detailed botanical comparison would be rewarding. At any event, so far as present knowledge goes, the two species nowhere coexist in the same area, the ranges apparently being mutually exclusive (see map). In the east *D. brachypterus* has a northern range and *D. broadbenti* a southern one. In the west the former is both to the north and the south of latter but, as far as is known does not overlap.

Consideration of the distribution of *D. broadbenti* and *D. brachypterus* today gives little clue as to the circumstances of origin of the two species. Both must once have had a wide range across the south of the continent and undertaken great colonisations. Today they can only be looked upon as relict forms. In that each has well-differentiated isolates it could be said that they were actively "speciating." The specialisation in habitat that has led to isolation and the "potential" of giving rise to new species in the southwest has also proved the high road to extinction. Had man not intervened and sealed the fate of the southwestern stocks who knows what would have been their future, early extinction due to the vagaries of a fickle climate, or a great resurgence in the wake of some favourable change?

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Variation in the Australian Emu-wrens (*Stipiturus*)

By Allen Keast, Australian Museum.

Stipiturus, an aberrant genus of small wren-like birds, is interesting from the speciation viewpoint. It contains a series of morphologically-differentiated isolates ranging from minor forms to others sufficiently distinct as to cause controversy as to whether they should be called "species" or merely well-differentiated races. The ecological transition from life in the dense undergrowth of the high-rainfall coastal regions to that in the arid porcupine-grass desert not only provides an interesting demonstration of habitat-changes accompanying morphological differentiation but poses questions as to the nature of the adaptational and distributional "pathway" involved in the bridging of such extremes in habitat.

The unusual characteristic of the emu-wrens is the long, upturned tail of only six rectrices, the broad individual feathers of which are loosely webbed and have a delicate filamentous appearance suggestive of emu feathers. The basic body colours are drab browns, with blackish striations dorsally. Sexual dimorphism is pronounced, the males being beautiful little birds with blue throats and heightened colours generally. Emu-wrens are timid and keep well-down in the undergrowth. Wilson (1930) describes his experiences with the form inhabiting the Victorian mallee (*mallee*): "When surprised in an isolated tuft they were very loth to leave it, and we sometimes kicked a large tuft to pieces, and jumped upon it until we were tired, before succeeding in dislodging them." Again, he states that he was: ". . . only apprised of a bird's presence in the tussock when half of it had been burnt."

Stipiturus is broken up into three main forms (listed as species in the 1926 Checklist of the Royal Aust. Ornithologists' Union) on size and colour-pattern and the fact that they inhabit distinct classes of country (coastal undergrowth, mallee, desert porcupine grass). Because these are distributionally isolated, however, their true status is doubtful. Of recent workers Mathews (1922 and 1946) first regarded them as two species (and the third as a race) but subsequently listed each as a species. Serventy and Whittell (1951) also recognise three species. Condon (1951), however, lumps them all under the one. In point of fact, so far as morphological characters go, the desert *ruficeps* is fairly well-differentiated but *mallee* is almost intermediate between it and the coastal *malachurus*. The real reason that the three have been regarded as species in Australia is the apparent extent of their ecological (habitat) differences. One of the objectives of the present paper is to analyse these, determine how they arose, and see if they are really as profound as has been supposed.

THE FORMS OF STIPITURUS.

The taxonomy of the group has been considered, amongst others, by Ashby (1920), Mathews (1922) and, more recently, by Condon (1951). My work was carried out in the main on the collections of the American Museum of Natural History, New York, with assistance from those in Sydney and Adelaide, and I should like to thank the authorities of these museums for permitting me to use their material.

Stipiturus ruficeps (Campbell 1899). In the male of this diminutive desert form, which occupies a broad belt across the centre of the continent (see map) there is a bright rufous crown (without striations) and the sides of the face are blue (compared with brown in *malachurus*). The abdomen is pale chestnut. The rectrices are small and narrow. Wing lengths of males range from 35-39 mm. (mean of seven, 38 mm.),

compared with 42-46 mm. (mean of eleven, 44 mm.) in *malachurus* from the southeast. The tail measures 64-74 mm., as against 108-119 mm. in the latter.

The females of *S. ruficeps* resemble the males but lack the blue on the throat and face. Three birds have wing-lengths of 36, 37 and 39 mm. respectively. *S. ruficeps* does not vary geographically.

Stipiturus mallee (Campbell 1908): This form, confined to the porcupine grass in the mallee (a dwarf eucalypt association) of western Victoria and south-eastern South Australia, is intermediate between *ruficeps* and *malachurus* in general colouring and tail-structure, but in that the blue extends to above and behind the eye it approaches *ruficeps*. Compared with *malachurus* from the adjacent coast, the dry-country (10-inch rainfall zone) *mallee* is browner on the top of the head, lacks the chestnut on the wings, has paler chestnut on the under surface, and has the markings on the back less marked. In the females the forehead and anterior part of the crown are drab, reddish-brown and free from striping, the back is drab and the striping almost lacking, and the chestnut of the wings and ventral surface is much reduced. In point of fact, apart from the "unique" *ruficeps*-type blue

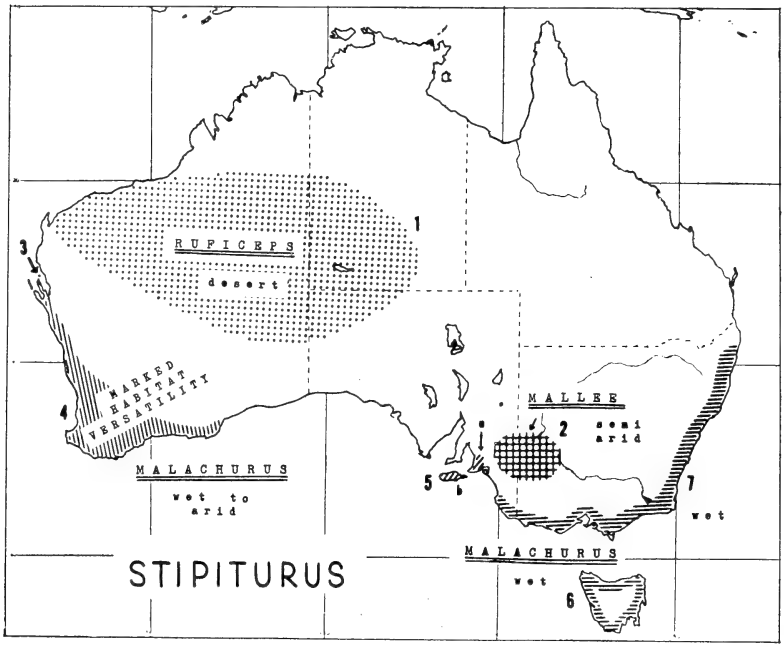

Figure 1.—Distribution of forms in the genus *Stipiturus*.
1. *S. ruficeps*, the diminutive inhabitant of the desert spinifex.
2. The form *mallee* (porcupine grass in semi-arid mallee country).
3-7. Isolates of *S. malachurus* (mostly damp coastal undergrowth) around the periphery of the continent. In the southwest, however, the species shows the full range of adaptations through to life in the semi-arid mallee.

The morphologically distinct forms of *malachurus* are as follows: 3, *hartogi;* 4, *westernensis* grading into *medius* (presumably); 5a, *intermedius;* 5b, *halmaturinus;* 6, *littleri;* 7, *malachurus.*

patch on the side of the face of the males, the characters of *mallee* resemble those seen in the races of *malachurus* from the drier areas.

In size *mallee* is somewhat smaller than *malachurus* from the more fertile areas of the continent (though not as small as the island race *hartogi* of the latter). Adult males vary in wing-length from 39-42 mm. (mean of seven, 40 mm.). Because of fraying it is not possible to give precise tail measurements but they would appear to be in the range of 80-90 mm. for *mallee*. Adult females of *mallee* range in wing-length from 38-40 mm., compared with 42-45 mm. (mean of six, 43 mm.) in females of *malachurus* from the adjacent coast.

Stipiturus malachurus: This form, probably the parental one, is characterised by well-developed striations on the top of the head, minimum of rufous dorsally, and long and finely developed rectrices. In its peripheral distribution it is broken up into a chain of forms, varying chiefly in the degree of development of the blackish dorsal striations and extent to whch reddish tones are developed. These are as follows:

(a) South Queensland to Victoria, along the coast (*malachurus* (Shaw) 1798). In this form some birds have the crown a pure chestnut, in others the dark markings persist faintly on the back of the head. The chestnut of the chest and sides of the body is rich. I do not consider that birds from the Melbourne area (*"tregellasi"* Mathews) are different, although I note that Ashby accepted it and Condon notes that birds from the Glenelg River, south-western Victoria, are "more brightly rufous on the back than two skins from New South Wales." These birds may be isolated here and in the Grampians. They could prove to warrant a name. There are no grounds for recognising Mathews' *richmondi* from the Richmond River, New South Wales. The author himself subsequently reduced it to synonymy.

(b) Tasmania (*littleri* Mathews 1912): Tasmanian specimens in the American Museum of Natural History show indications of being slightly darker than mainland birds. Condon describes specimens, presumably fresher material, as "very brightly-coloured rufous." At any event the Tasmanian form should carry a name.

(c) Mount Compass area of South Australia—isolated to west of Ninety Mile Desert (*intermedius* Ashby 1920). Birds in the A.M.N.H. from this area are much blacker dorsally than eastern birds, the striations being heavier. The forehead is plain (chestnut) but the crown is striated. The chestnut areas of the wings and underside are paler. Condon reiterates Ashby's definition of this form: distinguished by the "grey character of the back feathers, and the less rufous coloration generally."

(d) Kangaroo Island (*halmaturinus* Parsons 1920). As Condon notes: "Kangaroo Island birds are distinguished from those of the adjacent mainland chiefly by their duller appearance, especially on the dorsal surface, including the crown, which is light brown."

(e) Southwestern Australia (*westernensis* Campbell 1912). These birds are not quite so dark dorsally as South Australian birds. The chestnut on the top of the head covers just as large an area as in eastern birds but black markings now extend right through it to the bill. Areas below and about the eye tend towards greyish-white in these western birds (and to those from South Australia)—possibly the first step in the transition from the brownish of *malachurus malachurus* to the blue of *mallee*. The chestnut areas of *westernensis* are as bright as in eastern birds. Females from the southwest give the impression of being drabber (markings less contrasted, chestnut tones duller) than those from the east.

Campbell (1912) states that southwestern birds have tails only

about half the width of the eastern ones. This is not borne out by the material I have examined.

(f) "Inland southwestern Australia (north to Shark Bay)"—Condon. This is the form *medius* Mathews 1919 and is very interesting in that it is the only one not strictly coastal in distribution. I have not seen enough specimens to study it adequately but Serventy and Whittell (1951) record it as smaller and with narrower black streakings than *westernensis*. It is apparently intermediate between *westernensis* and *hartogi*.

(g) Dirk Hartog Island (*hartogi* Carter 1916). This interesting population is much paler than the others. The chestnut of the head and ventral surface is "washed out," the dorsal markings are narrower and paler (less pronounced), and the blue of the throat is paler. In the females the chestnut tones of the body are largely lost. The dorsal surface has an overall greyish appearance, resulting from narrower and less contrasted (browner) striations. There is no brownish colouring at the top of the bill and on the wings. The ventral colouring could best be described as a warm buff.

Stipiturus malachurus varies somewhat geographically in wing-length, as shown by adult males: Sydney area (6), 42-45 mm. (44); Melbourne area (5), 43-46 mm. (44); Tasmania (2), 42 and 44 mm.; Mount Compass-Myponga, South Australia (9), 42-45 mm. (44); Kangaroo Island (2), each 44 mm.; coastal southwestern Australia (8), 42-47 mm. (44); Dirk Hartog Island (3), 38-39 mm. (39). Because of marked individual variation in the material, plus tendency towards fraying, tail-lengths cannot be adequately compared. Well-developed tails would appear to range from about 108 to 119 mm. There is no apparent difference in the tail-lengths of eastern and western stocks.

GEOGRAPHIC VARIATION IN HABITAT.

Distribution of *Stipiturus ruficeps*, *S. mallee*, and the various forms of *S. malachurus* are set out on the map. It will be seen that *S. ruficeps* has a wide range but one that is continuous (and the species does not vary in colour geographically). *S. mallee* has a restricted range. *S. malachurus*, with its peripheral distribution, has a whole series of forms resulting from gaps in the "coastal undergrowth" habitat. *S. ruficeps* is an inhabitant of the great clumps of spiny porcupine grass on the desert sandhills and *S. mallee* lives in similar associations within the southeastern mallee belt. Both areas are of low rainfall, the former from perhaps 10 inches down to about 5 inches per annum, the latter is in the 10 inch zone. *S. malachurus*, by contrast, mostly lives where it is marshy underfoot—in the 30-40 inch rainfall zone. It does, however, extend to drier places and demonstrates the pathway followed from this (presumably the ancestral) habitat to life in the desert.

North (1904) describes the habitat of *S. malachurus* near Sydney as swamps, heathlands, and clumps of long rushes and grass tussocks around the low-lying shores of lagoons. In the Frankston area of Victoria the species inhabits dense, rank, grassed lands where there is a tangle of grass and scrub, and thickets of *Melaleuca* and *Leptospermum* (Chandler, 1922). The isolated colony in the Mount Compass area of South Australia is described by Ashby (1919) as inhabiting wide, peaty swamps between scattered hills, largely covered with low bushes, the whole area being very cold and wet in winter. The area is said to be subject to a certain amount of drying out seasonally. The habitat on Kangaroo Island "contrary to expectations" is "not cool, damp gullies, but in every instance they were encountered on the tops of dry, inhospitable, flat-topped hills, covered with a low growth of 'bull oak,' 'broombush,' and 'grass-tree' " (Parsons, 1922).

Equally dry is the area occupied on Dirk Hartog Island (annual rainfall of 12 inches), which is described as "a tract of scrub about 18 inches high, interspersed with a few dead bushes, around and through which various grasses were growing" (Whitlock, 1921). In the southwest of the continent, Whitlock (1939) has described *S. malachurus* as being confined to the tops of the sand-hills nearest the tide-line and which, exposed to the full force of the westerly winter gales, are thickly clothed with a low and fairly dense covering of bushes. Bradshaw (1928) refers to the species inhabiting mallee country to the north of the Stirling Range. Serventy and Whittell state that in the southwest the species occurs on the one hand in "damp heathy country and the scrubby vegetation of the coastal dunes" and on the other on "scrubby ironstone hills and on dry sandplain country." They draw attention to the fact that in the east of the continent these two extremes are occupied by different species (*malachurus* and *mallee*).

It will be seen that in the southwest of the continent, but not elsewhere, *S. malachurus* occupies a remarkable diversity of habitat, from the typical damp one of the east to dry mallee in the 10-12 inch rainfall belt. Something approaching an "intermediate" environment is, however, occupied in some other places, e.g. on Kangaroo Island. All in all, *S. malachurus* demonstrates very well the chain of habitat adaptations that has accompanied the speciation-process in the genus.

Significantly enough, it is in the southwest of the continent that the full habitat-adaptation is seen. In the east we see the prenomenon of two distinctive forms, occupying dry mallee and wet coastal undergrowth respectively, completely separated by a tract of dry savannah (50-100 miles wide ?), lacking the common denominator of all the *Stipiturus* habitats—thick cover. The long-standing nature of this barrier in Victoria is demonstrated by the fact that the coastal *malachurus* is less closely related to the inhabitants of the mallee (*mallee*), as judged by morphological characters, than it is to the distant (and also isolated) Tasmanian, southwestern, and even Dirk Hartog Island, populations.

ISOLATION AND SPECIATION.

Within *S. malachurus* the Tasmanian, Mount Compass, Kangaroo Island, southwestern, and Dirk Hartog Island, populations are isolated from the main stocks in the southeast of the Continent. This, known from field observation and vegetation data, supported by morphological distinctness of the populations, reflects a characteristic of *malachurus* as a whole, namely its concentration into favourable areas of undergrowth and, since these are discontinuous, the tendency to occur in "pockets." The distributional barriers are simply tracts of country lacking in undergrowth, for example the Ninety Mile Desert and Nullarbor Plain, or areas of sea.

S. malachurus has no fewer than five morphologically differentiated isolates (forms with the "potential" for speciation), an unusually large number. Since, however, it seems that some of these will be exterminated by adverse changes in climate and habitat (e.g. the Mount Compass population), or will resume contact with the main stock few, if any, are likely to become new species.

What barrier isolated the forebears of *S. ruficeps* and *S. mallee* from *S. malachurus*, and from each other? Since the common denominator in the habitats of all these is dense cover it must have been breaks in this. It would be most interesting to know more details of the country between *S. malachurus* and *S. mallee* today, assuming of course that they have always borne the same distributional relationship to each other. *S. ruficeps* is obviously isolated from *S. mallee* by the open gibber desert of northern South Australia and by a chain

of great salt lakes (Eyre, Torrens, Frome—see map). A reasonable hypothesis to account for *S. mallee* is that it represents the eastern outlier of a mallee-adapted stock from the southwest of the continent. The mallee whipbird (*Psophodes nigrogularis*) comes into this category. The eastern population has differentiated morphologically and, as in other mallee birds, is now isolated by the gap in the mallee habitat at the head of the Great Australian Bight (see vegetation maps).

Two points about the avifauna of the southwest might be noted. Firstly, as has been pointed out by Serventy and Whittell, many birds there tend to show a much greater habitat-versatility than their eastern forms. Secondly, life in the southwest is apparently such that adaptation to dry conditions may occur there and the drier parts be secondarily colonised in a west-east direction. An example of this is the sittella, *Neositta chrysoptera pileata* (Mayr, 1905). This form obviously arose in the southwest and has subsequently spread across the barren Nullarbor Plain to colonise western New South Wales.

THE TRUE STATUS OF THE FORMS RUFICEPS AND MALLEE.

(a) the forms *malachurus*, *mallee*, and *ruficeps*, represent three stages of morphological differentiation. The differences between them are moderate only, not of the striking type that would lead to universal agreement that they must be called species.

(b) The three are isolated, so that their true evolutionary (genetic) status cannot be determined.

(c) The ecological (habitat) differences between them are not as absolute as has been assumed, extreme populations of *malachurus* habitat-wise virtually bridging the differences between them. This does not mean that habitat is not important in assessing the status of forms for it is in one part of the continent only that *malachurus* is versatile in this respect. It could, of course, be purely a secondary adaptation.

(d) *S. ruficeps* is sufficiently distinct morphologically to be called a species, and there would be no doubt but for the presence of the intermediate *mallee*. Most workers would have serious misgivings about listing *mallee* as a species and it should be placed under *malachurus*.

CLIMATE AND COLORATION IN STIPITURUS.

The following generalisations may be made with respect to variation in the Australian emu-wrens:

(a) Races inhabiting the drier regions are plainer and have reduced markings (vide *halmaturinus*, *medius*, and *hartogi*). This is an expression of the Gloger Effect, as is the tendency towards redness in the desert *Stipiturus ruficeps*.

(b) Forms inhabiting the drier areas are smaller. This applies to *hartogi*, *mallee*, and *ruficeps*. As, however, these are also the northern forms (nearer the Equator) the modifications could be ascribed to the Bergmann Effect.

(c) Forms inhabiting the drier areas have smaller tails. In *ruficeps*, at least the tail is disproportionately small. Possibly the smaller tail is less liable to foul in the dense clumps of porcupine grass that form the home of this form.

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Notes on the Giant Toad (*Bufo marinus*)

By A. I. Ormsby, LL.B.

No ecological problem can be of greater interest to a zoologist than whether or not a species is likely to extend its range or if introduced to a given locality can establish itself.

The Giant Toad (*Bufo marinus*) was originally introduced to north Queensland to make war on the cane beetle but since its introduction it has assumed pest proportions. Coming from tropical Central and South America, general opinion appears to have been that this species could not establish itself in a temperate climate. The scope of these notes is confined therefore to facts relevant to the above considerations.

My first encounter with these interesting batrachians took place at Innisfail, north Queensland in the spring of 1944 when I was passing through on leave from a northern military camp. A breezy account by Gerald Durrell of his capture of 35 of these toads in Georgetown, British Guiana, stimulated my interest, previously only centred on reptiles, so I asked Eric Worrell to get me some when next in Cairns. Mr. Worrell had found specimens held and exhibited by him had not survived captivity for any length of time. I believe this was because he could not obtain sufficient live food as he did not then know the secret of feeding them.

In October 1955 he presented me with two specimens. One of them escaped in a cabin at the rear of my premises and, I suspect, got trapped behind some furniture stored there, as there is no egress and I have never seen it since. The other one has thrived in captivity and has increased in size.

The two factors to be considered are feeding habits and tolerance to local climatic conditions.

Bell, writing on toads last century, says, "Its food consists of insects and worms of almost every kind. It refuses food which is not living and indeed will only take it at the moment when it is in motion."

The Rev. Gregory Bateman also writing on toads says, "Toads are not very particular as to their food so long as it is small enough to enter their mouths and is alive and moving. . . . Sometimes they will attack any small thing that is moving, such as a twig waved before them. In this way they can be persuaded to take raw meat or dead insects., etc."

Speaking specifically of *Bufo marinus*, Bateman continues, "The giant toad will feed upon slugs, lob-worms, insects of almost any kind, mice, rats and young birds."

To this list I can add from my own experience: centipedes, spiders, crabs, frogs and meat, raw or cooked, given on a dish or dropped into the vivarium. On only two occasions have I seen the meat snapped up on dropping it, but it is usually gone the following morning.

For obvious reasons giant toads must be kept on their own. I did in fact have them in a vivarium with two fully grown *Hyla caerulea* when I first had them, but frogs smaller than these would be instantly snapped up. Unlike the tree frogs they do not pursue and spring on their prey, preferring to snap up the insects with the aid of their tongues.

With regard to their adaptability to local conditions I would have no hesitation in saying that these toads have a greater tolerance to dry conditions than our own local frogs. *Hyla aurea*, perhaps the most

widely distributed frog in Australia, will soon become dehydrated and die if taken away from its moist garden and allowed to wander in the house. True it is that our commonest broadheaded tree frogs, *Hyla caerulea* and *Hyla peronii*, can withstand dry conditions by settling in a crouched position in a secluded spot and presenting only a minimum of dorsal surface to the air, but *Bufo marinus* in common with all toads appears to lose less moisture by contact with the atmosphere and moves freely in the vivarium on dry ground. I have often gone away for a few days, once for a fortnight, leaving only the water jar in the vivarium. The toad usually but not necessarily spends the day in about one inch of water and by night gets on to the bare dry ground. I would say without experimenting by comparisons, as I dislike any experiments which may cause pain and suffering to these creatures, that *Bufo marinus* has a far higher tolerance of dry conditions than any of our local frogs unless they aestivate.

With regard to temperature.—I have never supplied artificial heat (I don't believe in unnecessary artificial conditions for reptiles and amphibia as, apart from being a lot of trouble, so many things can go wrong). The toad stopped eating about April and commenced again about September without apparent ill effect, so that appears to answer questions as to the species' tolerance of Sydney conditions. Admittedly I have kept the toad indoors but, for the most part, in a cabin at the rear of the house where there is no artificial heat of any description.

The giant toad's chief enemy is motor cars. It has an acrid excretion which would be objectionable to any mammal. It is unlikely also that birds or reptiles would fancy them as a delicacy.

As a matter of curiosity they progress by means of hopping like frogs unlike most other toads which walk rather than hop.

Bufo marinus also has the ability to learn from experience as I found out when it made a somewhat difficult escape from the vivarium on successive nights. Also one might deduce this from the fact that it will feed on scraps of meat contrary to accepted opinion. This would assist the survival of the species.

As a result of an enquiry I made to the Director of the Brisbane Museum I received the following reply from the Director, Mr. George Mack, which I quote: "(a) The toad is present in the vicinity of Brisbane, and if one accepts press reports, it has penetrated into New South Wales on the coast. (b) As an introduced species it has no natural enemies. As you remark, the motor car takes fair toll in the north. Apparently, they are not sufficiently common in the Brisbane district to be affected by the car."

From the above I would have no hesitation in saying that I believe the species could establish itself at least in coastal areas in and around Sydney. Should the species succeed in establishing itself in New South Wales it is extremely problematical how it would affect us economically. Doubtless, the farmers would complain, but exactly how these toads are going to obtain access to newly hatched chickens I cannot forsee. Undoubtedly they would affect the balance of nature by devouring our small indigenous frogs and many insects, so for this reason it would seem that the zoologist is the only person who would have any real cause for complaint.

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Ichthyological Illustrations

By Gilbert P. Whitley

Curator of Fishes, The Australian Museum, Sydney.

(Figures 1-12.)

Since my book, the "Fishes of Australia, Part 1 (Sharks, Rays, &c.)," was published in 1940, I have been collecting illustrations of Australian teleost fishes towards the later volumes I have been writing. Many of these figures have been printed in the publications of the Australian Museum, the Royal Zoological Society and other institutions, and the blocks have been put aside towards the main work. I continue to present ichthyological illustrations, because I am assured that they are of use to my fellow workers and students, though there appears to be no immediate prospect of publication of further volumes of my "Fishes of Australia." This is mentioned by way of explanation for the "mixed bag" presented in this paper. At first sight, what may appear to be scatteralia, is really a series of notes and figures which, with the others I have published, fill numerous gaps in an effort to illustrate at least every genus of Australian fishes. About the first third of them (from *Elops* to *Epinephelus*) is now tolerably complete, but at least seventy genera of major importance have yet to be illustrated, apart from novelties which are being discovered as the work progresses.

I am grateful to Dr. A. A. Racek of the Fisheries Branch, Chief Secretary's Dept., Sydney, for his excellent photographs of juvenile specimens.

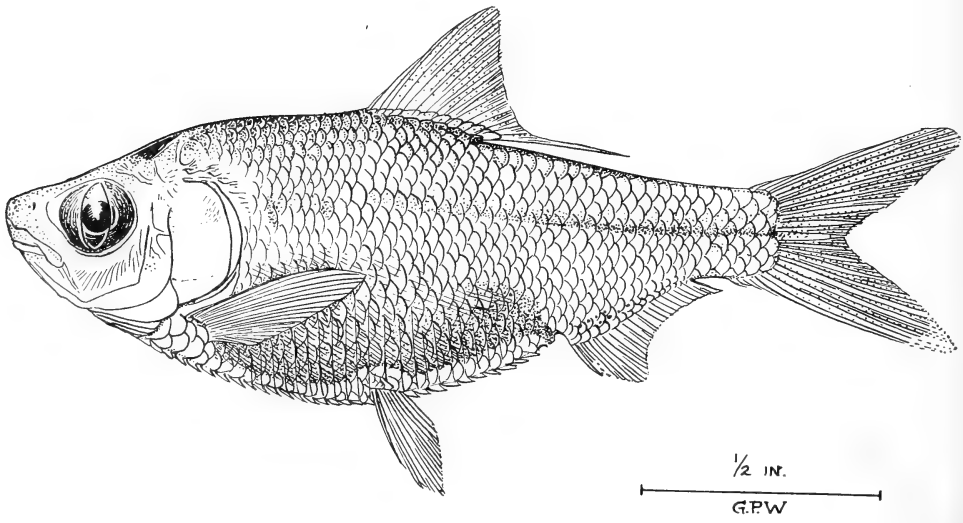


Figure 1.—Hairback Herring, *Fluvialosa erebi*. Juvenile from Queensland.

G. P. Whitley del.

Family CLUPANODONTIDAE.

Genus FLUVIALOSA Whitley, 1943.

FLUVIALOSA EREBI Gunther, 1868.

(Figure 1.)

I here describe and figure a juvenile, largest of many specimens collected by Mr. Ian Munro at Paluma Shoals, near Townsville, Queensland, on 29 Nov. 1941.

D. 14, A. 21; P. 17; V. 9. Sc. *c.* 40. Tr. 18. Predorsal 19. Scutes 18 + 13 = 31.

Head (13 mm.) 3, depth (14) 2.8 in standard length (40). Eye (5) 2.8 in head. Predorsal length nearly 20 mm.; anal base, 7; distance from ventral to anal origins 10 mm., thus less than head; length of pectoral 9.5; of ventral nearly 7; anal lobe nearly 5 mm.; interorbital 3.5 mm.

General facies as figured. Snout terminal. Eye large. Maxilla just reaching below front of eye.

Scales small, cycloid, without basal striae, about 35 around the body, and 14 around caudal peduncle. Axillary scales moderate, that of ventral fin with small auxiliary scales. Scaly sheaths to dorsal and anal fins. Large dorsal ray 8 mm. in largest, considerably shorter in others; the fin consists of three reduced simple and 13 branched rays, the first branched ray being highest. Ventral fin behind level of dorsal origin.

Colour in formalin, reddish-brown. Head, abdomen and fins whitish. Spaced brown chromatophores in snout. Brain yellow. A dark brown patch each side of occiput. Dark brown marks along each side of back from snout to tail. Some dark chromatophores around root of tail and over caudal rays; a few more over anal base. Eye and viscera dark blue. An indistinct cluster of chromatophores appears to foreshadow a humeral blotch and there is a dusky stripe along middle of each side of body posteriorly (or extending from head to tail in some examples).

Described and figured from a specimen, 40 mm. in standard length or 2 inches overall. Austr. Mus. regd. No. IB. 1997. Also more than 100 smaller fishes, IB. 1998-1999, with same data.

Loc.—Paluma Shoals, near Townsville, Queensland; 29 November 1941, coll. by Mr. I. S. R. Munro and presented by the Council for Scientific and Industrial Research. Marine.

Family GALAXIIDAE.

Genus GALAXIAS Cuvier, 1816.

GALAXIAS KAYI Ramsay and Ogilby, 1886.

(Figure 2.)

Galaxias kayi Ramsay & Ogilby, Proc. Linn. Soc. N. S. Wales (2) i, May 1886, p. 6. Fifth Creek, Torrens system, South Australia. Types in Australian Museum seen.

Id. Stokell, Rec. S. Austr. Mus. viii, 4, 1947, p. 671.

Id. T. Scott, National Park & Reserves (S. Austr.) 1953, p. 114, fig.

Galaxias olidus of authors, not of Gunther, 1866 (see Stokell, *loc. cit.*).

Galaxias oconnori Ogilby, Mem. Qld. Mus. i, 1912, p. 33. Lyra, south Queensland.

Id. McCulloch & Whitley, Mem. Qld. Mus. viii, 1925, p. 133 (listed).

Id. Duhig, Proc. Roy. Soc. Qld. xlii, 1931, p. xvi (melanosis and trematode).

Id. Whitley, Rec. Austr. Mus. xix, 1933, p. 61, pl. xii, fig. 3 (holotype figured) and Austr. Zool. xii, 1955, p. 155, fig. 2.

Lyragalaxias oconnori Whitley, Vict. Nat. lii, 1935, pl. iii, fig. 5.

D. 4, 9; A. 3, 9; P. 15; V. 7; C. 14 branched rays.

Head (12 mm.) 4.8, depth (8) 7.2, predorsal length (39) 1.4, distance from ventral to anal origins (12) 4.8 in standard length (58)

or 5.5, 8.2, 1.7 and 5.5 respectively in total length (66). Eye (3) 1.7 in interorbital (5) which equals maxilla. Eye in second fourth of length of head.

Snout, 4 mm.; preventral length, 30; snout to origin of anal, 41.5; length to end of anal base, 47.5; to end of dorsal base, 46; anal base, 6; its height, 7.5, equals dorsal base and slightly exceeds dorsal's height.

General form and proportions as figured. Lower jaw slightly longer. Maxillary reaches below front third of eye. Teeth in narrow strips, the outer row enlarged, curved, brown-tipped. Similar teeth on tongue and palatines.

About 8 to 10 gill-rakers on lower part of first gill-arch. Nostrils and mucous pores as in *Galaxias* spp. Myomeres about 18 to ventrals and 32 to anal. Vent behind level of dorsal origin.

Fins rounded. Anal fin adpressed, overlaps procurrent caudal. Origin of anal before level of middle of dorsal base. Sixth pectoral ray longest not nearly reaching half way to ventral. Ventral inserted about half way between snout and root of caudal.

Caudal emarginate with 14 branched rays with 1 simple and 7 procurrent rays above and below them.

Colour, in alcohol, yellowish with indistinct brown patches. Fins clear. Eyes blue.

Described and figured from a specimen, 58 mm. in standard length or $2\frac{5}{8}$ inches overall; Australian Museum regd. No. I. 14375 (largest of 39 specimens).

Loc.—Yetholme near Bathurst, New South Wales.

39 specimens (I. 14375) from Miss M. Erhard, and 7 (IB. 1355) from Dr. L. May, up to $3\frac{1}{2}$ inches long.

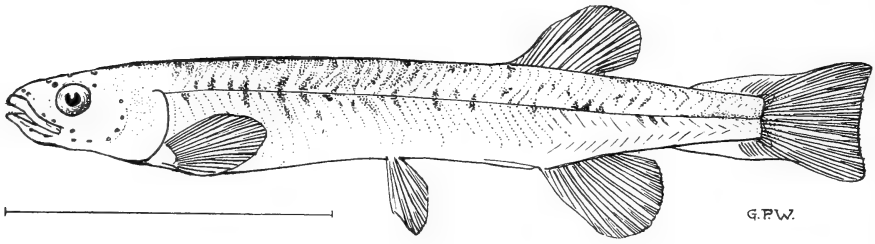


Figure 2.—Murray Galaxias, *Galaxias kayi*. Specimen from New South Wales.

G. P. Whitley del.

Family MYCTOPHIDAE.

Genus MYCTOPHUM Rafinesque, 1810.

MYCTOPHUM CUVIERI (Castelnau).

(Figure 3.)

Scopelus cuvieri Castelnau, Proc. Zool. Acclim. Soc. Vict. ii, May 10, 1873, p. 106. Knob Island, Queensland. Type in Paris Museum.

Id. Macleay, Descr. Cat. Austr. Fish, ii, 1882, p. 158.

Id. Lutken, Vidensk. Selsk. Skr. (6) vii, 1892, Spolia Atlantica, ii, p. 242, *fide* Waite, Rec. Austr. Mus. v, 1904, p. 156.

Myctophum cuvieri Fraser-Brunner, Proc. Zool. Soc. Lond., 118, 1949, p. 1057 and fig.

Here figured from a facsimile of Fraser-Brunner's 1949 illustration of this rare species, originally described from "Knob Island, Torres Strait." Perhaps the locality Noble Island (144° 50′ E. long. by 14° 30′ S. lat) was intended.

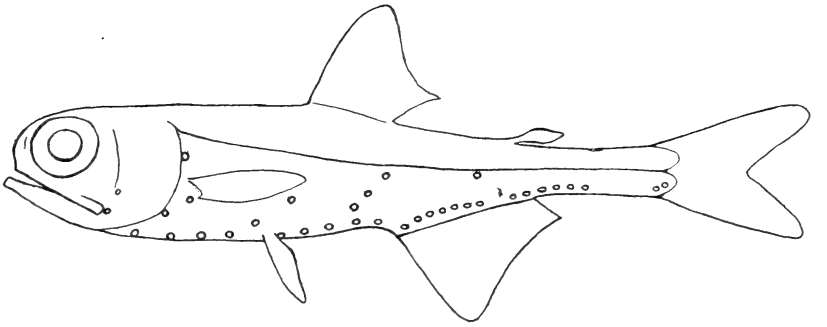


Figure 3.—Lantern Fish, *Myctophum cuvieri.* Type from Queensland. After Fraser Brunner.

Genus ELECTRONA Goode and Bean, 1895.

ELECTRONA CARLSBERGI (Taning).

(Figure 4.)

Myctophum carlsbergi Taning, Vidensk. Medd. Dansk. nat. Foren, 94, 1932, p. 126, fig. 1. East of New Zealand.

Electrona carlsbergi Fraser-Brunner, Proc. Zool. Soc. Lond., 118, 1949, pp. 1029 and 1048 and fig. *Id.* Bertelsen and Marshall, Dana Rept. 42, 1956, p. 13, footnote. *Id.* Graham, Treasury N.Z. Fish, ed. 2, 1956, p. 400.

The illustration is after Taning; the species was noted from southward of Australia, in the forties of south latitude, by Fraser-Brunner, 1949.

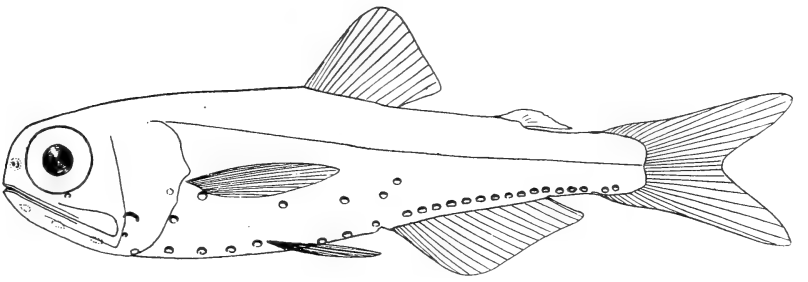
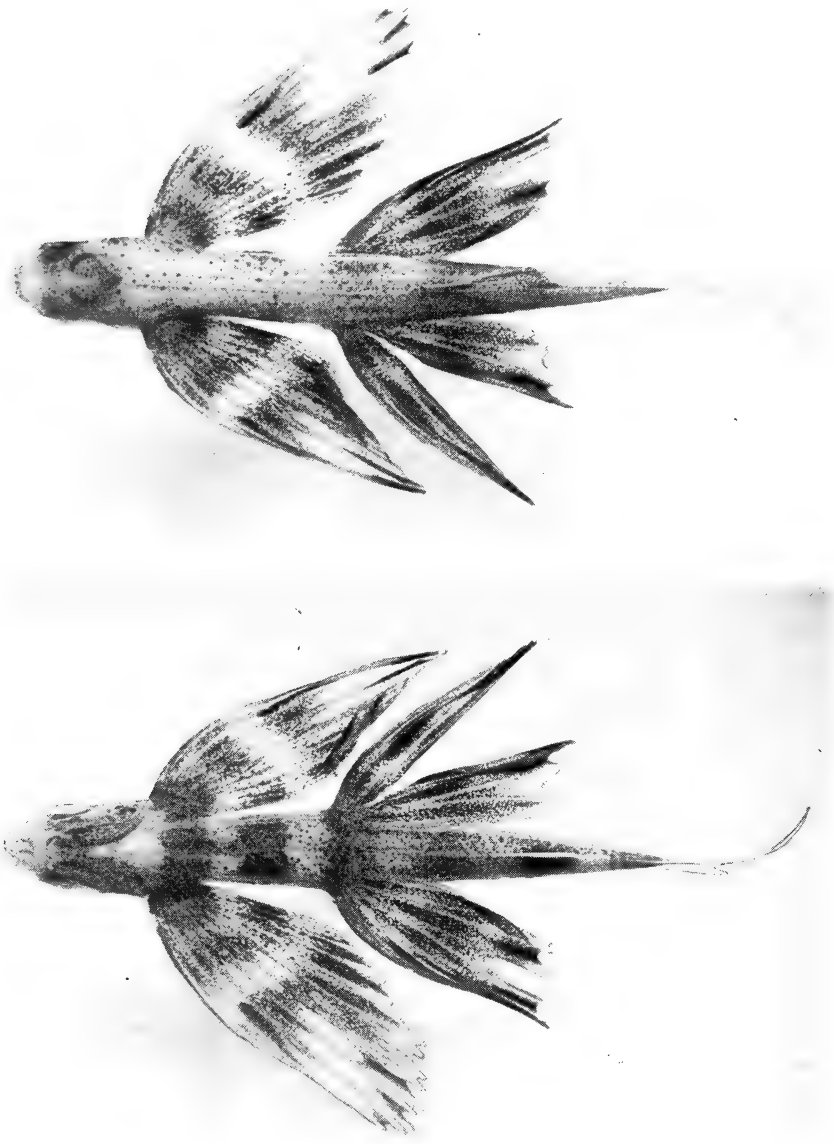


Figure 4.—Lantern Fish, *Electrona carlsbergi.* Type from east of New Zealand.

After Taning.

Family EXOCOETIDAE.
Genus CYPSILURUS Swainson, 1839, s.l.
CYPSILURUS MELANOCERCUS (Ogilby).
(Figures 5 & 6.)



Figures 5 & 6.—Dorsal and ventral views of a young Flying Fish, *Cypsilurus melanocercus*, from New South Wales.
Photo.—Dr. A. A. Racek.

Exocoetus melanocercus Ogilby, Proc. Linn. Soc. N. S. Wales x, June 1885, p. 123. Off Port Jackson, New South Wales.

Cypsilurus melanocercus Waite, Mem. Nat. Club N.S.W. i, 1904, p. 21. *Id.* Stead, Fish. Austr. 1906, pp. 64 & 70; Edib. Fish N.S.W., 1908, p. 39. *Id.* Ogilby, Ann. Qld. Mus. ix, 1908, p. 5. *Id.* McCulloch, Austr. Zool. ii, 1921, p. 31. *Id.* Griffin, Trans. N. Zeal. Inst. liv, 1923, p. 249, pl. xxii. *Id.* Roughley, Austr. Mus. Mag. iii, 9, 1929, p. 298, fig. of living fish in flight, and Gt Barr. Reef, 1936, p. 272, pl. ix, fig. 1. *Id.* Whitley, Austr. Mus. Mag. ix, 4, 1947, p. 116 (eggs & young). *Id.* Powell, Native Anim. N. Zeal., 1947, p. 66, fig. 313. And of lists, as *Cypselurus* or *Cypsilurus*.

"Flyvefisk" Schmidt a.o., Dana's Togt omkring jorden, 1932, p. 161, fig. 114.

This is the largest flying fish in the world, reaching 19.8 inches in length with a wingspread of two feet. It is probably deserving of a new generic name as the type of *Cypsilurus* Swainson (*nuttalii* LeSueur) was a young fish with elaborate barbels and a very high dorsal fin. The young of "*Cypsilurus*" *melanocercus*, figured here, has no barbels and a low dorsal fin.

The figured juvenile has the following characters: D. 13; A. 10; P. 2-3, 13; V. i, 5; L. Lat. c. 46. The pectoral and ventral fins are much shorter than in *Hirundichthys* of similar length from New South Wales, and the anal origin is well behind the level of that of the dorsal. Dimensions in mm.: Head, 8; snout, 2.4; eye and interorbital, 4; pectoral length, 20; ventral 15; predorsal, 22; depth, 6; preventral length, 18; preanal, 26; standard length, 36; total length, 45.

Colour in formalin: ground colour pale yellowish brown with dark greyish-brown markings as figured. Pectoral and ventral fins mostly dark greyish-brown, but with hyaline interspaces. Dorsal and anal mostly white with small dusky areas. Caudal white. It was the only one collected of seven seen by Mr. T. H. Webb swimming near Garden Island, Port Jackson, in the first week of December 1945 (Austr. Mus. regd. No. IB. 1436). He noted, "the dark lines are vivid red in life . . . six of the seven had the red colouring, the other very dark or black."

Family EPINEPHELIDAE.

Genus PROMICROPS Poey, 1868.

PROMICROPS LANCEOLATUS (Bloch, 1790).

(Figure 7.)

Here figured from the smallest specimen known to me of the Queensland Groper which grows to more than seven feet in length. This juvenile is only 48 mm. ($1\frac{7}{8}$ inches) long and was netted by Mr. Harold Cogger in 3 feet of water amongst zostera and posidonia weed at Woy Woy, New South Wales, on 28 April 1956. It was then about $1\frac{1}{4}$ inches long, with the same brilliant yellow and jet black pattern as it had after nearly 3 months in an aquarium. It now has the following characters: D. xi, 16; A. iii, 8. Head (16.5 mm.) 2.3, depth (14) 2.7 in standard length (38). Eye (4) equals snout; interorbital, 3 mm.; maxilla, 8; its depth more than 2 mm.; depth of caudal peduncle 5.5 mm. Middle opercular spine longest and reaching farthest back, nearer lower than uppermost opercular spine. The coloration in spirit is black and cream, patterned as illustrated here.

Several authors have figured similar young fishes but not all of them have given measurements of their specimens (Bloch's type of *lanceolatus* and the banded juvenile in Day's Fishes of Malabar, for example). The Woy Woy fish is similar to the 8-inch specimen figured in colour in J. L. B. Smith's Sea Fishes of Southern Africa (pl. 19, right-hand fig. 452).

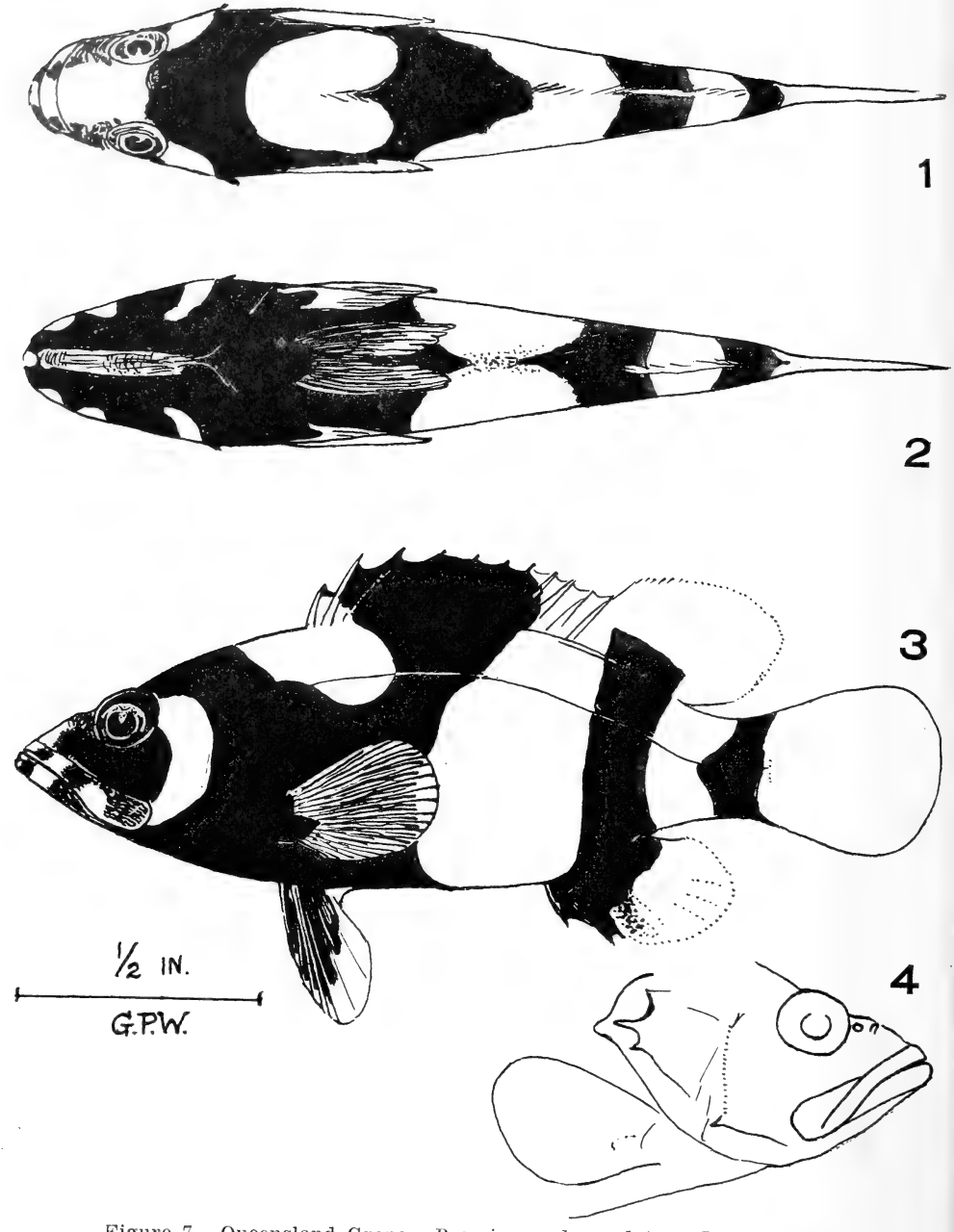


Figure 7.—Queensland Groper, *Promicrops lanceolatus*. Juvenile from New South Wales.
No. 1, dorsal; 2, ventral; 3, lateral views and 4, structure of foreparts.
G. P. Whitley del.

The disguise of this young fish afforded by its strongly contrasted pattern is an example of disruption of the creature's outlines for protective purposes similar to the cases given in Cott's Adaptive Coloration in Animals, 1940, esp. pp. 53 and 73, figs. 7, 13, 22 and 23. On the other hand there is some resemblance to such fishes as *Tetradrachmum* and *Amphiprion* which live in association with corals and sea-anemones, so that juvenile *Promicrops* may have some association, so far unsuspected, with some other marine organism, before it grows large enough to fend for itself, when its colour-pattern breaks up. Another case of striking coloration in a young fish is afforded by *Plectorhinchus chaetodonoides* (See Fowler, Bull. U.S. Nat. Mus. 100, xi, 1931, p. 257, fig. 21). Young *Coris* may be black with large white spots (Whitley, Rec. Austr. Mus. xxii, 1951, p. 401, fig. 8.).

Family CHAETODONTIDAE.

Genus THOLICHTHYS Gunther, 1868, s. lato.

Tholichthys Gunther, Ann. Mag. Nat. Hist. (4) i, 1868, p. 457, fig. Haplotype, *T. osseus* Gunther, from Zanzibar. *Id.* Day, Proc. Zool. Soc. 1870, p. 687. *Id.* Gunther, Ann. Mag. Nat. Hist. (4) viii, 1871, pp. 318-320, figs.; Journ. Mus. Godef. i, 2, 1873, p. 98, figs.; and Stud. Fish., 1880, p. 172, figs. 85-88. *Id.* Bleeker, Arch. Neerl. Sci. Nat. xi, 1876, ii, p. 305 (fide Weber & Beaufort, 1911). *Id.* Lutken, Vid Selks. Skr. Kjobenh. (5) xii, 6, 1880, pp. 569 and 608, pl. v, figs. 6-11. *Id.* Jordan, Gen. Fish. iii, 1919, p. 351. *Id.* Fraser-Brunner, Proc. Zool. Soc. 1933, p. 547, fig. 3. *Id.* Weber & Beaufort, Fish. Indo-Austr. Archip. vii, 1936, p. 1, figs. 1-4. *Id.* Fowler, Quart. Journ. Taiwan Mus. vi, 1953, p. 15, fig. 89.

Tetragonoptrus osseus Bleeker, Versl. Akad. Amst. (2) x, 1876, p. 318 (fide Weber & Beaufort, 1911). Not seen.

Tetragonoptrus (*Chaetodontops*) *dayi* Bleeker, Versl. Akad. Amst. (2) x, 1876, p. 319 (fide Weber & Beaufort, 1911). Not seen.

Osteochromis larvatus Franz, Abh. Akad. Munchen, Suppl. Band iv, 1, 1910 (1911), p. 52, pl. v, fig. 43.

Forcipiger longirostris Kendall & Goldsborough, Mem. Mus. Comp. Zool. xxvi, 1911, p. 306, pl. v, fig. 2.

The larval fish named *Tholichthys osseus* from Zanzibar by Gunther is generally regarded as a larval Chaetodontid, though its fincounts show that it is not a *Chaetodon* and Gunther later regarded it as more like a Cyttid.

Several families have *Tholichthys*-like larvae, some remarkable and curious forms of which have been described or figured in the above papers, though not all the genera to which they belong have been determined. I have not seen Bleeker's papers.

From New South Wales, the Australian Museum has recently received three postlarvae which seem nearest the Hawaiian *Tholichthys* of Fowler, 1953, of all the above references, but have different coloration and last dorsal rays much shorter; I name these below.

Genus CHAETODON Linnaeus, 1758, s. lato.

CHAETODON VITULUS, sp. nov.

(Figure 8.)

D. xiii, 22; A. iii, 18-19; P. 15; V. i, 5; C. 15 branched rays. L. Lat. 30 to 36. Sc., between head and hypural, 25 to 30. Tr. 7-10/1/18—23 from dorsal origin to anal base. Predorsal 3 or 4.

Head (11 mm.) 2 to 2.5, depth (18, 17, 15) 1.5 to 1.6 in standard length (28, 26, 24). Eye (4) 2.7 in head. Longest (2nd) dorsal spine, 7 mm. Interorbital, snout, and depth of caudal peduncle subequal (little over 3 mm.). Length of pectoral fin: 8, 7, 6 mm. Postorbital, including humeral plate, 5, 5, 4.5 mm.

General facies as figured in the accompanying photograph, for which I am indebted to Dr. A. A. Racek. Teeth compressed, uniserial. 15 gill-rakers on lower limb of first arch. Profile of snout mostly convex, except for slight dip before eye. Head-bones strongly granulated, the posterior ones with ripple-like ridges. Suprascapular and humeral plates overlap anterior body-scales. Preoperculum produced halfway back towards ventrals as a lobed plate. Form very compressed. Scales ctenoid. Lateral line tubes run around edges of head-bones, preoperculum, eyes, etc., and diverge into three branches over preorbital. Lateral line on body incomplete, situated very near back posteriorly and ceasing before caudal peduncle. Scale-rows of body ascending slightly posteriorly. Thoracic scales not enlarged.

Dorsal fins continuous, apparently no procumbent spine. The longest spine in the dorsal or anal fin is the second. Posterior margins of fins rounded, not vertical.

Colour, in formalin: yellowish to flesh-pink, with few small irregular dusky areas. Top of head yellow. A grey blotch over lower portions of 6th to 12th dorsal rays. Fins white or pinkish. Eye blue. In one small specimen there are darker inframarginal areas on soft dorsal and anal fins and rudiments of a dark ocular band.

Described and figured from the holotype (Austr. Mus. regd. No. IB. 3655), a specimen 33 mm. or 1.3 in. overall, and two paratypes (IB. 3656-7) of 30-31 mm., all trawled in New South Wales by Dr. A. A. Racek of the Fisheries Branch, Chief Secretary's Dept., Sydney.

Locs.—Jervis Bay, March 1954 (holotype); off Newcastle, 40-50 fathoms, sand and mud bottom, September 1956 (paratypes).

Vernacular name: Calf Fish, because it looks superficially like a young *Taurichthys*. Latin *vitulus*, a calf.

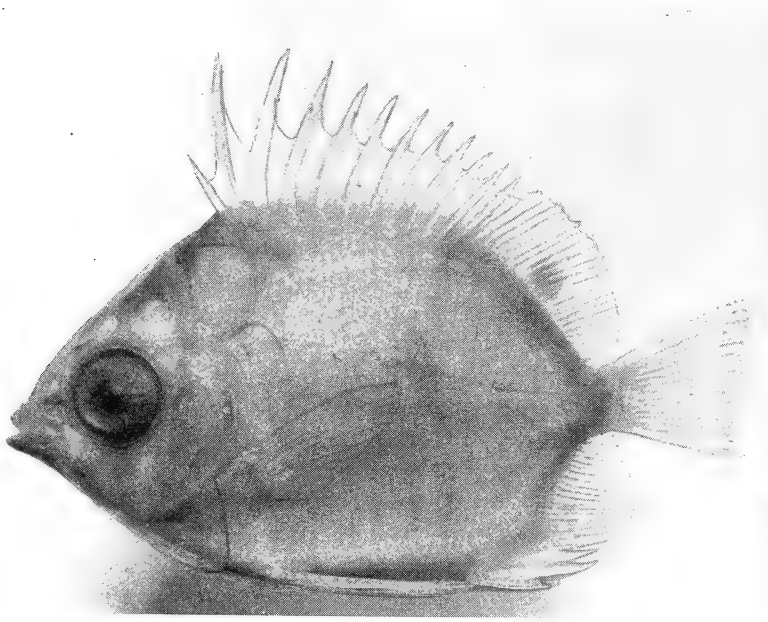


Figure 8.—Calf Fish, *Chaetodon vitulus*. Holotype from New South Wales.

Photo.—Dr. A. A. Racek.

Family CHEILODACTYLIDAE.

Genus CHEILODACTYLUS Lacepede, 1803.

Cheilodactylus Lacepede, Hist. Nat. Poiss. v, 1803, p. 5, pl. i, fig. 1. Haplotype, *C. fasciatus* Lacepede; no locality (Dutch collection).

Clodactylus Rafinesque, Anal. Nat., 1815, p. 88. Emendation. Same genotype.

Pteronemus Hoeven, Handb. Dierk. ii, 1833, p. 247, *fide* Neave, Nomencl. Zool. *Ibid.*, 1855 ed., p. 386; Hand. Zool. (ed. Clark), ii, 1858, p. 177. Logotype, *P. cynaedus* Hoeven, by present designation.

Trichopterus Gray, Cat. Fish. coll. Gronow Brit. Mus., 1854, p. 162. Haplotype, *T. indicus* Gray. Name preocc. by *Trichopterus* Agassiz, 1845, another genus of fishes.

CHEILODACTYLUS FASCIATUS Lacepede.

Cynaedus seu *Sparus mormyrus* Meuschen, Index Zoophyl. Gron., 1781, Pisces No. 221. On Gronow, Zoophylac. No. 221, pl. x, fig. 1. In oceano Indico. Not *Sparus mormyrus* Linne, Syst. Nat. ed. 10, 1758, p. 281, based on Hasselquist. "Habitat in M. infero."

Cheilodactylus fasciatus Lacepede, Hist. Nat. Poiss. v, 1803, p. 5, pl. i, fig. 1. No loc.

Cheilodactylus fasciculatus Bory de St. Vincent, Dict. class. hist. nat. iii, Sept. 1823, p. 532. Error for *C. fasciatus* Lac., ascribed to New Holland.

Pteronemus cynaedus Hoeven, Handb. Dierk., ii (? 1833 ed., p. 247, not seen), 1855 ed., p. 386; Handb. Zool. (ed. Clark) ii, 1858, p. 177. Cape of Good Hope and East Indies?

Trichopterus indicus Gray, Cat. Fish. coll. Gronow Brit. Mus., 1854, p. 162. Habitat in India (On Gronow, Zoophylac. No. 221, pl. x, fig. 1).

Cheilodactylus multiradiatus Castelnau, Mem. poiss. Afr. austr., 1861, p. 12. Cape of Good Hope.

In spite of Bory's remark, "Il se trouve dans les mers de la Nouvelle Hollande," this is not an Australian species, but is evidently South African. According to J. L. B. Smith and other authors, true *Cheilodactylus* has D. xviii-xix, 23-25; A. iii, 9; P. 9 plus 5 free rays; dorsal and anal fins with sheath of 3 to 6 scales. L. lat. about 80. Gill-rakers 12-13. Oblique dark bars on tail-lobes. At least one Australian "*Cheilodactylus*" consequently needs a new generic name and I propose

MORWONG, gen. nov.

Orthotype, *Chilodactylus fuscus* Castelnau = *Morwong fuscus*.

Distinguished from *Cheilodactylus* by having D. xvi-xvii, 31-34; A. iii, 9-10; P. 8 plus 6 free rays; L. lat. 57-62; Tr. 8/1/16 to 9/1/17. Dorsal and anal fins with sheaths of two scale-rows. Gill-rakers about 14 on lower portion. Dorsal fins subequal in height, or with front rays longer than spines in young.

MORWONG FUSCUS (Castelnau)

(Figure 9.)

Cheilodactylus fuscus Castelnau, Proc. Linn. Soc. N. S. Wales iii, May 1879, p. 376. Sydney markets. *Id.* Tenison-Woods, Fish. Fisher. N. S. Wales, 1882, p. 46. pl. xi. *Id.* Steindachner, Sitzungsb. Akad. Wiss. Wien lxxxviii, 1883 (1884), p. 1076. *Id.* Ogilby, Ed. Fish. N. S. Wales, 1893, p. 59, pl. xix. *Id.* Stead, Fish. Austr., 1906, pp. 119 and 263, fig. 43, and Ed. Fish. N. S. Wales 1908, p. 71, pl. xl. *Id.* Ogilby, Proc. Roy. Soc. Qld. xxi, 1908, p. 24. *Id.* Roughley, Fish. Austr. 1916, p. 125, pl. xl. *Id.* McCulloch, Austr. Zool. ii, 1922, p. 94, fig. 248a. And of Australian authors generally.

Cheilodactylus annularis Castelnau, Proc. Linn. Soc. N. S. Wales iii, May 1879, p. 377. Sydney Markets.

? Dactylosparus fuscus Fowler, Proc. Acad. Nat. Sci. Philad. lxxv, 1923, p. 44.

The smallest specimen of this, the Red Morwong, which I have seen, is a 2-inch one, unfortunately without locality, in the "old collection" of the Australian Museum (Regd. No. IB. 3681). It has D. xvii, 31; A. iii, 9; P. 15; L. lat. 56; Tr. 9/1/17 and is 45 mm. in standard length. A slightly larger one is illustrated here (IB. 3658). It was trawled off Newcastle, New South Wales, in 40-50 fathoms, in September 1956, by Dr. A. A. Racek and has the following characters: D. xvii, 33; A. iii, 9; P. 14; L. lat. *c.* 57; Tr. 9/1/17 and is 46 mm. in standard length or 2.2 inches overall. Head, 14; depth, 20; eye, 4.5; and interorbital, 4 mm. The longest pectoral ray is 5th from the bottom. Teeth conic. In formalin, its colour was reddish-brown, becoming grey along the back and blue at the viscera. The back and lateral line are crossed by eight oblique dark grey bars. Most of the spinous dorsal fin is dark grey and there are three dark grey blotches along lower part of soft dorsal; proximally the caudal is dark grey; otherwise fins are white. Eye blue. Distinguished from other young morwongs by the fin- and scale-counts and the transverse dark bars.

Grows to 18½ inches. New South Wales and southern Queensland.

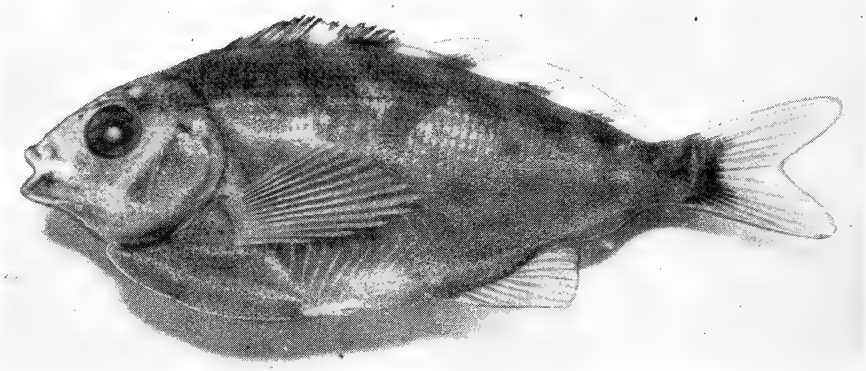


Figure 9.—Red Morwong, *Morwong fuscus*. Juvenile from New South Wales.

Photo.—Dr. A. A. Racek.

Genus NEMADACTYLUS Richardson, 1839.

For synonymy of genus, see Whitley, Austr. Zool. x, 1941, p. 34.

NEMADACTYLUS DOUGLASII (Hector).

(Figure 10.)

Chilodactylus carponemus Richardson, Proc. Zool. Soc., 1850, p. 61. *Id.* Johnston, Proc. Roy. Soc. Tas. 1883 (1884), p. lviii. *Id.* Ogilby, Ed. Fish. N. S. Wales, 1893, p. 55, pl. xviii and the *Dactylopagrus carponemus* of most authors dealing with eastern Australian specimens. Not *C. carponemus* Cuvier, Regne Anim. ed. 2, ii, 1829, p. 177 which equals *Cichla macropterus* Bloch & Schneider.

Chilodactylus douglasii Hector, Trans. N. Z. Inst. vii, July 1875, p. 244, pl. x, fig. 11b. Ngunguru and Bay of Islands, New Zealand. And of authors.

Chilodactylus morwong Ramsay, Cat. Exhib. N.S.W. Court, 1883, pp. 9 and 41. Tasmania; *nomen nudum*. *Id.* Ramsay & Ogilby, Proc.

Linn. Soc. N. S. Wales (2) i, 1886, pp. 879 and 881. Botany Bay, N.S.W. Type in Austr. Mus. seen. New synonym of *douglasii*.

Chilodactylus polyacanthus Ramsay & Ogilby, Abstr. Proc. Linn. Soc. N. S. Wales 25 Aug. 1886, p. iv and Proc. Linn. Soc. N. S. Wales (2) i, 1886, p. 880. *Nomen nudum*.

Dactylosparus douglasi Phillipps, N. Zeal. Journ. Sci. Tech. iv, 1921, p. 115; v, 1922, p. 92, with Hodgkinson.

Dactylopagrus morwong Waite, Rec. S. Austr. Mus. ii, 1921, p. 123 and of authors. *Id.* Roughley, Fish. Austr, 1951, p. 97, pl. xxxvi.

Sciaenoides morwong Whitley, Rec. Austr. Mus. xix, 1935, p. 235.

Chelidonichthys douglasii Phillipps, Nature in N. Zeal., Native Fish., 1949, p. 44 and figs.

The Morwong (*N. douglasii*) and the Jackass Fish (*N. macropterus*) are sometimes difficult to distinguish apart. Both differ from the Western Australian Queenfish (*N. valenciennesi*) in having deeper forms, less than 30 dorsal and 18 anal rays and less than 60 l. lat. scales. Key:

A. No black nuchal band. Young with dark blotch about middle of length near l. lat. In older fish, last anal ray is longer than eye-diameter. D. xvii-xix, 26-30; A. iii, 16-17; P. 8-9 plus 6-7. L. lat. 55 59. Eye slightly smaller, nape less concave and snout blunter ..... *douglasii*

AA. Black nuchal band nearly always present. No dark blotch on side of young. In older fish, last anal ray shorter than eye-diameter. D. xvii-xviii, 25-28; A. iii, 14-15; P. 9 plus 6. L. lat. 54-55 ..... *macropterus*

New Zealanders and Australians have independently worked on the biology of their Porae (*douglasii*) and Morwong (*morwong*) without realising that the two are conspecific, as is evidently the case, first discovered by Mr. J. Moreland in Wellington (in lit.) and since confirmed by other colleagues with whom I had discussions when recently in New Zealand.

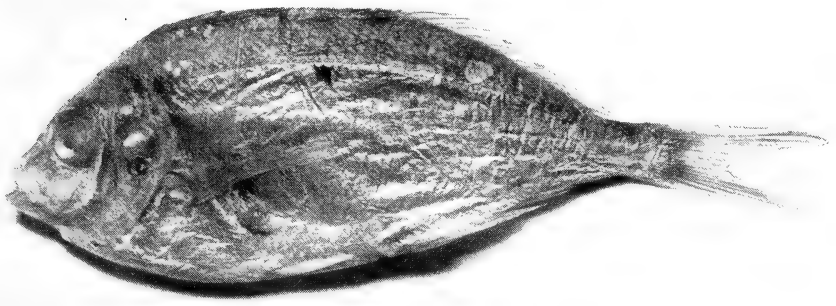


Figure 10—Morwong, *Nemadactylus douglasii*. Juvenile from New South Wales.

Photo.—Dr. A. A. Racek.

A young specimen, figured here, is 59.5 mm. in standard length (Austr. Mus. regd. No. IB. 1099) and has D. xviii, 29; A. iii, 17; P. 10 plus 6; it was olivaceous above and silvery below with a blackish spot below about the 20th L. lat. scale; first dorsal fin grey.

Loc.—Off Disaster Bay, southern New South Wales, taken by danish seine in 40 fathoms, 7 Nov. 1941; coll. Dr. D. L. Serventy, C.S.I.R.

NEMADACTYLUS MACROPTERUS (Bloch & Schneider)

(Figure 11.)

Cichla macroptera Bloch & Schneider, Syst. Ichth., 1801, p. 342. South Island of New Zealand.

Sciaena macroptera Bloch & Schneider, Syst. Ichth., 1801, p. 342, ex Forster, MS. South Is., N. Zealand. *Id.* Forster, Descr. Anim. (ed. Lichtenstein), 1844, p. 136.

Chilodactylus carponemus Cuvier, Regn. Anim. ed. 2, ii, 1829, p. 177. New name for *Cichla macroptera* Bl. Schn., New Zealand. *Id.* Cuvier & Valenciennes, Hist. Nat. Poiss. v, 1830, p. 362, part, not plate. *Id.* Richardson, Trans. Zool. Soc. Lond. iii, 1842, p. 99.

Sparus carponemus Cuvier & Valenciennes, Hist. Nat. Poiss. v, 1830, p. 363, ex Parkinson, MS. Queen Charlotte Sound, New Zealand.

Nemadactylus concinnus Richardson, Proc. Zool. Soc. Lond. vii, 1839, p. 97; Trans. Zool. Soc. Lond. iii, 1842, p. 116, pl. iv, fig. 2. Port Arthur, Tas. *Id.* Sauvage, Compt. Rend. Paris 81, 1875, p. 988 and Arch. Zool. Exper. viii, 1879, pp. 3 and 22. *Id.* Whitley & Phillipps, Trans. Roy. Soc. N. Zeal. 69, 1939, p. 234, pl. xxi, fig. 3.

Sciaenoides abdominalis Richardson, Trans. Zool. Soc. Lond. iii, June 16, 1842, p. 101; and later works. Ex Solander, MS. N. Zealand localities.

Chilodactylus macropterus Richardson, Rept. 12th meet. Brit. Assn. Adv. Sci. 1842 (1843), p. 19. And of authors.

Cheilodactylus aspersus, Richardson Proc. Zool. Soc. Lond. xviii, 1850, p. 64. Port Arthur, Tas. *Id.* Gunther, Cat. Fish. Brit. Mus. ii, 1860, p. 79. And of authors.

Dactylosparus macropterus Waite, Mem. Nat. Club N.S.W., 1904, p. 32. And of authors.

Sciaenoides aspersus Whitley, Rec. Austr. Mus. xx, 1937, p. 21.

Sciaenoides macropterus Whitley, Austr. Mus. Mag. vii, 1940, p. 179, fig. *Id.* Fowler, Proc. Amer. Philos. Soc. 82, 1940, p. 779, fig. 59.

Nemadactylus macropterus Whitley, Austr. Zool. x, 1941, p. 35, and of most modern authors.

To illustrate the young, silvery "Paper Fish" stage of the Jackass Fish I have chosen one (Austr. Mus. regd. No. IB. 777) found by Mr. K. A. Hindwood washed ashore at Long Reef, near Sydney, N. S. Wales, on 20 July 1941. It is 40 mm. in standard length and the fins are too broken for the rays to be counted. L. lat. 65. Dark grey above, beetroot-red on sides, brilliant silvery below. No dark spot near l. lat. Lower pectoral rays simple, but not produced.

Family GASTEROCHISMATIDAE.

GASTEROCHISMA MELAMPUS Richardson, 1845.

The Butterfly Mackerel can now be recorded from Victoria. A 6½ inch specimen was caught at the breakwater at Portland, Victoria, and was figured in the Sunday Mail (Adelaide) of 26 January 1957. I am grateful to Mr. J. Scott of Warrnambool, Victoria, for calling my attention to this occurrence and supplying me with data and a photograph of the specimen.

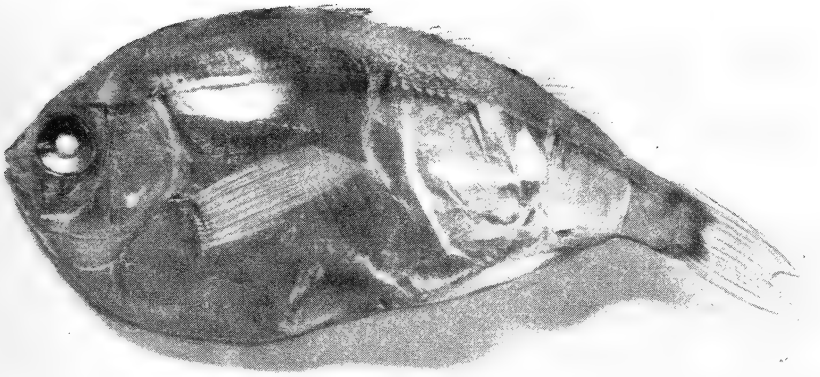


Figure 11.—Jackass Fish, *Nemadactylus macropterus*. Juvenile from New South Wales.

Photo.—Dr. A. A. Racek.

Family ANTENNARIIDAE.

Genus ANTENNARIUS Daudin, 1816.

ANTENNARIUS PICTUS (Shaw & Nodder).

Lophius pictus Shaw & Nodder, Nat. Miscell. v, May 1, 1794, pl. clxxvi, upper fig. New Holland (Banks) = Botany Bay, New South Wales. *Id.* Shaw, Gen. Zool. v, 2, 1804, p. 386, pl. clxv, upper fig. *Id.* Good & Gregory, Pantologia xiii, Nat. Hist., 1813, pl. cliii, fig. 1.

Lophius histrio var. *pictus* Bloch & Schneider, Syst. Ichth., 1801, p. 142.

Chironectes variegatus Schinz, Das Thierreich (Cuvier) ii, 1822, p. 501, footnote; Cuvier, Regne Anim. ed. 2, ii, 1829, p. 252 and Cuvier & Valenciennes, Hist. Nat. Poiss. xii, 1837, p. 422. No locality. Preoccupied by *C. variegatus* Rafinesque, Prec. Somiol., 1814, p. 19, *fide* Jordan, Proc. Acad. Nat. Sci. Philad. 1917, p. 278.

Chironectes pictus Cuvier, Regne Anim., ed. 2, ii, 1829, p. 252.

Chironectus pictus Swainson, Nat. Hist. Class. Fish. Amphib. Rept., ii, 1839, p. 330. Not of Hoeven, Handb. Zool. (ed. Clark), 1858, p. 141, pl. iii, fig. 6, which is a *Pterophrynoides*.

Pterophrynoides histrio var. *pictus* Whitley, Austr. Zool. vi, 1931, p. 328.

An uncommon little angler fish, found in New South Wales, where it grows to about 3¾ inches. It is not a *Pterophrynoides* because the esca is well developed and the skin is bristly. D. i/i/i/ about 14 to 17. This Painted Angler was originally obtained at Botany Bay, New South Wales, by or for (Sir) Joseph Banks. Later a drawing was made of it, perhaps by the convict-artist Thomas Watling, for I found at the British Museum that No. 318 of the "Watling drawings" there was the original of Shaw and Nodder's plate of *Lophius pictus*, the

"compressed brown Lophius with yellowish blotches margined with red." Their species was wrongly regarded by authors as a synonym of *histrio* Linn., or, in Gunther's Catalogue, as *Antennarius multiocellatus* var. *leucosoma* Bleeker, though Bleeker himself had (Nat. Tydschr. Ned. Ind. vi, 1854, p. 104) synonymised it with *chironectes* Cuvier. Watling's figure has been reproduced, facing left or right at the whim of engravers, in several books, including Oliver Goldsmith's "History of the Earth and Animated Nature" (1860 ed., Ichth. pl. xlvii, fig. 14) and I feel that *pictus* should be reinstated as a species of *Antennarius*. The Australian Museum has but few specimens, one from Ballina, New South Wales, in the fresh state, having been pale salmon-coloured or yellowish pink, crossed by several large irregular greyish blotches of uneven tone, the pattern continued over eyes and inside mouth; belly fairly uniform yellowish. As Swainson (op. cit. i, 1838, p. 202) has written: "The imagination can scarcely conceive more fanciful forms than such as are actually found in this group; and the monstrous combinations which painters have represented under the aspect of animals, can scarcely surpass the singularity of many of these real fish."

GOLEM, gen. nov.

Orthotype, *Antennarius cryptacanthus* Weber (Siboga Exped. Fische, 1913, p. 564, pl. iii, fig. 2, from Indonesia) = *Golem cryptacanthus*.

Differs from *Antennarius* Daudin, 1816, in lacking an illicium, all the dorsal spines being completely concealed by integument. Lips papillose. Mouth small, oblique. Skin smooth, lateral line system of spaced papillae, no conspicuous dermal processes.

Dorsal and anal fins joined to caudal. About 12 to 14 dorsal rays, 7 to 8 anal, 8 pectoral and 5 or 6 ventral.

Mr. Melbourne Ward collected a specimen from Port Moresby, Papua in 1933. (Austr. Mus. regd. No. IA. 5720) with the following characters:—

D. (iii) 14; A. 8; P. 8; V. 5; C about 10.
Head (15.5 mm.) 2.3, depth (24) 1.5 in standard length (37).
Eye (2) 1.7 in snout (3.5) and 3 in interorbital (6).

Colour: green, sprinkled on head, body and fins with regular, small, darker green spots; irregular dark brown marks on head.

The range of *Golem cryptacanthus* is thus from Indonesia to Papua. It is an angler-fish without any angling apparatus and rather recalls the allies of *Erosa* amongst the scorpion-fishes and *Gobiodon* in the gobies.

Family SPHAEROIDIDAE.

Genus SPHAEROIDES Anon., 1798.

SPHAEROIDES HALSTEADI, sp. nov.

(Figure 12.)

D. 2, 8; A. 7; P. i, 15; C. 7 branched rays.

Head without spines, mostly smooth; skin on top of head much wrinkled, mostly longitudinally. Eye covered by skin. Teeth laminate. Lips papillose. Chin receding. Each nostril a low papilla with two openings.

Head (31 mm.) 3.1 in standard length (102). Eye 10; interorbital 14; snout 15; gill-opening, 7 mm.

Gill-opening without papillae or cartilaginous spur. Lateral line very indistinct, apparently restricted to thin canals behind nostrils, eyes, and pectoral fins.

Body mostly smooth but a spinous area on middle of belly extends up each side behind pectoral fins. A patch of small spines on nape. No postero-ventral ridge and no scale-like spines.

Dorsal and anal fins irregularly rounded, not pointed or lobed, their last rays more than half length of anterior rays. Pectoral rounded. Caudal bisinuate, upper lobe longer, pointed.

Colours when fresh: upper half olivaceous, lower half white. Four or five indistinct darker crossbands on back. Along sides are honey-coloured round spots about the size of pupil. Fins olivaceous to yellow. Brown blotch before pectoral base; dark grey area before caudal root. Eye blue with bronze and gold iris. Nostrils golden. Teeth brown to dull white. No dark spots on back.

Length $4\frac{7}{8}$ inches.

Loc.—Chinaman's Beach, Middle Harbour, Sydney, New South Wales, 18 Aug. 1956. Coll. G. P. Whitley.

Described and figured from the holotype (Austr. Mus. regd. No. IB. 3623) and named after Dr. Bruce W. Halstead of California for his studies on poisonous and venomous fishes. Characterised by its coloration, rounded fins, having interorbital subequal to snout, few pectoral rays and restricted spiny areas on body.

One may perhaps deduce from the inflatable stomach and the long lower pectoral rays that this species may float at the surface a good deal and it is in several respects intermediate between *Sphaeroides* and *Liosaccus*.

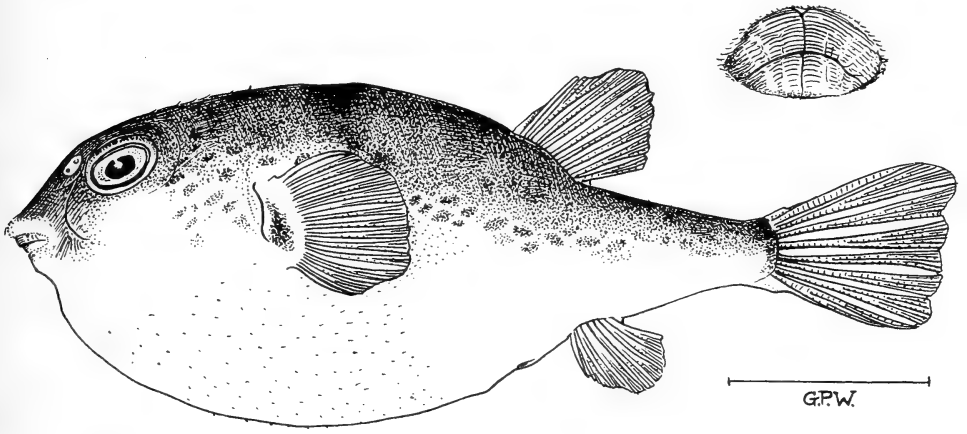


Figure 12.—Toado, *Sphaeroides halsteadi*. Holotype from New South Wales. Inset: the laminate teeth.
G. P. Whitley del.

Family GOBIIDAE.

Genus KOUMANSETTA Whitley, 1940.

Seychellea Smith (Ann. Mag. Nat. Hist. (12) ix, 1957, p. 726, not *Seychellesia* Boliver, 1912, in Orthoptera) is evidently congeneric with my *Koumansetta* (Austr. Zool. ix, 1940, p. 425, fig. 43) though his species *K. hectori* (Smith), differs in having more dorsal and anal rays, fewer scales, and in proportions and colouring. *Amblygobius inornatus* Herre, 1927 and *A. myersi* Herre, 1935 may be other species of *Koumansetta*.

An Investigation of the Food of the Bell Bird *Manorina melanophrys* Latham

By K. G. Campbell and K. M. Moore.
(Contribution from the Forestry Commission of N.S.W.)

INTRODUCTION.

Because of the more intensive utilisation of timber in forests of the Wyong-Gosford area in recent years, the incidence of deterioration and death of *Eucalyptus saligna* J. A. Smith (Sydney blue-gum) apparently due to insect attack, has caused increasing concern to forestry staff.

Sap-sucking insects of the family Psyllidae (Order Hemiptera) were reported as damaging areas of *E. saligna* at Ourimbah State Forest a few years ago, and it is probable that the large increase in their numbers has occurred over many years.

Psyllids of the genus *Spondyliaspis* are most numerous, but species of other genera are also present in small numbers.

During their immature stages they shelter beneath a dome-shaped covering which they construct from their body secretions. These coverings, known as "lerps," are of many colours and shapes according to the various species, but those of the *Spondyliaspis* sp. concerned are white to cream in colour, and occur in numbers on the leaves of their host plants. They may be found on both the upper and lower sides of the leaves. The lerp of a last instar nymph may be up to 4.5 mm. in diameter, and 3 mm. in height. During the early instars of the psyllids they are transparent, becoming increasingly opaque as the insect approaches the adult stage. They are slightly sweet to the taste. It is known that these insects occur in many gullies or on adjoining slopes throughout the Gosford and Wyong districts, and it has been observed that bell birds usually occur where these insects abound.

HOSTS.

The known hosts of this species of the Psyllidae in the Wyong-Gosford area are:—

E. saligna J. E. Smith (Sydney blue-gum),
E. acmenioides Schauer (white mahogany),
E. paniculata J. E. Smith (grey ironbark),
E. deanei Maiden (round-leaved gum).

THE BELL BIRD *Manorina melanophrys* LATHAM.

According to Cayley, the bell bird or bell miner is found in flocks, frequenting the leaves and branches of tall eucalypts as well as the undergrowth beneath the trees. Its food consists of insects and their larvae, procured among the leaves and branches or in crevices of bark.

Various opinions are expressed as to the influence of this insectivorous bird on the psyllid population. It is possible that the birds are an important controlling factor because the psyllids form a portion of their food. However, if they are not selective, then the parasites and predators are also eaten, consequently favouring an increase in psyllid population.

No definite information was available as to what constituted the food of these birds in the area of investigation, so when permission was granted by the Chief Secretary's Department, three bell birds were collected at Ourimbah State Forest.

STOMACH CONTENTS.

Dissections of the three birds were carried out with the assistance of Dr. A. Keast of the Australian Museum, and the stomach contents were examined on 19 November 1956.

The following insects etc. which constituted the food of each bird are listed in their order of abundance.

1. *Mature male.*
   (a) Coleoptera.—Numerous broken pieces of elytra, legs and heads, mainly of bright metallic blue, green, red and bronze. These insects were small species apparently of the families Chrysomelidae (leaf-eating beetles), and Tenebrionidae.
   (b) Hemiptera.—Psyllidae. Nymphs, adults and wings of *Spondyliaspis* sp. These were either whole or mutilated.
   (c) Hemiptera.—Psyllidae. Pieces of lerps.
   (d) Lepidoptera.—Three larval skins and some mandibles.
   (e) Hymenoptera.—Formicidae. One small ant.
   (f) Orthoptera.—Blattoidea. One egg-capsule of a cockroach.
   (g) Hemiptera.—Cicadoidea. Possibly Cercopidae (frog-hoppers). Exo-skeleton and wings.
   (h) ? —Insect eggs of undetermined origin.
2. *Immature male.*
   (a) Hemiptera.—Psyllidae. Nymphs, adults and wings of *Spondyliapsis* sp. similar to those found in the mature male bird.
   (b) Hemiptera.—Psyllidae. Pieces of lerps.
   (c) Coleoptera.—Pieces of elytra, legs etc., similar to those found in the mature male bird.
   (d) Orthoptera.—Blattoidea. Cockroach nymphs.
   (e) Lepidoptera.—One larval skin.
   (f) Diptera.—Syrphidae? Pieces of larval skins.
   (g) Arachnida.—One small spider.
3. *Mature female.*
   (a) Coleoptera.—Pieces of elytra, etc. similar to those found in the male birds. Curculionidae. Head of a weevil.
   (b) Hemiptera.—Psyllidae. A few *Spondyliaspis* sp.
   (c) Hemiptera.—Psyllidae. Pieces of lerps.
   (d) Lepidoptera.—One larval skin.
   (e) Diptera.—Syrphidae? Pieces of larval skin.

CONCLUSION.

The examination of the stomach contents revealed that the bell birds in the Ourimbah State Forest area, at this time of the year, feed on various insects, lerps and spiders.

Beetles and psyllids (both mature and immature) together with their lerps, form the main portion of their diet.

Psyllids predominated in the food of the immature male, and were proportionately numerous in the stomachs of the other two birds.

It should be remembered that only three specimens from a large population of bell birds were examined, but the pest insect formed a large proportion of their food.

There was no evidence to suggest that the very small wasp parasites (Chalcidoidea) of the psyllids were destroyed by these three birds. However, larvae of these endo-parasites would be destroyed when immature psyllids were taken by the birds.

What appeared to be the remains of larva of Diptera, family Syrphidae, were found in the stomachs of the immature male and the mature female. Some species of the Syrphidae are predatory on psyllids, and it is presumed that they are utilised as food by the bell birds.

Further investigations to assess the relative importance of other insects exerting influences on the psyllid population in the Wyong-Gosford area are being carried out by entomologists of the Forestry Commission of N.S.W.

REFERENCE.

1943. Cayley, N. W.—"What Bird Is That?" p. 97. Angus & Robertson, Sydney and London.

Observations on Some Australian Forest Insects

I. Notes on the biology of the sawfly *Polyclonus atratus* Kirby 1882, (Family PERGIDAE, Subfamily EURYINAE), and some of its parasites.

By K. M. Moore.

SUMMARY.

Polyclonus atratus Kirby 1882 (Family PERGIDAE, Subfamily EURYINAE) occurs only in Australia. The genus is monotypic.

Distribution, host plants and parasites of this insect are recorded.

The larvae are gregarious and feed on dying and dead leaves of *Eucalyptus* and *Angophora* spp. Adults oviposit in the leaves of *Eucalyptus* spp. and in blades of grass growing beneath the leafy tops of felled trees. The life-cycle occupies approximately 12 weeks in the warmer weather, but up to 6 months in cooler weather.

Parasites include Hymenoptera, Diptera and the fungus *Beauveria bassiana* (Balsamo) Vuillemin.

Figures are given of the wing and "saw" of the adult female, also an antenna of a male and a female. The last instar larva is described; the head capsule and 9th abdominal segment are figured.

HISTORICAL.

The type male of this sawfly was originally described by Kirby (1882) from a specimen which was then in the collection of the British Museum. The description is accompanied by a small illustration (29 mm. x 19 mm.) of the adult male and a figure (26 mm. in length) of the right antenna of the male. The details on the specimen label indicate that it was collected in Australia by Mr. Damel.

Konow (1905) placed the genus *Polyclonus* Kirby as a synonym of *Ancylonura* Cameron, but Rohwer (1918) was of the opinion that this reclassification was incorrect.

The original description of the female by S. A. Rohwer (1918) was made from a specimen which was at that time in the British Museum and labelled Melbourne, Victoria.

Forsius (1927), in his comments on the structure of the antenna of the male, confirmed Rohwer's opinion.

At present, the generic name *Polyclonus* is retained. The genus is monotypic, i.e., *P. atratus* is the only species yet described in that genus.

Benson (1938) transferred this species from the subfamily PERREYIINAE to the EURYINAE, having added it to his 1934 revision of this subfamily.

DISTRIBUTION.

Dr. R. B. Benson, in a personal communication (July 1955) stated that *P. atratus* has not been found outside Australia. He also kindly provided a list of the specimens of *P. atratus* in the British Museum collection, together with their label data.

The present known distribution of the insect and the location of specimens is as follows:—

(i) Specimens in the collection of the British Museum:—

Australia, †Mr. Damel, 1 ♂ (Type specimen).
Queensland, Tambourine Mts., 11-18 iv 1935, 1 ♂.
Queensland, Tambourine Mts., 19-26 iv 1935, R. E. Turner, 2 ♂ ♂
Queensland, Caloundra, 28 ix 1913, H. E. Hacker, 1 ♂.

N.S.W., Ebor, January, 1934, F. E. Wilson, 1 ♀
N.S.W., National Park, 29 v 1904, 1 ♀.
? * Guaylp, 1 ♂.
? † Mus. Godefa, (Brit. Mus. 1935-2), 1 ♀.

(ii) Specimens in the collection of the Australian Museum, Sydney, N.S.W., and determined by R. B. Benson, 1938:—
Queensland, Tambourine Mt., December 1926, A. Musgrave, 1 ♂.
? This specimen, K44013, is without label data. 1 ♀.

(iii) Mr. A. N. Burns, Curator of Insects at the National Museum, Melbourne, in a personal communication dated 29 August, 1955, kindly supplied particulars of a specimen determined by R. B. Benson in 1934, in the collection of the National Museum, Melbourne:—
Victoria, Bunyip, 1 ♀.

(iv) Specimens in the Macleay Museum collection at The University of Sydney:—
N.S.W., Sydney, 2 ♂♂.
N.S.W., ‡Gembrook, 2 ♂♂, 1 ?
N.S.W., 2 ♂♂.

(v) In a personal communication dated 9 November, 1955, Dr. W. A. MacDougall, Chief Entomologist of the Dept. of Agriculture & Stock, Brisbane, Queensland, kindly supplied the following information:—
Queensland, Caloundra, September 1913, H. Hacker, (one dilapidated specimen in the collection of the above Department).

(vi) N.S.W., Lisarow, 1954-55. Several ♂♂ and ♀♀ collected by the author. These specimens, some of which were determined by R. B. Benson 1955, are in the collection of the Forestry Commission of N.S.W., others with the N.S.W. Department of Agriculture.
N.S.W., Somersby Falls, December 1955. Several larvae were collected by the author.
N.S.W., Norah Head. Larvae and adults collected by the author.

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* From extensive enquiries, the only place-name in Australia found to resemble that on the label is in Western Australia, namely, Qualeup (pronounced "kwaylup" with only slight sounding of the "u"). With such a pronunciation it is possible that Qualeup is the locality mentioned on the label. Should this be correct, it becomes of particular interest, as this specimen would be the only one recorded from the western portion of Australia.

Qualeup, situated 207 miles to the south-east of Perth, and approximately 85-90 miles from the nearest coastline, is inland from the Stirling Range. The topography consists mainly of granite outcrops with *Eucalyptus marginata* J. E. Smith (jarrah) as the predominant tree stand. The rainfall is approximately 40 in. p.a., which compares with the rainfall of the sections of eastern Australia from Victoria to Queensland, where this insect has been collected.

† The following extract from "The History of the Collections contained in the N.H. Depts. of the B.M." 2: 548, may refer to the data on this label:—
"Godeffroy Museum, Hamburg.
From 1869-1881 many desiderata, including types, were received from the Godeffroy Museum. These were principally from the Australian coasts and the Pacific, and, with Whitmee's collections, formed the basis of Dr. Gunther's 'Fische der Sudsee,' published in the Journal of the Godeffroy Museum."

Also an extract from "Bibliography of Australian Entomology" by A. Musgrave, p. 64:—
"DIETRICH, AMALIE (1822-1891).
Frau Dietrich left Hamburg March 15, 1863, in the sailing vessel La Rochelle, for Australia, to collect specimens for the Godeffroy Museum in Hamburg."

Frau Dietrich forms the subject of a book by her daughter Charitas Bischoff, "The Hard Road: the life story of Amalie Dietrich, Naturalist, 1821-1891" London, wherein one may read something of the life and Australian wanderings of this remarkable woman collector.

Contemporaneous with her was another German collector, Edward Damel. He collected in the Pacific Islands as well as Australia for the Godeffroy Museum. He died Sept. 3rd, 1900, in Hamburg, aged 70. (See Musgrave, A., "Bibliog. Aust. Ent." 1932, p. 60.)

‡ There is no Gembrook in N.S.W. A town of that name is in the Dandenong Ranges, at an altitude of 1020 ft., 38 miles east of Melbourne, Victoria.

Polyclonus atratus appears to be widely distributed throughout the area between the coast at sea level, and the tablelands of the Great Dividing Range up to about 3,000 ft. altitude, in eastern Australia; from Caloundra in Queensland, approximately 60 miles north of Brisbane, through New South Wales and south to Gembrook and Bunyip, approximately 50 miles east of Melbourne, in Victoria. There is also a possibility of its range extending to Western Australia.

HOST PLANTS.

The following hosts are recorded from the Gosford area of N.S.W.:—
Eucalyptus saligna J. E. Smith (Sydney blue gum),
E. acmenioides Schauer (white mahogany),
E. resinifera J. E. Smith (red mahogany),
E. haemastoma J. E. Smith (scribbly gum),
E. pilularis J. E. Smith (blackbutt),
Angophora costata Domin (smooth-barked apple),
A. intermedia A. P. de Candolle (rough-barked apple).

It is to be expected that, from future observations, other hosts will be added to this list, since the above-mentioned tree species do not occur in all areas where the insect has been collected.

BIOLOGY.

Little is known of the biology of many Australian forest insects, and no data on the biology of *P. atratus*, or in fact any member of the subfamily EURYINAE of the PERGIDAE, to which it belongs, appear to have been published (personal communication, Benson, July 1955). Specimens were forwarded to the Commonwealth Institute of Entomology for identification and these were determined by Dr. R. B. Benson of the British Museum.

An adult male specimen of this small sawfly was first collected by the author on 24th September 1954 at Lisarow, near Gosford, approximately 56 miles north of Sydney. The specimen was taken on a sapling of *E. saligna* growing in association with *A. intermedia*, *E. acmenioides*, *Casuarina torulosa* Aiton (rose she-oak) and *Syncarpia laurifolia* Tenore (turpentine) on a ridge of Hawkesbury sandstone. This ridge, which rises to an altitude of about 250 ft., runs approximately north and south.

It was observed that the dead leaves of trees which had been felled for firewood, later became skeletonised. Superficially, the damage appeared to have been caused by lepidopterous larvae, but closer examination showed that sawfly larvae, which later proved to be those of *P. atratus*, were responsible.

Adults of *P. atratus* have been taken from August to May. During the warmer months males are usually seen flying near the leafy top of a felled tree, while the females seem to prefer the area close to the ground, or the lower leaves of the drooping tree-trop. The female, when disturbed, frequently feigns death and falls to the ground. Male sawflies appear to be attracted to an area when overhanging leaves and twigs are cleared away from damp ground beneath the crown of a felled tree.

During oviposition, the female assumes a position astride the leaf, inserting the eggs into the leaf edge. At the same time the antennae, contiguous for most of their length, slope downwards and forwards and are separated at the tips to extend on either side of the leaf. The ovipositor is held in a chitinous sheath (figs. 3 and 7) which is utilised to cut the slot in the leaves for the insertion of the ovipositor when egg-laying takes place.

In warm weather, oviposition usually takes place within 24 hours of the felling of a tree, the eggs being inserted along the edges of

leaves or in blades of grass growing beneath the foliage of the felled tree. The younger leaves nearest the ground and under the thickest cover where desiccation would be reduced, are preferred for oviposition, rather than the older and coarser leaves and those in the more exposed sites.

Oviposition continues for some weeks, so that larvae of various instars commonly occur together. The eggs hatch in approximately two weeks during the early spring or late autumn, a shorter period being necessary in the warmer weather. The approximate time from oviposition to the emergence of the adult insect is 10 to 12 weeks in summer, but this period is extended to 5 or 6 months for the winter generation.

This species of sawfly is multi-voltine.

EGGS. The eggs are white, opaque and more or less oval. At oviposition they are considerab'y flattened and are laid in rows of up to 30, between the upper and lower surfaces of a leaf. The thin chorion encloses a white, opaque fluid when the egg is first inserted into the leaf tissues. At this stage they measure approximately 0.75 mm. in length and almost 0.5 mm. in width. Each egg is inserted in a separate slot cut in the edge of the leaf by the saw-like ovipositor sheath of the female. The slots are generally slightly deeper than the length of the egg and somewhat wider, but in some instances the extremity of the egg has been observed to protrude beyond the edge of the leaf. Eggs obtained by dissection of a female adult specimen were found to be approximately 0.5 mm. long and 0.3 mm. wide.

LARVAL HABITS. *P. atratus* larvae, from their earliest instar, feed on the surfaces of the dying, or apparently dead and dry, leaves of the host plants previously ment'oned, later completely skeletonising them. Most other sawfly larvae are phytophagous, although Tillyard (1926) states that larvae of *Diphamorphos* (a genus also in the EURYINAE, Benson 1938) are found feeding on dead leaves, under bark etc.

During a bright day the gregarious larvae shelter beneath the leaves and litter close to, and on the ground, commencing to move around and feed as darkness approaches. However they have been observed feeding during some dull or cloudy days.

Generations of this insect overlap to such an extent that some larvae can be found during most months of the year in the Gosford district. Larvae appear to pass through six instars prior to pupation.

A description of the larvae of *P. atratus* has not previously been published.

(a) Description, last instar larva:—

Mottled light to dark velvety brown; maximum length approximately 13.5 mm.

(i) Head. Roughened by numerous flattened tubercles and mottled light to dark brown over the epicranium and laterally to the ocelli (figs. 4 and 5); frons, together with an area beyond the frontal sutures and bases of antennae, cream; curved, prominent brown markings, usually four, radiating from around the central area of the frons and a brown spot in apex of frons; clypeus and antennae paler than frons, almost white; labrum dark brown to black; mandibles brownish with apices black and conspicuously dentate; bases of antennae surrounded by a very narrow brown line; ocelli surrounded by a wide, black circle; dark brown to black lateral area extending for a short distance posteriorly from the black circles surrounding the ocelli; what appear to be very minute ocelli, one in each angle formed by the junction of the median epicranial suture and the frons suture; the head bears a number of short setae.

(ii) Dorsal thoracic and abdominal segments. Mottled light to dark brown, bearing numerous short setae (immediately following an ecdysis the larvae are almost completely white); a narrow, darker medio-dorsal stripe, and dorso-lateral areas each side of a pale stripe are discernible; the prothoracic segment is narrow, short, and slightly wider than the head, and bears four lateral and two dorsal, pointed tubercles; meso- and meta-thoracic segments are of approximately equal width and are the widest and longest; meso- and meta-thoracic segments, and abdominal segments 1 to 8 are produced laterally and more or less horizontally to form scallops, the thoracic segments tipped with a spine, the abdominal segments with setae; transverse bands of light-coloured verrucae on each segment; ninth abdominal segment (figs. 8a and 8b) produced at an angle posteriorly, into a transverse, four-pointed ridge, each point with a small spine at the extremity.

(iii) Ventral thoracic and abdominal segments. Light grey-brown with two short, longitudinal black stripes extending from the head-capsule to the bases of the forelegs; three pairs of thoracic legs with single tarsal claws; pro legs on abdominal segments 3 to 8; the pro-legs on segment 10 are modified to form a transversally elongate pad.

(b) Other instars:—

During the first, and sometimes the second instar, the colour of the head-capsule is a uniform dark brown, the radial marks being absent from the frons.

In the first instar the ninth abdominal segment bears four prominent dorsal points, with long setae arising from their tips. In other instars, the long setae are replaced by short spines.

At each ecdysis the head-capsule splits along the median epicranial suture and the sides of the frontal suture, and the larva emerges through a transverse split in the exuviae behind the capsule and along the medio-dorsal line of the abdomen. The head-capsules usually remain attached to the exuviae.

PUPATION. Metamorphosis occurs in small, black cocoons approximately 4 mm. to 7 mm. in length and 3 mm. to 4 mm. in width. The cocoons are composed of a tough, silky substance and are easily compressed. Their extremities are rounded, and the adult emerges through a hole which is usually cut from one end. Cocoons are found attached to sticks, stumps, rocks or rotting leaves near the host plants, or on the ground under the thickest cover of fallen leaves and other rubbish, and occasionally in the upper $\frac{1}{8}$ in. of soil. They are generally most numerous where larval excreta is thickest and a deposit of $\frac{1}{4}$ in. to $\frac{1}{2}$ in. of excreta is not unusual beneath the skeletonised leaves. The cocoons are often covered with attached excreta or soil which makes their detection difficult.

ADULTS. The adults of this sawfly are rather unattractive in appearance. They are black and shiny, have no apparent metallic suffusion, only small, pale coloured areas on the legs relieving the sombre coloration.

As the original descriptions of the adults by Kirby and Rohwer appear separately to be inadequate, and the number of the antennal segments given in most descriptions differs, it is hoped that the following description will assist in the identification of this species.

(i) Male. The male, which is approximately 4 mm. in length, with a wing-span of 8 mm., is black, with the exception of the legs and mouthparts. The legs show varying degrees of black coloration with cream; the coxae and femora are dark brown to black, except the distal ends which are cream; the posterior tibiae and tarsi darker than the anterior or median; each tibia bears a pair of distal spurs.

Antennae are 18 or 19 jointed and conspicuously pectinate below, the basal ramus being the thickest, and shorter than the second ramus (fig. 6).

(ii) Female. The female is approximately 5 mm. in length, with a wing-span of 12 mm. (fig. 1). The colouring is the same as in the male, and the same number of tibial spurs is present. The antennae of the female are serrate below and 14, 15 or 16 jointed (fig. 2).

PARASITES.

(i) Hymenoptera. Wasps of the family ICHNEUMONIDAE were reared from cocoons during 1954, but the species has not yet been determined.

(ii) Diptera. Flies of the family TACHINIDAE were also reared from cocoons during 1954 and 1955. The species has not yet been determined. When determinations of the parasites are received a supplementary paper will be published.

(iii) Fungus. When several larvae of *P. atratus* were collected for rearing during 1954, a white fungus developed on some which had been placed in jars, and no adults emerged from the constructed cocoons.

During the previous spring there were numerous showers of rain. In field observations the fungus was found to cover completely many of the larvae, both before and after construction of the cocoon. Particularly heavy fungal infections were noticed beneath the hanging dead tops of the trees where moisture was retained, and where frass or fallen leaves had collected. These were in sheltered situations where the air-currents were apparently restricted. This fungus was again evident during November 1955, after about eight weeks of fine, dry weather. Infected specimens were again collected. When infected larvae were disturbed, the fungus appeared to be powdery and readily dispersed.

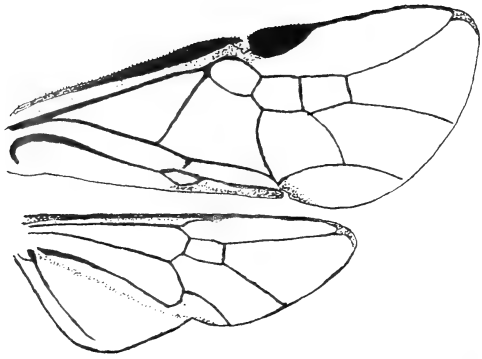
The fungus from the larvae collected in 1954 was examined, cultured on various media, and was determined as *Beauveria bassiana* (Balsamo) Vuillemin. It appears that during moist seasons, *B. bassiana* greatly reduces the numbers of these insects in the field, less control being exerted by this agent in drier seasons.

CONCLUSION.

The observations contained in this paper are regarded as of a preliminary nature. Much interesting work remains to be done on the biology and ecology of *P. atratus*, particularly the aspects of parthenogenesis, the association of *B. bassiana* with the range of humidity and temperature for its optimum development, further details on the distribution of *P. atratus* and its hosts, etc.

ACKNOWLEDGMENTS.

I wish to express my thanks to Dr. R. B. Benson of the British Museum for determination of specimens, for details of label data and other information; Mr. D. W. Edwards, Pathologist of the Forestry Commission of N.S.W., for identification of the fungus; Mr. A. Musgrave of the Australian Museum, Sydney, for assistance with the references; and the many who kindly assisted by their helpful criticism of the manuscript.



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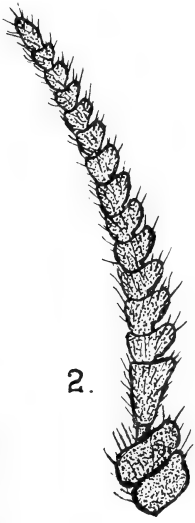

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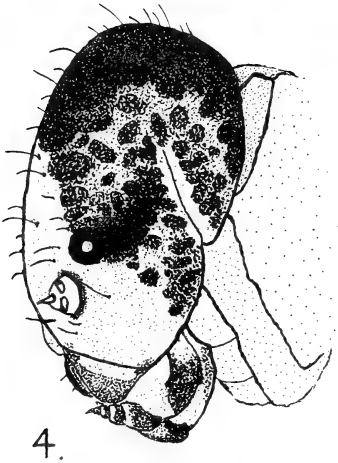

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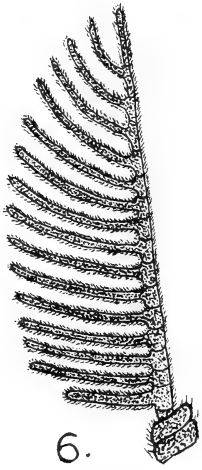

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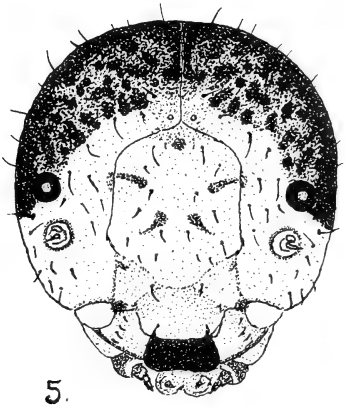

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EXPLANATION OF FIGURES.

Sawfly, *Polyclonus atratus* Kirby (all magnifications approximate only).

Fig. 1. Wings of female, showing venation, x 11.

Fig. 2. Antenna of female x 36.

Fig. 3. "Saw" or ovipositor sheath x 15.

Fig. 4. Head of last instar larva, lateral view, x 35.

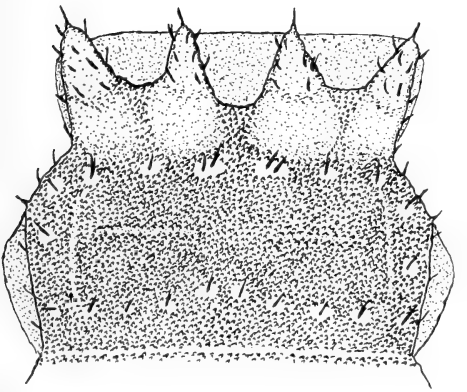
Fig. 5. Head of last instar larva, anterior view, x 32.

Fig. 6. Antenna of male x 22.

Fig. 7. Ovipositor sheath, enlarged to show minute serrations on the three proximal teeth x 150.

Fig. 8a. Spines on ninth abdominal segment of last instar larva (dorsal view). Portion of tenth segment showing below.

Fig. 8b. Same as fig. 8a (lateral view).



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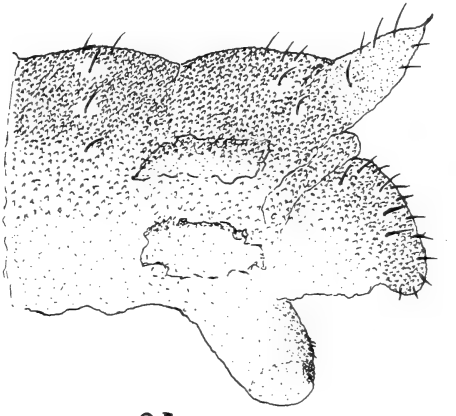

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Notes on Some Hesperiidae (Lepidoptera)

By E. O. Edwards.
(Menangle Park, N.S.W.).

1. The Brown Awl *Badamia exclamationis* Fabricius, 1775, near Sydney.

This butterfly was regarded as a rare visitor to Sydney. Waterhouse in "What Butterfly is That?" states that "not more than 5 specimens have been caught" near Sydney.

During 1954 in February and March two worn male specimens were caught by my son and myself on flowers of cultivate lantana in my garden at Menangle Park (36 miles south of Sydney). During this season northern butterflies appeared much farther south than usual. During 1956, a very wet season, from 24th January to 4th March, we collected six specimens, also in the garden of my home. A female collected on 24th January was worn but three specimens collected at the end of February and early March, and including one female, were in good condition giving the impression that they may be breeding far south of their normal range, which is from Cape York to Northern N.S.W.

The recorded foodplant of this butterfly is *Terminalia* but species of this plant do not occur naturally as far south as Brisbane, therefore it is reasonable to suspect that there are other foodplants not yet recorded.

2. Lilacine Grey Skipper, *Trapezites phigaloides*, Waterhouse, 1903.

We have caught specimens of this butterfly at Mittagong on 29th October but it was more plentiful on the 1st December when females were on the wing. We have also caught males at Putty, between Windsor and Singleton, N.S.W., at about 500 ft. in early October.

I prefer the name Lilacine Grey Skipper to Phigaloides Skipper as simpler names are more likely to encourage interest among younger people.

3. A New Foodplant of the Spotted Skipper, *Hesperilla ornata ornata*, Leach, 1814.

On 13th October, 1956, we collected a *Hesperilla* larva near Mt. Kiera (Wollongong) N.S.W. on "Tussock Sedge" *Carex appressa*. As many of the *Hesperilla* larvae are very alike they are not easily classified, but we were able to transfer the complete plant to a tin and succeeded in keeping it alive after bringing it home. The larva had a shelter in the centre of the sedge but was covered with a white powder unlike the usual *ornata* larva that I have bred on *Gahnia* (Swordgrass). On 13th November the larva pupated. The pupa was black with the two anterior projections thin and short. A female butterfly emerged on 5/12/56.

We find differences in the two projections on the pupal caps of *H. ornata*, *H. picta* and *H. crypsagyra crypsagyra*.

H. ornata: projections thin and short with the points close together.

H. picta: projections thicker and very slightly longer.

H. crypsagyra: projections thin and turning outwards at the tip. The pupa is smaller.

4. A New Locality for the Silvered Skipper, *Hesperilla crypsagyra crypsagyra*, Meyrick, 1888.

We collected specimens of this butterfly near Carrington Falls in the Robertson District, N.S.W., at an elevation below 2,000 ft. They were breeding on swordgrass (*Ghania microstachya*) on a ridge near the falls.

First Steps from the Cave

By Tarlton Rayment, F.R.Z.S.

(Hon Associate in Entomology, National Museum, Melbourne)

It is a strange fact that the history of man's rise, from caves in the ground, to houses of wood, concrete, and even more plastic materials, has an interesting parallel in the evolution of architecture among the bees, as I shall show you presently.

The thrilling story of the culture of *Homo sapiens* is fairly well known to that estimable fellow, the "man in the street," but I ask him to bear with me when I say he has little if any knowledge of the stages through which the bees have attained their present high estate.

The search for "first steps" has always held for me a peculiar fascination. It is an intriguing study, and one that readily conjures up attractive, if not always entirely satisfactory, postulations. But let us consult certain solitary insects for a little introductory information.

The old world bees, *Colletes*, and their Australian relatives, *Paracolletes*, have inherited more primitive characters than any other Family of Apoidea, but this is not the place to confuse you with the details of anatomical minutiae to prove my contention. For the moment, you may accept my word for it. Today we are more interested in the development of their Architecture.

These solitary archaic bees, then, are fossorial in habit, that is, they dig shafts in the ground and, at the base, construct a series of more or less egg-shaped cells. Indeed, I had to follow *Paracolletes tuberculatus* Ckll. down for nearly six feet before I discovered the cradles of her race. True, the soil was a fine sandy loam of even texture, and sinking a six ft. shaft presented few obstacles to an industrious mother obsessed with the building of cradles for her babies. The bees are usually of medium size, that is, the vast majority range about 11 mm. in length.

Paracolletes is not the only excavator of subearthen homes with acorn-shaped cradles, and hitherto she had never been known to utilise any other material for her buildings.

The gregarious Halictidae, too, are fossorial in habit, but they stand far higher than *Paracolletes* on the evolutionary scale, for they have long appreciated the advantages of co-operation, and several sisters combine for the labour of sinking the main shaft. The sisters also share the watch of the sentinel at the portal, where there is constructed a simple sentry-box, into which the bee on duty can retire, at a moment's notice, to clear the shaft for traffic inwards.

This beautifully co-ordinated labour, however, ends at the base of the main shaft, for each sister excavates her own exclusive lateral cluster of eight or so cells. The groups are naturally very close to one another; indeed, the cross-drives frequently intersect so that, in the case of *Halictus emeraldensis* Raym., the highways down below become a veritable maze of tunnels and galleries for which there is no key.

The halictine bees were once included in the Family Andrenidae, and they are distributed throughout the world with many hundreds of species. Did I say they are fossorial in habit? Never had they been recorded to dwell anywhere else but in shafts in the earth. Even that inimitable observer, Jean Henri Fabre, could not discover them elsewhere. Indeed, with all his perspicacity, yet he would not have sought them elsewhere.

In Australia, the naturalist must be forever on his guard lest the unexpected climax slip by him unobserved. Imagine, if you can, my utter amazement, one morning in March, 1950, when Norman Rodd informed me that, at Cheltenham, near Sydney, he had observed a colony of halictine bees well established in the butt of a tree, which he thought was *Eucalptus sydneyana*.

That would be revolutionary. No! No! Fossorial bees do not drill into wood. The rule holds good throughout the entire world. Pardon me, it did until Rodd communicated the reports on his observations in the field.

Of course, I had to send an urgent request that he obtain for me individuals of the Spring (Primarius); Midsummer (Secundarius) and Autumnal (Tertianus) generations, so that errors in identification could be eliminated.

Well, in the course of a year or so, I had them all before me, together with a slab of the tree-trunk containing puddings: eggs, larvae, pupae, adults, everything. There is not the shadow of a doubt, they are true halictine bees, *Halictus peraustralis*, Ckll., to be precise, and the cells were modelled in wood.

"Isn't that directly opposed to the observations of several famous men?"

Yes, it is, but it is the truth.

Several years pass. Then, on another morning, in 1953, I receive a second nest in wood; this time from Clifford Beauglehole, of Portland, Victoria. Architecturally it is practically identical with the "nest" from Sydney, but the bees are indeed very different. The tree was probably *Eucalyptus baxteri*.

True, they are in the Family Halictidae, but the genus is different. The black head and shining thorax and blood-red abdomen mark them out as *Parasphecodes wellingtoni* Ckll., hitherto known only from Mt. Wellington, near Hobart, Tasmania. Do not be perturbed, reader, they are only another ancient biological link binding the Island to the Mainland.

The wheel turns! The year is 1956, and Clifford Beauglehole is again busy in the forests in the vicinity of his home. He sends several more bees, large, robust, jet black. One is unmistakably *Parasphecodes noachinus* Ckll., and the other is equally unmistakable, for it is *Parasphecodes plorator* Ckll. I tell the collector, "There is no doubt whatever about the identification." However, my correspondent still harbours a doubt or two. "Why," he writes, with some surprise, "if what you say is correct, then we are faced with the extraordinary position of having one species in the genus excavating in the earth, and a near congener boring into wood."

Away back in 1934, I had an almost identical parallel to warn me. *Callomelitta perpicta* Ckll., a handsome colletid bee with lustrous purple abdomen and blood-red thorax, excavates her cells in punky wood, whereas *C. anomala* Raym. is of fossorial habit, constructing a group of earthen cells very similar indeed to those of *Nomia australica* Sm., and of which I have already told you.

However, I do not share Beauglehole's surprise, for it is no less true, two allied black species of *Parasphecodes* "nest" in very different conditions, one below the ground, and the other above, in a tree-trunk. It would be easy to postulate here that inversion of tropism is involved, for bees that excavate in earth are said to be geotropic, but those that dwell above are heliotropic.

But let us examine the subject in a more critical manner. There is no question of the woody origin of the tree-trunk, but its real character has been so masked by the ravages of age and decay that

it is now punk, and but little different in texture from fine red volcanic loam. It is saturated with water, for Rodd tells me it contained 70 per cent moisture. I can readily conceive that both punk and soil can be excavated by the bees with equal facility, and often the former is so close to earth that I cannot distinguish where one ends, and the other begins. It may be that the more elevated position has cerain advantages—it is warmer, and drainage must be better.

Certainly it is, that punky areas are frequently bounded by solid wood, and a few cells sometimes extend into the timber, so that one postulates that the punky bole provides an easy transition from a primitive cave to a timbered residence.

In other words, such exploratory experiments could well constitute "first steps" in the bees' ascent from fossorial to arboreal habits. Oh, no, I do not believe that bees' actions are mere mechanical reflexes. On the contrary, numerous experiments have convinced me that the Hymenoptera possess a good brain and a plastic intelligence.

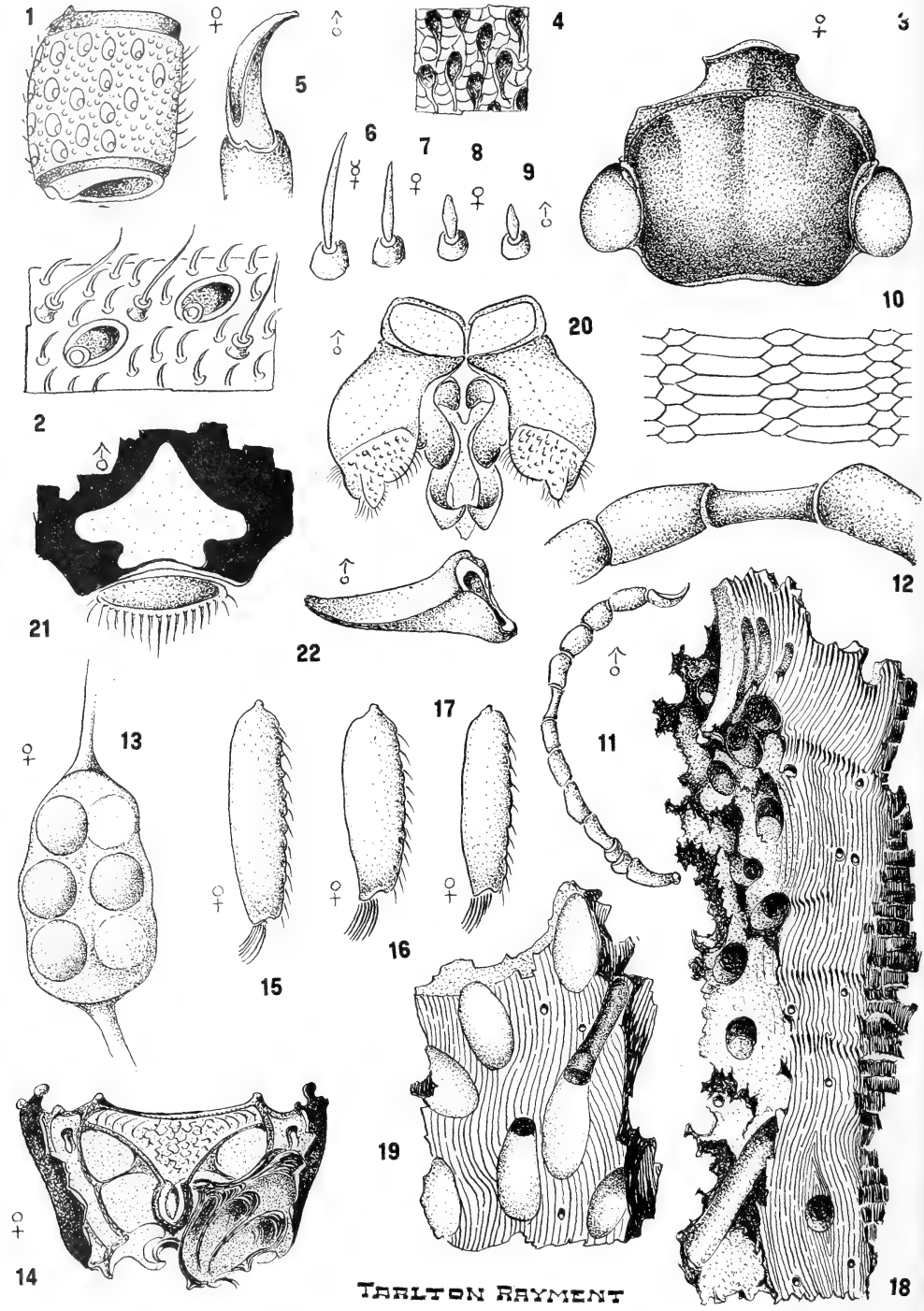
On the 6th July, 1956, Mr. L. S. Miller, Senior Entomologist, Dept. of Agriculture, Hobart, Tasmania, forwarded to the author a specimen of *Parasphecodes lithusca* Sm., which was described from no better locality than "Australia," and has not since been recorded until this date. The bee was taken from cells in punky wood at Lenah Valley, Tasmania, and it is now evident that several species in the gregarious fossorial genus, *Parasphecodes*, have left the caves far behind them, and ascended into logs. *P. plorator* Ckll. was collected in the same valley, and this quite black species also was in cells in punky wood, thus confirming the observations of Clifford Beauglehole, near Portland, Victoria.

EXPLANATION OF PLATE.

1. A segment of the flagellum of female, *Halictus dimorphus* Raym., showing the pore-plate organs magnified x 150.
2. Portion of the same segment magnified x 600 diameters to show sensory hairs.
3. Scutum with tegulae and protergum of thorax.
4. Pyriform sculpture of scutum.
5. Acute apical antennal segment of mutation male, *H. peraustralis* Ckll.
6. Hair-peg on glossa of worker honey-bee, *Apis*.
7. Hair-peg on glossa of Primarius female, *Halictus dimorphus*.
8. Hair-peg on glossa of female wasp, *Discoelius*.
9. Hair-peg on glossa of the male wasp.
10. Lineate sculpture on sterna of female, *Halictus dimorphus*.
11. Antenna of mutation of male *H. peraustralis* Ckll.
12. Eighth segment more highly magnified to show constriction.
13. Rectum of female *Halictus dimorphus*, before it had flown, showing the six excessively large rectal glands; which are relatively smaller in species feeding a secretion to the larvae, such as *Exoneura*.
14. View of the interior of the metathorax of *Halictus dimorphus* by transmitted light; the rugae are conspicuous.

15-16-17. Basitarsus of Primarius, Secundarius and Tertianus females; all magnified x 100.

18. Portion of the punky nest of *H. peraustralis* Ckll.
19. Cells excavated in comparatively sound wood; one of the cells contains the plug of punk.
20. Genitalia of male mutation, *H. peraustralis* Ckll.
21. Clypeal mark and labrum of male.
22. Acute mandible of male *Halictus*.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TARLTON RAYMENT

Closer Than a Brother

By Tarlton Rayment, F.R.Z.S.
(Hon. Associate in Entomology, National Museum, Melbourne.)

There's no need for me to ask whether or not you know Stylops, for the answer will almost certainly be in the negative. You may have a nodding acquaintance with many "bugs," and other insects, and yet not have been fortunate enough to discover a single specimen of these most intimate parasites.

Forgive me, for a minute or two, whilst I sketch a trifling page of their family history. In the Old World, naturalists have placed the Stylops in the Order Strepsiptera, which is reputed to have some distant relationship to those remarkable beetles, Cantharidae. The name of the Order is derived from the Greek *Strepsis*, a twisting, and *pteron*, a wing.

"And her portrait?"—Well, I shall have to consult the "Family Album," as it were, and limn a few lines on both males and females. The Order is a very small one, for less than 200 species are known to science. Summed up in the briefest terms, one would say, Stylops are minute insects, 2 mm. or less, parasitic, and exhibiting the peculiar phenomenon of sexual dimorphism, that is, the males are quite unlike the females. The Australian species have been separated into three families.

But today we cannot enter upon a detailed analysis of the anatomy, for that would perhaps distract your thoughts from the biology, to which I now propose to draw your attention. It is sufficient for our purpose to point out that the males of *Deinelenchus* have five segmented antennae with two branches. The males of *Austrostylops* have six segments, and those of *Pentozocera* have seven.

That is sufficient anatomy for the moment. Now, where do we find these strange small creatures? The "books" inform us that the species with seven segmented antennae are parasitic on the Jassidae, or plant-hoppers, but since I am more intimately acquainted with bees and wasps, we shall confine our observations to the Hymenoptera.

Every now and then I discover among the thousands of bees and wasps collected by my correspondents, one or two specimens that call for a more critical examination. Peering out, as it were, between the third and fourth rings of the abdominal segments, is a small brownish object, very considerably less than a pin-head in size. Here then, is the parasite, if you please!

Some authors declare that the head protrudes, but others are just as confident it is the caudal end, and all agree that the female is fecundated in situ. It is difficult to see how mating could be effected unless the caudal end be exposed, yet I would say it is the cephalic end that protrudes.

The rings of the bee's abdomen, as you know, have a tight telescopic action, but where the Stylops is seated, the chitinous ring bows up a little, and since the host had carried the parasite for most of its life, this tiny permanent arch reminds us of its origin.

Because it is impracticable to study microscopically all the bees and wasps that come under one's hand, it is only very rarely that the student secures living specimens of Stylops. Even when live bees are received, it usually happens that the killing bottle has them before the presence of the parasites is detected. But the damage is already done, for both the host and its parasite are killed. Time and time again one is defeated in this simple manner, nevertheless, I hasten to cut open the abdomen for examination under the microscope. Well,

I am astonished, for the body-structure of the female Stylops is so intimately associated with that of its host, that I am unable to determine just where it ends, or even begins.

It seems cerain that the nutriment for the parasite is drawn directly from the living tissues of the host, consequently, there is no necessity for any digestive system with its complementary alimentary canal. Because of the spiral speedometer-like construction of the tracheal tubes, I am able to discern that the Stylops had actually utilised the respiratory system of the bee, for the tracheal tube can definitely be identified to its outlet in a spiracle of the host. Indeed, I trepan a square of the chitin containing the spiracle, and lift it out with the trachea of the parasite still adhering to it. Surely in all the world there can be a no more intimate association of parasite and host.

How does the Stylops gain admittance to the body of the bee? The "books" seem to be lacking in precise information on this point, but I found an indicator in the reed-bees, *Exoneura*. Among the pollen-grains in the mesenteron of a bee I found a triungulin. "But why triungulin?"

It derives from the latin, *tres*, three, and *ungula*, claw. The body of the female Stylops is a mere sac containing an enormous number of eggs, which mature inside her, so that the parasite is little more than a fecund ovary. Each egg develops into a six-legged larva, with two long filamentous appendages. These anomalous creatures are said to escape through a "brood canal" which lies between the body and the pupa case of the parasite.

Among the spectacular Hymenoptera of Western Australia are certain robust shining wasps, *Paragia saussurei* (Sm.), over an inch in length, with a black head and thorax, they have a dark metallic-green abdomen with several ivory-coloured bands. The male has a mark of similar colour on his face, and the wings of both sexes are dark-purplish. Oh, I forgot to tell you an important detail: the wings at rest do not fold over as in so many Diploptera. The Masaridae are not a big Family, but an impressive one.

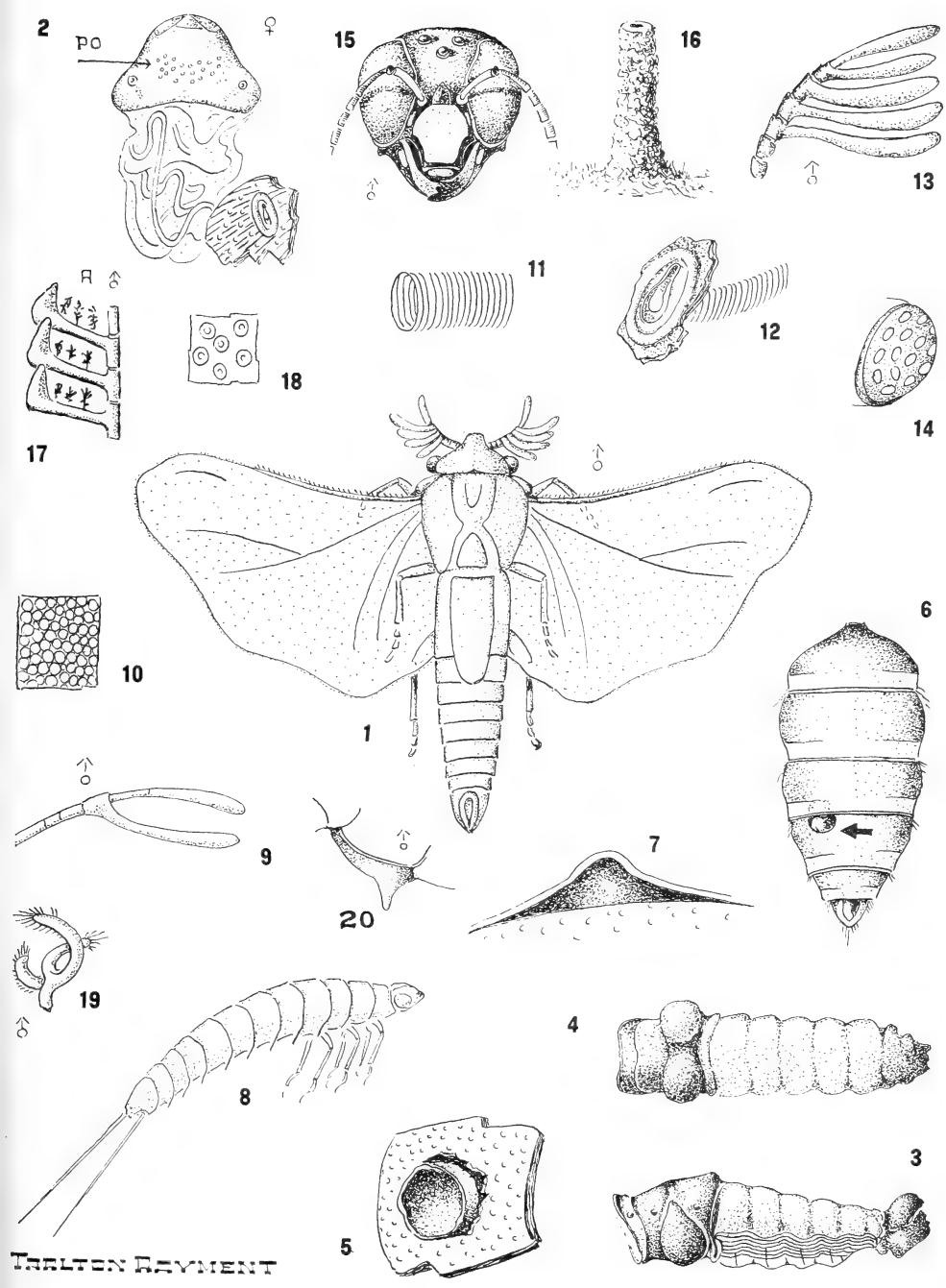
The secrets of the life-history of the beautiful masarids have always eluded me, but I have several intriguing tall mud "chimneys" which were erected over the shafts of an unidentified species not far from the bank of the Murray River.

One of my correspondents, an indefatigable collector, Alfred Snell, sweeping over the pale flowers of "marri," *Eucalyptus calophylla*, 30 miles from Bunbury, on the 12th February, 1956, obtained a long series of both sexes.

Well, a number of the wasps had been stylopised, but all of them must have harboured male parasites, for the vacant pupal cases did not escape the alert eye of the Preparator, Miss Elizabeth Matheson, who had no difficulty in withdrawing them with a pair of forceps. With one exception, all the Stylops had emerged from between the abdominal rings; the exception had broken through the pleura of the mesothorax.

The cases are more heavily chitinised at the cephalic end, and the caudal region is blackened with the biological debris in the base, but in between, the puparium is very pale, as one would expect in an internal parasite, with only faintly darker bands. Laterally, there is a longitudinal line microscopically striated.

I postulate that the microscopic triungulins are ingested together with the pollen, but they escape from the alimentary canal just at the junctioning of the mesenteron and the proctodeum, hence their favourite position between the abdominal rings.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The wingless female, such as she is, never leaves the host, but the active winged male emerges freely, leaving behind the brownish puparium lining the cavity which, in certain views, has a fish-like aspect. It is said that the presence of the Stylops modifies the genital organs of the host; affected males developing female characteristics, and vice versa (parasitic castration), but my investigations failed to discover any structural difference in the genital anatomy of the hosts.

I have found Stylops present in *Paracolletes providellus*; *Parasphecodes fulviventris* Fr.; *Euryglossimorpha nigra* (Sm.); *Halictus*, and several other genera, also in a few wasps, and it will be observed that all are fossorial in habit, that is, they dig shafts in the ground. The *Exoneura* mentioned above inhabit reed and stick dwellings, and lead a very elemental social life, so I take the presence of a triungulin in the mesenteron to be merely accidental—the parasite had made a fatal error in its choice of a host.

EXPLANATION OF PLATE.

1. Male parasite, *Pentozocera australensis* Perk.
2. Female of unidentified species removed from abdomen of bee, *Paracolletes providellus bacchalis* Ckll. Pore organs (P.O.) may function in determining the presence of the male.
3. Dry puparium of unidentified male stylops removed from the pleura of Masarid wasp, *Paragia saussurei* (Sm.), lateral view.
4. Dorsal view of dry puparium.
5. Cephalic end of puparium protruding from pleural plate of the wasp.
6. Abdomen of bee, *Paracolletes providellus bacchalis*, with parasite.
7. The tergites of bees are often deformed owing to the presence of the parasite.
8. Larva of *Pentozocera* (after Perkins).
9. Laminate antenna of *Deinelenchus australensis*.
10. Sculpture of tegument of parasite from bee, *Paracolletes*.
11. Portion of a tracheal tube of the bee.
12. Spiracle of the bee, with tracheal tube attached.
13. Antenna of parasite, *Pentacladocera schwarzi* Perk.
14. The facets of the compound eyes of the parasites are well separated.
15. Front view of head capsule of male wasp *Paragia saussurei*.
16. Mud chimney built over shaft by masarid wasp.
17. Only one bee, the male of *Cladocerapis bipectinatus* (Sm.), has retained the genes for flabellate antennae.
18. Pore organs of female parasite more highly magnified.
19. One of the remarkable processes (at "A" in fig. 17) on the antennal segments of the bee, *Cladocerapis bipectinatus*.
20. Lateral view of first abdominal tergite of masarid wasp. The tubercle has survived in many bees, such as *Parasphecodes*, *Meroglossa*, and *Hylaeioides;* the last bee also has the pale mark of the clypeus.

Another Australian Volute

By Tom Iredale.

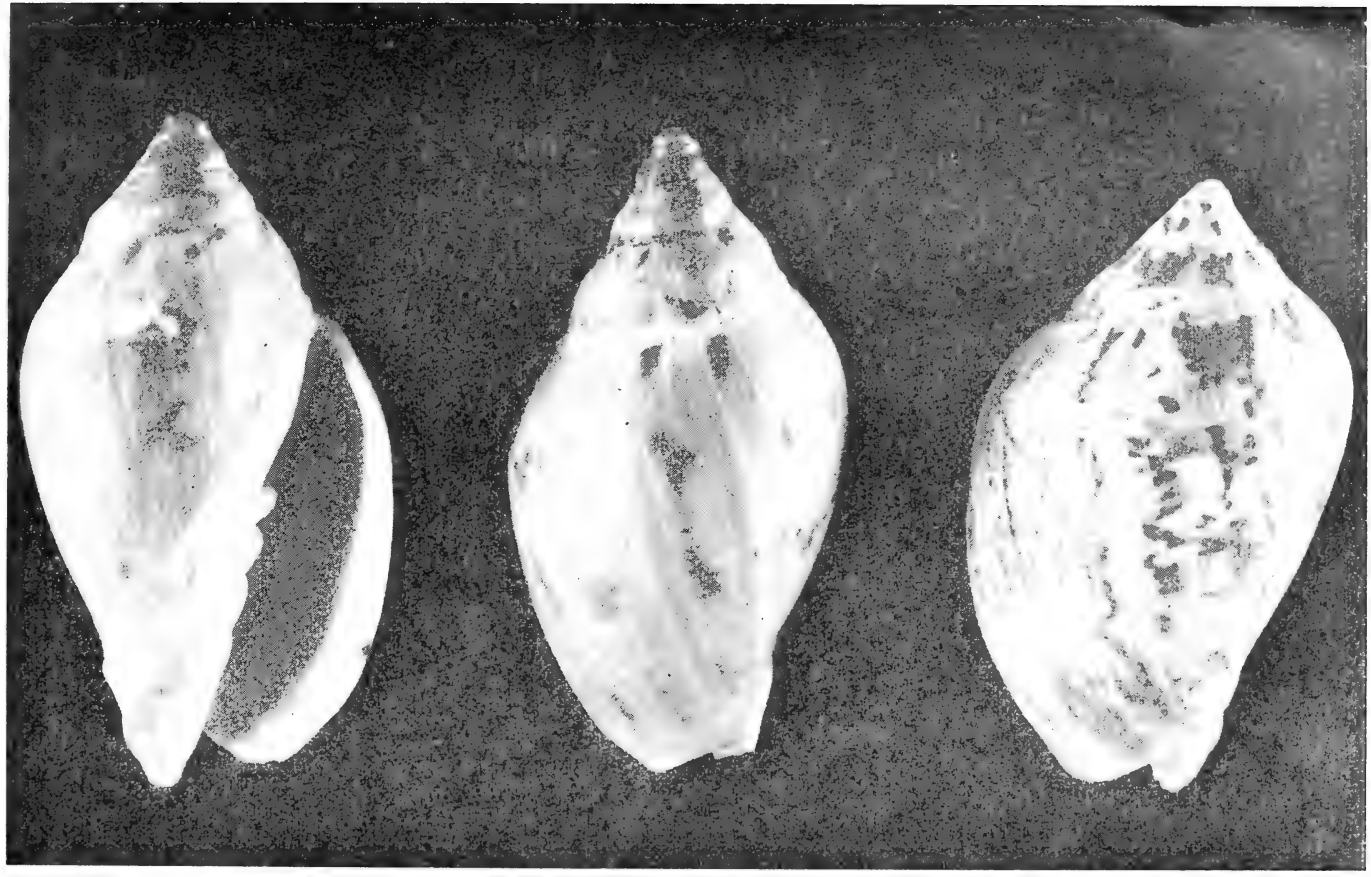
When I described *Aulica quaesita* last year, I hoped the matter was settled, but almost at once a confusion of species has arisen. I have seen a large series which indicates that the words "the living shell is cream," added after the original description had been drawn up, were unfortunate. It is necessary therefore to amend the description and elucidate the matter before too much confusion can occur. The series of *quaesita* suggests that the holotype figured is somewhat aberrant as the large irregularity seen in the photo suggests. The figure of the paratype is an excellent one of the immature shell. A photograph of a fine adult is here given to clarify the situation. An emended description of this specimen of *quaesita* follows: Shell stout, spire rather small. Coloration creamy white, boldly marked with purple streaking, obscure bands sometimes massing medially, but never prominent. The subsutural markings are purple, well marked on the early whorls, and increasing with the shell's growth, descending irregularly across the whorl, the last whorl adorned with zigzag flashes, sometimes running together in places. The other species is narrower, more elongate, with spire longer, the basic coloration white, covered with a pale brown, persistent, very gne periostracum. The markings consist of small pale purplish spots, quite distinctly separate but very often becoming obsolete, so that albinos and semi-albinos are found. On the larger senile specimen figured the spots are vaguely defined so that a fully grown better marked specimen is also figured to show the markings more clearly. Four rows can be seen, a subsutural, a peripheral, and two below, the spots numbering eight to ten in each row. The inner lip is devoid of periostracum to a fairly large extent as seen in the figures. The adult has the outer lip thin, only slightly thickened, but senile specimens show thickening according to age, some runts showing coarse thickening, while some large shells show none. The type measures 79 mm. in height and 38 mm. in breadth. The type locality is eastern Arnhem Land, North Australia. I am naming this species

AULICA KELLNERI, sp. nov.

for Mr. Stephen Kellner, the well-known dealer, who acquired the series I have studied and who will present the specimens figured to the Australian Museum. It is hoped that Mr. Kellner will succeed in discovering many more novelties for the benefit of science, and especially Museums. The dealer has a much greater range of his efforts than any local museum can expect, and the shell collection of the British Museum (Natural History) has benefited much by dealers' co-operation. Thus the basic greatness of its collection is the collection made by Cuming, who wanted his great acquisition to pass into good keeping by putting a paper value on it for that purpose. Nearly one hundred thousand specimens were added by his efforts, and thousands of types and figured specimens were included. The history of the British Museum collections cites throughout the assistance of dealers as Parzudaki, Parreyss, Damon, Reeve, the Sowerbys, Fulton, Preston, &c., who generally allowed the museum first choice of rarities.

REFERENCE.

Iredale, T. (1956).—A Northern Australian Volute. *Proc. Roy. Zool. Soc. N. S. Wales* 1954-55, pp. 76-77, fig. 1.



EXPLANATION OF PLATE.

Aulica kellneri (type), *A. kellneri* (paratype), *A. quaesita* (adult bee).

A New Native Dog from the Papuan Highlands

By Ellis Troughton,

Curator of Mammals, Australian Museum.

Evidently, at least two breeds of dog have been reported from Papua, a vari-coloured lowland form of domesticated dog, and a small dingo-like dog of the extreme highlands. Skulls and skins of a dog from about 7,000 ft. on Mount Scratchley, Northern Division, were sent to the Queensland Museum by their Excellencies Sir William MacGregor and Sir Hubert Murray, the first specimen being briefly described by De Vis[1] and illustrated from a stuffed skin. Longman[2] described one skin as "black and white, the black dominant," the other as "russet" (Ridgway), interspersed with darker hairs. The breadth of the palate between the canines was relatively greater than in the dingo, and the upper carnassial tooth-length was comparable proportionately with that of the dingo.

Reviewing this Mt. Scratchley material Wood Jones[3] concluded that it probably afforded "definite evidence that the Papuan feral dog is a very definite race, possessing a relatively large upper carnassial tooth typical of primitive canine breeds, and differing widely in its characters from the dogs of certain other Pacific Islands." He stressed the need for accumulating more material before the breed became too hybridized for study purposes.

Fortunately, while on patrol in 1956 in the remote Lavani Valley, or so-called "Shangri-La," in the uncontrolled Huri-Duna country, Southern Highlands District of Papua, a pair of the mountain "dingo" was obtained by A.D.O. J. P. Sinclair and Medical Assistant Albert Speer. As a gift to Sir Edward Hallstrom, the dogs were sent by Mr. Speer to the Hallstrom Livestock and Fauna Station at Nondugl, Western Highlands of New Guinea, in the care of Mr. Fred Shaw Mayer. Recent examination of the almost identical adult male and young female, in Taronga Zoological Park, Sydney, undoubtedly confirm the views of the late Professor Wood Jones and it is proposed now to name the Lavani Valley dog as a distinct species in honour of Sir Edward Hallstrom, President of the Taronga Park Trust, according to the following preliminary description.

Family CANIDAE.

Genus *Canis* Linne, 1758.

Canis Linne, Syst. Nat. ed, 10, 1758, p. 38; ed, 12, 1766, p. 56. Type of genus, *Canis familiaris* Linne.

Canis hallstromi, sp. nov.

Specimens.—Male holotype, female allotype, in possession of Sir Edward Hallstrom at Taronga Zoological Park, Sydney, for eventual lodgment in the collection of the Australian Museum.

General characters: Muzzle or rostral region short and narrow in contrast with the remarkable facial or bi-zygomatic width, imparting the strikingly vulpine or fox-like appearance. This comparison is sustained in the narrow body and very short bushy tail which measures little more than one third of the combined head-and-body length, with the width of the brush a fraction under 4 in. The fleshy, softly-furred, triangulate ears remain erect, though rounded and curved forward in conch-like fashion. Colour (Ridgway) of the head a clear

[1] De Vis, Ann. Qld. Mus., No. 10, 1911, p. 19, pl. 1.
[2] Longman, Mem. Qld. Mus., vol. ix, pt. 2, 1928, pp. 151-7.
[3] Wood Jones, Journal of Mammalogy, x, No. 4, 1929, pp. 329-333, figs. 1-2 (skulls).

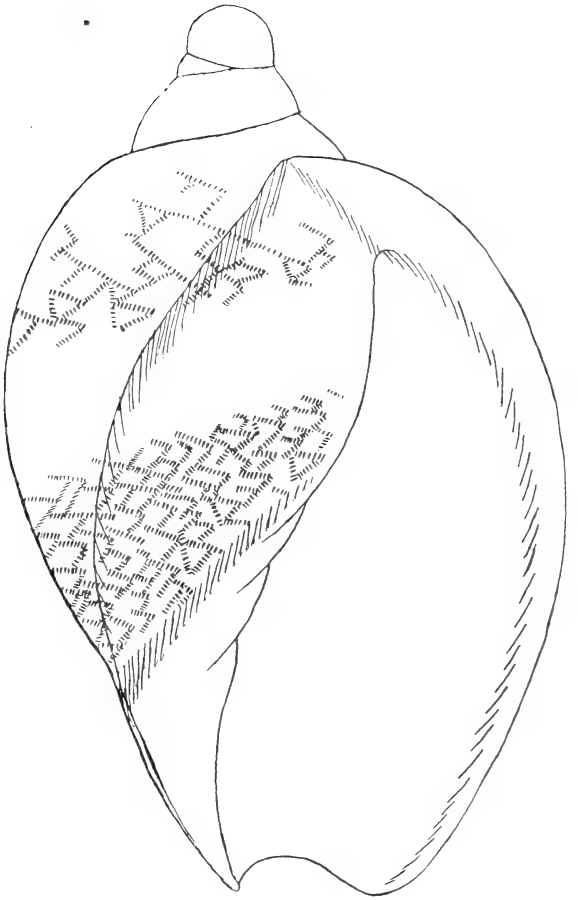
tawny brown; the back a darker russet-brown owing to the admixture of blackish-brown hairs, the darker hairs enclosing a yellowish "saddle-mark," somewhat more conspicuous in the female. Outer shoulders and hips clear ochraceous-tawny; tail about tawny-olive brindled above with blackish-brown, tip white; four paws whitish. Underparts a light buffy, a dark mark across the jaw separating the light chin-spot from the pale undersurface.

Dimensions of Holotype: Head and body approximately 650; tail exactly 245, less brush; heel to longest toe, less nail, 145; dew-claw from base to ground, 25; ear, length from outer base to tip 75, mid-width 40; longest vibrissa 52; length of head to extremity of sagittal crest 180 (approx.) and bi-zygomatic width 100; rear molar to incisor 90; width across incisors 23; height of upper canine 16 mm.

Despite difficulties in examining and measuring the sensitive animals, the remarkable identity of their colour, broad vulpine faces, and short wide-brushed tails, which may be curled to one side over the rump, permits of no doubt that a similar identity of unusual cranial and dental features will ultimately confirm the validity of this primitive species. The name *Canis familiaris* var. *papuensis* suggested by Ramsay[4] for a lowland variety of dog is invalidated as a *nomen nudum*.

[4] Ramsay, Proc. Linn. Soc., N.S.W., lii, No. 3, 1879, p. 242.

THE MARINE ZOOLOGIST



Vol. 1. No. 5.

1957

"THE MARINE ZOOLOGIST"

Vol. 1. No. 5.

(Incorporated with the Proceedings of the Royal Zoological Society of N.S.W., 1955-56, published May 8, 1957)

Observations

It was pleasing to receive notes and articles since the last publication of "The Marine Zoologist," and it is hoped that many more will be sent in in the very near future to be ready for the next number. All observations from readers are welcome. Notes on increasing or declining populations, descriptions of living animals and their habits, and any relative material will be published on a special "Observations" page. Longer articles will be separate.

Here are the notes of observations during 1956.

Subitopinna menkei.—Unusually plentiful, January 1956, Gunnamatta Bay, New South Wales. Olive Wills.

Notovola fumatus.—Very plentiful, January 1956, Gunnamatta Bay, Muriel Trenerry.

Tapes turgida.—Abundant, September 1st, 1956, Gunnamatta Bay. Olive Wills.

Scutus antipodes and *Notohaliotis ruber.*—On holiday down the south coast of N.S.W. in February 1956 I witnessed the destruction of marine molluscs on a vast scale. The extremely heavy and constant rain, day after day, flooded creeks and rivers and muddy water poured into the sea in a steady stream. The seas were rather rough at Eden, and rotting seaweed, dead and dying shells and echinoderms gave off a most unpleasant odour. The mortality of *Notohaliotis* and *Scutus* was really shocking and it will take years to restock that part of our coast. Many other species took a severe beating, but nothing to equal the two species mentioned, and it is obvious hat they are very susceptible to any "fresh."
The effect of fresh water or pollution caused by the run-off will be discussed by members during the coming year. We would be pleased to hear from any collector who has made observations on this subject. Lee Woolacott.

Tonna cerevisina.—Four good specimens, three alive, January 1956, Gunnamatta Bay. Muriel Trenerry.

Conomurex luhuanus.—Formerly somewhat rare on the north coast of New South Wales but during last few years they have been increasing in numbers. Quite a number of live specimens crawling in shallow sandy basins, Woolgoolga and Angourie, November 1956. Lee Woolacott.

Aplustrum amplustre.—The animal is a delicate, semi-translucent cream; the mantle slightly more opaque at the edge but uncoloured. A young shell, under a small rock in a shallow weedy pool. Angourie, December 1956. Lee Woolacott.

Address all communications to:—

The Publishing Committee, "Marine Zoologist."

C/- Royal Zoological Society of N.S.W.,

28 Martin Place, Sydney.

The Systematic Status of Ctiloceras and Some Comparative Genera

By Tom Iredale and C. F. Laseron.

(Plates 1-2, figures 1-35.)

GENERAL DISCUSSION.

In the study of minute gasteropod molluscs the problem of their possible immaturity is for ever present. The peculiar history of *Sinusigera* has served as a warning to conchologists, and has made them perhaps a little too conservative in accepting as generic types shells which are under 2 mm. in size. It will be recalled that certain minute gasteropods of peculiar form were monographed as the genus *Sinusigera*, but were later discovered to be immature and the actual protoconchs of many larger shells belonging to the Thaidae and other families.

Hence a minute shell of curious form collected by the "Challenger" Expedition in dredgings off Cape York was treated cautiously by the monographer R. B. Watson in 1886. He named it *Vermetus*(?) *cyclicum*, but suggested that it be called *Ctiloceras*, at the same time saying that "the creation of a new genus could not really be justified for a shell about which so little was known." In 1902 Hedley used *Ctiloceras* in describing two more species from northern Australia, but he considered them as probably juveniles of larger shells. Since that date additional material has slowly accumulated. In the Australian Museum are some specimens collected by Hedley, Brazier, Henn, Iredale, Mel Ward and A. R. McCulloch, all from Queensland and the Northern Territory, and one imperfect specimen sorted from material collected by A. C. Cameron from northern New South Wales. Now this material has been more than doubled by a large number of specimens collected by John Laseron from Darwin and one of a distinctive species from Thursday Island. This latter material fortunately survived the bombing of Darwin in 1942 and safely reached Sydney to throw much further light on this interesting group. In a brief note Iredale (1943, p. 166) remarked of this material that it contained "at least five distinct groups, each bearing the distinctive apex, which is similar to that of *Caecum*," and stated "if this curious mollusc be restricted to Australian waters, it may class as the Platypus or Lyre Bird of the molluscan world."

It is now the reasoned opinion of the authors that *Ctiloceras* and allied forms now separated as distinct genera are mature shells and not juveniles of larger forms. In the first place they all have a distinctive protoconch terminating in a prominent varix, and the subsequent whorls all have the texture and appearance of maturity, one species at least having the final aperture surrounded by a heavy, double varix. Though all the species here described are minute, the size in each species is constant, the smallest a little over 1 mm., the largest 2.5 mm. This uniformity of size points to maturity, for many of the species are represented by many specimens. In collecting these specimens a great deal of material was examined, and among the thousands of small shells procured it is reasonable to expect some further stage of growth would have been found if indeed such further growth actually occurred. In the whole of Australia no larger shell has been found with an apex similar to *Ctiloceras*, and this apex is so distinctive that it could hardly escape recognition. Amongst the gasteropoda generally the termination of the protoconch is recognised as the final metamorphosis, and though there may be some later change in details of sculpture and growth there is nothing of a radical nature except in some cases a progressive adaptation to a particular environ-

ment. For all these reasons we consider not only that *Ctiloceras* and its allies are mature, but also that they comprise a novel and highly specialised group which is worthy of family status. Provisionally and in the absence of further data the group can be designated the Ctiloceratidae. In relationship it may be nearest to the Caecidae.

So far no members of the family have been seen alive, and nothing is known of the animal nor even of the operculum. The shell characters are distinctive. The protoconch is relatively very large, smooth, the apex twisted and tightly coiled in a spiral of $1\frac{1}{2}$ whorls, thence long and conical, more or less curved and terminating in a sharp, raised varix. Mature growth is in the form of a spiral around an open umbilicus; the spire may be quite flat, or it may descend slightly or assume nearly turbinate form. The whorls are few, from $1\frac{1}{2}$ to 2, more or less loosely coiled; the aperture is round and free, and may be simple or expanded, or even terminate in a heavy varix. Sculpture may be either spiral or transverse, or both, or may be nearly absent.

In form the mature shell recalls some of the "Liotiidae," particularly *Liotella*, from which it is at once distinguished by the open coiling and the extraordinary protoconch. The protoconch at once suggests other relationship, particularly with several curious groups with quite different mature shells which have been referred to the Caecidae. *Caecum* itself has a bean shaped mature shell and a similar protoconch which is, however, rarely seen, as it is cast at an early stage and replaced by a mammillate plug. Another group from Australia has previously been identified with *Strebloceras* Carpenter, a European Eocene fossil, but for which later in this paper the new generic name *Pedumicra* is proposed. *Pedumicra* has a similar protoconch to *Ctiloceras*, but the mature shell is in the form of a long, slender, smooth and slightly twisted tube. *Meioceras* Carpenter from the West Indies may be related to *Pedumicra*. It is suggested that these together may be called the Pedumicrinae, but whether they should be linked to the Ctiloceratidae or Caecidae is uncertain. *Parastrophia* de Folin may also come here. *Parastrophia* has a mature shell like *Pedumicra*, but the coiled apex has only half a whorl and there is no varix terminating the protoconch. There is, however, a curious swelling some distance from the apex which may mark the end of the protoconch.

Watsonia de Folin is another curious northern Australian shell of uncertain relationship. In *Watsonia* the fine coiled apex has been cast and replaced by a septum, and there is again no varix to mark the termination of the protoconch. The mature shell is conical and twisted and ends in an expanded aperture surrounded by a heavy varix. The sculpture is of transverse rings. Very like *Watsonia* in mature form is a Queensland shell for which the new genus *Gladioceras* is proposed. Here the coiled apex is also cast and replaced by a septum, but beyond this the protoconch is long, smooth and conical and terminated as in *Pedumicra* by a sharp varix. Provisionally these two genera can be grouped as the Watsoniinae, but again their relationship is uncertain.

The following will then summarise the characters of the four families or subfamilies under discussion.

1. Whole or part of protoconch cast and replaced by plug or septum.
   Whole protoconch cast and replaced by plug, mature shell bean shaped ..... CAECIDAE
   Coiled tip only of protoconch cast and replaced by septum, mature shell conical and elongate ..... WATSONIINAE
2. Protoconch retained throughout maturity.
   Mature shell conical and elongate ..... PEDUMICRINAE
   Mature shell coiled ..... CTILOCERATIDAE

In this discussion particular importance has been attached to the protoconch, and it has been used as a basis of wide classification. The taxonomic value of the protoconch varies a great deal, and both of us have pointed out in previous papers the dangers of its too rigid use. It can always be accepted as of specific and sometimes of generic value, but rarely for phylogenetic purposes. Here, however, it is so distinctive that it has become unusually significant, linking together and suggesting relationship between quite a large assemblage of gasteropods. Even so it is not yet known just what part it plays in the life histories of the animals themselves. One of its features is its large size in relation to that of the adult shell, showing that the larval stage is comparatively very prolonged. The presence of a varix also shows that there is an appreciable interval or break in the life history representing the metamorphosis to the adult stage. Whether the larval stage is a free swimming one is not known, but it is probably so. Many of the species of the Ctiloceratidae have a considerable range, some from Darwin to well down the east coast of Queensland. The fact that so far they have not been found beyond Australia is probably due to insufficient collecting and their minute size which makes them easily overlooked. More significant is the fact that *Caecum* with its similar though decollated protoconch has an oceanic range. It is found on the far atolls of the Pacific Ocean, in the Ellice Group, in Hawaii and worldwide elsewhere, and has therefore in its migrations negotiated in some way the vast ocean basins between.

DESCRIPTION OF SPECIES.

In the forthcoming descriptions all recognised species of Ctiloceratidae, previously known or new, are figured and discussed. In addition opportunity has been taken to figure and discuss the species of the other comparative genera mentioned in the general discussion which occur in Australian waters, with the exception of *Caecum*. The latter group is so large and widely distributed that it would need a separate monograph for a review of Australian species only. This has been left for future consideration.

All the material examined, including types and specimens illustrated, which is not already in the Australian Museum, has been presented to that institution.

FAMILY CTILOCERATIDAE.

Key to Genera.

1. Mature shell planoid.
   - Sculpture of transverse (axial) ribs ..... *Ctiloceras* Watson.
   - Sculpture spirally striate to nearly smooth .. *Torresella*, gen. nov.
   - Sculpture clathrate ..... *Transcopia*, gen. nov.
   - Sculpture 2 or more plain spiral keels, axial sculpture confined to summit and base ..... *Carinocera*, gen. nov.
   - Sculpture of 1 serrated spiral keel, axial sculpture confined to summit and base ..... *Jayella*, gen. nov.
2. Mature shell turbinate ..... *Enigmerces*, gen. nov.

Genus CTILOCERAS Watson, 1886.

Type-species, *Vermetus*(?) *cyclicum* Watson, 1886, p. 465.

Mature whorls 1½ to 2½, loosely coiled, umbilical aperture large, spire planoid or slightly descending, aperture upright or slightly oblique, protoconch very large and only slightly curved or smaller and strongly curved, aperture with or without a varix. Sculpture of narrow, raised, axial (transverse) ribs surrounding the whorls. Three species are here referred to *Ctiloceras*, but their differences are such, particularly in the aperture and protoconch, that if further species be discovered, they might all be relegated to different genera.

As it is the sculpture keeps them within one easily recognisable group.

Ctiloceras cyclicum (Watson).

(Plate 1, figs. 1 (after Watson), 2, 3.)

Vermetus(?) *cyclicum* Watson, 1886, p. 465, pl. 31, fig. 1.

The type locality is 7 fms. Flinders Passage, Cape York, Queensland. Hedley (1902, p. 22, pl. 2, fig. 28) figured another imperfect specimen collected by J. Brazier from 8 fms. Torres Straits. Another imperfect specimen in the Australian Museum collected by C. Hedley is from the Palm Islands, Queensland. That now figured (fig. 2) is from Darwin, Northern Territory (J. Laseron), and though immature by about half a whorl shows the characters of the species satisfactorily. The essential features are the relatively large protoconch which bends upwards and is quite free from the opposite whorl, the initial open coiling, the flat spire, the summit of the aperture approximately level with the previous whorl, and the sculpture, consisting of regularly spaced, sharp, elevated, transverse rings. The maximum diameter is .9 mm., approximating to 1.3 mm. for the mature shell, which is close to that of the type.

Ctiloceras variciferum, sp. nov.

(Plate 1, figs. 6, 7.)

Shell exceedingly minute, white, solid and opaque. Protoconch of medium size for the family, relatively smaller than in *C. cyclicum*, apex twisted and tightly coiled, thence conical and slightly coiled, terminated by a sharp raised varix. Spire very loosely coiled, flat, practically involute, becoming quite uncoiled towards the aperture. Mature whorls $1\frac{1}{2}$, rounded. Umbilicus wide and open. Sculpture of fine, distant transverse (axial) ribs, completely encircling the whorls, with very fine, spiral striae between. Aperture round, margined by a very heavy varix which in some specimens is doubled. Maximum diameter 1 mm.

Locality.—Hope Islands, Queensland (C. Hedley), holotype and a number of paratypes.

Remarks.—All the specimens were sorted from a tube in the Australian Museum labelled *C. cyclicum* Watson, only one of which was that species. Under the microscope they were easily separated, the smaller size, the uncoiling towards the aperture, the even more involute coiling, the finer sculpture and the heavy terminal varix all being distinctive characters. A single specimen from Angowrie on the north coast of New South Wales, though worn and imperfect, is probably this species, extending the range into the Peronian Province.

Ctiloceras annulatum, sp. nov.

(Plate 1, figs. 4, 5.)

Shell small but large for the group, white, opaque, subturbinate. Protoconch short and stout, strongly curved in the line of the later mature coiling and filling most of the relatively small umbilical opening. Spire descending, at first closely coiled, but becoming free at the aperture. Mature whorls $2\frac{1}{2}$, evenly rounded. Sculpture transverse, numerous, distant, narrow, raised ribs completely encircling the whorls, smooth between, the ridges becoming fainter towards the aperture above but still strong below. Aperture round, without a varix, and slightly oblique downwards. Maximum diameter 3 mm.

Locality.—Van Dieman's Inlet, Queensland (C. Hedley), holotype in Australian Museum (C15377).

Remarks.—This is the largest of the species described, and in its sculpture resembles *C. cyclicum*, but it is much larger, and has a descending spire, it is more tightly coiled, and it differs markedly in the small, highly curved protoconch.

Genus TRANSCOPIA, gen. nov.

Type-species, *Ctiloceras clathratum* Hedley, 1902.

Like *Ctiloceras* in coiling and protoconch, but with sculpture of numerous keels crossed by transverse cords, making the sculpture more or less clathrate.

Transcopia clathrata (Hedley).

(Plate 1, figs. 8 (after Hedley), 9-12.)

Ctiloceras clathratum Hedley, 1902, p. 22, pl. 2, fig. 30.

The type was collected by J. Brazier in 8 fms. in the Torres Straits and the maximum diameter is given as 1.54 mm. Other material in the Australian Museum labelled *clathrata* proved to be another species, but two specimens collected by Mel Ward from 20 fms. off Port Darwin are very close to Hedley's drawing and are without doubt the same species. One is here figured for comparison (figs. 9, 10), its maximum diameter 1.2 mm. A character not mentioned by Hedley but shown in the lateral drawing (Fig. 10) is the slightly descending spire, the summit of the aperture being level with the centre of the preceding whorl. The clathration is also uneven, as it weakens slightly towards the aperture. A series from the shore at Darwin collected by J. Laseron were at first thought to be a different species, but careful comparison beneath the microscope led to the conclusion that they were the same. In this series the axial cords are very faint and only visible in certain lights, so that the clathration practically disappears, but in all other characters they are essentially the same. One with a maximum diameer of 1.4 mm. is here figured (figs. 11, 12).

Genus TORRESELLA, gen. nov.

Type-species, *Ctiloceras striatum* Hedley, 1902.

The shell is flatter and more tightly coiled than *Ctiloceras* and with a translucent vitreous texture. The sculpture is faint, confined to fine spiral striae, and the final aperture is expanded all round.

Torresella striata (Hedley).

(Plate 1, figs. 13 (after Hedley), 14, 15.)

Ctiloceras striatum Hedley, 1902, p. 22, pl. 2, fig. 29.

The type was collected by J. Brazier in 20 fms. off Cape Grenville, Queensland, its maximum diameter 1.36 mm. A specimen collected by J. Laseron (figs. 14, 15) from Darwin was compared with the type, and from it the original description can be amplified, as Hedley did not figure the lateral view. From this it can be seen that the coiling is planoid, the summit of the aperture being well above the previous whorl. The texture also is thin, vitreous and translucent, the surface shining and apparently smooth, the fine spiral striae and very faint axial threads only visible in certain lights under the microscope. It is also somewhat larger than the type, the maximum diameter 2 mm.

Genus CARINOCERA, gen. nov.

Type-species, *Carinocera bicarinata*, sp. nov.

Like *Ctiloceras*, but with a smaller protoconch, and the scultpure primarily of 2 or 3 prominent smooth spiral keels. Axial scultpure when present is discontinuous and confined to the summit of the whorls and the base.

Carinocera bicarinata, sp. nov.

(Plate 2, figs. 16, 17.)

Shell minute, white, solid, slightly translucent. Protoconch comparatively small, slender, the apex small, twisted and tightly coiled, thence smooth, conical, slightly curved, terminated by a sharp raised varix. Mature whorls $1\frac{1}{2}$, slightly descending, the upper margin of the aperture just above the bottom of the preceding whorl, the umbilical opening of medium width above and very wide below. The sculpture is dominated by 2 prominent spiral keels, narrow and

raised, forming a platform above and below, and separated by a concave space. This space at first sight appears smooth, but close examination shows that 3 or 4 fine spiral threads are present, much more apparent in some specimens than others. The transverse sculpture is of fairly strong, well separated ribs, which do not quite reach the peripheral keel from above, and which become weak towards the aperture. On the base the ribs are stronger and curve into the umbilical opening. Aperture round, simple and free. Maximum diameter 1.7 mm.

Localities.—5 fathoms off Horsey River, Queensland (C. Hedley), holotype in Australian Museum, C.15116; 20 fms. off Endeavour River, Queensland (A. R. McCulloch); Darwin, Northern Territory (J. Laseron).

Remarks.—The strong double keel and the sculpture generally at once distinguish this from all other species here discussed. No difference could be distinguished between the Queensland and the Darwin specimens except that the former have the threads between the keels a little more distant.

Carinocera sp.
(Plate 2, figs. 18, 19.)

A single specimen, 1.5 mm. in maximum diameter, was sorted from shell sand from Thursday Island, Queensland, by J. Laseron, and though not quite perfect and badly cracked, was obviously different from any other species here discussed. Unfortunately after the drawing was completed it disintegrated under further handling and with it the only material available for description. Under the circumstances no new specific name is proposed, though the figures and description should facilitate recognition at such time when it is rediscovered. The shell is minute, white and translucent. The protoconch is of medium size, slender, slightly curved and terminated by a varix. The spire is flat, the mature whorls 1½, loosely coiled, the summit of the aperture level with the top of the preceding whorl, the umbilical perforation large. The sculpture is of spiral keels, one on the summit and two peripheral, the lowermost wide and rounded, the space between the peripheral keels smooth and concave. Axial sculpture faint and obscure. Aperture imperfect but apparently polygonal. The nearest species for comparison is *C. bicarinata*.

Genus JAYELLA, gen. nov.

Type-species, *Jayella serrata*, sp. nov.

The main characteristic of this genus is the strong, serrated peripheral keel, the serrations appearing broad and rounded from above, but from the lateral view rising at an angle to give the appearance of spines. It is named from the initials of John Laseron who collected so much of the material. Two species have been recognised, one with the spire descending, the other flat and compressed.

Jayella serrata, sp. nov.
(Plate 2, figs. 20, 21.)

Shell minute, white transparent. Protoconch relatively large, elevated, reaching to the margin, the apex tightly coiled, thence tapering, smooth, slightly curved, terminating in a slight varix. Mature whorls 1½, closely coiled, umbilical opening narrow above, the spire descending so that the summit of the aperture is below the base of the preceding whorl. Sculpture predominately of a single, sharp peripheral spiral keel, standing well out from the whorl, broadly serrated at the edge, the serrations bending sharply upwards, appearing spinose from a lateral view. Above the peripheral keel the slope is concave to the summit of the whorl where it is sharply ridged before descending to the suture. Lower surface with a gentle convex curve. The transverse sculpture consists of narrow ribs coinciding with the peripheral serrations, and finally curving into the umbilical opening

which is very wide below. Aperture becoming round with maturity, but with a protruding spur marking the termination of the peripheral keel. Maximum diameter 1.5 mm.

Locality.—Darwin, Northern Territory (J. Laseron), holotype and several paratypes.

Remarks.—The scultpure is so striking that this species cannot be readily confused with any other, and the serrations of the peripheral keel make even fragments easy to recognise.

Jayella compressa, sp. nov.
(Plate 2, figs. 22, 23.)

Shell minute, white and translucent. Protoconch of medium size, conforming to the description of other species, terminated by a sharp varix. Mature whorls $1\frac{1}{4}$ (the holotype may not be quite mature), loosely coiled, the umbilical opening large, the spire flat, the summit of the aperture above that of the preceding whorl. Sculpture of a single strong, sharp, protruding peripheral keel, serrated as in *J. serrata*, the serrations bent sharply upwards and appearing spinose from the lateral view. Above the peripheral keel the whorl is convex to the summit where another slight spiral ridge is also slightly serrated. The whorl below the peripheral keel is concave, the base of the whorl marked by a broad, low, rounded spiral rib. Axial sculpture weak, slight ridges corresponding to the serrations of the peripheral keel, stronger in the early stages, becoming obsolete towards the aperture and barely visible on the base. Aperture becoming rounded with maturity, quite free and separated from the preceding whorl. Maximum diameter 1.5 mm.

Locality.—Buchanan Island, Northern Territory, holotype. Collector unknown.

Remarks.—The only other species with which this can be compared is *J. serrata*. From above the two are nearly similar, the serrated peripheral keel giving them the same facies, though *J. compressa* is more loosely coiled, has a larger umbilical opening and a smaller protoconch. Viewed laterally, however, the differences are very marked, the flat open spire of *J. compressa* and the contour of the whorls being distinctive.

Genus ENIGMERCES, gen. nov.
Type-species, *Enigmerces turbinata*, sp. nov.

Form turbinate, tightly coiled, umbilical opening comparatively small, whorls rounded, sculpture both axial and spiral but weak. Protoconch relatively small, strongly curved.

Enigmerces turbinata, sp. nov.
(Plate 2, figs. 24, 25.)

Shell minute, turbinate, white, translucent to opaque. Protoconch comparatively small, short, strongly curved, the varix slight. Mature whorls 2, closely coiled, round, the umbilical opening narrow above but widening below, the spire descending, the whole aperture quite below the preceding whorl. Sculpture weak, both axial and spiral, the spiral sculpture often only visible when viewed in profile, the axial when viewed from above or below. The spiral sculpture is of numerous fine threads not continuous on the base, the axial of distant, narrow ribs, weak on the summit but stronger on the base where they curve into and plicate the umbilical opening. Aperture free, round and without a varix. Maximum diameter 1.3 mm.

Localities.—Darwin, Northern Territory (J. Laseron), holotype and 2 paratypes; 20 fms. off Port Darwin, N.T. (Mel Ward); 5-10 fms. Hope Islands, Queensland (C. Hedley, No. C27508 in Aust. Museum, labelled *Ctiloceras striatum*); Cape Sidmouth, Queensland (Iredale).

Remarks.—The turbinate form, narrow umbilicus, and small strongly curved protoconch readily separate this from all other species

discussed. Throughout its wide range it is remarkably constant, except that some specimens are slightly larger than the type.

SUBFAMILY PEDUMICRINÆ.

Genus PEDUMICRA, gen. nov.

Type-species, *Strebloceras cygnicollis* Hedley, 1904.

Protoconch similar to that seen in the family Ctiloceratidae, long, smooth, conical and curved, the apex of 1½ whorls twisted and tightly coiled, the whole terminated by a sharp varix, but the adult shell in the form of a long, thin, conical tube which is slightly twisted, the aperture round, simple and without a varix.

Strebloceras, to which Hedley referred his species *cygnicollis*, is an English Eocene fossil described by Carpenter (1858, p. 440), and first recorded as living by De Folin (1879 and 1886). Carpenter published no figure of his type species, *S. cornuoides*, but his description makes no reference to a varix terminating the protoconch, in this case, considering the great period of time and distance involved, a very important difference. De Folin described *S. subannulatum* from Honolulu (1886, p. 682, pl. 1, figs. 2 and 3), showing a long conical shell with transverse sculpture, but again with no varix terminating the protoconch. No opinion is here expressed as to the identity of the Honolulu species with true *Strebloceras*, though it is considered unlikely, but the Australian species are undoubtedly different and need a new name.

Pedumicra cygnicollis (Hedley).

(Plate 2, figs. 26, 27.)

Strebloceras cygnicollis Hedley, 1904, p. 189, pl. 8, figs. 12-14.

This is the Peronian species the types of which came from Bottle and Glass Rocks and Long Bay, New South Wales, and it has also been recorded from Victoria and South Australia. A specimen collected by Gatliff from Port Albert, Victoria, now in the National Museum, was kindly sent for comparison by Miss Hope Macpherson, and no difference could be detected between it and the New South Wales specimens. That now illustrated is from Port Stephens, N.S.W., its length 5 mm., which is somewhat larger than the type. This may be due to greater maturity, as the length of the protoconch, .6 mm., is approximately the same. Specimens from 17-20 fms. off Masthead Island, Queensland (C. Hedley) are also this species.

Pedumicra queenslandica, sp. nov.

(Plate 1, figs. 28, 29.)

Shell small, thin, glassy and translucent, white to colourless, smooth. Protoconch long and slender, conical, with a fine coiled apex, terminated by a thin varix. Shell characters as in *P. cygnicollis*. Length 2.7 mm., of protoconch .7 mm.

Locality.—15 fms. off Palm Islands, Queensland (C. Hedley, C10237 in Australian Museum), holotype and 2 paratypes.

Remarks.—This would be considered the same species as *cygnicollis* were it not for the protoconch. In actual size the protoconch of *queenslandica* is longer by about one sixth, it is slenderer and has a much finer apex, and the varix is also thinner. Comparison of figs. 27 and 29, drawn to the same scale, will show this difference. No differences could be distinguished in the mature shells. A single specimen from Port Sampson, N.W. Australia is very close to *P. queenslandica*, but has no discernible varix. Further material may show this to be still another species.

Genus PARASTROPHIA de Folin, 1869.

Type-species, *Parastrophia asturiana* de Folin, 1869 Fonds de la Mer, 1, pp. 174, 218.

De Folin separated *Parastrophia* from *Strebloceras* by the protoconch which he states has the apex fine and not twisted, the coiling

of only half a whorl, and without a varix. Some distance from the apex there is a slight swelling which may denote the termination of the protoconch. The mature shell is a long conical tube with fine transverse sculpture.

Parastrophia challengeri de Folin.

(Plate 2, fig. 30 (after de Folin).)

Parastrophia challengeri de Folin, 1880, p. 806; 1886, p. 681, pl. 1, fig. 1.

The type locality is 8 fms. off Cape York, Queensland, the length .9 in. or approximately 2.3 mm. This species has not been rediscovered, and further material is needed before its full characters, particularly of the apex, can be given. The original figure in the meantime is here copied for reference. The sculpture is given as transversely and irregularly minutely striate.

Parastrophia ? sp.

(Plate 2, figs. 21, 32.)

A single specimen sorted from shell sand from Michaelmas Cay, Queensland, is doubtfully referred to *Parastrophia*, but if the apex is unbroken it is probably quite distinct and will need a new generic as well as specific name. Under high magnification the apex certainly does not appear broken, as the truncate termination is quite even and appears slightly thickened. For a short distance the shell is then conical and smooth, then it suddenly enlarges slightly and normal growth continues. The mature shell is elongate and conical, slightly curved and twisted, increasing regularly with a simple circular aperture. The sculpture under high magnification is seen as fine, transverse, closely packed threads. The length is 3 mm.

SUBFAMILY WATSONIINAE.

Genus WATSONIA de Folin, 1880.

Type-species, *Watsonia elegans* de Folin, 1880, p. 807.

Again de Folin uses the apex for generic separation, stating that the extreme coiled portion is decollate and replaced by a septum. The form of the elongate shell is conical, curved and slightly twisted, the sculpture is of transverse rings, and the aperture is surrounded by a heavy varix.

Watsonia elegans de Folin.

(Plate 2, fig. 33 (after de Folin).)

Watsonia elegans de Folin, 1880, p. 808; 1886, p. 682, pl. 1, figs. 4-6.

The type locality is 8 fms. off Wednesday Island, Cape York, Queensland, the length given .1 in or approximately 2.5 mm. This is another species which has not been seen since its original discovery, and one of the three original figures is here copied for comparison. The characters are as given in the generic description, and its future recognition should not be difficult.

Genus GLADIOCERAS, gen. nov.

Type-species, *Gladioceras armorum*, sp. nov.

Like *Watsonia* in the form of the adult shell and also in having the coiled apex decollate, but the protoconch thence as in *Pedumicra* smooth and conical and separated from the mature shell by a high, raised varix.

Gladioceras armorum, sp. nov.

(Plate 2, figs. 34, 35.)

Shell small, elongate, conical, white. Protoconch in form like a bayonet, the apex obliquely truncate, any apical whorls probably decollate and replaced by a septum, the remainder smooth and conical, terminated by a very sharp varix. Under strong magnification,

the latter two-thirds of the protoconch appear centrally shadowed (fig. 35), suggesting a central cavity. If so the apex is probably quite solidified. Mature shell regularly conical, elongate, slightly curved and twisted, the aperture round and oblique, and encircled by a heavy varix. Sculpture transverse, of fine threads obliquely encircling the shell and separated by about their own width. Length 3.8 mm.

Locality.—Holotype selected from a tube of specimens from 5-10 fms. Hope Islands (C. Hedley, C27502 in Australian Museum).

Remarks.—This is a slenderer species than *Watsonia elegans*, and has quite a different protoconch.

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[*Vermetus* (?) *cyclicus*, p. 465; Caecidae, p. 680.]

The following genera have been proposed as new in this paper: *Carinocera*, *Enigmerces*, *Gladioceras*, *Jayella*, *Pedumicra*, *Torresella*, *Transcopia*.

EXPLANATION OF PLATE 1.

Fig.

1. *Ctiloceras cyclicum* Watson, (after Watson).
2. *Ctiloceras cyclicum* Watson, immature, from above.
3. *Ctiloceras cyclicum* Watson, the same, lateral view.
4. *Ctiloceras annulatum*, sp. nov., holotype, from above.
5. *Ctiloceras annulatum*, sp. nov., the same, lateral view.
6. *Ctiloceras variciferum*, sp. nov., holotype, from above.
7. *Ctiloceras variciferum*, sp. nov., the same, lateral view.
8. *Transcopia clathrata* (Hedley), (after Hedley).
9. *Transcopia clathrata* (Hedley), another specimen, from above.
10. *Transcopia clathrata* (Hedley), the same, lateral view.
11. *Transcopia clathrata* (Hedley), variation, from above.
12. *Transcopia clathrata* (Hedley), the same, lateral view.
13. *Torresella striata* (Hedley), after Hedley.
14. *Torresella striata* (Hedley), another specimen, from above.
15. *Torresella striata* (Hedley), the same, lateral view.

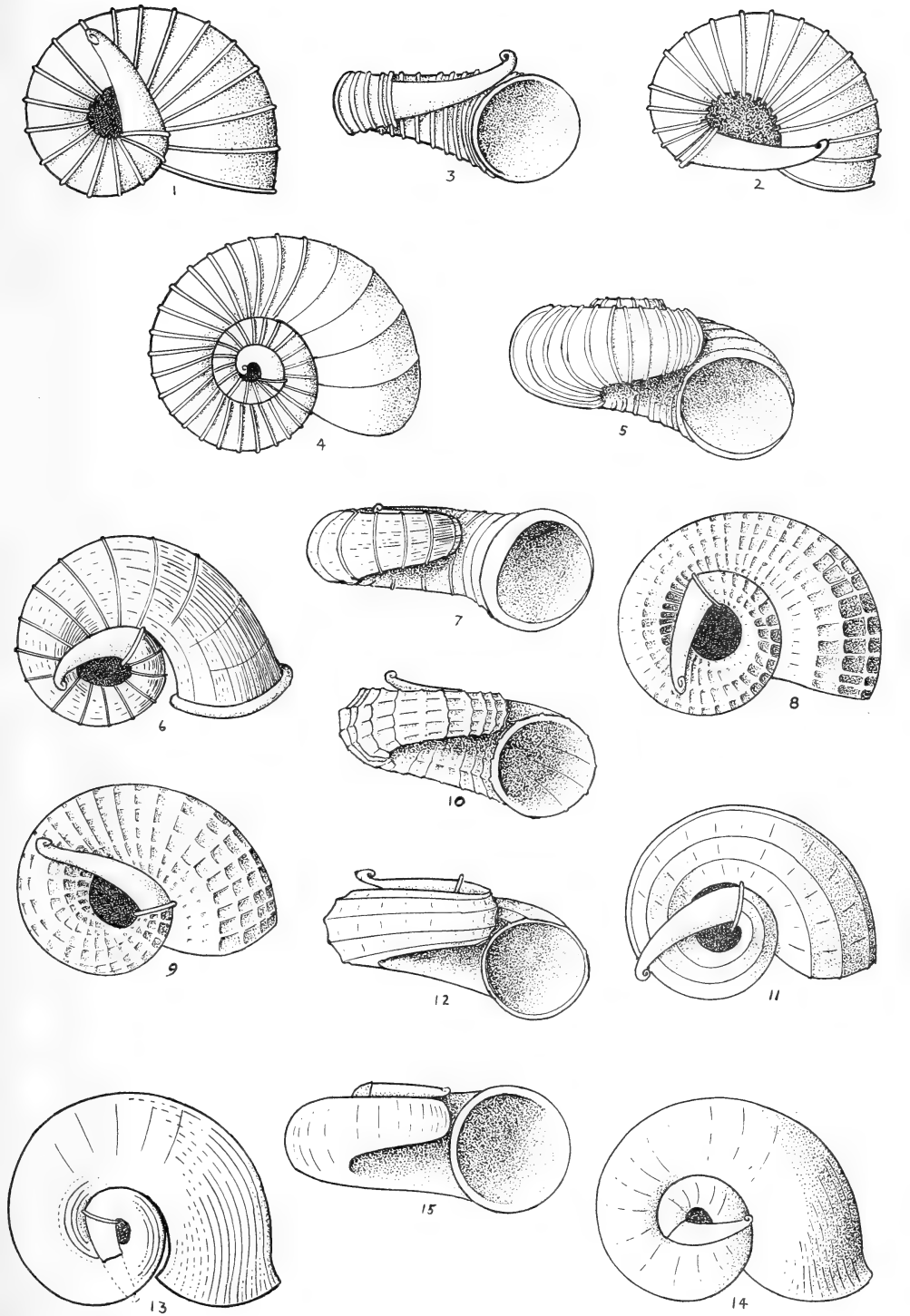

Plate 1.

EXPLANATION OF PLATE 2.

Fig.

16. *Carinocera bicarinata*, sp. nov., holotype, from above.
17. *Carinocera bicarinata* sp. nov., the same, lateral view.
18. *Carinocera sp.*, from above.
19. *Carinocera sp.*, the same, lateral view.
20. *Jayella serrata*, sp. nov., holotype, from above.
21. *Jayella serrata*, sp. nov., the same, lateral view .
22. *Jayella compressa*, sp. nov., holotype, from above.
23. *Jayella compressa*, sp. nov., the same, lateral view.
24. *Enigmerces turbinata*, sp. nov., holotype, from above.
25. *Enigmerces turbinata*, sp. nov., the same, lateral view.
26. *Pedumicra cygnicollis* (Hedley).
27. *Pedumicra cygnicollis* (Hedley), protoconch, further enlarged.
28. *Pedumicra queenslandica*, sp. nov., holotype.
29. *Pedumicra queenslandica*, sp. nov., protoconch, further enlarged.
30. *Parastrophia challengeri* de Folin (after de Folin).
31. *Parastrophia* ? sp.
32. *Parastrophia*, apex further magnified.
33. *Watsonia elegans* de Folin, (after de Folin).
34. *Gladioceras armorum*, sp. nov., holotype.
35. *Gladioceras armorum*, sp. nov., apex, further enlarged.

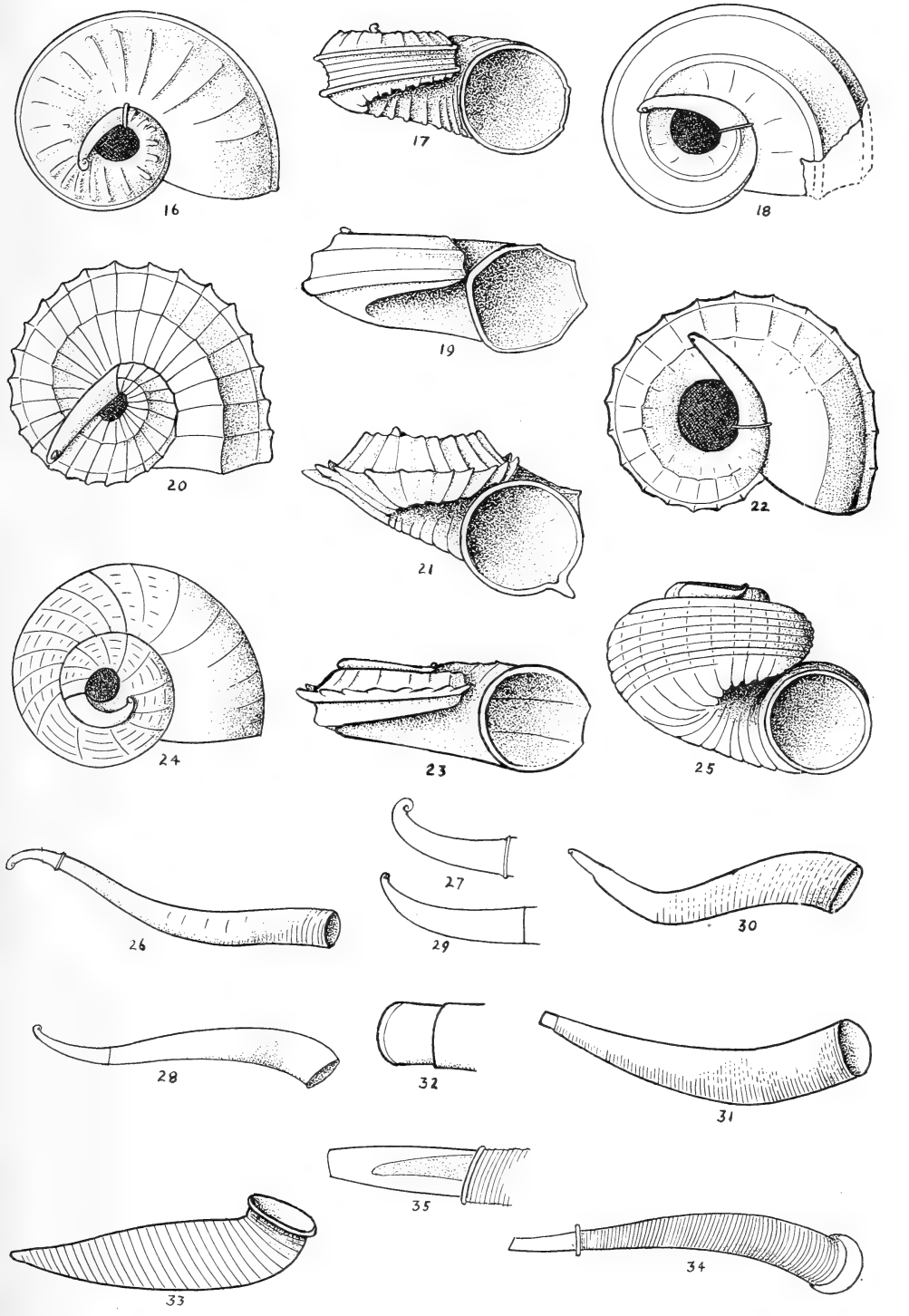

Plate 2.

Poisonous Bites by Octopus

By Donald F. McMichael,

The Australian Museum, Sydney.

Although the octopus has long been regarded as harmful to man, there are few authentic records of attacks. The mythological giant octopus described in the writings of the ancient scholars received a good deal of support when Denys de Montfort (1810) published a figure and description of "Le Poulpe Colossal," in which a gigantic octopus was shown engulfing a three-masted ship, and the idea of giant "man-eating" octopus is still held by many people. These ideas have reached their climax in the realistic "creations" of Hollywood film-producers, but the fact remains that there is a complete absence of authentic records of such giants. The largest known forms come from the Alaskan coast and Dall (1873) has recorded a size of 28 feet in diameter, though the body was fairly small, the great size being due to long tenuous arms.

The few unverified accounts of attacks by large *Octopus* may yet prove to have a basis of truth, for there may be very large animals living in the depths of the ocean. Le Poulpe Colossal may exist, but for the time being we can eliminate giant species from the list of harmful *Octopus*.

It is well known, however, that some species of *Octopus* are capable of inflicting painful bites. The literature on such bites has been reviewed by Halstead (1949) who noted that there was a "paucity of actual instances" on record. Halstead gave a detailed account of two cases, one at San Francisco and the other at Hawaii, and reviewed briefly the experimental work which had been done on the toxic effects of *Octopus* venom. Berry and Halstead (1954) added four more case histories to the record and summarised the data on the nature of the bites as follows: "Symptoms consisted of a sharp pain upon contact (described as similar to a bee sting), tingling, throbbing, redness, swelling and in one case abnormally profuse bleeding. Symptoms seem to vary considerably, depending upon the size and possibly the species of octopus, the size of the wound, and doubtless the amount of venom injected. Octopus bites are of the puncture-wound variety and with the smaller animals commonly handled are relatively minor in nature. The venom is secreted by the anterior and posterior salivary glands. Little is yet known regarding the pharmacological and biochemical properties of the toxin."

Despite this lack of knowledge of the biochemical nature of the toxin, it is known that the poison acts on the central nervous system i.e. is a neuro-toxin and it seemed reasonable to suppose that a severe bite would prove fatal. Unfortunately the first recorded fatal octopus bite took place in Darwin in 1954. Flecker and Cotton (1955) have described this case and the symptoms were typical of the action of a neuro-toxin. They agree closely with those recorded in cases of bites by poison cone shells, although in this case, Flecker and Cotton point out that the victim was known to be mildly asthmatic and suggest that there could have been some hypersensitive reaction.

Because of the very limited data available on octopus bites, it is felt that the following case should be placed on record, especially as the octopus responsible was apparently one of our commonest species. The attack was reported by a resident of Wollongong, New South Wales, in May, 1950, and the following account is extracted from his letter:

"I was on the rocks looking for octopus for bait and found a small one about 4 inches in diameter. Its colour was two shades of brown and when touched it changed to a very bright blue, striped and

spotted, the blue spots encircled with bright gold. I let the octopus cling to the part of the hand at the base of the thumb and first finger. About ten minutes later I began to feel my tongue and mouth 'freezing'; next I started to feel 'strange' and my eye-sight began to fail—objects began to move about; my legs felt strange. I put the octopus in a rock pool and then walked back above high tide mark in case I collapsed, for I could see no one near to help me and my car was half a mile away. About ten minutes after the first symptoms were felt, I vomited. By the time I reached my car I was near collapse. My speech was very thick and I could not swallow. A doctor was called and I was taken home. Although my mind was perfectly clear, I seemed to have no control over myself. When I moved my hands at all they seemed to float up to my head and hit my ears instead of going to my mouth. I could not keep my eyes open for long. While travelling home in the car, I could not explain the movements of other traffic, which all seemed to be confined and moving in a very small space. I was absolutely paralysed in the legs and had to be carried in and spoon-fed. I slept soundly and next morning the paralysis was gone, but I could not walk straight throughout the day. The only sign of anything on my hand was a strange soreness (as when hit on a sinew or vein) but I did not feel any bite or sting."

When questioned, the victim denied having touched any shellfish which could have been a species of *Conus*, and reiterated that the portion of the hand where the octopus had been clinging was swollen, and was very itchy for four days afterwards.

These symptoms are remarkably similar to those recorded in cases of poison cone bite and indicate a virulent neuro-toxin; it must be accepted that the poisoning was due to a bite from the octopus, even though none was felt, especially in view of the swelling of the hand at the place of contact.

The species will have been instantly identified by local malacologists as *Octopus maculosus* Hoyle, which is very common along the rocky shores of New South Wales. Apart from the value of recording such bites and their effects, this report should serve as a warning to New South Wales students of molluscs against the excessive handling of these dangerous animals.

Some research on the nature of *Octopus* neuro-toxin is being carried out in the United States and elsewhere, but to date no published reports are available. It is to be hoped that medical research-workers will soon take an interest in both *Octopus* and *Conus* poisons, and that some antidote will be developed before further fatalities occur.

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An Addition to the New South Wales Check List of Mollusca

By J. Kerslake.

Family VENERIDAE.

Venerupis iridescens Tate (Trans. Royal Society of South Australia. Vol. XI., 1888, p. 61, pl. ii, fig. 10).

The identification of the New South Wales species was made from five single valves found on Collaroy Beach during the past three years. Two of these will be presented to the Australian Museum, Sydney.

Tate has given a long and detailed description of his species from deep water off Kangaroo Island, South Australia. However, for the benefit of local collectors, I will recapitulate a few of the outstanding characteristics. The shell is similar to *Venerupis fabagella* Deshayes in outline and is approximately 15 mm. long. The colour is dirty-white, iridescent and with a few small brown spots. It is ornamented with about fifteen conspicuous laminae and about four concentric, rounded threads in the interspaces. These latter are crossed by fine, close striae.

I am indebted to Miss Hope Macpherson for permission to inspect the South Australian specimens in the National Museum of Victoria.

Notes on Australian Shells

No. 2

By Lee Woolacott.

It is apparent that certain molluscs are migratory. Some species travel slowly from point to point establishing colonies where conditions are suitable, and over a considerable period of time appear capable of withstanding greater differences of temperature and salinity, thus gradually expanding their territory. Others probably drift in the ocean currents in the larval stage, and being of a sturdy nature capable of considerable adjustment to differing conditions, survive long enough to breed and so form populations which may live and go on breeding for many years, or even become permanent additions to our molluscan fauna. Another probability is that, in the past, when ships unloaded ballast, the eggs and partly-grown molluscs were dumped at various places along our coast. Some species are remarkably tenacious of life and, so long as they are able to find food which they can use, will survive extremely varying conditions. It is very likely that the unloading of ballast with the accompanying eggs or young is responsible for the establishment of a sizable colony of *Conomurex luhuanus* at Shellharbour (on the south coast of N.S.W.), a colony which has thrived there for well over forty years.

The ebb and flow, the ever-changing pattern of population density, and the ability of certain molluscs to survive and breed are of interest and concern to all molluscan collectors.

It is difficult to assess the stability of various tropical molluscan populations which are found on the coast of N.S.W., especially the far north coast where collectors are few and information not readily available, but in the region of the Clarence River, both north and south of the entrance, there are to be found many tropical species which have, undoubtedly, set up permanent colonies.

One of these, *Mancinella mancinella*, can be traced back for, at least, fifteen years. Small, immature specimens have been found by John Laseron and other collectors at Woolgoolga over a number of years. I found one good specimen of medium size, perfectly adult in

appearance, at Angourie in 1947. This shell is well described by Joyce Allan in "Australian Shells," p. 145, but a short description may be included here as it is advisable to add this shell to the N.S.W. Molluscan List now that the species has firmly established itself.

Mancinella mancinella Linne (*syn. gemmulata* Lamarck).

(Figure 7.)

Adult shell about 2 x 1½ inches (Angourie specimen 1½ x 1 in.). A strong creamy-yellow shell with very large body whorl bearing five rows of light chestnut-brown nodules. Numerous fine spiral ridges, stronger towards the base. Longitudinal dense, short lamellae. The penultimate whorl has two rows of small nodules, the remaining three whorls usually eroded. Columella and aperture rich yellow; within the aperture are a number of equally-spaced thin, orange-red ridges which start, in a uniform manner, about one quarter of an inch within the lip.

Family PYRENIDAE.

Genus PYRENE Bolten, Mus. Bolt., 1798.

Pyrene opulens, sp. nov.

(Figure 10.)

Size of shell 20 mm. x 12 mm., of six rounded whorls giving a very stout appearance. Ground colour is golden-brown with rich, dark chestnut bands at top of each whorl, apex pink. The pattern consists of seven large, white oval spots set below the chestnut band, at regular intervals, a few clusters of smaller ones irregularly placed and some very small, scattered white spots. Sutures well marked, and there are several small basal ridges. The aperture and columella are white, pale pink or mauve, and there are about seven small nodules within the lip.

This most attractive, brightly-coloured shell is from Angourie, north coast of New South Wales. It is included in Hedley's Check List of the Marine Fauna of N.S.W. under the name *Pyrene filmerae* Sowerby. On checking this species I was surprised to note the habitat was Pondoland, South Africa. The illustration is quite similar to our shell, but the habitat being so puzzling I kept the shells with a query mark (?) for years. Eventually I was most fortunate, Mrs. Boswell of South Africa being generous enough to send me some of the genuine South African *filmerae* (see figure 9). It was at once apparent that the shells were quite different. The proportions, background colour and disposition of the spotting are three outstanding differences which are obvious when one has authentic specimens from the two different localities. The N.S.W. shell is much broader, having a swollen appearance, with a rotund spire, brighter colouring and fewer spots. The South African shell, 20 mm. x 10 mm. is darker and narrower; with six whorls slightly tapered and banded with dark brown. Ground colour tan brown heavily and profusely spotted with white, several of these white spots invading the brown bands. Aperture and columella white to mauve with approximately nine nodules within the lip.

Holotype presented to the Australian Museum.

Paratypes: 16 from Angourie, N.S.W., in my possession.

Family TURBINIDAE.

Genus SENECTUS, Swainson 1840.

Senectus perspeciosus Iredale.

(Figures 3-4.)

This handsome Turbo may have arrived in ballast many years ago or be a survival of the tropical fauna which once inhabited Sydney Harbour; probably the former as no intermediate colonies have been recognised to date. I found this shell in North Harbour in 1943, 1945 and 1951, and Mrs. Trenerry found two very good specimens in the same area in 1956. It is, therefore, obvious that a colony has been established there for some considerable time, and the shell a further addition to our list.

As this shell is always being confused with *Turbo argyrostomus* L. (the silvermouth) it is advisable to give a short description of the main differences.

Both shells are umbilicate and a rich silvery-pearl within the mouth. The greatest difference is in the ribbing: *argyrostomus* has a small number of large, smooth-looking, rounded ribs, obsoletely scaled (some ribs more prominently scaled), interstices deeply excavated with an occasional small ridge intervening and is yellowish, variegated with chestnut-brown and green. *S. perspeciosus* has a greater number of smaller, sharply scaled ribs, and the whole shell is over-ridden by closely-set laminations; interstices wider and not so deep. A striking feature of *perspeciosus* is that the most prominent ribs are jade green. The shell is variegated with ochre, white and fawn-brown; the mouth small and round. The mouth of *argyrostomus* has a downward flare at the base of the columella.

This shell was formerly known as *Turbo speciosus* Reeve.

Family OSTREIDAE.

Pretostrea bresia Iredale.

(Figures 11-12.)

This oyster is quite common in Moreton Bay and central Queensland under rocks at low tide. I have seen several valves (top valves) from time to time on Sydney beaches, but did not realise their significance until I picked up one of the lower valves at Kurnell in July 1952. The tubular projections reminded me at once, so this will be a further addition to the N.S.W. list.

The shell, irregular in shape, round, oval or trigonal, is radially folded. The folds vary in number from two to eight, mostly weak but occasionally sharp when they bear a resemblance to the cockscomb oyster. Colouring is a most attractive bronze-red or bronze-pink, and internally it is opalescent-white with green-bronze patches. The sculpture consists of irregular, thin lamellose layers. The lower valves develop tubular projections which clasp any irregularities and invade suitable hollows. The adherent area varies greatly in size. As the shell grows older the edge has a tendency to turn upward.

Superfamily MURICACEA.

Family MURICIDAE.

Genus BEDEVA Iredale 1924.

Bedeva vapida, sp. nov.

(Figures 5-6.)

A fairly large *Bedeva* found on beaches from central to north Queensland has, so far, been unnamed. Similar to *Bedeva hanleyi* in shape, but much larger and stronger and with the emphasis on the spiral ribbing; the longitudinal ridges fewer and the lamellose scaling very much weaker. The body whorl is larger and broader.

The shell here described is $1\frac{3}{8}$ x $\frac{5}{8}$ inch, though the species grows bigger, and has six to seven whorls. All specimens in my possession are eroded at the apex and have lost the protoconch. The colour ranges from a dull leaden grey to brownish-grey with a faint tendency to a lighter band below the two strong peripheral ribs. The area below the periphery of each whorl bears well-defined brown spiral ridges, ten to twelve on body whorl, three to four on penultimate whorl and decreasing to two strong ones on spire whorls. The strong peripheral ribs are slightly nodulose, the nodules being dirty-cream on the upper rib and brown on the lower. The area between periphery and suture showing a few very weak ridges. The overriding growth striae are barely lamellose on the spire whorls but a little stronger on the body whorl. Aperture ovate, greyish with the brown external ribs showing through, lip dirty-cream. Columella cream and brown, and the canal open.

Holotype presented to the Australian Museum.

Paratypes: 12 from Yeppoon, Queensland, in my possession.

Genus MINNIMUREX gen nov.

Genotype *Minnimurex phantom* sp. nov.

This genus is proposed for very small lamellose Murex with six to eight strong, thick spiral ribs on body whorl and two (occasionally three) such ribs on the remaining whorls; four to eight frilled varices, deep narrow interstices, reticulate, with deep pockets behind the varices. Ribs with a tendency to central guttering and bearing semi-nodulose scales which project laterally for the most part. Aperture oval, canal medium and partly open.

Minnimurex phantom sp. nov.

(Figure 8.)

A small, broad shell 11 x 7 mm., of a cream colour, with approximately six strong, thick spiral ribs on body whorl and two on the remaining whorls. The ribs frequently guttered centrally and bearing semi-nodulose scales projecting laterally and lamellose in part. Interstices narrow, deep and reticulated, with deep pits behind the varices; these pits sometimes brown in colour. There are four adult whorls and a glassy 1½-whorled protoconch. The beautifully frilled varices number four on the body whorl and five on the preceding whorls, and they project upwards sharply. The area between the periphery and the well-defined sutures is practically flat. Aperture oval, canal medium and partly open. Found in shell drift from Eden to Angourie, New South Wales. Figured specimen from Gerringong, New South Wales, November 1952.

The dainty little *brazieri* is smaller and narrower, with five whorls and three-whorled protoconch; the spire, therefore, proportionately longer. It is more lamellose, with seven to eight very small, partially frilled varices to each whorl, and is less strongly reticulate. Colouring usually pink, salmon or yellow with occasional touches of brown on the varices.

Holotype presented to the Australian Museum.

Paratypes: 7 from Gerringong in my possession.

Family CERITHIDAE.

Genus ATAXOCERITHIUM Tate 1894.

Ataxocerithium gemmulatum sp. nov.

(Figures 1-2.)

Comparable in size to the N.S.W. Ataxocerithiums, but differs markedly in sculpture and general appearance.

The shell, 9/10ths x 2/10ths of an inch, consists of nine adult whorls and a brown, glassy 1½-whorled protoconch. Colour cream blotched with light chestnut. The five rows of beads on each whorl are remarkably uniform in plan; the three basal rows elongate, the fourth of semi-round beads, and the fifth of longitudinal, very close-set, slightly flattened beads. The three apical whorls with fewer rows. The whorls are slightly rounded and the sutures impressed. Shell is more "stout" in appearance and the spiral sculpture more pronounced than in other N.S.W. members of the genus. Mouth sub-circular, lip slightly flared and marked internally by the ribbing. Canal open. Found at Gerringong, N.S.W., in shell drift with several broken pieces, November 1952.

Holotype presented to the Australian Museum.

Paratype: 1 from Gerringong in my possession.

I wish to thank Dr. D. F. McMichael and Mr. T. Iredale for assistance in the preparation of this article.

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EXPLANATION OF PLATE 3.

Fig.

1. *Ataxocerithium gemmulatum* Woolacott.
2. *Ataxocerithium gemmulatum* Woolacott; details of sculpture magnified.
3. *Senectus perspeciosus* Iredale.
4. *Senectus perspeciosus* Iredale; operculum.
5. *Bedeva vapida* Woolacott.
6. *Bedeva vapida* Woolacott; details of sculpture magnified.
7. *Mancinella mancinella* Linne.
8. *Minnimurex phantom* Woolacott.
9. *Pyrene filmerae* Sowerby.
10. *Pyrene opulens* Woolacott.
11. *Pretostrea bresia* Iredale; Lower valve.
12. *Pretostrea bresia* Iredale; Upper valve.

Lee Woolacott del.

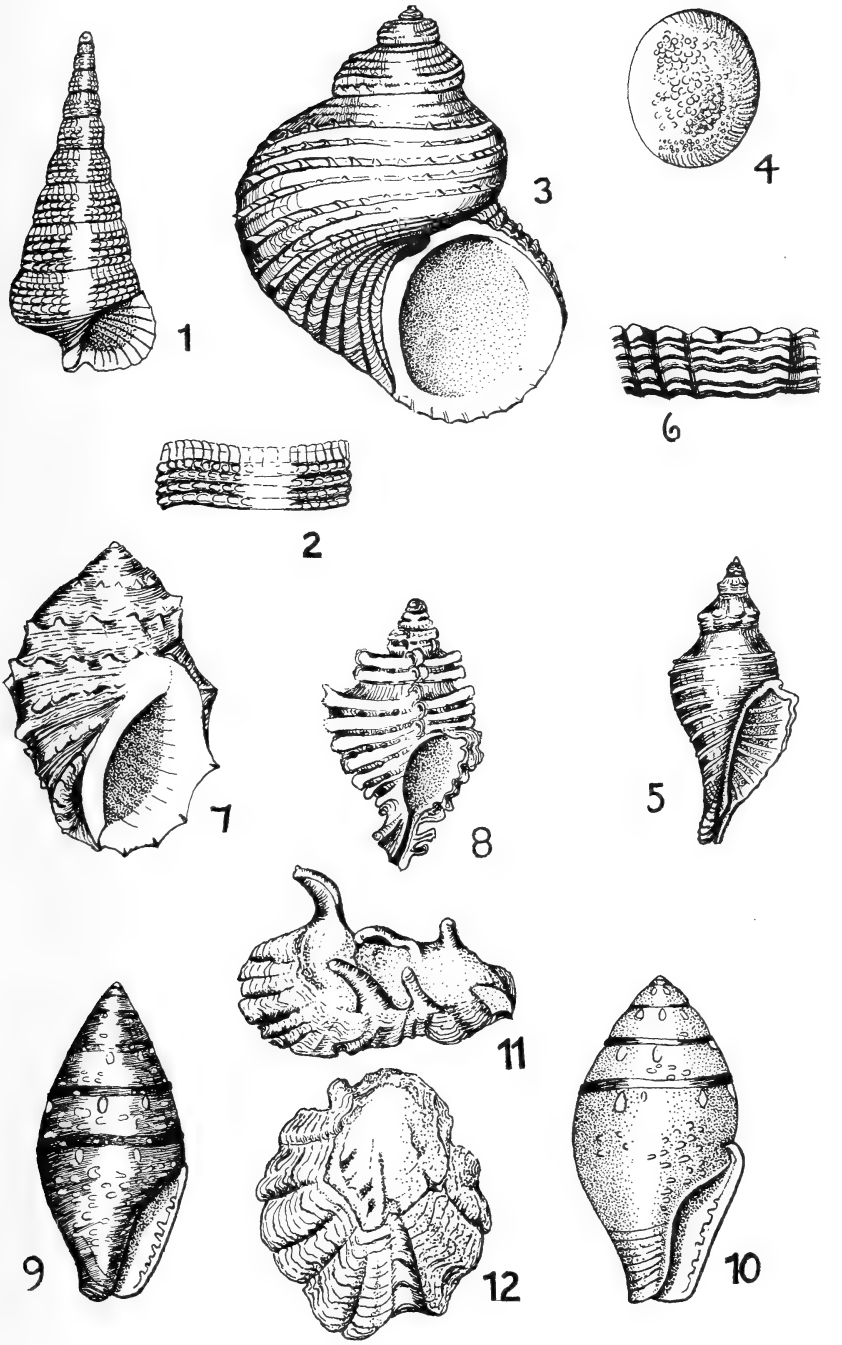

Plate 3.

Shell Collecting in Gloucester and Whitsunday Passages, Queensland

By Natasha Jackson.

The names Gloucester Passage and Whitsunday Passage convey a great deal to people who have collected in that vicinity, but to most they are just romantic names of a region somewhere near the Great Barrier Reef. Those living in the area smile at that inexact statement and explain that the Great Barrier Reef is some 40 to 50 miles away, and that many of them have never seen the Great Barrier Reef itself. So, let me say that the Gloucester and Whitsunday Passages are roughly in the Bowen Proserpine area.

There are, of course, quite good "pickings" to be had from the Bowen beaches. Queen's Beach is exceptionally good after a cyclone when all kinds of rarities are likely to come up, e.g. *Rapa rapiformis* and *Mitra taeniata*, also many interesting Cymatiums which are quite difficult to name.

Fourteen miles across Edgecumbe Bay from Bowen one comes to Sinclair Bay. There, after a cyclonic disturbance, exciting and spectacular rarities can be picked up, such as *Spondylus wrightianus ella* and several *Chlamys* including *subgloriosa, ellochena grossiana* and *gavena*. There too, if you are very lucky, you can find the "mud-bailer," a species very distinct from *Melo amphora* and *umbilicata*. Mr. Iredale was very interested in this *Melo* which, so far, has not been identified and may well turn out to be a new species.

However, it is in Gloucester Passage, between Gloucester Island and the mainland that the collecting is most rewarding. The sandflat collecting is the most exciting to us southerners who are used to places like Long Reef where, after turning hundreds of rocks, one may come home with nothing. The sandflats off Gloucester Island are a delight. All you have to do is step gingerly along the beautiful and clean sand, and look carefully for a break in the sand. Seeing one, you "dive" and bring up an Olive or an orange Tellin, *Tellina foliacea*, or a Stromb. After the back-breaking and navvying work that we are used to, this is indeed, "pennies from Heaven."

I have more treasures which bear the legend "from Gloucester Island" than from any other location. Among the Cowries are:— *metavona, walkeri continens, saulae nugata, lutea humphreysi, eburnea, Volva volva, Volva nectarea, Neosimnia (Pellasimnia) angasi*, and a beautiful red, unnamed *Volva*. In the *Terebra* group are *muscaria, praelonga, maculosa* and several others. There are numerous beautiful Cones including *suturatus, circumactus* and another Cone which is like our *peronianus*. *Mitra fasciata* is also found there, and a few years ago, Mr. Knight collected two *Bistolida fluctuans*. There are also good bivalves, and the Naticas are well represented and very plentiful, the one recently named, described and illustrated by Mrs. L. Woolacott, *Naticarius lavendula*, is not at all rare there.

This time we tried some dredging in the deeper water off Gloucester Island and trapped, amongst other things, the rare little *Cantharus molleri* and *Conus tessulatus*.

Further down the Passage is "Dingo Beach," a local name for that portion of Cape Gloucester. It sometimes surpasses Gloucester Island. It is there that a very, very rare white cowry comes up. Only three or four specimens of this have so far been found; the last one being collected while I was there during August 1956 by Miss Marion Birchall. Superficially it is like *Albacypraea eburnea*, but is more humped and has an olive-green animal. *A. eburnea*. is a sand-dweller, but this one lives on coral rocks and is almost certain to be a new species. At present it remains a mystery.

In Gloucester Passage also lives *Austropteria saltata*. It provides an example of the value of ecology. If you know where it lives, you can attempt to look for it, and if you don't know, your chances of finding it are very slim indeed. It attaches itself to a kind of sea-tree, or gorgonia, which is never uncovered even on the lowest tide, but, on a very low minus tide when one is in about a foot of water, these gorgonians are plainly discernible and the Pterias adhere to the branches.

Sailing past Gloucester Passage one is soon within the Whitsunday Passage with Saddleback Island right in front. Its shape is well described by the name.

The islands of the Whitsunday Passage form an archipelago and though sometimes are a considerable distance apart, yet at some points give one the illusion of being within a land-locked harbour: then, as the boat travels a little distance, one finds oneself in the open sea. It is an unforgettable sight, majestic and unspoilt by man! To us, brought up in the tradition of Sydney Harbour, it is a revelation and a source of wonderment to see such a noble waterway with no buildings cluttering up the foreshores. How many islands there are, I do not know. There are many of these mainland islands with a thin strip of beach here and there. Most of them are large and mountainous, and with the exception of the few resorts, totally uninhabited except for goats. Many years ago the goats were let loose on some of the islands and were intended to provide food for shipwrecked sailors.

Most of the Whitsunday islands have a reef from which you can get a different series of shells. You can get some shells there that you never see at Gloucester and vice versa.

One of the best collecting grounds is Haslewood Island. It is a joy to turn rocks on the vast area of reef and find Cones, Cowries, Trochids, Thaids and an occasional Murex thrown in for good measure.

This August we were fortunate in striking an untouched reef which abounded in Cones of which we found about 24 or 25 different species. As even this area is being assailed by reef-wreckers (who, as is the case with Armit Island, do not stop before they have killed out a whole reef), it will have to remain nameless for the present. In addition to reef-wrecking, some of them are pyromaniacs who set alight to the timber on the headlands, so that the result is total devastation.

On the return journey it blew and blew and the seas were rough. We got into a rip-tide, a very frightening experience, but fortunately managed to get out of it again. We were forced to attempt the trip at this unfavourable time as we had only two days' water supply left. The journey back was neither pleasant nor comfortable; but we made it!

Descriptions of the Animals of Three Queensland Cowries

By J. Kerslake.

The following notes were made at North-West Island, Capricorn Group, during a collecting expedition in September 1954.

Nivigena melwardi Iredale, 1930.

Foot scarlet, without patterning. Mantle the same shade of scarlet as the foot. The mantle tubercles also scarlet with a few here and there pale cream (there were six of these on the specimen described). Between the tubercles, the mantle has a very fine reticulation of black but this is not strong enough to dim the brilliant red of the base colour. Siphon of a tan-scarlet with its edge entire.

Blasicrura rhinoceros Souverbie, 1865.

Mantle black, lightly peppered with pale cream specks which are distributed unevenly, tending to be more numerous around the tubercles. These are few—twelve being counted on the specimen described. They are pale cream and variable in respect of size and number of branches. Foot pale cream underneath. Its upper area is much paler than the mantle and is best described as cream with black flecks. Siphon grey and tentacles tan-orange.

Paulonaria fimbriata Gmelin, 1791.

Foot yellow-flesh colour. Mantle deep orange-salmon. Mantle tubercles not visible to the naked eye. Siphon cream with a fringed orifice. Tentacles orange.

Shells of Interest from Tryon Island, Queensland

By J. Kerslake.

Of the half dozen or so coral cays that form the Capricorn Group, Tryon Island is, perhaps, the least visited and its molluscan fauna the least known. Shells from the larger islands of the group, Masthead, Heron and North-West, are well known to conchologists as several museum expeditions and many private collectors have worked these areas.

In September 1954, while staying at nearby North-West Island, I had an opportunity to make a one-day trip to this tiny island about ten miles to the east. The number of species found in the few hours available was extraordinary. Live collecting on the reef near the anchorage was not good so that almost all the species reported here were from the beach or the very large hermit crab colonies. Many of the shells found were, of course, the same as those from North-West Island but the numbers of each species were in different proportions. For example, the dominant lagoon shell at North-West Island was *Fragum fragum* L. but this was not so at Tryon Island.

It is the rarities, however, that I wish to report here, a few of them being recorded for the first time from Queensland. Of five large species of *Murex*, three have been identified as: *clavus* Kiener, *tripteris* Born, and *triqueter* Born. About twenty species of cowry were found on the beach, the most noteworthy being *mariae* Schilders. Another of the day's prizes was the handsome *Astraea aureolum* Hedley. The *Cymatium* and *Bursa* group was the most surprising of all. At North-West Island in three weeks' collecting only five species were taken; here, in three hours, fourteen were found. The list is as follows:

Cymatium aquatile Reeve.
Cymatium gemmatum Reeve.
Cymatium chlorostoma Lamarck.
Cymatium tuberosum Lamarck.
Cymatium clandestinum Lamarck.
Cymatium rubecula Linne.
Cymatium gyrineum Linne.
Cymatium pusillum roseum Reeve.
Bursa granifera Lamarck.
Bursa rubeta Linne.
Bursa cruentata Sowerby.
Bursa condita Gmelin.
Bursa bufonia Gmelin.
Bursa siphonata Reeve.

I am indebted to Miss Hope Macpherson of the National Museum of Victoria for assistance in identifying some of the species listed.

An Intriguing Volute

By Tom Iredale.

Years ago I commented upon the close relationship of deep water molluscs trawled off the south-east coast of Australia and the fossils found in Victoria. I examined many specimens when I prepared the report on molluscs from Twofold Bay, New South Wales, and suggested a possible means of indicating relationship (Iredale, 1924). Little consideration has been taken of the suggestions as the duties of a conchologist and those of a palaeontologist rarely bring such authorities in contact and each ploughs his lonely furrow almost at right angles. The present instance will indicate the need of co-ordination to produce a reasonable solution. It must be noted that Mr. B. Cotton, the conchologist at the South Australian Museum, Adelaide, has reported upon recent and fossil members while reviewing some groups in years just past and his account of the Volutes (Cotton, 1949) has been very useful in the present connection.

A few years ago I was shown by the late Mr. Mayblom a fine Volute which he regarded as a hybrid between the well-known *Livonia mamilla* (Sowerby, 1844) and the rare *Pterospira roadknightae* (McCoy, 1881). It showed features suggesting relationship with both of these apparently distantly related species. The species *mamilla* is now well known since the trawlers have brought in many shells from various depths along the south-east coast of New South Wales. It is a very large shell, smooth, brightly coloured, with a large bulbous ("mamillate") apex, hence its name. Little variation has been observed save that the deeper water form has become thinner and much paler in coloration, the aperture becoming shining white, in contrast to the brown of the normal form. It has been named *leucostoma* Mayblom, 1951, subspecifically. There is no pronounced sculpture on the body-whorl of the species. The other species, *Pterospira roadknightae* is a smaller shell, much more solid, duller with less marked coloration, with pronounced longitudinal sculpture transversed by strong threads, and a smaller apex which would not be termed mamillate.

The suggested hybrid was the size of *mamilla*, thin, with similar coloration, but the apex was comparatively smaller, though still of the *mamilla* form, while the adult whorls showed the sculpture of the *roadknightae* form. The matter had to be left in abeyance, but recently a similar specimen was found in the Australian Museum collection, Sydney, among a large number of *mamilla* which had been trawled in Bass Strait, between 60 and 100 fathoms, in August-November, 1912, by the Federal Investigation Vessel *Endeavour*. This renewed consideration of the puzzling form. At first sight it was noted that the large pullus differed a little from that of *mamilla*, but did not recall that of *roadknightae*. The latter had been placed in the genus *Pterospira* Harris, 1897, which was based on the fossil *Voluta hannafordi* McCoy, 1874, so it became necessary to investigate that species. It proved to have an immense inflated pullus, with the aperture showing a strong posterior wing. The sculpture was pronounced as in *roadknightae*, but there the matter seems to end. Mr. Harold Fletcher, the Museum Palaeontologist, assisted me in the examination of the fossils. The type mentioned above (*hannafordi*) has a large pullus and expanded wing, but specimens from the type-locality all showed small proto-conchs. Cotton's figure (1949, pl. xiv, fig. 13) shows the original features of *hannafordi*. This variation in the protoconch suggests denial of *Pterospira* for the recent *roadknightae* and reference of that species to *Livonia* Gray, 1855. Examination then of a large number of *mamilla* showed slight variation in the size of the mamillate apex, variation in breadth being between 22 and 27 mm. An item worth consideration is that while *hannafordi* has been met with in places

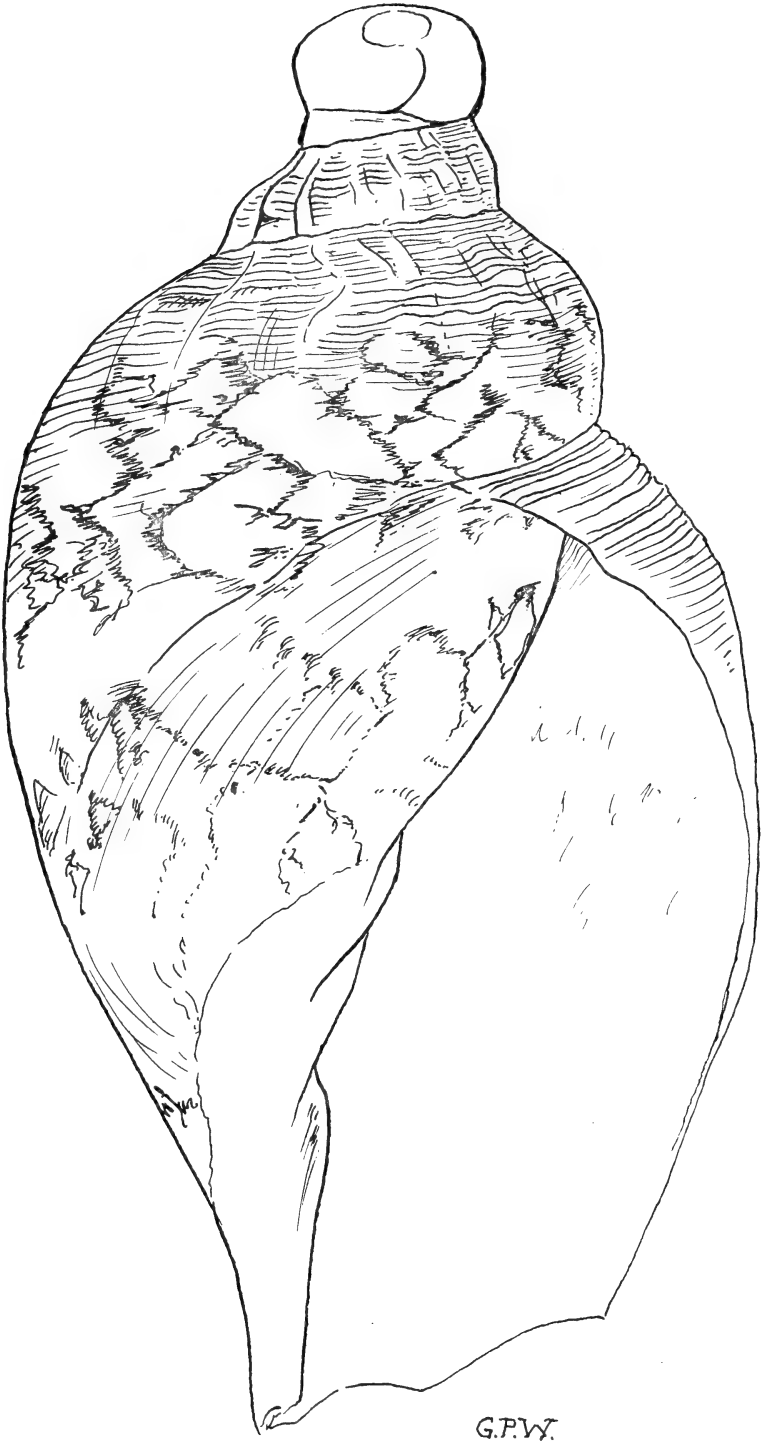

Figure 1.—*Livonia quisqualis* Iredale. Holotype, natural size.
G. P. Whitley del.

as a fossil (never in good condition?) there is practically no record of a fossil *mamilla*. Cotton mentions that there may be one specimen in existence and *Voluta mortoni* Tate, 1889, suggests a *mamilla*, but it has a small apex. It may be that these two, *mamilla* and *roadknightae*, have descended from a common ancestor, approaching *hannafordi*, and that the more common *mamilla* is the more recent and more progressive form, *roadknightae* being the older and less advanced. From this suggestion the conclusion might be reached that the present form is a relict of one of the intermediate growth-stages. To keep the matter under review the present form is named.

LIVONIA QUISQUALIS, sp. nov.

(Figure 1.)

Shell large, oval, body-whorl nine-tenths of bulk, spire very short, apical whorl very large, about a quarter of the width of the body-whorl, adult whorls three, increasing rapidly. Coloration brownish-cream splashed with brownish red medially forming two bands. Pullus large, massive, obliquely wound, smooth, first adult whorl small, finely concentrically striate, distant longitudinal ribs developing, earliest obscure, second whorl deeper showing fourteen more developed ribs, more pronounced above the periphery, longitudinal lirae becoming obsolete towards the suture; third body-whorl has lirae much heavier, still mostly above the periphery, fading below, almost vanishing medially, but becoming noticeable again anteriorly, half a dozen well marked ridges being seen, but disappearing towards the outer lip; a large area of transparent glaze over the body-whorl from the inner lip. Three pronounced stout plaits on columella, anterior canal short, rather wide. Outer lip extending posteriorly upwards almost a whorl, then sweeping anteriorly to the canal, aperture fairly wide and open, outer lip thin, slightly recurved.

Length 7½ inches (190 mm.); breadth about half the length, 97 mm. Pullus, height 25 mm., breadth 16 mm. Aperture about two-thirds the length of the shell (120 mm.).

Holotype (Australian Museum registered No. C. 34551) from 60-100 fathoms, Bass Strait.

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An Exciting Find

By Tom Iredale.

Mrs. C. Mortensen sent me some shells for advice, and as an afterthought added one for determination. To my amazement this shell was one of the most marvellous I have seen, being a giant of a well-known family, of which most of the sizeable members are figured in books of reference. These are the False Staircase Shells, placed alongside the true Staircase Shells, but with which they have little affinity. They are now separated as a Family Heliacidae, apart from the Staircase Shells, which form the Family Architectonidae. The genus was called *Torinia* Gray, 1842, but more recently *Heliacus* d'Orbigny, 1842 both names being given to the same species, but the latter name has priority. The type of *Heliacus* is the shell figured by Chemnitz as *cylindraceum*, a very flat planate shell with a very large umbilicus, now known as *crenellus* Linne. It is beautifully sculptured and has a peculiar operculum not easy to describe. It is about fifteen millimetres in breadth, a little more than half an inch, and shallow in height.

The present shell measures 39 mm. in breadth and 28 mm. in height, and while some members of the family are deeper than the type, their breadth is about the same, showing the great discrepancy in size of this find, which I have called exciting, as it was so unexpected.

Mrs. Mortensen has been persuaded to present the specimen to the Australian Museum, and my sincere thanks, and those of all conchologists, are tendered for this sacrificial act and for the preservation of this wonderful shell. I am dedicating the shell to her so that her name will be perpetuated in connection with this grand species. Moreover, as it differs appreciably in size and form from the other members of the family, I am giving it a distinctive generic name *Grandeliacus*.

Family HELIACIDAE.

Genus GRANDELIACUS, nov.

Type-species, *G. mortensenae*, sp. nov.

(Figure 1.)

Heliacoid shell of large size for the family, depressed globose, spire comparatively high, not elevated, widely umbilicate, umbilicus nearly one-third the width of the shell, mouth subcircular, columella slightly incurved, ending in a small anterior notch suggesting a minute canal. Colour uniform golden fawn or pale honey.

The species has the whorls rather rapidly increasing, sutures canaliculate, periphery with rounded subkeeling on last whorl. Adult whorls five and a half, protoconch small, of one anastrophe whorl, almost smooth. The adult sculpture is very complex, the first whorl with a very fine clathrate sculpture with an upper beaded peripheral keel, the sculpture being better defined on the antepenultimate whorl. Between the suture and the periphery there are closely set radial flattened ribs cut sharply into lozenges by three circular deep spirals forming four distinct lozenges to each radial rib, the beaded spiral succeeding this being separated by another channel followed by a stronger peripheral beaded spiral. The last whorl has the three spirals cutting the radials more weakly, the radials themselves being similarly weakened. The periphery now shows two broad peripheral spirals with a deep channel between them, the lower spiral weaker. The base has about six similar spirals, only slightly marked longitudinal ribbing, while a similar stronger spiral surrounds and enters the umbilicus, decreasing inwards, the spirals still weakly engraved. Breadth as above

39 mm.; height 28 mm.; aperture, breadth 17 mm., height 18 mm., umbilicus about 12 mm. The specimen was collected at Hummock Hill Island, Port Curtis area, Queensland, by Mrs. C. Mortensen, of Miriam Vale, North Coast line, Queensland.

Figure 1.—Three aspects of the holotype of *Grandeliacus mortensenae* Iredale.

History of New South Wales Shells

Part II: The Settlement Years

By Tom Iredale.

After Cook came the settlement of the new discovery. The place suggested was Botany Bay, recommended by Banks from his visit (Cook had died) and the date of departure was 1787, the arrival 1788, and the bulk of the settlers were to be convicts. The leader was Captain Phillip who was to be the Governor of the new colony. Upon reaching Botany Bay Phillip rightly concluded it was not a suitable place for such a project and ventured northwards in search of a better location. To his delight (and to the benefit of the later Australian Nation) he entered Port Jackson, an unknown inlet, so named by Cook, when passing in the distance. Phillip immediately transferred his little colony and settled well inside the Port (better known now as Sydney Harbour) at a little cove where there was a stream—which he named Sydney Cove. It was not intended as the permanent base, which he established further up the river and named Rosehill (now Parramatta). More experience showed Sydney Cove to be more suitable as it developed itself, and a town named Albion was proposed to be constructed. Through mischance the name was never given and the name Sydney (like Topsy) "just growed." This slight history is given to explain that in the business of a penal settlement and town planning there was little leisure to devote to the study of natural history. Nevertheless the obvious animals such as birds, fishes, mammals, etc., became familiar, especially on account of the strangeness of the forms, as Emus, Port Jackson Sharks, Kangaroos were seen and procured. Shells, however, did not come into much prominence, though it has been noted that "Governor Phillip spared a little time to collect shells," while Governor Hunter in his account of the early days included three plates showing shells in his account of the colony. Surgeon John White of the First Fleet was very interested in Natural History, and employed a convict named Thomas Watling to paint specimens of the fauna, including shells, and these will be discussed later.

Phillip noted that natives ate a large worm found in decayed wood drawn out of a creek—the first reference to the Shipworm or

cobra as food in Australia (Hunter, Histor. Journ., 1793, 4to ed., p. 516; 8vo ed., p. 447).

A later Governor, Bligh, was also interested in the collection of shells for his wife, as will be mentioned further on. The famous Flinders also reported after his shipwreck at a reef in the Coral Sea, now known as Wreck Reef, "My little collection in mineralogy and conchology was much defaced and one-half lost." With Flinders was the great botanist, Robert Brown, who prepared the basis of Australian botany, but who also collected zoological items, including shells. As above mentioned, the work of establishing the settlement precluded any systematic collecting, and shells which arrived in the homeland were unlabelled, and the exact localities are only gauged by our present knowledge of their distribution. Thus New South Wales was the name of the east coast of Australia from Cape York to southern Tasmania. The name Australia did not appear until about 1820 when Governor Macquarie accepted a suggestion by the then dead Flinders, who had merely mentioned it in a footnote in his book issued in 1814. Shells arrived in London from various sources between 1789 and 1822, but little is known about the collectors. Thus Swainson, in a little book entitled "The Naturalist's Guide (for collecting Subjects of Natural History . . . intended for the use of Students and Travellers)," giving advice as to the places whence shells were desirable, observed "From the coasts of New Holland we have a great number of beautiful species, and some of very high price. The Music Shells from this country (having teeth on the left hand side of the mouth) should be particularly sought after." To prove this he issued very beautifully coloured figures of some of these Volutes in a work entitled Exotic Conchology. About the same time the shells collected by Captain Bligh for his wife were sold at her decease and the catalogue mentions many fine shells from New South Wales, but as above mentioned that included Tasmanian forms such as the smoothish *Haliotis* (*glabra*) and *Bulimus Dufresnii*, a land shell, as from New South Wales. Altogether it will be concluded that the years 1789-1822 were pretty blank as regards the collection of shells by the settlers of the new colony.

On the other hand it was a good time through the visits of exploring vessels, English and French, the latter so acquisitive that they demand a section on their own, which will follow this. One local collector, however, must not be overlooked, as though his contributions were small, they are of outstanding interest. That is Stutchbury, who described that quaint bivalve, *Cleidothaerus*, one of the anomalies of the order. His other treasures were the even stranger *Myochama*, but his name lives through his discovery, when dredging in Sydney Harbour, of the "living fossil" *Trigonia*, which immortalised him as well as itself, by jumping back into the sea after he had caught it, a feat scarcely worth mentioning as regards a fish but unique in a "shellfish."

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