Pi 260 C-1 (magasins)

MUSÉUM NATIONAL D'HISTOIRE NATURELLE

ORSTOM

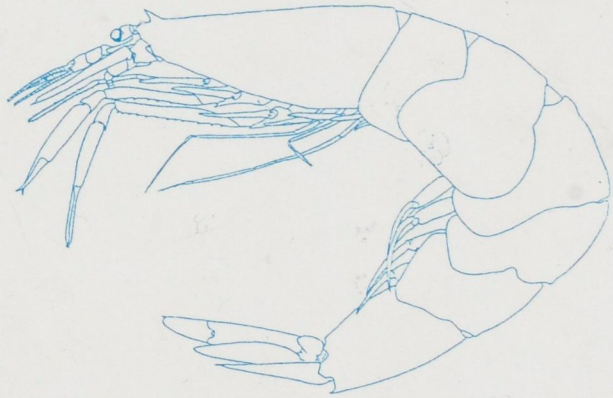
MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE

TOME 180

1999

Résultats des Campagnes MUSORSTOM

Volume 20



Coordonné par

Alain CROSNIER

Publié avec le concours de l'Institut français de Recherche scientifique pour le Développement en Coopération (ORSTOM)

COM

MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE

Rédacteur en chef *(Editor-in-Chief)* : Jean-Lou JUSTINE

Rédacteurs (*Editors*) : Jean-Marie BETSCH, Philippe BOUCHET, Christian ÉRARD & Jean-Lou JUSTINE

Assistante de rédaction (*Copy editor*) : Bernadette GOTTINI-CHARLES

Adresse (*Address*)

Mémoires du Muséum national d'Histoire naturelle

57, rue Cuvier

F-75005 Paris

Tél. : [33] 01 40 79 34 37

Fax. : [33] 01 40 79 38 08

e-mail : memoires@mnhn.fr

Les *Mémoires du Muséum national d'Histoire naturelle* publient des travaux originaux majeurs, tels que des monographies ou des volumes à auteurs multiples. Les auteurs sont invités, pour toutes les questions éditoriales, à prendre contact avec le directeur de la publication. Les manuscrits peuvent être en français ou en anglais.

The Mémoires du Muséum national d'Histoire naturelle *publishes major original contributions, such as monographs or multi-authored volumes. Prospective authors should contact the Editor-in-Chief. Manuscripts in French or English will be considered.*

Vente en France :

MUSÉUM NATIONAL D'HISTOIRE NATURELLE
SERVICE DES PUBLICATIONS SCIENTIFIQUES
Diffusion : Delphine HENRY
57, rue Cuvier
F-75005 Paris
Tél. : [33] 01 40 79 37 00
Fax : [33] 01 40 79 38 40
e-mail : dhenry@mnhn.fr

Sales Office:

UNIVERSAL BOOK SERVICES
Dr W. BACKHUYS
P.O. Box 321
NL-2300 AH Leiden
The Netherlands
Tel. : [31] (71) 517 02 08
Fax : [31] (71) 517 18 56
e-mail: backhuys@euronet.nl

Parution et prix irréguliers. Les ordres permanents d'achat et les commandes de volumes séparés sont reçus par le **Service des Publications Scientifiques, Diffusion** (pour la France et les DOM-TOM uniquement), ou par **Backhuys Publishers**. Catalogue sur demande. Une liste des derniers titres parus figure en page 3 de couverture.

Volumes are published at irregular intervals, and at irregular prices. Standing orders and orders for single volumes should be directed to the ***Service des Publications Scientifiques du Muséum****, (France and DOM-TOM only) or* ***Backhuys Publishers****. Price list and catalogues are available on request. Recently published memoirs are listed on page 3 of the cover.*

Printed on acid-free paper
Imprimé sur papier non acide

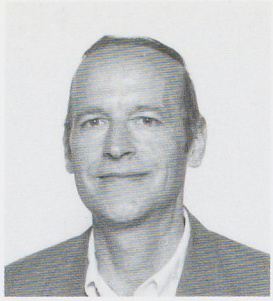
Bibliothèque Centrale Muséum
3 3001 00057288 2



Michèle BERTONCINI



Sylvie CHALIER



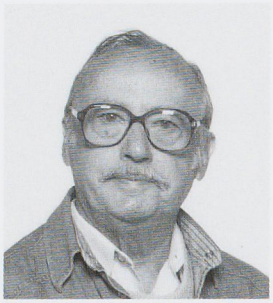
Régis CLÉVA



Jean-François DEJOUANNET



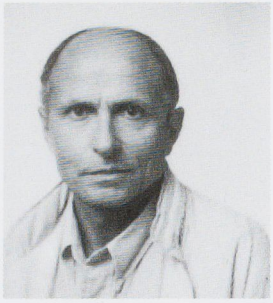
Gabrielle GADALETA



Maurice GAILLARD



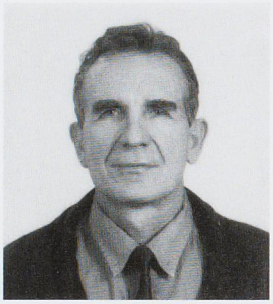
Virginie HEROS



Pierre LABOUTE



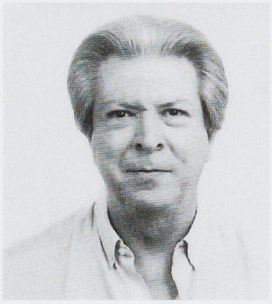
Philippe MAESTRATI



Jean-Louis MENOU



Mireille MOREAU



Pierre OPIC



Jacques REBIÈRE



Françoise THEUREAU

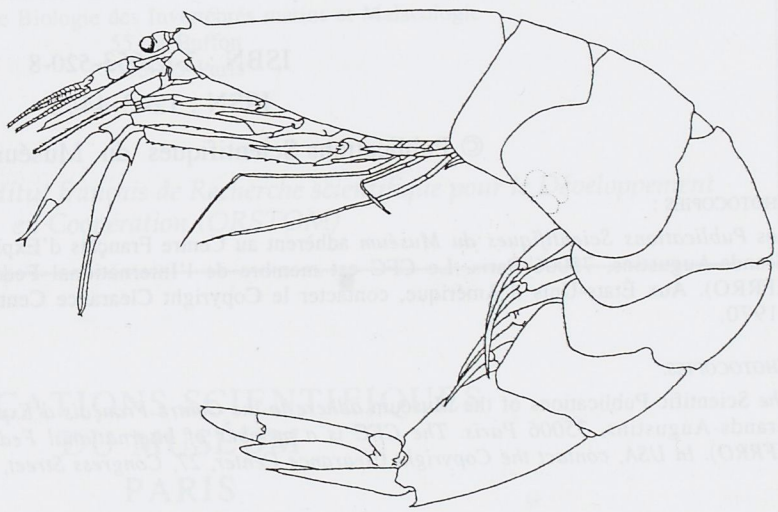
Le vingtième volume des Résultats des Campagnes MUSORSTOM est dédié à ceux qui, discrètement, ont joué un rôle essentiel dans la réussite de la série. Soit qu'ils aient participé aux campagnes en mer, aidé à trier les récoltes, à les étiqueter, à les expédier aux spécialistes, à les classer dans les collections après étude (Mmes BERTONCINI, GADALETA, HEROS et MOREAU; MM. CLÉVA et MAESTRATI), soit qu'ils se soient occupés de gestion administrative (Mlle CHALIER), soit qu'ils aient utilisé leur talent pour effectuer les dessins (Mlle THEUREAU, MM. DEJOUANNET, GAILLARD et OPIC) ou les photos (MM. LABOUTE, MENOU et REBIÈRE) illustrant les volumes.

À tous, les divers éditeurs de la série expriment leur reconnaissance.

résultats des campagnes

MUSORSTOM

Volume 20



BIBL. DU MUSÉUM PARIS

Résultats des Campagnes MUSORSTOM

Volumes déjà parus :

Volume 1 : *Mém. ORSTOM*, **91** : 1-558, 225 fig., 39 pl. (1981). ISBN : 2-7099-0578-7.
Volume 2 : *Mém. Mus. natn. Hist. nat.*, (A), **133** : 1-525, 126 fig., 37 pl. (1986). ISBN : 2-85653-136-9.
Volume 3 : *Mém. Mus. natn. Hist. nat.*, (A), **137** : 1-254, 82 fig., 9 pl. (1987). ISBN : 2-85653-141-5.
Volume 4 : *Mém. Mus. natn. Hist. nat.*, (A), **143** : 1-260, 103 fig., 23 pl. (1989). ISBN : 2-85653-150-4.
Volume 5 : *Mém. Mus. natn. Hist. nat.*, (A), **144** : 1-385, 128 fig., 35 pl. (1989). ISBN : 2-85653-164-4.
Volume 6 : *Mém. Mus. natn. Hist. nat.*, (A), **145** : 1-388, 190 fig., 4 pl. couleur (1990). ISBN : 2-85653-171-7.
Volume 7 : *Mém. Mus. natn. Hist. nat.*, (A), **150** : 1-264, 587 fig. (1991). ISBN : 2-85653-180-6.
Volume 8 : *Mém. Mus. natn. Hist. nat.*, (A), **151** : 1-468, 198 fig. (1991). ISBN : 2-85653-186-5.
Volume 9 : *Mém. Mus. natn. Hist. nat.*, (A), **152** : 1-520, 283 fig., 6 pl. couleur (1992). ISBN : 2-85653-191-1.
Volume 10 : *Mém. Mus. natn. Hist. nat.*, **156** : 1-491, 163 fig., 2 pl. couleur (1993). ISBN : 2-85653-206-3.
Volume 11 : *Mém. Mus. natn. Hist. nat.*, **158** : 1-426, 159 fig., (1993). ISBN : 2-85653-208-X.
Volume 12 : *Mém. Mus. natn. Hist. nat.*, **161** : 1-569, 269 fig., 11 pl. couleur (1994). ISBN : 2-85653-212-8.
Volume 13 : *Mém. Mus. natn. Hist. nat.*, **163** : 1-517, 132 fig., 4 pl. couleur (1995). ISBN : 2-85653-224-1.
Volume 14 : *Mém. Mus. natn. Hist. nat.*, **167** : 1-647, 987 fig., 3 pl. couleur (1995). ISBN : 2-85653-217-9
Volume 15 : *Mém. Mus. natn. Hist. nat.*, **168** : 1-539, 205 fig., 6 pl. couleur (1996). ISBN : 2-85653-501-1.
Volume 16 : *Mém. Mus. natn. Hist. nat.*, **172** : 1-667, 432 fig., 2 pl. couleur (1997). ISBN : 2-85653-506-2.
Volume 17 : *Mém. Mus. natn. Hist. nat.*, **174** : 1-213, 93 fig., (1997). ISBN : 2-85653-500-3.
Volume 18 : *Mém. Mus. natn. Hist. nat.*, **176** : 1-570, 458 fig., 7 pl. couleur (1997). ISBN : 2-85653-511-9.
Volume 19 : *Mém. Mus. natn. Hist. nat.*, **178** : 1-255, 70 fig., 4 pl. couleur (1998). ISBN : 2-85653-517-8.
Volume 20 : *Mém. Mus. natn. Hist. nat.*, **180** : 1-588, 192 fig., 2 pl. couleur (1999). ISBN : 2-85653-520-8.

ISBN : 2-85653-520-8

ISSN : 1243-4442

© Publications Scientifiques du Muséum, Paris, 1999

PHOTOCOPIES :

Les *Publications Scientifiques du Muséum* adhèrent au Centre Français d'Exploitation du Droit de Copie (CFC), 20, rue des Grands-Augustins, 75006 Paris. Le CFC est membre de l'International Federation of Reproduction Rights Organisations (IFRRO). Aux États-Unis d'Amérique, contacter le Copyright Clearance Center, 27, Congress Street, Salem, Massachusetts 01970.

PHOTOCOPIES:

The Scientific Publications of the Muséum *adhere to the Centre Français d'Exploitation du Droit de Copie (CFC),* 20, rue des Grands-Augustins, *75006 Paris. The CFC is a member of International Federation of Reproduction Rights Organisations (IFRRO). In USA, contact the Copyright Clearance Center, 27, Congress Street, Salem, Massachusetts 01970.*

MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE

TOME 180
ZOOLOGIE

Résultats des Campagnes MUSORSTOM

Volume 20

Coordonné par

Alain CROSNIER

Muséum national d'Histoire naturelle
Laboratoire de Biologie des Invertébrés marins et Malacologie
55 rue Buffon
F-75005 Paris

Publié avec le concours de l'Institut français de Recherche scientifique pour le Développement en Coopération (ORSTOM)

PUBLICATIONS SCIENTIFIQUES
DU MUSÉUM
PARIS
1999

SOMMAIRE

Pages

1. **La campagne MUSORSTOM 9 dans l'archipel des îles Marquises (Polynésie française). Compte rendu et liste des stations** 9
Bertrand RICHER DE FORGES, Joseph POUPIN & Pierre LABOUTE

2. **Cnidaria Anthozoa : Scléractiniaires d'eau profonde sans zooxanthelles du Vanuatu et des îles Wallis et Futuna** (en anglais) 31
Stephen D. CAIRNS

3. **Entoproctes et Bryozoaires Cheilostomida (Pseudomalacostegomorpha et Cryptocystomorpha) des campagnes MUSORSTOM autour de la Nouvelle-Calédonie** 169
Jean-Loup D'HONDT & Dennis P. GORDON

4. **Crustacea Isopoda : Bopyridae des collections MUSORSTOM récoltés dans l'Indo-Pacifique tropical. II. Espèces de la sous-famille Pseudioninae infestant des hôtes non anomuriens** (en anglais) 253
John C. MARKHAM

5. **Crustacea Decapoda : Révision de *Pasiphaea sivado* (Risso, 1816) et des espèces qui lui sont proches. Description d'un genre et cinq espèces nouveaux (Pasiphaeidae)** (en anglais) 267
Ken-Ichi HAYASHI

6. **Crustacea Decapoda: Révision des espèces du genre *Parapagurus* Smith, 1879 (Parapaguridae) des océans Indien et Pacifique** (en anglais) 303
Rafael LEMAITRE

7. **Crustacea Decapoda: Albuneidae et Hippidae de l'Indo-Ouest Pacifique tropical** (en anglais) 379
Christopher B. BOYKO & Alan W. HARVEY

8. **Crustacea Decapoda: Espèces des genres *Agononida* Baba & de Saint Laurent, 1996 et *Munida* Leach, 1820 (Galatheidae) récoltées durant la campagne MUSORSTOM 8 au Vanuatu** (en anglais) 407
Enrique MACPHERSON

9. **Crustacea Decapoda: Révision de la famille Dynomenidae** (en anglais) 427
Colin L. McLAY

10. **Pisces Anguilliformes: Poissons-serpents d'eau profonde (Ophichthidae) de la région néo-calédonienne (Pacifique sud-ouest)** (en anglais) 571
John E. McCOSKER

CONTENTS

Pages

1. **The MUSORSTOM 9 cruise in the Marquesas Archipelago. Report and list of stations** (in French) 9
Bertrand RICHER DE FORGES, Joseph POUPIN & Pierre LABOUTE

2. **Cnidaria Anthozoa: Deep-water azooxanthellate Scleractinia from Vanuatu, and Wallis and Futuna Islands** 31
Stephen D. CAIRNS

3. **Entoprocta and Bryozoa Cheilostomatida (Pseudomalacostegomorpha and Cryptocystomorpha) from the MUSORSTOM cruises around New Caledonia** (in French) 169
Jean-Loup D'HONDT & Dennis P. GORDON

4. **Crustacea Isopoda: Bopyridae in the MUSORSTOM collections from the tropical Indo-Pacific. II. Species in subfamily Pseudioninae infesting nonanomuran hosts** 253
John C. MARKHAM

5. **Crustacea Decapoda: Revision of *Pasiphaea sivado* (Risso, 1816) and related species, with descriptions of one new genus and five new species (Pasiphaeidae)** 267
Ken-Ichi HAYASHI

6. **Crustacea Decapoda: A review of the species of the genus *Parapagurus* Smith, 1879 (Parapaguridae) from the Pacific and Indian Oceans** 303
Rafael LEMAITRE

7. **Crustacea Decapoda: Albuneidae and Hippidae of the tropical Indo-West Pacific region** 379
Christopher B. BOYKO & Alan W. HARVEY

8. **Crustacea Decapoda: Species of the genera *Agononida* Baba & de Saint Laurent, 1996 and *Munida* Leach, 1820 (Galatheidae) collected during the MUSORSTOM 8 cruise in Vanuatu** 407
Enrique MACPHERSON

9. **Crustacea Decapoda: Revision of the family Dynomenidae** 427
Colin L. MCLAY

10. **Pisces Anguilliformes: Deepwater snake eels (Ophichthidae) from the New Caledonia region, Southwest Pacific Ocean** 571
John E. MCCOSKER

La campagne MUSORSTOM 9 dans l'archipel des îles Marquises (Polynésie française). Compte rendu et liste des stations

*Bertrand RICHER DE FORGES *, Joseph POUPIN ** & Pierre LABOUTE**

*ORSTOM
B. P. A5, Nouméa Cedex
Nouvelle-Calédonie

**Laboratoire d'Océanographie
École navale
29240 Brest naval

RÉSUMÉ

La campagne MUSORSTOM 9, réalisée à bord du N. O. *"Alis"*, s'est déroulée dans les eaux de Polynésie française, dans l'archipel des îles Marquises, du 18 août au 11 septembre 1997. 168 opérations de dragages et de chalutages ont eu lieu dans les zones bathyale supérieure et circalittorale sur les pentes des îles et sur le sommet du haut-fond Dumont d'Urville. Une terrasse en pente douce entoure chaque île et se termine par une brusque rupture de pente à 100 m de profondeur. Ensuite les pentes sont très abruptes et accidentées avec, parfois, des terrasses entre 400 et 600 m. Cet archipel isolé, situé dans le Pacifique central, présente une faune benthique remarquablement pauvre en espèces dans tous les groupes zoologiques.

ABSTRACT

The MUSORSTOM 9 cruise in the Marquesas Archipelago. Report and list of stations.

The MUSORSTOM 9 cruise was carried out in the Marquesas Archipelago from 18 August to 11 September 1997. 168 samples by dredging and trawling were made in the upper-bathyal zone and in the circalittoral depths, on the slope of the islands and on the top of the Dumont d'Urville Seamount. A terrace with a gentle slope is surrounding each island. Deeper than 100 meters the slope is very steep with from time to time terraces between 400 and 600 meters deep. The benthic fauna of this remote archipelago isolated in the Central Pacific is remarkably poor in all the groups.

RICHER DE FORGES, B., POUPIN, J. & LABOUTE, P., 1999. — La campagne MUSORSTOM 9 dans l'archipel des îles Marquises (Polynésie française). Compte rendu et liste des stations. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*, **180** : 9-29. ISBN-2-85653-520-8.

INTRODUCTION

L'étude des faunes littorales de l'Indo-Pacifique tropical a montré que la richesse spécifique des zones littorales n'est pas homogène en longitude (PAULAY, 1997). On observe en effet, pour tous les groupes sur lesquels les données sont suffisamment fiables, une décroissance de la richesse spécifique d'ouest en est dans le Pacifique (EKMAN, 1953 ; BRIGGS, 1974, 1996 ; SPRINGER, 1982 ; ROSEN, 1988). Ceci a été particulièrement bien illustré pour le groupe des coraux constructeurs qui servent à la fois d'abri et de nourriture à de très nombreuses espèces d'autres groupes (VERON, 1995).

Pour la faune bathyale, le petit nombre d'études zoologiques portant sur les collections constituées lors des "Grandes Expéditions", entre 1873 et 1952, ne permettait pas de vérifier si cette décroissance de la diversité spécifique s'observait également. Les données des campagnes russes, récemment publiées, apportent quelques informations sur la répartition géographique de cette faune et plus particulièrement du groupe des brachiopodes (ZEZINA, 1997).

L'exploration du benthos profond de l'Indo-Ouest Pacifique, entreprise conjointement par l'ORSTOM et le Muséum national d'Histoire naturelle, essaye depuis une vingtaine d'années de combler les lacunes des connaissances zoologiques dans l'Indo-Ouest Pacifique, tout en apportant des informations sur les ressources halieutiques et en mettant en évidence des molécules actives extraites des espèces profondes (Fig. 1).

L'exploration s'est déroulée en plusieurs étapes. Celle des îles Philippines a été relatée par FOREST (1981, 1985, 1989), celle de la Nouvelle-Calédonie et des îles Wallis et Futuna par RICHER DE FORGES (1990, 1993) et RICHER DE FORGES et MENOU (1993), celle de l'archipel de Vanuatu par RICHER DE FORGES *et al.* (1996). L'ensemble des faunes récoltées lors de ces différentes campagnes permet d'observer la répartition géographique des espèces des profondeurs bathyales. Il était donc particulièrement intéressant d'échantillonner la faune bathyale de l'archipel des îles Marquises situées dans le Pacifique central, à l'extrémité la plus pauvre du gradient de biodiversité et, de plus, éloigné de plus de 500 km des atolls de l'archipel des Tuamotu au sud-ouest (sans monts sous-marins entre eux), de 2000 km de l'île Christmas au nord-ouest, de 4000 km des îles Hawaii au nord, et de 6000 km des îles Galapagos à l'est (SPRINGER, 1982 ; WHEELER & CARILLET, 1997). Tel fut l'objectif de la campagne MUSORSTOM 9 qui s'est déroulée, du 18 août au 11 septembre 1997, aux îles Marquises, en Polynésie française.

Le seul archipel qui soit plus isolé que les îles Marquises est celui des îles Hawaii, formé d'un alignement d'îles volcaniques et de monts sous-marins pour lesquels l'étude de la faune marine a mis en évidence un taux d'endémisme élevé (CARLQUIST, 1980 ; KAY, 1994).

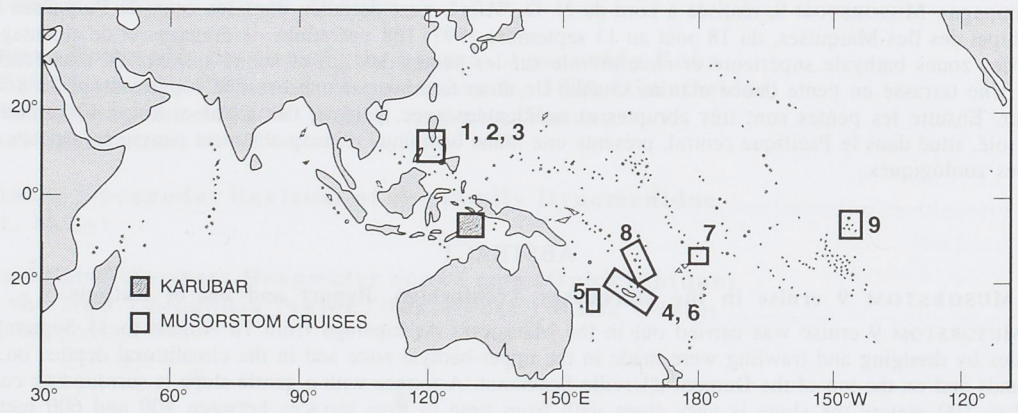


FIG. 1. — Répartition géographique des campagnes océanographiques d'étude de la faune bathyale de l'Indo-Pacifique réalisées depuis 1976. *Philippines* : MUSORSTOM 1 (1976), MUSORSTOM 2 (1980), MUSORSTOM 3 (1985) ; *Indonésie* : KARUBAR (1991) ; *Nouvelle-Calédonie (plus Chesterfield et Loyauté)* : MUSORSTOM 4 (1985), MUSORSTOM 5 (1986), MUSORSTOM 6 (1989) ; *Wallis et Futuna* : MUSORSTOM 7 (1992) ; *Vanuatu* : MUSORSTOM 8 (1994) ; *Marquises* : MUSORSTOM 9 (1997).

GÉNÉRALITÉS

ORIGINE GÉOLOGIQUE DES ÎLES MARQUISES (Fig. 2). — L'archipel des îles Marquises est situé dans le Pacifique central (ANONYME, 1988 ; DUPON *et al.*, 1993; DUPON & SODTER, 1993).

Ces îles volcaniques, habitées par des populations préhistoriques polynésiennes depuis environ 200 av. J.- C. (IRWIN, 1992 ; PANOFF, 1995), furent découvertes par les occidentaux en plusieurs étapes : en 1595 par D'ALVARO MENDANA, en 1775 par James COOK, en 1791 par INGRAHAM et par Etienne MARCHAND. La prise de possession par la France, par DUPETIT THOUARS, a eu lieu le 1er mai 1842.

Cet archipel est encore très mal cartographié et hydrographié. Les îles, volcaniques, sont constituées de sept à dix volcans individuels érigés sur des fonds océaniques de plus de 4000 m de profondeur.

Parmi les îles des Marquises, quatre présentent un faciès de volcans effondrés avec une caldera centrale, ouverte vers le sud pour Ua Huka (853 m), Nuku Hiva (1208 m), Tahuata (1050 m), et vers l'ouest pour Fatu Hiva (960 m). L'île d'Hiva Oa, qui culmine à 1190 m d'altitude, est formée de la coalescence de quatre volcans. Ua Pou présente un relief très caractéristique avec sa série de pitons phonolithiques et trachytiques culminant à 1252 m (BROUSSE *et al.*, 1978).

Les mesures d'âges absolus réalisées sur les roches des îles Marquises vont de 6,3 + ou - 0,2 M. A. au nord, à Eiao, et de 1,3 + ou - 0,02 M. A. au sud, à Fatu Hiva (BROUSSE & BELLON, 1974). Cet "alignement" volcanique serait dû au mouvement SE-NO de la plaque Pacifique à une vitesse moyenne de 10,3 cm/an.

La superficie totale des îles de l'archipel est d'environ 1050 km^2, répartie en 10 îles dont les plus vastes sont Nuku Hiva, 330 km^2, et Hiva Oa, 320 km^2.

ENVIRONNEMENT HYDROCLIMATIQUE. — Les conditions hydrologiques régnant aux îles Marquises ont été décrites à la suite des campagnes HYDROPOL réalisées par le N. O. *"Marara"* entre 1986 et 1990 (ROUGERIE *et al.*, 1992 ; ROUGERIE & WAUTHY, 1993). Ces campagnes ont mis en évidence la présence d'eaux côtières vertes, riches en plancton et turbides par rapport aux eaux oligotrophes du Pacifique central.

Les eaux de surface ont une température comprise entre 26,7 et 28,3°C (parfois 30° dans les baies) et une salinité de 35 à 35,8 ‰. Ces eaux sont plus riches en nutriants, en phytoplancton, et en particules que celles du reste de la Polynésie.

Le régime des pluies est très irrégulier (960 à 2880 mm/an) et les cours d'eau permanents peu nombreux (3 rivières de plus de 9 km de long). Le couvert végétal originel, qui se composait essentiellement de forêts, a été presque totalement détruit par l'homme (incendies, bétail) accentuant ainsi les phénomènes de sécheresse et d'érosion par ruissellement (HALLÉ, 1978).

LES CAMPAGNES ANTÉRIEURES ET LA BIODIVERSITÉ MARINE. — Les campagnes réalisées antérieurement dans cet archipel sont peu nombreuses et ont échantillonné principalement la faune marine littorale, accessible à la plongée en scaphandre autonome. Le navire *"Pele"* appartenant à Mrs Mariel KING a travaillé aux Marquises de septembre à octobre 1967 ; outre des récoltes littorales, il a effectué quelques dragages jusqu'à 130 m de profondeur. La mission "Muséum-IX", réalisée en février-mars 1973, a permis des récoltes de poissons de coraux et de mollusques. D'après PLESSIS et MAUGÉ (1978), la faune ichtyologique (45 familles et 391 espèces) ne serait pas sensiblement différente de celle des autres îles de Polynésie. RANDALL (1985) dans sa liste des poissons de Polynésie française (800 espèces) mentionne 353 espèces signalées des Marquises. RANDALL (1978) estimait qu'environ 10% des espèces de poissons connues des îles Marquises étaient endémiques.

CHEVALIER (1978) a donné un inventaire préliminaire des espèces de coraux des îles Marquises. Il constate la pauvreté de la faune corallienne et le faible développement des formations récifales. On dénombre 3 à 4 fois plus d'espèces de coraux dans les autres archipels polynésiens qu'aux Marquises. VERON (1995) indique dans son étude de la biogéographie des coraux, que les îles Marquises auraient environ 50 espèces de scléractiniaires, alors que PICHON (1985) relève 51 genres et 168 espèces de scléractiniaires signalés de Polynésie française. CHEVALIER (1978) signalait aussi l'absence du genre *Acropora* aux îles Marquises (alors que 39 espèces de ce genre sont présentes dans les autres archipels de Polynésie française) ainsi que celle des Mussidae et des Faviidae.

Dans le groupe des Mollusques, REHDER (1968) évaluait le taux d'endémisme de la faune malacologique des îles Marquises à 20 %, ce qui les place juste après les îles Hawaii et l'île de Pâques.

SPRINGER (1982) attire l'attention sur le fait qu'aux îles Marquises le fort taux d'endémisme dans plusieurs groupes est associé à l'absence ou à la raréfaction de certains groupes, comme c'est le cas pour les scléractiniaires.

Pour la faune profonde, il y a lieu de signaler les campagnes du N. O. *"Marara"*, sous la direction scientifique de J. POUPIN, qui ont réalisé des échantillonnages avec de nombreuses poses de casiers et quelques dragages (POUPIN *et al.*, 1990 ; POUPIN, 1991). Les pêches au casier ont exploré la tranche bathymétrique de 100 à 1000 m, récoltant principalement des crustacés (POUPIN *et al.*, 1990 ; POUPIN & RICHER DE FORGES, 1991).

Une partie du matériel zoologique de ces campagnes a déjà fait l'objet d'études. Le crabe de profondeur du genre *Chaceon*, qui était la cible principale des pêches aux casiers, s'est révélé être une nouvelle espèce, *Chaceon poupini* Manning, 1992 (POUPIN *et al.*, 1991 ; MANNING, 1992).

Parmi les 758 espèces de crustacés décapodes répertoriées par POUPIN (1994 ; 1996a, b ; sous presse) pour l'ensemble des archipels composant la Polynésie française, environ 171 sont connues des îles Marquises.

DÉROULEMENT DE LA CAMPAGNE MUSORSTOM 9

ITINÉRAIRE (Fig. 2). — La campagne a eu lieu à bord du N. O. *"Alis"*, au départ de Vairao, situé sur la presqu'île de l'île de Tahiti. Compte tenu du mauvais état de la mer, trois jours et demi de route furent nécessaires pour rallier l'île de Ua Pou aux Marquises. Le travail débuta dans le nord de l'île d'Ua Pou (première station DW 1142), en baie d'Hakahau, le 22 août, par des stations de dragages en petites profondeurs (30 à 100 m) destinées à échantillonner la faune circalittorale, tout en mettant au point le matériel de pêche (RICHER DE FORGES & LABOUTE, 1998). Après quelques essais réussis dans le nord-est de l'île, sur des fonds rocheux de 150 à 450 m de profondeur, nous perdions l'une de nos deux dragues Waren. Cet incident malencontreux devait nous obliger à utiliser une drague à roche (DR) et à modifier notre itinéraire pour tenter de faire construire une nouvelle drague dans l'île de Nuku Hiva où se trouve le plus important village de l'archipel, Taiohae, qui compte environ 1600 habitants. Après une nuit de route, l'exploration se poursuivit dans le nord-est de l'île d'Eiao, la plus au nord de l'archipel, où J. POUPIN avait observé des fonds meubles en pente douce lors de ses dragages à bord du N. O. *"Marara"* en 1990. En fait, les fonds y sont aussi rocheux que sur les autres îles mais la pente, effectivement plus faible, permet par endroit la présence de sable grossier. Le lendemain, 24 août, nous devions regagner Nuku Hiva, plus tôt que prévu, pour y débarquer l'un des matelots. Après une visite à Taiohae pour voir, auprès du chef du Service des Travaux Publics, la possibilité de faire fabriquer sur place une nouvelle drague, nous repartions sans grand espoir. Les travaux de dragages reprirent immédiatement dans l'axe de la baie de Taiohae, à partir des fonds de 30 m. Trois dragages eurent lieu sur la plateforme corallienne, à 30, 45 et 80 m avant d'aborder la pente de l'île proprement dîte. La rupture de pente est très nette et rappelle tout à fait celle d'une pente externe de récif frangeant. Les nombreuses opérations de dragages, qui furent réalisées entre 80 et 120 m, confirmèrent qu'il s'agit d'un substrat corallien ancien, couvert de sédiments grossiers. Quatre jours furent consacrés à l'échantillonnage des pentes de l'île de Nuku Hiva. Des fonds de sables détritiques grossiers permirent l'utilisation du chalut à perche avec succès (CP 1169) ramenant de nombreuses espèces de poissons et de crustacés et des débris végétaux avec leur faune associée. Les échinodermes, échinides et astérides, dominent largement les captures, jusqu'à constituer parfois l'essentiel du contenu des chaluts (CP 1175, 1176, 1177). Sur les petits fonds sablo-vaseux (25-55 m) des baies du nord de Nuku Hiva, furent récoltées en abondances des Mytilidae du genre *Amygdalum*. Un chalutage réussi par 390-400 m de profondeur ramenait un énorme bloc de calcaire qui fut brisé et conservé pour des études géologiques.

Le 28 août les opérations de dragages débutaient sur les pentes de l'île d'Hiva Oa par des stations à l'ouest du canal du Bordelais. Ce chenal, étroit et peu profond (60 m), sépare Hiva Oa de l'île de Tahuata (Fig. 2). La pente, en face du canal, présente des fonds d'éboulis sablo-vaseux avec des éléments détritiques grossiers (coquilles). Le fond du chenal est composé de maerl, caractéristique des zones à fort hydrodynamisme (DW 1203, 1204, 1209, 1210). A notre grande déception, la partie sud de l'île d'Hiva Oa, qui correspond à l'intérieur du cratère de l'ancien volcan, se révéla difficile à travailler. Les pentes y sont très accores et rocheuses et les profondeurs dépassent

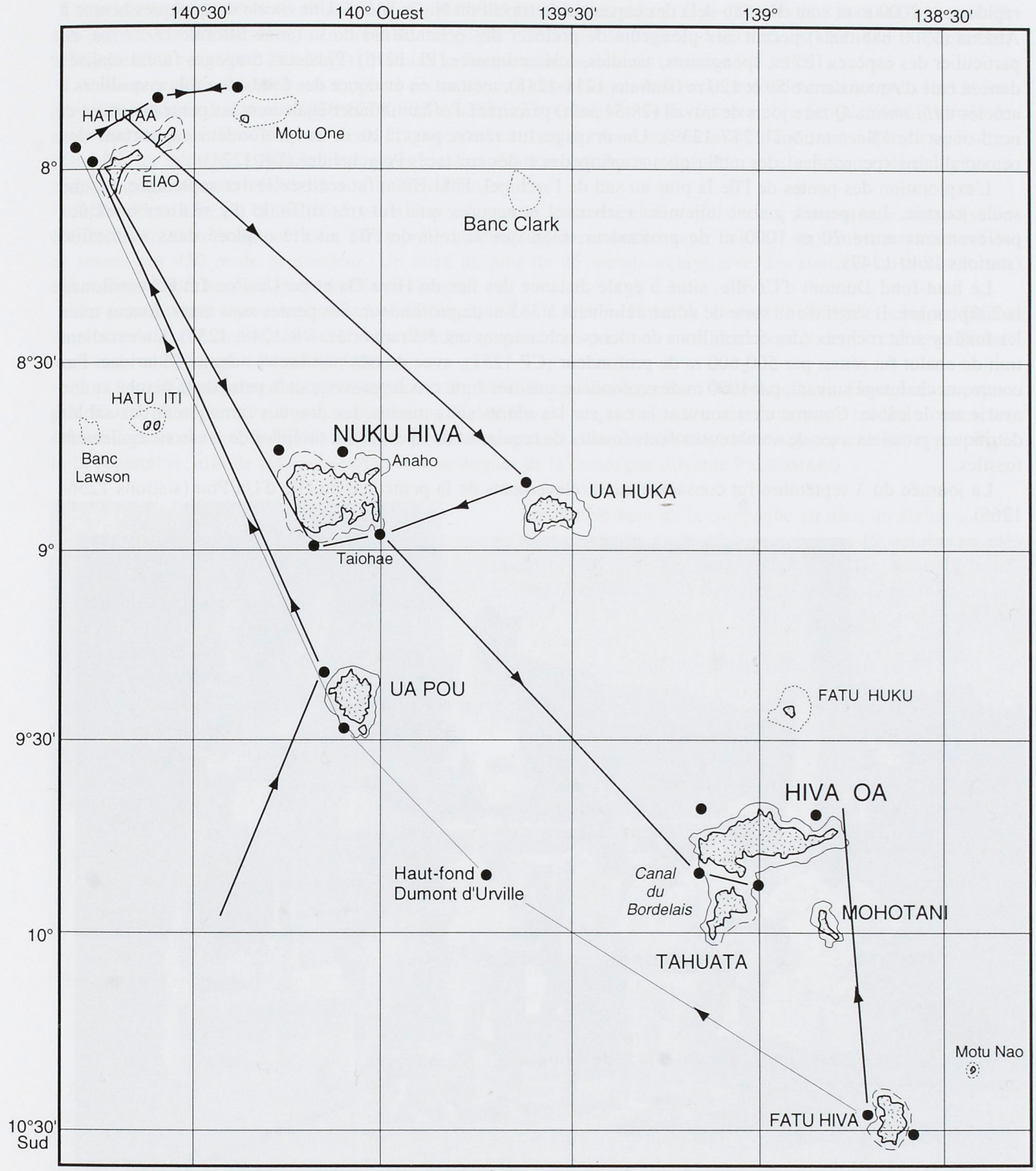


FIG. 2. — Carte de l'archipel des îles Marquises (Polynésie française) montrant l'itinéraire de la campagne MUSORSTOM 9. *Ua Pou* (stations 1142-1151, 1256-1265) ; *Eiao* (1152-1160, 1266-1280) ; *Motu One* (1281-1282) ; *Hatutaa* (1283-1287) ; *Ua Huka* (1288-1297) ; *Nuku Hiva* (1161-1197, 1298-1307) ; *Hiva Oa* (1198-1239) ; *Fatu Hiva* (1240-1247) ; *haut-fond Dumont d'Urville* (1248-1255).

rapidement 2000 m et sont donc au-delà des capacités de travail du N. O. *"Alis"*. Une escale de quelques heures à Atuona (1300 habitants) permit aux plongeurs de prélever des échantillons de la faune littorale (3-27 m), en particulier des espèces fixées, spongiaires, ascidies, scléractiniaires (PL 1216). Plusieurs dragages furent réalisés dans la baie d'Atuona entre 50 et 120 m (stations 1211-1218), mettant en évidence des fonds de sable coquilliers à articles d'*Halimeda*. Quatre jours de travail (28-31 août) permirent d'échantillonner également les pentes nord-est et nord-ouest de l'île (stations 1217-1239). Un dragage fut réussi par 1110 m de profondeur rapportant des octocoralliaires (pennatules), des mollusques scaphopodes et des crustacés Polychelidae (DR 1221).

L'exploration des pentes de l'île la plus au sud de l'archipel, Fatu Hiva, fut réalisée le 1er septembre, en une seule journée. Les pentes y sont tellement rocheuses et accores qu'il fut très difficile d'y réaliser quelques prélèvements entre 70 et 1000 m de profondeur, bien que le tour de l'île ait été exploré dans sa totalité (stations 1240-1247).

Le haut-fond Dumont d'Urville, situé à égale distance des îles de Hiva Oa et de Ua Pou fut échantillonné le 2 septembre. Il s'agit d'une sorte de dôme culminant à 333 m de profondeur. Ses pentes sont assez douces mais les fonds y sont rocheux (des échantillons de roches volcaniques ont été rapportés, DR 1249, 1253). Un excellent trait de chalut fut réussi par 500-600 m de profondeur (CP 1251), avec de très nombreux oursins Cidaridae. Par contre, au chalutage suivant, par 1000 m de profondeur, une très forte croche provoquait la perte de la perche et une avarie sur le câble. Comme c'est souvent le cas sur les monts sous-marins, les dragues ramenèrent des sables détritiques grossiers avec de nombreuses dents fossiles de requins et de raies, et des otolithes de poissons également fossiles.

La journée du 3 septembre fut consacrée aux prélèvements de la pente sud de l'île d'Ua Pou (stations 1256-1265).



FIG. 3. — L'équipe scientifique embarquée à bord de l'*"Alis"*, à l'exception de Pierre LABOUTE absent. De gauche à droite : Joseph POUPIN, Helmut ZIBROWIUS, Bertrand RICHER DE FORGES, Benoît DAYRAT, Philippe BOUCHET, Régis CLEVA. En arrière-plan, le navire *"Alis"* mouillé à Nuku Hiva.

Les derniers jours furent utilisés pour compléter l'échantillonnage du groupe d'îles les plus au nord, qui avait dû être prématurément interrompu en début de campagne : Eiao du 4 au 6 septembre (stations 1266-1280) ; Motu One le 7 septembre (stations 1281-1282) ; Hatutaa le 7 septembre également (stations 1283-1287).

Cette zone présente des fonds en pente douce au nord-ouest jusqu'à 800 m de profondeur sur lesquels les chaluts à perche ont bien fonctionné (CP 1270, 1271, 1272, 1276). La journée du 6 septembre fut décrétée "journée de repos" et, ce jour là, seulement deux dragages eurent lieu en zone circalittorale d'Eiao ainsi que des récoltes littorales en plongée. Certains membres de l'expédition profitèrent de cette escale pour récolter la faune malacologique terrestre et d'eau douce de l'île d'Eiao.

L'îlot Motu One est la seule formation non volcanique de l'archipel. Il s'agit, en fait, d'une grosse caye de sable érigée sur un vaste banc corallien. Deux prélèvements seulement ont pu avoir lieu le 7 septembre sous le vent de ce relief, par 450 m de profondeur. Un alizé de plus de 25 nœuds s'étant levé, les stations suivantes furent effectuées à l'abri, au nord-ouest de l'île de Hatutaa.

La journée du 8 septembre fut occupée à l'exploration de l'île Ua Huka. A la suite d'une forte croche par 800 m de profondeur, fort heureusement à la fin de la campagne, nous perdions notre deuxième et dernière drague Waren avec environ 500 m de câble (DW 1291).

Les 9 et 10 septembre furent employés à compléter l'échantillonnage dans l'ouest de Nuku Hiva. La campagne prît fin le 10 septembre dans la matinée à Nuku Hiva, ce qui laissa l'après-midi pour reconditionner les échantillons et changer le liquide fixateur. Les membres de la mission MUSORSTOM 9 regagnèrent Tahiti par avion le 11 septembre, afin de laisser le bateau aux géologues de la campagne suivante PALEOMARQ.



FIG. 4. — L'équipe de l'atelier à terre. De gauche à droite : Jean TARDY, Jean TRÖNDLÉ et Rudo VON COSEL

En complément de la campagne en mer, un atelier à terre de quatre semaines (du 16 septembre au 19 octobre) a été organisé sur l'île Ua Huka. Des récoltes dans la zone intertidale et jusqu'à une trentaine de mètres de profondeur, en plongée et à la drague, ont été effectuées par une équipe de trois chercheurs.

Les dragages ont utilisé une petite drague de 30 et 40 cm de largeur, manœuvrée à partir d'une embarcation à moteur locale de 8 mètres de longueur.

Quarante stations ont été explorées (quelques-unes en échantillonnage répété) et, au total, les opérations suivantes ont été effectuées :

— 22 sorties à pied, en marée;

— 8 sorties de plongée en apnée entre 0,5 et 5 m de profondeur.

— 115 traits de drague entre 5 et 32 m de profondeur.

— 3 récoltes en eau douce.

— 4 prélèvements d'échantillons pour la recherche de mollusques terrestres.

La liste détaillée des stations est publiée, en annexe, après celle des stations de la campagne MUSORSTOM 9.

MATÉRIEL ET MÉTHODES. — Pour cette campagne, nous disposions de deux dragues Waren seulement. Or dès la fin de la première journée de travail de la campagne, une drague fut perdue. Durant la suite de la campagne, la seule drague restante ne fut utilisée qu'avec précaution sur des fonds plats et non rocheux. Toutes les autres opérations de dragages eurent lieu à l'aide d'une drague à roche (DR). Cette drague est habituellement employée par les géologues pour rapporter des échantillons de roches volcaniques. Elle est constituée d'un cylindre de 40 cm de diamètre et de 60 cm de longueur, prolongé par un sac muni d'une cotte de maille (Fig. 5). Cet engin s'est avéré assez efficace sur les fonds tourmentés et rocheux des îles Marquises. Des essais comparés avec la drague Waren montrèrent que la différence de récolte est seulement quantitative mais que les peuplements sont bien échantillonnés.



FIG. 5. — La drague à roches (DR) est vidée sur le pont au large de Nuku Hiva (photo P. LABOUTE).

Le chalut à perche de 4 m a été maintes fois décrit (FOREST, 1981). Il fut utilisé dès que les fonds étaient suffisamment meubles, même avec une forte pente. Par contre, aucun fond permettant l'utilisation du chalut à crevette ne fut trouvé.

Le tamisage a été effectué dans l'eau, sur mailles successives allant de 20 mm à 1 mm. Le tri des résidus supérieurs à 3 mm a été effectué à bord (Fig. 6) et les refus de tailles inférieures ont été fixés et seront triés au laboratoire pour en extraire les micromollusques.

Certains crustacés ont fait l'objet de dissections pour prélever les gonades destinées aux études sur la morphologie des spermatozoïdes (Albuneidae, Geryonidae, Pinnotheridae, Parthenopidae, Palinuridae).

La plupart des espèces de crustacés, quelques mollusques et quelques poissons ont fait l'objet de photographies en couleurs.

COMMENTAIRES SUR LES ZONES PROSPECTÉES ET LA FAUNE RÉCOLTÉE

LES PLATEFORMES CORALLIENNES. — L'absence de véritables récifs coralliens autour des îles des Marquises a intrigué différents auteurs (AGASSIZ, 1903 ; CROSSLAND, 1927 ; SOURNIA, 1976 ; BROUSSE *et al.*, 1978 ; WAUTHY *et al.*, 1988 ; ROUGERIE *et al.*, 1992). Par ailleurs, ces mêmes auteurs avaient remarqué que les îles sont bordées d'une sorte de plateforme de quelques milles de largeur et dont la profondeur ne dépasse pas 90-100 m. Une hypothèse a donc été émise : il s'agirait des anciennes constructions récifales vestige d'un ancien niveau marin. La similitude bathymétrique observée entre le rebord de ce plateau et les pentes externes des récifs barrières renforce l'idée qu'il s'agirait bien d'un récif fossile. Au cours de la campagne MUSORSTOM 9, les dragages réalisés, à la demande des géologues, confirment bien que la rupture de pente (80-120 m) porte de vieilles constructions coralliennes. Les échantillons de *Porites* morts rapportés dans les dragues (DW 1173, 1182, CP 1191, DW 1201, 1202, 1206, 1246, CP 1262, DW 1275) permettront, peut-être, de vérifier par datation si l'âge de ces coraux correspond bien à celui de la dernière glaciation (BLOOM *et al.*, 1974 ; BARD *et al.*, 1996).

Pour CHEVALIER (1978), deux hypothèses expliqueraient la pauvreté des îles Marquises en espèces et en formations récifales : 1) l'isolement géographique limitant l'arrivée des larves, d'autant plus que les courants dominants viennent de l'est ; 2) des mauvaises conditions écologiques limitant l'installation des larves et ayant sélectionné les espèces les plus résistantes.

Pour ROUGERIE *et al.* (1992), les eaux froides issues de la dernière déglaciation auraient provoqué, aux îles Marquises, l'arrivée d'eaux d'une température inférieure à 17°C, provoquant la mort du récif barrière. Un phénomène d'endo-upwelling géothermique à travers cette plateforme corallienne fossile serait à l'origine de l'enrichissement des eaux et de la forte production planctonique. Cet "effet d'île" caractérisé par une forte production primaire a été mis en cause pour expliquer le faible développement corallien (SOURNIA, 1976 ; ROUGERIE & WAUTHY, 1993).

Au cours de la campagne MUSORSTOM 9 et de la campagne suivante PALEOMARQ, les plongées réalisées ont permis à P. LABOUTE d'observer la présence des scléractiniaires vivants suivants : *Porites lobata*, *P.* (?) *lutea*,

Millepora platyphyllia, *Pocillopora* sp 1 et sp 2, *Leptoseris hawaiensis*, *Dendrophyllia* sp., *Fungia* sp., *Pavona* sp., *Montipora* sp.

Parmi les coraux morts remontés dans les dragages pendant MUSORSTOM 9, figuraient des spécimens du genre *Acropora*, supposé absent de cette région (DW 1201, 1275).



FIG. 6. — Tri du benthos sur la plage arrière, devant le paysage grandiose de l'île d'Ua Pou. De gauche à droite : Régis CLEVA, Benoît DAYRAT, Philippe BOUCHET, Bertrand RICHER DE FORGES et Joseph POUPIN (Photo P. LABOUTE).

LA RICHESSE SPÉCIFIQUE. — L'isolement géographique et bathymétrique de cet archipel a certainement conditionné la relative pauvreté des formations récifales entrainant celle des organismes marins qui leurs sont ordinairement associés (PAULAY, 1997). Il est bien connu en écologie théorique des îles que la biodiversité présente dépend à la fois de l'isolement, de la dimension, et de la capacité dispersive des organismes : "...the degree of isolation relative to the mean dispersal distance will usually be decisive" (MAC ARTHUR & WILSON, 1967).

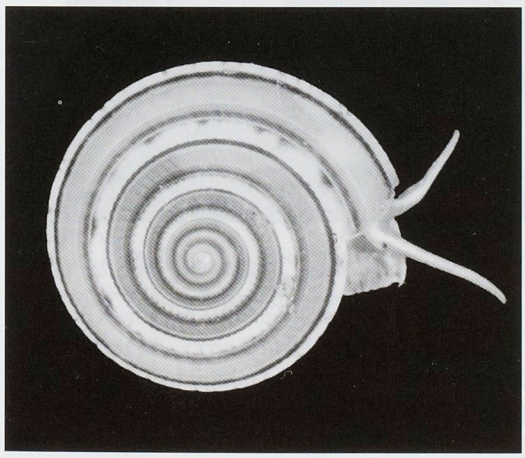


FIG. 7. — Mollusque gastéropode de la famille des Architectonicidae, très commun sur la plateforme corallienne des îles Marquises.

Joseph POUPIN, s'appuyant sur la littérature (MONTEFORTE, 1984 ; POUPIN, 1996a, b, sous presse ; CHAN & YU, 1998 ; POUPIN & MCLAUGHLIN, sous-presse) a trouvé qu'environ 171 espèces de crustacés décapodes et stomatopodes ont été signalés aux îles Marquises. D'après ses observations pendant la campagne MUSORSTOM 9, environ 60 espèces supplémentaires de crustacés ont été récoltées, ce qui porterait le nombre d'espèces connues de décapodes et stomatopodes à 240 espèces. Les espèces nouvellement reconnues pendant MUSORSTOM 9 concernent surtout des groupes de profondeur : des crevettes bathypélagiques (Aristeidae, Benthesicymidae, Solenoceridae et

Sergestidae) ; des Stenopodidae ; des Crangonidae ; des Polychelidae (*Stereomastis phosphorus*) pas encore signalés du Pacifique central ; des anomoures (Diogenidae, Galatheidae (*Munida*), Chirostylidae) ; des crabes Dromiidae, Dorippidae, Calappidae, Leucosiidae, Majidae, Portunidae, Xanthidae, Palicidae. Les familles des Dorippidae et Palicidae n'étaient pas encore connues de cette région du Pacifique.

A l'occasion du congrès international sur les récifs coralliens qui s'est tenu à Tahiti en 1985, une tentative d'inventaire de la faune et de la flore marines de Polynésie française a été faite (RICHARD, 1985). Pour le groupe des mollusques, 262 espèces connues des îles Marquises ont été recensées à cette occasion. De nombreuses espèces supplémentaires ont été récoltées durant MUSORSTOM 9. Sur la plateforme littorale, le groupe des gastéropodes Architectonicidae (Fig. 7) et celui des bivalves Mytilidae sont particulièrement fréquents.

Le groupe des échinodermes est particulièrement fréquent et abondant dans les prélèvements bien qu'il s'agisse souvent de peuplements peu diversifiés d'oursins (Cidaridae, Loveniidae, Echinothuridae) et d'étoiles de mer (Fig. 8). Bien que le groupe des crinoïdes ne soit pas censé s'étendre jusqu'au Pacifique central, une tige de crinoïde pédonculé a été récoltée aux îles Marquises sur le sommet du haut-fond Dumont d'Urville (DR 1255) et une comatule vivante a été rapportée de 1000 m de profondeur sur la pente sud d'Ua Pou (CP 1263).

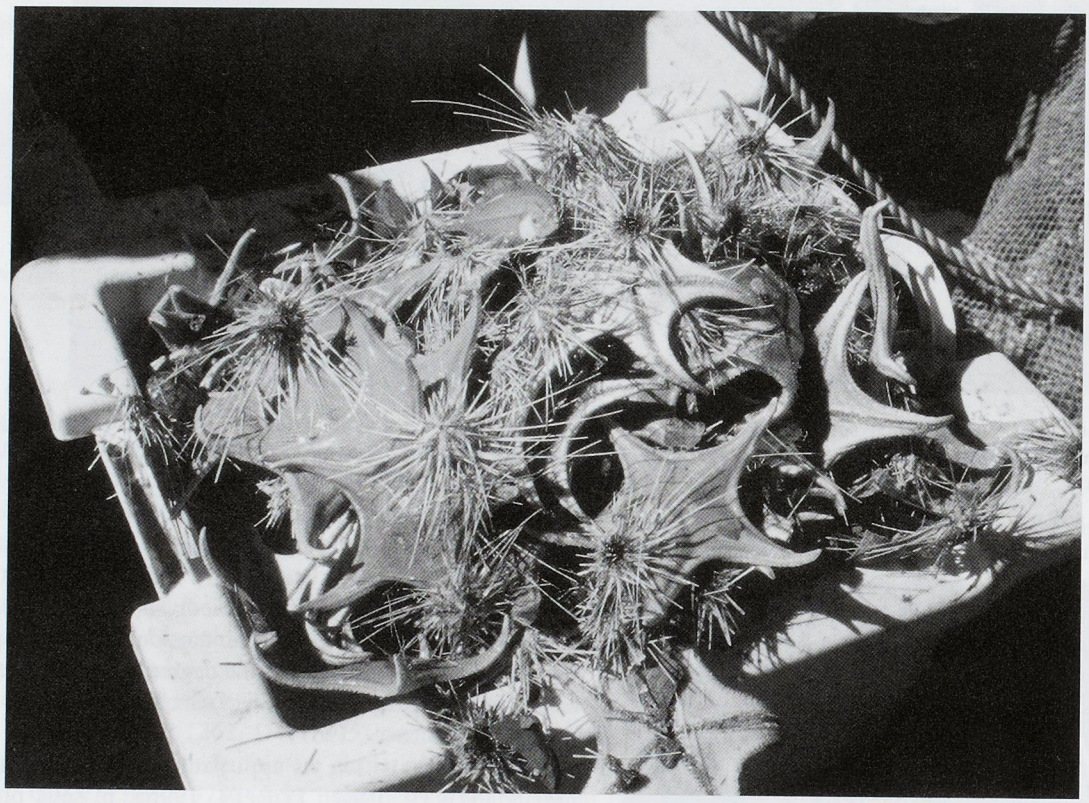


FIG. 8. — Exemple du contenu d'un chalut à perche montrant un peuplement à dominante d'échinodermes.

Le groupe des poissons est le seul qui semble présenter une diversité spécifique assez élévée (une vingtaine d'espèces par trait) avec des Moridae, Lophiidae (*Lophiomus*), Chaunacidae (*Chaunax*), Macrouridae, Macrorhamphosidae, Chlorophthalmidae, Hoplichthyidae, Ogcocephalidae (*Halieutea*), Ophidiidae, ainsi que de nombreux poissons plats Bothidae (*Chascanopsetta* spp.), Cynoglossidae, et Soleidae. Les stations de chalutages au delà de 800 m de profondeur ramenèrent en abondance un *Hoplosthetus* de couleur sombre et de petite taille (Fig. 9). Signalons la présence, par 300 m de profondeur, d'une raie de l'espèce *Plesiobathys daviesi* (Fig. 10). Sur la plateforme littorale, vers 60 m de profondeur, on note l'abondance de Scorpaenidae et de Triglidae ainsi que plusieurs petites espèces de Pegasidae.

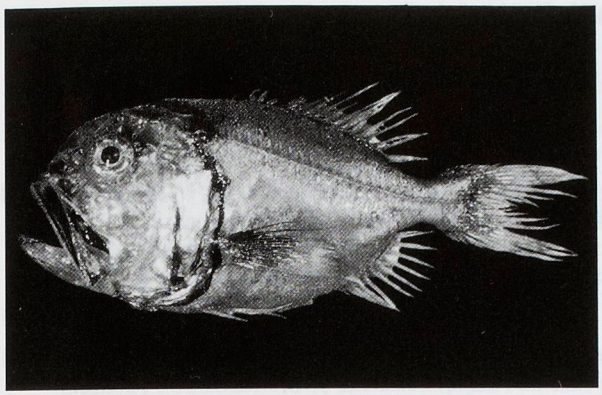


FIG. 9. — *Hoplostethus melanopus*, poisson béryciforme de la famille des Trachychtyidae récolté à la station CP 1195 (identifié par B. SERET.).

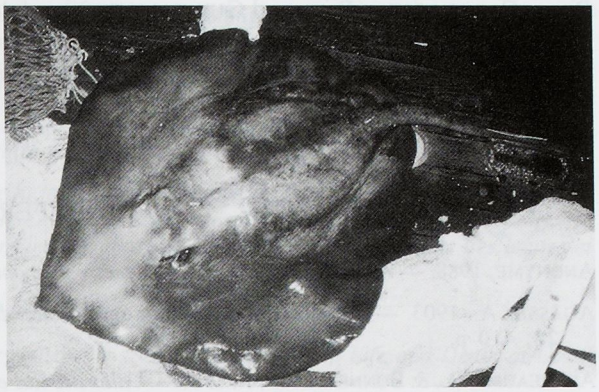


FIG. 10. — Raie récoltée à la station CP 1129 au large d'Hiva Oa, *Plesiobathys daviesi* (identifiée par B. SÉRET).

CONCLUSIONS

Le programme MUSORSTOM, débuté aux îles Philippines, zone proche du maximum de biodiversité marine de la planète, vient, après de nombreuses étapes intermédiaires, d'échantillonner l'archipel le plus éloigné vers l'est, dans la zone réputée la plus pauvre en espèces de l'Indo-Ouest Pacifique. L'exploration de la faune de profondeur des îles Marquises par la campagne MUSORSTOM 9, avec des techniques efficaces ayant fait leurs preuves dans d'autres régions de l'Indo-Ouest Pacifique et une équipe de recherche aguerrie, va permettre d'obtenir des données fiables sur la diversité spécifique de cet archipel isolé. L'inventaire des espèces sera notablement accru dans tous les groupes zoologiques pour lesquels il existe encore des taxonomistes. A partir de ces nouvelles bases, il sera alors possible de tester les différentes hypothèses sur l'origine des peuplements, les raisons de la pauvreté corallienne, spécifique et quantitative (isolement ou conditions environnementales défavorables) et l'appauvrissement des faunes marines vers l'est du Pacifique.

Une fois encore, il est démontré qu'avec des moyens relativement modestes, petit bateau, petite équipe de recherche et campagne de courte durée, il est possible de rénover totalement les connaissances sur la faune d'un archipel. Ce qui manque à la biogéographie marine dans l'Indo-Pacifique n'est pas tant des théories que des données géographiques et taxonomiques de qualité. Bien sûr, l'équipe de terrain assurant la collecte, le tri et la préservation des échantillons biologiques n'est que la partie émergente du programme MUSORSTOM qui ne saurait exister sans les dizaines de taxonomistes étudiant ce matériel de par le monde et surtout sans une édition efficace des résultats scientifiques.

D'ores et déjà, il est possible de confirmer que la plateforme entourant les îles correspond bien à des formations récifales anciennes, lagon et récif barrière ; que la faune bathyale est, tout comme la faune littorale, beaucoup plus pauvre en espèces que celle du Pacifique ouest. L'absence supposée du groupe des crinoïdes dans le Pacifique central est infirmé.

Sur le plan quantitatif, seul le groupe des échinodermes présente de fortes concentrations d'échinides et d'astérides. Aucun organisme pouvant faire l'objet d'exploitation halieutique n'a été détecté avec les engins utilisés.

REMERCIEMENTS

Nous remercions vivement les personnes qui, d'une manière ou d'une autre, ont contribué à la réussite de cette campagne : pour la préparation, l'obtention des financements et les commandes, Patrice CAYRÉ, René GRANDPERRIN, Alain CROSNIER et Philippe BOUCHET ; pour l'aide logistique à Tahiti, François-Xavier BARD,

Pierre CARABASSE et Raymond GUILHAMAT ; à bord du N. O. *"Alis"*, le Commandant Raymond PRONER a fait le maximum pour réaliser de bons prélèvements dans des zones souvent non hydrographiées ; le Maître d'équipage Loic LEGOFF a inlassablement ramendé les chaluts ; les cartes sont l'oeuvre d'Yves PENVERN, dessinateur au Centre ORSTOM de Nouméa.

RÉFÉRENCES

ANONYME, 1988. — *Atlas de Tahiti et de la Polynésie Française*, 79 p. Les Éditions du Pacifique.

AGASSIZ, A., 1903. — The coral reefs of the tropical Pacific. *Memoirs of the Museum of comparative Zoology, Harvard*, **28**, 410 p.

ANTHEAUME, B., & BONNEMAISON, J., 1988. — *Atlas des îles et états du Pacifique sud,* 126 p. GIP RECLUS : Publisud.

BARD, E., JOUANNIC, C., HAMELIN, B., PIRAZZOLI, P., ARNOLD, M., FAURE, G., SUMOSUSATRO, P. & SYAEFUDIN, 1996. — Pleistocene sea levels and tectonic uplift based on dating of corals from Sumba, Indonesia. *Geophysic Research Letters*, **23** : 1473-1476.

BLOOM, A. L., BROECKER, W. S., CHAPPELL, J. M. A., MATTHEWS, R. K. & MESOLELLA, K. J., 1974. — Quaternary sea-level fluctuations on a tectonic coast : new Th230/U234 dates from the Huon Peninsula, New Guinea. *Quaternary Research*, **4** : 185-205.

BRIGGS, J. C., 1974. — *Marine Zoogeography*, 475 p. McGraw-Hill, New York.

BRIGGS, J. C., 1996. — Tropical diversity and conservation. *Conservation Biology*, **10** (3) : 713-718.

BROUSSE, R. & BELLON, H., 1974. — Âge du volcanisme de l'île d'Eiao au nord de l'archipel des Marquises (Océan Pacifique). *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences, Paris*, **278** (D) : 827-830.

BROUSSE, R., CHEVALIER, J.-P., DENIZOT, M. & SALVAT, B., 1978. — Étude géomorphologique des îles Marquises. *Cahiers du Pacifique,* **21** : 9-74.

CARLQUIST, S., 1980. — *Hawaii. A Natural History,* 468 p. SB Printers Inc., Honolulu, Hawaii.

CHAN, T.-Y. & YU, H. P., 1998. — A new reef lobster of the genus *Enoplometopus* A. Milne Edwards, 1862 (Decapoda, Nephropoidea) from the western and southern Pacific. *Zoosystema*, **20** (2) : 183-192.

CHEVALIER, J.-P., 1978. — Les coraux des îles Marquises. *Cahiers du Pacifique,* **21** : 243-283.

CROSSLAND, C., 1927. — Marine ecology and coral formations in the Panama region, Galapagos and Marquesas Islands and the atoll of Napuka. *Transactions of the Royal Society of Edinburgh*, **55** : 531-554.

DUPON, J.-F., BONVALLOT, J. & VIGNERON, E. (eds), 1993. — *Atlas de la Polynésie Française*, 112 pl. Éditions de l'ORSTOM, Paris.

DUPON, J.-F. & SODTER, F., 1993. — Les îles Marquises. *In* : J.-F. DUPON, J. BONVALLOT & E. VIGNERON (eds), *Atlas de la Polynésie Française*. Éditions de l'ORSTOM : 9-10.

EKMAN, S., 1953. — *Zoogeography of the Sea*, 417 p. Sidgwick & Jackson, London.

FOREST, J., 1981. — Compte rendu et remarques générales / Report and general comments. *In* : Résultats des Campagnes MUSORSTOM. I-Philippines (18-28 mars 1976). Tome 1. *Mémoires ORSTOM*, (91) : 9-50.

FOREST, J., 1985. — La campagne MUSORSTOM II (1980). Compte rendu et liste des stations / The MUSORSTOM II Expedition (1980). Report and list of stations. *In* : Résultats des Campagnes MUSORSTOM. I & II. Philippines, Tome 2. *Mémoires du Muséum national d'Histoire naturelle*, (A), **133** : 7-30.

FOREST, J., 1989. — Compte rendu de la Campagne MUSORSTOM 3 aux Philippines (31 mai-7 juin 1985) / Report on the MUSORSTOM 3 Expedition to the Philippines (May 31st-June 7th 1985). *In* : J. FOREST (ed.), Résultats des Campagnes MUSORSTOM, Volume 4. *Mémoires du Muséum national d'Histoire naturelle*, (A), **143** : 9-23.

HALLÉ, F., 1978. — Arbres et forêts des îles Marquises. *Cahiers du Pacifique*, **21** : 315-357.

IRWIN, G., 1992. — *The prehistoric exploration and colonisation of the Pacific*, 240 p. Cambridge University Press.

KAY, E. A. (ed.), 1994. — *A Natural History of the Hawaiian Islands.* Selected readings II, 520 p. University of Hawaii, Honolulu.

MAC ARTHUR, R. H. & WILSON, E. O., 1967. — *The theory of Island Biogeography*, 203 p. Princeton University Press.

MANNING, R. B., 1992. — Two new species of the deep-sea crab genus *Chaceon* from the Pacific Ocean (Crustacea Decapoda Brachyura). *Bulletin du Muséum national d'Histoire naturelle, Paris*, 4e sér., **14** (A1) : 209-215.

MONTEFORTE, M., 1984. — *Contribution à la connaissance de la faune carcinologique de Polynésie Française. Inventaire faunistique, répartition bionomique et données quantitatives sur les Crustacés Décapodes (Reptantia, Brachyura, Anomura, Macrura) et les Crustacés Stomatopodes habitant les complexes récifo-lagonaires de quelques îles hautes et atolls.* Thèse E.P.H.E., 3ème section, 196 p.

PANOFF, M. (ed.), 1995. — *Trésors des îles Marquises*, 140 p. Musée de l'Homme & ORSTOM, Paris.

PAULAY, G., 1997. — Diversity and Distribution of Reef Organisms. *In* : C. BIRKELAND (ed.), *Life and Death of Coral Reefs*. Chapman & Hall, New York : 298-353.

PICHON, M., 1985. — Scleractinia. *In* : G. RICHARD, Faune et Flore. Premier abrégé des organismes marins de Polynésie Française. *In* : B. DELESALLE, R. GALZIN & B. SALVAT, French Polynesian coral reefs, Volume 1. *Proceedings of the 5th International Coral Reef Congress, Tahiti, 27 May-1 June 1985* : 399-403.

PLESSIS, Y. B. & MAUGÉ, L. A., 1978. — Ichtyologie des îles Marquises. *Cahiers du Pacifique*, **21** : 215-235.

POUPIN, J., 1991. — Campagnes de dragages en Polynésie française (N/O Marara). *Rapport scientifique du Service mixte de Contrôle biologique (SMCB, Centre de Tahiti)*, 21 p., 5 fig.

POUPIN, J., 1994. — Quelques Crustacés Décapodes communs de Polynésie Française. *Rapport scientifique du Service mixte de Surveillance radiobiologique et biologique (SMSRB), Montlhéry*, 86 p., 8 pl. couleur.

POUPIN, J., 1996a. — Atlas des crustacés marins profonds de Polynésie Française. Récoltes du navire MARARA (1986/1996). *Service mixte de Surveillance radiobiologique et biologique (SMSRB), Montlhéry*, 59 p.

POUPIN, J., 1996b. — Crustacea Decapoda of French Polynesia (Astacidea, Palinuridea, Anomura, Brachyura). *Atoll Research Bulletin*, **442** : 1-114.

POUPIN, J., sous presse. — Crustacea Decapoda and Stomatopoda of French Polynesia (Dendrobranchiata, Stenopodidea, Caridea, Thalassinidea, and Stomatopoda, with additions to Astacidea, Palinuridea, Anomura, and Brachyura). *Atoll Research Bulletin*, (451).

POUPIN, J., BUAT, P. & ELLIS, T., 1991. — Les crabes profonds des îles Marquises (*Chaceon* sp. nov. - Decapoda - Geryonidae). *Rapport scientifique et technique. Service mixte de Contrôle biologique, (SMCB), Tahiti*, 42 p.

POUPIN, J. & MCLAUGHLIN, P., sous-presse. — Additional *Calcinus* (Decapoda, Anomura, Diogenidae) from French Polynesia with three new species and a key to Indo-West Pacific species. *Crustacean Research*, Tokyo.

POUPIN, J. & RICHER DE FORGES, B., 1991. — New or rare crustaceans from french Polynesia (Crustacea : Decapoda). *In* : P. J. F. DAVIE, & R. H. QUINN (eds). Proceedings of the 1990 International Crustacean Conference, Brisbane, 1 September, 1991. *Memoirs of the Queensland Museum*, **31** : 211.

POUPIN, J., TAMARII, T. & VANDENBOOMGAERDE, A., 1990. — Pêches profondes aux casiers sur les pentes externes des îles de Polynésie Française (N/O Marara, 1986:1989). *Notes et Documents d'Océanographie du Centre ORSTOM de Tahiti*, (42) : 1-100.

RANDALL, J. E., 1978. — Marine biological and archeological expedition to southeast Oceania. *National Geographic Society Research Reports, 1969 Projects* : 473-495.

RANDALL, J. E., 1985. — Fishes. *In* : G. RICHARD, Faune et Flore. Premier abrégé des organismes marins de Polynésie Française. *In* : B. DELESALLE, R. GALZIN & B. SALVAT, French Polynesian coral reefs, Volume 1. *Proceedings of the 5th International Coral Reef Congress, Tahiti, 27 May-1 June 1985* : 462-481.

REHDER, H. A., 1968. — The marine Molluscan fauna of the Marquesas Islands. *Bulletin of the American Malacological Union Inc., Annual Reports, 1968* : 29-32.

RICHARD, G., 1985. — Faune et Flore. Premier abrégé des organismes marins de Polynésie Française. *In* : B. DELESALLE, R. GALZIN & B. SALVAT, French Polynesian coral reefs, Volume 1. *Proceedings of the 5th International Coral Reef Congress, Tahiti, 27 May-1 June 1985* : 381-518.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie / Explorations for bathyal fauna in the New Caledonian economic zone. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 6. *Mémoires du Muséum national d'Histoire naturelle*, (A), **145** : 9-54.

RICHER DE FORGES, B., 1993. — Campagnes d'exploration de la faune bathyale faites depuis mai 1989 dans la zone économique de la Nouvelle-Calédonie. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 10. *Mémoires du Muséum national d'Histoire naturelle*, **156** : 27-32.

RICHER DE FORGES, B., FALIEX, E. & MENOU, J.-L., 1996. — La campagne MUSORSTOM 8 dans l'archipel de Vanuatu. Compte rendu et liste des stations. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 15. *Mémoires du Muséum national d'Histoire naturelle*, **168** : 9-32.

RICHER DE FORGES, B. & LABOUTE, P., 1998. — La campagne MUSORSTOM 9 aux îles Marquises. *ORSTOM-Actualités*, (55) : 8-14.

RICHER DE FORGES, B. & MENOU, J.-L., 1993. — La campagne MUSORSTOM 7 dans la zone économique des îles Wallis et Futuna. Compte rendu et liste des stations. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 10. *Mémoires du Muséum national d'Histoire naturelle*, **156** : 9-25.

ROSEN, B. R., 1988. — Progress, problems and patterns in the biogeography of reef corals and other tropical marine organisms. *Helgoländer Meeresuntersuchungen*, **42** : 269-301.

ROUGERIE, F., WAUTHY, B. & RANCHER, J., 1992. — Le récif barrière ennoyé des îles Marquises et l'effet d'île par endo-upwelling. *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences, Paris*, **315** (sér. 2) : 677-682.

ROUGERIE, F. & WAUTHY, B., 1993. — L'océanographie du Pacifique central sud. *In* : J.-F. DUPON., J. BONVALLOT & E. VIGNERON (eds), *Atlas de la Polynésie Française*. Editions de l'ORSTOM : 20-21.

SOURNIA, A., 1976. — Abondance du phytoplancton et absence de récifs coralliens sur les côtes des îles Marquises. *Comptes Rendus hebdomadaires des Séances de l'Académie des Sciences, Paris*, **282**, sér. D : 553-555.

SPRINGER, V. G., 1982. — Pacific Plate Biogeography, with special reference to shorefishes. *Smithsonian Contributions to Zoology*, (367), 182 p.

VERON, J. E. N., 1995. — *Corals in space and time. The biogeography and evolution of the scleractinia*, 321 p. UNSW Press, Sydney .

WAUTHY, B., ROUGERIE, F., CHARPY, L., RANCHER, J. & THOUARD, M., 1988. — Formations récifales et effet d'île par endo-upwelling autour des îles Marquises. *Notes et Documents du Centre ORSTOM de Tahiti*, (37), 36 p.

WHEELER, T. & CARILLET, J.-B., 1997. — *Tahiti & French Polynesia*, 386 p. Lonely planet. Travel survival kit.

ZEZINA, O. N., 1997. — Biogeography of the bathyal zone. *In* : A. V. GEBRUK, E. C. SOUTHWARD & P. A. TYLER (eds), The biogeography of the oceans. *Advances in Marine Biology*, **32** : 389-426.

ANNEXES

LISTE DES PARTICIPANTS À LA CAMPAGNE MUSORSTOM 9

Chef de mission : B. RICHER DE FORGES.

Autres participants : P. BOUCHET, R. CLEVA, B. DAYRAT, P. LABOUTE, J. POUPIN, H. ZIBROWIUS.

LISTE DES STATIONS DE LA CAMPAGNE MUSORSTOM 9

(DW : drague Waren ; DR : drague à roche ; CP : chalut à perche)

Station	Date (1997)	Profondeur (m)	Latitude S	Longitude W
UA POU				
DW 1142	22.08	33-34	9°21,1'	140°02,7'
DW 1143	" "	18-55	9°20,9'	140°02,7'
DW 1144	" "	85-95	9°19,3'	140°03,8'
DW 1145	" "	150-180	9°19,0'	140°06,3'
DW 1146	" "	200	9°18,8'	140°06,2'
DW 1147	" "	250-302	9°19,1'	140°06,5'
DW 1148	" "	300	9°18,9'	140°06,3'
DW 1149	" "	300-350	9°18,0'	140°05,6'
DR 1150	" "	450-480	9°18,2'	140°04,8'
DR 1151	" "	70-77	9°19,4'	140°03,7'
EIAO				
DW 1152	23.08	85-150	7°58,9'	140°43,5'
DW 1153	" "	613-620	7°56,3'	140°44,0'
DW 1154	" "	102	7°58,5'	140°43,7'
CP 1155	" "	80	7°58,9'	140°43,3'
CP 1156	" "	80	7°59,0'	140°43,7'
CP 1157	" "	100	7°59,2'	140°44,2'
CP 1158	" "	109-110	7°58,7'	140°43,9'
CP 1159	" "	145	7°58,3'	140°43,7'
CP 1160	" "	49-55	7°57,8'	140°42,0'
NUKU HIVA				
DW 1161	24.08	30-37	8°55,6'	140°06,1'
DW 1162	" "	45-64	8°56,2'	140°06,1'
DW 1163	" "	78-85	8°57,3'	140°06,1'
DW 1164	" "	170-180	8°57,7'	140°05,7'
DW 1165	" "	350-360	8°58,2'	140°05,0'
DW 1166	" "	380	8°58,3'	140°04,6'
DW 1167	" "	420-430	8°58,7'	140°04,5'
DW 1168	" "	524-550	8°59,7'	140°04,7'
CP 1169	" "	391-408	8°58,6'	140°04,6'
DW 1170	25.08	104-109	8°45,1'	140°13,1'
DW 1171	" "	248-252	8°44,9'	140°14,9'

DW 1172	" "	300-302	8°44,8'	140°15,3'
DW 1173	" "	350-355	8°44,4'	140°14,9'
DW 1174	" "	400-415	8°43,9'	140°16,6'
CP 1175	" "	300	8°45,1'	140°16,2'
CP 1176	" "	260	8°44,8'	140°14,5'
CP 1177	" "	108-112	8°45,1'	140°14,1'
CP 1178	" "	74-75	8°46,1'	140°14,5'
CP 1179	" "	58-62	8°46,7'	140°13,4'
DW 1180	26.08	80-82	8°46,2'	140°04,6'
DR 1181	" "	102-130	8°45,5'	140°03,2'
DR 1182	" "	90-120	8°45,6'	140°03,9'
DR 1183	" "	86-120	8°45,5'	140°03,8'
DW 1184	" "	23-30	8°49,3'	140°03,6'
DW 1185	" "	31-33	8°48,9'	140°03,4'
DW 1186	" "	42-45	8°48,1'	140°03,5'
CP 1187	" "	25-30	8°49,2'	140°03,5'
CP 1188	" "	35-55	8°48,6'	140°03,4'
CP 1189	" "	70	8°46,4'	140°03,6'
CP 1190	" "	350	8°46,3'	140°07,2'
CP 1191	" "	390-400	8°45,8'	140°07,2'
CP 1192	27.08	977	9°03,7'	139°59,3'
DR 1193	" "	790-800	9°02,2'	139°58,3'
DR 1194	" "	500	8°59,6'	139°59,5'
CP 1195	" "	800	9°01,8'	139°57,6'
CP 1196	" "	1000	9°03,6'	139°58,7'
DR 1197	" "	277-372	8°57,4'	140°01,9'
HIVA OA				
DR 1198	28.08	290-320	9°50,0'	139°09,4'
DR 1199	" "	210-258	9°49,2'	139°09,6'
DR 1200	" "	96-100	9°49,9'	139°08,9'
DW 1201	" "	275-300	9°50,6'	139°09,2'
DW 1202	" "	388-406	9°49,9'	139°09,7'
DW 1203	" "	60-61	9°52,7'	139°02,2'
DW 1204	" "	60-62	9°52,6'	139°03,2'
CP 1205	" "	420-450	9°51,3'	139°09,3'
DW 1206	" "	352-358	9°51,4'	139°09,1'
DW 1207	" "	500-525	9°50,8'	139°09,8'
DW 1208	" "	117	9°48,9'	139°09,5'
DW 1209	29.08	85	9°50,2'	139°00,8'
DW 1210	" "	98-100	9°50,4'	139°00,5'
DW 1211	" "	50	9°50,2'	139°02,5'
CP 1212	" "	50-80	9°49,9'	139°02,2'
DW 1213	" "	18-20	9°50,3'	139°03,2'
DW 1214	" "	25-40	9°49,8'	139°03,1'
CP 1215	" "	49-62	9°49,5'	139°02,2'
PL 1216	" "			
DW 1217	30.08	85-87	9°44,5'	138°49,9'
DW 1218	" "	125-135	9°44,5'	138°50,9'
DR 1219	" "	300-320	9°44,3'	138°51,1'

DR 1220	" "	380-419	9°44,0'	138°50,5'
DR 1221	" "	1110	9°43,0'	138°51,0'
DW 1222	" "	352-340	9°44,0'	138°51,3'
DR 1223	" "	90-150	9°44,5'	138°51,3'
DW 1224	" "	115-120	9°44,6'	138°51,1'
DW 1225	" "	42-70	9°45,2'	138°52,6'
CP 1226	" "	38-77	9°45,3'	138°52,6'
CP 1227	" "	84-85	9°44,2'	138°52,5'
CP 1228	" "	107-108	9°44,6'	138°51,5'
CP 1229	" "	310-320	9°44,3'	138°51,2'
DW 1230	31.08	95-100	9°43,6'	139°06,6'
DR 1231	" "	270-285	9°42,5'	139°05,1'
DR 1232	" "	410-413	9°42,3'	139°05,6'
DW 1233	" "	391	9°41,8'	139°04,7'
DW 1234	" "	408	9°42,4'	139°05,6'
DW 1235	" "	105-285	9°41,8'	139°03,5'
DW 1236	" "	250-400	9°41,1'	139°03,9'
CP 1237	" "	95-305	9°41,9'	139°03,6'
CP 1238	" "	280-370	9°41,4'	139°03,8'
CP 1239	" "	89-95	9°42,2'	139°03,6'
FATU HIVA				
DR 1240	01.09	70-90	10°25,5'	138°40,5'
DW 1241	" "	85-130	10°27,8'	138°40,6'
DW 1242	" "	119-122	10°28,1'	138°41,1'
DR 1243	" "	142	10°28,7'	138°41,1'
DR 1244	" "	1015-1020	10°28,4'	138°42,1'
DR 1245	" "	85-130	10°29,2'	138°36,2'
DR 1246	" "	90-130	10°28,9'	138°35,9'
DR 1247	" "	1150-1250	10°34,0'	138°41,6'
DUMONT D'URVILLE				
DR 1248	02.09	333	9°47,9'	139°37,9'
DR 1249	" "	430	9°47,7'	139°37,8'
DR 1250	" "	500-650	9°47,3'	139°38,1'
CP 1251	" "	500-650	9°47,2'	139°38,2'
CP 1252	" "	1000	9°47,1'	139°39,1'
DR 1253	" "	360-405	9°47,9'	139°38,1'
DR 1254	" "	386-413	9°48,5'	139°38,1'
DR 1255	" "	416-440	9°38,5'	139°48,4'
UA POU				
DW 1256	03.09	70-72	9°25,4'	140°07,9'
DR 1257	" "	85-127	9°25,8'	140°08,2'
DR 1258	" "	95-120	9°26,8'	140°08,0'
DR 1259	" "	90-180	9°25,6'	140°08,3'
DW 1260	" "	49-100	9°25,4'	140°07,3'
DR 1261	" "	850	9°19,9'	140°08,6'
CP 1262	" "	850-905	9°19,8'	140°08,3'
CP 1263	" "	1107	9°19,2'	140°08,2'
CP 1264	" "	53-57	9°21,3'	140°07,7'

CP 1265	" "	90-92	9°20,4'	140°07,3'
EIAO				
DW 1266	04.09	84	7°57,3'	140°42,6'
DR 1267	" "	300-319	7°55,9'	140°42,7'
CP 1268	" "	285-320	7°55,8'	140°42,6'
CP 1269	" "	420-430	7°56,3'	140°43,3'
CP 1270	" "	497-508	7°56,0'	140°43,2'
CP 1271	" "	600	7°53,6'	140°42,2'
CP 1272	" "	660-680	7°55,5'	140°43,6'
CP 1273	" "	970-1020	7°52,6'	140°39,1'
DW 1274	05.09	100-120	7°54,6'	140°40,1'
DW 1275	" "	627	7°52,7'	140°38,2'
CP 1276	" "	800-805	7°51,9'	140°37,3'
CP 1277	" "	1000-1100	7°51,7'	140°38,8'
CP 1278	" "	1000	7°52,1'	140°38,6'
DW 1279	06.09	23-70	7°59,4'	140°42,2'
DW 1280	" "	87-98	7°58,9'	140°43,3'
MUTU ONE, HATUTAA				
DW 1281	07.09	450-455	7°47,8'	140°20,8'
CP 1282	" "	416-460	7°51,7'	140°30,6'
DW 1283	" "	55-56	7°53,8'	140°34,5'
CP 1284	" "	53-55	7°54,5'	140°35,8'
CP 1285	" "	91	7°52,7'	140°36,4'
DW 1286	" "	760	7°53,1'	140°39,2'
DW 1287	" "	163-245	7°54,5'	140°40,2'
UA HUKA				
DW 1288	08.09	200-220	8°53,9'	139°38,0'
DW 1289	" "	320-374	8°52,6'	139°38,1'
CP 1290	" "	341-344	8°53,2'	139°38,2'
DW 1291	" "	820	8°54,3'	139°34,6'
DR 1292	" "	95-100	8°54,1'	139°37,8'
DR 1293	" "	50	8°54,3'	139°37,5'
CP 1294	" "	100	8°54,2'	139°37,9'
CP 1295	" "	50-54	8°54,2'	139°37,5'
DR 1296	" "	34-38	8°53,5'	139°36,3'
DR 1297	" "	90-150	8°54,2'	139°37,4'
NUKU HIVA				
DR 1298	09.09	305	8°49,1'	140°17,1'
DR 1299	" "	405-418	8°49,4'	140°17,5'
CP 1300	" "	416-430	8°49,9'	140°17,4'
DR 1301	" "	489-497	8°57,3'	140°15,1'
CP 1302	" "	478-502	8°56,7'	140°15,3'
CP 1303	" "	705-794	8°50,1'	140°18,8'
DR 1304	10.09	50-58	8°54,4'	140°13,9'
DR 1305	" "	90-155	8°54,1'	140°14,5'
CP 1306	" "	283-448	8°55,2'	140°14,8'
CP 1307	" "	708-738	8°57,9'	140°15,8'

LISTE DES PARTICIPANTS À L'ATELIER À TERRE DE UA HUKA

Chef d'atelier : Rudo VON COSEL.

Autres participants : Jean TARDY, Jean TRÖNDLÉ.

LISTE DES STATIONS DE L'ATELIER À TERRE

STATION 1. *Baie de Hane*, côté ouest de la baie. 8°55,6'S, 139°32,1'W.
Zone intertidale, sous les rochers et cailloux (pierres rondes volcaniques plus quelques morceaux de corail et beachrock).

STATION 2. *Baie de Hane*. 8°55,6'S, 139°32,1'W.
Zone supralittorale, rochers et sable.

STATION 3. *Baie de Hane*. 8°55,5'S, 139°32,1'W.
Digue au fond de la baie. Zone supralittorale.

STATION 4. *Baie de Haavei*. 8°56,50'S, 139°35,63'W.
Côté est de la baie, trottoir très battu, sur et entre des rochers.

STATION 5. *Baie de Haavei*. 8°56,45'S, 139°35,78'W.
Embouchure du ruisseau côté ouest, eau douce stagnante derrière une dune de sable.

STATION 5bis. *Baie de Haavei*. 8°56,45'S, 139°35,80'W.
Embouchure côté mer, rochers et sable. Zone supralittorale.

STATION 6. *Baie de Haavei*. 8°56,44'S, 139°35,80'W.
Dans la vallée proche du ruisseau, bas de la falaise ouest, dans la litière. Récoltes terrestres.

STATION 7. *Baie de Vaipaee*. 8°56,30'S, 139°34,40'W.
Digue côté est. Zone supralittorale.

STATION 8. *Baie de Vaipaee*. 8°56,00'S, 139°34,50'W.
Vaipaee, rivière face au "Chez Christelle", sur et sous les cailloux. Récoltes fluviatiles.

STATION 9. *Baie de Vaipaee*. 8°56,30'S, 139°34,40'W.
Sable intertidal proche de l'embouchure de la rivière.

STATION 10. *Baie de Vaipaee*. 8°56,30'S, 139°34,40'W.
Côté est, sur la rampe destinée à la mise à l'eau des bateaux.

STATION 11. *Baie de Vaipaee*. 8°56,30'S, 139°34,50'W.
Côté ouest, côte rocheuse. Zone intertidale.

STATION 12. *Baie Hiniaehi - baie Hinitaihava*. 8°56,00'S, 139°32,80'W.
Large trottoir de rocher avec des grandes cuvettes à fonds de sable ou d'algues, alimentées par la houle.

STATION 13. *Baie Vaioina*. 8°52,50'S, 139°35,20'W.
Falaise et fonds rocheux, 0-5 m. Plongées.

STATION 14. *Baie Haahevea*. 8°53,15'S, 139°35,60'W.
Falaise et fonds rocheux avec de grands rochers et des algues encroûtantes, 0-3 m. Plongées.

STATION 15. *Baie Manihina*. 8°56,40'S, 139°33,80'W.
Côtés est et ouest de la pointe rocheuse; cailloux, blocs et cuvettes à algues. Zone intertidale.

STATION 16. *Baie Hanainamoa*. 8°53,35'S, 139°35,70'W.
Falaise; fonds à cailloux, pierres et gros blocs, 0,5-3 m. Plongées.

STATION 17. *Baie Haahue.* 8°53,65'S, 139°35,95'W.
Falaise; fonds à pierres et gros blocs, 0,5-3 m; plateau couvert d'algues vers 1-1,5 m. Plongées.

STATION 18. *Baie (Pointe) Kuiapaku* (est de Manihina). 8°56,45'S, 139°33,50'W.
Côte rocheuse, trottoir avec cuvettes garnies de sable, cailloux et algues; plateforme battue; plage de galets.

STATION 19. *Baie de Hane,* côté ouest. 8°55,65'S, 139°32,40'W.
Dalle de corail avec prairie d'algues (surtout *Halimeda*), cailloux, morceaux de corail, aussi des gros blocs et quelques patates de corail (*Porites* spp. etc.) isolées et peu de sable, 0-3 m. Plongées et récoltes à pied.

STATION 20. *Baie Hinipahue.* 8°56,20'S, 139°32,90'W.
Côté est et ouest d'une langue de trottoir, grandes cuvettes et baignoires à fonds de sable, algues et cailloux; dalle avec prairie d'algues et légère couche de sable. Zone intertidale.

STATION 21. *Baie Hiniaehi.* 8°56,15'S, 139°32,90'W.
Fonds de pierres et cailloux (volcaniques) avec quelques algues. Milieu battu, 0-1 m. Récoltes à pied.

STATION 22. *Baie de Vaipaee.* 8°56,40'S, 139°34,40'W - 8°56,60'S, 139°34,25'W.
Dragages 6-10 m, sable fin gris, vaseux vers la plage, plus propre au large. 6 traits.

STATION 23. Partie ouest de la *baie Haamamao* (à l'est de Hokatu). 8°55,90'S, 139°31,45'W.
Côte rocheuse battue avec des cuvettes contenant du sable et des cailloux. Prise d'un échantillon de sable.

STATION 24. *Baie Haahue.* 8°53,60'S, 139°37,00'W.
Dragages 9-25 m, sable fin.

STATION 24 bis. *Baie Haahue.* 8°53,60'S, 139°37,00'W.
Dragages 25-34 m, sable fin et moyen. 10 traits pour l'ensemble des stations 24 et 24 bis.

STATION 25. *Baie Teuahai.* 8°55,70'S, 139°36,70'W.
Dragages 6-15 m, sable calcaire grossier et galets et *Halimeda.* 3 traits.

STATION 26. *Baie Manihina.* 8°56,35'S, 139°33,70'W.
Côté est de la baie, sous rochers à marée haute et en zone supralittorale.

STATION 27. *Baie Manihina.* 8°56,50'S, 139°33,95'W.
Côté ouest de la baie. Rochers. Zone intertidale.

STATION 28. *Vallée de Vaipaee.* 8°54,90'S, 139°34,20'W.
Sortie terrestre. Route vers le fond de la vallée, ravin humide.

STATION 29. *Baie de Hane.* 8°55,70'S, 139°32,00'W.
Dragages 7-11 m, sable fin, mixte et grossier. 10 traits.

STATION 30. Entre *Motu Hane* et *pte Teavatainamanu.* 8°56,10'S, 139°32,00'W.
Dragages 20-30 m à la sortie de la baie, sable calcaire plus ou moins grossier. 3 traits.

STATION 31. *Baie Hiniaehi.* 8°56,10'S, 139°32,70'W.
Dragages 4-7 m. Sable fin, cailloux et dalle avec algues. 5 traits.

STATION 32. *Baie Hiniaehi* 8°56,10'S, 139°32,70'W.
Dragages 12-17 m, sable fin, cailloux et algues. 4 traits.

STATION 33. *Baie de Manihina.* 8°55,60'S, 139°33,90'W.
Dragages 15 m, sable, cailloux et patates. 2 traits avec des croches.

STATION 34. Entre *baie Haavei, pointe Tenoni* et *île aux Oiseaux* (îlot Teuaua). 8°56,80'S, 139°35,70'W (position sommaire).
Dragages 10-15 m. Entrée de la baie (6 traits) et entre île aux Oiseaux et pte Tenoni (10 traits). Sable calcaire, cailloux et boules d'algues calcaires.

STATION 34 bis. Dragages 20-32 m. Entre *île aux Oiseaux, Motukeokeo* et *pte. Teaeopiki*. 8°57,00'S, 139°36,00'W (position sommaire). Sable fin avec de débris de coquilles de *Pinna* et quelques algues calcaires et cailloux proche des îlots. 19 traits.

STATION 35. *Baie Haamamao.* 8°55,90'S, 139°31,20'W.
Dragages 24-25 m, sable calcaire et débris de coquilles. 3 traits.

STATION 35 bis. *Haavahae.* 8°55,85'S, 139°30,60'W.
Dragage 20 m, sable. 1 trait.

STATION 36. *Baie de Hane.* 8°55,60'S, 139°32,17'W.
Platier intertidal avec algues, 0,5 m. Brossage de cailloux

STATION 37. *Baie Haamamao.* 8°55,80'S, 139°31,00'W.
Sable et cailloux, 4-5 m. Plongées.

STATION 38. Au large de la *baie de Vaipaee*. 8°56,70'S, 139°34,23'W - 8°56,90'S, 139°34,23'W.
Dragages 10-25 m, sable et algues calcaires avec débris de coquilles. 4 traits.

STATION 39. 8°56,10'S, 139°34,70'W. Dans le ravin du chemin vers Haavei.
Prise d'échantillon de litière et de terre.

STATION 40. 8°55,80'S, 139°34,60'W. Dans un ravin plus au nord en face colonie de vacances, proche de la rivière.
Prise d'échantillon de litière et de terre.

2

Cnidaria Anthozoa: Deep-water azooxanthellate Scleractinia from Vanuatu, and Wallis and Futuna Islands

Stephen D. CAIRNS

National Museum of Natural History
NHB-163, W-329
Smithsonian Institution
Washington, D. C. 20560
USA

ABSTRACT

A total of 134 Recent species of azooxanthellate Scleractinia are reported from the Vanuatu (116 species) and Wallis and Futuna (83 species) Archipelagos, all but one being new records for this region of the tropical central Pacific. The newly reported specimens originate primarily from the MUSORSTOM 7 and 8 expeditions, including approximately 4400 specimens from 227 stations, most of these stations from deeper than 100 m. Sixteen new species and one new subspecies are described, and two new combinations are proposed: *Asterosmilia gigas* and *Javania fusca*. Tables of comparison are provided for the Indo-Pacific species of *Fungiacyathus (Fungiacyathus)*; the Recent *Trochocyathus (Aplocyathus)*; all species of *Aulocyathus*; all species of spined *Deltocyathus*; and the Recent species and subspecies of *Anthemiphyllia*. To facilitate comparisons of species among these taxa, three additional species having distributions other than the Vanuatu/Wallis and Futuna region are described as new: *Deltocyathus corrugatus, Anthemiphyllia multidentata*, and *A. macrolobata*.

The distribution and bathymetric ranges of the 134 species known from the Vanuatu/Wallis and Futuna region are tabulated. Within the tropical central Pacific these corals show a strong affinity with those from the ridges and islands north of New Zealand (56 species) and a lesser relationship with the Hawaiian Island fauna (24 species). Other regions in the central Pacific are too poorly known for comparison. Beyond the tropical central Pacific, the Vanuatu/Wallis and Futuna fauna is part of the larger Indo-Polynesian province, sharing 95 (71%) of its species with the tropical western Pacific and 62 species (46%) with the Indian Ocean. Only seven species are found in common with the tropical eastern Pacific and 11 with the Atlantic Ocean. Finally, 43 species from the Vanuatu/Wallis and Futuna Archipelagos are also known from temperate Japan (exclusive of the Ryukyu Islands) and 32 from temperate New Zealand and southern Australia.

Examples of commensal/parasitic relationships are reported to occur with petrarcid ascothoracican crustaceans (2 coral hosts) and acrothoracican cirripede crustaceans (8 hosts). The shells of the gastropod *Xenophora* ("carrier shells") were found to be effective collectors of deep-water corals; a total of 19 coral species were found incorporated into the shells, including three species that were found only on these shells and another five species that were otherwise very rarely collected by conventional means.

CAIRNS, S. D., 1999. — Cnidaria Anthozoa: Deep-water azooxanthellate Scleractinia from Vanuatu, and Wallis and Futuna Islands. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*, **180**: 31-167. Paris ISBN 2-85653-520-8.

RÉSUMÉ

Cnidaria Anthozoa : Scléractiniaires d'eau profonde sans zooxanthelles du Vanuatu et des îles Wallis et Futuna.

Cent-trente-quatre espèces récentes de Scléractiniares sans zooxanthelles sont recensées dans l'archipel du Vanuatu (116 espèces) et aux îles Wallis et Futuna (83 espèces). À une exception près, il s'agit de signalisations nouvelles pour cette région du Pacifique central tropical. Le matériel étudié provient essentiellement des campagnes MUSORSTOM 7 et 8 et comprend environ 4400 spécimens provenant de 227 stations, le plus souvent à plus de 100 m de profondeur. Seize espèces nouvelles (*Fungiacytahus sandoi, Anthemiphyllia spinifera, Caryophyllia abrupta, Oxysmilia corrugata, O. epithecata, Trochocyathus efateensis, T. patelliformis, Polycyathus octuplus, Deltocyathus crassiseptum, D. cameratus, Conotrochus asymmetros, Lochmaeotrochus gardineri, Cryptotrochus brevipalus, Flabellum arcuatile, Truncatoflabellum vigintifarium,* et *Javania exserta*) et une sous-espèce nouvelle (*Anthemiphyllia patera costata*) sont décrites et 2 combinaisons nouvelles sont proposées (*Asterosmilai gigas* et *Javania fusca*). Des tableaux de comparaison sont fournis pour les espèces indo-pacifiques de *Fungiacyathus (Fungiacyathus)*, les espèces récentes de *Trochocyathus (Aplocyathus)*, toutes les espèces d'*Aulocyathus*, toutes les espèces de *Deltocyathus* à épines et les espèces et sous-espèces d'*Anthemiphyllia*. Afin de faciliter les comparaisons, trois espèces nouvelles d'origine autre que MUSORSTOM 7 et 8 (*Deltocyathus corrugatus, Anthemiphyllia multidentata*, et *A. macrolobata*) sont incluses dans les tableaux.

Les répartitions géographique et bathymétrique des 134 espèces connues du Vanuatu et de Wallis et Futuna sont rassemblées dans un tableau. A l'intérieur du Pacifique central tropical, la faune étudiée ici a une forte affinité avec celle des rides et îles se trouvant au nord de la Nouvelle-Zélande (56 espèces) et une affinité moindre avec la faune des îles Hawaii (24 espèces). Les autres régions du Pacifique central sont trop peu connues pour être comparées. Au vu de leur faune, la région du Vanuatu et celle de Wallis et Futuna font partie de la large province biogéographique indo-polynésienne. Elles ont en commun 95 espèces (71%) avec le Pacifique occidental tropical et 62 (46%) avec l'océan Indien. Seules sept espèces sont connues aussi dans le Pacifique oriental tropical et onze dans l'Atlantique. Par ailleurs, si l'on compare cette faune à celles de quelques régions tempérées du Pacifique, on relève que 43 des 134 espèces recensées au Vanuatu et aux îles Wallis et Futuna sont connues aussi au Japan et 32 en Nouvelle-Zélande et dans l'Australie du Sud.

Les relations commensales ou parasites observées concernent les crustacés ascothoraciques Petrarcidae (deux espèces hôtes) et les crustacés cirripèdes acrothoraciques (huit espèces hôtes). Des coraux de profondeur sont souvent incorporés dans les coquilles des gastéropodes *Xenophora*. Dix-neuf espèces de coraux ont ainsi été trouvées sur ces coquilles "porteuses"; dont trois n'ont pas été récoltées autrement et cinq n'ont été que très rarement récoltées par les engins de capture conventionnels.

CONTENTS

INTRODUCTION 33
LIST OF ABBREVIATIONS 33
COMBINED LIST OF STATIONS AND OF SPECIES OBTAINED PER STATION 34
HISTORICAL REVIEW 46
MATERIAL 48
METHODS 48
DISTRIBUTION 49
SYSTEMATIC ACCOUNT 53
- FAMILY POCILLOPORIDAE 53
- FAMILY FUNGIACYATHIDAE 54
- FAMILY MICRABACIIDAE 59
- FAMILY OCULINIDAE 60
- FAMILY ANTHEMIPHYLLIIDAE 63
- FAMILY CARYOPHYLLIIDAE 69
- FAMILY TURBINOLIIDAE 108
- FAMILY GUYNIIDAE 113
- FAMILY FLABELLIDAE 115
- FAMILY GARDINERIIDAE 128
- FAMILY DENDROPHYLLIIDAE 129

ACKNOWLEDGEMENTS 135
REFERENCES 135

INTRODUCTION

The azooxanthellate corals of Vanuatu, Wallis, and Futuna Archipelagos are representative of the tropical central Pacific, which, in turn, is very closely tied to that of the Indo-West Pacific fauna. For the purpose of this study, the tropical central Pacific is defined as those islands east of the Philippines, Indonesia, New Guinea, and Australia, and extending to the Tuamotu Archipelago in the east, the Hawaiian Islands to the north, and the Kermadec Islands to the south. Although this vast region was and is still not comprehensively sampled, the intensive MUSORSTOM collections provide a good basis for the deep-water coral fauna for this province, and provide zoogeographic data for one of the last poorly-known deep-water coral faunas. It should be noted that, whereas Table 1 lists all papers pertaining to azooxanthellates in the central tropical Pacific, the MUSORSTOM collections made very few collections shallower than 200 m or deeper than 1500 m, which reduces the number of species reported herein.

LIST OF ABBREVIATIONS

MUSEUMS:

MNHN Muséum National d'Histoire Naturelle, Paris.
MoNZ Museum of New Zealand Te Papa Tonga-rewa, Wellington (formerly the National Museum of New Zealand: **NMNZ**).
NHM The Natural History Museum, London (formerly the British Museum (Natural History): **BMNH**).
NMV National Museum Victoria, Melbourne.
NMNH National Museum of Natural History, Smithsonian, Washington, D. C.
NZOI New Zealand Oceanographic Institute, Wellington.
USNM United States National Museum, now the National Museum of Natural History, Smithsonian, Washington, D.C.
YPM Yale Peabody Museum, New Haven.
ZMB Zoologisches Museum, Berlin.

EXPEDITIONS AND VESSELS:

Throughout the paper, the names of vessels are given in italics and quotation marks.

BANZARE British, Australian, New Zealand Antarctic Research Expedition, 1929-1931.
CANCAP III *"Tydeman"*, Madeira-Mauritania Expedition 1978. Initiated by the Nationaal Natuurhistorisch Museum (Leiden). Named for **Can**aries and **Cap**e Verde Islands.
HURL Hawaiian Underseas Research Laboratory.
KARUBAR French-Indonesian expedition (1991) that collected in the southeastern Banda Sea. Named for the **Ka**i, **Aru**, and Tanim**bar** Islands.
MUSORSTOM Cruises organized jointly by the **Mus**éum National d'Histoire Naturelle and the Institut Français de Recherche Scientifique pour le Développement en Coopération (formerly: **O**ffice de la **R**echerche **S**cientifique et **T**echnique d'**O**utre-**M**er, = **ORSTOM**).
USGS United States Geological Survey.

MORPHOLOGICAL TERMS:

CD Calicular diameter.
GCD Greater calicular diameter.
GCD:LCD Ratio of greater calicular diameter to lesser calicular diameter.

PD	Pedicel diameter.
PD:GCD	Ratio of pedicel diameter to greater calicular diameter of a solitary corallum.
Sx, Cx, Px	Septa, costae, or pali (respectively) of cycle designated by numerical subscript.
Sx>Sy	In the context of a septal formula, septa of cycle x more wide than septa of cycle y.

COMBINED LIST OF STATIONS AND OF SPECIES OBTAINED PER STATION

This list provides the data for all stations mentioned in this report. Vessels and expeditions are listed alphabetically, whereas listing of species per station follows the order of the text. If the specimen was collected as a result of being cemented to a *Xenophora* gastropod shell, the species name is followed by an X in brackets.

BANZARE

Stn 115. — 24.03.1931, 41°03'S, 148°42'E, 128 m, northeastern Tasmania: *Anthemiphyllia multidentata.*

CANCAP

Stn 3.053. — 20.10.1978, 32°25'N, 16°57'W, 2850-3010 m, south of Madeira: *Truncatoflabellum stabile.*

HURL

Stn 83-202. — 16.10.1983, 16°41'12"N, 169°24'18"W, 183 m, Johnston Atoll: *Madracis kauaiensis.*

Stn P5-063. — 23.05.1988, 20°35.8'N, 156°03.5'W, 1020 m, Alenuihaha, Hawaiian Is: *Trochocyathus* (*Trochocyathus*) *patelliformis.*

KARUBAR, *"Baruna Jaya I"*

Stn 5. — 22.10.1991, 5°46'39"S, 132°20'04"E, 285-323 m, Kai Is: *Trochocyathus* (*Trochocyathus*) *vasiformis.*

Stn 18. — 24.10.1991, 5°17'49"S, 133°01'51"E, 205-212 m, Kai Is: *Anthemiphyllia spinifera.*

Stn 44. — 29.10.1991, 7°52'27"S, 132°48'24"E, 291-295 m, Tanimbar Is: *Javania exserta.*

Stn 49. — 29.10.1991, 7°59'51"S, 132°58'50"E, 206-209 m, Tanimbar Is: *Javania exserta.*

Stn 86. — 04.11.1991, 9°23'59"S, 131°14'29"E, 222-226 m, Tanimbar Is: *Javania exserta.*

KIMBLA

Stn K7/73-37. — 23.11.1973, 39°02.0'S, 148°36.5'E, 256 m, northeastern Tasmania: *Anthemiphyllia multidentata.*

MUSORSTOM 1, *"Vauban"*

Stn 65. — 27.03.1976, 14°00.0'N, 120°19.2'E, 194-202 m, SW Luzon, Philippines: *Javania exserta.*

MUSORSTOM 3, *"Coriolis"*

Stn 87. — 31.05.1985, 14°00.6'N, 120°19.6'E, 191-197 m, SW Luzon, Philippines: *Aulocyathus juvenescens.*

MUSORSTOM 7, *"Alis"*

Stn 494. — 10.05.1992, 14°18.9'S, 178°03.0'W, 100-110 m, Futuna: *Polycyathus octuplus*, *Heterocyathus* cf. *sulcatus*, *Heteropsammia cochlea*

Stn 495. — 10.05.1992, 14°19.2'S, 178°04.3'W, 180-210 m, Futuna: *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Truncatoflabellum phoenix, Heteropsammia cochlea.*

Stn 496. — 10.05.1992, 14°19.6'S, 178°04.3'W, 250-330 m, Futuna: *Madracis kauaiensis*, *Caryophyllia (Acanthocyathus) grayi*, *Oxysmilia epithecata*, *Trochocyathus (Trochocyathus) philippinensis*, *Polycyathus octuplus*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Balanophyllia desmophyllioides*, *Heteropsammia cochlea*.

Stn 499. — 10.05.1992, 14°19.6'S, 178°04.6'W, 290-395 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Caryophyllia (Acanthocyathus) grayi*, *Trochocyathus (Trochocyathus) maculatus*, *Polycyathus octuplus*, *Thalamophyllia tenuescens*, *Dactylotrochus cervicornis*, *Truncatoflabellum vanuatu*, *Javania exserta*, *Endopachys grayi*.

Stn 500. — 11.05.1992, 14°19.5'S, 178°04.1'W, 350-394 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Balanophyllia desmophyllioides*.

Stn 501. — 11.05.1992, 14°19.8'S, 178°06.1'W, 500-530 m, Futuna: *Truncatoflabellum angustum*, *Enallopsammia rostrata*.

Stn 502. — 11.05.1992, 14°19.8'S, 178°06.5'W, 516-535 m, Futuna: *Madracis kauaiensis*, *Madrepora oculata* forma *tenuis*, *M. porcellana*, *Caryophyllia (Caryophyllia) lamellifera*, *Crispatotrochus rubescens*, *Truncatoflabellum angustum*, *Balanophyllia desmophyllioides*.

Stn 504. — 11.05.1992, 14°19.6'S, 178°04.5'W, 300-390 m, Futuna: *Madracis kauaiensis*, *Caryophyllia (Caryophyllia) hawaiiensis*, *Trochocyathus (Trochocyathus) maculatus*, *Polycyathus octuplus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Dactylotrochus cervicornis*, *Guynia annulata*, *Flabellum (Flabellum) pavoninum*, *Endopachys grayi*, *Heteropsammia cochlea*.

Stn 505. — 11.05.1992, 14°19.5'S, 178°04.3'W, 245-400 m, Futuna: *Trochocyathus (Trochocyathus) maculatus*, *Truncatoflabellum vanuatu*.

Stn 506. — 11.05.1992, 14°19.8'S, 178°05.0'W, 400 m, Futuna: *Dendrophyllia alcocki*.

Stn 507. — 11.05.1992, 14°19.6'S, 178°06.7'W, 419-425 m, Futuna: *Madracis kauaiensis*, *Madrepora oculata forma formosa*, *Crispatotrochus rubescens*, *Oxysmilia epithecata*, *Endopachys grayi*.

Stn 508. — 11.05.1992, 14°19.5'S, 178°04.5'W, 245-400 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Trochocyathus (Trochocyathus) maculatus*.

Stn 509. — 12.05.1992, 14°14.8'S, 178°11.5'W, 200-240 m, Futuna: *Madracis kauaiensis*, *Madrepora porcellana*, *Oxysmilia epithecata*, *Trochocyathus (Trochocyathus) maculatus*, *Polycyathus octuplus*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Rhizosmilia robusta*, *Idiotrochus kikutii*, *Truncatoflabellum phoenix*, *T. vanuatu*, *Balanophyllia desmophyllioides*, *Heteropsammia cochlea*.

Stn 510. — 12.05.1992, 14°14.5'S, 178°11.5'W, 280-370 m, Futuna: *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Asterosmilia gigas*.

Stn 511. — 12.05.1992, 14°14.0'S, 178°11.5'W, 400-450 m, Futuna: *Anthemiphyllia dentata*, *Crispatotrochus rubescens*, *C. rugosus*, *Oxysmilia epithecata*, *Tethocyathus virgatus*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *Deltocyathus stella*, *Conotrochus funicolumna*, *C. brunneus*, *Rhizotrochus flabelliformis*.

Stn 512. — 12.05.1992, 14°13.5'S, 178°10.3'W, 210-245 m, Futuna: *Madrepora porcellana*, *Anthemiphyllia spinifera*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Thalamophyllia tenuescens*, *Dactylotrochus cervicornis*, *Deltocyathoides orientalis*, *Idiotrochus kikutii*, *Truncatoflabellum phoenix*, *Balanophyllia desmophyllioides*, *Heteropsammia cochlea*.

Stn 513. — 12.05.1992, 14°13.5'S, 178°10.8'W, 260-300 m, Futuna: *Madrepora minutiseptum*, *M. porcellana*, *Anthemiphyllia spinifera*, *Polycyathus octuplus*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus brunneus*, *C. asymmetros*, *Thalamophyllia tenuescens*, *Dactylotrochus cervicornis*, *Idiotrochus kikutii*, *Guynia annulata*, *Flabellum (Flabellum) pavoninum*, *Truncatoflabellum phoenix*, *Javania exserta*.

Stn 514. — 12.05.1992, 14°13.3'S, 178°10.7'W, 349-355 m, Futuna: *Madrepora porcellana*, *Anthemiphyllia spinifera*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *D. heteroclitus*, *Heterocyathus* cf. *sulcatus*, *Thalamophyllia tenuescens*, *Dactylotrochus cervicornis*, *Truncatoflabellum phoenix*, *Javania exserta*, *Dendrophyllia alcocki*.

Stn 515. — 12.05.1992, 14°13.5'S, 178°10.3'W, 224-252 m, Futuna: *Madracis kauaiensis*, *Madrepora minutiseptum*, *M. porcellana*, *Dactylotrochus cervicornis*, *Asterosmilia gigas*.

Stn 516. — 12.05.1992, 14°13.5'S, 178°11.6'W, 441-550 m, Futuna: *Polycyathus octuplus*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum phoenix*, *Endopachys grayi*, *Heteropsammia cochlea*.

Stn 517. — 12.05.1992, 14°13.4'S, 178°10.4'W, 233-235 m, Futuna: *Madrepora minutiseptum*.

Stn 520. — 13.05.1992, 14°10.6'S, 176°16.7'W, 920-930 m, Wallis: *Deltocyathus cameratus*, *Javania lamprotichum* (or station 521), *Enallopsammia rostrata*.

Stn 521. — 13.05.1992, 14°11.0'S, 176°17.3'W, 890-915 m, Wallis: *Javania lamprotichum* (or station 520).

Stn 522. — 13.05.1992, 13°10.7'S, 176°15.0'W, 650-765 m, Wallis: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Tethocyathus virgatus*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus funicolumna*, *Enallopsammia rostrata*.

Stn 523. — 13.05.1992, 13°12.0'S, 176°15.6'W, 455-515 m, Wallis: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Stephanophyllia complicata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Crispatotrochus rubescens*, *C. rugosus*, *Oxysmilia epithecata*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. stella*, *Conotrochus funicolumna*, *Asterosmilia gigas*, *Deltocyathoides orientalis*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*, *Javania exserta*.

Stn 524. — 13.05.1992, 13°11.8'S, 176°15.6'W, 300 m, Wallis: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Rhizosmilia robusta*, *Flabellum* (*Flabellum*) *arcuatile*, *Truncatoflabellum vanuatu*, *Balanophyllia desmophyllioides*.

Stn 525. — 13.05.1992, 13°10.6'S, 176°14.7'W, 500-600 m, Wallis: *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *marmorea*, *Deltocyathus taiwanicus*, *Conotrochus funicolumna*, *C. brunneus*, *Javania fusca*.

Stn 527. — 14.05.1992, 13°24.1'S, 176°14.6'W, 540-560 m, Wallis: *Trochocyathus* (*Trochocyathus*) *vasiformis*.

Stn 529. — 16.05.1992, 12°31.4'S, 176°39.6'W, 500 m, Waterwitch Bank: *Deltocyathus suluensis*, *D. taiwanicus*, *D. crassiseptum*.

Stn 530. — 16.05.1992, 12°32.7'S, 176°39.3'W, 580-600 m, Waterwitch Bank: *Anthemiphyllia dentata*, *A. patera costata*, *A. spinifera*, *Caryophyllia* (*Caryophyllia*) *rugosa*, *C.* (*C.*) *abrupta*, *Deltocyathus suluensis*, *D. cameratus*, *Conotrochus brunneus*, *Lophelia pertusa*, *Flabellum* (*Flabellum*) *arcuatile*, *Javania fusca*, *Enallopsammia rostrata*.

Stn 532. — 16.05.1992, 12°28.9'S, 176°41.0'W, 516-530 m, Waterwitch Bank: *Deltocyathus suluensis*, *Conotrochus funicolumna*, *Flabellum* (*Ulocyathus*) *deludens*.

Stn 534. — 16.05.1992, 12°23.3'S, 176°42.0'W, 440-500 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Fungiacyathus* (*Bathyactis*) *margaretae*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *C.* (*C.*) *marmorea*, *Deltocyathus suluensis*, *Flabellum* (*Flabellum*) *arcuatile*.

Stn 535. — 16.05.1992, 12°29.6'S, 176°41.3'W, 340-470 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Fungiacyathus* (*Bathyactis*) *margaretae*, *Stephanophyllia complicata*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus funicolumna*, *Asterosmilia gigas*, *Flabellum* (*Flabellum*) *arcuatile*.

Stn 537. — 16.05.1992, 12°30.0'S, 176°41.0'W, 325-400 m, Waterwitch Bank: *Anthemiphyllia dentata*, *A. spinifera*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. cameratus*, *D. stella*, *Conotrochus funicolumna*, *Asterosmilia gigas*, *Javania exserta*.

Stn 538. — 16.05.1992, 12°30.8'S, 176°40.3'W, 275-295 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *hawaiiensis*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum phoenix*, *Javania exserta*, *Balanophyllia desmophyllioides*.

Stn 539. — 17.05.1992, 12°27.3'S, 177°27.3'W, 700 m, Combe Bank: *Trochocyathus* (*Trochocyathus*) *discus*, *Lochmaeotrochus gardineri*.

Stn 540. — 17.05.1992, 12°26.7'S, 177°28.4'W, 600 m, Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *F.* (*F.*) *sandoi*, *Fungiacyathus* (*Bathyactis*) *margaretae*, *Stephanophyllia complicata*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus funicolumna*, *Javania fusca*.

Stn 541. — 17.05.1992, 12°26.7'S, 177°28.0'W, 500-505 m, Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Fungiacyathus* (*Bathyactis*) *margaretae*, *Anthemiphyllia spinifera*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. cameratus*, *D. stella*, *Conotrochus funicolumna*.

Stn 542. — 17.05.1992, 12°26.4'S, 177°28.2'W, 370 m, Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Stephanophyllia neglecta*, *Anthemiphyllia dentata*, *A. patera costata*, *A. spinifera*, *Crispatotrochus rugosus*, *Deltocyathus taiwanicus*, *D. cameratus*, *Conotrochus funicolumna*, *Flabellum* (*Flabellum*) *arcuatile*.

Stn 546. — 17.05.1992, 12°26.9'S, 177°29.1'W, 550-552 m, Combe Bank: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Anthemiphyllia dentata*, *A. patera costata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. cameratus*, *Conotrochus brunneus*, *Flabellum* (*Flabellum*) *arcuatile*.

Stn 548. — 17.05.1992, 12°23.3'S, 177°24.4'W, 700-740 m, Combe Bank: *Lochmaeotrochus gardineri*.

Stn 551. — 18.05.1992, 12°15.3'S, 177°28.1'W, 791-795 m, Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Madrepora oculata forma tenuis*, *Flabellum* (*Ulocyathus*) *apertum apertum*.

Stn 552. — 18.05.1992, 12°15.7'S, 177°27.8'W, 786-800 m, Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Madrepora oculata* forma *tenuis*, *Caryophyllia* (*Caryophyllia*) *scobinosa*, *Deltocyathus cameratus*, *Flabellum* (*Ulocyathus*) *apertum apertum*.

Stn 555. — 19.05.1992, 11°47.5'S, 178°19.2'W, 540-542 m, Tuscarora Bank: *Anthemiphyllia dentata*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Deltocyathus taiwanicus*, *D. cameratus*, *Conotrochus funicolumna*

Stn 556. — 19.05.1992, 11°48.7'S, 178°18.0'W, 440 m, Tuscarora Bank: *Stephanophyllia neglecta*, *Caryophyllia* (*Caryophyllia*) *quadragenaria*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus taiwanicus*, *D. stella*, *Heterocyathus* cf. *sulcatus*, *Conotrochus funicolumna*.

Stn 557. — 19.05.1992, 11°48.1'S, 178°18.2'W, 600-608 m, Tuscarora Bank: *Stephanophyllia complicata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. cameratus*, *Conotrochus funicolumna*, *Lochmaeotrochus gardineri*.

Stn 560. — 19.05.1992, 11°47.0'S, 178°20.0'W, 697-702 m, Tuscarora Bank: *Deltocyathus taiwanicus*, *D. cameratus*, *Conotrochus funicolumna*, *Lochmaeotrochus gardineri*.

Stn 564. — 20.05.1992, 11°46.1'S, 178°27.4'W, 1015-1020 m, Tuscarora Bank: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Caryophyllia* (*Caryophyllia*) *ambrosia*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Aulocyathus recidivus*, *Flabellum* (*Ulocyathus*) *apertum apertum*.

Stn 565. — 20.05.1992, 11°47.4'S, 178°25.3'W, 900 m, Tuscarora Bank: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Fungiacyathus* (*Bathyactis*) *margaretae*, *Caryophyllia* (*Caryophyllia*) *scobinosa*, *C.* (*C.*) *ambrosia*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Flabellum* (*Ulocyathus*) *apertum apertum*.

Stn 567. — 20.05.1992, 11°47.0'S, 178°27.3'W, 1010-1020 m, Tuscarora Bank: *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus*, *Aulocyathus recidivus*, *Flabellum* (*Ulocyathus*) *apertum apertum*.

Stn 569. — 21.05.1992, 12°30.0'S, 176°51.2'W, 300-305 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Anthemiphyllia dentata*, *A. spinifera*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *D. ornatus*, *D. cameratus*, *Guynia annulata*, *Flabellum* (*Flabellum*) *pavoninum*, *Javania exserta*.

Stn 570. — 21.05.1992, 12°30.9'S, 176°51.4'W, 420-439 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Deltocyathus crassiseptum*, *Heterocyathus* cf. *sulcatus*, *Conotrochus funicolumna*.

Stn 571. — 21.05.1992, 12°31.3'S, 176°51.7'W, 502-508 m, Waterwitch Bank: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Conotrochus funicolumna*.

Stn 572. — 21.05.1992, 12°31.8'S, 176°52.2'W, 500-560 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Vaughanella concinna*, *Lophelia pertusa*.

Stn 574. — 21.05.1992, 12°30.9'S, 176°52.3'W, 105-410 m, Waterwitch Bank: *Enallopsammia rostrata*.

Stn 575. — 21.05.1992, 12°30.9'S, 176°52.3'W, 425 m, Waterwitch Bank: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Anthemiphyllia patera costata*, *Deltocyathus suluensis*.

Stn 578. — 22.05.1992, 13°08.2'S, 176°15.6'W, 640-730 m, North of Wallis: *Anthemiphyllia patera costata*, *Deltocyathus suluensis*, *D. cameratus*, *Flabellum* (*Flabellum*) *arcuatile*, *Javania fusca*.

Stn 581. — 22.05.1992, 13°09.9'S, 176°13.9'W, 461-550 m, North of Wallis: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Caryophyllia* (*Caryophyllia*) *crosnieri*.

Stn 584. — 22.05.1992, 13°11.2'S, 176°14.3'W, 360-400 m, North of Wallis: *Crispatotrochus rugosus*, *Dactylotrochus cervicornis*.

Stn 585. — 22.05.1992, 13°10.2'S, 176°12.6'W, 415-475 m, North of Wallis: *Madrepora oculata* forma *formosa*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *marmorea*, *Crispatotrochus rubescens*, *Bourneotrochus stellulatus*, *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. stella*, *Conotrochus funicolumna*, *Truncatoflabellum mortenseni*.

Stn 586. — 22.05.1992, 13°10.7'S, 176°13.1'W, 510-600 m, North of Wallis: *Madrepora oculata* forma *formosa*, *Anthemiphyllia dentata*, *A. patera costata*, *A. spinifera*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *Conotrochus brunneus*, *C. asymmetros*, *Asterosmilia gigas*.

Stn 589. — 23.05.1992, 12°16.2'S, 174°41.4'W, 400 m, Field Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Anthemiphyllia dentata*, *A. spinifera*, *Caryophyllia* (*Caryophyllia*) *lamellifera*, *Crispatotrochus rugosus*, *Deltocyathus taiwanicus*, *D. cameratus*, *Dactylotrochus cervicornis*, *Flabellum* (*Flabellum*) *arcuatile*, *Balanophyllia desmophyllioides*.

Stn 590. — 23.05.1992, 12°31.4'S, 174°18.7'W, 400 m, Field Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Anthemiphyllia dentata*, *A. patera costata*, *Deltocyathus suluensis*, *D. taiwanicus*, *Conotrochus brunneus*.

Stn 591. — 23.05.1992, 12°31.1'S, 174°19.4'W, 320 m, Field Bank: *Anthemiphyllia dentata*, *A. patera costata*, *Bourneotrochus stellulatus*, *Deltocyathus taiwanicus*, *Conotrochus brunneus*.

Stn 592. — 24.05.1992, 12°32.4'S, 174°22.0'W, 730-775 m, Field Bank: *Javania fusca*.

Stn 594. — 24.05.1992, 12°31.0'S, 174°19.9'W, 495-505 m, Field Bank: *Anthemiphyllia dentata*, *A. patera costata*, *Bourneotrochus stellulatus*, *Deltocyathus suluensis*, *D. taiwanicus*, *D. stella*.

Stn 595. — 24.05.1992, 12°30.9'S, 174°18.9'W, 566-580 m, Field Bank: *Anthemiphyllia patera costata*, *Bourneotrochus stellulatus*, *Deltocyathus suluensis*.

Stn 597. — 24.05.1992, 12°31.4'S, 174°18.6'W, 469-475 m, Field Bank: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Letepsammia franki*, *Anthemiphyllia dentata*, *Deltocyathus taiwanicus*, *D. crassiseptum*, *D. cameratus*, *Conotrochus brunneus*.

Stn 598. — 24.05.1992, 12°30.5'S, 174°18.4'W, 702-708 m, Field Bank: *Madrepora oculata* forma *tenuis*, *Caryophyllia* (*Caryophyllia*) *ambrosia*.

Stn 601. — 25.05.1992, 13°18.7'S, 176°17.2'W, 350 m, SE of Wallis: *Madrepora oculata* forma *formosa*, *Truncatoflabellum mortenseni*, *Balanophyllia desmophyllioides*.

Stn 604. — 26.05.1992, 13°21.4'S, 176°08.3'W, 415-420 m, SE of Wallis: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Crispatotrochus rubescens*, *Bourneotrochus stellulatus*, *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Deltocyathus crassiseptum*, *Conotrochus funicolumna*.

Stn 605. — 26.05.1992, 13°21.3'S, 176°08.4'W, 335-340 m, SE of Wallis: *Fungiacyathus* (*Fungiacyathus*) *sandoi*, *Anthemiphyllia spinifera*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Dactylotrochus cervicornis*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum vanuatu*.

Stn 606. — 26.05.1992, 13°21.4'S, 176°08.3'W, 420-430 m, SE of Wallis: *Madrepora oculata* forma *formosa*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Stephanocyathus* (*Acinocyathus*) *spiniger*.

Stn 608. — 26.05.1992, 13°21.7'S, 176°08.5'W, 440-458 m, SE of Wallis: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum.*

Stn 609. — 26.05.1992, 13°21.5'S, 176°08.5'W, 430 m, SE of Wallis: *Madrepora oculata* forma *formosa*, *Trochocyathus* (*Trochocyathus*) *vasiformis.*

Stn 610. — 26.05.1992, 13°21.5'S, 176°08.9'W, 286 m, SE of Wallis: *Anthemiphyllia spinifera*, *Caryophyllia* (*Caryophyllia*) *rugosa*, *Crispatotrochus rugosus*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Conotrochus asymmetros*, *Flabellum* (*Flabellum*) *pavoninum.*

Stn 618. — 27.05.1992, 14°21.7'S, 178°00.5'W, 420-435 m, E + SE of Alofi: *Stephanophyllia neglecta*, *Madrepora oculata* forma *formosa*, *M. porcellana*, *Anthemiphyllia dentata*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *Conotrochus funicolumna.*

Stn 619. — 27.05.1992, 14°21.8'S, 178°00.4'W, 455 m, E + SE of Alofi: *Fungiacyathus* (*Bathyactis*) *granulosus*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Conotrochus funicolumna.*

Stn 620. — 28.05.1992, 12°34.4'S, 178°11.0'W, 1280 m, bank SW of Combe Bank: *Madrepora oculata* forma *formosa*, *Aulocyathus recidivus*, *Flabellum* (*Ulocyathus*) *apertum apertum.*

Stn 621. — 28.05.1992, 12°35.0'S, 178°11.5'W, 1280-1300 m, bank SW of Combe Bank: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Madrepora oculata* forma *tenuis*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Flabellum* (*Ulocyathus*) *apertum apertum.*

Stn 622. — 28.05.1992, 12°34.5'S, 178°10.9'W, 1280-1300 m, bank SW of Combe Bank: *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Aulocyathus recidivus.*

Stn 623. — 28.05.1992, 12°34.2'S, 178°15.1'W, 1280-1300 m, bank SW of Combe Bank: *Madrepora oculata* forma *tenuis*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Aulocyathus recidivus*, *Flabellum* (*Ulocyathus*) *apertum apertum.*

Stn 625. — 29.05.1992, 11°52.4'S, 179°33.8'W, 425-430 m, Bayonnaise Bank: *Conotrochus brunneus.*

Stn 626. — 29.05.1992, 11°53.6'S, 179°32.0'W, 597-600 m, Bayonnaise Bank: *Deltocyathus stella.*

Stn 631. — 29.05.1992, 11°54.0'S, 179°31.6'W, 600 m, Bayonnaise Bank: *Deltocyathus suluensis.*

Stn 635. — 30.05.1992, 13°49.0'S, 179°56.0'E, 700-715 m, SW of Rotumah Bank: *Anthemiphyllia patera costata*, *Caryophyllia* (*Caryophyllia*) *scobinosa*, *C.* (*C.*) *ambrosia*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus.*

Stn 636. — 30.05.1992, 13°39.4'S, 179°55.5'E, 650-700 m, SW of Rotumah Bank: *Caryophyllia* (*Caryophyllia*) *ambrosia*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus.*

Stn 637. — 30.05.1992, 13°37.2'S, 179°56.0'E, 820-830 m, SW of Rotumah Bank: *Madrepora oculata* forma *tenuis*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Desmophyllum dianthus*, *Pleotrochus zibrowii.*

MUSORSTOM 8, *"Alis"*

Stn 956. — 20.09.1994, 20°33'S, 169°35'E, 1175-1210 m, Anatom: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus cameratus*, *Lochmaeotrochus gardineri*, *Flabellum* (*Ulocyathus*) *marcus.*

Stn 958. — 20.09.1994, 20°20'S, 169°47'E, 497-570 m, Anatom: *Stephanophyllia neglecta*, *Trochocyathus* (*Trochocyathus*) *discus*, *Deltocyathus crassiseptum*, *Cyathotrochus pileus.*

Stn 959. — 20.09.1994, 20°20'S, 169°48'E, 436-475 m, Anatom: *Stephanophyllia complicata*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *diomedeae*, *Oxysmilia epithecata*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *T.* (*A.*) *brevispina*, *Deltocyathus crassiseptum*, *Conotrochus brunneus*, *Cyathotrochus pileus*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Javania fusca*, *Enallopsammia rostrata.*

Stn 961. — 21.09.1994, 20°18'S, 169°49'E, 100-110 m, Anatom: *Trochocyathus* (*T.*) *maculatus*, *T.* (*T.*) *cooperi*, *Rhizosmilia robusta*, *Heteropsammia cochlea.*

Stn 962. — 21.09.1994, 20°19'S, 169°49'E, 370-400 m, Anatom: *Letepsammia franki*, *Madrepora porcellana*, *Caryophyllia (Caryophyllia) quadragenaria, Oxysmilia epithecata*, *Flabellum* (*Flabellum*) *pavoninum*, *Javania exserta*, *Balanophyllia laysanensis.*

Stn 963. — 21.09.1994, 20°20'S, 169°49'E, 400-440 m, Anatom: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *F.* (*F.*) *paliferus*, *Fungiacyathus* (*Bathyactis*) *margaretae*, *Stephanophyllia neglecta*, *S. complicata* [X], *Madrepora porcellana*, *Caryophyllia* (*Caryophyllia*) *abrupta* [X],*Trochocyathus* (*Aplocyathus*) *hastatus*, *T.* (*A.*) *brevispina*, *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Deltocyathus magnificus*, *Bourneotrochus stellulatus* [X], *Tropidocyathus labidus* [X], *Temnotrochus kermadecensis* [X], *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum mortenseni*, *Balanophyllia laysanensis*.

Stn 964. — 21.09.1994, 20°19'S, 169°49'E, 360-408 m, Anatom: *Madrepora porcellana*, *Caryophyllia* (*Caryophyllia*) *octonaria*, *Trochocyathus* (*Aplocyathus*) *brevispina*, *Deltocyathus magnificus*, *D. ornatus*, *Rhizosmilia robusta*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum mortenseni*, *Javania exserta*, *Balanophyllia desmophyllioides*.

Stn 965. — 21.09.1994, 20°20'S, 169°51'E, 361-377 m, Anatom: *Stephanophyllia neglecta*, *Caryophyllia* (*Caryophyllia*) *quadragenaria*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum dens*, *Javania fusca*, *Balanophyllia laysanensis*.

Stn 967. — 21.09.1994, 20°19'S, 169°53'E, 295-334 m, Anatom: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *rugosa*, *C.* (*C.*) *quadragenaria*, *Deltocyathus stella*, *D. ornatus*, *Truncatoguynia irregularis*, *Truncatoflabellum mortenseni*, *Endopachys grayi*, *Heteropsammia cochlea*.

Stn 968. — 21.09.1994, 20°18'S, 169°53'E, 199-214 m, Anatom: *Madrepora porcellana*.

Stn 969. — 21.09.1994, 20°19'S, 169°53'E, 252-280 m, Anatom: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Stephanophyllia neglecta*, *Madrepora porcellana*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *hawaiiensis*, *C.* (*C.*) *octonaria*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Bourneotrochus stellulatus*, *Deltocyathus stella*, *Heterocyathus* cf. *sulcatus*, *Truncatoflabellum mortenseni*, *Balanophyllia desmophyllioides*, *Endopachys grayi*, *Heteropsammia cochlea*.

Stn 970. — 21.09.1994, 20°18'S, 169°53'E, 252-310 m, Anatom: *Truncatoflabellum mortenseni*, *Balanophyllia rediviva*.

Stn 971. — 21.09.1994, 20°19'S, 169°53'E, 250-315 m, Anatom: *Rhizosmilia robusta*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*, *Dendrophyllia alcocki*.

Stn 973. — 22.09.1994, 19°21'S, 169°27'E, 460-480 m, Tanna: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Tethocyathus virgatus*, *Truncatoflabellum pusillum*.

Stn 974. — 22.09.1994, 19°21'S, 169°28'E, 492-520 m, Tanna: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Javania lamprotichum*, *Enallopsammia rostrata*.

Stn 975. — 22.09.1994, 19°23'S, 169°29'E, 536-566 m, Tanna: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Deltocyathus suluensis*, *Javania lamprotichum*, *Polymyces wellsi*.

Stn 976. — 22.09.94, 19°25'S, 169°27'E, 160-182 m, Tanna: *Madrepora porcellana*, *Caryophyllia* (*Caryophyllia*) *octonaria*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Heterocyathus* cf. *sulcatus*, *Aulocyathus juvenescens*, *Flabellum* (*Flabellum*) *pavoninum*, *Endopachys grayi*, *Heteropsammia cochlea*.

Stn 977. — 22.09.1994, 19°25'S, 169°29'E, 410-505 m, Tanna: *Fungiacyathus* (*Bathyactis*) *granulosus*, *Anthemiphyllia dentata*, *Crispatotrochus rugosus*, *Oxysmilia circularis*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *T.* (*T.*) *rhombocolumna*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Tethocyathus virgatus*, *Deltocyathus crassiseptum*, *Conotrochus brunneus*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum dens*, *Balanophyllia gigas*, *Dendrophyllia alcocki*, *Enallopsammia rostrata*.

Stn 978. — 22.09.1994, 19°23'S, 169°27'E, 408-413 m, Tanna: *Stephanophyllia neglecta*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Tethocyathus virgatus*, *Deltocyathus crassiseptum*, *Javania exserta*, *Balanophyllia crassitheca*, *Dendrophyllia alcocki*.

Stn 980. — 22.09.1994, 19°21'S, 169°25'E, 433-450 m, Tanna: *Fungiacyathus* (*Bathyactis*) *granulosus*, *Letepsammia franki*, *Deltocyathus magnificus*, *D. crassiseptum*, *Cyathotrochus pileus*, *Dendrophyllia alcocki*

Stn 982. — 23.09.1994, 19°22'S, 169°26'E, 408-410 m, Tanna: *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Tethocyathus virgatus*, *Javania fusca*, *Dendrophyllia alcocki*.

Stn 983. — 23.09.1994, 19°22'S, 169°28'E, 475-480 m, Tanna: *Anthemiphyllia dentata*, *Crispatotrochus rubescens*, *Oxysmilia circularis*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Deltocyathus crassiseptum*, *Dendrophyllia alcocki*..

Stn 988. — 23.09.1994, 19°16'S, 169°24'E, 372-466 m, Tanna: *Madracis kauaiensis*, *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Stephanophyllia neglecta*, *Madrepora porcellana*, *Anthemiphyllia spinifera*, *Caryophyllia* (*Caryophyllia*) *rugosa*, *C.* (*C.*) *abrupta*, *Crispatotrochus rugosus*, *Labyrinthocyathus limatulus*, *Dactylotrochus cervicornis*, *Cryptotrochus brevipalus*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum dens*, *T. pusillum*, *Javania lamprotichum*, *J. fusca*, *Balanophyllia desmophyllioides*, *Dendrophyllia alcocki*.

Stn 990. — 24.09.1994, 18°52'S, 168°51'E, 980-990 m, Erromango: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*.

Stn 992. — 24.09.1994, 18°52'S, 168°55'E, 748-775 m, Erromango: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Caryophyllia* (*Caryophyllia*) *scobinosa*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus*, *Lochmaeotrochus gardineri*.

Stn 996. — 24.09.1994, 18°52'S, 168°56'E, 764-786 m, Erromango: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Truncatoflabellum stabile*.

Stn 999. — 25.09.1994, 18°49'S, 169°00'E, 80-110 m, Erromango: *Trochocyathus* (*Aplocyathus*) *brevispina*.

Stn 1001. — 25.09.1994, 18°49'S, 168°59'E, 150-250 m, Erromango: *Caryophyllia* (*Acanthocyathus*) *grayi*.

Stn 1002. — 25.09.1994, 18°49'S, 168°59'E, 200-300 m, Erromango: *Caryophyllia* (*Acanthocyathus*) *grayi*.

Stn 1003. — 25.09.1994, 18°49'S, 168°59'E, 200-327 m, Erromango: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Trochocyathus* (*Aplocyathus*) *brevispina*, *Stephanocyathus* (*Acinocyathus*) *spiniger*.

Stn 1004. — 25.09.1994, 18°49'S, 168°59'E, 319-350 m, Erromango: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Aplocyathus*) *brevispina*, *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Heterocyathus alternatus*, *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum vigintifarium*.

Stn 1005. — 25.09.1994, 18°49'S, 168°59'E, 360-450 m, Erromango: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Stephanophyllia complicata*, *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Endopachys grayi*.

Stn 1006. — 25.09.1994, 18°50'S, 168°57'E, 574-611 m, Erromango: *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Deltocyathus vaughani*, *Conotrochus brunneus*, *Gardineria hawaiiensis*, *Enallopsammia rostrata*.

Stn 1007. — 25.09.1994, 18°52'S, 168°56'E, 720-830 m, Erromango: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus*.

Stn 1009. — 27.09.1994, 17°46'S, 168°13'E, 430-460 m, Efaté: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Balanophyllia gemma*.

Stn 1011. — 27.09.1994, 17°50'S, 168°11'E, 547-585 m, Efaté: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Deltocyathus vaughani*, *Gardineria hawaiiensis*.

Stn 1014. — 27.09.1994, 17°54'S, 168°19'E, 495-498 m, Efaté: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Anthemiphyllia spinifera*, *Caryophyllia* (*Caryophyllia*) *diomedeae*, *Cryptotrochus brevipalus*, *Flabellum* (*Ulocyathus*) *hoffmeisteri*, *Javania lamprotichum*, *Gardineria hawaiiensis*, *G. paradoxa*.

Stn 1015. — 27.09.1994, 17°54'S, 168°22'E, 375-420 m, Efaté: *Crispatotrochus rugosus*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Tethocyathus virgatus*, *Truncatoflabellum dens*, *Balanophyllia gemma*, *Dendrophyllia alcocki*, *Enallopsammia rostrata*.

Stn 1016. — 27.09.1994, 17°53'S, 168°28'E, 291-300 m, Efaté: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Letepsammia franki*, *Anthemiphyllia dentata*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Conotrochus asymmetros* [X], *Tropidocyathus lessonii*, *Cyathotrochus pileus*, *Guynia annulata*, *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*, *Truncatoflabellum pusillum* [X], *Endopachys grayi*..

Stn 1017. — 27.09.1994, 17°53'S, 168°26'E, 294-295 m, Efaté: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Letepsammia franki*, *Deltocyathus ornatus*, *Conocyathus asymmetros* [X], *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*, *Endopachys grayi* [X].

Stn 1018. — 27.09.1994, 17°53'S, 168°25'E, 300-301 m, Efaté: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Letepsammia franki*, *Stephanophyllia complicata*, *?Caryophyllia* (*C.*) *lamellifera*, *Crispatotrochus rugosus*, *Oxysmilia epithecata*, *Deltocyathus ornatus*, *Bourneotrochus stellulatus* [X], *Heterocyathus alternatus*, *Notocyathus conicus* [X], *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*, *T. vigintifarium*, *Endopachys grayi*, *Dendrophyllia arbuscula*.

Stn 1019. — 28.09.1994, 17°38'S, 168°34'E, 397-430 m, Efaté: *Stephanophyllia neglecta*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *T.* (*T.*) *efateensis*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *Balanophyllia gemma*, *Dendrophyllia alcocki*.

Stn 1020. — 28.09.1994, 17°40'S, 168°35'E, 380-391 m, Efaté: *Trochocyathus* (*Trochocyathus*) *efateensis*, *Trochocyathus* (*Aplocyathus*) *hastatus*, *T.* (*A.*) *brevispina*.

Stn 1021. — 28.09.1994, 17°43'S, 168°37'E, 124-130 m, Efaté: *Trochocyathus* (*Trochocyathus*) *maculatus*, *T.* (*T.*) *cooperi*, *Rhizosmilia robusta*, *Javania exserta*, *Rhizotrochus typus*, *Dendrophyllia arbuscula*.

Stn 1023. — 28.09.1994, 17°48'S, 168°49'E, 321 m, Efaté: *Letepsammia franki*, *?Caryophyllia* (*C.*) *lamellifera*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus* [X], *Temnotrochus kermadecensis* [X], *Flabellum* (*Ulocyathus*) *aotearoa*, *Dendrophyllia alcocki*.

Stn 1024. — 28.09.1994, 17°48'S, 168°39'E, 335-370 m, Efaté: *Enallopsammia rostrata*.

Stn 1026. — 28.09.1994, 17°50'S, 168°39'E, 437-504 m, Efaté: *Oxysmilia epithecata*, *Trochocyathus* (*Trochocyathus*) *efateensis*, *Tethocyathus virgatus*, *Tropidocyathus labidus*.

Stn 1028. — 28.09.1994, 17°54'S, 168°40'E, 624-668 m, Efaté: *Madrepora oculata forma tenuis*, *Deltocyathus suluensis*, *Cryptotrochus brevipalus*.

Stn 1030. — 29.09.1994, 17°51'S, 168°30'E, 180-190 m, Efaté: *Crispatotrochus rugosus*, *Oxysmilia circularis*, *O. corrugata*, *Javania exserta*, *Balanophyllia desmophyllioides*, *Dendrophyllia arbuscula*.

Stn 1031. — 29.09.1994, 17°52'S, 168°33'E, 310 m, Efaté: *Madrepora oculata* forma *tenuis*, *Anthemiphyllia pacifica*.

Stn 1034. — 29.09.1994, 17°54'S, 168°42'E, 690-750 m, Efaté: *Caryophyllia* (*Caryophyllia*) *scobinosa*, *Lochmaeotrochus gardineri*, *Cryptotrochus brevipalus*.

Stn 1035. — 29.09.1994, 17°56'S, 168°44'E, 765-780 m, Efaté: *Caryophyllia* (*Caryophyllia*) *scobinosa*.

Stn 1036. — 29.09.1994, 18°01'S, 168°48'E, 920-950 m, Efaté: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus cameratus*, *Lochmaeotrochus gardineri*, *Truncatoflabellum stabile*.

Stn 1037. — 29.09.1994, 18°03'S, 168°54'E, 1058-1086 m, Efaté: *Flabellum* (*Ulocyathus*) *marcus*, *Truncatoflabellum stabile*.

Stn 1042. — 30.09.1994, 16°52'S, 168°27'E, 200-260 m, Epi: *Javania exserta*.

Stn 1043. — 30.09.1994, 16°52'S, 168°25'E, 350-372 m, Epi: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Crispatotrochus rugosus*.

Stn 1047. — 30.09.1994, 16°53'S, 168°10'E, 486-494 m, Epi: *Trochocyathus* (*Trochocyathus*) *maculatus*.

Stn 1051. — 01.10.1994, 16°36'S, 167°59'E, 555-558 m, Epi: *Fungiacyathus* (*Bathyactis*) *margaretae*, *Caryophyllia* (*Caryophyllia*) sp. cf. *calveri*.

Stn 1056. — 01.10.1994, 16°33'S, 167°55'E, 602-620 m, Epi: *Caryophyllia* (*Caryophyllia*) sp. cf. *calveri*.

Stn 1058. — 02.10.1994, 16°12'S, 167°20'E, 319 m, Malakula: *Trochocyathus* (*Aplocyathus*) *brevispina*, *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Dendrophyllia arbuscula*.

Stn 1059. — 02.10.1994, 16°12'S, 167°20'E, 408-430 m, Malakula: *Conotrochus funicolumna*.

Stn 1060. — 02.10.1994, 16°13'S, 167°20'E, 375-397 m, Malakula: *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Conotrochus funicolumna*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum dens*, *T. vigintifarium*, *Javania exserta*.

Stn 1061. — 02.10.1994, 16°14'S, 167°20'E, 458-512 m, Malakula: *Bourneotrochus stellulatus*, *Deltocyathus crassiseptum*, *D. cameratus*.

Stn 1065. — 02.10.1994, 16°16'S, 167°21'E, 360-419 m, Malakula: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Aplocyathus*) *brevispina*, *Conotrochus funicolumna*, *Tropidocyathus labidus*, *Flabellum* (*Flabellum*) *pavoninum*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*, *T. vigintifarium*, *T. mortenseni*, *Balanophyllia desmophyllioides*.

Stn 1067. — 02.10.1994, 16°16'S, 167°21'E, 344-366 m, Malakula: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Notocyathus conicus*, *Cryptotrochus brevipalus*, *Gardineria hawaiiensis*.

Stn 1068. — 02.10.1994, 16°15'S, 167°19'E, 536-619 m, Malakula: *Deltocyathus crassiseptum*, *Alatotrochus rubescens*, *Tropidocyathus labidus*.

Stn 1069. — 04.10.1994, 15°32'S, 167°14'E, 122-125 m, SE of Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Heterocyathus* cf. *sulcatus*.

Stn 1070. — 04.10.1994, 15°36'S, 167°16'E, 184-190 m, SE of Espiritu Santo: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Letepsammia franki*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Aulocyathus juvenescens*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*.

Stn 1071. — 04.10.1994, 15°36'S, 167°16'E, 180-191 m, SE of Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Rhizosmilia robusta*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*, *Endopachys grayi*.

Stn 1072. — 04.10.1994, 15°39'S, 167°19'E, 622-625 m, SE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *octonaria*, *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Conotrochus funicolumna*, *Heteropsammia cochlea*.

Stn 1074. — 04.10.1994, 15°48'S, 167°24'E, 775-798 m, SE of Espiritu Santo: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Caryophyllia* (*Caryophyllia*) *crosnieri*, *C.* (*C.*) *scobinosa*, *Stephanocyathus* (*Odontocyathus*) *weberianus*.

Stn 1077. — 05.10.1994, 16°04'S, 167°06'E, 180-210 m, Malakula: *Madracis kauaiensis*, *Oculina virgosa*, *Madrepora porcellana*, *Caryophyllia* (*Caryophyllia*) *lamellifera*, *Trochocyathus* (*Trochocyathus*) *maculatus*, *Rhizosmilia robusta*, *Truncatoflabellum mortenseni*, *Balanophyllia rediviva*.

Stn 1078. — 05.10.1994, 16°03'S, 167°26'E, 194-230 m, Malakula: *Rhizosmilia robusta*, *Rhizotrochus typus*.

Stn 1080. — 05.10.1994, 15°57'S, 167°27'E, 799-850 m, Malakula: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Caryophyllia* (*Caryophyllia*) *diomedeae*, *Stephanocyathus* (*Odontocyathus*) *weberianus*.

Stn 1084. — 05.10.94, 15°50'S, 167°17'E, 207-280 m, Malakula: *Madrepora porcellana*, *Rhizosmilia robusta*, *Flabellum* (*Flabellum*) *pavoninum*.

Stn 1085. — 05.10.1994, 15°48'S, 167°18'E, 155-161 m, Malakula: *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum martensii*, *Javania exserta*, *Endopachys grayi*.

Stn 1086. — 05.10.1994, 15°36'S, 167°16'E, 182-215 m, Malakula: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *philippinensis*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum candeanum*, *T. martensii*, *Endopachys grayi*.

Stn 1087. — 06.10.1994, 15°10'S, 167°14'E, 394-421 m, NE of Espiritu Santo: *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Bourneotrochus stellulatus* [X], *Conotrochus funicolumna*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum angustum*.

Stn 1088. — 06.10.1994, 15°09'S, 167°15'E, 425-455 m, NE of Espiritu Santo: *Madrepora oculata* forma *formosa*, *Caryophyllia* (*Caryophyllia*) *abrupta*, *Trochocyathus* (*Trochocyathus*) *discus*, *Conotrochus funicolumna*, *Desmophyllum dianthus*, *Peponocyathus folliculus*.

Stn 1089. — 06.10.1994, 15°08'S, 167°17'E, 494-516 m, NE of Espiritu Santo: *Madrepora porcellana*, *Trochocyathus* (*Trochocyathus*) *discus*, *Conotrochus brunneus*, *Desmophyllum dianthus*.

Stn 1090. — 06.10.1994, 15°08'S, 167°17'E, 470-502 m, NE of Espiritu Santo: *Trochocyathus* (*Trochocyathus*) *discus*, *Conotrochus brunneus*.

Stn 1091. — 06.10.1994, 15°10'S, 167°13'E, 344-350 m, NE of Espiritu Santo: *Stephanophyllia complicata* [X], *Caryophyllia* (*Caryophyllia*) *abrupta* [X], *Conotrochus funicolumna*, *Flabellum* (*Flabellum*) *pavoninum* [X], *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum angustum*.

Stn 1092. — 06.10.1994, 15°10'S, 167°12'E, 314-321 m, NE of Espiritu Santo: *Stephanocyathus* (*Acinocyathus*) *spiniger*, *Conotrochus brunneus* [X].

Stn 1094. — 06.10.1994, 15°08'S, 167°11'E, 312-314 m, NE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *abrupta*, *Deltocyathus ornatus*, *Heterocyathus* cf. *sulcatus*, *Truncatoflabellum pusillum*, *T. vigintifarium*.

Stn 1095. — 06.10.1994, 15°07'S, 167°11'E, 304-320 m, NE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *rugosa*, *?C. (C.) lamellifera*, *Crispatotrochus rugosus*, *Tethocyathus virgatus*, *Dactylotrochus cervicornis*, *Dendrophyllia alcocki*.

Stn 1097. — 07.10.1994, 15°05'S, 167°10'E, 281-288 m, NE of Espiritu Santo: *Stephanophyllia complicata* [X], *Caryophyllia* (*Caryophyllia*) *rugosa*, *Oxysmilia epithecata*, *Bourneotrochus stellulatus* [X], *Deltocyathus stella* [X], *Heterocyathus* cf. *sulcatus*, *Conotrochus asymmetros* [X], *Guynia annulata* [X], *Truncatoflabellum pusillum*, *T. vigintifarium*, *Javania fusca*.

Stn 1098. — 07.10.1994, 15°04'S, 167°10'E, 277-285 m, NE of Espiritu Santo: *Truncatoflabellum pusillum*, *T. vigintifarium*, *Balanophyllia desmophyllioides*.

Stn 1102. — 07.10.1994, 15°03'S, 167°08'E, 208-210 m, NE of Espiritu Santo: *Oculina virgosa*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*.

Stn 1103. — 07.10.1994, 15°03'S, 167°07'E, 163-165 m, NE of Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*, *Trochocyathus* (*Trochocyathus*) *semperi*, *Flabellum* (*Flabellum*) *pavoninum*, *Truncatoflabellum mortenseni*.

Stn 1106. — 07.10.1994, 15°05'S, 167°11'E, 305-314 m, NE of Espiritu Santo: *Fungiacyathus* (*Fungiacyathus*) *paliferus*, *Caryophyllia* (*Caryophyllia*) *quadragenaria*, *Crispatotrochus rugosus*, *Bourneotrochus stellulatus* [X], *Deltocyathus stella*, *D. heteroclitus* [X], *Truncatoflabellum vigintifarium*, *T. pusillum* [X], *Javania fusca*

Stn 1107. — 07.10.1994, 15°05'S, 167°15'E, 397-402 m, NE of Espiritu Santo: *Trochocyathus* (*Trochocyathus*) *vasiformis*, *Conotrochus funicolumna*.

Stn 1108. — 07.10.1994, 15°04'S, 167°15'E, 405-419 m, NE of Espiritu Santo: *Caryophyllia* (*Caryophyllia*) *crosnieri*, *Tethocyathus virgatus*, *Dendrophyllia alcocki*.

Stn 1109. — 08.10.1994, 14°52'S, 167°18'E, 1550-1620 m, N of Espiritu Santo: *Stephanocyathus* (*Stephanocyathus*) *regius*.

Stn 1110. — 08.10.1994, 14°49'S, 167°15'E, 1360 m, N of Espiritu Santo: *Stephanocyathus* (*Stephanocyathus*) *regius*.

Stn 1111. — 08.10.1994, 14°51'S, 167°14'E, 1210-1250 m, N of Espiritu Santo: *Trochocyathus* (*Trochocyathus*) *patelliformis*.

Stn 1113. — 08.10.1994, 14°52'S, 167°06'E, 700-736 m, N of Espiritu Santo: *Stephanophyllia complicata*, *Conotrochus funicolumna*, *Pleotrochus zibrowii*, *Cryptotrochus brevipalus*, *Truncatoflabellum vigintifarium*.

Stn 1114. — 08.10.1994, 14°52'S, 167°03'E, 647 m, N of Espiritu Santo: *Pleotrochus venustus*, *Javania fusca*.

Stn 1125. — 10.10.1994, 15°57'S, 166°38'E, 1160-1220 m, Guyot Bougainville: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Stephanocyathus* (*Odontocyathus*) *coronatus*, *Deltocyathus rotulus*, *Truncatoflabellum stabile*.

Stn 1127. — 10.10.1994, 15°58'S, 166°37'E, 1052-1058 m, Guyot Bougainville: *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus rotulus*, *Truncatoflabellum stabile*.

Stn 1128. — 10.10.1994, 16°02'S, 166°38'E, 778-811 m, Guyot Bougainville: *Fungiacyathus* (*Fungiacyathus*) *pusillus pacificus*, *Caryophyllia* (*Caryophyllia*) *diomedeae*, *Desmophyllum dianthus*, *Javania fusca*.

Stn 1129. — 10.10.1994, 16°00'S, 166°39'E, 1014-1050 m, Guyot Bougainville: *Fungiacyathus* (*Fungiacyathus*) *stephanus*, *Stephanocyathus* (*Stephanocyathus*) *regius*, *Deltocyathus rotulus*, *Flabellum* (*Ulocyathus*) *marcus*

Stn 1131. — 11.10.1994, 15°38'S, 167°03'E, 140-175 m, S of Espiritu Santo: *Rhizotrochus typus*.

Stn 1132. — 11.10.1994, 15°38'S, 167°02'E, 161-182 m, S of Espiritu Santo: *Flabellum* (*Flabellum*) *pavoninum*.

Stn 1134. — 11.10.1994, 15°39'S, 167°02'E, 230-287 m, S of Espiritu Santo: *Letepsammia franki*, *Caryophyllia* (*Caryophyllia*) *octonaria*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Flabellum* (*Ulocyathus*) *aotearoa*, *Truncatoflabellum mortenseni*, *Balanophyllia rediviva*, *Endopachys grayi*.

Stn 1135. — 11.10.1994, 15°40'S, 167°02'E, 282-375 m, S of Espiritu Santo: *Flabellum* (*Flabellum*) *pavoninum* [X], *Truncatoflabellum angustum* [X].

NIMBUS

Stn 12. — ?.07.1968, 26°32'S, 153°45'E, depth unknown, Queensland: *Anthemiphyllia multidentata*.

Stn 55. — 1968, 26°27'S, 153°50'E, 270-272 m, Queensland: *Anthemiphyllia multidentata*.

NZOI (New Zealand Oceanographic Institute), *"Tangaroa"*

Stn C527. — 18.09.1960, 32°30.0'S, 179°12.0'W, 508 m, southern Kermadec Ridge: *Anthemiphyllia macrolobata*.

Stn I92. — 23.07.1975, 29°24.8'S, 168°13.2'E, 570-578 m, Norfolk I.: *Flabellum* (*Flabellum*) *arcuatile*.

Stn I97. — 25.07.1975, 32°22.9'S, 167°28.2'E, 540-544 m, southern Norfolk Ridge: *Flabellum* (*Flabellum*) *arcuatile*.

Stn I741. — 12.05.1979, 22°43.0'S, 159°16.0'E, 328 m, Lord Howe Seamount Chain: *Balanophyllia desmophyllioides*.

Stn K803. — 22.07.1974, 29°16.0'S, 177°50.3'W, 190-140 m, Raoul I., Kermadec Is: *Madracis kauaiensis*.

Stn K825. — 25.07.1974, 28°47.8'S, 177°47.8'W, 145 m, Raoul I., Kermadec Is: *Madracis kauaiensis*.

Stn K826. — 25.07.1974, 28°48.0'S, 177°48.0'W, 142 m, Raoul I., Kermadec Is: *Madracis kauaiensis*.

Stn K830. — 26.07.1974, 29°11.5'S, 177°53.0'W, 545-590 m, Raoul I., Kermadec Is: *Oxysmilia circularis*.

Stn K842. — 29.07.1974, 30°10.2'S, 178°35.9'W, 325-370 m, McCauley I., Kermadec Is: *Anthemiphyllia pacifica*.

Stn K858. — 30.07.1974, 30°34.2'S, 178°29.8'W, 465-501 m, Curtis I., Kermadec Is: *Oxysmilia circularis*.

Stn K872. — 2.08.1974, 31°20.4'S, 178°49.2'W, 280-235 m, Esperance Rock, Kermadec Is: *Anthemiphyllia pacifica*

Stn P115. — 31.05.1977, 31°25.9'S, 159°02.2'E, Lord Howe Is: *Thalamophyllia tenuescens*.

Stn U599. — 08.02.1988, 30°43.0'S, 173°16.0'E, 640-590 m, Three Kings Ridge, New Zealand: *Flabellum* (*Flabellum*) *arcuatile*.

"Townsend Cromwell"

Stn 81-01-14. — 02.02.1981, 23°15'48"N, 161°50'12"W, 369 m, Hawaiian Is: *Anthemiphyllia macrolobata*.

"Toyoshio-Maru"

Stn 11. — 11.11.1995, 28°05'N, 129°47'40"E, 302 m, Ryukyu Is: *Madrepora minutiseptum*.

USGS (United States Geological Survey)

Stn 24918. — Late Pleistocene, Navaka River, Espiritu Santo: *Madrepora porcellana*.

Stn 25715. — Late Pleistocene, Kere River, Espiritu Santo: *Madrepora porcellana*, *Caryophyllia* (*Acanthocyathus*) *grayi*, *Dendrophyllia ijimai*.

Stn 25718. — Late Pleistocene, Kere River, Espiritu Santo: *Madrepora porcellana*.

Stns SM242, 129a and 129b. — Late Pleistocene, Kere River, Espiritu Santo: *Caryophyllia* (*Acanthocyathus*) *grayi*.

HISTORICAL REVIEW

No azooxanthellate Scleractinia were previously known from the Wallis and Futuna region, and only two authors reported azooxanthellate corals from Vanuatu: *Neohelia porcellana* from Epi (MOSELEY, 1881), and 17 Late Pleistocene species from Espiritu Santo (WELLS, 1984). However, many species have been reported from other islands throughout the tropical central Pacific, which are summarized in Table 1. Although the specimens reported in this paper are primarily deep-water in habitat, it was attempted to include references to all azooxanthellate species in Table 1, regardless of depth. Only some of the more significant papers are briefly discussed below.

TABLE 1. — Summary of azooxanthellate Scleractinia previously reported from the tropical central Pacific. (S = 0-100 m, D = over 100 m, + = fossil).

Year	Author	Locality	Depth	Species reported
1831	LESSON	Hawaiian Is.	D	*Flabellum pavoninum* sp. nov.
1846	DANA	Fiji	S	3 species: *Tubastraea* and *Culicia*, including two new species.
1878	STUDER	Solomon Is. (Bougainville)	S	*Madracis hellana, Phyllangia papuensis* sp. nov.
1881	MOSELEY	Admiralty, Kermadec Is., Fiji, **Vanuatu**, Caroline, Louisiade Is.	D	6 species, including 4 new
1892	REHBERG	Fiji	D	*Madracis singularis* sp. nov.
1898	WHITELEGGE	Tuvalu (Funafuti)	SD	*Caryophyllia "clavus"*
1899a	GARDINER	Loyalty Is. (Lifou)	S	9 new species, all from Sandal Bay (73 m)
1899b	GARDINER	Tuvalu (Funafuti)	D	*Rhizotrochus levidensis*
1900	GARDINER	Loyalty Is.	S	*Coenopsammia willeyi* sp. nov.
1903	BOURNE	Funafuti (Tuvalu)	D	4 species, including 2 new
1907	VAUGHAN	Hawaiian Is.	D	32 species and 7 varieties, 27 new
1936	YABE & SUGIYAMA	Palau	D	3 species, including 2 new *Madracis*
1954	WELLS	Bikini Atoll (Marshall Is.)	SD	13 species, including a new genus, 2 new species, 1 new variety
1971	CHEVALIER	New Caledonia	S	3 species of *Culicia* and *Oulangia*, including 2 new
1973	ZIBROWIUS	Tuamotu Is.	D	*Enallopsammia rostrata*
1974	KELLER	Marcus-Necker Ridge	D	*Flabellum marcus* sp. nov.
1976	KELLER	Caroline, Marquesas, Tuamotu Is.	D	*Fungiacyathus fragilis fragilis* subsp. nov.
1977	WELLS	Tonga (Late Eocene)	+	17 species, including 13 new
1978	CHEVALIER	Marquesas	S	4 species, 3 unidentified to species
1980	CHEVALIER	Tubuai	S	2 species, both unidentified to species
1981a	KELLER	Marcus-Necker Ridge, Hermit Atoll, Dimitri Mendeleev Seamount, Hawaiian Is.	D	8 species, including 1 new
1981b	KELLER	Bonin Is., Marcus-Necker Ridge	D	*Caryophyllia pacifica* sp. nov., *C. scobinosa*
1982	KELLER	Cook, Kermadec, Hawaiian Is.	D	3 species of *Deltocyathus*
1984	CAIRNS	Hawaiian, Christmas, Line Is.	D	19 new records, including 8 new species
1984	WELLS	**Vanuatu** (Late Pleistocene)	+	17 species, including 3 new species
1985	ZIBROWIUS & GRYGIER	New Caledonia, Guam, Cook, Hawaiian, Santa Cruz Is.	D	6 species as hosts of ascothoracidan Crustacea

Year	Author	Locality	Depth	Species reported
1985	GRYGIER & NEWMAN	Tonga, Hawaiian Is.	D	*Enallopsammia rostrata* as host of acrothoracican cirripedes
1985	ZIBROWIUS	Chesterfield Is.	S	2 species of budd-shedding *Balanophyllia*
1985	RANDALL & MYERS	Guam	S	5 species
1989	SIEG & ZIBROWIUS	New Caledonia	D	4 unidentified species as hosts for tanaiedacean
1991	MANNING	New Caledonia	D	*Dendrophyllia alcocki* as host for cryptochirid crab
1991	GRYGIER	Johnston Atoll	D	*Enallopsammia rostrata* as host of ascothoracidan Crustacea
1995	CAIRNS	Kermadec, Colville, Norfolk Ridges; Chesterfield, Cook, Tonga, Samoa Is.	DS	76 species, including 15 new species, mostly from southern border of tropical region
1995	GUERRIERO *et al.*	Loyalty Is.	D	steroids from *Deltocyathus magnificus*
1996	STOLARSKI	Loyalty Is.	D	unidentified gardinariid genus and species
1997	CAIRNS & ZIBROWIUS	Fiji, New Caledonia, Palau, Marquesas, Kermadecs Is.; Norfolk Ridge	DS	9 species, including 2 new species
1998	CAIRNS (this paper)	**Vanuatu, Wallis and Futuna**, Hawaiian Is., Chesterfield Is., Guam, Lord Howe Seamount Chain	D	134 species (see Historical Review), including 15 new species

The first azooxanthellate coral reported from the tropical central Pacific was *Flabellum pavoninum* Lesson, 1831 from the "Sandwich Islands" (= Hawaiian Islands), which is ironic, since it is a deep-water species that was collected before the era of deep-water dredging. The *"Challenger"* Expedition, which ushered in the era of deep-water biology, collected 6 species from various localities throughout the central Pacific, including one new species (*Neohelia porcellana*) from the Vanuatu archipelago (MOSELEY, 1881). The collection of the nine species reported by GARDINER (1899a) from the Loyalty Islands, all from Sandal Bay at 73 m, is significant in that many of these species are also found at greater depths, as reported herein. GARDINER's specimens were split between the British Museum and the University Museum of Zoology, Cambridge.

The Hawaiian azooxanthellate fauna is relatively well known, due to the seminal work of VAUGHAN (1907) and later additions by CAIRNS (1984), all specimens of which are deposited at the USNM. Although a northern outlier to the central Pacific region, the Hawaiian fauna includes many species found throughout the Indo-Pacific (see Distribution section), as well as some apparent endemics.

Another significant paper on corals from the central tropical Pacific was that of WELLS (1954) on the Recent corals of the Marshall Islands, in which 13 azooxanthellate species are reported from Bikini Atoll, mostly from depths shallower than 200 m. These specimens are deposited at the USNM.

KELLER (1981a) reported eight species from several exotic central Pacific bathyal localities, including the Marcus-Necker Ridge (18-23°N, 157-178°E), Hermit Atoll (1°S, 145°E), Demitri Mendeleev Seamount (5°N, 155°E), and the Hawaiian Islands. These specimens are deposited at the Institute of Oceanology, Moscow.

As the Hawaiian Islands are to the northern border of the central tropical Pacific, the ridges and islands north of New Zealand (north of 33°S) are to the southern central tropical Pacific. In his revision of the New Zealand azooxanthellate Scleractinia, CAIRNS (1995: Table 2) listed 76 species from the Kermadec and the Lord Howe Islands, and the northern Colville, Three Kings, and Norfolk ridges; additional records of 12 of these species were also reported from Chesterfield, Cook, Tonga, and Samoa Islands.

Azooxanthellate species were reported in an incidental fashion in a number of papers published after 1984 (see Table 1), often as host species for symbionts, or as a part of a larger checklist of the shallow water coral fauna

from a region. It was attempted to make Table 1 as complete as possible, but undoubtedly some references of this nature were overlooked.

As a result of this study, 116 azooxanthellate species are reported from the Vanuatu Archipelago and 83 from the Wallis and Futuna Archipelago (Table 2). Incidental records are also reported from the Kermadec Islands (3 species), Hawaiian Islands (2), Johnston Atoll (1), Lord Howe Seamount Chain (1), Guam (1), Chesterfield Island (1), and the ridges and islands north of New Zealand (1).

The following azooxanthellate coral faunas have been reviewed from regions bordering the tropical central Pacific: northern temperate Pacific (CAIRNS, 1994), eastern temperate Pacific (CAIRNS, 1994), eastern tropical Pacific (CAIRNS, 1991a), southern temperate Pacific (CAIRNS, 1982, 1995), and western tropical Pacific (CAIRNS, 1989a; CAIRNS & ZIBROWIUS, 1997).

MATERIAL

This study was based on the examination of approximately 4400 specimens (1042 lots) collected from 227 stations. Most of the specimens were collected by the French research expedition MUSORSTOM 7 in the Wallis and Futuna archipelago in 1992 (RICHER DE FORGES & MENOU, 1993) and MUSORSTOM 8 in the Vanuatu archipelago in 1994 (RICHER DE FORGES, FALIEX & MENOU, 1996).

A novel source of specimens heretofore overlooked by most are those deep-water corals that have been cemented into the shell of *Xenophora* carrier shells. Nineteen species and several more unidentified taxa were distinguished from 40 *Xenophora* shells from the MUSORSTOM 8 expedition in the Vanuatu Archipelago, some shells bearing as many as 6 different species. This source of specimens is considered promising because, despite numerous stations made by the MUSORSTOM expedition in this region, of the 19 species found on these shells, three (*Fungiacyathus variegatus, Peponocyathus folliculus*, and *Temnotrochus kermadecensis*) are known from this region only as *Xenophora*-collected, and another five species (*Guynia annulata, Tropidocyathus labidus, Notocyathus conicus, Deltocyathus heteroclitus*, and *Trochocyathus discus*) were otherwise rarely collected from this region by conventional means. The depth ranges of the *Xenophora*-collected coralla are consistent with the known depth range of the coral species, implying that bathymetric transport by the gastropod is probably negligible. Furthermore, although most coralla cemented to *Xenophora* shells are dead, some were still alive when attached and when collected.

METHODS

Species descriptions and illustrations are provided only for those species described as new or for those for which no adequate description previously existed. Shorter diagnoses are provided for most of the remaining species for which new material is reported, with an indication as to where to find a more complete description.

Species synonymies are complete unless otherwise indicated with a reference to a more complete account; however, it was attempted to include in the synonymies all references to specimens reported from the tropical central Pacific. When possible, historical records were verified, but when material was unavailable and the published account unclear, the synonymy entry and corresponding distribution record are queried. In order to clarify what historical material was examined by the author, the following convention was employed (see MATTHEWS, 1973). The three symbols used in the synonymies, which always precede the year of publication, are:

*, meaning this entry represents a valid species under the terms of the ICZN (1985);

v*, meaning that the author (SDC) has examined the type of this species;

v., meaning that the author (SDC) has examined this/these nontype specimens and agrees that they belong in synonymy.

The letter "v" is Latin for *vidimus* (we have seen). The *vidimus* convention is not used for publications written by the author of the cited publication, since it is self-evident that he has seen the specimens that he has previously reported.

In the "Material Examined" sections, the number of specimens examined follows the station number, followed by the museum of deposition, and its catalog number, if any. Holotypes and paratypes are deposited primarily at the MNHN and NMNH.

In order to avoid erroneous depth ranges for species as a result of bathymetrically wide-ranging trawls, a confirmed depth range is employed in this paper, which is defined as the deepest shallow to the shallowest deep component of all trawls considered. For example, if a species was trawled at a station indicating 20-300 m and again at a station indicating 250-500 m, the confirmed depth range is 250-300 m, a depth range within which the species must occur.

Conventional photography was done by the author, in some cases the corallum dyed black with cloth dye and recoated with sublimed ammonium chloride in order to improve contrast for photography.

DISTRIBUTION

Inter-regional comparisons. — The Vanuatu archipelago and Wallis and Futuna islands and adjacent seamounts lie near the centre of the large Indo-Polynesian tropical marine province as defined by BRIGGS (1974), which extends from the Persian Gulf to the Tuamotu Archipelago. The 116 azooxanthellate species listed for the Vanuatu region (Table 2) compare closely in number to the 125 listed by CAIRNS & ZIBROWIUS (1997) for the highly diverse Kai Islands, Indonesia, especially considering that the shallow and extremely deep environments of the Vanuatu region were not sampled. Indeed, 95 (71%) of the 134 species from the Vanuatu and Wallis and Futuna regions are also known in the tropical western Pacific region, this number decreasing to 62 (46%) farther west in the tropical Indian Ocean (Table 2). On the other hand, only seven species are found in common with the Vanuatu/Wallis and Futuna region and the tropical eastern Pacific: five of those being cosmopolitan; one, *Endopachys grayi*, being Indo-Pacific in distribution; and the seventh, *Polymyces wellsi*, amphi-Pacific in distribution. Ironically, the Vanuatu/Wallis and Futuna region has more species in common with the Atlantic Ocean (11) than the eastern Pacific (7)(see Table 2). Among these 11 species, 6 may be considered to be cosmopolitan; two (*Caryophyllia ambrosia* and *Truncatoflabellum stabile*) have potentially continuous distributions via the Indian Ocean; but three species (*Stephanocyathus coronatus*, *Vaughanella concinna*, and *Peponocyathus folliculus*) have apparent disjunct distributions between the central Pacific and the western or northern Atlantic.

Because deep water temperature gradients do not always exactly correspond to shallow water gradients, the zoogeographic boundaries of deep-water corals are sometimes less well-defined than for shallow-water organisms (BRIGGS, 1974; CAIRNS, 1994, 1995). Thus, it is not considered unusual that 43 species from the Vanuatu/Wallis and Futuna region are also known from the warm to cold temperate region of Japan, and 32 species extend to the temperate regions of New Zealand and southern Australia (Table 2).

Intraregional comparisons. — Within the tropical central Pacific, the Vanuatu/Wallis and Futuna azooxanthellates have a strong affinity (56 species, Table 2) to those species found in the tropical regions to the south, composed of the Kermadec Islands and Ridge, Colville Ridge, Norfolk Island and Ridge, and the Lord Howe Islands and Seamount Chain. These submarine ridge systems north of New Zealand form a natural conduit for the migration of corals in both directions between the New Zealand region and the Tonga Platform and the New Caledonian region. And, whereas only 9 species are listed for the New Caledonian region in Table 2, unstudied MUSORSTOM collections from this region and the Loyalty Islands suggest an extremely diverse fauna very similar to that of the Vanuatu region. The Hawaiian azooxanthellate fauna constitutes a separate province in the tropical Pacific (Briggs, 1974), having an endemic component of 48% (CAIRNS, 1984). Nonetheless, 24 species known from the Vanuatu/Wallis and Futuna region also occur off the Hawaiian Islands (Table 2). Other than the Hawaiian Islands, the ridges north of New Zealand, and the region under study, azooxanthellates are poorly known from other tropical central Pacific regions, only 17 species listed in Table 2: column 5, symbol X; see also Table 1.

TABLE 2. — Geographic distribution and bathymetric ranges of the Recent azooxanthellate scleractinian species known from the regions of Wallis & Futuna and Vanuatu Archipelagos.

Key to areas: **1-7**, **Tropical regions**: 1, Indian Ocean; 2, western Pacific; 3, Vanuatu region; 4, Wallis and Futuna region; 5, other central Pacific islands (H, Hawaiian Islands; NZ, ridges north of New Zealand; NC, New Caledonia, Loyalty Islands, and/or Chesterfield Islands; OI, other central Pacific islands); 6, eastern Pacific; 7, Atlantic Ocean. — **8-9**, **Temperate regions**: 8, Japan (excluding Ryukyu Isl.); 9, New Zealand, Australia.
Bathymetric ranges (given in meters) only for records from Vanuatu/Wallis and Futuna region.
Symbols: + fossil occurrence.

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
POCILLOPORIDAE										
Madracis kauaiensis Vaughan, 1907	?		x	x	H, NZ, OI					210-516
FUNGIACYATHIDAE										
Fungiacyathus (F.) stephanus (Alcock, 1893)	x	x	x	x	NZ			x	x	440-1280
F. (F.) pusillus pacificus Cairns, 1995			x	x	NZ				x	425-811
F. (F.) sandoi sp. nov.				x						295-600
F. (F.) paliferus (Alcock, 1902)	x	x	x					x	x	190-400(+)
F. (Bathyactis) margaretae Cairns, 1995			x	x	NZ					440-175
F. (B.) granulosus Cairns, 1989	x	x	x	x				x		433-455
F. (B.) variegatus Cairns, 1989	x	x	x					x		400-440(+)
MICRABACIIDAE										
Letepsammia franki Owens, 1994	x		x	x						190-475
Stephanophyllia neglecta Boschma, 1923		x	x	x						280-497
S. complicata Moseley, 1876	x	x	x	x	NZ				x	288-700(+)
OCULINIDAE										
Oculina virgosa Squires, 1958			x						x	180-210
Madrepora oculata Linnaeus, 1758	x	x	x	x	H, NZ	x	x	x	x	310-1280
M. minutiseptum Cairns & Zibrowius, 1997		x		x						233-260
M. porcellana (Moseley, 1881)		x	x	x	NC					115-516(+)
ANTHEMIPHYLLIIDAE										
Anthemiphyllia dentata (Alcock, 1902)	x	x	x	x	H, NZ					280-650
A. pacifica Vaughan, 1907			x		H, NZ					310
A. patera costata subsp. nov.				x						320-700
A. spinifera sp. nov.		x	x	x						245-510
CARYOPHYLLIIDAE										
Caryophyllia (C.) hawaiiensis Vaughan, 1907		x	x	x	H, NZ					252-300
C. (C.) crosnieri Cairns & Zibrowius, 1997	x	x	x	x	NZ				x	386-600
C. (C.) rugosa Moseley, 1881	x	x	x	x				x	x	314-440
C. (C.) octonaria Cairns & Zibrowius, 1997		x	x							182-622
C. (C.) abrupta sp. nov.			x	x						300-650
C. (C.) marmorea Cairns, 1984				x	H					475-600
C. (C.) quadragenaria Alcock, 1902	x	x	x	x				x	x	314-440
C. sp. cf. *C. (C.) calveri* Duncan, 1873	x	x	x	x				x	x	314-440
C. (C.) diomedeae Marenzeller, 1904	x	x	x		NZ, OI	x	x		x	475-799
C. (C.) lamellifera Moseley, 1881	?	x	x	x	NZ					180-516
C. (C.) scobinosa Alcock, 1902	x	x	x	x	NZ, OI			x		715-900
C. (C.) ambrosia Alcock, 1898	x	x		x	NZ		x	x	x	715-1015

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
C. (Acanthocyathus) grayi (H. Milne Edwards & Haime, 1848)	x	x	x	x				x		125-160(+)
Crispatotrochus rubescens (Moseley, 1881)		x	x	x	H, OI			x		420-516
C. rugosus Cairns, 1995	x	x	x	x	NZ					190-455
Labyrinthocyathus limatulus (Squires, 1964)			x		NZ				x	372-466
Oxysmilia circularis Cairns	x		x		NZ					190-475
O. corrugata sp. nov.			x							180-190
O. epithecata sp. nov.			x	x						240-455
Trochocyathus (T.) vasiformis Bourne, 1903		x	x	x	OI					366-650
T. (T.) rhombocolumna Alcock, 1902	x	x	x		H, NZ					397-410
T. (T.) philippinensis Semper, 1872	x	x	x	x						182-330
T. (T.) maculatus Cairns, 1995		x	x	x	NZ					110-550
T. (T.) efateensis sp. nov.			x							391-437
T. (T.) patelliformis sp. nov.			x		H					1210-1250
T. (T.) semperi Cairns & Zibrowius, 1997		x	x							163-165
T. (T.) cooperi (Gardiner, 1905)	x	x	x		OI			x		101-124
T. (T.) discus Cairns & Zibrowius, 1997		x	x	x						455-470
T. (Aplocyathus) hastatus Bourne, 1903			x	x	NZ, OI					391-540
T. (A.) brevispina Cairns & Zibrowius, 1997		x	x							110-436
Tethocyathus virgatus (Alcock, 1902)		x	x	x	NZ					320-650
Polycyathus octuplus sp. nov.				x						110-441
Bourneotrochus stellulatus (Cairns, 1984)		x	x	x	H, NZ, NC, OI					240-566(+)
Stephanocyathus (S.) regius Cairns & Zibrowius, 1997		x	x	x	NZ					700-1550
S. (Odontocyathus) coronatus (Pourtalès, 1867)		x	x	x	NZ		x			1175-1300
S. (O.) weberianus (Alcock, 1902)		x	x		NZ			x		798-799
S. (Acinocyathus) spiniger (Marenzeller, 1888)	x	x	x	x	NZ			x	x	319-420(+)
Vaughanella concinna Gravier, 1915				x	NZ		x			500-560
Deltocyathus magnificus Moseley, 1876	x	x	x					x	x	408-433
D. rotulus (Alcock, 1902)	x	x	x	x				x		1050-1300
D. suluensis Alcock, 1902	x	x	x	x	NZ					400-650
D. taiwanicus Hu, 1987		+		x						320-697
D. vaughani Yabe & Eguchi, 1932		x	x					x		585-919
D. crassiseptum sp. nov.			x	x						413-536
D. cameratus sp. nov.			x	x						305-1175
D. stella Cairns & Zibrowius, 1997		x	x	x						240-597
D. heteroclitus Wells, 1984			x	x						208-355(+)
D. ornatus Gardiner, 1899			x	x	NC					295-360
Heterocyathus sp. cf. *H. sulcatus* (Verrill, 1866)	x	x	x	x						110-312
H. alternatus Verrill, 1865	x	x	x							301-319
Conotrochus funicolumna (Alcock, 1902)	x	x	x	x	H			x		350-700
C. brunneus (Moseley, 1881)	x	x	x	x	NZ					300-580
C. asymmetros sp. nov.			x	x						210-510
Lochmaeotrochus gardineri sp. nov.			x	x						608-1175
Aulocyathus recidivus (Dennant, 1906)	x	x		x	NZ			x	x	1020-1280
A. juvenescens Marenzeller, 1904	x	?	x							182-184
Desmophyllum dianthus (Esper, 1794)	x	x	x	x	H, NZ	x	x	x	x	455-830
Thalamophyllia tenuescens (Gardiner, 1899)	x	x		x	NZ, NC, OI					240-249

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
Lophelia pertusa (Linnaeus, 1758)	x			x		x	x	x		560-580
Dactylotrochus cervicornis (Moseley, 1881)		x	x	x	NC, OI					245-400
Rhizosmilia robusta Cairns, 1993	x	x	x	x						100-360
Asterosmilia gigas (van der Horst, 1931)	x			x						252-510
TURBINOLIIDAE										
Alatotrochus rubescens (Moseley, 1876)		x	x		NZ			x		536-619
Pleotrochus venustus (Alcock, 1902)		x	x		NZ					647
P. zibrowii Cairns, 1997			x	x	NZ					700-830
Tropidocyathus lessonii (Michelin, 1842)	x	x	x					x		291-300
T. labidus Cairns & Zibrowius, 1997	x	x	x							419-536
Cyathotrochus pileus (Alcock, 1902)	x	x	x		NZ			x		300-497
Deltocyathoides orientalis (Duncan, 1876)	x	x	+	x				x	x	245-455(+)
Notocyathus conicus (Alcock, 1902)		x	x		NZ			x		301-366
N. venustus (Alcock, 1902) sensu WELLS, 1984	x	x	?+					x		(+)
Cryptotrochus brevipalus sp. nov.			x							466-700
Idiotrochus kikutii (Yabe & Eguchi, 1941)	x	x		x				x		240-260
Peponocyathus folliculus (Pourtalès, 1868)		x	x				x	x		425-455
GUYNIIDAE										
Guynia annulata Duncan, 1872	x	x	x	x	H		x		x	260-300
Truncatoguynia irregularis Cairns, 1989		x	x		NZ					295-334
Temnotrochus kermadecensis Cairns, 1995			x		NZ					321-400
FLABELLIDAE										
Flabellum (F.) pavoninum Lesson, 1831	x	x	x	x	H			x		161-455
F. (F.) arcuatile sp. nov.				x	NZ					300-640
F. (Ulocyathus) deludens Marenzeller, 1904	x	x		x				x		516-530
F. (U.) aotearoa Squires, 1964			x		NZ, NC				x	287-436(+)
F. (U.) marcus Keller, 1974			x		H, OI					1050-1075
F. (U.) hoffmeisteri Cairns & Parker, 1992	x	x	x		NZ				x	495-498
F. (U.) apertum apertum Moseley, 1876	x			x					x	795-1280
Truncatoflabellum stabile (Marenzeller, 1904)	x	x	x			x				786-1160
T. dens (Alcock, 1902)		x	x	x	NZ, NC					286-500
T. pusillum Cairns, 1989	x	x	x							285-460
T. angustum Cairns & Zibrowius, 1997		x	x	x	NZ					295-530
T. phoenix Cairns, 1995		x		x	NZ			x		240-441
T. vigintifarium sp. nov.			x							288-700
T. mortenseni Cairns & Zibrowius, 1997		x	x	x						165-455
T. vanuatu (Wells, 1984)			+	x						240-375(+)
T. aculeatum (H. Milne Edwards & Haime, 1848)	x	x	x							30-50
T. candeanum (H. Milne Edwards & Haime, 1848)		x	x					x		182-215
T. martensii (Studer, 1878)			x						x	161-182(+)
Javania lamprotichum (Moseley, 1880)	x	x	x	x	H, NZ, OI					486-920
J. fuscus (Vaughan, 1907)		x	x	x	H, NZ, OI				x	314-778
J. exserta sp. nov.		x	x	x	OI					130-455
Rhizotrochus typus H. Milne Edwards & Haime, 1848	x	x	x					x		130-194

	TROPICAL							TEMPERATE		Depth (m)
	1	2	3	4	5	6	7	8	9	
R. flabelliformis Cairns, 1989		x		x	NZ				x	400-450
Polymyces wellsi Cairns, 1991		x	x		NZ	x				536-566
GARDINERIIDAE										
Gardineria hawaiiensis Vaughan, 1907	x	x	x		H, NZ, NC				x	366-574
G. paradoxa (Pourtalès, 1868)		x	x					x		495-498
DENDROPHYLLIIDAE										
Balanophyllia desmophyllioides Vaughan, 1907		x	x	x	H, NC					190-516
B. laysanensis Vaughan, 1907			x		H					
B. rediviva Moseley, 1881		x	x							210-252
B. gemma (Moseley, 1881)		x	x							397-430
B. gigas Moseley, 1881	x	x	x		H			x	x	410-505(+)
B. crassitheca Cairns, 1995			x		NZ				x	408-413
Endopachys grayi H. Milne Edwards & Haime, 1848	x	x	x	x	H, NZ	x		x	x	181-441
Heteropsammia cochlea (Spengler, 1781)	x	x	x	x						110-622
Dendrophyllia ijimai Yabe & Eguchi, 1934	x	x	+					x		(+)
D. arbuscula van der Horst, 1922	x	x	x		NZ			x		130-319
D. alcocki (Wells, 1954)	x	x	x	x	NZ, OI				x	315-475
Enallopsammia rostrata (Pourtalès, 1878)	x	x	x	x	H, NZ, OI	x	x	x	x	370-920

NUMBER OF SPECIES IN EACH AREA: **1** = 62; **2** = 95; **3** = 116; **4** = 83; **5** = 72; **6** = 7; **7** = 11; **8** = 42; **9** = 32.

SYSTEMATIC ACCOUNT

Order SCLERACTINIA

Suborder ASTROCOENIINA

Family POCILLOPORIDAE

Genus *MADRACIS* H. Milne Edwards & Haime, 1849

Madracis kauaiensis Vaughan, 1907

Figs 1 a-e

?*Madracis Hellena* - STUDER, 1878: 636 [Not *M. hellana* H. Milne Edwards & Haime, 1850].
?*Madracis singularis* Rehberg, v*1892: 10-11, pl. 1, figs 3-4 (Not specimen from Fiji).
Madracis kauaiensis Vaughan, v*1907: 83-84, pl. 9, figs 1-4. — CAIRNS, 1984: 6.
?*Madracis interjecta* Marenzeller, *1907: 20-21, pl. 2, fig. 3.

MATERIAL EXAMINED. — **Wallis and Futuna Islands**. MUSORSTOM 7: stn 496, 1 branch (MNHN). — Stn 499, 1 branch (98543). — Stn 500, 1 branch (USNM 98544). — Stn 502, 1 branch (MNHN). — Stn 504, 6 branches (MNHN). — Stn 507, 1 branch (MNHN). — Stn 508, 1 branch (MNHN). — Stn 509, 1 large colony and numerous branches (MNHN), 5 branches and SEM stubs 869-870 (USNM 98541). — Stn 515, 5 branches (MNHN).

Vanuatu. MUSORSTOM 8: stn 988, 41 branches (MNHN). — Stn 1077, 2 colonies and several branches (USNM 98549).

Hawaii Islands. HURL: stn 83-202, 1 colony (USNM 83460).

New Zealand. NZOI: stn K803, 1 branch (USNM 93996). — Stn K825, 4 branches (USNM 93997). — Stn K826, 1 branch (USNM 93998).

TYPE LOCALITY. — *"Albatross"* stn 3982: 21°56'25"N, 159°21'40"W (Kauai, Hawaiian Islands), 73-426 m.

DIAGNOSIS. — Colonies flabellate to slightly bushy; irregularly branched; lower branches of large colonies often anastomosing with one another. Largest corallum (MUSORSTOM 7 stn 509) 14 cm in height, 14 cm wide, and uniplanar. Branches circular in cross-section: basal branches up to 8 mm in diameter, distal branches 2.5-3.0 mm in diameter. Corallites slightly elliptical in shape, their greater axis aligned with the branch axis; corallites 1.25-1.35 mm in greater diameter, occurring homogeneously and well spaced on all branch surfaces. Coenosteum white, bearing prominent spines up to 15 mm in height. Corallites contain 10 equal-sized septa, each about 0.15 mm exsert and bordered internally by a small (0.05 mm wide) paliform lobe. Central region of calice a broad, flat platform, connected to axial edges of septa and supporting a laterally compressed styliform to lamellar columella, the greater axis of columella aligned with the greater axis of corallite.

REMARKS. — H. MILNE EDWARDS & HAIME (1850) described *Madracis hellana* from Reunion at a depth of 37 m, for a branching species of this genus having 10-12 septa per corallite. STUDER (1878) reported a second specimen of this species from Bougainville Island (88 m), this specimen deposited at the ZMB, the first report of this genus for the Pacific. REHBERG (1892), believing that STUDER's southwest Pacific specimen must be different from the western Indian Ocean *M. hellana*, redescribed STUDER's specimen as *Madracis singularis*, n. sp., and reported another specimen of his presumed new species from Viti (Fiji) at 146 m. Finally, VAUGHAN (1907) described another decameral Pacific *Madracis* species, *M. kauaiensis*, from the Hawaiian Islands (44-541 m). The type of *M. hellana* was not examined and the type of *M. singularis* Rehberg, 1892 (Studer's *M. hellana* from Bougainville, ZMB 1842) was not available for examination and thus their identity with the specimens reported herein remains in doubt, but the second specimen reported by REHBERG from Fiji at 80 fathoms (= 146 m)(ZMB 601) was examined and found to be quite different from the specimens reported herein. The Fiji specimen, which might be interpreted as a syntype of *M. singularis*, has thicker, blunt to clavate branches; larger calices (GCD 1.6-2.2 mm); no paliform lobes; and a continuous, spinose ridge that encircles each calice. The specimens reported above are, however, indistinguishable from the type series of *M. kauaiensis* Vaughan, 1907, and thus are identified as such.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 240-516 m. Vanuatu region: Tanna and Malakula; 210-372 m. Elsewhere: Hawaiian Islands; Johnston Island (reported herein); Kermadec Ridge (reported herein); ?Bougainville (STUDER, 1878); ?Gulf of Aqaba (MARENZELLER, 1907); 44-541 m.

Suborder FUNGIINA

Family FUNGIACYATHIDAE

Genus *FUNGIACYATHUS* Sars, 1872

Subgenus *FUNGIACYATHUS (FUNGIACYATHUS)* Sars, 1872

Fungiacyathus (F.) stephanus (Alcock, 1893)

Bathyactis stephanus Alcock, *1893: 149, pl. 5, figs 12-12a.

Bathyactis sibogae Alcock, v*1902a: 108 (in part); v.1902c: 38 (in part: *"Siboga"* stn 95 and large specimen of 57 mm GCD).

Fungiacyathus (F.) stephanus - CAIRNS, 1989a: 7-9, pl. 1, figs a-k, pl. 2, figs a-b (synonymy); 1994: 37, pl. 13, figs g-i; 1995: 31-32, pl. 1, figs a-c, map 1; 1998: 369. — CAIRNS & ZIBROWIUS, 1997: 68-69 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 551, 2 (MNHN). — Stn 552, 3 (MNHN). — Stn 565, 1 (MNHN). — Stn 621, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 963, 2 (MNHN). — Stn 975, 1 (MNHN). — Stn 990, 1 (MNHN). — Stn 992, 1 (USNM 98539). — Stn 996, 3 (USNM 98537). — Stn 1007, 1 (MNHN). — Stn 1036, 3 (MNHN). — Stn 1074, 1 (MNHN). — Stn 1080, 1 (USNM 98540). — Stn 1125, 1 (MNHN). — Stn 1129, 13 (MNHN).

TYPE LOCALITY. — *"Investigator"* stn 133: 15°43'30"N, 81°19'30"E (off Kristna Delta, Bay of Bengal), 1240 m.

TABLE 3. — Characteristics of the seven Indo-Pacific species of *Fungiacyathus (Fungiacyathus)*.

	F. stephanus (Alcock, 1893)	*F. fragilis* Sars, 1872	*F. pusillus pacificus* Cairns, 1995	*F. sandoi* sp. nov.	*F. paliferus* (Alcock, 1902)	*F. multicarinatus* Cairns, 1998	*F.* sp. A sensu CAIRNS, 1994
Maximum Calicular Diameter (mm)	57	45	23	20	25	26	36
Shape of Base	Concave or flat	Flat to slightly concave	Flat to slightly concave	Patellate (140°-170°)	Flat to slightly concave	Undulating	Flat
Nature of Costae	Thin, serrate, sinuous ridges	Thin ridges	Thin, serrate, closely spaced ridges	Rounded, coarsely granular	Rounded, finely granular	Finely dentate ridges	Thin ridges
Marginal Shelf	Present, especially in concave-based forms	Present	Present	Well developed	Present	Absent	Present
Septal Faces; Septal Edges	Corrugated; sinuous	Corrugated; sinuous	Planar; straight	Planar; straight	Planar; straight	Planar; straight	Planar; straight
Number and Largest of S_1 Synapticulae	12-15 (6-8th tallest)	12-14 (6-7th tallest)	11-12 (6th tallest)	7-9 (4-5th tallest)	9-14 (7th tallest)	Small, poorly developed	8-9 (8th tallest)
Number of S_1 Carinae/Face	20-23	11-12	28-34	15-21	15-20	30-34	20-23
S_2 Paliform Lobes or Spines	Small, acute, triangular lobes	Crispate spines	Slender trabecular spines	Thick, blunt spines	Small, rounded paliform lobes	Spatulate spines	Spinose
Other Characters	Very fragile; S_{1-2} lobes high	Very fragile	Robust; innermost S_3 spines most prominent; peripheral septal edges form vertical wall	Robust; S_{1-3} lobes tall and slender, undercut at calicular edge	Robust; corallum regeneration common	Robust; corallum regeneration; septal carinae quite tall	Fragile; septal canopies and columella porous
Distribution; Depth	Indo-West Pacific; 245-2000 m	N. Atlantic; Macquarie Ridge; Hawaiian Is.; 285-2200 m	New Zealand to Wallis and Futuna; 350-988 m	Wallis and Futuna; 295-600 m	Indo-West Pacific; 69-823 m	Western Australia; 348-350 m	Kuril Islands; 3175-4110 m

REMARKS. — This species is more fully described and illustrated by CAIRNS (1989a, 1994). It is distinguished from its consubgenerics by having corrugated septa and sinuous costae; small, acute paliform lobes (P_2); and a very fragile corallum, probably a result of its greater depth of occurrence (Table 3).

DISTRIBUTION. — Wallis and Futuna region: Combe Bank; 795-1280 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Espiritu Santo, and Malakula; Guyot Bougainville; 440-1160 m. Elsewhere: widespread throughout Indo-West Pacific; 245-2000 m (CAIRNS & ZIBROWIUS, 1997).

Fungiacyathus (F.) pusillus pacificus Cairns, 1995

Fungiacyathus (F.) pusillus pacificus Cairns, *1995: 32-33, pl. 1, figs g-i, l, map 13.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 522, 3 (MNHN). — Stn 534, 1 (USNM 98536). — Stn 535, 2 (MNHN). — Stn 540, 2 (MNHN). — Stn 570, 1 (MNHN). — Stn 572, 3 (USNM 98535). — Stn 575, 1 (USNM 98534). — Stn 581, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1128, 1 (MNHN).

TYPE LOCALITY. — NZOI stn U599: 30°43'S, 173°16'E (northern Three Kings Ridge), 590-640 m.

REMARKS. — Based on these specimens little can be added to the original description, except to note a maximum size of 23.3 mm GCD (MUSORSTOM 7 stn 535). The species is distinguished by its tall S_{1-4} septal lobes, the peripheral edges of which all extend about the same distance outward and are almost vertical, which results in an almost cylindrical corallum with a domed surface, like a thick button. The species is compared to other consubgenerics from this region in Table 3.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch and Combe Banks; 425-650 m. Vanuatu region: Guyot Bougainville; 778-811 m. Elsewhere: Norfolk, Three Kings, and Colville Ridges north of New Zealand; 350-988 m.

Fungiacyathus (F.) sandoi sp. nov.

Figs 1 f-h

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 523, 2 paratypes (MNHN). — Stn 538, holotype (MNHN) and 1 paratype (USNM 98531). — Stn 540, 1 paratype (MNHN). — Stn 541, 1 paratype (MNHN). — Stn 542, 1 paratype (USNM 98533). — Stn 569, 5 paratypes (USNM 98532). — Stn 589, 1 paratype (MNHN). — Stn 590, 3 paratypes (MNHN). — Stn 597, 1 paratype (MNHN). — Stn 605, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 7, stn 538: 12°30.8'S, 176°40.3'W (Waterwitch Bank), 275-295 m.

ETYMOLOGY. — This species is named in honour of my friend and colleague William J. SANDO (1927-1996), noted Lower Carboniferous coral taxonomist and stratigrapher.

DESCRIPTION. — Corallum circular: largest specimen (MUSORSTOM 7 stn 542) 20.2 mm in CD; holotype 15.2 mm in CD. Base slightly convex, the basal angle ranging from 140°-170°. All costae equally wide and prominent (no cycle larger than another), rounded, each ornamented with a row of coarse (0.16-0.18 mm diameter) rounded granules. All costae project about 0.4 mm beyond calicular edge. Septa hexamerally arranged in 5 complete cycles in typical fungiacyathid fashion, the S_5 easily visible in a corallum of 8 mm CD. S_1 consist of 3 or 4 blunt, axial trabecular spines inclined toward the fossa; peripheral to these spines is a tall septal lobe composed of 9-13 vertically oriented trabeculae, each trabeculum corresponding to a serrate ridge on the septal face. The peripheral edge of the S_1 lobe is vertical, changing abruptly into a low marginal shelf region consisting of 3 or 4 low spines. Seven to nine synapticular plates occur along the length of an S_1, the 4th or 5th from the centre being the tallest. S_2 also consist of 3 or 4 blunt, axial trabecular spines, but these spines are longer and wider than

those on the S_1, some composed of 2 trabeculae; peripheral to these spines is a prominent septal lobe composed of 7-9 trabeculae, the lobe inclined slightly outward. The peripheral edge of the S_2 lobe is vertical to slightly undercut, also changing abruptly to a low marginal shelf. S_3 consist of 4-6 slender, axial trabecular spines peripheral to which is a small septal lobe composed of 3-6 trabeculae. S_3 septal lobe shorter and more inclined outward than S_3 lobe, but its peripheral edge is similar. S_4 consist of 5-7 small trabecular spines; S_5, 3 or 4 spines. All septa planar, with straight upper and peripheral edges. A low marginal shelf of about 0.4 mm width surrounds the corallum. The columella is an intermingling of the innermost, blunt S_{1-2} trabecular spines.

REMARKS. — *Fungiacyathus sandoi* appears to be most similar to *F. paliferus* (Alcock, 1902), both species having granular costae, a similar septal structure, and achieving the same size. But, *F. sandoi* is distinguished in having: a convex base; coarsely granular costae; thick, blunt S_2 trabecular spines (not small P_2 paliform lobes); and uniformly exsert costosepta (Table 3).

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, and Field Banks; 295-600 m.

Fungiacyathus (F.) paliferus (Alcock, 1902)

Fig. 2 a

Bathyactis palifera Alcock, v*1902a: 108; v.1902c: 38, pl. 5, figs 34, 34a.
Fungiacyathus sp. cf. *F. stephanus* - WELLS, v.1984: 207, fig. 1, 3-4 (USGS 25715, USNM 71828).
Fungiacyathus fragilis - WELLS, v.1984: 205-206 (in part: USGS 25718, USNM 73957).
Fungiacyathus (F.) paliferus - CAIRNS, 1989a: 9-10, pl. 2, figs c-i, pl. 3, figs a-c (synonymy and description); 1994: 37-38, pl. 14, figs a-e (synonymy and description); 1998: 369-370. — CAIRNS & ZIBROWIUS, 1997: 69-70.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 963, 8 (USNM 98529). — Stn 967, 3 (USNM 98530). — Stn 969, 1 (MNHN). — Stn 988, 1 (MNHN). — Stn 1003, 5 (MNHN). — Stn 1005, 3 (MNHN). — Stn 1016, 2 (MNHN). — Stn 1017, 2 (MNHN). — Stn 1018, 9 (USNM 98528). — Stn 1043, 1 (MNHN). — Stn 1070, 1 (MNHN). — Stn 1106, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 153 and 98: Sulu Sea and Moluccas, 141-350 m.

REMARKS. — The species was redescribed and illustrated by CAIRNS (1989a, 1994); however, several well-preserved specimens listed above allow an additional observation that the CS_{1-2}, and their adjacent CS_5, project about 1.2 mm beyond the other costosepta as rectangular lancets.

All specimens reported above were intact coralla, not the result of asexual fragmentation. Comparisons to other species in this region are made in Table 3.

Although the Pleistocene Vanuatu specimens reported by WELLS (1984) as *F. fragilis* from USGS stn 25718 are reidentified herein as *F. paliferus*, those he reported and illustrated from USGS stn 24918 (USNM 71837 and 73977) belong to the subgenus *F. (Bathyactis)*, but are too small to identify to species.

DISTRIBUTION. — Vanuatu region: Anatom, Tanna, Erromango, Efaté, Epi, and Espiritu Santo (also Pleistocene of Vanuatu: WELLS, 1984); 190-400 m. Elsewhere: widespread throughout Indo-West Pacific; 69-823 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus ***FUNGIACYATHUS (BATHYACTIS)*** Moseley, 1881

Fungiacyathus (B.) margaretae Cairns, 1995

Figs 2 b-c

Fungiacyathus (B.) margaretae Cairns, *1995: 33-34, pl. 2, figs a-c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 534, 9 (MNHN). — Stn 535, 4 (MNHN). — Stn 540, 21 (USNM 98524). — Stn 541, 1 (MNHN). — Stn 546, 7 (MNHN). — Stn 564, 57 (USNM 98527). — Stn 565, 56 (MNHN).
Vanuatu. MUSORSTOM 8: stn 956, 2 (MNHN). — Stn 963, 47 (MNHN). — Stn 1011, 1 (USNM 98525). — Stn 1014, 1 (MNHN). — Stn 1051, 2 (USNM 98526).

TYPE LOCALITY. — NZOI stn P944: 27°20.8'S, 179°20.9'W (northern Colville Ridge), 673 m.

REMARKS. — Previously known from a type series of only 5 specimens: 188 additional coralla are reported herein, the largest specimen (MUSORSTOM 8 stn 963) 18.6 mm in CD, the same diameter as the largest type. Although the base of this species is always concave, the MUSORSTOM specimens show that the types had unusually concave bases. Many of these specimens also show a pronounced ridging of the C_{1-2} (Fig. 2 c).

Fungiacyathus margaretae is most similar to *F. granulosus*, small and/or damaged specimens of the latter being difficult to distinguish from the former. In general, *F. margaretae* is distinguished by having a concave base (that of *F. granulosus* is usually flat); higher S_1 septal lobes with vertical peripheral edges, and constructed of vertically aligned trabeculae (the S_1 septal lobes of *F. granulosus* are lower and sloped at the peripheral calicular edge, and composed of trabeculae that are inclined outward toward the peripheral edge); and having taller synapticular plates between septa. Both species have fine or coarse granular costae, and often granular coenosteum between the costae.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch, Combe, and Tuscarora Banks; 470-1015 m. Vanuatu region: Anatom, Efaté, and Epi; 440-1175 m. Elsewhere: northern Colville Ridge; 635-673 m.

Fungiacyathus (B.) granulosus Cairns, 1989

Fungiacyathus (B.) granulosus Cairns, *1989a: 11, pl. 4, figs d-i; 1994: 39, pl. 15, figs d-e; 1998: 370. — CAIRNS & ZIBROWIUS, 1997: 71.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 619, 2 (MNHN).
Vanuatu. MUSORSTOM 8: stn 977, 1 (MNHN). — Stn 980, 3 (USNM 98520).

TYPE LOCALITY. — *"Albatross"* stn 5590: 4°10'50"N, 118°39'35"E (Celebes Sea off Sabah), 567 m.

REMARKS. — See Remarks for previous species.

DISTRIBUTION. — Wallis and Futuna region: Alofi; 455 m. Vanuatu region: Tanna; 433-450 m. Elsewhere: northern Ryukyu Islands to Rowley Shoals, Western Australia; 287-640 m (CAIRNS & ZIBROWIUS, 1997; CAIRNS, 1998).

Fungiacyathus (B.) variegatus Cairns, 1989

Fig. 2 d

Fungiacyathus fragilis - WELLS, v.1984: 205-206 (in part: USGS 24918, pl. 1, figs 1-2) [Not *F. fragilis* Sars, 1872].
Fungiacyathus variegatus Cairns, *1989a: 11-12, pl. 5, figs a-h; 1994: 38-39, pl. 15, figs a-b. — CAIRNS & ZIBROWIUS, 1997: 71-72.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 963, 1 cemented to *Xenophora* shell (MNHN).

TYPE LOCALITY. — *"Albatross"* stn 5113: 13°52'N, 120°51'E (Verde Is. Passage, Luzon, Philippines), 291 m.

REMARKS. — This species is more fully described by CAIRNS (1989a) and CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Vanuatu region: Anatom; 400-440 m (Late Pleistocene of Espiritu Santo, WELLS, 1984). Elsewhere: Japan through Indonesia; 84-715 m (CAIRNS & ZIBROWIUS, 1997).

Family MICRABACIIDAE Vaughan, 1905

Genus ***LETEPSAMMIA*** Yabe & Eguchi, 1932

Letepsammia franki Owens, 1994

Letepsammia franki Owens, v*1994: 586-589, figs 1-2.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 597, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 962, 1 (MNHN). — Stn 980, 3 (MNHN). — Stn 1016, 2 (MNHN). — Stn 1017, 8 (MNHN). — Stn 1018, 18 (USNM 98519). — Stn 1023, 1 (USNM 98518). — Stn 1070, 2 (MNHN). — Stn 1134, 1 (USNM 98517).

TYPE LOCALITY. — *"Anton Bruun"* stn 390-S: 29°35'S, 31°42'E (off Durban, South Africa), 138 m.

REMARKS. — In describing the type material, OWENS (1994) stated that the septa were highly perforate, which led to an assignment of this species to *Letepsammia*. However, re-examination of the type series shows that, whereas the higher cycle septa are always highly perforate, the S_1 of the holotype and most paratypes are imperforate. (The S_1 of some paratypes from the same lots are highly perforate). The same is the case for the southwest Pacific specimens reported above. The imperforate nature of the S_1 suggests an affinity with *Rhombopsammia*, and the variation in the expression of this character casts doubt on the distinction between the genus *Rhombopsammia* and *Letepsammia*.

The specimens reported above are very similar to the type series, except that many of the specimens contain 108 septa (18 septa per system), instead of 120 septa (20 septa per system). The largest paratype (USNM 75640) measures 32.2 mm in CD (slightly larger than that reported by OWENS, 1994), whereas the largest Pacific (MUSORSTOM 8 stn 1018) specimen measures 32.4 mm in CD.

Letepsammia franki differs from *L. formosissima* in having a papillose columella, coarser septal dentition, and a more robust corallum. It differs from *L. superstes* in having more septa; a larger corallum; and nondentate, vertical axial edges of the S_1.

DISTRIBUTION. — Wallis and Futuna region: Field Bank; 469-475 m. Vanuatu region: Anatom, Tanna, Efaté, and Espiritu Santo; 190-433. Elsewhere: southwest Indian Ocean; 50-650 m.

Genus ***STEPHANOPHYLLIA*** Michelin, 1841

Stephanophyllia neglecta Boschma, 1923

Stephanophyllia neglecta Boschma, v*1923: 144-145, pl. 10, figs 28-30. — CAIRNS, 1989a: 23-24, pl. 11, figs c-j (synonymy). — CAIRNS & ZIBROWIUS, 1997: 77.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 542, 1 (MNHN). — Stn 556, 5 (MNHN). — Stn 618, 1 (USNM 98523).
Vanuatu. MUSORSTOM 8: stn 958, 1 (MNHN). — Stn 963, 1 (MNHN). — Stn 965, 7 (MNHN). — Stn 969, 2 (MNHN). — Stn 978, 1 (MNHN). — Stn 988, 3 (USNM 98522). — Stn 1019, 1 (USNM 98521).

TYPE LOCALITY. — *"Siboga"* stn 260: 5°36.5'S, 132°55.2'E (Kai Islands, Banda Sea), 90 m.

REMARKS. — This species was redescribed and compared to all congenerics by Cairns (1989a).

DISTRIBUTION. — Wallis and Futuna region: Alofi; Combe and Tuscarora Banks; 370-440 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; 280-497 m. Elsewhere: Philippines; Indonesia; 49-555 m (CAIRNS & ZIBROWIUS, 1997).

Stephanophyllia complicata Moseley, 1876

Stephanophyllia complicata Moseley, v*1876: 558-561, text-fig.; v.1881: 198-201, pl. 4, fig. 12, pl. 13, figs 3-5. — CAIRNS, 1989a: 21, pl. 12, figs a-b; 1995: 37-38, pl. 3, fig. h, pl. 4, figs a-e, map 10 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 77-78.

Stephanophyllia japonica - WELLS, v.1984: 207, pl. 1, figs 5-6 (USGS stn 24918, USNM 71839) [Not *S. japonica* Yabe & Eguchi, 1934a].

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 523, 2 (MNHN). — Stn 535, 2 (MNHN). — Stn 540, 10 (USNM 98552). — Stn 557, 9 (USNM 98551).

Vanuatu. MUSORSTOM 8: stn 959, 22 (USNM 98553). — Stn 963, 3, including 1 cemented to *Xenophora* shell (MNHN). — Stn 1005, 1 (MNHN). — Stn 1018, 1 (MNHN). — Stn 1091, 1 cemented to *Xenophora* shell (MNHN). — Stn 1097, 1 cemented to *Xenophora* shell (MNHN). — Stn 1113, 1 (MNHN).

TYPE LOCALITY. — *"Challenger"* stn 192: 5°42'S, 132°25'E (Kai Islands, Banda Sea), 236 m.

REMARKS. — *Stephanophyllia complicata* was redescribed and illustrated by CAIRNS (1989a, 1995). It is distinguished from *S. neglecta* by having a thin, lamellar columella; a narrow marginal shelf; S_1 with vertical, non-spinose axial edges; and in attaining a larger size.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, and Tuscarora Banks; 470-600 m. Vanuatu region: Anatom, Erromango, Efaté, and Espiritu Santo (also Pleistocene, WELLS, 1984); 288-700 m. Elsewhere: Indo-West Pacific; 73-635 m (CAIRNS & ZIBROWIUS, 1997).

Suborder FAVIINA

Superfamily FAVIOIDEA Gregory, 1900

Family OCULINIDAE Gray, 1847

Genus *OCULINA* Lamarck, 1816

Oculina virgosa Squires, 1958

Oculina virgosa Squires, v*1958: 39, pl. 5, figs 8-16, text-fig. 11. — CAIRNS, 1995: 40, pl. 4, figs f, i, pl. 5, figs c-d, color frontispiece (top left), color cover (synonymy and description), map 8.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1077, 6 branches: 4 (MNHN), 2 (USNM 98550). — Stn 1102, 1 colony (MNHN).

TYPE LOCALITY. — Sandstone, Waitemata Group, The Funnel, Kaipara Harbour, Auckland, North Island (Altonian, early Miocene).

REMARKS. — This species was recently redescribed and figured by CAIRNS (1995). The two lots reported above differ slightly from New Zealand specimens in lacking S_4, all corallites having only 24 septa arranged in three complete cycles, the New Zealand populations usually having 28 septa. This is the first report of this species outside New Zealand waters.

DISTRIBUTION. — Vanuatu region: southeast and northeast of Espiritu Santo; 180-210 m. Elsewhere: northeastern North Island, New Zealand; 29-388 m (CAIRNS, 1995); early Miocene to early Pliocene, New Zealand (SQUIRES, 1958).

Genus *MADREPORA* Linnaeus, 1758

Madrepora oculata Linnaeus, 1758

Figs 2 e-f

Madrepora oculata Linnaeus, *1758: 798. — ZIBROWIUS, 1974a: 762-766, pl. 2, figs 3-5 (synonymy). — CAIRNS, 1991a: 9-10, pl. 2, fig. j, pl. 3, figs a-d (synonymy); 1994: 18-19, pl. 3, figs f-h (synonymy); 1995: 41, pl. 5, figs e-f, pl. 6, figs a-b, map 2; 1998: 372-373, figs 1 f-i. — CAIRNS & ZIBROWIUS, 1997: 79-80.
Lophohelia tenuis Moseley, *1881: 180-181, pl. 8, figs 11-14. — BOURNE, 1903: 26.
Cyathohelia formosa Alcock, *1898: 26-27, pl. 3, figs 2, 2a.
Sclerohelia formosa - ALCOCK, 1902c: 36.
Madrepora kauaiensis Vaughan, v*1907: 81-83, pl. 8, figs 1-2.
Madrepora tenuis - FAUSTINO, 1927: 107-108, pl. 14, figs 2, 5.
Madrepora formosa - ZIBROWIUS, 1974b: 568-570, figs 6-9.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: forma *tenuis*: stn 502, 1 branch (MNHN). — Stn 551, numerous branches (USNM 98545). — Stn 552, 19 branches (MNHN), SEM stub 874 (USNM 98548). — Stn 598, 6 branches (MNHN). — Stn 621, 8 branches (MNHN). — Stn 623, 1 branch (USNM 98547). — Stn 637, 2 branches (MNHN); forma *formosa*: Stn 507, 3 branches (MNHN). — Stn 585, 1 branch (MNHN). — Stn 586, 1 branch (USNM 98581). — Stn 601, 1 branch (MNHN). — Stn 606, 5 colonies and numerous branches (USNM 98583). — Stn 609, 3 colonies (MNHN), SEM stub 875 (USNM 98580). — Stn 618, 3 branches (MNHN). — Stn 620, 5 branches (USNM 98546).
Vanuatu. MUSORSTOM 8: forma *tenuis*: stn 1028, 2 branches (98546). — Stn 1031, 1 branch (MNHN); forma *formosa*: stn 1088, 1 branch (MNHN).

TYPE LOCALITY. — Tyrrhenian Sea and off Sicily (depth not given).

REMARKS. — This widespread and variable species has been redescribed and discussed at great length (ZIBROWIUS, 1974a,b; CAIRNS, 1991a, 1994, 1995; CAIRNS & ZIBROWIUS, 1997). Two forms of the species occur in the material reported herein. One form is characterized by having rather large, uniplanar colonies with nonanastomosing branches formed of regular, sympodially budded corallites. The coenosteum is light beige, finely granular, and longitudinally striate. Corallites are 3.0-3.6 mm in CD, containing 2 or 3 cycles of slightly exsert septa, the S_3 often rudimentary or absent. The axial edges of S_2 often bear laciniate paliform lobes. The fossa is deep and the columella rudimentary. This form corresponds to MOSELEY's (1881) *Madrepora tenuis*; probably *M. kauaiensis* Vaughan, 1907; *Madrepora oculata* forma *beta* of CAIRNS (1991a); and most specimens reported by CAIRNS & ZIBROWIUS (1997) from the Philippines and Indonesia. It is herein reported as forma *tenuis*. The second form is characterized by having smaller, uniplanar to bushy colonies. Colonies are formed by sympodially branched corallites, but often result in anastomosing branches caused by a symbiosis with a eunicid polychaete worm, which produces a gall tube along the larger branches. The coenosteum is usually white and finely granular. Corallites are smaller (2.2-2.5 mm in CD), more closely spaced, containing 3 cycles of highly exsert septa, the S_1 usually well developed. The axial edges of the S_2 usually bear prominent paliform lobes. The fossa is shallow and the columella well developed. This form was described as *Cyathohelia formosa* by ALCOCK (1898) and as the "symbiotic form" by CAIRNS (1995). It is herein reported as forma *formosa*.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe, Field, Rotumah, and Alofi Banks; 350-1280 m. Vanuatu region: Efaté and Espiritu Santo; 310-624 m. Both forms are equally distributed in these regions. Elsewhere: cosmopolitan, except for off continental Antarctica; 15-1500 m (CAIRNS & ZIBROWIUS, 1997).

Madrepora minutiseptum Cairns & Zibrowius, 1997

Madrepora minutiseptum Cairns & Zibrowius, *1997: 82-84, figs 4a-d, 5a-b.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 513, 3 branches (MNHN). — Stn 515, 3 colonies and several branch fragments (MNHN). — Stn 517, 4 colonies and many branch fragments (USNM 98549).
Ryukyu Islands. *"Toyoshio-Maru"* : stn 11, 2 colonies (USNM 98461).

TYPE LOCALITY. — *"Snellius 2"* stn 4.196: 6°23'S, 120°26.5'E (southwest of Salayer, Flores Sea), 150- 200 m.

REMARKS. — Nothing can be added to the description of this recently named species. It is distinctive within the genus by having 24 rudimentary septa; small, infundibuliform corallites; and a low, papillose columella. All colonies contain a polychaete-induced tubular deformation that runs the length of all major branches.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 233-260 m. Elsewhere: Ryukyu Islands (reported herein), Taiwan, Indonesia; 150-302 m.

Madrepora porcellana (Moseley, 1881)

Neohelia porcellana Moseley, v*1881: 176-177, pl. 10, figs 7, 7a. — PRATT, 1900: 591-603, pls 62-63. — HICKSON, 1903: 344.
Madrepora porcellana - WELLS, v.1984: 207, figs 1, 7-9.
Neohelia sp. cf. *N. porcellana* - CAIRNS & ZIBROWIUS, 1997: 84-85, figs 5c-e, g-h.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 499, 1 branch (MNHN). — Stn 500, 1 branch (MNHN). — Stn 502, 1 branch (MNHN). — Stn 508, 2 branches (MNHN). — Stn 509, 2 branches (MNHN). — Stn 512, 4 branches (MNHN). — Stn 513, 5 branches (MNHN). — Stn 514, 1 colony (USNM 98569). — Stn 515, 3 colonies (USNM 98575). — Stn 618, 1 branch (MNHN).
Vanuatu. MUSORSTOM 8: stn 962, 4 colonies (USNM 98578). — Stn 963, 1 branch (MNHN). — Stn 964, 5 branches (MNHN). — Stn 968, 1 colony (MNHN). — Stn 969, 1 colony (USNM 98576). — Stn 976, 1 branch (MNHN). — Stn 988, 2 branches (MNHN). — Stn 1077, 2 branches (MNHN). — Stn 1084, 2 colonies (USNM 98577). — Stn 1089, 1 branch (MNHN).
USGS: stn 25718, 6 fragments (USNM 73958). — Stn 25715, (USNM 71840). — Stn 24918 (USNM 71841), all reported by WELLS (1984).

TYPE LOCALITY. — *"Challenger"* stn 177: 16°45'S, 168°07'E [Api (= Epi), Vanuatu Archipelago], 115 m.

REMARKS. — Without explanation, WELLS (1984) placed this species in *Madrepora*, which automatically synonymized the genus *Neohelia* with *Madrepora*, a view not adopted by CAIRNS & ZIBROWIUS (1997). The basic difference between the genera is that *Neohelia* is reputed to lack a columella, *Madrepora* to have one. However, examination of many additional specimens of *Neohelia* shows that it usually does have a well-formed papillose columella, even though some distal corallites sometimes lack one. Likewise, corallites of *Madrepora* often have well-developed columella, but sometimes lack them altogether. Because the presence or absence of a columella does not appear to be a conservative generic character, even within species, I now agree with WELLS (1984) in considering *Neohelia porcellana* to belong to the genus *Madrepora*.

All of the specimens reported above are pentamerally symmetrical, having 20 septa. The hexamerally symmetrical specimens having 24 septa reported by CAIRNS & ZIBROWIUS (1997) from Indonesia are considered as a form of *M. porcellana* that occurs to the west and usually in shallower water than the typical form.

This species was recently redescribed by CAIRNS and ZIBROWIUS (1997) and more fully monographed by Pratt (1900). A consistent characteristic of the species is a tubular cavity that runs the length of the larger branches, which is lined by a parchment-like encrustation. PRATT (1900) suggested that the encrustation was secreted by the coral, but HICKSON (1903) implied that a polychaete was responsible. Polychaetes are often found in these tubes, and it cannot be doubted that gorgonians or antipatharians often form the framework for the encrustation of *M. porcellana*. However, the specimens reported herein also indicate that a thecate hydroid may be responsible for the internal parchment-like lining of the tubes, short branches of which project from the apertures of the tube through the coenosteum. This complex symbiosis is a fascinating one that requires the examination of additional well-preserved specimens.

DISTRIBUTION. — Wallis and Futuna region: Futuna and Alofi; 240-516 m. Vanuatu region: Anatom, Tanna, Epi, Malakula, and Espiritu Santo (also Pleistocene: WELLS, 1984); 115-494 m. Elsewhere: Loyalty Islands; New Caledonia; Indonesia (as the hexameral form); 55-238 m.

Family ANTHEMIPHYLLIIDAE Vaughan, 1907

Genus *ANTHEMIPHYLLIA* Pourtalès, 1878

Anthemiphyllia dentata (Alcock, 1902)

?Discotrochus investigatoris Alcock, *1893: 142, pl. 5, figs 5, 5a.
Discotrochus dentatus Alcock, v*1902a: 104; v.1902c: 27, pl. 4, figs 26, 26a.
Not *Anthemiphyllia dentata* - CAIRNS, 1984: 11, pl. 1, figs F-G (= *A. macrodentata* sp. nov.).
Anthemiphyllia dentata - ZIBROWIUS & GRYGIER, 1985: 137 (New Caledonia). — CAIRNS & PARKER, 1992: 16-17 (in part: only those specimens from Western Australia). — CAIRNS, 1994: 44, pl. 18, figs d-f (synonymy); 1995: 41-42 (in part: not stns NZOI K842 and K872 (= *A. pacifica*) and C527 (= *A. macrodentata*), pl. 6, figs c-g (synonymy); 1998: 374-375. — CAIRNS & ZIBROWIUS, 1997: 86.
Deltocyathus andamanicus - KELLER, 1982: 52 (in part: pl. 1 [=4], figs 3-4, *Dimitri Mendeleev* stn 1411) [Not *D. andamanicus* Alcock, 1898].

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 1 (MNHN). — Stn 522, 3 (MNHN). — Stn 525, 1 (MNHN). — Stn 530, 6 (MNHN). — Stn 534, 2 (MNHN). — Stn 535, 12 (USNM 98565). — Stn 537, 3 (MNHN). — Stn 538, 2 (MNHN). — Stn 540, 1 (MNHN). — Stn 542, 4 (MNHN). — Stn 546, 1 (MNHN). — Stn 555, 1 (MNHN). — Stn 569, 3 (MNHN). — Stn 570, 6 (USNM 98564). — Stn 572, 2 (USNM 98563). — Stn 585, 3 (USNM 98562). — Stn 586, 1 (USNM 98566). — Stn 589, 2 (MNHN). — Stn 590, 4 (MNHN). — Stn 591, 4 (USNM 98574). — Stn 594, 3 (USNM 98561). — Stn 597, 1 (USNM 98560). — Stn 618, 1 (USNM 98567). — Stn 619, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 2 (MNHN). — Stn 967, 2 (MNHN). — Stn 969, 2 (MNHN). — Stn 977, 6 (MNHN). — Stn 982, 1 (MNHN). — Stn 983, 1 (MNHN). — Stn 1016, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 95, 98, 100: Sulu Sea, 350-522 m.

REMARKS. — The holotype of *Discotrochus investigatoris* Alcock, 1893 is probably a juvenile specimen of *A. dentata* and thus would have nomenclatural priority. It has a CD of only 8 mm and 48 septa, which is consistent with the number of septa present in an *A. dentata* at that size. However, the type, presumed to be deposited at the Indian Museum, Calcutta, was not examined by the author. Until this verification can be made, the later name of *A. dentata* is used.

Whereas some of the largest specimens have a full fifth cycle (96 septa), most adult coralla have 60-72 septa, resulting from the insertion of one or two pairs of S_5 in each system, respectively. The addition of S_5 pairs usually occurs in a fixed manner as follows. In most coralla a bilateral symmetry can be determined by drawing a line through the slightly elongate or elliptical columella, dividing the corallum into two halves each containing six half-systems (Fig. A). If the 12 half-systems are numbered clockwise, pairs of S_5 first occur in half-systems I, II, V, VIII, X, and XII, which results in a mirror image septal complement, but with two adjacent half-systems with pairs of S_5 (I and XII) and two other half-systems (V and VIII) separated by two half-systems having no S_5 at all. Note that the numbering of half-systems is somewhat arbitrary in that, if the corallum is rotated 180°, the half-systems with pairs of S_5 are then: II, IV, VI, VII, IX, and XI, but the configuration is the same.

Anthemiphyllia dentata is more fully described by CAIRNS (1995) and compared to other congenerics in Table 4. All specimens were unattached, except for one (MUSORSTOM 8 stn 977), which was firmly attached to a rock. I (CAIRNS & PARKER, 1992; CAIRNS, 1995) had previously identified all *Anthemiphyllia* with S_5 as *A. dentata* (synonymy), but it now appears that at least three other species are involved, which consistently differ from one another in corallum shape, basal ornamentation, and septal architecture (Table 4).

Table 4. — Comparison of the Recent species and subspecies of the genus *Anthemiphyllia*.

	A. dentata Alcock, 1902	*A. multi-dentata* sp. nov.	*A. pacifica* Vaughan, 1907	*A. macro-lobata* sp. nov.	*A. patera costata* subsp. nov.	*A. patera patera* Pourtalès, 1878	*A. spinifera* sp. nov.	*A. frustum* Cairns, 1994
Shape of Colony; Attachment	Flat to shallow bowl; usually free	Shallow bowl;free	Shallow bowl to turbinate; free or attached	Deep bowl; attached or free	Shallow bowl; free	Shallow bowl; free or attached	Short cylinder with 6 costal spines; anthocyathus free	Frustum-shaped; anthocyathus free
Maximum Calicular Diameter (mm)	26.4	25.3	10.5	16.9	9.3	13.1	6.2	9.9
Nature of Base	Costate, with intercostal ridges	Costate, with intercostal ridges	Covered with epithecal bands	Costate	Costate	Porcellaneous (no costae)	Porcellaneous	Costate
Transverse Division	No	No	No	No	No	No	Yes	Yes
Colour of Corallum	White	White	White	White	White	White	Reddish-brown calicular margin	White to reddish brown
Septal Formula; Adult Number of Septa	$S_1>S_2>S_3>S_4>>S_5$; 60-72-96	$S_1>S_2>S_3>S_4>>S_5$; 96	$S_1>S_2>S_3>>S_4>S_5$; 48-56	$S_1>S_2>S_3>S_4>>S_5$; 60	$S_1>S_{2-3}>>S_4$; 48	$S_1>S_{2-3}>>S_4$; 48	$S_{1-3}>>S_4$; 36	$S_1>S_2>S_3>S_4$; 48
S_1 Trabecular Spines: Number; Largest Spine; Cross Section of Inner S_1 Spines	10-12; 3-4th from calicular edge; circular	20-23; uniform-sized; flattened perpendicular to septal plane	7; 3rd from calicular edge; circular	5-8; outermost septum a large lobe; inner spines flattened perpendicular to septal plane	7-8; 4-5th from edge; flattened perpendicular to septal plane	7-9; 4-5th from edge; flattened perpendicular to septal plane	4-5; equal-sized; slightly flattened in septal plane	6-7; largest lobes near columella; flattened in septal plane
Columella: Type; Similarity to Inner Trabeculae	Papillose; indistinguishable	Papillose; indistinguishable	Papillose; indistinguishable	Papillose; indistinguishable	Massive: irregularly shaped elements, undercut; discrete	Massive: irregularly shaped elements, undercut; discrete	Fused papillae; discrete	Papillose; indistinguishable
Distribution; Depth	Indo-West Pacific; 50-570 m	Southeastern Australia; 128-270 m	Hawaiian Is., Vanuatu, Kermadec Is; 205-325 m	Hawaiian Is, Kermadec Ridge; 369-508 m	Wallis & Futuna Is.; 320-700 m	Tropical northwestern Atlantic; 500-700 m	Tropical southwestern Pacific; 282-534 m	Japan through Indonesia; 209-340 m

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Waterwitch, Combe, Tuscarora, and Field Banks; 295-650 m. Vanuatu region: Anatom, Tanna, and Efaté; 280-475 m. Elsewhere: widespread throughout Indo-West Pacific; 50-570 m (CAIRNS & ZIBROWIUS, 1997).

Anthemiphyllia multidentata sp. nov.

Figs 3 a-b

Anthemiphyllia dentata - Wells, v.1958: 264, pl. 1, figs 8-11. — CAIRNS & PARKER, 1992: 16-17, figs 4e-f (in part: all but Western Australian specimen).

MATERIAL EXAMINED/TYPES. — **Australia**. Off Cronulla, NSW, depth unknown, holotype (USNM 83010).
"Nimbus": stn 12, 1 paratype (USNM 78611). — Stn 55, 2 paratypes (USNM 78609).
BANZARE: stn 115, 3 paratypes (SAM H500-501).
"Kimbla": stn K7/73-37, 1 paratype (NMV F57153).

TYPE LOCALITY. — Off Cronulla, New South Wales, depth unknown.

ETYMOLOGY. — The species name *multidentata* (Latin *multi*, many + *dens*, tooth), literally bearing many teeth, refers to the numerous trabecular teeth on all septa.

DESCRIPTION. — Corallum unattached, with a flat to slightly bowl-shaped base. Holotype 25.3 mm in CD and 6.5 mm in height. Costae equal in width, rounded, and finely granular. Intercostal grooves shallow; however, in most specimens there is a very narrow ridge that bifurcates the intercostal region. No evidence of transverse division or attachment to substrate. Corallum white.

Septa hexamerally arranged in 5 cycles, the fifth cycle often missing several pairs of septa, e.g., the holotype has only 88 septa. Septal formula: $S_1>S_2>S_3>S_4»S_5$ regarding size and exsertness; S_{1-3} all extend to the columella, whereas the S_4 do only as rudimentary structures. All septa low in profile, closely fitting contour of inner wall. S_1 bear 20-23 tall, slender, similarly-sized trabecular spines, the innermost (axial) spines highly compressed perpendicular to plane of septum. S_2, S_3, and S_4 similar in shape to S_1 but progressively smaller and having more slender trabecular spines. There are actually more spines on the S_3 (22-24) than the S_{1-2} because the spines on the S_3 are more slender and yet the width of the septum is about the same. S_5 bear 10-13 extremely slender trabecular spines, the septa becoming rudimentary near the columella. Fossa shallow, containing a papillose columella consisting of numerous small papillae that are indistinguishable from the inner (axial) septal spines.

REMARKS. — *Anthemiphyllia multidentata* is similar to *A. dentata*, and has been reported as such at least twice (see synonymy). However, *A. multidentata* differs from that species in having a significantly different septal architecture, consisting of more uniformly-sized trabecular spines per septum, and spines that are flattened in the plane perpendicular to the septum (Table 4). Thus far, *A. multidentata* is known only from southeastern Australia at relatively shallow depths. Although not found in the study region of this report, it is included to make the name available, and to facilitate comparisons among all Recent species (Table 4).

DISTRIBUTION. — Southeastern Australia from northeastern Tasmania to New South Wales; 128-270 m.

Anthemiphyllia pacifica Vaughan, 1907

Figs 2 g-h

Anthemiphyllia pacifica Vaughan, v*1907: 79-80, pl. 7, fig. 5. — CAIRNS, 1984: 10-11.
Anthemiphyllia dentata - CAIRNS, 1995: 41-42 (in part: NZOI stns K842 and K872).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1031, 1 (MNHN).

TYPE LOCALITY. — *"Albatross"* stn 3858: 21°01'25"N, 156°47'20"W (off Molokai, Hawaiian Islands), 225-252 m.

REMARKS. — Both VAUGHAN (1907) and CAIRNS (1984) noted that this species occurred in the free and attached (pedicellate) forms, the types being free. The MUSORSTOM specimen reported above belongs to the pedicellate form and is the largest specimen known, measuring 10.5 mm in CD and 7.3 mm in height, with a basal fracture of 5.2 mm. It bears well-developed epithecal bands, characteristic of the species, and perhaps because of its large size, contains 56 septa (4 pairs of S_4). It is otherwise similar to typical Hawaiian specimens and is compared to other congenerics in Table 4. One of the pedicellate species reported as *A. dentata* by CAIRNS (1995) is reidentified as *A. pacifica* herein.

DISTRIBUTION. — Vanuatu region: Efaté; 310 m. Elsewhere: Hawaiian Islands; Kermadec Islands (reported herein); 205-325 m.

Anthemiphyllia macrolobata sp. nov.

Figs 3 c-d

Anthemiphyllia dentata - CAIRNS, 1984: 11, pl. 1, figs F-G; 1995: 41-42 (in part: NZOI stn C527).

MATERIAL EXAMINED. — **Haiwaiian Islands**. *"Townsend Cromwell"*: stn 81-01-14, holotype (USNM 60559). **Kermadec Ridge**. NZOI: stn C527, 9 paratypes (USNM 93990).

TYPE LOCALITY. — *"Townsend Cromwell"* stn 81-01-14: 23°15'48"N, 161°50'12"W (Hawaiian Is.), 369 m.

ETYMOLOGY. — The species name *macrolobata* (Greek *makros*, long or large + *lobos*, lobe), literally bearing large lobes, refers to the large septal lobes on the S_{1-3}.

DESCRIPTION. — Holotype shaped as a deep bowl, unattached, measuring 16.9 mm in CD and 10.0 mm in height. Costae well developed, rounded, and finely granular, separated by deep intercostal grooves only at calicular edge. No evidence of transverse division; however, the Kermadec paratypes are firmly attached to the substrate. Corallum white.

Septa hexamerally arranged in 5 cycles, the fifth incomplete, only 1 pair of S_5 occurring in each system, resulting in 60 septa. Each S_1 consists of a highly exsert (3.3 mm), very wide (up to 5 mm) peripheral septal lobe, which occasionally bears shallow indentations, but is not completely subdivided into smaller lobes. Proximal to this lobe are 1-3 (depending on size of peripheral lobe) smaller, blunt lobes that are cylindrical in cross section. Most proximal (axial) are 3 or 4 narrow septal spines that are flattened perpendicular to septal plane. S_2 similar in shape to S_1, but slightly less exsert, having smaller peripheral lobes. S_3 and S_4 that are flanked by S_5 are equally as wide as S_2, but slightly less exsert and have smaller septal lobes. S_5 and unflanked S_4 are smallest septa, only about half the width of an S_3, bearing 10-12 narrow trabecular teeth. All septa bear relatively low granules on their faces. Fossa deep, containing a well-developed papillose columella composed of elements that are indistinguishable from the inner axial septal spines.

REMARKS. — As well as being reported as *A. dentata* twice (see synonymy), this species has been referred to as an "undescribed species" by CAIRNS & PARKER (1992), CAIRNS (1995), and CAIRNS & ZIBROWIUS (1997). Although not yet found in the study region, this species is included to make the name available, and to facilitate comparisons among the Recent species (Table 4). *A. macrolobata* is unique in having large peripheral S_{1-3} septal lobes.

DISTRIBUTION. — Hawaiian Islands; Kermadec Ridge; 369-508 m.

Anthemiphyllia patera costata subsp. nov.

Figs 3 e-h, 4 a-b

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 522, 1 paratype (MNHN). — Stn 530, 5 paratypes (USNM 98558). — Stn 535, 2 paratypes (MNHN). — Stn 540, 2 paratypes (MNHN). — Stn 542, 1 paratype (MNHN). — Stn 546, 1 paratype (USNM 98557). — Stn 575, 19 paratypes (USNM 98554). — Stn 578,

2 paratypes (MNHN). — Stn 586, holotype (MNHN), and 7 paratypes (MNHN). — Stn 590, 5 paratypes (MNHN). — Stn 591, 1 paratype (MNHN). — Stn 594, 8 paratypes (MNHN), SEM stub 871 (USNM 98555). — Stn 595, 7 paratypes (USNM 98556). — Stn 635, 5 paratypes (USNM 98559).

TYPE LOCALITY. — MUSORSTOM 7, stn 586: 13°10.7'S, 176°13.1'W (north of Wallis), 510-600 m.

ETYMOLOGY. — The subspecies name *costata* (Latin *costa*, rib) refers to the presence of costae on the theca of this species.

DESCRIPTION. — Corallum shaped as a shallow bowl, with rounded, slightly upturned edges. Holotype 8.3 mm in CD and 3.9 mm in height; largest specimen (MUSORSTOM 7 stn 594) 9.3 mm in CD. Base covered by equal, rounded, finely granulated costae. Intercostal regions shallow and narrow on base, but deeply incised at calicular edge, as in a turbinoliid. No evidence of a basal scar or propagation by transverse division. Corallum uniformly white.

Septa hexamerally arranged in 4 complete cycles (48 septa) according to the formula: $S_1 > S_{2-3} >> S_4$. S_1 bear 7 or 8 narrow trabecular spines, the outermost peripheral spines quite small and directed outward, the fourth and fifth from the outside usually the tallest, and the innermost (axial) 2 or 3 inclined toward and over the columella, these spines highly compressed perpendicular to plane of septum. S_1 extend approximately 1 mm into central columella. S_{2-3} only slightly less wide than the S_1, usually bearing one less trabecular spine. S_4 much smaller, about one-third width of S_{1-3}, but equally as exsert, consisting of 2 or 3 slender trabecular spines, and a laciniate axial edge that follows the contour of the inner theca. Fossa shallow, containing a massive (up to 4 mm in diameter), irregularly circular, flat columella composed of irregularly-shaped, fused elements. The columella protrudes into each of the 6 systems, fusing with and uniting the axial edges of the S_2 and their flanking S_3, increasing the columellar diameter to over 5 mm at these points. Edges of columella undercut, being wider at the top than the base.

REMARKS. — This subspecies is very similar to the nominate subspecies *A. patera patera* Pourtalès, 1878, both taxa having the same septal and columellar structure and corallum shape. *A. patera costata* differs primarily in having a costate base (that of *A. patera patera* is smooth and porcellaneous), and in not attaining quite as large a size (Table 4). *A. patera patera* is also known to have attached as well as free coralla. The nominate subspecies is known only from tropical northwestern Atlantic at depths of 500-700 m (CAIRNS, 1979). Because of these slight, but consistent morphological differences and the apparent geographic separation, a new subspecies is warranted.

Anthemiphyllia patera costata is compared to other Recent congeners in Table 4, but it also bears a resemblance to the fossil species *A. catinata* Wells, 1977 (Late Eocene, Tonga), as noted by WELLS (1977). Both species are similar in corallum size and shape, costal ornamentation, and columellar structure, but *A. patera costata* differs in having more septa (48 vs 32-40). Details of septal dentition are similar, but not possible to compare due to the poor preservation of the four known specimens of the fossil species.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, Field, and Rotumah Banks; 320-700 m.

Anthemiphyllia spinifera sp. nov.

Figs A, 4 c-j,

Discotrochus sp. Alcock, v.1902c: 27-28.
Deltocyathus andamanicus - KELLER, 1982: 52 (in part: pl. 1 [= 4], figs 5a-b).

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 512, 1 paratype (USNM 98571). — Stn 513, 2 paratypes (MNHN). — Stn 514, 13 paratypes: 12 (MNHN), 1 (USNM 98573). — Stn 530, 2 paratypes (MNHN). — Stn 537, 2 paratypes (USNM 98572). — Stn 541, 1 paratype (MNHN). — Stn 542, 4 paratypes (USNM 98569). — Stn 569, 3 paratypes (MNHN). — Stn 586, 1 paratype (MNHN). — Stn 589, 1 paratype (MNHN). — Stn 605, holotype (MNHN) and 18 paratypes (MNHN). — Stn 610, 2 paratypes, including SEM stub 872 (USNM 98570).

Vanuatu. MUSORSTOM 8: stn 988, 1 paratype (MNHN). — Stn 1014, 1 paratype (MNHN).
Indonesia *(Moluccas)*. KARUBAR: stn 18, 6 paratypes (USNM 96777).
"Albatross": stn 5584, 4°17'40"N, 118°57'42"E, 532 m, 27.09.1909, 1 paratype (USNM 87605).

TYPE LOCALITY. — MUSORSTOM 7 stn 605: 13°21.3'S, 176°08.4'W (southeast of Wallis), 335-340 m.

ETYMOLOGY. — The species name *spinfera* (Latin *spina*, thorn + *fer*, to bear) refers to the 6 costal spines.

DESCRIPTION. — Corallum (anthocyathus) discoidal, with a flat base, vertical edges, and circular calice. Holotype 4.76 mm in CD and 2.34 mm in height; largest specimen (MUSORSTOM 7 stn 513) 6.2 mm in CD and tallest (MUSORSTOM 7 stn 605) 3.8 mm in height. Base smooth, porcellaneous, and white, usually with a small (2.3 mm in diameter), slightly concave scar or repaired scar of attachment in centre. Six elongate, tapered, smooth costal spines (C_3) project from the calicular edge in a specific pattern (see Remarks). Spines straight, or sometimes curved or bent, and often broken, the longest spine 3.7 mm. Well-preserved coralla reddish brown at calicular edge, otherwise white. One anthocaulus is known (MUSORSTOM 8 stn 1014, Fig. 4j), consisting of a nondescript, faintly costate, cylindrical corallum 2.3 mm in height and 4.2 mm in diameter, bearing an anthocyathus 4.8 mm in CD. There is an annular constriction between the anthocaulus and anthocyathus, but at this stage they are still firmly attached. The attached anthocyathus bears 36 septa but has no evidence of costal spines.

Septal hexamerally arranged in 3 1/2 cycles, each system containing one pair of S_4 inserted in a very specific pattern (see Remarks), resulting in 36 septa. Only 2 size classes of septa exist: the larger septa, consisting of the 12 S_{1-2} and the 6 S_3 that are flanked by S_4 (18 of the 36 septa), and the smaller septa, consisting of all 12 S_4 and the remaining 6 S_3 that are unflanked by S_4 (the remaining 18 septa), which alternate with the larger septa. The larger septa extend to the columella, and bear of 4 or 5 equally sized, prominent, highly granular trabecular spines, the innermost spines only slightly compressed in the plane of the septum. Innermost 2 trabecular spines of larger septa inclined toward columella more than peripheral spines, the latter being vertical, which produces a small notch in each septum, and altogether, a narrow circumferential demarcation about half way between the columella and calicular edge. Although the S_{1-3} are of the same size, the S_2 and accelerated S_3 can be distinguished because the columella extends slightly outward in each system to fuse these inner edges of the S_2 and its adjacent accelerated S_3, as in *A. patera costata*. Smaller septa only about one-third width of the larger septa, bearing 3 slender trabecular teeth. Fossa shallow, containing a low, massive (up to 2 mm in diameter) papillose columella, the elements of which are often fused. Columellar elements usually easily distinguished from inner septal trabeculae.

REMARKS. — Most specimens reported above bear six elongate costal spines (C_3) associated with the 6 S_3 that are flanked by pairs of S_4, one of which occurs in each half-system. Because the columella is circular, not elongate as in *A. dentata*, an obvious plane of symmetry is not available for the numbering of half-systems. But, if the 12 half-systems are arbitrarily numbered in a clockwise direction beginning from the S_1 that occurs between the two most closely spaced spines (Fig. A), then the costal spines invariably occur in half-systems I, III, V, VIII, X, and XII, which are the same half-systems in which S_5 pairs first occur in *A. dentata*. This results in two closely spaced spines (half-systems XII and I) separated from one another by only 3 septa, or an angular separation of 40°; and four spines (half-systems III, V, VIII, and X) separated from their adjacent dorsal spines by 5 septa, or 60°; and the spines of half-systems V and VIII separated from each other by 80° (Fig. A). There are only three anomalies to this pattern in the material examined: a specimen from *"Albatross"* 5584 has 8 spines and thus 40 septa, the additional costal spines occurring in half-systems IV and IX; a specimen from MUSORSTOM 7 stn 542 has 7 spines and 38 septa, the additional spine in half-system V; and the specimen reported by KELLER (1982), which appears to have a seventh spine in half-system VIII.

Anthemiphyllia spinifera is easily distinguished from congeners by having costal spines. Other differences are noted in Table 4.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, and Field Banks; 245-510 m. Vanuatu region: Tanna and Efaté; 466-495 m. Elsewhere: Indonesia (Kai Islands, Banda Sea; south of Sumba); Malaysia (Darvel Bay); Celebes Sea (off Mindanao); 212-534 m.

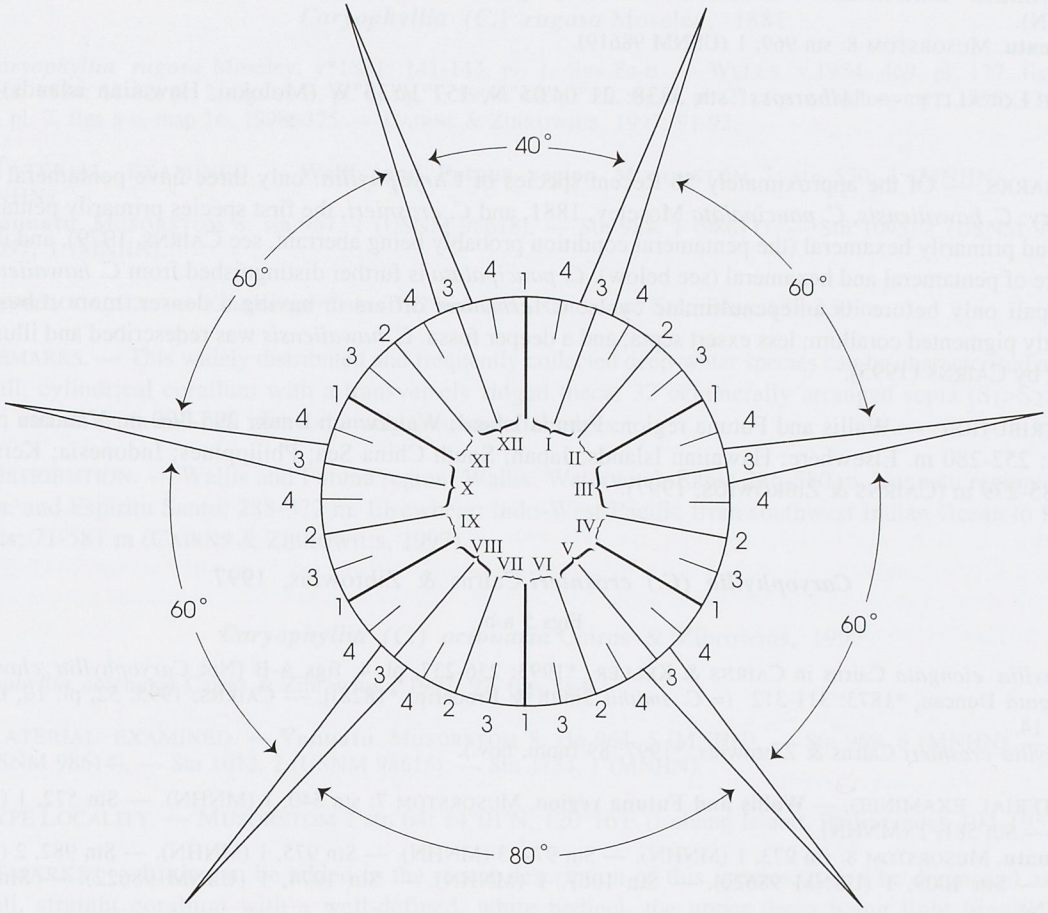


FIG. A. — Diagrammatic representation of the calice of *Anthemiphyllia spinifera* or *Deltocyathus heteroclitus*, showing the insertion pattern of the six costal spines (C_3). Roman numerals define the 12 half-systems in the corallum, arbitrarily beginning with the S_1 that bifurcates the smallest angular separation of costal spines, and proceeding in a clockwise direction. Arabic numerals indicate the respective septal cycles. Length of costal spines and septa drawn in proportion to calicular diameter of *A. spinifera*.

Suborder CARYOPHYLLIINA

Superfamily CARYOPHYLLIOIDEA Dana, 1846

Family CARYOPHYLLIIDAE Dana, 1846

Genus ***CARYOPHYLLIA*** Lamarck, 1816

Subgenus ***CARYOPHYLLIA (CARYOPHYLLIA)*** Lamarck, 1816

Caryophyllia (C.) hawaiiensis Vaughan, 1907

Caryophyllia hawaiiensis Vaughan, v*1907: 76, pl. 5, figs 4a-b. — CAIRNS, 1984: 11; 1995: 44-45, pl. 7, figs d-f, map 18. — CAIRNS & ZIBROWIUS, 1997: 93.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 504, 1 (MNHN). — Stn 538, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 969, 1 (USNM 98619).

TYPE LOCALITY. — *"Albatross"* stn 3838: 21°04'05"N, 157°10'35"W (Molokai, Hawaiian islands), 168-388 m.

REMARKS. — Of the approximately 56 Recent species of *Caryophyllia*, only three have pentameral septal symmetry: *C. hawaiiensis*, *C. paucipalata* Moseley, 1881, and *C. crosnieri*, the first species primarily pentameral, the second primarily hexameral (the pentameral condition probably being aberrant, see CAIRNS, 1979), and the last a mixture of pentameral and hexameral (see below). *C. paucipalata* is further distinguished from *C. hawaiiensis* by having pali only before its antepenultimate cycle. *C. crosnieri* differs in having a denser, more robust, and differently pigmented corallum; less exsert septa; and a deeper fossa. *C. hawaiiensis* was redescribed and illustrated in detail by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Futuna Island; Waterwitch Bank; 295-300 m. Vanuatu region: Anatom; 252-280 m. Elsewhere: Hawaiian Islands; Japan; South China Sea; Philippines; Indonesia; Kermadec Ridge; 85-279 m (CAIRNS & ZIBROWIUS, 1997).

Caryophyllia (C.) crosnieri Cairns & Zibrowius, 1997

Figs 5 a-b

Caryophyllia elongata Cairns in CAIRNS & KELLER, *1993: 236-237, pl. 4, figs A-B [Not *Caryophyllia clavus* var. *elongata* Duncan, *1873: 311-312 (= *C. smithii* Smith & Broderip, *1828)]. — CAIRNS, 1995: 52, pl. 10, figs d-f, map 14.
Caryophyllia crosnieri Cairns & Zibrowius, *1997: 89 (nom. nov.).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 540, 1 (MNHN). — Stn 572, 1 (USNM 98623). — Stn 581, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 973, 1 (MNHN). — Stn 974, 3 (MNHN). — Stn 975, 1 (MNHN). — Stn 982, 2 (USNM 98621). — Stn 1009, 1 (USNM 98620). — Stn 1067, 1 (MNHN). — Stn 1074, 1 (USNM 98622). — Stn 1108, 1 (MNHN).

TYPE LOCALITY. — *"Vityaz "* stn 2716: 33°17'S, 44°55'E (Walters Shoal, Madagascar Plateau), 630-680 m.

REMARKS. — Additional large, well-preserved specimens reported herein allow the observation that this species is not consistently hexamerally symmetrical. Whereas most previously reported specimens were hexamerally symmetrical ($S_1>S_2>S_4\geq S_3$, 48 septa and 12 pali), most of the specimens listed above are pentamerally symmetrical (5:5:10:20, 40 septa and 10 pali), only the 3 specimens from MUSORSTOM 8 stns 975, 1067, and 1074 being hexamerally symmetrical ($S_1>S_2>S_4>S_3$, 12 pali), and the specimen from MUSORSTOM 8 stn 974 having 11 pali (44 septa). Furthermore, a lot reported by CAIRNS & ZIBROWIUS (1997), e.g., KARUBAR stn 31, contains a mixture of specimens with pentameral or hexameral symmetry.

The species may be diagnosed as having: a robust, cylindrical corallum with a broadly encrusting base; noncostate, coarsely granular, yellowish-brown theca; pentameral or hexameral septal symmetry, usually resulting in 40 or 48 septa, respectively; highest cycle septa equal to or wider than penultimate septal cycle; carinate septal faces; and a very deep fossa with a well-defined columella of 3-9 slender twisted elements. The axial palar edges are highly sinuous, and, in some specimens, form a narrow lamella on their axial margin oriented perpendicular to the plane of the palus.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch and Wallis; Combe Bank; 550-600 m. Vanuatu region: Tanna, Efaté, Malakula, and Espiritu Santo; 366-536 m. Elsewhere: southwest Indian Ocean; Philippines; Indonesia; Kermadec and Three Kings Ridges; 165-680 m (CAIRNS & ZIBROWIUS, 1997).

Caryophyllia (C.) rugosa Moseley, 1881

Caryophyllia rugosa Moseley, v*1881: 141-143, pl. 1, figs 8a-b. — WELLS, v.1954: 469, pl. 177, figs 5-6. — CAIRNS, 1984: 11-12, pl. 2, figs A-B, pl. 4, fig. I; 1994: 47, pl. 20, fig. i, pl. 21, fig. a (synonymy); 1995: 43-44, pl. 6, fig. h, pl. 7, figs a-c, map 16; 1998: 375. — CAIRNS & ZIBROWIUS, 1997: 91-92.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 530, 1 (MNHN). — Stn 610, 2 (MNHN).

Vanuatu. MUSORSTOM 8: stn 967, 1 (USNM 98618). — Stn 988, 1 (98617). — Stn 1095, 1 (USNM 98616). — Stn 1097, 1 (MNHN).

TYPE LOCALITY. — *"Challenger"* stns 192 and 201: Banda and Sulu Seas, 187-230 m.

REMARKS. — This widely distributed and frequently collected deep-water species can be characterised as having: a small, cylindrical corallum with a transversely ridged theca; 32 octamerally arranged septa ($S_1>S_2>S_3$) and 8 pali; and all septa and pali with extremely sinuous axial edges.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch Bank; 286-580 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; 288-372 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Hawaiian Islands; 71-581 m (CAIRNS & ZIBROWIUS, 1997).

Caryophyllia (C.) octonaria Cairns & Zibrowius, 1997

Caryophyllia octonaria Cairns & Zibrowius, *1997: 92, figs 7a-b.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 964, 5 (MNHN). — Stn 969, 6 (MNHN). — Stn 976, 12 (USNM 98614). — Stn 1072, 2 (USNM 98615). — Stn 1134, 1 (MNHN).

TYPE LOCALITY. — MUSORSTOM 1 stn 64: 14°01'N, 120°16'E (Lubang Island, Philippines), 194-195 m.

REMARKS. — Little can be added to the recent description of this species. It can be diagnosed as having: a small, straight corallum with a well-defined, white pedicel, the upper theca being light brown; granular costae sometimes covered with epitheca; a circular to only slightly elliptical calice; 32 octamerally arranged septa ($S_1>S_{2-3}$) with only moderately sinuous axial edges; and eight very sinuous pali with carinate faces.

DISTRIBUTION. — Vanuatu region: Anatom and Espiritu Santo; 182-622 m. Elsewhere: Philippines; 186-194 m.

Caryophyllia (C.) abrupta sp. nov.

Figs 5 d-e

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 522, 1 paratype (MNHN). — Stn 523, 8 paratypes (MNHN). — Stn 524, 2 paratypes (USNM 98607). — Stn 530, 1 paratype (MNHN). — Stn 534, 4 paratypes (MNHN). — Stn 535, holotype (MNHN), 14 paratypes (USNM 98609). — Stn 537, 2 paratypes (MNHN). — Stn 546, 2 paratypes (MNHN). — Stn 557, 3 paratypes (USNM 98610). — Stn 569, 1 paratype (USNM 98611). — Stn 570, 1 paratype (MNHN). — Stn 571, 2 paratypes (MNHN). — Stn 586, 4 paratypes (MNHN). — Stn 604, 5 paratypes (MNHN). — Stn 605, 2 paratypes (MNHN). — Stn 606, 1 paratype (MNHN). — Stn 608, 2 paratypes (USNM 98606). — Stn 619, 2 paratypes (USNM 98608).

Vanuatu. MUSORSTOM 8: stn 963, 1 nontype cemented to a *Xenophora* shell (MNHN). — Stn 988, 1 (MNHN). — Stn 1016, 1 paratype (USNM 98612), and another nontype cemented to a *Xenophora* shell (MNHN). — Stn 1065, 1 paratype (MNHN). — Stn 1088, 2 nontypes cemented to a *Xenophora* shell (MNHN). — Stn 1091, 2 nontypes cemented to *Xenophora* shells (MNHN). — Stn 1094, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 7 stn 535: 12°29.6'S, 176°41.3'W (Waterwitch Bank), 340-470 m.

ETYMOLOGY. — The species name *abrupta* (Latin *abruptus*, broken off, separated, sheer) refers to the process of transverse division that separates the anthocyathus from the anthocaulus.

DESCRIPTION. — Anthocaulus stage unknown. Anthocyathus ceratoid, curved between 45°-90° usually in plane of GCD; one to 7 episodes of rejuvenescence not uncommon in larger coralla. Holotype 8.4 x 7.5 mm in CD and 18.5 mm in height; largest corallum (MUSORSTOM 7 stn 619) 10.9 x 8.4 mm in CD. Basal scar circular to slightly elliptical: 1.8-2.1 x 1.7-1.8 mm in diameter, displaying 8 major septa. Calice strongly compressed: GCD:LCD = 1.12-*1.29*-1.37 (N=8). Costal expression variable, but 8 primary costae usually prominent, the other 24 flat and poorly defined; however, in some specimens the theca is smooth or bears uniformly small granules. Most coralla uniformly white, but some are reddish brown near calicular edge.

Septa usually octamerally arranged in 3 size classes: 8:8:16 (32 septa); however, two specimens of 6.6 mm CD from MUSORSTOM 7 stn 535 have a septal complement of 6:6:12 (6 pali) and 7:7:14 (7 pali), and the largest specimen has an extra pair of septa resulting in 34 septa and 9 pali. Eight primary septa highly exsert (1.5-1.6 mm), extend 3/4 distance to columella, having moderately sinuous axial edges. Secondary septa about half width and exsertness of primaries, but have extremely sinuous axial edges. Tertiaries slightly more exsert than secondaries, being fused to their adjacent primary septa to form low, triangular lancets. Tertiaries equal to or slightly less wide than secondaries, becoming relatively wider with age, having slightly sinuous axial edges. Fossa of moderate depth, containing 8 narrow P_2 that form a distinct palar crown, each palus having extremely sinuous edges, equivalent to those of the secondary septa they border. Columella fascicular, composed of 2-4 narrow elements arranged linearly or in a rhomboid pattern.

REMARKS. — There are six species of octamerally symmetrical *Caryophyllia*, all of which generally have 32 septa: *C. rugosa* Moseley, 1881; *C. octopali* Vaughan, 1907; *C. mabahithi* Gardiner & Waugh, 1938; *C. barbadensis* Cairns, 1979; *C. marmorea* Cairns, 1984; and *C. octonaria* Cairns & Zibrowius, 1997; a seventh species has a variable symmetry that includes octameral: *C. cornuformis* Pourtalès, 1868. *C. abrupta* differs from these species by propagating by transverse division, and by having a compressed corallum. It is perhaps most similar to *C. cornuformis* (a species known only from the Atlantic and the southwest Indian Ocean) in size, shape, and septal architecture. Both species also have an abruptly terminated base: in the case of *C. abrupta*, due to transverse division, in the case of *C. cornuformis*, probably due to budding, which results in an irregularly-shaped, open base. *C. abrupta* also differs from that species in having a very regular octameral symmetry with a well-defined palar crown, an elongate calice, exsert primary and secondary septa, and often prominent primary costae.

One other species of this genus is known to have transverse division: *C. secta* Cairns & Zibrowius, 1997, from the Philippines and Indonesia (220-366 m), which differs from *C. abrupta* in septal symmetry (hexameral, 48 septa), size (up to 15.7 mm GCD), and corallum shape (straight, trochoid).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Alofi; Waterwitch, Combe, and Tuscarora Banks; 305-650 m. Vanuatu region: Anatom, Tanna, Efaté, Malakula, and Espiritu Santo; 300-400 m.

Caryophyllia (C.) marmorea Cairns, 1984

Figs 5 c, f

Caryophyllia marmorea Cairns, *1984: 13, pl. 2, figs C-D.

MATERIAL EXAMINED. — MUSORSTOM 7: stn 525, 1 (MNHN). — Stn 534, 1 (USNM 98613). — Stn 585, 1 (MNHN).

TYPE LOCALITY. — Deep Ocean Disposal Site Investigations, Hawaii, Stn HON 9-3: 19°48'N, 154°58'W (off Hilo, Hawaii), 337 m.

REMARKS. — This species is diagnosed as having a small (CD < 4 mm), straight, attached subcylindical corallum. The theca is light brown, granular, and glisteny; primary costae are prominent. Septa are octamerally arranged: $S_1>S_2>S_3$ (32 septa). This is the first report of this species subsequent to its original description from Hawaii.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch Bank; 475-500 m. Elsewhere: Hawaii, Hawaiian Islands; 331-337 m.

Caryophyllia (C.) quadragenaria Alcock, 1902

Caryophyllia quadragenaria Alcock, v*1902a: 91-92; v.1902c: 10, pl. 1, figs 4, 4a. — CAIRNS, 1994: 46-47, pl. 20, figs c-h, pl. 41, figs c-d (synonymy); 1995: 45-46, pl. 7, figs g-h, map 7 (synonymy); 1998: 375. — CAIRNS & ZIBROWIUS, 1997: 93.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 556, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 962, 1 (MNHN). — Stn 965, 1 (MNHN). — Stn 967, 5 (USNM 98603). — Stn 1106, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 90, 251, and 289: Makassar Strait, Banda, and Timor Seas, 54-281 m.

REMARKS. — In addition to *C. quadragenaria*, there are six other decamerally symmetrical *Caryophyllia*: *C. abyssorum* Duncan, 1873; *C. calveri* Duncan, 1873; *C. antillarum* Pourtalès, 1874; *C. zopyros* Cairns, 1979; *C. perculta* Cairns, 1991; and *C. solida* Cairns, 1991. *C. quadragenaria* can be diagnosed as having: a relatively small (GCD < 12 mm), straight corallum attached by a narrow pedicel; poorly defined costae; three cycles of decamerally arranged septa resulting in 40 septa, the tertiary septa usually equal to or wider than the secondaries; and a well-formed palar crown of 10 pali. The species was recently redescribed and illustrated by CAIRNS (1994, 1995).

DISTRIBUTION. — Wallis and Futuna region: Tuscarora Bank; 440 m. Vanuatu region: Anatom, Efaté, and Espiritu Santo; 314-430 m. Elsewhere: western Pacific from Japan to New Zealand; 54-385 m (CAIRNS & ZIBROWIUS, 1997).

Caryophyllia (C.) sp. cf. *C. calveri* Duncan, 1873

Figs 5 g-i

?*Caryophyllia calveri* Duncan, *1873: 316. — ZIBROWIUS, v.1980: 57-59, pl. 21, figs A-L.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1051, 1 (MNHN). — Stn 1056, 11: 7 (MNHN), 4 (USNM 98605).

TYPE LOCALITY of *C. calveri*. — *"Porcupine"*: stn 24, 37°19'N, 9°13'W (off Portugal), 534 m.

DESCRIPTION. — Corallum elongate-conical and straight, having a robust pedicel (PD:GCD = 0.32-0.62) that is firmly attached by a thin, broadly encrusting base. All specimens examined attached to small bits of pumice. Largest specimen (MUSORSTOM 8 stn 1056) 10.9 x 9.3 mm in CD, and 3.5 mm in PD, having a basal encrustation of 16 mm. Calice slightly elliptical: GCD:LCD = 1.08-1.19. Costae low and poorly defined, the intercostal striae being infilled with glisteny textura. Base, pedicel, and calicular elements white; however, upper theca a light yellow-brown.

Septal symmetry variable. Half of the specimens examined have hexameral symmetry ($S_{1-2}>S_4\geq S_3$, 48 septa and 12 pali); 5 specimens have decameral symmetry (10:10:20, 40 septa and 10 pali); and one specimen has nonameral symmetry (11:11:22, 44 septa and 11 pali). The 10-12 larger septa (primaries) are highly exsert

(up to 2.1 mm), extend about 3/4 distance to the columella, and have moderately sinuous axial edges. Second size class of septa (secondaries) about 0.7 mm exsert, 4/5 width of a primary septum, also having moderately sinuous axial edges. Third size class of septa (tertiary septa) equal to or slightly wider than the secondaries, and about 0.9 mm exsert, fusing with their adjacent primary septa at the calicular edge to form low, triangular lancets. Depending on septal symmetry, 10-12 wide (1.1-1.2 mm) pali form a well-defined crown, the pali having highly sinuous edges and bearing prominent granules and short ridges. Fossa of moderate depth, bearing a fascicular columella composed of an elongate field of 3-10 slender (0.5 mm diameter), tightly twisted and closely spaced elements.

REMARKS. — Of the approximately 56 Recent valid species of *Caryophyllia*, nine species can be characterised as having an attached corallum, decameral or hexameral symmetry, and its highest cycle septa equal to or wider than its penultimate cycle: *C. calveri* Duncan, 1873; *C. atlantica* (Duncan, 1873); *C. polygona* Pourtalès, 1878; *C. lamellifera* Moseley, 1881; *C. arnoldi* Vaughan, 1900; *C. panda* Alcock, 1902; *C. alberti* Zibrowius, 1980; *C. quadragenaria* Alcock, 1902; and *C. perculta* Cairns, 1991, the last two species usually having decameral symmetry. The specimens reported above from Epi are morphologically indistinguishable from specimens identified as *C. calveri* by ZIBROWIUS (1980), even to the point of having a variable septal symmetry that includes both decameral and hexameral. *C. calveri* is known only from the northeast Atlantic and Mediterranean at 130-1050 m (ZIBROWIUS, 1980). This disjunct distribution would imply that the Epi Island population represents a different species or that intermediate populations between the south Pacific and northeast Atlantic have not yet been recorded.

DISTRIBUTION. — Vanuatu region: Epi; 558-602 m.

Caryophyllia (C.) diomedeae Marenzeller, 1904

Caryophyllia diomedeae Marenzeller, v*1904: 79-80, pl. 1, fig. 2. — CAIRNS, 1995: 49-50, pl. 9, figs a-d, map 3 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 88.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 959, 1 (MNHN). — Stn 1014, 1 (USNM 98604). — Stn 1080, 1 (MNHN). — Stn 1128, 3 (MNHN).

TYPE LOCALITY. — *"Albatross"* stn 3358: 6°30'N, 81°44'W (off Coiba Island, Panama), 1043 m.

REMARKS. — This widespread species was redescribed and discussed by CAIRNS (1995). It can be characterised as having: an elongate, slender but slightly flared, straight corallum attached by a narrow pedicel; flat to porcellaneous theca; only slightly exsert septa; a septal formula of $S_{1-2}>S_3>S_4$ (48 septa); and a shallow fossa.

DISTRIBUTION. — Vanuatu region: Anatom, Efaté, and Malakula; Guyot Bougainville; 475-799 m. Elsewhere: widespread, including Indo-Pacific and Atlantic Ocean; 225-2200 m (CAIRNS, 1995).

Caryophyllia (C.) lamellifera Moseley, 1881

Caryophyllia lamellifera Moseley, v*1881: 140-141, pl. 1, figs 7a-b. — CAIRNS, 1995: 51-52, pl. 9, fig. i, pl. 10, figs a-c, map 18 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 90.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 502, 1 (MNHN). — Stn 589, 2 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1077, 1 (USNM 98591).

TYPE LOCALITY. — *"Challenger"* stn 170: 29°55'S, 178°14'W (north of Macauley Island, Kermadec Ridge), 1152 m.

REMARKS. — *Caryophyllia lamellifera* is distinguished from the many other Pacific *Caryophyllia*, by having a fine, transversely ridged, brown-striped theca. The species is more fully described by CAIRNS (1995), who also compared it to the other two congenerics that have transversely ridged theca: *C. rugosa* and *C. corrugata*. CAIRNS (1995) noted variation in septal symmetry (12-14 primary septa) and relative width of the S_4 and S_3 (S_4 being wider, as in the holotype, or narrower than S_3, as in most other specimens). The four specimens reported above all have 48 septa arranged as: $S_{1-2}>S_3>S_4$. However, three other specimens from MUSORSTOM 8 stns 1018, 1023, 1091, and 1095 (not reported above), are only tentatively assigned to this species. They differ from the typical form in lacking transverse thecal ridges and in having S_4 that are equal to or slightly wider than their S_3, as in the holotype. It is possible that both of these characters may be found to constitute intraspecific variation for some species.

DISTRIBUTION. — Wallis and Futuna region: Futuna; Field Bank; 400-516 m. Vanuatu region: Malakula; 180-210 m. Elsewhere: Philippines; Indonesia; Kermadec and Norfolk Ridges; Taupo Tablemount; 89-1152 m (CAIRNS & ZIBROWIUS, 1997).

Caryophyllia (C.) scobinosa Alcock, 1902

Caryophyllia scobinosa Alcock, v*1902: 8, pl. 1, figs 2, 2a. — CAIRNS, 1995: 52-53, pl. 10, figs g-i, pl. 11, figs a-c, map 16 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 94.

Not *Caryophyllia scobinosa* - WELLS, v.1984: 207-209, figs 2 (1-4) [= *Asterosmilia* sp. cf. *A. marchadi* (Chevalier, 1966)].

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 552, 1 (MNHN). — Stn 565, 1 (MNHN). — Stn 635, 2 (USNM 98601).

Vanuatu. MUSORSTOM 8: stn 992, 2 (MNHN). — Stn 1034, 11 (MNHN). — Stn 1035, 7 (USNM 98602). — Stn 1074, 2 (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 45 and 102: Flores and Sulu Seas, 535-794 m.

REMARKS. — This species was redescribed and figured by CAIRNS (1995). It is distinguished from the other unattached cornute species known from this region, *C. ambrosia*, by having a much smaller, and more slender corallum (GCD < 16 mm); and only 48 septa and 12 pali.

DISTRIBUTION. — Wallis and Futuna region: Combe, Tuscarora, and Rotumah Banks; 715-900 m. Vanuatu region: Erromango, Efaté, and Espiritu Santo; 750-775 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan and Tonga; 353-1276 m (CAIRNS & ZIBROWIUS, 1997).

Caryophyllia (C.) ambrosia Alcock, 1898

Caryophyllia ambrosia Alcock, v*1898: 12, pl. 1, figs 1, 1a. — ZIBROWIUS, v.1980: 63-65, pl. 25, figs A-K (synonymy). — CAIRNS, 1994: 48, pl. 21, figs d-h; 1995: 53-54, pl. 11, figs d-e, map 7. — CAIRNS & ZIBROWIUS, 1997: 95-96.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 564, 2 (MNHN). — Stn 565, 2 (MNHN). — Stn 598, 1 (USNM 98599). — Stn 635, 2 (USNM 98600). — Stn 636, 4 (MNHN).

TYPE LOCALITY. — *"Investigator"* stns 104 and 176: Laccadive Sea, Arabian Sea, 1829-1957 m.

REMARKS. — The regional variation of corallum size and number of septa was discussed by CAIRNS (1994, 1995), who also provided descriptions and illustrations of the species. The specimens reported above have 14-22 (mode = 16) primary septa and 56-88 (mode = 64) total septa, which allies them most closely with northern Indian Ocean populations. Populations to the north (Japan), west (Indonesia), and south (New Zealand), usually have more septa, e.g., 18-30 primary septa or a total of 72-120 septa.

DISTRIBUTION. — Wallis and Futuna region: Tuscarora, Field, and Rotumah Banks; 700-1015 m. Else where: Amphi-Atlantic; Indo-West Pacific, including Japan and New Zealand; 311-2670 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *CARYOPHYLLIA (ACANTHOCYATHUS)* H. Milne Edwards & Haime, 1848

Caryophyllia (A.) grayi (H. Milne Edwards & Haime, 1848)

Acanthocyathus grayi H. Milne Edwards & Haime, *1848a: 293, pl. 9, figs 2, 2a. — UMBGROVE, 1950: 641-642, pl. 81, figs 27-32 (synonymy). — WELLS, v.1984: 209, pl. 2, figs 5-9.
Caryophyllia (A.) grayi - CAIRNS, 1994: 49, pl. 21, figs i-k (synonymy); 1998: 377. — CAIRNS & ZIBROWIUS, 1997: 97-98, figs 7 c, f, i.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 496, 1 (USNM 98598). — Stn 499, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1001, 1 (MNHN). — Stn 1002, 1 (USNM 98597). — Stn 1004, 2 (USNM 98596). — Stn 1065, 1 (MNHN). — Stn 1069, 1 (MNHN). — Stn 1070, 2 (MNHN). — Stn 1071, 2 (MNHN). — Stn 1086, 4 (MNHN). — Stn 1103, 3 (MNHN). — Stn 1134, 1 (USNM 98595).
USGS *(Late Pleistocene of Kere River, Espiritu Santo)*: stn 25715, 4 (USNM 71844, 71846, 78610), WELLS, 1984; Stn SM242, 129a and 129b, 4 (USNM 71845 and 73963), WELLS, 1984.

TYPE LOCALITY. — Unknown.

REMARKS. — The species is characterised as having a compressed, ceratoid corallum, with a narrow pedicel and rounded thecal edges, each of which bears several thecal spines that are circular in cross section. Costae are rounded, not ridged, and the theca is often reddish brown. Septa are usually arranged: 14:14:28, resulting in 56 septa and 14 pali, but large coralla have 16 and even 18 primary septa, resulting in up to 72 septa (CAIRNS, 1995). The species was redescribed and figured by CAIRNS (1995) and CAIRNS and ZIBROWIUS (1997), the latter including a key and discussion of most of the species in this subgenus.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 290-300 m. Vanuatu region: Erromango, Malakula, and Espiritu Santo (also Late Pleistocene, WELLS, 1984); 125-360 m. Elsewhere: Indo-West Pacific from South Africa to Japan; 37-490 m (CAIRNS & ZIBROWIUS, 1997).

Genus *CRISPATOTROCHUS* Tenison Woods, 1878

Crispatotrochus rubescens (Moseley, 1881)

Cyathoceras rubescens Moseley, *1881: 157, pl. 2, figs 8a-c. — Cairns, 1984: 15.
Cyathoceras tydemani Alcock, v*1902a: 93-94; v.1902c: 14, pl. 1, figs 7, 7a.
Cyathoceras diomedeae Vaughan, v*1907: 77-78, pl. 7, figs 1-2.
Crispatotrochus rubescens - CAIRNS, 1994: 51, pl. 22, figs g-h (synonymy). — CAIRNS & ZIBROWIUS, 1997: 103-104, figs 10 a-c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 502, 1 (USNM 98585). — Stn 507, 2 (MNHN). — Stn 511, 1 (MNHN). — Stn 523, 1 (MNHN). — Stn 585, 5 (MNHN). — Stn 604, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 983, 1 (USNM 98584).

TYPE LOCALITY. — *"Challenger"* stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 236 m.

REMARKS. — This species was recently redescribed and figured by CAIRNS (1994).

DISTRIBUTION. — Wallis and Futuna; 420-516. Vanuatu region: Tanna; 475-480 m. Elsewhere: western and central Pacific: Japan; South China Sea; Philippines; Indonesia; Hawaiian and Christmas Islands; 110-634 m (CAIRNS & ZIBROWIUS, 1997).

Crispatotrochus rugosus Cairns, 1995

Figs 6 a-b

Crispatotrochus rugosus Cairns, *1995: 57, pl. 13, figs a-b, map 16; 1998: 378. — CAIRNS & ZIBROWIUS, 1997: 104.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 1 (MNHN). — Stn 523, 1 (MNHN). — Stn 542, 1 (MNHN). — Stn 584, 2 (USNM 98586). — Stn 589, 1 (MNHN). — Stn 610, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 977, 3 (MNHN). — Stn 988, 8 (USNM 98589). — Stn 1015, 3 (USNM 98590). — Stn 1018, 6 (USNM 98587). — Stn 1030, 2 (MNHN). — Stn 1043, 1 (MNHN). — Stn 1095, 2 (MNHN). — Stn 1106, 1 (USNM 98588).

TYPE LOCALITY. — NZOI stn Q70: 26°59.7'S, 159°18.9'E (Lord Howe Seamount Chain), 376 m.

REMARKS. — *Crispatotrochus rugosus* is distinguished from the other 10-12 species in the genus by having fine, transverse thecal ridges, and S_1 that are larger than the S_2. All but one of the specimens reported above are consistent with the type series, having 48 septa arranged in 4 cycles. However, the specimen from MUSORSTOM 8 stn 1043 (Figs 6 a-b) is considerably larger (CD = 29.2 x 18.3 mm, height = 37.1 mm) and has a fifth cycle of septa, although missing 4 pairs of S_5 (88 septa). This large specimen is similar to the fragmented specimen reported by CAIRNS and ZIBROWIUS (1997) that had an estimated GCD of 32 mm.

Corallum pigmentation is variable, including uniformly white, uniformly brownish-black, and white with brown longitudinal stripes corresponding to the C_{1-2} near the calicular edge. One specimen from MUSORSTOM 8 stn 988 contains an acrothoracican cirripede boring in its pedicel.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe and Field Banks; 286-455 m. Vanuatu region: Tanna, Efaté, Epi, and Espiritu Santo; 190-410 m. Elsewhere: Kermadec Islands; Lord Howe Seamount Chain; Philippines; Malaysia; Western Australia; 142-508 m (CAIRNS & ZIBROWIUS, 1997).

Genus *LABYRINTHOCYATHUS* Cairns, 1979

Labyrinthocyathus limatulus (Squires, 1964)

Ceratotrochus (Ceratotrochus) limatulus Squires, v*1964: 3-5, pl. 1, figs 5-9. — SQUIRES & KEYES, v.1967: 24, pl. 2, figs 9-10.
Labyrinthocyathus limatulus - CAIRNS, 1979: 70; 1995: 58, pl. 13, figs c-f, map 17.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 988, 3: 2 (MNHN), 1 (USNM 98592).

TYPE LOCALITY. — 7.2 km northeast of the Alderman Islands, Coromandel Peninsula, North Island, New Zealand, 102 m.

REMARKS. — This is the only species in the genus to have a transversely ridged theca, the ridging becoming less apparent toward the calicular edge. It is more fully described by CAIRNS (1995). This is the first record of *L. limatulus* outside the New Zealand region.

DISTRIBUTION. — Vanuatu region: Tanna; 372-466 m. Elsewhere: northern New Zealand region; Lord Howe Seamount Chain; 20-508 m (CAIRNS, 1995).

Genus *OXYSMILIA* Duchassaing, 1870

Oxysmilia circularis Cairns, 1998

Figs 6 g-h, 7 a

Oxysmilia circularis Cairns, *1998: 378, figs 2 i-k.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 977, 1 (MNHN). — Stn 983, 2 (USNM 98624). — Stn 1030, 2 (MNHN).
Kermadec Islands. NZOI: stn K830, 1 (USNM 99293). — Stn K858, 1 (USNM 99294).

TYPE LOCALITY. — *"Soela"* stn 02/82/16: 18°41'S, 117°54'E (off Port Hedland, Western Australia), 200-204 m.

REMARKS. — A characteristic of this species is the irregularity of S_5 pair insertion, some half-systems within the same specimen having a full two pairs of S_5, some only one pair, and some no S_5. A redescription of the species is not included here since it was so recently described. A specimen from MUSORSTOM 8 stn 983 is the largest known, measuring 29.8 x 27.9 mm in CD and 41.0 mm in height.

DISTRIBUTION. — Vanuatu region: Tanna and Efaté; 190-475 m. Elsewhere: northwestern Western Australia; Kermadec Islands (Curtis and Raoul), reported herein; 201-545 m.

Oxysmilia corrugata sp. nov.

Figs 6g-h, 7a

MATERIAL EXAMINED/TYPES. — **Vanuatu**. MUSORSTOM 8: stn 1030, 11: holotype and 7 paratypes (MNHN), 3 (USNM 98625).

TYPE LOCALITY. — MUSORSTOM 8 stn 1030: 17°51'S, 168°30'E (Efaté), 180-190 m.

ETYMOLOGY. — The species name *corrugata* (Latin *corrugatus*, ridged) refers to the fine file-like, regularly corrugated thecal ridging.

DESCRIPTION. — Corallum straight and elongate-conical, with a slightly flared calice. Largest specimen (holotype) 11.0 x 9.6 mm in CD, 4.3 mm in PD, and 12.5 mm in height. Calice slightly elliptical: GCD:LCD = 1.07-*1.14*-1.27. Corallum firmly attached through a thick, robust pedicel: PD:GCD = 0.39-*0.60*-0.77. Theca uniformly covered with well-defined, thin-edged, transverse ridges, about 6 parallel ridges per mm. Whereas thecal ridges occasionally bifurcate and rejoin one another, they often run uninterrupted for the entire circumference of the pedicel. Ridges cover the entire thecal surface, from base to distal peripheral edges of septa, but are often encrusted toward the base by bryozoa, foraminifera, and sponges. Corallum white.

Septa hexamerally arranged in 4 complete cycles: $S_1 > S_2 > S_3 > S_4$ (48 septa), the complete fourth cycle attained at a GCD of 5.7 mm or less. S_1 about 2.4 mm exsert, thick, having straight axial edges that penetrate into the columella, and coarsely granular faces. S_2 similar to the S_1 but slightly less wide and less exsert. S_3 slightly less exsert, wide, and thick than S_2. S_4 only slightly less exsert and wide as S_3. Thus, there are four size classes of septa, but the differences in size are minimal. Fossa of moderate depth. Columella composed of 4-6 coarse, granular papillae, which in larger coralla fuse into a solid, elongate, massive structure. The linear shape of the columella is sometimes modified into a cross-shape by short symmetrical outpocketings of the columella into the two lateral septal systems.

REMARKS. — There are three other Recent species of *Oxysmilia*: *O. rotundifolia* (H. Milne Edwards & Haime, 1848); *O. circularis* Cairns, 1998; and *O. epithecata*. *O. corrugata* differs from the first two in having a smaller

corallum with fewer septa, a transversely ridged theca, and a better-developed columella. It is compared to *O. epithecata* in the account of that species (below).

DISTRIBUTION. — Vanuatu region: Efaté; 180-190 m.

Oxysmilia epithecata sp. nov.

Figs 6 d-e, 7 b-g

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 496, 1 paratype (MNHN), SEM stub 873 (USNM 98626). — Stn 507, 2 paratypes (USNM 98627). — Stn 509, 1 paratype (USNM 98628). — Stn 511, 1 paratype (MNHN). — Stn 514, 6 paratypes (USNM 98629). — Stn 523, 2 paratypes (MNHN). — Stn 556, 1 paratype (MNHN). — Stn 605, 17 paratypes (USNM 98630). — Stn 610, 1 paratype (MNHN).
Vanuatu. MUSORSTOM 8: stn 959, 1 paratype (MNHN). — Stn 962, 1 paratype (MNHN). — Stn 1018, holotype (MNHN). — Stn 1023, 5 paratypes (MNHN). — Stn 1026, 1 paratype (MNHN). — Stn 1097, 7 paratypes (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1018: 17°53'S, 168°25'W (Efaté), 300-301 m.

ETYMOLOGY. — The species name *epithecata* (Greek *epi*, on + *theke*, sheath) refers to the wrinkled epitheca that covers the lower corallum.

DESCRIPTION. — Corallum straight and elongate-conical, with a slightly flared calice. One to four coralla often originate from the dead calicular edge of a conspecific corallum, producing a small, bushy pseudocorallum (Fig. 7 b). Holotype 7.1 x 6.4 mm in CD, 3.3 mm in PD, and 10.7 mm in height; largest specimen (MUSORSTOM 8 stn 1026) 11.3 mm in GCD. Calice circular as juvenile, becoming elliptical with age (GCD:LCD = 1.07-1.34). Corallum firmly attached through a robust pedicel (PD:GCD = 0.33-0.46) and thin, expansive, encrusting base, the base often twice the diameter of the calice. Entire base and lower quarter to half of theca covered with fine transverse epithecal ridges, those ridges on the base (6 per mm) more widely spaced than those on the pedicel (13 per mm). As in *O. corrugata*, the ridges may run uninterrupted around the entire circumference of the pedicel or base, but, in general, are more irregular in arrangement and spacing. The ridges are about 10 µm wide and 30 µm tall (Figs 7 f-g). Proximal to the epithecal ridging, the upper 3/4 to half of the theca is costate, the C_{1-2} usually slightly ridged; all costae granular. Corallum white.

Septa hexamerally arranged in 4 cycles, the fourth cycle complete only in the largest corallum: $S_1>S_2>S_3>S_4$. Coralla below 3.5 mm in GCD contain only 3 cycles of septa (24), whereas coralla with a GCD between 3.5 and 11.0 mm have an increasing number S_4, the intermediate number of 36 septa being most common. The holotype has 44 septa. S_1 up to 1.3 mm exsert, having straight axial edges that reach the columella. S_2 slightly less exsert (about 0.9 mm), also having straight axial edges that reach the columella. S_3 less exsert than S_2 and well developed only in large coralla, where they are about half the width of an S_2, their lower axial edges sometimes fusing to the adjacent S_2. S_4 least exsert septa, only developed in largest of coralla; otherwise restricted to exsert lobes at the calicular edge. Fossa deep, usually containing a deep-seated papillose columella. Small coralla often have no columella, whereas most larger coralla have a small columella composed of several small fused papillae, and one specimen (MUSORSTOM 8 stn 1097) has a robust columella.

REMARKS. — *Oxysmilia epithecata* is most similar to *O. corrugata*, both species being about the same size, having the same number of septal cycles, and having transverse thecal ridges. *O. epithecata* differs in having finer, irregular transverse ridges that are restricted to the lower corallum, and a granular costate upper theca; a less robust pedicel; less septa at a corresponding GCD; a deeper fossa; and a less developed columella.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Tuscarora Bank; 240-455 m. Vanuatu region: Anatom, Efaté, and Espiritu Santo; 288-437 m.

Genus *TROCHOCYATHUS* H. Milne Edwards & Haime, 1848

Subgenus *TROCHOCYATHUS (TROCHOCYATHUS)* H. Milne Edwards & Haime, 1848

Trochocyathus (T.) vasiformis Bourne, 1903

Figs 8 a-b, f

Trochocyathus vasiformis Bourne, v*1903: 27-28, pl. 5, figs 6-7.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 522, 1 (MNHN). — Stn 527, 1 (MNHN). — Stn 535, 2 (MNHN). — Stn 609, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 959, 2 (USNM 98634). — Stn 973, 2 (USNM 98636). — Stn 977, 19 (MNHN), SEM stub 883 (USNM 98635). — Stn 978, 4 (MNHN). — Stn 983, 3 (MNHN). — Stn 1006, 1 (MNHN). — Stn 1011, 1 (MNHN). — Stn 1015, 1 (USNM 98633). — Stn 1019, 1 (MNHN). — Stn 1067, 8 (USNM 98632). — Stn 1072, 1 (MNHN). — Stn 1107, 1 (MNHN).

Indonesia *(Mollucas)*. KARUBAR: stn 5, 2 (USNM 98637).

TYPE LOCALITY. — Tutanga, Funafuti, Tuvalu Islands, 366 m.

DESCRIPTION. — Corallum straight, elongate-conical (ceratoid), and attached through a robust pedicel (PD:GCD = 0.47-0.84) and an encrusting base. Largest specimen (MUSORSTOM 8 stn 977) 14.9 x 11.9 mm in CD and 25 mm in height. Calice elliptical: GCD:LCD = 1.11-1.35. Theca thick; costae usually low, rounded, and finely granular, but occasionally C_{1-2} are slightly ridged. Theca and outer septa a light yellow-brown (beige), the pali and columella white; however, one specimen (MUSORSTOM 8 stn 1107) completely white.

Septa regularly hexamerally arranged in 4 complete cycles: $S_{1-2}>S_{3-4}$ (48 septa). S_{1-2} exsert (up to 2.5 mm), having straight axial edges each bordered by a small (0.4 mm wide) palus; however, the 2 P_1 aligned with the greater calicular axis (those before the principal septa) only about half width and not as exsert as the other P_{1-2}. S_{3-4} equal in width, about 3/4 that of the S_{1-2}; although equal in width, S_3 slightly more exsert than S_4. A single, well-defined, elliptical palar crown occurs in the fossa, composed of 12 P_{1-2} and 12 P_3, the P_3 2-3 times the width (0.9-1.0 mm) of the P_{1-2} and usually rising slightly higher in the fossa. A large P_3 alternates with each smaller P_{1-2}, but axial edges of all pali are the same distance from the columella, which gives the impression of a single crown, even though the pali are of three size classes and heights. Each palus bears several prominent, finely dentate, obliquely-oriented menianes (Fig. 8f). Outer edges of P_3 quite broad, occupying not only space before the S_3 but the two adjacent S_4. Fossa of moderate depth. Columella an elliptical field of 10-25 slender, foliaceous elements. Columellar elements often shaped as papillae that support several horizontal to slightly inclined, circular plates, the papillae passing through the centre of these platelets (Fig. 8f). The shape of the columellar elements is intermediate between the typical papillose elements characteristic of *Trochocyathus* and the twisted elements common to *Caryophyllia*.

REMARKS. — This is believed to be the first report of this species subsequent to its description, most of the specimens reported above collected in the same sector of the Pacific as the type locality (Funafuti), and at similar depths to the types. The species is distinctive in having prominent menianes on its pali, a beige corallum, and distinctively shaped columellar elements.

BOURNE (1903) stated in the original description that the smaller, worn syntype had only 42 septa, lacking 3 pairs of S_4, but that specimen (BM 1903.12.1.5-6) actually has 44 septa, lacking pairs of S_4 only in half-systems II and IV, as counted from a principal septum.

Specimens from four stations contained coralla that were bored by acrothoracican cirripede Crustacea: MUSORSTOM 7 stn 609, MUSORSTOM 8 stns 959, 977, and 1011.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch Bank; 430-650 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Malakula, and Espiritu Santo; 366-622 m. Elsewhere: Banda Sea (recorded herein); Funafuti; 323-366 m.

Trochocyathus (T.) rhombocolumna Alcock, 1902

Trochocyathus rhombocolumna Alcock, v*1902a: 98; v.1902c: 16, pl. 2, fig. 12. — CAIRNS, 1995: 60-61, pl. 13, fig. 1, pl. 14, figs a-b, map 19 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 106-107.
Paracyathus tenuicalyx Vaughan, v*1907: 69-70, pl. 6, figs 1a-b.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 977, 1 (MNHN). — Stn 1060, 1 (USNM 98631).

TYPE LOCALITY. — *"Siboga"* stn 95: 5°43.5'N, 119°40'E (Sulu Sea), 522 m.

REMARKS. — This relatively commonly collected species is distinguished by having a transversely ridged theca (basally); hexamerally symmetrical septa ($S_1>S_2>S_4>S_3$); three size classes of pali, the P_{2-3} of each system arranged in a distinctive chevron pattern; and robust columellar elements. It is more fully described and illustrated by CAIRNS (1995).

DISTRIBUTION. — Vanuatu region: Tanna and Malakula; 397-410 m. Elsewhere: Indo-West Pacific from southwestern Indian Ocean to Hawaiian Islands; 110-530 m (CAIRNS & ZIBROWIUS, 1997).

Trochocyathus (T.) philippinensis Semper, 1872

Trochocyathus philippinensis Semper, v*1872: 253, pl. 20, fig. 16. — CAIRNS & ZIBROWIUS, 1997: 107-108, figs 10 d-e. — CAIRNS, 1998: 380.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 496, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 969, 2 (MNHN). — Stn 976, 23 (USNM 98678). — Stn 1070, 1 (MNHN). — Stn 1071, 1 (MNHN). — Stn 1086, 2 (MNHN).

TYPE LOCALITY. — Pandanon, Philippines, 27-54 m.

REMARKS. — *Trochocyathus philippinensis* is characterized as having a small straight, ceratoid corallum; a porcellaneous theca that is pigmented chocolate-brown near the calicular edge; and a hexameral symmetry of $S_{1-2}>S_{3-4}$. Some specimens have several thecal edge spines or slightly more prominent edge costae. The species was more fully described and illustrated by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 250-330 m. Vanuatu region: Anatom, Tanna, Espiritu Santo, and Malakula; 182-252 m. Elsewhere: Ryukyu Islands; South China Sea; Philippines; Indonesia; northwestern Australia; 54-268 m (CAIRNS & ZIBROWIUS, 1997).

Trochocyathus (T.) maculatus Cairns, 1995

Trochocyathus maculatus Cairns, *1995: 61, pl. 14, figs c-d. — CAIRNS & ZIBROWIUS, 1997: 107.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 499, 2 (USNM 98641). — Stn 504, 11 (MNHN). — Stn 505, 1 (MNHN). — Stn 508, 3 (MNHN). — Stn 509, 3 (USNM 98639). — Stn 524, 4 (USNM 98640). — Stn 546, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 961, 1 (MNHN). — Stn 1021, 2 (MNHN). — Stn 1047, 1 (MNHN). — Stn 1077, 1 (MNHN).

TYPE LOCALITY. — NZOI stn P115: 31°25.9'S, 159°02.2'E (Lord Howe Island), 183 m.

REMARKS. — This species is distinguished from other *Trochocyathus* by having distinctively speckled (brown-black) theca and septa, and by having exothecal dissepiments that cover raised costae around its base, similar to the morphology of *Rhizosmilia*. It was fully described and figured by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe Bank; 240-550 m. Vanuatu region: Anatom, Efaté, Epi, and Malakula; 110-486 m. Elsewhere: Philippines; Kermadec Islands; Lord Howe Islands; seamounts off eastern Australia; 92-183 m.

Trochocyathus (T.) efateensis sp. nov.

Figs 8 d-e

MATERIAL EXAMINED/TYPES. — **Vanuatu**. MUSORSTOM 8: stn 1019, 25: holotype and 19 paratypes (MNHN), 5 paratypes (USNM 98642). — Stn 1020, 1 paratype (MNHN). — Stn 1026, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1019: 17°38'S, 168°34'E (Efaté), 397-430 m.

ETYMOLOGY. — Although this species is not thought to be endemic to Efaté, it is named for the island of its type locality.

DESCRIPTION. — Corallum straight, elongate-conical, having a slightly flared calice, and attached through a slender (PD:GCD = 0.29-0.42), but solid, pedicel. Pedicel reinforced with layers of textura, which are usually subsequently encrusted by epizoic organisms. Calice strongly elliptical (GCD:LCD = 1.21-2.00), small coralla being closer to circular, larger coralla becoming more elongate, sometimes slightly constricted medially. The constriction is accentuated by an upward arching of the calicular edges as viewed from the side. Holotype 16.7 x 11.2 mm in CD, 5.7 mm in PD, and 21.6 mm in height; largest specimen (MUSORSTOM 8 stn 1028) 17.3 x 13.6 mm in CD. Costae broad, equal in width, and inconspicuous, covered with low, rounded granules. Corallum uniformly white.

Septa hexamerally arranged in 5 cycles, the fifth cycle never complete ($S_{1-2}>S_3>S_4>S_5$). One specimen (MUSORSTOM 8 stn 1019) of 13.4 mm GCD contains only 4 cycles of septa (48), but all other coralla have between 1 and 10 pairs of S_5, resulting in 50-68 septa. The holotype contains 68 septa. Order of insertion of S_5 pairs quite irregular, but S_5 pairs tend to be more common in end systems; some systems may contain 3 pairs of S_5 and other systems within the same corallum no S_5. All septa equally exsert (1.3-1.5 mm), having straight axial edges. S_{1-2} quite thick: 0.8-1.1 mm at their widest upper edges. The remaining three size classes of septa are less thick and progressively less wide, the S_5 being about half the width of an S_{1-2}. All pali have straight, thin axial edges that border the columella, and broad, ridged peripheral edges that are separated from their corresponding septa by narrow slits. Distal edges of all pali bluntly pointed, not evenly rounded as in most species of the genus. The 12 slender (0.8 mm wide) P_{1-2} form an elliptical crown around the columella. The 12 P_3 are about twice the width and rise higher in the fossa than the P_{1-2}, but, since their axial edges are in the same position relative to the columella as those of the P_{1-2}, the P_3 contribute to the same palar crown. P_4 present only when pairs of S_5 occur, these pali about the same width of a P_{1-2}, but recessed farther from the columella and positioned higher in the fossa. Fossa of moderate depth. Columella papillose, composed of 9-20 robust, irregularly-shaped, granular elements, in some coralla rhomboidal in cross section.

REMARKS. — Of the 29 Recent species in the nominate subgenus of *Trochocyathus*, *T. efateensis* is most similar to *T. caryophylloides* Alcock, 1902. Although both species may have 64 septa, *T. caryophylloides* achieves it by having 16 sectors (three size classes of septa and two size classes of pali), whereas *T. efateensis* retains a hexameral symmetry and has four size classes of septa and three size classes of pali. *T. efateensis* is further differentiated by its thick S_{1-2}, equally exsert septa, highly elliptical calice, and arched upper thecal faces.

DISTRIBUTION. — Vanuatu region: Efaté; 391-437 m.

Trochocyathus (T.) patelliformis sp. nov.

Figs 8 g, 9 a-c

MATERIAL EXAMINED/TYPES. — **Vanuatu**. MUSORSTOM 8: stn 1111, 1 paratype (MNHN).
Hawaiian Islands. HURL: stn P5-063, holotype (USNM 83026).

TYPE LOCALITY. — HURL stn P5-063: 20°35.8'N, 156°03.5'W (Alenuihaha Channel, Hawaiian Is.), 1020 m.

ETYMOLOGY. — The species name *patelliformis* (Latin *patella*, small pan + *forma*, shape) refers to the patelliform shape of the corallum, which in Scleractinia includes those species having a basal angle of 80°-160°.

DESCRIPTION. — Corallum short and patellate, the thecal edges diverging at about 120° from a massive basal attachment. Holotype 22.7 x 19.2 mm in CD, 9.0 mm in pedal attachment, and only 11.0 mm in height. Smaller paratype 10.9 mm in GCD. Costae well defined, rounded, and covered with fine, spiny granules. Intercostal grooves equal in width to costae on lower corallum, becoming wider and deeper near calicular edge. Corallum uniformly white.

Septa hexamerally arranged in 5 cycles, the fifth cycle incomplete ($S_{1-2}>S_3>S_4>S_5$). The holotype contains 12 pairs of irregularly inserted S_5: 5 half-systems having 2 pairs of S_5, 5 having no S_5, and 2 half-systems having 1 pair of S_5, for a total of 72 septa. The smaller paratype contains 8 pairs of incipient S_5, also irregularly distributed, or 64 septa. S_{1-2} highly exsert (up to 3.7 mm), having straight axial edges and granular faces. S_3 less exsert (about 3.3 mm) and 3/4 width of S_{1-2}. S_4 less exsert (about 2.7 mm) but almost as wide as the S_3. S_5 about 1.3 mm exsert and 3/4 width of an S_4. Two size classes and 4 crowns of pali occur in the holotype. The 6 S_1 are quite large (2.2 mm wide), each having a straight axial edge that abuts the columella, but a moderately sinuous peripheral edge, separated from its corresponding septum by a small notch. Remaining pali (P_2-P_4) all about 1.7 mm wide, each cycle progressively more recessed from the columella and rising slightly higher in the fossa. Fossa shallow. Columella composed of several finely granulated massive papillae that are fused into an irregular, elongate mass.

REMARKS. — *Trochocyathus patelliformis* is unique among the approximately 29 Recent, valid species in the genus in having a patellate-shaped corallum, in having P_1 that are significantly broader than the higher cycle pali, and in having finely spinose costae. The Hawaiian holotype was diagnosed as a potentially new species shortly after its collection in 1988 but put aside until more specimens might be collected. The Vanuatu paratype, while apparently a juvenile corallum, was collected from a similar depth range and is morphologically consistent with the holotype.

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 1210-1250 m. Elsewhere: Hawaiian Islands; 1010 m.

Trochocyathus (T.) semperi Cairns & Zibrowius, 1997

Trochocyathus (T.) semperi Cairns & Zibrowius, *1997: 108-109, figs 10g-h, 11f.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1103, 1 (MNHN).

TYPE LOCALITY. — CORINDON 2 stn 251: 0°53.7'S, 119°29.6'E (Makassar Strait), 65 m.

REMARKS. — This recently described species is distinguished from all others in the genus by having spatulate edge spines and decameral septal symmetry (10:10:20, 40 septa).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 163-165 m. Elsewhere: Philippines; Indonesia; 38-245 m (CAIRNS & ZIBROWIUS, 1997).

Trochocyathus (T.) cooperi (Gardiner, 1905)

Tropidocyathus cooperi Gardiner, *1905: 955, pl. 93, fig. 30.
Trochocyathus cooperi - CAIRNS, 1994: 54, pl. 23, figs f-g. — CAIRNS & ZIBROWIUS, 1997: 111, fig. 11e (synonymy).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 961, 1 (MNHN). — Stn 1021, 1 (MNHN).

TYPE LOCALITY. — Kolumadulu and Suvadiva, Maldive Islands, 64-70 m.

REMARKS. — This is a very distinctive species, characterised by having transverse division, thecal edge crests, and usually a brown mottled pigmentation at the calicular edge. It is more fully described and illustrated by CAIRNS (1994).

DISTRIBUTION. — Vanuatu region: Anatom and Efaté; 101-124 m. Elsewhere: widespread from Maldive Islands to northern Ryukyu Islands and the Marquesas; 25-100 m (CAIRNS & ZIBROWIUS, 1997).

Trochocyathus (T.) discus Cairns & Zibrowius, 1997

Figs 9 d-e, 18 a

Trochocyathus (T.) discus Cairns & Zibrowius, *1997: 112, figs 11 g-h, 12 a-c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: 539, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 958, 1 (MNHN). — Stn 1088, 3 cemented to a *Xenophora* gastropod shell (MNHN). — Stn 1089, 1 (MNHN). — Stn 1090, 1 (USNM 98643).

TYPE LOCALITY. — KARUBAR stn 3: 5°48'S, 132°12'E (Kai Islands, Banda Sea), 278-300 m.

REMARKS. — Little can be added to the original description except to note that the corallum from MUSORSTOM 8 stn 1089 (Figs 9 d-e) is the largest yet recorded: 11.3 x 9.3 mm in CD and 7.9 mm in height. The species is characterised by having a discoidal to bowl-shaped corallum; a flat base, the result of transverse division; four cycles of septa, the S_4 adjacent to the S_1 being wider than the S_3; and having a reddish-brown pigment to the calicular edge.

DISTRIBUTION. — Wallis and Futuna region; Combe Bank; 700 m. Vanuatu region: Anatom and Espiritu Santo; 455-497. Elsewhere: Banda Sea; 240-278 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *TROCHOCYATHUS (APLOCYATHUS)* d'Orbigny, 1849

Trochocyathus (A.) hastatus Bourne, 1903

Trochocyathus hastatus Bourne, v*1903: 29-32 (in part: pl. 5, figs 2-3; not pl. 6, figs 8-11, = *Bourneotrochus stellulatus* Cairns, *1984). — CAIRNS, 1995: 63-64, pl. 15, figs c-h, map 21.
Stephanocyathus (Acinocyathus) hastatus - WELLS, v.1984: 213.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 523, 1 (MNHN). — Stn 555, 1 (MNHN). — Stn 586, 1 (MNHN). — Stn 618, 1 (MNHN). — Stn 619, 2 (MNHN).
Vanuatu. MUSORSTOM 8: stn 959, 7 (MNHN). — Stn 963, 3 (USNM 98645). — Stn 977, 2 (USNM 98646). — Stn 1019, 2 (USNM 98644). — Stn 1020, 1 (MNHN).

TYPE LOCALITY. — Tutanga, Funafuti, Tuvalu, 366 m.

REMARKS. — *Trochocyathus hastatus* is compared to the other two Recent species in the subgenus in Table 5, and was redescribed and illustrated by CAIRNS (1995). It is easily distinguished from congenerics by having hexameral septal symmetry but only 5 costal spines. CAIRNS (1995) noted that the S_1 unaccompanied by a costal spine was always significantly smaller than the other S_1; however, both this septum and the opposing principal S_1 (opposite to the first) are equally small, the 4 other lateral S_1 being significantly wider and more exsert.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Alofi; Tuscarora Bank; 435-540 m. Vanuatu region: Anatom and Efaté; 391-436 m. Elsewhere: Kermadec Islands; Funafuti; 366-710 m (CAIRNS, 1995).

Table 5. — Comparison of the three Recent species of *Trochocyathus (Aplocyathus)*.

	T. (A.) hastatus Bourne, 1903	*T. (A.) brevispina* Cairns & Zibrowius, 1997	*T. (A.) longispina* Cairns & Zibrowius, 1997
Nature of Base	Rounded (protuberant); small, circular scar; porcellaneous	Usually flat; hexagonally shaped epitheca surrounds epicentre, substrate usually incorporated in base; porcellaneous	Usually flat; circular scar; granular
Costae near Calicular Margin	Finely granular	Coarsely granular	Coarsely granular
Maximum Calicular Diameter (mm)	18.0	26.1	17.0
Colour of Corallum	Upper theca and septa brown-black	Upper theca and septa usually reddish-brown	White
Number (Size) and Shape of Costal Spines	5 elongate (up to 15 mm) spines, circular in cross section	6 compressed spines (up to 8 mm), often ridged basally and extending to epicentre; often crooked or curved	6 elongate (up to 10 mm) spines, circular in cross section
Septal Formula (Number of Septa); S_1 Dimorphism	$S_1>S_2>S_4><S_3$ (48); 2 principal S_1 smaller then others	$S_1>S_2>S_4\geq S_3>S_5$ (48-72); all S_1 equal-sized	$S_{1\text{-}2}>S_3>S_4$ (48); all S_1 equal-sized
Relative Palar Width (Number of Palar Crowns)	$P_1<P_2<<P_3$ (3 crowns)	$P_{1\text{-}4}$ equal-sized (3 or 4 crowns)	$P_{1\text{-}2}<<P_3$ (2 crowns)
Distribution; Depth	Funafuti, Wallis, Vanuatu, Kermadec Islands; 366-710 m	Banda Sea, Vanuatu region; 240-560 m	Philippines, Celebes Sea; 326-760 m

Trochocyathus (A.) brevispina Cairns & Zibrowius, 1997

Figs 9 f-i

Trochocyathus (A.) brevispina Cairns & Zibrowius, *1997: 113, figs 12 d-f.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 959, 2 (MNHN). — Stn 963, 65: 56, including one cemented to a *Xenophora* shell (MNHN), 9 (USNM 98649). — Stn 964, 14 (MNHN). — Stn 999, 1 (USNM 98647). — Stn 1003, 4 (MNHN). — Stn 1004, 12: 8 (MNHN), 4 (USNM 98648). — Stn 1020, 1 (MNHN). — Stn 1058, 2 (MNHN). — Stn 1065, 1 (MNHN).

TYPE LOCALITY. — KARUBAR stn 3: 5°47'40"S, 132°12'11"E (Kai Islands, Banda Sea), 278-300 m.

REMARKS. — *Trochocyathus brevispina* is compared to the other two Recent species in the subgenus in Table 5, and was described and illustrated by CAIRNS & ZIBROWIUS (1997). It is easily distinguished from other species by its relative septal and palar sizes and by its frequent incorporation of substrate into its base. The most commonly incorporated substrates are gastropod and bivalve fragments (Figs 9 f, i), but also include: pteropod shells, sand conglomerate, pebbles, serpulid tubes, and other dead solitary corals.

The specimens reported above allow the observation that the costal spines are often curved or crooked, and can reach a length of up to 8 mm. Although not as long as the 10 mm costal spines of *T. longispina*, the distinction of costal spine length between these two species is not as much as previously thought and hardly warrants the etymological distinction; however, several other characters do distinguish these two species (Table 5).

Specimens from three stations (MUSORSTOM 8 stn 1004, 1058, and 1103) bear elaborate, irregularly-shaped, nodular proliferations at the base of their costal spines and sometimes around the entire calicular edge (Figs 9 g-h). It is unknown what stimulates or irritates the coral to produce these growths.

One aberrant specimen from MUSORSTOM 8 stn 963 of 16.5 mm GCD is septameral in septal and costal symmetry, having 7 septal systems (54 septa, 1 half-system lacking S_4) and 7 costal spines.

DISTRIBUTION. — Vanuatu region: Anatom, Erromango, Efaté, and Malakula; 110-436 m. Elsewhere: Banda Sea; 240-560 m (CAIRNS & ZIBROWIUS, 1997).

Genus *TETHOCYATHUS* Kühn, 1933

Tethocyathus virgatus (Alcock, 1902)

Trochocyathus (Tethocyathus) virgatus Alcock, v*1902a: 98-99; v.1902c: 16-17, pl. 2, fig. 13.
Tethocyathus virgatus - CAIRNS, 1995: 65-66, pl. 16, figs c-f, map 11 (synonymy). — CAIRNS & ZIBROWIUS, 1997: 114-115.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 1 (MNHN). — Stn 522, 1 (USNM 98652).
Vanuatu. MUSORSTOM 8: stn 973, 7 (USNM 98650). — Stn 977, 5 (MNHN). — Stn 978, 2 (MNHN). — Stn 982, 2 (MNHN). — Stn 1015, 1 (MNHN). — Stn 1026, 1 (MNHN). — Stn 1095, 1 (MNHN). — Stn 1108, 3 (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 96 and 105: Sulu Archipelago, 275 m.

REMARKS. — *Tethocyathus virgatus* is more fully described and illustrated by CAIRNS (1995). One of the differences between this species and the species of the similar genus *Trochocyathus* is that the edge zone of *T. virgatus* periodically secretes additional nontrabecular calcium carbonate on the outside of the corallum, which, in time, produces a very thick theca, transforming a conical corallum into a subcylindrical or cylindrical shape. The layering of the added calcium carbonate is particularly noticeable in a basal fracture, and additional evidence of the periodic layering is evidenced by the covering and incorporation into the theca of small epizoic organisms that become covered and subsequently buried in the increasingly thick theca. According to STOLARSKI (1995), the proper name for this deposit is textura, not epitheca, the latter term being reserved for nontrabecular calcium carbonate that is secreted only at the calicular edge of a corallum (lappet cavity) and that does not periodically form layers. One of the adaptive values of textura (in the basal region) is to strengthen attachment to a substrate; however, it is suggested that another possible adaptive value of textura (in the wall region) is to guard against the boring of acrothoracican cirripeds, to which this genus is particularly susceptible (see ZIBROWIUS, 1976; CAIRNS, 1995; CAIRNS & ZIBROWIUS, 1997). Coralla from two stations (MUSORSTOM 8 stns 972 and 982) contain coralla having the characteristic lenticular-shaped outline of acrothoracican cirripede borings in the corallum of living specimens.

DISTRIBUTION. — Wallis and Futuna; 450-650 m. Vanuatu region: Tanna, Efaté, and Espiritu Santo; 320-460 m. Elsewhere: Philippines; Indonesia; ridges north of New Zealand; 137-530 m.

Genus *POLYCYATHUS* Duncan, 1876

Polycyathus octuplus sp. nov.

Figs 10 a-c

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 494, 1 holotype (MNHN). — Stn 496, 2 paratypes (MNHN). — Stn 499, 1 paratype (USNM 98654). — Stn 504, 7 paratypes (MNHN), 3 paratypes (USNM 98653). — Stn 509, 3 paratypes (MNHN). — Stn 513, 1 paratype (MNHN). — Stn 516, 1 paratype (MNHN).
Solomon Islands *(Pelau)*: short drop off, 90 m, 3 paratypes (USNM 98954).

TYPE LOCALITY. — MUSORSTOM 7 stn 494: 14°18.9'S, 178°03.0'W (Futuna), 100-110 m.

ETYMOLOGY. — The species name *octuplus* (Latin *octuplus*, eight fold) refers to the octameral septal symmetry.

DESCRIPTION. — Corallum solitary, straight, and subcylindrical, firmly attached to substrate through a thick pedicel (PD:GCD = 0.56-0.79). Holotype 6.7 x 6.4 mm in CD, 4.4 mm in PD, and 7.5 mm in height. Calice circular to slightly elliptical: GCD:LCD = 1.02-1.20. Costae well developed and finely granular; however, at an early stage thin bands of epitheca are secreted around the corallum base, and as the coral increases in size the epithecal bands thicken, eventually extending from the base to the calicular edge. Underlying costae and outer edges of septa chocolate brown in colour, but overlying epitheca, basal encrustation, pali and columella are white.

Septa octamerally arranged in 2 or 3 size classes. Small coralla below a GCD of 4.6 mm usually have 8 primary septa and 24 equally-sized secondary and tertiary septa (8:8:16, 32 septa). Larger coralla have up to 5 pairs of quaternary septa (e.g., the holotype, 8:8:16:10, 42 septa) as 3 size classes of septa: primaries, secondaries, and tertiaries + quaternaries, the latter two of equal size. One aberrant specimen (MUSORSTOM 7 stn 504) has heptameral symmetry (7:7:14:6, 34 septa, Fig. 10 c). Primary septa about 1.2 mm exsert, having moderately sinuous distal and axial edges. In small specimens, secondaries and tertiaries of equal exsertness (about 0.9 mm) and width (about 3/4 that of the primaries), also having sinuous distal and axial edges. In larger specimens containing sectors in which quaternaries are present, the secondaries are slightly wider than the remaining tertiaries and quaternaries. Quaternaries equal in size to tertiaries. Small pali (0.3-0.4 mm wide) occur on axial edges of the primary septa, whereas the pali flanking the secondary septa are twice as wide and rise slightly higher in the fossa. Occasionally there is an accessory paliform lobe internal to the P_2. When quaternary septa occur in a sector, the flanked tertiary septum bears a palus of equal size to the P_2, but slightly recessed from the columella and also rising slightly higher than the P_2. All pali are obliquely carinate and highly sinuous, their peripheral edges (edge adjacent to their corresponding septum) being quite contorted. Fossa shallow, containing a discrete columella composed of a field of 10-16 slender, finely granular papillae.

REMARKS. — It is with some hesitation that this species is placed in *Polycyathus*, since it does not display the defining character for the genus, i.e., budding from a common encrusting coenosteum. It may be that all the specimens examined are founder corallites or that they were broken from the substrate above their common attachment. In all other characteristics, this species is characteristic of the genus *Polycyathus*. Five species of this genus are known from the western Pacific: *P. fulvus* Wijsman-Best, 1970; *P. hodgsoni*, *P. marigondoni*, and *P. furanaensis*, all described by VERHEIJ and BEST, 1987; and *P. norfolkensis* Cairns, 1995. *P. octuplus* differs from these and all other known species (BEST *et al.*, in press) in having primarily octameral septal symmetry.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 110-441 m. Elsewhere: Solomon Islands, Pelau; 90 m.

Genus ***BOURNEOTROCHUS*** Wells, 1984

Bourneotrochus stellulatus (Cairns, 1984)

Figs 8 c, 10 d-g

Trochocyathus hastatus Bourne, v*1903: 32-37 (in part: pl. 6, figs 9-11).
Deltocyathus stellulatus Cairns, *1984: 15-16, pl. 3, figs C-D.
Bourneotrochus veroni Wells, v*1984: 213-214, pl. 3, figs 7-18.
Bourneotrochus stellulatus - CAIRNS, 1995: 71-72, pl. 18, figs f, i, pl. 19, figs a-c, map 18. — CAIRNS & ZIBROWIUS, 1997: 115.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 509, 4 (MNHN) and SEM stub 879 (USNM 98708). — Stn 510, 3 including 1 anthocaulus (MNHN). — Stn 511, 14 including 3 anthocauli and SEM stubs 880-881 (USNM 98704). — Stn 512, 65 including 1 anthocaulus (MNHN). — Stn 513, 25 including 1 anthocaulus

(USNM 98707). — Stn 514, 13 (USNM 98706). — Stn 516, 5 (USNM 98705). — Stn 556, 2 (MNHN). — Stn 569, 3 (MNHN). — Stn 585, 5 including 3 anthocauli (USNM 98710). — Stn 586, 2 (MNHN). — Stn 591, 1 (MNHN). — Stn 594, 2 (MNHN). — Stn 595, 1 (MNHN). — Stn 604, 13 including 3 anthocauli and SEM stub 878 (USNM 98711). — Stn 605, 8 (USNM 98711). — Stn 608, 5 (USNM 98709). — Stn 610, 14 including 1 anthocaulus (MNHN). — Stn 618, 3 anthocauli (MNHN).

Vanuatu. MUSORSTOM 8: stn 963, 2 cemented to *Xenophora* shell (MNHN). — Stn 969, 1 (MNHN). — Stn 1018, 1 cemented to *Xenophora* shell (MNHN). — Stn 1023, 1 cemented to *Xenophora* shell (MNHN). — Stn 1061, 1 (MNHN). — Stn 1087, 2 cemented to *Xenophora* shells (MNHN). — Stn 1097, 11 cemented to *Xenophora* shells (MNHN). — Stn 1106, 10 cemented to *Xenophora* shells (MNHN).

TYPE LOCALITY. — HON stn 9-3: 19°48'N, 154°58'W (off Hawaiian Islands), 337 m.

REMARKS. — The anthocyathus of *B. stellulatus* was recently redescribed and illustrated by CAIRNS (1995); however, the anthocaulus stage remained unknown. Of the 215 specimens reported above, 15 are the anthocaulus stage, in some cases still attached to an incipient anthocyathus (Fig. 10 e). The anthocaulus is cylindrical to barrel shaped, 1.5-2.9 mm in height and 2.6-3.3 mm in maximum diameter, usually having 36 septa, as in most of anthocyathi. The base is slightly expanded over the substrate and firmly attached to it. It has a white, porcellaneous theca and lacks spines. The small, still-attached anthocyathus also lack costal spines at this stage.

Most anthocyathi examined contained 36 septa, one pair of S_4 in each system. Because the costal spines are associated with the C_1, they are symmetrically distributed around the perimeter of the corallum (Fig. 10 d). However, about 20% of the examined coralla lack one to three pairs of S_4, resulting in a total of 30-34 septa and a closer arrangement of the costal spines that border these systems. Some anthocyathi (e.g., MUSORSTOM 7 stn 513, 594, 604) appear to have the ability to asexually bud another anthocyathus from its calice. These "secondary" anthocyathi are small (2.7-3.0 mm in diameter), cylindrical coralla that have a well-developed basal scar, lack spines, often have less than 36 septa, and appear to have a primitive epithecal wall.

Although no anthocyathus was found to have a CD larger than that previously reported (i.e., 6 mm by CAIRNS, 1995), some specimens (e.g., MUSORSTOM 7-510) have elongate costal spines up to 4 mm long, twice the previously reported length.

Among the 21 coral species found cemented to *Xenophora* shells, *B. stellulatus* was most commonly found, 27 coralla recorded from six MUSORSTOM stations (see Material Examined). In all cases the calicular face was directed upward and in some cases the corallum appeared to have been alive when collected.

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Tuscarora, Waterwitch, and Field Banks; 240-566 m. Vanuatu region: Anatom, Efaté, Malakula, and Espiritu Santo; 280-458 m [Pleistocene of Espiritu Santo (Wells, 1984)]. Elsewhere: Queensland; ridges north of New Zealand; Indonesia; Chesterfield Islands; Funafuti and Tuvalu; Cook Islands; Hawaiian Islands; 263-476 m (CAIRNS & ZIBROWIUS, 1997).

Genus *STEPHANOCYATHUS* Seguenza, 1864

Subgenus *STEPHANOCYATHUS (STEPHANOCYATHUS)* Seguenza, 1864

Stephanocyathus (S.) regius Cairns & Zibrowius, 1997

Figs 10 h, 11 a-c

Stephanocyathus (S.) regius Cairns & Zibrowius, *1997: 117-118, figs 14a-c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 564, 68 (MNHN). — Stn 565, 8 (USNM 98659). — Stn 567, 14 (MNHN). — Stn 621, 5 (MNHN). — Stn 623, 2 (MNHN). — Stn 635, 24 (MNHN). — Stn 636, 14 (MNHN). — Stn 637, 14 (USNM 98660).

Vanuatu. MUSORSTOM 8: stn 990, 1 (MNHN). — Stn 992, 5 (USNM 98655). — Stn 996, 2 (MNHN). — Stn 1007, 2 (MNHN). — Stn 1036, 11 (MNHN). — Stn 1109, 5 (USNM 98656). — Stn 1110, 1 (MNHN). — Stn 1125, 1 (USNM 98658). — Stn 1127, 1 (MNHN). — Stn 1129, 8, including SEM stub 882 (USNM 98657).

TYPE LOCALITY. — *"Hokuho-Maru"* stn KH72-1-26: 9°27'S, 127°58.6'E (Timor Sea, south of Leti Islands), 610-690 m.

REMARKS. — Little can be added to the original description; however, the microstructure of an actively growing costal edge was examined, which revealed its irregularly-shaped tufts of calcareous fibres. The tufts measured 11-15 µm in diameter, and consisted of elongate fibres about 0.9 µm in diameter (Figs 11 b-c).

DISTRIBUTION. — Wallis and Futuna region: Tuscarora, Combe, and Rotumah Banks; 700-1280 m. Vanuatu region: Erromango, Efaté, and Espiritu Santo; Guyot Bougainville; 775-1550 m. Elsewhere: South China Sea; Philippines; Indonesia; Kermadec Islands; 563-2160 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *STEPHANOCYATHUS (ODONTOCYATHUS)* Moseley, 1881

Stephanocyathus (O.) coronatus (Pourtalès, 1867)

Figs 11 d-f

Platycyathus coronatus Pourtalès, v*1867: 114.
Odontocyathus coronatus - MOSELEY, v.1881: 148-151, pl. 2, figs 4a-b, 5a-b.
Sabinotrochus flatiliseptis Alcock, v*1902a: 103; v.1902c: 26, pl. 4, figs 24, 24a (**new synonymy**).
Stephanocyathus (O.) coronatus - CAIRNS, 1979: 109-111, pl. 20, figs 5-6, 8-9 (synonymy); 1995: 69, pl. 17, figs j-l, pl. 18, figs a-b.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 621, 3 (MNHN). — Stn 622, 4 (MNHN). — Stn 623, 7 (USNM 98661).
Vanuatu. MUSORSTOM 8: stn 956, 2 (MNHN). — Stn 1125, 1 (MNHN).

TYPE LOCALITY. — 30°41'N, 77°03'W (Blake Plateau off Florida), 841 m.

REMARKS. — This species was recently redescribed and illustrated based on specimens collected from submarine ridges north of New Zealand (CAIRNS, 1995). The material reported herein contains several ontogenetic suites including coralla as small as 9 mm CD, which allows the synonymy of the juvenile specimen ALCOCK (1902a) reported as *Sabinotrochus flatiliseptis*. The holotype of ALCOCK's species (CD = 11.6 mm) was figured by CAIRNS & ZIBROWIUS (1997: fig. 14i) and a similarly-sized corallum (CD = 9.1 mm) is figured herein (Fig. 11 f).

DISTRIBUTION. — Wallis and Futuna region: Combe Bank; 1280-1300 m. Vanuatu region: Anatom; Guyot Bougainville; 1175-1210 m. Elsewhere: Selayar, Flores Sea (ALCOCK, 1902a); Lord Howe Rise; Three Kings Ridge; Kermadec Ridge; western Atlantic; 543-1276 m (CAIRNS, 1995).

Stephanocyathus (O.) weberianus (Alcock, 1902)

Stephanotrochus weberianus Alcock, v*1902a: 101-102; v.1902c: 25, pl. 3, figs 22, 22a.
Stephanotrochus sibogae Alcock, v*1902a: 101-102; v.1902c: 25-26, pl. 3, figs 23, 23a.
Stephanocyathus (O.) ixine Squires, v*1958: 54 (in part: *"Albatross"* stn 5545, pl. 8, figs 3-4).
Stephanocyathus (O.) weberianus - CAIRNS, 1994: 57-58, pl. 25, figs d-f (synonymy); 1995: 68-69, pl. 17, figs g-i (synonymy). — CAIRNS & ZIBROWIUS, 1997: 119-120, figs 14g-h.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1074, 7 (USNM 98662). — Stn 1080, 3 (MNHN).

TYPE LOCALITY. — *"Siboga"* stn 284: 8°43.1'S, 127°16.7'E (Timor Sea), 828 m.

REMARKS. — The species was redescribed and illustrated by CAIRNS (1994) and compared to *S. (O.) coronatus* by CAIRNS (1994, 1995). It is a relatively common deep-water species found throughout the western Pacific at depths of 700-1500 m.

DISTRIBUTION. — Vanuatu region: Espiritu Santo and Malakula; 798-799 m. Elsewhere: western Pacific from Japan to Lord Howe Seamount Chain; 206-1756 m, although most records are deeper than 700 m (CAIRNS & ZIBROWIUS, 1997).

Subgenus *STEPHANOCYATHUS (ACINOCYATHUS)* Wells, 1984

Stephanocyathus (A.) spiniger (Marenzeller, 1888)

Stephanotrochus spiniger Marenzeller, *1888b: 20-21.
Odontocyathus spiniger - YABE & EGUCHI, 1942: 124-125, pl. 10, figs 26-28 (synonymy).
Stephanocyathus (O.) spiniger - WELLS, v.1984: 209, pl. 2, figs 10-13. — CAIRNS & PARKER, 1992: 26-27, pl. 7, figs g-i (synonymy). — CAIRNS, 1994: 57, pl. 25, figs a-c (synonymy); 1995: 67-68, pl. 17, figs d-f, pl. 18, fig. c (synonymy); 1998: 381. — CAIRNS & ZIBROWIUS, 1997: 118-119, figs 13f, 14d.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 585, 1 (MNHN). — Stn 604, 1 (MNHN). — Stn 606, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 963, 8 (MNHN). — Stn 1003, 1 (MNHN). — Stn 1004, 2 (USNM 98664). — Stn 1058, 1 (MNHN). — Stn 1087, 1 (USNM 98665). — Stn 1092, 1 (USNM 98663).

TYPE LOCALITY. — Sagami Bay, Honshu, Japan (depth not given).

REMARKS. — This commonly collected, distinctive species, characterised by having six elongate costal spines (C_1) and highly exsert S_1, has been described and figured several times in the recent past (see synonymy). It is compared to *S. explanans*, the only other Recent species in this subgenus, by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Wallis; 420 m. Vanuatu region: Anatom, Erromango, Malakula, and Espiritu Santo; 319-400 m. Pleistocene of Vanuatu (WELLS, 1984). Elsewhere: widespread throughout Indo-West Pacific from southwestern Indian Ocean to Japan and South Australia; 120-695 m (CAIRNS & ZIBROWIUS, 1997). Neogene of Japan (YABE & EGUCHI, 1932b); Oligocene of Victoria, Australia (DENNANT, 1899; see YABE & EGUCHI, 1942).

Genus *VAUGHANELLA* Gravier, 1915

Vaughanella concinna Gravier, 1915

Figs 11 g-h

Vaughanella concinna Gravier, v*1915: 10. — ZIBROWIUS, v.1980: 104-105, pl. 52, figs A-K, pl. 53, figs A-L (synonymy).
Vaughanella oreophila - CAIRNS, 1995: 70, pl. 18, figs d-e (Not *V. oreophila* Keller, *1981).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 572, 1 (MNHN).

TYPE LOCALITY. — 38°35'30"N, 28°05'45"W (Azores), 1250 m.

REMARKS. — One specimen is reported, measuring 30.4 x 27.9 mm in CD, 30.3 mm in height, 12.3 mm in pedicel diameter, and having 62 septa (7 pairs of S_5). It is indistinguishable from coralla reported from the eastern Atlantic (e.g., *Jean Charcot* 134, USNM 48765) by ZIBROWIUS (1980). A re-evaluation of the specimens I (CAIRNS, 1995) previously reported from north of New Zealand as *V. oreophila* Keller, 1981 also appear to be typical *V. concinna*. KELLER's (1981) type material of *V. oreophila* is not included as *V. concinna* because she stated that her specimens did not have P_3, which are prominent in all coralla of *V. concinna*.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 500-560 m. Elsewhere: Norfolk and Colville Ridges; 646-757 m (CAIRNS, 1995); eastern Atlantic between Celtic Sea, the Azores, and Madeira; 1022-3018 m (ZIBROWIUS, 1980).

Genus *DELTOCYATHUS* H. Milne Edwards & Haime, 1848

Deltocyathus magnificus Moseley, 1876

Fig. 11 i

Deltocyathus magnificus Moseley, v*1876: 552-553; v.1881: 147-148, pl. 4, figs 1-2. — CAIRNS & PARKER, 1992: 27-28, pl. 7, figs j-l, pl. 8, fig. a. — CAIRNS, 1994: 56, pl. 24, figs d-e, g-h (synonymy); 1998: 381-382, fig. 4a. — GUERRIERO *et al.*, 1996: 986. — CAIRNS & ZIBROWIUS, 1997: 126-127.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 963, 12: 8 (MNHN), 4 (USNM 98666). — Stn 964, 1 (MNHN). — Stn 980, 1 (MNHN).

TYPE LOCALITY. — *"Challenger"* stn 192: 5°49'S, 132°14'E (Kai Islands, Banda Sea), 236 m.

REMARKS. — *Deltocyathus magnificus* is one of four species in the genus to have 5 cycles of septa in its adult state, the others being *D. rotulus* (Alcock, 1898), *D. suluensis* Alcock, 1902, and *D. sarsi* (Gardiner & Waugh, 1939), the last thought to reproduce primarily by fragmentation. *D. magnificus* is the largest of the four species and was redescribed and illustrated by CAIRNS (1995) and CAIRNS & PARKER (1992), and is distinguished from other western Pacific species in a key published by CAIRNS & ZIBROWIUS (1997). The Vanuatu specimens differ from others previously reported in having only 72 septa, pairs of S_5 lacking from each half-system adjacent to an S_2. Perhaps because of this deficiency, some of these specimens have a hexameral outline (Fig. 11 i). Normally a corallum of 8 mm CD would have a full complement of 96 septa, but Vanuatu coralla as large as 25 mm CD have only 72 septa. All other characters being similar, the septal number and shape differences are considered to be only population differences.

DISTRIBUTION. — Vanuatu region: Anatom and Tanna; 408-433 m. Elsewhere: western Pacific from Japan to southeastern Australia; Western Australia; 88-1500 m (CAIRNS & ZIBROWIUS, 1997).

Deltocyathus rotulus (Alcock, 1898)

Trochocyathus rotulus Alcock, *1898: 16, pl. 2, figs 1, 1a.
Deltocyathus fragilis Alcock, v*1902a: 99-100; v.1902c: 21, pl. 2, figs 15, 15a.
Deltocyathus rotulus - CAIRNS, 1994: 55-56, pl. 24, figs j-k. — CAIRNS & ZIBROWIUS, 1997: 125-126, figs 16 a-c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 621, 3 (MNHN). — Stn 622, 3 (MNHN). — Stn 623, 2 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1125, 5 (USNM 98667). — Stn 1127, 1 (MNHN). — Stn 1129, 11 (USNM 98668).

TYPE LOCALITY. — *"Investigator"* stn 216: North Maldive Atoll, 1408-1756 m.

REMARKS. — Medium- to large-sized specimens of *Deltocyathus rotulus* are easily distinguished as having 5 cycles of septa; a serrate (lancetted) calicular margin, each S_4 and adjacent pair of S_5 projecting beyond the S_{1-3}; a large, undercut papillose columella; and a prominent crown of large P_4. Smaller specimens (i.e., CD < 12 mm) may be confused with juveniles of *D. suluensis*, both species having between 48-72 septa at this size. Juvenile *D. rotulus* differ from *D. suluensis* by having S_4 solidly attached to the S_3, not just attached by trabecular processes, as in *D. suluensis*; and in having a lancetted calicular margin. It also appears to be adapted to a deeper

(i.e., cooler) environment, most commonly found between 1000- 2000 m. *D. rotulus* is more fully described and illustrated by CAIRNS (1994), and included in a key to congenerics by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Field Bank; 1280-1300 m. Vanuatu region: Guyot Bougainville; 1050-1160 m. Elsewhere: Indo-West Pacific from Durban, South Africa to Japan; 210-1986 m (CAIRNS & ZIBROWIUS, 1997).

Deltocyathus suluensis Alcock, 1902

Deltocyathus magnificus var. *suluensis* Alcock, v*1902c: 20-21.
Deltocyathus formosus Cairns, *1995: 73-74, pl. 19, figs f-g.
Deltocyathus suluensis - CAIRNS & ZIBROWIUS, 1997: 125, fig. 16d. — CAIRNS, 1998: 382.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 522, 1 (MNHN). — Stn 529, 2 (USNM 98672). — Stn 530, 4 (MNHN). — Stn 532, 3 (MNHN). — Stn 534, 17 (USNM 98674). — Stn 535, 14 (USNM 98671). — Stn 540, 74 (MNHN). — Stn 541, 3 (MNHN). — Stn 546, 1 (MNHN). — Stn 557, 1 (MNHN). — Stn 575, 1 (MNHN). — Stn 578, 1 (MNHN). — Stn 590, 6 (MNHN). — Stn 594, 2 (MNHN). — Stn 595, 3 (USNM 98673). — Stn 631, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 975, 7 (USNM 98669). — Stn 1028, 3 (USNM 98670).

TYPE LOCALITY. — *"Siboga"* stns 95 and 100: Sulu Archipelago, 450-522 m.

REMARKS. — *Deltocyathus suluensis* is characterised by having a relatively thin, flat, costate, coarsely granular base; a finely serrate (not lancetted) calicular edge, the lower cycle septa (e.g., S_{1-3}) projecting beyond the higher cycle septa (e.g., S_{4-5}); 5 cycles of septa (96) above a CD of 18 mm; and rudimentary S_5, joined to adjacent S_4 close to the columella by several slender processes. The largest known specimen (MUSORSTOM 7 stn 540) is 22.3 mm in CD. The species is described in greater detail by CAIRNS (1995) as *D. formosus*, and included in a key to western Pacific *Deltocyathus* species by CAIRNS & ZIBROWIUS (1997), who also figured one of the syntypes. It is one of four species in the genus that has 5 cycles of septa in the adult stage, three of which are reported herein.

DISTRIBUTION. — Wallis and Futuna region: Wallis, Waterwitch, Combe, Tuscarora, Field, and Bayonnaise Banks; 400-650 m. Vanuatu region: Tanna and Efaté; 566-624 m. Elsewhere: western Australia; Philippines to ridges north of New Zealand; 142-565 m (CAIRNS & ZIBROWIUS, 1997).

Deltocyathus taiwanicus Hu, 1987

Figs 12 a-b

Deltocyathus taiwanicus Hu, *1987: 39, pl. 1, figs 1, 4-5, 10.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 522, 11 (MNHN). — Stn 523, 1 (MNHN). — Stn 525, 1 (MNHN). — Stn 529, 12 (USNM 98680). — Stn 535, 1 (MNHN). — Stn 537, 1 (MNHN). — Stn 540, 5 (MNHN). — Stn 541, 2 (MNHN). — Stn 542, 6 (USNM 98679). — Stn 546, 4 (MNHN). — Stn 555, 5 (MNHN). — Stn 556, 10 (MNHN). — Stn 557, 1 (MNHN). — Stn 560, 1 (MNHN). — Stn 585, 1 (MNHN). — Stn 589, 4 (USNM 98678). — Stn 590, 9 (USNM 98675). — Stn 591, 22 (MNHN). — Stn 594, 19 (USNM 98677). — Stn 597, 9 (USNM 98676).

TYPE LOCALITY. — Maanshan Mudstone (Plio-Pleistocene), Tantzu Village, Nanwan Bay, Hengchun Peninsula, southern Taiwan.

DESCRIPTION OF RECENT SPECIMENS. — Corallum shaped as a shallow bowl, sometimes with a flat base, but always with upturned outer edges. Centre of base sometimes bears a concave scar or, just as often, is slightly protuberant. Calice circular, but often slightly irregularly formed; margin not lancetted or serrate. Largest specimen reported above (MUSORSTOM 7 stn 541) 15.6 mm in CD; however the fossil holotype is 19.1 mm in CD. Costae equal in width and rounded, each bearing coarse (0.2 mm in diameter), unilinearly arranged granulations near

the centre of base, which rather abruptly grade into very fine (0.05 mm in diameter) granulations arranged 4-7 across a costa nearer the calicular edge. Intercostal furrows deeply incised only near calicular edge. Well-preserved coralla have a light reddish-brown base.

Septa hexamerally arranged in 4 complete cycles and a portion of the fifth: $S_{1-2}>S_3>S_4>S_5$. Between a CD of about 6.5-7.0 mm, pairs of S_5 begin to appear, up to an observed maximum of 13 pairs, or a total of 74 septa, e.g., in a specimen 12.4 mm in CD (MUSORSTOM 7 stn 546) as well as the holotype. A specimen of CD 13.2 mm (MUSORSTOM 7 stn 556) has 5 pairs of S_5 (58 septa) and the largest specimen (CD = 15.6 mm) 11 pairs (70 septa), thus the correlation between CD and number of septa is not always direct. There also appears to be no order in which the S_5 pairs are inserted, some half-systems in the same corallum having 2 pairs, 1 pair, or no S_5. S_{1-2} about 1.2 mm exsert, extending about half distance to columella, where each is separated from its broad palus (up to 1.7 mm wide) by a deep notch; however, the 2 P_1 associated with the principal septa are noticeably smaller, only about 0.9 mm wide. S_3 about 0.7 mm exsert and half the width of the S_{1-2}, each bordered by a P_3 about 1.4 mm wide that is slightly recessed from the columella, its axial edge strongly fused to its adjacent P_2. S_4 dimorphic in size. If unflanked by S_5, S_4 are rudimentary, well developed only at the calicular edge and represented by discontinuous spines within the theca, joining to their adjacent S_3 by 4 or 5 thin (0.15 mm in diameter) processes well below the S_3-P_3 notch (Fig. 12 b). However, if S_4 are flanked by a pair of S_5, they are 2/3 the width of an S_3 and bear pali (P_4) of equal size to the P_3, the axial edges of which are strongly fused to the P_3 and recessed slightly more from the columella than the P_3. In this case the S_5 resemble the unflanked S_4 as described above. All septal and palar faces are covered with spinose granulations. Fossa shallow, containing a papillose columella consisting of 10-22 granular elements, each about 0.3 mm in diameter. Columellar elements arranged in an elongate ellipse, the greater axis aligned with the 2 principal septa (by definition), which confers a bilateral symmetry to the corallum.

REMARKS. — *Deltocyathus taiwanicus* is very similar to *D. suluensis*, equal-sized coralla of both species having a similar septal insertion pattern and number of septa, and both species being found at many of the same stations. *D. taiwanicus*, however, seems to have a smaller corallum, a specimen of *D. taiwanicus* having a thick, upturned calicular edge at the same CD that a *D. suluensis* would have a thin, flat, serrate edge, characteristic of a juvenile corallum. *D. suluensis* ultimately achieves a full fifth cycle (96 septa) and a CD of 22.3 mm, whereas the largest *D. taiwanicus* is 19.1 mm (holotype) and yet no specimen is known to have over 74 septa. Furthermore, the costae of *D. taiwanicus* are finely granular at the calicular edge, whereas they are coarsely granular on *D. suluensis*. Also, the columellar elements of *D. taiwanicus* appear to be coarser and more independent than those in *D. suluensis*.

Although the three specimen type series was not examined (deposited at the Taiwan Normal University, Taipei), HU's description and figures were considered adequate to identify the species.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, Tuscarora, and Field Banks; 320-697 m. Elsewhere: Plio-Pleistocene of southern Taiwan (HU, 1987).

Deltocyathus vaughani Yabe & Eguchi, 1932

Deltocyathus vaughani Yabe & Eguchi, *1932a: 388-389. — CAIRNS, 1994: 54-55, pl. 23, figs i-j, pl. 24, figs a-c, f (synonymy). — CAIRNS & ZIBROWIUS, 1997: 122.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1006, 1 (MNHN). — Stn 1011, 1 (MNHN).

TYPE LOCALITY. — Bosyu (= Awa), Japan (depth not given).

REMARKS. — The species is distinguished from others in the region by having four cycles of septa, pali or paliform lobes before all septa, coarsely dentate costae, and equally exsert septa. The species can attain a CD of 27 mm and often has a patellate corallum, the basal angle ranging from 130° to 170°. It is fully described and illustrated by CAIRNS (1994), and included in a key to western Pacific *Deltocyathus* in CAIRNS & ZIBROWIUS

(1997). Although coarsely dentate costae are diagnostic for the species, it is interesting to note that the specimen from MUSORSTOM 8 stn 1006 (CD = 20.4 mm) has finely granular costae.

DISTRIBUTION. — Vanuatu region: Erromango and Efaté; 585-919 m. Elsewhere: western Pacific from Japan through Indonesia; 88-1097 m (CAIRNS & ZIBROWIUS, 1997).

Deltocyathus crassiseptum sp. nov.

Figs 12 c-f

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 2 paratypes (MNHN). — Stn 523, 6 paratypes (MNHN). — Stn 529, 13 paratypes (USNM 98683). — Stn 537, 38 paratypes (MNHN). — Stn 570, 3 paratypes (MNHN). — Stn 585, 8 paratypes (USNM 98684). — Stn 586, 1 paratype (MNHN). — Stn 597, 1 paratype (MNHN). — Stn 604, 5 paratypes (MNHN). — Stn 608, 2 paratypes (MNHN). — Stn 618, 1 paratype (MNHN).

Vanuatu. MUSORSTOM 8: stn 958, 9 paratypes (USNM 98682). — Stn 959, 14 paratypes (MNHN). — Stn 977, 2 paratypes (USNM 98681). — Stn 978, 3 paratypes (MNHN). — Stn 980, holotype (MNHN). — Stn 983, 5 paratypes (USNM 98686). — Stn 1061, 2 paratypes (MNHN). — Stn 1068, 2 paratypes (USNM 98685).

TYPE LOCALITY. — MUSORSTOM 8 stn 980: 19°21'S, 169°25'E (Tanna), 433-450 m.

ETYMOLOGY. — The species name *crassiseptum* (Latin *crassus*, thick + *septum*, partition) refers to the thick S_{1-2}. The name is treated as a noun in apposition.

DESCRIPTION. — Corallum shaped as a small, shallow bowl, with a flat to slightly convex base and upturned calicular edge. Largest specimen (holotype) 14.1 mm in CD and 5.8 mm in height. Calice circular; theca relatively thick. Costae rounded and finely granular, the granules changing to slender spines near calicular edge. Costae separated by deep intercostal grooves at calicular edge, near point of upward thecal inflection. In most coralla, each intercostal groove is bisected by a low, narrow (0.1 mm wide) row of granules (Fig. 12 f). Most coralla bear evidence of a former scar of detachment located at or near the centre of base. This scar may be pear-shaped in outline, circular, or an irregularly-shaped depression. Circular-shaped scars may also occur in various diameters, those of 0.8 mm diameter usually showing the traces of 6 larger and 6 smaller septa; larger scars of 1.3 mm diameter or more showing 24 septa. In some cases there are 2 concentric scars, with different numbers of septa. Most coralla are uniformly white, but some well-preserved coralla (e.g., the holotype) have a light reddish-brown colour to the calicular edge.

Septa hexamerally arranged in 4 complete cycles ($S_1>S_2>S_3>S_4$), for a total of 48 septa; however, the holotype is missing one half-system, resulting in 11 major septa and a total of only 44 septa. S_1 about 2 mm exsert, extend about half way to the columella, having straight, vertical to slightly concave axial edges. S_1 can be remarkably thick, up to 1.0 mm at the calicular edge. S_2 only slightly smaller than S_1 and equally thick. S_3 about half as exsert and wide as S_{1-2}, and of normal thickness (i.e., 0.4 mm). S_4 rudimentary in small coralla, but up to 3/4 exsertness and width of an S_3 in larger coralla. Lower axial edges fuse to adjacent S_4 low in fossa adjacent to columella through 3 or 4 slender processes. P_{1-3} all about 1 mm wide, the 6 P_1 being the only independent pali, forming a crown low in the fossa encircling the columella. The 6 P_2 rise slightly higher in the fossa, and the 12 P_3 higher still and are recessed from the columella, the axial edges of each pair of P_3 fusing to its adjacent P_2 in the typical deltocyathid chevron arrangement. Fossa moderately deep, containing a papillose columella composed of many fine interconnected elements.

REMARKS. — Among the approximately 24 Recent *Deltocyathus* species, *D. crassiseptum* can most easily be distinguished by its unusually thick S_{1-2}. Other consistent characters include its relatively small size, basal scar, deep peripheral intercostal grooves, and the small rows of granules that bisect each intercostal groove. It also appears to be restricted to a rather narrow bathymetric (i.e., temperature) range.

One corallum from MUSORSTOM 7 stn 585 showed evidence of a petrarcid ascothoracidan gall beneath its columella, a symbiosis previously reported in this genus by ZIBROWIUS & GRYGIER (1985), GRYGIER (1991), and GRYGIER & NOJIMA (1995).

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Waterwitch and Field Banks; 420-510 m. Vanuatu region: Anatom, Tanna, and Malakula; 413-536 m.

Deltocyathus cameratus sp. nov.

Figs 12 g-i, 13 a

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 520, 2 paratypes (MNHN). — Stn 530, 1 paratype (MNHN). — Stn 537, 1 paratype (MNHN). — Stn 541, 1 paratype (MNHN). — Stn 542, 4 paratypes (USNM 98688). — Stn 546, 1 paratype (MNHN). — Stn 552, 1 paratype (USNM 98690). — Stn 555, 1 paratype (MNHN). — Stn 557, 3 paratypes (USNM 98691). — Stn 560, 1 paratype (USNM 98687). — Stn 567, 1 paratype (MNHN). — Stn 569, 1 paratype (USNM 98689). — Stn 578, 2 paratypes (MNHN). — Stn 589, 2 paratypes (MNHN). — Stn 597, 1 paratype (MNHN). — Stn 635, 18 paratypes (MNHN). — Stn 636, 3 paratypes (MNHN).
Vanuatu. MUSORSTOM 8: stn 956, 4 paratypes (USNM 98693). — Stn 992, 1 paratype (USNM 98692). — Stn 1007, holotype (MNHN). — Stn 1036, 4 paratypes (MNHN). — Stn 1061, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1007: 18°52'S, 168°52'E (Erromango), 720-830 m.

ETYMOLOGY. — The species name *cameratus* (Latin *camerata*, chambered) refers to the 24 elliptical chambers formed by the robust S_4-P_3 and P_2-P_3 fusions.

DESCRIPTION. — Corallum shaped as a shallow bowl, with a flat or slightly convex base. Holotype 13.7 mm in CD and 5.2 mm in height; largest specimen (MUSORSTOM 7 stn 557) 15.2 mm in CD. Calice circular but with a jagged margin, the 12 CS_3 and adjacent pairs of CS_4 projecting outward as short (about 0.9 mm) triangular to rectangular lancets. Costae inconspicuous except at calicular edge, where they are separated by intercostal grooves. Costae on base covered with a low granulation, changing to slender spines at calicular edge; no attachment scar. Most coralla uniformly white, but some (e.g., the holotype) are a light reddish-brown in the palar region.

Septa hexamerally arranged in 4 complete cycles (S_1>S_2>S_4>S_3). In a large well-preserved corallum, S_1 are about 1.6 mm exsert, extending about half distance to columella; S_2 similar in shape and exsertness but only slightly less wide. S_3 about 1.3 mm exsert and half the width of an S_1. S_4, although less exsert than the S_3 (about 1.0 mm), are slightly wider than the S_3, the axial edges of each S_4 pair solidly fused as a thick lamella to the outer edge of the adjacent P_3. This fusion reaches as high as the S_3-P_3 notch and is thick and solid except near the columella, where it is perforated with several small pores. All septa uniformly thin and have straight axial edges. Pali (P_{1-3}) uniform in width (about 1.2 mm) and separated from their corresponding septa by wide notches (about 0.8 mm). Axial edges of P_1 and P_2 solidly fused to the columella, although P_2 rise slightly higher in the fossa. Axial edges of each pair of P_3 solidly fused to their adjacent P_2, this fusion being imperforate and reaching as high as the S_3-P_3 notch. The fossa is shallow to nonextant, containing a well-developed papillose columella consisting of 10-15 robust (0.3-0.6 mm in diameter), granular rods, in some coralla ornately sculptured (Fig. 13 a).

REMARKS. — The well-developed lamellar fusions of the S_4 to P_3 and P_3 to P_2 serve to differentiate this species from all others, as well as subdivide the corallum into 24 elliptical compartments, or chambers. In each system there are 2 small chambers formed by each pair of S_4, bisected by the S_3; 1 slightly larger compartment formed between each S_3, bisected by the S_2; and an elongate compartment between each system, bisected by an S_1. This compartmentalization is better seen in a worn specimen in which the bisecting septa are reduced or missing (Fig. 12 i). At least two other species, *D. pourtalesi* Cairns, 1979 and *D. italicus* (Michelotti, 1838), both Atlantic species, have similarly high S_4-P_3/P_3-P_2 fusions, joining at or above the notch that separates septum from palus, but in neither case are these fusions as robust, and in both cases there are many other differences among the 3 species.

On corallum from MUSORSTOM 7 stn 557 showed evidence of a petrarcid ascothoracidan gall beneath its columella.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, Tuscarora, Field, and Rotumah Banks; 305-1010 m. Vanuatu region: Erromango and Malakula; 512-1175 m.

Deltocyathus stella Cairns & Zibrowius, 1997

Figs 13 b-c

Deltocyathus stella Cairns & Zibrowius, *1997: 123-124, figs 15 f-h.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 509, 6 (USNM 98695). — Stn 510, 1 (MNHN). — Stn 511, 1 (MNHN). — Stn 512, 41 (MNHN). — Stn 513, 22 (MNHN). — Stn 514, 4 (MNHN). — Stn 516, 5 (MNHN). — Stn 523, 11 (USNM 98694). — Stn 537, 1 (MNHN). — Stn 541, 1 (MNHN). — Stn 556, 4 (MNHN). — Stn 569, 6 (USNM 98696). — Stn 585, 1 (USNM 98697). — Stn 594, 1 (MNHN). — Stn 605, 16 (USNM 98698). — Stn 610, 6 (MNHN). — Stn 626, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 967, 3 (USNM 98700). — Stn 969, 4 (MNHN). — Stn 1097, 1 cemented to *Xenophora* shell (MNHN). — Stn 1106, 1 (MNHN).

TYPE LOCALITY. — KARUBAR stn 35: 5°46'45"S, 132°11'10"E (Kai Islands, Banda Sea), 156-305 m.

Table 6. — Comparison of the spined species of *Deltocyathus*.

	D. stella Cairns & Zibrowius, 1997	*D. heteroclitus* Wells, 1984	*D. ornatus* Gardiner, 1899	*D. corrugatus* sp. nov.	*D. calcar* Pourtalès, 1874
Calicular Margin	Lancetted	Polygonal, asymmetric hexagonal	Circular	Prominently lancetted	Serrate
Maximum Calicular Diameter, Exclusive of Spines (mm)	12.3	5.4	10.4	12.0	14.8
Costal Spines: Number; Length; Shape	12 C_3; short (1.2 mm); stubby, thick	6-8 C_3; short (1.5 mm); wide-based, circular in cross section, attenuate	12 C_3; short (1.6 mm); slender, circular in cross section, flattened	12 C_3; long (3.5 mm); slender, circular in cross section	6 C_1; long (4.0 mm); slender, attenuate, circular in cross section
Corallum Shape	Shallow bowl	Shallow bowl	Discoidal (flat base)	Discoidal (flat base)	Patellate
Costae: Relative Width; Granules/ Costal Width	C_3>$C_{1-2, 4}$; 2 granules/costa	All costae equal; 1 granule/costa	C_3>$C_{1-2, 4}$; several granules/costa	C_3>$C_{1-2, 4}$ (C_3 prominent); 1 granule/costa	C_3>$C_{1-2, 4}$ (C_3 prominent); 2-3 granules/costa;
Number of Septa	48	40	48	48	48
Height and Nature of S_4-P_3 Junction	Just below S_3-P_3 notch, 4-5 slender processes	At S_3-P_3 notch, slender processes	Slightly below S_3-P_3 notch, thick processes	At S_3-P_3 notch, slender processes	Just below S_3-P_3 notch, 5-6 slender processes
Pali: Relative Width; P_1 Size Dimorphism	P_3>P_{1-2} (axial edges sinuous and dentate); P_1 dimorphic	P_3>P_{1-2}; not dimorphic	All palar cycles equal sized, but P_1 dimorphic	All palar cycles equal sized, but P_1 dimorphic	P_3>P_{1-2}; not dimorphic
Distribution; Depth	Philippines, Indonesia, Wallis and Futuna, Vanuatu; 206-597 m	Futuna, Vanuatu; 208-335 m	Wallis and Futuna, Vanuatu, Loyalty Islands; 73-360 m	Norfolk Ridge, Lord Howe Rise; 280-390 m	W. Atlantic; 81-675 m

REMARKS. — Little can be added to the original description of this recently described species except to note that in well-preserved coralla the distal and axial edges of the P_3, and occasionally the P_1 and P_2, are dentate. *Deltocyathus stella* is most easily distinguished from other spined *Deltocyathus* (Table 6), by having short, thick, stubby costal spines, and large, sinuous, dentate P_3.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Combe, Tuscarora, Waterwitch, Bayonnaise, and Field Banks; 240-597 m. Vanuatu region: Anatom and Espiritu Santo; 280-305 m. Elsewhere: Philippines and Indonesia; 206-280 m (CAIRNS & ZIBROWIUS, 1997).

Deltocyathus heteroclitus Wells, 1984

Figs 13 d-g, Fig. A

Deltocyathus heteroclitus Wells, v*1984: 210, figs 3, 1-6. — CAIRNS & ZIBROWIUS, 1997: 124 (mentioned).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 514, 16: 12 (MNHN), 4 (USNM 98701).

Vanuatu. MUSORSTOM 8: stn 1106, 2 cemented to *Xenophora* shells (MNHN).

TYPE LOCALITY. — USGS stn 24918: Navaka River, Espiritu Santo, Vanuatu (Late Pleistocene).

DESCRIPTION. — Corallum shaped as a shallow bowl, the largest known specimen (MUSORSTOM 7 stn 514) 5.4 mm in CD (exclusive of costal spines). Costae coarsely granular and not well defined. Six to eight robust costal spines (C_3) project up to 1.5 mm from the calicular edge, spines forming only in half-systems in which the CS_3 is flanked by a pair of CS_4 (see Remarks). Costal spines thick at base, circular in cross section, attenuate at the tip, and coarsely granular. Corallum primarily white, but with a circular band of light red-brown pigmentation in palar region.

Septa hexamerally arranged in 4 cycles, but usually only 1 pair of S_4 occurs in each system, resulting in 36 septa (Fig. A, but see Remarks). S_1 only independent septa, each bordered axially by a slender (0.4 mm wide) palus. S_2 about 2/3 width of the S_1, each bearing a similarly sized palus, but rising higher in the fossa. S_3 dimorphic in size: S_3 unflanked by S_4 about 3/4 width of the S_2, their axial edges fused to the adjacent P_2, and often bear a small paliform lobe. S_3 flanked by S_4 are the smallest of septa, seeming to rest on the centre of the costal spine, each having a dentate upper edge and bordered by a prominent palus. P_3 wide (0.6 mm), sinuous, highly granular, and are the tallest and most recessed pali from the fossa. S_4 slightly wider than flanked S_3, have a dentate distal margin, a peripheral margin that borders the costal spine, and an axial margin that fuses to the adjacent P_3 at the level of the S_3-P_3 notch. Fossa shallow, containing a papillose columella composed of 5-9 well-formed (0.25 mm in diameter), finely granular elements.

REMARKS. — I (CAIRNS, 1995: 72) questionably considered *D. heteroclitus* to be a junior synonym of *D. ornatus* Gardiner, 1899; however, this decision was based on a misconception of the latter species and the knowledge of only the small type series of the former. The additional MUSORSTOM specimens and subsequent examination of the type of *D. ornatus* show the two species to be distinct, as compared in Table 6. This is considered to be the first report of *D. heteroclitus* subsequent to its original description and the first record from the Recent, the types having been collected from the Late Pleistocene.

The pattern of costal spine insertion (as well as S_4 pair insertion) in *D. heteroclitus* is identical to that of *Anthemiphyllia spinifera* (Fig. A), the first 6 spines occurring in the "anterior" half-system of each system (i.e., half-systems I, III, V, VIII, X, and XII), which produces the "roughly hexagonal" calicular perimeter noted by WELLS (1984). The majority of specimens (the holotype, 4 paratypes, and 12 of the MUSORSTOM specimens) have this complement, i.e., 6 costal spines and 36 septa. One paratype and 4 MUSORSTOM specimens have 7 costal spines and 38 septa, the additional costal spine occurring in half-system VI in two specimens, half-system VII in one specimen, and half-system IX in two specimens. Two MUSORSTOM specimens have 8 costal spines and 40 septa, one corallum being poorly preserved, the other with the additional costal spines in half-systems VI and VII (Fig. 13 g).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 349-355 m. Vanuatu region: Espiritu Santo; 208-210 m and Late Pleistocene of Espiritu Santo (WELLS, 1984).

Deltocyathus ornatus Gardiner, 1899

Figs 13 h-i

Deltocyathus ornatus Gardiner, v*1899a: 163-164, pl. 20, figs 25a-b.
Not *Deltocyathus ornatus* - Cairns, 1995: 72-73, pl. 19, figs d-e (=*D. corrugatus* n. sp., described below in Remarks).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 569, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 964, 2 (USNM 98703). — Stn 967, 1 (MNHN). — Stn 1017, 1 (MNHN). — Stn 1018, 1 (USNM 98702). — Stn 1094, 2 (MNHN).

TYPE LOCALITY. — Sandal Bay, Lifu, Loyalty Islands, 73 m.

REMARKS. — *Deltocyathus ornatus* is compared to the other spined *Deltocyathus* in Table 6. It can be characterised as having a circular calice, 12 relatively short costal spines (C_3), dimorphic P_1, and an S_4-P_3 junction slightly below the S_3-P_3 notch. Before I examined the holotype of *D. ornatus* (deposited at the University Museum of Zoology, Cambridge), I (CAIRNS, 1995) incorrectly identified several specimens from New Zealand as this species, based on the resemblance in size and costal spines. It is now clear that the New Zealand specimens differ in having a strongly lancetted calicular margin; C_3 so prominent that they give the base of the corallum a corrugated aspect; much longer costal spines; a higher S_4-P_3 fusion; and a flatter corallum (Table 6). To this, as yet unnamed, species I propose the name *Deltocyathus corrugatus*, new species, described and figured by CAIRNS (1995) as *Deltocyathus ornatus*, and diagnosed and compared in Table 6, herein. The holotype is the specimen figured by CAIRNS (1995: pl. 19, figs d-e, ex USNM 94169, now NZOI H 689) from NZOI stn P27 (28°54'36"S, 167°44'12'E, Norfolk Island, 390 m, = type locality), and the other 15 specimens from four NZOI stations reported by CAIRNS (1995) as *D. ornatus* are considered as paratypes. The name *corrugatus* (Latin *corrugatus*, ridged) refers to the corrugated base.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 300-305 m. Vanuatu region: Anatom, Efaté, and Espiritu Santo; 295-360 m. Elsewhere: Loyalty Islands; 73 m (holotype).

Genus *HETEROCYATHUS* H. Milne Edwards & Haime, 1848

Heterocyathus sp. cf. *H. sulcatus* (Verrill, 1866)

Figs 14 a-d

Stephanoseris sulcatus Verrill, v*1866: 48.
Heterocyathus sulcatus - HOEKSEMA & BEST, 1991: 231-233, figs 19-23 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 494, 4 (USNM 98717). — Stn 495, 16 (USNM 98716). — Stn 496, 1 + (3) (USNM 98715). — Stn 509, 5 (USNM 98713). — Stn 510, 1 (MNHN). — Stn 512, 19 + (6) (MNHN). — Stn 513, 70 + (3): 60 + (3) (MNHN), 10 and SEM stubs 886-888 (USNM 98712). — Stn 514, 2 (MNHN). — Stn 516, 2 + (2) (MNHN). — Stn 556, 1 (MNHN). — Stn 570, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 969, 1 (MNHN). — Stn 976, 17 + (2) (USNM 98714). — Stn 1069, 10 (USNM 98718). — Stn 1094, 1 (MNHN). — Stn 1097, 2 (MNHN).

TYPE LOCALITY. — Ceylon (= Sri Lanka), depth not reported.

DESCRIPTION. — All specimens reported above are unattached, the base usually forming a low, flattened cylinder that completely encapsulates a small gastropod that was colonized by a sipunculid worm. If the gastropod was small or circular in diameter, the concentric internal sipunculid tube forms a regular cylinder, whereas if the

gastropod was elongate, an irregularly-shaped base results. A cylindrical corallum of smaller diameter sits upon the base, which contains the coral polyp. The corallum base is up to 6.0 mm in diameter and about 2.5 mm in height, whereas the upper corallum rarely exceeds 4.0 mm in diameter and is also up to 2.5 mm tall. The sipunculid canal is about 1.2 mm in diameter, opening to the surface of the coral through a pore of equal diameter on the lower lateral surface of the base. Smaller efferent pores associated with the sipunculid are rare, occasionally one 0.2 mm in diameter opening on the lower surface of the base or on the upper edge of the base. Costae well-developed, rounded and very finely granular; however, in older coralla tectural deposits completely cover the costae resulting in a smooth porcellaneous surface. Costae occur only on lateral faces of the corallum, including both upper and lower sections, but the flat base of the corallum is smooth. The costal width must gradually increase in the region of the base that covers the sipunculid worm tube, in order to cover the larger circumference formed by the housing of the worm. Intercostal furrows quite thin (about 30 μm) and deep, such that the underlying theca cannot be seen. C_{1-3} light brown to chocolate-brown in colour, alternating with the white C_4; however, only the S_{1-2} are similarly coloured, the pigment of the C_3 stopping at the calicular edge. Palar and columellar elements usually also pigmented, but in some cases are white.

Septa hexamerally arranged in 4 cycles, but a complete fourth cycle is rare, most coralla missing 1 or more pairs of S_4 resulting in 36 to 46 septa: $S_1>S_2>S_4>S_3$. S_1 about 1.1 mm exsert, extend about half way to columella, and bordered by 1 or 2 narrow paliform lobes. S_2 0.7 mm exsert, about 3/4 width of the S_1, and also bear 1 or 2 paliform lobes. S_3 that are flanked by a pair of S_4 are the smallest septa, only 0.5 mm exsert and half the size of the S_2, but if not flanked by S_4, an S_3 is as wide as an S_2 and often considerably thicker. S_4 also dimorphic in size, those adjacent to S_1 as wide as an S_2 and fused to its adjacent S_1 in a lancet. S_4 adjacent to S_2 are smaller, only slightly wider than an S_3. Both S_3 and S_4 bear 2 or 3 slender paliform lobes. Septa crowded in arrangement and bear prominent granulations on their faces. All paliform lobes slender, not lamellar, about 0.25 mm in diameter, and bear obliquely oriented menianes. Fossa shallow, containing a papillose columella consisting of 10-15 cylindrical elements that are similarly transversely ridged as the paliform lobes. In fact there is little difference between palar and columellar elements except that the former rise higher in the fossa and are aligned with particular septa.

REMARKS. — HOEKSEMA & BEST (1991) consolidated the 23 described species and subspecies of *Heterocyathus* into three species and provided a key for their differentiation. According to their diagnoses, coralla having a dark brown centre, alternating costal pigmentation, and a compact, cylindrical upper corallum, should be identified as *H. sulcata*. However, I have noted that several specimens in larger lots that were certainly conspecific did not have a dark brown centre, and I have also noted other specimens of *Heterocyathus* with dark brown centres that were otherwise very different from the species described herein. The type of *H. sulcata* (YPM 764) from Sri Lanka is now so damaged that it is of little use in defining the species; only about one-third of the original corallum is present. Because of the large number of nominal species and the variation inherent in this genus these specimens are only provisionally identified as *H. sulcatus*.

Specimens from six of the lots listed above, indicated with parentheses around the specimen number, differ in having a larger corallum (CD up to 6.0 mm, basal diameter up to 8.5 mm) and in having 2-6 sipunculid efferent pores located circumferentially at the junction of the base and upper corallum. These are assumed to be larger individuals of the same species, the larger size mediated by the increased development of the sipunculid.

DISTRIBUTION. — Wallis and Futuna region: Futuna; Tuscarora and Waterwitch Banks; live specimens from 110-260 (dead specimens found to 550 m). Vanuatu region: Anatom, Tanna, and Espiritu Santo; 182-312 m (live specimens). Elsewhere: See HOEKSEMA & BEST (1991).

Heterocyathus alternatus Verrill, 1865

Figs 14 e-f

Heterocyathus alternatus Verrill, v*1865: 149. — HOEKSEMA & BEST, 1991: 230-231, figs 12-18 (synonymy). — CAIRNS, 1998: 384, figs 3d-e.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1004, 1 (MNHN). — Stn 1018, 4 (USNM 98719).

TYPE LOCALITY. — "Gaspar Straits" = Selat Gelasa, between the islands of Bangka and Belitung, Sumatra, Indonesia.

DIAGNOSIS (specimen from MUSORSTOM 8 stn 1004). — Corallum cylindrical and free: 10.2 x 9.4 mm in CD and 8.1 mm in height. Costae well defined, rounded, and finely granular (not porcellaneous); intercostal grooves narrow and relatively deep. Base flat and not costate, but covered with fine granulations; the sipunculid tube opening and one efferent pore also occur on the flat base. Septa hexamerally arranged in 4 complete cycles ($S_1>S_2>S_4>S_3$), although HOEKSEMA and BEST (1991: fig. 17) show that this species may sometimes attain a full fifth cycle. S_1 highly exsert (3.7 mm), forming tall lancets with their adjacent S_4, and axially bordered with 2 or 3 slender paliform lobes. S_2 about 2.5 mm exsert, also forming lancets with their adjacent S_4. S_3 bear only 1 or 2 paliform lobes, whereas the larger S_4 bear 4 or 5 lobes that merge indistinguishably into the columella. All paliform lobes are slender (cylindrical) and not ridged. Fossa quite deep, containing a papillose columella composed of numerous fine elements.

REMARKS. — These specimens appear to be conspecific with the diagnosis and illustrations of HOEKSEMA and BEST (1991). The holotype (YPM 6828), although well preserved, appears to be a juvenile specimen.

Heterocyathus alternatus differs markedly from the species described above as *H.* cf. *sulcatus* by having a larger corallum with more septa, granular costae (not porcellaneous) and base, more highly exsert S_1 and S_2, nonridged paliform lobes, a deeper fossa, and finer columellar elements.

DISTRIBUTION. — Vanuatu region: Erromango and Efaté; 301-319 m. Elsewhere: Indonesia; Philippines; northern Indian Ocean; Western Australia; South China Sea (HOEKSEMA & BEST, 1991).

Genus ***CONOTROCHUS*** Seguenza, 1864

Conotrochus funicolumna (Alcock, 1902)

Ceratotrochus (Conotrochus) funicolumna Alcock, v*1902a: 93; v.1902c: 11-12, pl. 1, figs 6, 6a.
Conotrochus funicolumna - CAIRNS, 1994: 58-59, pl. 24, fig. i, pl. 25, figs g-l (synonymy). — CAIRNS & ZIBROWIUS, 1997: 127. — CAIRNS, 1998: 385.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 6 (MNHN). — Stn 522, 1 (MNHN). — Stn 523, 5 (MNHN). — Stn 525, 2 (MNHN). — Stn 532, 1 (MNHN). — Stn 535, 1 (MNHN). — Stn 537, 1 (MNHN). — Stn 540, 4 (MNHN). — Stn 541, 1 (MNHN). — Stn 542, 1 (MNHN). — Stn 555, 1 (USNM 98721). — Stn 556, 3 (MNHN). — Stn 557, 4 (USNM 98720). — Stn 560, 1 (MNHN). — Stn 570, 12 (MNHN). — Stn 571, 2 (MNHN). — Stn 585, 3 (USNM 98724). — Stn 604, 3 (MNHN). — Stn 618, 40 (USNM 98722). — Stn 619, 14 (USNM 98723).

Vanuatu. MUSORSTOM 8: stn 1059, 1 (USNM 98728). — Stn 1060, 1 (MNHN). — Stn 1065, 8 (USNM 98726). — Stn 1072, 3 (MNHN). — Stn 1087, 8 (USNM 98729). — Stn 1088, 1 (USNM 98725). — Stn 1091, 1 (MNHN). — Stn 1107, 1 (USNM 98727). — Stn 1113, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 95 and 100: Sulu Archipelago, 450-522 m.

DIAGNOSIS. — Corallum ceratoid (edge angle up to 35°), straight, and attached by a narrow pedicel that is usually reinforced by an extensive secondary attachment along the lower edge of the corallum contiguous with the pedicel. Calice circular to slightly elliptical, the largest specimen reported herein 12.5 mm in GCD. The theca of a well-preserved corallum often bears slender, hollow, hispid granulations; worn coralla often show longitudinal costae. Theca of well-preserved coralla sometimes longitudinally streaked with brown pigmentation that occurs without symmetry, the streaks ranging from 1 to 8 septa in width, alternating with white theca. Theca thick, projecting 0.5-0.7 mm above the peripheral distal septal edges as a continuous rim;

stereome present internally. Septa hexamerally arranged in 4 cycles ($S_1>S_2>S_3>S_4$), a full fourth cycle complete in some coralla at a CD of 4.6 mm, but larger specimens sometimes lacking several pairs of S_4. Columella a well-formed, discrete concentration of lamellar elements, often swirled in a circular manner, and occasionally fused into a more solid structure. Lamellar elements often fused to one another in a labyrinthiform arrangement.

REMARKS. — *Conotrochus funicolumna* is similar to *C. brunneus*, both species secondarily attached basally and having a similar thecal structure. *C. funicolumna* differs in having: a larger corallum (up to 12.5 mm CD vs <8.0 mm for *C. brunneus*); more septa at the same CD, most *C. funicolumna* have 48 septa, whereas most *C. brunneus* have only 36-40 septa; a more open corallum (slightly higher edge angle); less internal stereome; and occasionally a streaked theca, whereas that of *C. brunneus* is white or uniformly brown. The species is more fully described and figured by CAIRNS (1994).

DISTRIBUTION. — Wallis and Futuna region: Wallis, Futuna, and Alofi; Waterwitch, Combe, and Tuscarora Banks; 370-697 m. Vanuatu region: Malakula and Espiritu Santo; 350-700 m. Elsewhere: Philippines; Indonesia; Japan; Australia; Hawaiian Islands; 88-616 m (CAIRNS & ZIBROWIUS, 1997).

Conotrochus brunneus (Moseley, 1881)

Pleurocyathus brunneus Moseley, v*1881: 159-160, pl. 2, figs 1a-c.
Conotrochus brunneus - CAIRNS, 1995: 74-75, pl. 20, figs a-b (synonymy). — CAIRNS & ZIBROWIUS, 1997: 127-128, fig. 16e.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 1 (USNM 98734). — Stn 513, 1 (MNHN). — Stn 525, 1 (MNHN). — Stn 530, 1 (USNM 98731). — Stn 546, 1 (MNHN). — Stn 586, 1 (MNHN). — Stn 590, 1 (MNHN). — Stn 591, 1 (MNHN). — Stn 597, 1 (MNHN). — Stn 625, 1 (USNM 98730).
Vanuatu. MUSORSTOM 8: stn 959, 2 (USNM 98732). — Stn 977, 1 (MNHN). — Stn 1006, 1 (MNHN). — Stn 1089, 1 (MNHN). — Stn 1090, 1 (USNM 98733). — Stn 1092, 1 cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — *"Challenger"* stn 194: 4°34'S, 129°57'30"E (Banda Island, Banda Sea), 366 m.

REMARKS. — *Conotrochus brunneus* was redescribed and figured by CAIRNS (1995), and compared to *C. funicolumna* in the previous account.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, Field, and Bayonnaise Banks; 300-580 m. Vanuatu region: Anatom, Tanna, Erromango, and Espiritu Santo; 321-574 m. Elsewhere: Indo-West Pacific from Madagascar to South China Sea; 97-1051 m (CAIRNS & ZIBROWIUS, 1997).

Conotrochus asymmetros sp. nov.

Figs 14 g, 15 a-e

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 495, 3 paratypes and SEM stub 890 (USNM 98735). — Stn 496, 1 holotype (MNHN). — Stn 504, 6 paratypes (MNHN). — Stn 509, 10 paratypes (USNM 98736). — Stn 512, 3 paratypes (MNHN). — Stn 513, 6 paratypes (MNHN). — Stn 516, 3 paratypes (MNHN). — Stn 586, 1 paratype (MNHN). — Stn 610, 1 paratype (MNHN).
Vanuatu. MUSORSTOM 8: stn 1016, 1 nontype cemented to a *Xenophora* shell (MNHN). — Stn 1017, 1 nontype cemented to a *Xenophora* shell (MNHN). — Stn 1097, 1 nontype cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — MUSORSTOM 7 stn 496: 14°19.6'S, 178°04.3'W (Futuna), 250-330 m.

ETYMOLOGY. — The species name *asymmetros* (Greek *asymmetros*, without symmetry) refers to the asymmetrical arrangement of septa within the calice.

DESCRIPTION. — Corallum varies from conical (edge angle = 30°) to flabellate (e.g., the holotype: edge angle up to 65°, face angle = 15°), depending on the corallum and its stage of thecal edge spine development. Holotype 8.9 x 4.6 mm in CD, 7.3 mm in height, and 1.3 mm in pedicel diameter. Calice elliptical (GCD:LCD = 1.2) to highly compressed (GCD:LCD = 2.0), the higher ratio characteristic of coralla in process of edge spine formation, which temporarily elongates the corallum. Elliptical calices are sometimes asymmetrical in shape, one face being almost straight, the other convex. Several more septa often originate from the convex thecal face than the straight face. Calicular edge finely serrate, separated from the peripheral septal edges by a shallow trough. Basal disc 0.8-1.3 mm in diameter, in many cases augmented by a contiguous secondary thecal attachment up to 2.0 mm in diameter. Thecal edges bear 1-3 pairs of spines (up to 2.0 mm long); short, triangular crests; or low eversions. Transverse division not noted. Theca porcellaneous, covered with low, rounded granules characteristic of the genus. Theca usually white, but occasionally longitudinally streaked with brown pigment.

Septa hexamerally arranged in 3 size classes, usually resulting in 32 or 30 septa accordingly: 6:10:16 or 6:9:15. The 6 primary septa are up to 0.7 mm exsert, having straight axial edges that reach the columella. Primary septa are not aligned with the greater calicular axis, as in all other known corals having an elliptical calice. Rather, they occur on either side of the calicular axis and on the lateral faces, resulting in a secondary or tertiary septum being aligned with the greater axis, usually one of each size class on either end of the corallum. Secondary septa 0.4 mm exsert, about 4/5 width and less thick than a primary septum. In coralla having 32 septa, all 6 systems contain at least one secondary septum and 4 systems contain a pair of equal-sized secondary septa; in coralla having 30 septa, only 3 systems contain a pair of secondaries. There seems to be no consistent arrangement in which systems contain pairs of secondaries, only that they are usually in contiguous systems and often occur in a system aligned with the greater axis. Tertiary septa nonexsert and rudimentary, only about 1/4 the width of a secondary, and quite thin. Fossa of moderate depth, containing a papillose columella composed of 6-11 granular, interconnected papillae that are also attached to the lower, axial edges of primary and secondary septa.

REMARKS. — The unusual septal symmetry and thecal edge spines distinguish this species from all others in the genus. In fact, I know of no other scleractinian species that possesses a pair of equal-sized secondary septa within one system or a septal arrangement that aligns a secondary and/or tertiary septum on the greater calicular axis.

DISTRIBUTION. — Wallis and Futuna; 210-510 m. Vanuatu region: Efaté and Espiritu Santo; 288-294 m.

Genus *LOCHMAEOTROCHUS* Alcock, 1902

Lochmaeotrochus gardineri sp. nov.

Figs 15 f-g

MATERIAL EXAMINED/TYPES. — MUSORSTOM 7: stn 539, 17 paratypes (MNHN). — Stn 548, 1 paratype (MNHN). — Stn 557, 1 paratype (MNHN). — Stn 560, 1 paratype (USNM 98739).

Vanuatu. MUSORSTOM 8: stn 956, 9 paratypes (MNHN). — Stn 992, 3 paratypes (USNM 98738). — Stn 1034, 1 paratype (MNHN). — Stn 1036, holotype (MNHN) and 13 paratypes (USNM 98737).

TYPE LOCALITY. — MUSORSTOM 8, stn 1036: 18°01'S, 168°48'E (Efaté), 920-950 m.

ETYMOLOGY. — This species is named for J. Stanley GARDINER, in recognition of his pioneering work on azooxanthellate corals from the central and South Pacific (GARDINER, 1899a, b).

DESCRIPTION. — Corallum conical (ceratoid, having an edge angle of 18° -23°), straight, and free, having a basal disc about 1.1 mm in diameter that is occasionally reinforced with a small contiguous secondary attachment of equal diameter. Largest specimen (holotype) 10.8 mm in CD and 17.4 mm in height; calice circular. Theca covered with slender, hispid granulations, characteristic of the genus *Conotrochus*. Theca lipped with successive

circumferential growth ridges or lips, each projecting up to 0.3 mm in height, the uppermost thecal rim projecting upward about 0.7 mm and separated from the distal, peripheral septal edges by a shallow trough. Theca relatively thick, containing layers of internal stereome. Corallum uniformly white.

Septa hexamerally arranged in 4 cycles, the fourth cycle never complete: $S_1>S_2>S_3>S_4$. Most coralla have 1 pair of S_4 in each system, resulting in 36 septa; however, the holotype has 40 septa, and a smaller specimen (CD 9.4 mm) has 42 septa. S_1 nonexsert, extend about 3/4 distance to the columella, having straight, vertical axial edges. Rarely (e.g., the holotype) the S_1 bear a small (0.6 mm wide), lamellar P_1, separated from its septum by a deep, narrow notch. S_2 about 3/4 width of the S_1. S_3 dimorphic in size: S_3 unflanked by S_4 about half the size of the S_2, but those flanked by S_4 are only slightly less wide than the S_2 and usually bear a broad (1.2 mm wide), lamellar palus. The position of the P_3 is variable. Although it is usually aligned with the S_3, it is sometimes aligned between the S_3 and adjacent S_2, or may be absent. Even when aligned with the S_3, lower in the fossa the P_3 is usually connected to the adjacent S_2. Also, in some systems having a full complement of 2 pairs of S_4, only one palus is present before the S_2, but this palus having connections to the 2 adjacent S_3 lower in the fossa. S_4 about half width of a flanked S_3. Axial edges of S_{2-4} very slightly sinuous. Fossa moderately deep, containing a papillose columella composed of 0-10 interconnected cylindrical elements 0.2-0.3 mm in diameter.

REMARKS. — *Lochmaeotrochus gardineri* is similar to but differs from the only other species described in this genus, *L. oculeus* Alcock, 1902, in having: a solitary, free habit with a small basal disc (vs a quasicolonial habit with a broad secondary attachment); circumferential thecal ridges; fewer septa at a corresponding size and a lower maximum number of septa (most *L. oculeus* have 48 septa); wider and better developed pali; and a deeper fossa. It is also known from greater depths than *L. oculeus*.

Lochmaeotrochus gardineri is also similar to *Conotrochus funicolumna*, particularly in corallum size and thecal granulation; these species also co-occur at one station. *L. gardineri* is distinguished by having at least 6 lamellar pali (P_3), which are different in shape from its cylindrical columellar elements, *C. funicolumna* only having swirled, interconnected (labyrinthiform) lamellar columellar elements and no pali. *L. gardineri* also has a narrower basal attachment, a deeper fossa, fewer septa at a corresponding CD, and a greater disparity between the width of its S_1 and S_2. *L. gardineri* also seems to be found, in general, at greater depths than *C. funicolumna*.

DISTRIBUTION. — Wallis and Futuna region: Combe and Tuscarora Banks; 608-700 m. Vanuatu region: Anatom, Erromango, and Efaté; 750-1175 m.

Genus ***AULOCYATHUS*** Marenzeller, 1904

Aulocyathus recidivus (Dennant, 1906)

Ceratotrochus recidivus Dennant, *1906: 159-160, pl. 6, figs 1-2.
Aulocyathus recidivus - CAIRNS, 1982: 25-26, pl. 7, figs 7-9, pl. 8, fig. 1 (synonymy); 1994: 59-60, pl. 26, fig. a-b. — CAIRNS & PARKER, 1992: 22-24, pl. 6, figs d-e, g-h (synonymy). — CAIRNS & ZIBROWIUS, 1997: 129-130.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 564, 4 (USNM 98741). — Stn 567, 1 (MNHN). — Stn 620, 1 (MNHN). — Stn 622, 1 (MNHN). — Stn 623, 2 (MNHN).

TYPE LOCALITY. — Off Cape Jaffa and Neptune Island, South Australia, 165-190 m.

REMARKS. — *Aulocyathus recidivus* was more fully redescribed and figured by CAIRNS (1982, 1994) and CAIRNS & PARKER (1992). The four known species of *Aulocyathus* are compared in Table 7, and the three Pacific species illustrated by CAIRNS (1994: pl. 26). *A. recidivus* is unique in having a notch between the theca and peripheral septal edges, and is further distinguished by having a relatively large, fragile corallum with well-spaced septa and a well-developed columella.

TABLE 7. — Comparison of the four known species of *Aulocyathus*.

	A. recidivus Dennat, 1906	*A. atlanticus* Zibrowius, 1980	*A. matricidus* (Kent, 1871)	*A. juvenescens* (Kent, 1871)
Calicular Diameter (mm)	15.0	9.5	8.5	4.5
H:GCD	2.7	1.1-6.6	3.6	2.9-3.5
Costae	Hispid granules	Granular to hispid	Hispid, twice as many as septa	Porcellaneous
Number of Septa	32-66	<48	36-48	30-32
Calicular Edge	Serrate	Serrate	Smooth	Serrate
Upper Peripheral Septa	Notched	Not notched	Not notched	Not nochted
Columella	Well developed, papillose	Well developed, papillose	Rudimentary	Rudimentary
Distribution; Depth	Indo-West Pacific; 128-1137 m	Eastern Atlantic; 450-1716 m	Japan; 84-207 m	Indo-West Pacific; 182-463 m

DISTRIBUTION. — Wallis and Futuna region: Tuscarora and Combe Banks; 1020-1280 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 128-1137 m (CAIRNS & ZIBROWIUS, 1997).

Aulocyathus juvenescens Marenzeller, 1904

Fig. 15 h

Aulocyathus juvenescens Marenzeller, v*1904: 301-302, pl. 18, fig. 17. — ZIBROWIUS, 1980: 107. — CAIRNS & KELLER, 1993: 247. — CAIRNS, 1994: pl. 26, figs h-i. — CAIRNS & ZIBROWIUS, 1997: 130 (mentioned).

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 3: stn 87, 1 juvenile (USNM 97653).
Vanuatu. MUSORSTOM 8: stn 976, 2 (MNHN). — Stn 1070, 1 (USNM 98740).

TYPE LOCALITY. — Pemba and Zanzibar Islands, Tanzania, 400-463 m.

REMARKS. — Two adult, intact coralla are reported herein: one (MUSORSTOM 8 stn 1070) 4.4 mm in CD and 14.6 mm in height, the other (MUSORSTOM 8 stn 976) 3.7 mm in CD and 11.0 mm in height. Both specimens have a smooth, porcellaneous theca with no indication of granulation or intercostal striae. The theca of the larger specimen has streaks of brown pigment, the other is pure white. Both coralla have a finely serrate, circular calicular margin and both have 32 septa arranged $S_1>S_2>S_3>S_4$; however, the size difference between the S_2 and the flanking S_3 is slight. The lower axial edges of S_1 bear robust tubercles; the columella is rudimentary. These specimens resemble the syntypes of *A. juvenescens* in all respects except for thecal texture, the syntypes having faint, longitudinal intercostal striae and low, glisteny granulations.

Aulocyathus juvenescens is compared to the other Recent congeners in Table 7. It is distinguished by having the smallest calicular diameter, least number of septa, and a porcellaneous theca.

DISTRIBUTION. — Vanuatu region: Tanna and Espiritu Santo; 182-184 m. Elsewhere: Philippines; Tanzania; 196-463 m (CAIRNS & ZIBROWIUS, 1997).

Genus *DESMOPHYLLUM* Ehrenberg, 1834

Desmophyllum dianthus (Esper, 1794)

Madrepora dianthus Esper, *1794: pl. 69, figs 1-3.

Desmophyllum cristagalli H. Milne Edwards & Haime, v*1848a: 253.
Not *Desmophyllum* sp. cf. *D. cristagalli* - WELLS, 1954: 470 (= *Javania exserta*).
Desmophyllum dianthus - CAIRNS, 1994: 26-27, pl. 9, figs a-d (synonymy and neotype designation); 1995: 77, pl. 21, figs d-f, map 4 (synonymy); 1998: 385-386. — CAIRNS & ZIBROWIUS, 1997: 131, figs 17g-h.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 637, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1088, 8 (MNHN). — Stn 1089, 1 (MNHN). — Stn 1128, 1 (USNM 98742).

TYPE LOCALITY. — Sagami Bay, Japan (depth not known).

REMARKS. — This ubiquitous coral has been redescribed and figured many times, often under the junior synonym name of *D. cristagalli* (see ZIBROWIUS, 1980; CAIRNS, 1979, 1982, 1994, 1995). But, despite its widespread distribution and abundance in certain regions, it is rarely collected in the tropical South Pacific (CAIRNS & ZIBROWIUS, 1997).

DISTRIBUTION. — Wallis and Futuna region: Rotumah Bank; 820-830 m. Vanuatu region: Espiritu Santo; Guyot Bougainville; 455-778 m. Elsewhere: cosmopolitan except off continental Antarctica and northern boreal Pacific; 35-2460 m (CAIRNS, 1994).

Genus ***THALAMOPHYLLIA*** Duchassaing, 1870

Thalamophyllia tenuescens (Gardiner, 1899)

Desmophyllum tenuescens Gardiner, v*1899a: 161-162, pl. 19, figs 1a-b.
Desmophyllum delicatum - WELLS, v.1954: 470 (Not *Desmophyllum delicatum* Yabe & Eguchi, 1942).
Thalamophyllia tenuescens - CAIRNS, 1995: 78, pl. 21, figs g-i, map 19; 1998: 386. — CAIRNS & ZIBROWIUS, 1997: 133, figs 17d-e.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 496, 1 (MNHN). — Stn 499, 1 (MNHN). — Stn 504, 2 (MNHN). — Stn 509, 2 (MNHN). — Stn 512, 3 (USNM 98744). — Stn 513, 1 (MNHN). — Stn 514, 1 (USNM 98743).
Lord Howe Island. NZOI: stn P115, 2 colonies (USNM 94363).

TYPE LOCALITY. — Sandal Bay, Lifu, Loyalty Islands, 73 m.

REMARKS. — This species was rently redescribed and illustrated by CAIRNS (1995). The largest known corallite, reported herein from Lord Howe Seamount Chain (NZOI P115), measures 24 x 15 mm in CD, 27 mm in height, and contains three pairs of S_5 (54 septa).

DISTRIBUTION. — Futuna; 240-349 m. Elsewhere: Philippines; Indonesia; Bikini Island, Marshall Islands (WELLS, 1954); Loyalty Islands (GARDINER, 1899a); Kermadec Islands; Lord Howe Seamount Chain (reported herein); off Queensland; 8-315 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***LOPHELIA*** H. Milne Edwards & Haime, 1849

Lophelia pertusa (Linnaeus, 1758)

Madrepora pertusa Linnaeus, *1758: 797.
Madrepora prolifera Pallas, *1766: 307.
Lophelia prolifera - CAIRNS, 1979: 125-127, pl. 24, figs 1-5 (synonymy); 1991a: 17-18, pl. 6, fig. j.
Lophelia pertusa - ZIBROWIUS, v.1980: 126-130, pl. 66, figs A-L (synonymy). — CAIRNS, 1995: 27-28, pl. 9, figs e-i (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 530, 19 fragments: 15 (MNHN), 4 (USNM 98745). — Stn 572, 1 (MNHN).

TYPE LOCALITY. — Not stated, but probably the fjords of Norway (ZIBROWIUS, 1980).

REMARKS. — This species, which is common in the Atlantic, is rarely collected in the Indo-Pacific, represented in this collection only by several dead fragments.

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 560-580 m. Elsewhere: cosmopolitan, except off continental Antarctica (rare in western Pacific); 60-2170 m (CAIRNS, 1995).

Genus *DACTYLOTROCHUS* Wells, 1954

Dactylotrochus cervicornis (Moseley, 1881)

Figs B, 16 a-f

Tridacophyllia cervicornis Moseley, *1881: 183-184, pl. 10, figs 2a-d, 3a. — BASSETT-SMITH, 1890: 368.
Tridacophyllia primordialis Gardiner, v*1899a: 168, pl. 19, figs 7a-e.
Dactylotrochus cervicornis - WELLS, v.1954: 470-471, pl. 178, figs 1-3. — CAIRNS & ZIBROWIUS, 1997: 131.

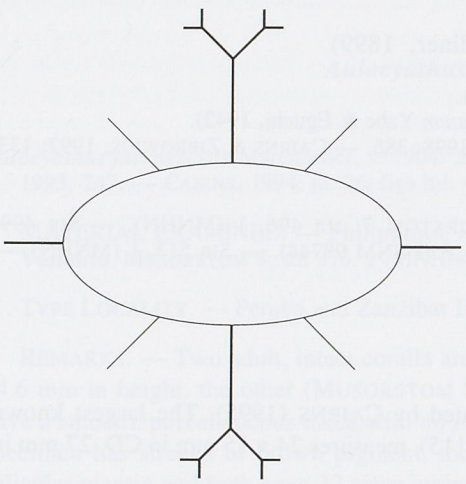


FIG. B. — Diagrammatic representation of the calice of *Dactylotrochus cervicornis*, showing the placement, length, and orientation of the calicular extensions. Thick lines represent a vertical extension; thin lines represent a horizontal to oblique extension. Length of extensions drawn in proportion to calicular diameter.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 499, 1 (MNHN). — Stn 504, 1 (MNHN). — Stn 512, 2 (MNHN). — Stn 513, 1 (MNHN). — Stn 514, 4 (MNHN) and SEM stub 889 (USNM 98746). — Stn 515, 1 (USNM 98747). — Stn 584, 1 (MNHN). — Stn 589, 1 (MNHN). — Stn 605, 3 (MNHN).

Vanuatu. MUSORSTOM 8: stn 988, 3 (USNM 98749). — Stn 1095, 1 (USNM 98748).

Guam. East Agana Bay, 7.08.1986, 128-137 m, 1 (USNM 96503).

TYPE LOCALITY. — Unknown.

DESCRIPTION. — Corallum attached through a robust (3-6 mm in diameter) cylindrical to subcylindrical pedicel and a thin, slightly expansive base, the base and lower pedicel usually covered with several faint, annular epithecal ridges. One damaged specimen (MUSORSTOM 8 stn 1095) and two syntypes display a polycyclic base, achieved by thecal bridging of raised costal ridges in the vicinity of the base. Above the pedicel, at a height of 3-10 mm, the theca and corresponding internal septa are divided into several (up to 8) elongate, tapered and sometimes bifurcating thecal extensions (Fig. B). The largest thecal extensions originate from the two thecal faces, the basal part of each extension 6-8 mm in length and 4-6 mm wide, beyond which it bifurcates into two smaller extensions 2-3 mm in width, which, in larger specimens, bifurcate once more. These laterally-placed, bifurcating extensions are vertical in orientation, producing a constricted fossa. In a well-developed corallum, between each laterally-placed extension and the greater axis may be 4 smaller, nonbifurcating extensions, each about 5 mm long, 3 mm in width, oriented outward from the calicular edge. Finally, 2 more nonbifurcating, upward-projecting extensions originate from the greater axis of the corallum, each about 4 mm long and 3 mm wide. Not all coralla have all 8 digitiform projections, but the two lateral and two axial extensions are usually

present even in the smallest coralla. Largest specimen (MUSORSTOM 8 stn 988) 23.1 x 12.9 mm in CD and 30 mm in height. Theca white, covered with granules that are sometimes arranged in longitudinal rows, but costae and intercostal striae absent.

Septal symmetry is difficult to determine. Large coralla have about 240 septa arranged in 7 size classes, each progressive size class being narrower and originating closer to the calicular margin. Septa closely spaced, have smooth faces, and bear 2-5 elongate ridges (menianes) oriented parallel to the septal edge. The menianes are 60-70 µm in height and about 30 µm wide, alternating in position with those from the adjacent septal faces (Figs 16 d-e), thus blocking a view of the lower interseptal spaces. Fossa deep and elongate; no columella.

REMARKS. — *Dactylotrochus cervicornis* is assumed to be a solitary coral since no stolons were detected and only one elongate fossa (one mouth) is present. All previous authors described the septate digitiform thecal extensions of this species as branches, but it seems incongruous to refer to a solitary coral as having branches, thus the term "thecal extension" is used.

The five syntypes of *T. primordialis* Gardiner, 1899 are deposited at the University Museum of Zoology, Cambridge, the largest specimen a juvenile 10 mm in height and 2.4 mm in pedicel diameter, having only 66 septa and only three septal extensions.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Field Bank; 245-400 m. Vanuatu region: Tanna and Espiritu Santo, 320-372 m. Elsewhere: Philippines; South China Sea; Guam (reported herein); Bikini, Marshall Islands; New Caledonia and Loyalty Islands; 73-400 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***RHIZOSMILIA*** Cairns, 1978

Rhizosmilia robusta Cairns, 1993

Rhizosmilia robusta Cairns in CAIRNS & KELLER, *1993: 250-253, pl. 6, figs F-I. — CAIRNS & ZIBROWIUS, 1997: 133-134.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 509, 2 (MNHN). — Stn 524, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 961, 2 (MNHN). — Stn 964, 1 (MNHN). — Stn 971, 1 (MNHN). — Stn 1021, 1 (USNM 98752). — Stn 1071, 1 (USNM 98750). — Stn 1077, 3 (USNM 98751). — Stn 1078, 1 (MNHN). — Stn 1084, 1 (MNHN).

TYPE LOCALITY. — *"Anton Bruun"* stn 373B: 26°00'S, 33°05'E (off southwestern Mozambique), 135 m.

REMARKS. — Because of its size, shape, and palar configuration, this species can be taken for a *Caryophyllia* at first view, but differs from that genus in having a polycyclic base, endothecal dissepiments, and a columella composed of irregularly shaped papillae, not twisted lamellae.

DISTRIBUTION. — Wallis and Futuna; 240-300 m. Vanuatu region: Anatom, Efaté, Espiritu Santo, and Malakula; 110-360 m. Elsewhere: southwestern Indian Ocean; Philippines; 66-202 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***ASTEROSMILIA*** Duncan, 1867

Asterosmilia gigas (van der Horst, 1931), n. comb.

Figs 16 g-i, 17 a-b

Caryophyllia gigas van der Horst, v*1931: 4-5, pl. 2, figs 1, 4. — ZIBROWIUS, 1980: 70.
Rhizosmilia gigas - CAIRNS & KELLER, 1993: 251-252.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 510, 1 (MNHN). — Stn 515, 16: 10 (MNHN), 6 (USNM 98754). — Stn 523, 4 (MNHN). — Stn 535, 2 (USNM 98753). — Stn 537, 2 (MNHN). — Stn 586, 1 (MNHN).

TYPE LOCALITY. — Mauritius, 183-366 m.

DESCRIPTION. — Corallum robust and ceratoid, either regularly curved or irregularly bent in a scolecoid fashion. Corallum free, always with an open, broken base 1.5-2.5 mm in diameter revealing 12 septa. Base monocyclic, not reinforced with rootlets-like. Largest specimen reported herein (MUSORSTOM 7 stn 515) 28.2 x 26.0 mm in CD and 65 mm in height; however, the holotype (BM 1939.7.20.851) measures 39.4 x 31.6 mm in CD and 79 mm in height. C_{1-3} expressed as low, rounded ridges; in some coralla C_{4-5} also present as faint ridges. No intercostal striae or granules. Theca white, often covered with encrusting organisms (e.g., foraminifera) and small buds, presumably of the same species. Buds are found on most coralla and cluster near the calicular margin, each measuring 1.5-3.0 mm in diameter and up to 2 mm in height and having 12 septa.

Septa hexamerally arranged in 5 cycles ($S_1>S_2>S_3>S_4>S_5$); however, it is not unusual for even large coralla to lack several pairs of S_5 resulting in less than 96 septa, or for some coralla to have additional pairs of S_6. The holotype, for example, has 5 pairs of S_6 for a total of 100 septa. S_1 up to 3.5 mm exsert, having straight vertical axial edges. S_{2-4} progressively and gradually narrower; however, S_5 only half width of S_4. Triangular lancets corresponding to S_1 and S_2 form at calicular margin. Wide (2.5-3.0 mm), thin paliform lobes (P_4) usually border every S_4 that is flanked by a pair of S_5, the P_4 appearing as pairs in those half-systems containing both pairs of S_5; however, occasionally a paliform lobe occurs before an S_3, even though pairs of S_5 are present. Stereome sometimes present in base of corallum, giving it a dense aspect. Lower portion of corallum also filled with abundant vesicular endothecal dissepiments. Fossa of moderate depth, containing a well-developed, papillose columella composed of irregularly-shaped, crispate elements.

REMARKS. — This appears to be the first report of this species subsequent to its original description, which was based on one specimen, and the first record from the Pacific Ocean. Both VAN DER HORST (1931) and CAIRNS & KELLER (1993) noted that the broken cross section of the base of the holotype was surrounded by what appeared to be contiguous rootlets, which is characteristic of the genus *Rhizosmilia*. However, all specimens reported above propagated by asexual budding, the open base of every corallum corresponding in shape, size, and number of septa to the buds that occur on its theca. A budding mode of reproduction is inconsistent with the polycyclic reinforcement of a *Rhizosmilia*, and thus the root-like structures of the holotype are not interpreted as such, but as an artifact. Discounting the rootlet structures, this species belongs in the genus *Asterosmilia*, which often reproduces by asexual budding. In fact, *A. gigas* is remarkably similar to *A. profunda* (Duncan, 1864)(see CAIRNS & WELLS, 1987), known only from the Eocene to Pliocene of the Caribbean.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 252-510 m. Elsewhere: Mauritius; 183-366 m.

Family TURBINOLIIDAE H. Milne Edwards & Haime, 1848

Genus *ALATOTROCHUS* Cairns, 1994

Alatotrochus rubescens (Moseley, 1876)

Platytrochus rubescens Moseley, v*1876: 553.
Sphenotrochus rubescens - MOSELEY, v.1881: 157-159, pl. 6, figs 8, 8a.
Alatotrochus rubescens - CAIRNS, 1994: 68-69, pl. 29, figs g-l; 1995: 84, pl. 24, figs a-b, map 14; 1997: 14, pl. 1, fig. a, pl. 4, fig. a; 1998: 390. — CAIRNS & ZIBROWIUS, 1997: 141, fig. 18h.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1068, 2: 1 (MNHN), 1 (USNM 98755).

TYPE LOCALITY. — *"Challenger"* stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 236 m (not 136 m, as reported by CAIRNS (1994, 1995) and CAIRNS & ZIBROWIUS (1997)). However, the *"Challenger"* station list presented as Appendix II of the "Narrative" (TIZZARD *et al.*, 1885) lists 140 fathoms (= 256 m) as the depth for station 192.

REMARKS. — This species was recently redescribed and the types illustrated by CAIRNS (1994).

DISTRIBUTION. — Vanuatu region: Malakula; 536-619 m. Elsewhere: Japan; Philippines; Banda Sea; northwestern Australia; southern Norfolk Ridge; 180-751 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***PLEOTROCHUS*** Cairns, 1997

Pleotrochus venustus (Alcock, 1902)

Figs 17 d-e

Ceratotrochus venustus Alcock, v*1902a: 92; v.1902c: 10, pl. 1, figs 5, 5a.
Cryptotrochus venustus - CAIRNS, 1995: 88 (in part: only pl. 27, figs a-b; remaining figures and description pertain to *P. zibrowii* Cairns, *1997).
"Cryptotrochus" venustus - CAIRNS & ZIROWIUS, 1997: 142-143.
Pleotrochus venustus - CAIRNS, 1997: 14 , pl. 1, fig. b, pl. 4, fig. b.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1114, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stn 256: 5°26.6'S, 132°32.5'E (Kai Islands, Banda Sea), 397 m.

REMARKS. — Although worn and obviously long dead when collected, the single specimen reported above is undoubtedly conspecific with *P. venustus*. It represents the first record outside the Banda Sea and the largest known corallum: 13.5 x 11.4 mm in CD and 11.7 mm in height. The species is more fully described by CAIRNS & ZIBROWIUS (1997), and the species and genus are figured and discussed by CAIRNS (1997).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 647 m. Elsewhere: Banda Sea, Indonesia: 200-397 m (CAIRNS & ZIBROWIUS, 1997).

Pleotrochus zibrowii Cairns, 1997

Figs 17 g-h

Cryptotrochus venustus - CAIRNS, 1995: 88-89 (in part: pl. 26g-i; not pl. 27a-b, which is *Ceratotrochus venustus* Alcock, 1902).
Pleotrochus zibrowii Cairns, *1997: 14-15, pl. 1, fig. c, pl. 4, fig. c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 637, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1113, 1 (USNM 98756).

TYPE LOCALITY. — NZOI stn U584: 31°26.3'S, 172°35.6'E (Three Kings Ridge, New Zealand), 1137-1150 m.

REMARKS. — Although worn and obviously dead when collected, the two specimens reported above are virtually identical to specimens in the type series, the larger specimen (MUSORSTOM 7 stn 637) measuring 13.4 x 12.6 mm in CD and 11.5 mm in height. These records represent the second collection of this recently described species.

DISTRIBUTION. — Wallis and Futuna region: Rotumah Bank; 820-830 m. Vanuatu region: Espiritu Santo; 700-736 m. Elsewhere: Three Kings Ridge, New Zealand; 1137-1150 m.

Genus *TROPIDOCYATHUS* H. Milne Edwards & Haime, 1848

Tropidocyathus lessonii (Michelin, 1842)

Fig. 17 c

Flabellum Lessonii Michelin, *1842: 119.
Tropidocyathus lessoni - CAIRNS, 1989a: 33-34, pl. 16, figs d-l (synonymy); 1994: 67, pl. 29, figs a-b (synonymy).
Tropidocyathus lessonii - CAIRNS & ZIBROWIUS, 1997: 146-147. — CAIRNS,1997: 16, pl. 1, fig. e, pl. 4, fig. e, pl. 7, fig. d; 1998: 390-392.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1016, 1 (MNHN).

TYPE LOCALITY. — Unknown.

REMARKS. — The single specimen reported above, worn and dead when collected, measures 12.8 x 10.7 mm in CD and 10.8 mm in height. This species is distinctive in having a rhomboidal calice (the lateral thecal faces bulging outward) and highly developed edge crests up to 3.4 mm in height. This relatively common deep-water species was redescribed, illustrated, and discussed by CAIRNS (1989, 1994, 1997).

DISTRIBUTION. — Vanuatu region: Efaté; 291-300 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 50-421 m (CAIRNS & ZIBROWIUS, 1997).

Tropidocyathus labidus Cairns & Zibrowius, 1997

Fig. 2 d

"Tropidocyathus" labidus Cairns & Zibrowius, 1997: 148, figs 20 a-g. — CAIRNS, 1998: 392.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 8: stn 963, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1026, 1 (MNHN). — Stn 1065, 1 (MNHN). — Stn 1068, 2 (USNM 98758).

TYPE LOCALITY. — KARUBAR stn 2: 5°47'00"S, 132°11'35"E (Kai Islands, Banda Sea), 209-240 m.

REMARKS. — This small, distinctive species was recently described and illustrated. All specimens reported above were alive when collected and well preserved.

DISTRIBUTION. — Vanuatu region: Anatom, Efaté, and Malakula; 419-536 m. Elsewhere: Indonesia; Ryukyu Islands; tropical Western Australia; 206-425 m (CAIRNS, 1998).

Genus *CYATHOTROCHUS* Bourne, 1905

Cyathotrochus pileus (Alcock, 1902)

Trochocyathus pileus Alcock, v*1902a: 96-97; v.1902c: 15-16, pl. 2, figs 11, 11a.
?*Cyathotrochus herdmani* Bourne, *1905: 193, pl. 1, figs 2, 2a.
Tropidocyathus pileus - CAIRNS, 1989a: 34-35, pl. 17, figs a-h (synonymy); 1994: 68, pl. 29, figs d-e; 1995: 91, pl. 28, figs a-c, map 11. — CAIRNS & ZIBROWIUS, 1997: 147-148, figs 19 h-i.
Cyathotrochus pileus - CAIRNS, 1997: 16, pl. 1, figs f-g, pl. 4, fig. f; 1998: 392.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 958, 2 (USNM 98760). — Stn 959, 1 (MNHN). — Stn 980, 1 (MNHN). — Stn 1016, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stn 95: 5°43'N, 119°40'E (Sulu Archipelago, Philippines), 522 m.

REMARKS. — Descriptions and illustrations of this commonly collected deep-water coral can be found in CAIRNS (1989a, 1994, 1997). Most of the specimens reported above were alive when collected and possess four cycles of septa.

DISTRIBUTION. — Vanuatu region: Anatom, Tanna, and Efaté; 300-497 m. Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 123-522 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***DELTOCYATHOIDES*** Yabe & Eguchi, 1932

Deltocyathoides orientalis (Duncan, 1876)

Deltocyathus orientalis Duncan, *1876: 431.
Peponocyathus orientalis - WELLS, v.1984: 214.
Peponocyathus australiensis - CAIRNS, 1989a: 29, 30-32, pl. 14, figs d-j, pl. 15, figs a-d (synonymy); 1994: 65-66, pl. 28, figs c-f, pl. 41, fig. 1 (synonymy). [Not *Deltocyathus italicus* var. *australiensis* Duncan, v*1870].
Deltocyathoides orientalis - CAIRNS & ZIBROWIUS, 1997: 144. — CAIRNS, 1997: 17, pl. 1, fig. h, pl. 7, fig. f; 1998: 392.

MATERIAL EXAMINED. — MUSORSTOM 7: stn 512, 1 (MNHN). — Stn 523, 1 (MNHN).

TYPE LOCALITY. — 34°12'N, 136°20'E (southeastern Honshu, Japan), 95 m.

REMARKS. — This small, commonly collected and locally abundant coral was redescribed and illustrated by CAIRNS (1989, 1994) as *Peponocyathus australiensis*.

DISTRIBUTION. — Wallis and Futuna; 245-455 m. Late Pleistocene of Espiritu Santo, Vanuatu (WELLS, 1984). Elsewhere: Indo-West Pacific from southwest Indian Ocean to Japan; 44-635 m.

Genus ***NOTOCYATHUS*** Tenison Woods, 1880

Notocyathus conicus (Alcock, 1902)

Citharocyathus conicus Alcock, v*1902b: 118-119; v.1902c: 22, pl. 3, figs 18, 18a.
Notocyathus conicus - CAIRNS, 1989a: 28, pl. 13, figs a-i (synonymy); 1994: 64-65, pl. 28, figs a-b; 1995: 91-92, figs c, g, map 10; 1997: 17, pl. 4, fig. j. — CAIRNS & ZIBROWIUS, 1997: 143-144.
Not *Citharocyathus conicus* - WELLS, v.1984: 214, figs 4, 2-5 [= ?*Notocyathus venustus* (Alcock, 1902)].

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1018, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1067, 2 (MNHN).

TYPE LOCALITY. — *"Siboga"* stn 95: 5°43.5'N, 119°40'E (Sulu Sea, Philippines), 522 m.

REMARKS. — Three well-preserved specimens of *N. conicus* are reported herein, the largest 6.2 mm in CD and 7.8 mm in height. This species was redescribed and figured by CAIRNS (1989, 1994), as well as compared to the other Recent sibling species, *N. venustus* (Alcock, 1902). WELLS (1984) reported the "*venustus*" form of *N. conicus* from the Pleistocene of Vanuatu, but the small size and poor condition of his specimens do not allow a definite attribution between these two very similar species.

DISTRIBUTION. — Vanuatu region: Efaté and Malakula; 344-366 m. Elsewhere: Japan; Philippines; Indonesia; Norfolk and Kermadec Ridges; 34-923 m (CAIRNS & ZIBROWIUS, 1997).

Genus *CRYPTOTROCHUS* Cairns, 1988

Cryptotrochus brevipalus sp. nov.

Figs 17 f, i

MATERIAL EXAMINED/TYPES. — **Vanuatu**. MUSORSTOM 8: stn 988, 2 paratypes (MNHN). — Stn 1014, 1 paratype (MNHN). — Stn 1028, 1 paratype (USNM 98762). — Stn 1034, holotype (MNHN) and 1 paratype (MNHN). — Stn 1067, 1 paratype (MNHN). — Stn 1113, 1 paratype (USNM 98763).

TYPE LOCALITY. — MUSORSTOM 8: stn 1034: 17°54'S, 168°42'E (Efaté), 690-750 m.

ETYMOLOGY. — The species name *brevipalus* (Latin *brevis*, short + *palus*, stick) is a reference to the relatively short pali (P_2) of this species. The name is treated as a noun in apposition.

DESCRIPTION. — Corallum a regular inverted cone, the blunt basal angle ranging from 68° to 72° (turbinate). Largest specimen (holotype) 10.3 mm in CD and 10.0 mm in height. Calice circular; theca thick, about 0.7 mm. Costae 0.4-0.5 mm wide at calicular edge, separated by deep intercostal furrows 40-50% the costal width. C_{1-2} independent in origin, but C_4 originate by trifurcation of C_3 2.3-2.5 mm above base. Costae serrate, the outer edge of each costa covered with a single row of small teeth about 0.15 mm in diameter and height; smaller spines about 0.1 mm in height and 0.04 mm diameter project laterally from each costa into the intercostal spaces, although they are so small and well spaced that they do not obscure the view of the underlying theca between the costae. Corallum uniformly white.

Septa hexamerally arranged in 4 complete cycles in all specimens examined (CD = 6.0-10.3 mm): $S_1>S_2>S_3>S_4$, 48 septa. S_1 about 1.8 mm exsert, extend about 3/4 distance to columella, having straight, vertical axial edges that fuse to the columella lower in fossa. S_2 about 1.2 mm exsert and 2/3 with of the S_1, each bearing a prominent palus (P_2). S_3 about 0.9 mm exsert and 3/4 width of the S_2, their lower axial edges strongly fused to the peripheral edge of the P_2 lower in fossa, but easily visible in calicular view. In fact, in some specimens it would appear that each S_3 bears a palus, a pair of which unite before their common S_2 to form a V-shaped P_2 (as in the case of *Notocyathus*); however, each P_2 in this species rises higher in the fossa (usually just above the level of the columella) as a single slender structure. S_4 about 0.7 mm exsert, 2/3 width of the S_3, and have free axial edges. Septal faces covered with very small spines, the same size and shape as those occurring on the lateral faces of the costae. Fossa of moderate depth, containing a papillose columella of 4-7 strongly fused elements.

REMARKS. — Of the two other species known in the genus, *C. brevipalus* is most similar to *C. javanus* Cairns, 1988 (Java Sea, 585 m) in size and shape, and in having independent S_4; however, differs in having serrate costae (not granular), S_3 fused to the peripheral edge of P_2, and in having less prominent P_2. *C. brevipalus* resembles *C. carolinensis* Cairns, 1988 (western Atlantic, 320-338 m) in having serrate costae and S_3 that fuse with the P_2, but differs in having a larger and more open corallum (higher basal angle), independent S_4, and pointed P_2 that rise slightly higher in the fossa. Although not in the same genus, *C. brevipalus* resembles *Pleotrochus zibrowii* Cairns, 1997, in size, shape, and in having S_3 that fuse to the peripheral edge of the P_2. The two species have also been found at the same station; however, *C. brevipalus* differs in having a costae:septa ratio of 1 (vs 2), costal trifurcation (vs independent origin), a blunt base (vs pointed), and less prominent P_2.

DISTRIBUTION. — Vanuatu region: Tanna, Efaté, Malakula, and Espiritu Santo; 466-700 m.

Genus *IDIOTROCHUS* Wells, 1935

Idiotrochus kikutii (Yabe & Eguchi, 1941)

Placotrochides kikutii Yabe & Eguchi, *1941: 104; 1942: 149, pl. 9, fig. 16a-c.

Idiotrochus kikutii - CAIRNS, 1989a: 36-37, pl. 18, figs a-b, d-h (synonymy); 1994: 69, pl. 30, figs a-d; 1997: 21, pl. 5, fig. g, pl. 7, fig. l; 1998: 390. — CAIRNS & ZIBROWIUS, 1997: 148-149.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 509, 6 (MNHN). — Stn 512, 1 (USNM 98764). — Stn 513, 1 (MNHN).

TYPE LOCALITY. — Toyama Bay, Honshu, Japan (depth not given).

REMARKS. — This distinctive, wedge-shaped species is well described and illustrated by CAIRNS (1989a) and CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 240-260 m. Elsewhere: western Pacific from Japan through Indonesia; Western Australia; 97-645 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***PEPONOCYATHUS*** Gravier, 1915

Peponocyathus folliculus (Pourtalès, 1868)

Figs 18 a-b

Stephanophyllia folliculus Pourtalès, v*1868: 139.
Peponocyathus variabilis Gravier, v*1915: 5; v.1920: 39, pl. 4, figs 60-73, pl. 13, fig. 202, pl. 14, figs 203-204.
Peponocyathus folliculus - CAIRNS, 1979: 113-115, pl. 22, figs 1-4; 1989a: 32-33 (in part: pl. 16, figs a-c); 1994: 66-67, pl. 28, figs g-k (synonymy and description); 1997: 30, pl. 3, fig. k, pl. 6, figs h-j. — ZIBROWIUS, v.1980: 113-115, pl. 58, figs A-L, pl. 59, figs A-K (synonymy). — CAIRNS & ZIBROWIUS, 1997: 146.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1088, 1 attached to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — *"Bibb"* stn 51: 24°12'40"N, 81°19'25"W (Straits of Florida, western Atlantic), 433 m.

REMARKS. — The single specimen reported herein is "gourd"- or "onion-shaped", measuring 4.9 mm in greatest diameter, but only 3.3 mm in CD, having 30 septa. The species is known to be variable in shape, the onion-shaped form being well illustrated and discussed by GRAVIER (1920) and ZIBROWIUS (1980). The specimen was dead when collected, and basally incorporated into a *Xenophora* gastropod shell. *Xenophora* gastropods, also called "carrier shells", appear to be efficient collectors of small, otherwise rarely collected deep-water Scleractinia, this particular shell (Fig. 18 a) having cemented eight solitary corals to its outer whorls, including: one *P. folliculus*, two *Caryophyllia abrupta*, three *Trochocyathus discus*, and two as yet unidentified species (i.e., Gardineriidae gen. nov. sp. nov. sensu STOLARSKI, 1996).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 425-455 m. Elsewhere: Atlantic; western Pacific from Japan through Indonesia; 50-582 m (CAIRNS & ZIBROWIUS, 1997).

Superfamily FLABELLOIDEA Bourne, 1905

Family GUYNIIDAE Hickson, 1910

Genus ***GUYNIA*** Duncan, 1872

Guynia annulata Duncan, 1872

Guynia annulata Duncan, v*1872: 32, pl. 1, figs 1-8. — ZIBROWIUS, v.1980: 161-162, pl. 83, figs A-Q (synonymy). — CAIRNS, 1989a: 42-43, pl. 21, fig. f, pl. 22, figs a-e; 1998: 392. — CAIRNS & PARKER, 1992: 42-43, pl. 14, figs g-h. — CAIRNS & ZIBROWIUS, 1997: 150 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 504, 4 attached to theca of ?dead corallum of *Conotrochus asymmetros* (MNHN). — Stn 513, 1 attached to theca of dead corallum of *Heterocyathus* cf. *sulcatus* (MNHN). — Stn 569, 1 attached to theca of dead corallum of *Flabellum arcuatile*, n. sp. (MNHN).

Vanuatu. MUSORSTOM 8: stn 1016, 1 attached to base of dead discoidal coral, perhaps a *Deltocyathus* (USNM 98765). — Stn 1097, 1 cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — Adventure Bank, Mediterranean, 168 m.

REMARKS. — This extremely small, serpulid-like corallum is often found attached to living and dead coralla of other scleractinian species (see Material Examined). Although difficult to detect in collections because of its small size (CD about 1 mm) and its sometimes cryptic habit, its widespread distribution is becoming increasingly well known as large collections are closely examined. The species is more fully described and illustrated by ZIBROWIUS (1980), CAIRNS (1989a), and CAIRNS & PARKER (1992).

DISTRIBUTION. — Wallis and Futuna region: Futuna; Waterwitch Bank; 260-300 m. Vanuatu region: Efaté and Espiritu Santo; 288-300 m. Elsewhere: cosmopolitan in tropical and warm temperate regions; 28-653 m (CAIRNS & ZIBROWIUS, 1997).

Genus ***TRUNCATOGUYNIA*** Cairns, 1989

Truncatoguynia irregularis Cairns, 1989

Fig. 18 c

Truncatoguynia irregularis Cairns, *1989a: 43, pl. 22, figs f-g, pl. 23, figs a-c, f; 1994: 70, pl. 30, figs e-f; 1995: 93-94, pl. 29, figs g-h, pl. 30, figs a-b, map 12.
Truncatoguynia sp. Cairns, 1989a: 43, pl. 23, figs d-e.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 967, 4 (one in 5 pieces) (USNM 98766).

TYPE LOCALITY. — *"Albatross"* stn 5311: 21°33'N, 116°15'E (north of Pratas Island, South China Sea), 161 m.

REMARKS. — This species was described and illustrated several times recently as indicated in the synonymy. The specimens reported above pertain to the diminutive form of the species, similar to those reported from NZOI stn C531 by CAIRNS (1989a, 1995). These specimen are characterised by an elongate, curved corallum up to 21 mm in length, but having a small calice of only 2.4-2.8 mm GCD, resulting in a length:GCD ratio of 7.3-7.6. The basal scar is correspondingly small (1.1-1.8 x 0.9-1.4 mm), coralla containing only 24 hexamerally arranged septa: $S_{1-2}>>S_3$.

DISTRIBUTION. — Vanuatu region: Anatom; 295-334 m. Elsewhere: Ryukyu Islands; South China Sea; Norfolk and Kermadec Ridges; 80-248 m (CAIRNS, 1995).

Genus ***TEMNOTROCHUS*** Cairns, 1995

Temnotrochus kermadecensis Cairns, 1995

Figs 18 d-e

Temnotrochus kermadecensis Cairns, *1995: 96, pl. 31, figs a-d.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 963, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1023, 2 cemented to a *Xenophora* shell (MNHN).

TYPE LOCALITY. — 3.7 km off Nugent Island, Raoul Island, Kermadec Ridge, 366-402 m.

REMARKS. — Little can be added to the original description based on these three specimens. *Temnotrochus kermadecensis* is characterised as having an elongate compressed-cylindrical anthocyathus that originates by transverse division, a papillose columella, and paliform lobes before the S_{1-2}. The characteristic thecal spots are often difficult to see, and are evident only on the specimen from MUSORSTOM 8 stn 963. The specimens reported above constitute the second report of this species and include specimens larger than in the type series, one from MUSORSTOM 8 stn 963 being 2.1 mm in GCD and 6.0 mm in length. All three specimens were obtained as objects cemented to the "carrier" gastropod shell *Xenophora*, an efficient collector of azooxanthellate corals of this size range.

DISTRIBUTION. — Vanuatu region: Anatom and Efaté; 321-400 m. Elsewhere: Kermadec Ridge; 366-402 m.

Family FLABELLIDAE Bourne, 1905

Genus ***FLABELLUM*** Lesson, 1831

Subgenus ***FLABELLUM (FLABELLUM)*** Lesson, 1831

Flabellum (F.) pavoninum Lesson, 1831

Figs 18 g-i

Flabellum pavoninum Lesson, v*1831: 2. — CAIRNS, 1989a: 46-50, pl. 23, figs g-l, pl. 24, figs a-d, g-h (synonymy); 1994: 70-71, pl. 30, figs g-i, pl. 31, figs a-c. — CAIRNS & ZIBROWIUS, 1997: 150-151, fig. 20h.
Flabellum coalitum Marenzeller, v*1888a: 48-49. — CAIRNS, 1989a: 46, 47, 50, pl. 24, figs e-f, i-l.
Flabellum sp. - CAIRNS, 1989a: 24, pl. 24, figs e-f.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 504, 1 (MNHN). — Stn 513, 2 (MNHN). — Stn 516, 2 (MNHN). — Stn 523, 4 (MNHN). — Stn 538, 3 (USNM 98767). — Stn 569, 3 (MNHN). — Stn 605, 4 (MNHN). — Stn 610, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 962, 1 (MNHN). — Stn 963, 12 (USNM 98871). — Stn 964, 3 (USNM 98874). — Stn 971, 1 (USNM 98873). — Stn 976, 7 (MNHN). — Stn 988, 2 (MNHN). — Stn 1004, 1 (MNHN). — Stn 1005, 1 (MNHN). — Stn 1016, 2 (USNM 98770). — Stn 1017, 1 (MNHN). — Stn 1018, 4 (USNM 98768). — Stn 1065, 5 (USNM 98769). — Stn 1070, 1 (MNHN). — Stn 1071, 2 (MNHN). — Stn 1084, 4 (MNHN). — Stn 1085, 125 (MNHN). — Stn 1086, 6 (MNHN). — Stn 1087, 1 (USNM 98872). — Stn 1091, 3, including 1 cemented to a *Xenophora* shell (MNHN). — Stn 1102, 1 (MNHN). — Stn 1103, 15: 12 (MNHN), 3 (USNM 98875). — Stn 1132, 3 (MNHN). — Stn 1134, 3 (MNHN). — Stn 1135, 2 (MNHN).

TYPE LOCALITY. — "Sandwich Islands" (= Hawaiian Islands), no depth given.

DESCRIPTION (*coalitum* form). — Corallum flabellate: angle of thecal faces, 27°-47°; angle of thecal edges bimodal, the lower 5 mm of the corallum (the pedicel) having an edge angle of 40°-50°, above which the corallum widens to an edge angle of 62°-143°. Thecal faces virtually planar, meeting in acute thecal edges that bear a prominent, discontinuous edge crest composed of 1-4 (depending on size of corallum) thecal eversions, each eversion an irregularly shaped discrete structure up to 2.5 mm in height. Largest specimen examined (MUSORSTOM 8 stn 1102) 29.1 x 16.3 mm in CD and 22.5 mm in height. Basal disc quite small (0.9-1.0 mm in diameter), containing 6 protosepta, only the smallest coralla maintaining its original attachment to substrate. Theca dull in lustre, covered with fine transversely oriented ridges, and often covered with encrusting organisms, in four cases (MUSORSTOM 7 stn 538, MUSORSTOM 8 stns 976, 1104 and 1132) bored by acrothoracican Crustacea (Fig. 18 h). Lower 5 mm of corallum (basal disc and lower pedicel) white; remaining theca a light reddish brown, with more intense radial stripes corresponding to S_{1-3}.

Septa hexamerally arranged in 5 cycles and often part of a sixth cycle ($S_{1-3}>S_4>S_5>S_6$) in larger coralla, pairs of S_6 particularly common in the quarter systems adjacent to the principal septa, but also occurring in random

order in lateral face quarter systems; largest corallum contains 140 septa. Distal peripheral edges of S_{1-3} nonexsert, separated from thecal edge by a low notch or slight concavity, then projecting into fossa as a prominent lobe; midaxial edges of S_{1-3} often slightly concave, and lower axial edges thickened and very sinuous. The two principal S_1 aligned with the GCD are smaller than the other 4 S_1. Distal edges of S_4 not lobate and thus much narrower than S_{1-3}, but lower in fossa almost 3/4 width of the S_{1-3}; axial edges straight. S_5 about 1/3 width of an S_4. When pairs of S_6 are present, the S_5 they flank widen to 2/3 the width of an S_4 and the S_6 are the size of a typical S_5. Fossa deep and elongate; lower axial edges of S_{1-3} fuse to form a rudimentary columella.

REMARKS. — Although recently redescribed and figured (CAIRNS, 1989a, 1994; CAIRNS & ZIBROWIUS, 1997), *F. pavoninum* is redescribed above based on the abundance of well-preserved specimens of this otherwise poorly represented species. All specimens reported above pertain to the *"coalitum"* form of the species, as discussed by CAIRNS (1994) and CAIRNS & ZIBROWIUS (1997), which is distinguished from the typical form by having a smaller corallum, a lower edge angle, and fewer septa.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 286-455 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Espiritu Santo, and Malakula; 161-400 m. Elsewhere: Indo-Pacific from southwest Indian Ocean to Hawaiian Islands, forma *coalitum* being most common off Japan; 73-665 m (CAIRNS & ZIBROWIUS, 1997).

Flabellum (F.) arcuatile sp. nov.

Figs 19 a-d

Flabellum (F.) angiostomum - CAIRNS, 1995: 99, pl. 32, figs d-f, map 13 [Not *Flabellum angiostomum* Folkeson, v*1919].

MATERIAL EXAMINED/TYPES. — **Wallis and Futuna region**. MUSORSTOM 7: stn 524, 2 paratypes (MNHN). — Stn 530, 3 paratypes (MNHN). — Stn 534, 1 paratype (MNHN). — Stn 535, 2 paratypes (MNHN). — Stn 542, 1 paratype (USNM 98876). — Stn 546, 2 paratypes (USNM 98877). — Stn 578, 1 paratype (USNM 98878). — Stn 589, 1 paratype (MNHN).

New Zealand region. NZOI: stn I92, 9 paratypes (USNM 94322). — Stn I97, 35: 20 paratypes (NZOI), holotype (NZOI H688), 14 paratypes (USNM 94323). — Stn U599, 1 paratype (NZOI).

TYPE LOCALITY. — NZOI stn I97: 32°22.9'S, 167°28.2'E (southern Norfolk Ridge), 540-544 m.

ETYMOLOGY. — The species name *arcuatile* (Latin *arcuatilis*, shaped like a bow) refers to the regular crescent-shaped arc formed by the calicular margin.

DIAGNOSIS. — Corallum flabellate, highly compressed (GCD:LCD = 2.1-3.1), never constricted, and robust. Corallum wider than tall: GCD: H = 1.25-1.45. Thecal edges always rounded, the lower 7-9 mm of the corallum having an edge angle of 60°-80°, changing to a more open 125°-180° with height. Face angle = 26°-39°. Holotype 38.4 x 15.4 mm in CD and 28.3 mm in height, chosen because it represents a corallum with a full sixth cycle of septa; largest corallum (paratype from NZOI I97, NZOI) 49.8 x 20.5 mm in CD and 33.8 mm in height. Pedicel small: 1.1-1.3 mm in diameter. Thecal of well-preserved specimens uniformly reddish brown. Septa hexamerally arranged in 6 or more cycles, the sixth cycle attained at a GCD of 20-25 mm, and larger coralla having some pairs of S_7: $S_{1-4}>S_5>S_6>S_7$. Axial edges of S_{1-4} extremely sinuous.

REMARKS. — Among the 23 Recent species in the subgenus, *F. arcuatile* is one of three species to have a flabellate corallum with rounded thecal edges, the other two species being *F. knoxi* Ralph & Squires, 1962 (New Zealand region south of 38°S), and *F. impensum* Squires, 1962 (Antarctic, 46-2200 m). *F. arcuatile* is most similar to *F. knoxi*, but differs in having a more robust corallum, a smaller pedicel with fewer protosepta (6 vs 12), a lesser developed columella, and a more compressed corallum.

A fuller description of *Flabellum arcuatile* can be found in CAIRNS (1995), as *Flabellum angiostomum*. I (CAIRNS, 1998) subsequently examined the type of *Flabellum angiostomum*, transferred it to the genus *Truncatoflabellum*, and eliminated the New Zealand records from its range, but did not at that time indicate the

identity of the New Zealand specimens previously identified as *F. angiostomum*, which now form part of the type series of *F. arcuatile*.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Waterwitch, Combe, and Field Banks; 300-640 m. Elsewhere: southern Norfolk Ridge; Three Kings Ridge; 544-590 m (CAIRNS, 1995).

Subgenus *FLABELLUM (ULOCYATHUS)* Sars, 1851

Flabellum (U.) deludens Marenzeller, 1904

Fig. 18 f

Flabellum deludens Marenzeller, *1904: 269-272, pl. 17, figs 10, 10a. — CAIRNS, 1989a: 55-56, pl. 29, figs a-f (synonymy); 1994: 73, pl. 32, figs d-e; 1998: 395. — CAIRNS & ZIBROWIUS, 1997: 154-156.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 532, 1 (MNHN).

TYPE LOCALITY. — *"Valdivia"* stns 185 and 203: west of Sumatra, 614-660 m.

REMARKS. — Only one worn specimen is reported herein, measuring 27.8 x 16.1 mm in CD, 20.6 mm in height, and 1.8 x 1.5 mm in PD, containing 72 septa - a pair of rudimentary S_5 flanking each S_3. This specimen is unusual in that its C_{1-2} are produced as prominent, rounded ridges (Fig. 18 f). The species is redescribed and illustrated by CAIRNS (1989a, 1994) and a table comparing similar species is given by CAIRNS & ZIBROWIUS (1997: Table 2).

DISTRIBUTION. — Wallis and Futuna region: Waterwitch Bank; 516-530 m. Elsewhere: Indo-West Pacific from northern Indian Ocean through Indonesia to Japan; 106-1035 m (CAIRNS & ZIBROWIUS, 1997).

Flabellum (U.) aotearoa Squires, 1964

Fig. 19 e

Flabellum aotearoa Squires, v*1964: 7-9, pl. 2, figs 15-18. — CAIRNS, 1995: 102-103, pl. 33, figs d-f, i, Map 16 (synonymy).
Flabellum sp. cf. *F. deludens* - WELLS, v.1984: 215, pl. 4, figs 8-10 [Not *Flabellum deludens* Marenzeller, *1904].

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn *959, 3 (MNHN). — Stn 963, 25, including 1 cemented to a *Xenophora* shell (USNM 98882). — Stn *964, 4 (MNHN). — Stn *977, 1 (MNHN). — Stn *1004, 1 (MNHN). — Stn 1005, 2 (MNHN). — Stn *1016, 30 (MNHN). — Stn *1017, 6 (USNM 98880). — Stn *1018, 148 (MNHN). — Stn *1023, 2 (MNHN). — Stn 1060, 1 (MNHN). — Stn 1065, 1 (USNM 98881). — Stn 1091, 4 (USNM 98879). — Stn *1134, 1 (MNHN).

TYPE LOCALITY. — *"Ikatare"* stn B-26: 35°04'S, 174°23.2'E (Bay of Islands, near Cape Brett, New Zealand), 184 m (see CAIRNS, 1995).

REMARKS. — Although previously known from the Late Pleistocene of Vanuatu (WELLS, 1984), this is the first record of living specimens from this archipelago. The species was recently redescribed and illustrated by CAIRNS (1995). It is characterised by having a scalloped calicular edge; a granular, but lustrous theca; and S_{1-4} with highly sinuous axial edges. Several stations reported above (indicated with an asterisk) include populations that are diminutive in size, the coralla never exceeding 15 mm in GCD. These specimens nonetheless have a full fifth cycle and often have highly developed edge crests (Fig. 19 e), resulting in an edge angle (crests included) of 180°.

DISTRIBUTION. — Vanuatu region: Anatom, Tanna, Erromango, Efaté, Malakula, and Espiritu Santo (including Late Pleistocene, see WELLS, 1984); 287-436 m. Elsewhere: northern New Zealand and ridges north of New Zealand; Chesterfield Islands; 130-1300 m (CAIRNS, 1995).

Flabellum (U.) marcus Keller, 1974

Fig. 19 f

Flabellum deludens - VAUGHAN, v*1907: 63-65, pl. 3, fig. 5 [Not *Flabellum deludens* Marenzeller, *1904].
Flabellum marcus Keller, *1974: 208-209, pl. 1, fig. 5, pl. 3, figs 5-6, pl. 5, fig. 8, text-fig. 1; 1981a: 31-32, pl. 1, figs 7a-b, pl. 2, figs 5a-b. — CAIRNS, 1984: 21.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 956, 7 (USNM 98883). — Stn 1037, 8 (MNHN). — Stn 1129, 1 (MNHN).

TYPE LOCALITY. — *"Vityaz"* stn 6363: 21°10'N, 163°16'E (Marcus-Necker Ridge), 1350 m.

REMARKS. — The best description of this species is that of specimens from Hawaii by VAUGHAN (1907), as *Flabellum deludens*. The specimens reported above differ from the Hawaiian populations in having a lesser edge angle (125°-142° vs 180°), and a taller pedicel (up to 4 mm vs 1.5-1.8 mm in diameter). They are otherwise quite similar and found at a comparable depth range.

DISTRIBUTION. — Vanuatu region: Anatom and Efaté; Guyot Bougainville; 1050-1175 m. Elsewhere: central Pacific, including Marcus-Necker Ridge and Hawaiian Islands; 1261-1602 m (CAIRNS, 1984).

Flabellum (U.) hoffmeisteri Cairns & Parker, 1992

Flabellum (U.) hoffmeisteri Cairns & Parker, *1992: 47-48, pl. 16, figs d-f (synonymy). — CAIRNS, 1995: 103-104, pl. 33, figs g-h, map 22; 1998: 394-395. — CAIRNS & ZIBROWIUS, 1997: 157-158.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1014, 1 (MNHN).

TYPE LOCALITY. — *"Soela"* stn 27: 37°59'S, 150°05'E (off Victoria, Australia), 452 m.

REMARKS. — Only one poorly-preserved corallum is reported herein measuring 33.1 x 20.6 mm in CD and 22.5 mm in height. Descriptions and illustrations can be found in CAIRNS & PARKER (1992) and CAIRNS (1995), and a table comparing similar species in CAIRNS & ZIBROWIUS (1997: Table 2).

DISTRIBUTION. — Vanuatu region: Efaté; 495-498 m. Elsewhere: Indonesia; Western Australia; Victoria; Tasmania; Kermadec and Colville Ridges; 110-646 m (CAIRNS, 1998).

Flabellum (U.) apertum apertum Moseley, 1876

Flabellum apertum Moseley, v*1876: 556 (in part: *"Challenger"* stn 145); v.1881: 167-168 (in part: pl. 6, figs 7a-c). — CAIRNS, 1982: 44-46, pl. 13, figs 8-11, pl. 14, figs 1-4 (synonymy).
Flabellum patagonichum Moseley, v*1881: 166-167, pl. 15, figs 1-7.
Flabellum raukawaensis Squires & Keyes, v*1967: 27, pl. 4, figs 8-9.
Flabellum apertum apertum - CAIRNS, 1995: 104-105, pl. 35, figs a-c, map 4 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 551, 49 (MNHN). — Stn 552, 53 (USNM 98884). — Stn 564, 30 (MNHN). — Stn 565, 53 (USNM 98885). — Stn 567, 6 (MNHN). — Stn 620, 1 (MNHN). — Stn 621, 1 (MNHN). — Stn 623, 1 (MNHN).

TYPE LOCALITY. — *"Challenger"* stn 145: 46°40'S, 37°50'E (off Prince Edward Island), 567 m.

REMARKS. — Little can be added to the redescriptions and figures of CAIRNS (1982, 1995). Once thought to be a species with an antiboreal distribution, it is now known from the warm temperate region off New Zealand (CAIRNS, 1995), and now from beneath tropical waters.

DISTRIBUTION. — Wallis and Futuna region: Combe and Tuscarora Banks; 795-1280 m. Elsewhere: circum-Subantarctic; New Zealand region to Three Kings Islands; 220-1575 m (CAIRNS, 1995).

Genus *TRUNCATOFLABELLUM* Cairns, 1989

Truncatoflabellum stabile (Marenzeller, 1904)

Figs 19 i-j

Flabellum stabile Marenzeller, *1904: 273-274, pl. 17, figs 12a-b. — ZIBROWIUS, 1980: 150.
Truncatoflabellum stabile - CAIRNS, 1989a: 61. — ZIBROWIUS & GILI, 1990: 39.
Truncatoflabellum sp. cf. *T. stabile* - CAIRNS & KELLER, 1993: 264-265, fig. 10C, F.
Truncatoflabellum sp. A - CAIRNS, 1994: 79, pl. 34, figs c-e.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 996, 1 (MNHN). — Stn 1036, 1 (MNHN). — Stn 1037, 1 (USNM 98887). — Stn 1125, 2 (including an anthocaulus) (MNHN). — Stn 1127, 1 (MNHN).
Madeira Islands. CANCAP III: stn 3.053, 4 (USNM 98886).

TYPE LOCALITY. — *"Valdivia"* stn 37: 16°14'01"N, 22°38'03"W (Cape Verde Islands), 1694 m.

DESCRIPTION. — Anthocyathus: Angle of straight thecal edges 59°-73°; inclination of slightly convex thecal faces, 29°-40°. Thecal faces meet in an acute angle at the edges and are very slightly ridged within 1-4 mm of the basal scar, but edges do not bear crests or spines. Largest specimen reported herein (MUSORSTOM 8 stn 996) 28.2 x 16.9 mm in CD and 28.4 mm in height. Calicular margin slightly arched and finely serrate; GCD:LCD = 1.36-1.67; GCD:H = 1.00-1.15. Basal scar small and elliptical: 3.6-6.4 x 2.6-4.1 mm. Theca overlying C_{1-2} produced as low, rounded longitudinal ridges, perpendicular to which are fine growth lines. Theca uniformly white. Anthocaulus 5.3 mm in height and 2.0 mm in pedicel diameter, having 3 cycles of septa.

Septa hexamerally arranged in 5 complete cycles: $S_{1-2}>S_3>S_4>S_5$, the base of an anthocyathus having only 3 cycles plus several pairs of S_4 (24-32 septa), and a full fourth cycle present by a GCD of 11 mm. S_{1-2} only slightly wider than S_3, whereas S_3 are twice the width of the S_4, and S_5 are only about 1/3 the width of the S_4. Axial edges of all septa straight and vertical, those of the S_{1-3} thickened deep in fossa near their fusion to the columella. Fossa deep, containing a well-developed, elongate columella 1.8-2.0 mm wide.

REMARKS. — Although smaller than previously reported specimens from the Atlantic, Mozambique, and Japan, which reach 48 mm in GCD, the specimens reported herein are believed to be conspecific. MARENZELLER (1904) described his larger syntype as having a GCD of 60 mm, but his figure implies a corallum with a GCD of 41 mm. The syntypes of *Flabellum stabile* appear to be lost (ZIBROWIUS, 1980). Among the 29 Recent species of *Truncatoflabellum*, only four lack edge spines and edge crests: *T. inconstans* (Marenzeller, 1904); *T. trapezoideum* (Keller, 1981); *T. paripavoninum* (Alcock, 1898); and *T. stabile* (Marenzeller, 1904), the last three being found at great depths. Although I previously hesitated in identifying Pacific specimens as *T. stabile*, I now believe them to be the same based on the examination of specimens from the Madeira Islands (see Material Examined). Discussions and comparisons of the nonspinose *Truncatoflabellum* species are found in ZIBROWIUS & GILI (1990) and CAIRNS (1994). Although they are similar in corallum morphology, *T. stabile* differs from: *T. trapezoideum* in having a smaller basal scar; from *T. paripavoninum* in having a smaller basal scar, a small edge angle, less septa, and a more robust corallum; and from *T. inconstans* in having less septa, a more circular calice, and a much deep depth range.

DISTRIBUTION. — Vanuatu region: Erromango and Efaté; Guyot Bougainville; 786-1160 m. Elsewhere: Cape Verde, Selvagems, and Madeira Islands; Mozambique; Ryukyu Islands; 964-3010 m (ZIBROWIUS & GILI, 1990).

Truncatoflabellum dens (Alcock, 1902)

Figs 19 g-h

Flabellum dens Alcock, v*1902a: 106-107; v.1902c: 32, pl. 4, figs 30, 30a. — CAIRNS, 1989a: 54, pl. 28, figs g-k. *Truncatoflabellum dens* - CAIRNS, 1995: 114-115 (in part: pl. 37, fig. g). — CAIRNS & ZIBROWIUS, 1997: 170.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 546, 1 (MNHN). — Stn 569, 8 (USNM 98889). — Stn 585, 2 (MNHN). — Stn 597, 1 (MNHN). — Stn 605, 4 (USNM 98890). — Stn 610, 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 965, 3 (MNHN). — Stn 977, 1 (MNHN). — Stn 988, 3 (USNM 98888). — Stn 1015, 1 (MNHN). — Stn 1060, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stn 95: 5°43.5'N, 119°40'E (Sulu Archipelago, Philippines), 522 m.

DIAGNOSIS. — Corallum small and compressed (GCD:LCD = 1.7-2.3), the largest specimen reported herein (MUSORSTOM 8 stn 1060) 8.6 mm in CD. Thecal edges rounded, at a height of about 6 mm above basal scar changing from an angle of 60°-80° to a more slender 20°-35°. At point of angular change there is usually a pair of short edge spines or low crests, often broken or worn away, as in the case of the syntypes. Basal scar quite small and almost circular, ranging from 1.4-1.7 x 1.1-1.3 mm in diameter, containing only 6 protosepta. Well-preserved coralla often show a reddish-brown longitudinal striping. Septa hexamerally arranged in 4 cycles ($S_{1-2}>S_3>>S_4$); however, pairs of S_4 often lacking in lateral half-systems, resulting in 40-44 total septa. Large coralla may have additional pairs of S_5 in the end half-systems, but may also be lacking pairs of S_4 in the lateral half-systems. Axial edges of S_{1-2} highly sinuous.

REMARKS. — This species is more fully described by CAIRNS (1989a, 1995). It is distinctive in having a relatively small corallum with a bimodal edge angle, and a very small, almost circular basal scar.

DISTRIBUTION. — Wallis and Futuna region: Wallis; Combe, Waterwitch, and Field Banks; 286-500 m. Vanuatu region: Anatom, Tanna, Efaté, Malakula, and Espiritu Santo; 314-410 m. Elsewhere: Philippines; Indonesia; Kermadec and Norfolk Ridges; New Caledonia; 300-555 m (CAIRNS & ZIBROWIUS, 1997).

Truncatoflabellum pusillum Cairns, 1989

Fig. 20 a

Truncatoflabellum pusillum Cairns, *1989a: 71-72, pl. 37, figs a-e. — CAIRNS & KELLER, 1993: 265, pl. 11, fig. E. — CAIRNS & ZIBROWIUS, 1997: 170.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 973, 2 (USNM 98891). — Stn 988, 1 (MNHN). — Stn 1016, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1094, 1 (MNHN). — Stn 1097, 10, including 1 cemented to a *Xenophora* shell (MNHN). — Stn 1098, 1 (USNM 98892). — Stn 1106, 3 attached to a *Xenophora* shells (MNHN).

TYPE LOCALITY. — *"Albatross"* stn 5178: 12°43'N, 122°06'15"E (Sibuyan Sea, Philippines), 143 m.

REMARKS. — The original description suffices for this species. It is characterised as having a small corallum (usually less than 7 mm GCD) with straight, rounded thecal edges (edge angle = 14°-18°), each edge bearing 2-4 downward projecting thecal spines. The basal scar is elliptical, up to 3.3 mm in greater diameter, bearing 12-24 septa. Septa are arranged in 3 cycles ($S_{1-2}>S_3$), larger specimen having pairs of S_4 in their end half-systems (i.e., usually 24-32 septa). It differs from *T. dens* by having a larger basal scar with more septa, a constant edge angle, and additional pairs of edge spines.

DISTRIBUTION. — Vanuatu region: Tanna and Espiritu Santo; 285-460 m. Elsewhere: Philippines; Indonesia; Mozambique; 85-300 m (CAIRNS & ZIBROWIUS, 1997).

Truncatoflabellum angustum Cairns & Zibrowius, 1997

Fig. 20 b

Truncatoflabellum dens - CAIRNS, 1995: 114 (in part, pl. 37, figs f, h; NZOI K858)[Not *Flabellum dens* Alcock, v*1902].
Truncatoflabellum angustum Cairns & Zibrowius, *1997: 172-173, figs 23c-f.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 501, 1 (MNHN). — Stn 502, 2 (MNHN).
Vanuatu. MUSORSTOM 8: stn 1016, 5 (USNM 98894). — Stn 1017, 1 (MNHN). — Stn 1018, 11 (MNHN). — Stn 1065, 3 (MNHN). — Stn 1087, 1 (MNHN). — Stn 1091, 1 (USNM 98893). — Stn 1135, 3 (USNM 98895).

TYPE LOCALITY. — MUSORSTOM 3 stn 143: 11°28.3'N, 124°11.6'E (Visayan Sea, Philippines), 205-214 m.

REMARKS. — *Truncatoflabellum angustum* was recently described and figured. In that account, specimens from MoNZ stn BS441, previously illustrated as *T. dens* by CAIRNS (1995: pl. 37, fig. g), were incorrectly listed as nontype specimens of *T. angustum*. Instead, those specimens should be considered as valid *T. dens*. *T. angustum* is most similar to *T. pusillum*, but differs by having a larger corallum, a higher edge angle, and more septa (i.e., usually 56).

Most of the specimens reported herein and most of the paratypes differ from the holotype in having 20 highly sinuous primary septa, not 24 S_{1-3}.

DISTRIBUTION. — Futuna; 516-530 m. Vanuatu region: Efaté, Malakula, and Espiritu Santo; 295-394 m. Elsewhere: Philippines; Indonesia; Kermadec Islands; 195-465 m (CAIRNS & ZIBROWIUS, 1997).

Truncatoflabellum phoenix Cairns, 1995

Truncatoflabellum sp. B. - CAIRNS, 1994: 79, pl. 33, figs i, l.
Truncatoflabellum phoenix Cairns, *1995: 115-116, pl. 37, fig. i, pl. 38, figs a-f. — CAIRNS & ZIBROWIUS, 1997: 171.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 495, 1 (USNM 98896). — Stn 509, 7 (MNHN). — Stn 512, 11 (USNM 98897). — Stn 513, 4 (MNHN). — Stn 514, 1 (MNHN). — Stn 516, 1 (MNHN). — Stn 538, 1 (MNHN).

TYPE LOCALITY. — NZOI stn C531: 29°14'40"S, 178°02'W (Raoul Island, Kermadecs Islands), 179 m.

REMARKS. — This species is best characterised in its original description, and is distinguished from other species by having a small corallum with parallel thecal edges, and often elongate coralla caused by incomplete separation of successive anthocyathi. The specimens listed above differ from previously reported specimens in having an edge angle of 0°-10°, which results in a calicular diameter slightly greater than that of the basal scar, and a basal scar that reveals only 12 protosepta, instead of 24 protosepta as in typical *T. phoenix*. All other characters are similar.

DISTRIBUTION. — Wallis and Futuna region: Futuna; Waterwitch Bank; 240-441 m. Elsewhere: Philippines; Indonesia; Ryukyu Islands; Kermadec Islands; 18-421 m (CAIRNS & ZIBROWIUS, 1997).

Truncatoflabellum vigintifarium sp. nov.

Figs 20 c-f

MATERIAL EXAMINED/TYPES. — **Vanuatu**. MUSORSTOM 8: stn 1004, 1 paratype (MNHN). — Stn 1018, 3 paratypes (USNM 98900). — Stn 1060, 1 paratype (MNHN). — Stn 1065, 3 paratypes (USNM 98899). — Stn 1094,

2 paratypes (MNHN). — Stn 1097, 5 paratypes (MNHN). — Stn 1098, holotype (MNHN) and 4 paratypes (USNM 98898). — Stn 1106, 9 paratypes (MNHN). — Stn 1113, 1 paratype (MNHN).

TYPE LOCALITY. — MUSORSTOM 8 stn 1098: 15°04'S, 167°10'E (northeast of Espiritu Santo), 277-285 m.

ETYMOLOGY. — The species name *vigintifarium* (Latin *viginti*, twenty + *farius*, a suffix meaning a multiplication in number of parts) refers to the 20-fold septal symmetry of the anthocyathus.

DESCRIPTION OF ANTHOCYATHUS. — Corallum flabellate: angle of straight, rounded thecal edges, 67°-84°; face angle, 25°-30°. Holotype 21.1 x 9.7 mm in CD, 17.3 mm in height, and 2.9 x 2.0 mm in basal scar diameter; largest specimen (MUSORSTOM 8 stn 1018) 26.4 x 13.4 mm in CD. Calice elliptical: GCD:LCD = 1.95-2.40. Thecal edges bear 2 or 3 (usually 3) pairs of elongate (up to 5 mm), attenuate spines, the first pair occurring 3-4 mm above the basal scar and additional pairs regularly spaced at 2.5-3.0 mm intervals. Basal scar small (2.9-3.6 x 2.0-2.7 mm) and elliptical in shape (ratio of greater to lesser scar diameters 1.24-*1.37*-1.60), clearly showing 12 septa (Fig. 20 c). Theca thin and transversely wrinkled in a chevron pattern. Theca longitudinally striped with reddish-brown pigment. Anthocaulus stage unknown.

Despite the hexameral arrangement of septa in the basal scar, the septa of mature (GCD over 20 mm) specimens as expressed at the calicular margin are arranged 20-fold: 20:20:40, resulting in 80 septa. The distal, axial edges of the 20 primary septa are not exsert, but project well into the fossa, having straight distal axial edges and sinuous lower axial edges. Secondary septa much narrower, reaching their greatest width near the columella where they are about half the width of the primaries. Tertiary septa often rudimentary, usually only half the width and length of a secondary. Fossa deep and narrow, the columella a fusion of the lower axial edges of the 20 primary septa.

REMARKS. — Among the 30 known Recent species of *Truncatoflabellum*, only one other has decamerally arranged septa in the adult anthocyathus stage: *T. formosum* Cairns, 1989. *T. vigintifarium* differs from that species primarily in shape, having a more flabellate corallum characterised by a higher edge angle (67°-84° vs 37°-59°) and a higher GCD:LCD (1.95-2.4 vs 1.4-1.8). It has a smaller basal scar and usually one more pair of edge spines.

DISTRIBUTION. — Vanuatu region: Erromango, Efaté, Malakula, and Espiritu Santo; 288-700 m; however, most records between 300 to 400 m.

Truncatoflabellum mortenseni Cairns & Zibrowius, 1997

Truncatoflabellum mortenseni Cairns & Zibrowius, *1997: 171-172, figs 22g-h.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 523, 5 anthocauli (MNHN). — Stn 585, 1 anthocaulus (MNHN). — Stn 601, 4 anthocauli (MNHN).

Vanuatu. MUSORSTOM 8: stn 963, 1 anthocaulus (MNHN). — Stn 964, 1 anthocaulus (MNHN). — Stn 967, 5 anthocauli and 2 anthocyathi (MNHN). — Stn 969, 5 anthocauli (MNHN). — Stn 970, 1 anthocaulus (USNM 98901). — Stn 971, 3 anthocauli (USNM 98902). — Stn 1065, 2 anthocauli (MNHN). — Stn 1070, 1 anthocyathus (MNHN). — Stn 1071, 1 anthocaulus and 1 anthocyathus (MNHN). — Stn 1077, 1 anthocaulus (MNHN). — Stn 1102, 2 anthocauli and 1 anthocyathus (USNM 98903). — Stn 1103, 3 anthocauli and 30 anthocyathi (USNM 98904). — Stn 1134, 1 anthocaulus and 1 anthocyathus (MNHN).

TYPE LOCALITY. — MORTENSEN'S JAVA-SOUTH AFRICA EXPEDITION stn 5: 11°36'N, 121°43'E (Sulu Sea), 120-122 m.

REMARKS. — This species is characterised by having an anthocaulus that, even after forming a single pair of edge spines, usually resists the tendency to transversely divide. This results in a relatively large, triangular anthocaulus with a small pedicel (0.9-1.1 mm in diameter), 1 pair of edge spines, and 56, 64, or 80 septa, depending on the development of the fifth septal cycle. Most of the specimens reported above represent this distinctive anthocaulus stage; however, some coralla represent the anthocyathus stage, which has a greater basal scar diameter of 6-8 mm, several pairs of edge spines, and usually a full five cycles of septa (96). Anthocauli and anthocyathi are often found at the same station.

DISTRIBUTION. — Wallis; 350-455 m. Vanuatu region: Anatom, Malakula, and Espiritu Santo; 165-400 m. Elsewhere: Philippines; Indonesia; 50-156 m (CAIRNS & ZIBROWIUS, 1997).

Truncatoflabellum vanuatu (Wells, 1984)

Flabellum vanuatu Wells, v*1984: 215, figs 4 (11-12), 5 (1).
Truncatoflabellum vanuatu - CAIRNS, 1989a: 63, 69, pl. 36, fig. c.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 499, 1 (MNHN). — Stn 505, 1 (MNHN). — Stn 509, 6 (MNHN). — Stn 524, 4 (MNHN). — Stn 605, 1 (USNM 98906).

TYPE LOCALITY. — Kere River (Late Pleistocene), Espiritu Santo, Vanuatu.

REMARKS. — This species is characterised as having a small basal scar (4.1-4.9 mm in greater diameter) with 12 protosepta, low edge and face angles (20°-27°, 12°-17°, respectively), and a relatively tall corallum that bears up to five pairs of edge spines. In small to medium-sized coralla there are 16 primary septa (16:16: 24-32, = 56-64 septa), but in larger coralla there may be up to 20 primary septa (20:20:32-40, = 72-80 septa). Theca reported herein are all smaller than those in the type series, most having 16 primary septa and 56 septa. They are the first report of this species subsequent to its original description and first report from the Recent.

DISTRIBUTION. — Wallis and Futuna; 240-335 m. Vanuatu region: Late Pleistocene of Espiritu Santo (WELLS, 1984).

Truncatoflabellum aculeatum (H. Milne Edwards & Haime, 1848)

Flabellum aculeatum H. Milne Edwards & Haime, v*1848a: 272, pl. 8, figs 3, 3a.
Truncatoflabellum aculeatum - CAIRNS, 1989a: 61, 64, table 6, pl. 31, figs h-l, pl. 32, figs a-c (synonymy); 1998: 399-400, table 4. — CAIRNS & ZIBROWIUS, 1997: 166-167.

MATERIAL EXAMINED. — **Vanuatu**. South Santo Island, coll. J.N. CARNEY, stn SDC-5, 30-50 m, II 1975, 2 (USNM 98905).

TYPE LOCALITY. — Philippines (depth not given).

REMARKS. — Although not reported from the MUSORSTOM cruises in this region, probably because of its shallow depth range, two typical specimens are reported from an independent collection made by J. N. CARNEY in 1975. The appearance of the specimens suggests a fossil age, perhaps Late Pleistocene, similar to the fauna reported by WELLS (1984). *T. aculeatum* was redescribed and illustrated by CAIRNS (1989a).

DISTRIBUTION. — Vanuatu region: Espiritu Santo; 30-50 m. Elsewhere: Philippines; Indonesia (also Pleistocene of Talaud); Western Australia; Northern Territory; 11-115 m (CAIRNS, 1998).

Truncatoflabellum candeanum (H. Milne Edwards & Haime, 1848)

Flabellum candeanum H. Milne Edwards & Haime, *1848a: 278, pl. 8, fig. 13.
Truncatoflabellum candeanum - CAIRNS, 1989a: 70-71, table 6, pl. 36, figs d-h (synonymy, neotype designation); 1994; 76-77, pl. 33, figs e-f. — CAIRNS & ZIBROWIUS, 1997: 167.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1086, 4: 3 (MNHN), 1 (USNM 98907).

TYPE LOCALITY. — *"Albatross"* stn 5369: 13°48'N, 121°43'E (Luzon, Philippines), 194 m.

REMARKS. — Only one lot of this species is reported herein, probably because of its relatively shallow depth range. It is distinguished from other species by its slightly scalloped calicular margin and its three pairs of flattened edge spines. It is more fully described and illustrated by CAIRNS (1989a).

DISTRIBUTION. — Vanuatu region: Malakula; 182-215 m. Elsewhere: western Pacific from Kyushu through Indonesia; 70-290 m (CAIRNS & ZIBROWIUS, 1997).

Truncatoflabellum martensii (Studer, 1878)

Figs 21 a-f

Flabellum Martensii Studer, v*1878: 630-631, pl. 1, figs 4a-b; 1889: 268.
Flabellum paripavoninum - WELLS, v.1984: 214-215 (in part: USGS 25715, fig. 4 (6-7)) [Not *F. paripavoninum* Alcock, 1894].
Truncatoflabellum martensii - CAIRNS, 1989a: 61.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1085, 13: 10 (MNHN), 3 (USNM 98908). — Stn 1086, 4 (MNHN).

TYPE LOCALITY. — *"Gazelle"* stn 40: 26°51.1'S, 153°29.6'E (off Brisbane, Queensland), 139 m.

DESCRIPTION. — Corallum flabellate: edge angle, 40°-63°; face angle, 17°-19°. Thecal faces almost planar, meeting in straight, sharply defined (but not carinate) edges that usually bear 3 pairs of spines. Holotype (ZMB 1798) 21.7 x 10.9 mm in CD, 7.7 mm in greater basal scar diameter, and 18.6 mm in height; largest known specimen (Pleistocene specimen figured by WELLS, 1984; USNM 71858) 28.6 x 12.0 mm in CD, 8.3 mm in greater basal scar diameter, and 22.9 mm in height. Range of greater basal scar diameter 7.2-9.3 mm, well-preserved scars showing 4 complete cycles of septa. Theca dark reddish-brown overall, with more intense longitudinal striping associated with the S_{1-3}. Basal scar, edge spines, and septa white. Anthocaulus unknown.

Septa hexamerally arranged in 5 cycles, small coralla having less than 96 septa, larger coralla having additional pairs of S_6 in half-systems adjacent to the principal septa (See Remarks). Septa formula: $S_{1-3}>S_4>S_5>S_6$. Axial edges of S_{1-3} highly sinuous, their lower axial edges fusing into a columellar structure low in centre of fossa. S_{4-6} progressively narrower and less sinuous, their axial edges not attaining the columella.

REMARKS. — The number of septa per corallum is roughly a function of the GCD, the largest specimen (WELLS' Pleistocene corallum from Vanuatu) of 28.6 mm GCD having 15 pairs of S_6, or 126 septa, whereas a small anthocyathus of 16 mm GCD (e.g., MUSORSTOM 8 stn 1085) has only 64 septa. The transition to a full fifth cycle of 96 septa occurs at a GCD of 20-22 mm, the holotype of GCD 21.7 mm still having only 88 septa, but other specimens of similar GCD having 96 or even 104 septa. The first S_6 occur in the four half-systems adjacent to the two principal septa, resulting in 104 septa, and are progressively inserted in half-systems away from the edge.

This is believed to be the first report of this species subsequent to its original description from off Brisbane. It is distinguished from other congeners by its sharply angled thecal edges, almost planar thecal faces, and its overall reddish-brown theca.

DISTRIBUTION. — Vanuatu region: Malakula; 161-182 m. Vanuatu region: Late Pleistocene of Espiritu Santo (WELLS, 1984). Elsewhere: off Brisbane, Queensland, 139 m (STUDER, 1878).

Genus *JAVANIA* Duncan, 1876

Javania lamprotichum (Moseley, 1880)

Desmophyllum lamprotichum Moseley, v*1880: 41-42, figs 1-2.

Javania lamprotichum - CAIRNS, 1984: 21, pl. 4, figs D-E; 1995: 112, pl. 37, figs b-c, map 20; 1998: 403, figs 8j, m. — CAIRNS & ZIBROWIUS, 1997: 164 (synonymy).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 520 or 521 (confusion on label), 1 (MNHN).
Vanuatu. MUSORSTOM 8: stn 974, 1 (USNM 98909). — Stn 975, 1 (MNHN). — Stn 988, 1 (MNHN). — Stn 1014, 1 (USNM 98910).

TYPE LOCALITY. — Unknown.

REMARKS. — Of the ten Recent species in this genus, *J. lamprotichum* is one of five that has five cycles of septa. It is further distinguished by having a relatively large corallum, a flared calice, and usually having a reddish-brown theca, although the thick tectural deposits reinforcing the pedicel are usually white. Reported herein is the largest known specimen of this species (MUSORSTOM 8 stn 975), measuring 46.8 x 36.2 mm in CD and 47.9 mm in height, the base being broken above its attachment. One corallum, from MUSORSTOM 8 stn 974, contains several acrothoracican cirripede borings, a commensalism previously reported for this species by CAIRNS & ZIBROWIUS (1997) and CAIRNS (1998). The species was most recently redescribed and illustrated by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Wallis; 890-920 m. Vanuatu region: Tanna and Efaté; 466-536 m. Elsewhere: central and western Pacific (Hawaiian Islands, Johnston Atoll, Philippines, Kermadec Ridge); Western Australia; 191-842 m (CAIRNS, 1998).

Javania fusca (Vaughan, 1907) comb. nov.

Figs 20 g-i

Placotrochus fuscus Vaughan, v*1907: 66-67, pl. 4, figs 2-3.
"Placotrochus" fuscus - CAIRNS, 1989a: 45, 75.
Javania pachytheca CAIRNS, *1995: 112-113, pl. 36, figs j-l, pl. 37, fig. a, map 17. — CAIRNS & ZIBROWIUS, 1997: 165, figs 21i, 22a.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 525, 1 (USNM 98913). — Stn 530, 2 (MNHN). — Stn 540, 1 (MNHN). — Stn 578, 3 (MNHN). — Stn 592, 1 (USNM 98912).
Vanuatu. MUSORSTOM 8: stn 959, 1 (MNHN). — Stn 965, 3 (USNM 98911). — Stn 982, 1 (MNHN). — Stn 988, 3 (MNHN). — Stn 1097, 2 (MNHN). — Stn 1106, 1 (MNHN). — Stn 1114, 2 (USNM 98914). — Stn 1128, 20 (MNHN).

TYPE LOCALITY. — *"Albatross"* stns 3886 and 3999: Kauai and Molokai Islands, Hawaiian Islands, 271 m.

DIAGNOSIS. — Corallum small (GCD usually less than 9 mm), straight, and ceratoid to subcylindrical, with a thickened pedicel. Calice only slightly elliptical: GCD:LCD = 1.1-1.2; calicular edge serrate, triangular apices corresponding to the 24 S_{1-3}, these projections best preserved and seen in small specimens. Theca thick, covered with numerous, very small, porcellaneous granules. Base colour of corallum white, but often pigmented with brownish-black rings encircling the theca, and irregular pigmentation of the same colour on the distal peripheral faces of the S_{1-2}. Septa hexamerally arranged in 4 complete cycles: $S_{1-2}>S_3>>S_4$ (48 septa). S_{1-2} 1.2-1.5 mm exsert, having slightly sinuous axial edges. S_3 up to 0.5 mm exsert and only 1/2-2/3 width of the S_{1-2}, having moderately sinuous axial edges. S_4 nonexsert, in fact, their distal edges often several mm below the calicular edge. S_4 only 1/5-1/4 width of the S_3, also having moderately sinuous axial edges. Fossa deep and lacking a columella, as is consistent with the generic definition.

REMARKS. — This species was originally placed in the genus *Placotrochus* by VAUGHAN because of the presence of a well-formed lamellar columella in one of the three syntypes (corallum number "1" of VAUGHAN, 1907, USNM 20734), notwithstanding the fact that a columella could not be found in the other two syntypes. After careful cleaning and examination, it was discovered that the columella in specimen 1 was simply a fragment from a distal septal margin, probably from the same specimen, that had accidently become lodged in an axial

columellar position. This fragment has now been removed from the fossa. Lacking a columella, this species naturally falls into the genus *Javania*; in fact, it is the senior synonym of a species I recently described as *J. pachytheca* Cairns, 1995.

VAUGHAN (1907) originally designated three syntypes of *Placotrochus fuscus*, two from *"Albatross"* stn 3999 and one from stn 3886, listing two USNM catalog numbers for the specimens: 20731 and 20732. Whereas USNM 20732 applies to the single syntype (specimen #2: VAUGHAN's pl. 4, fig. 2) from *"Albatross"* stn 3886, USNM 20731 was previously assigned to the holotype of *Gardineria hawaiiensis*, a species described by VAUGHAN on the page previous to *Placotrochus fuscus*. The true catalog numbers (see CAIRNS, 1991b) for the remaining two syntypes from *"Albatross"* stn 3999 are: 20733 (specimen #3, VAUGHAN's pl. 4, fig. 3) and 20734 (specimen #1, unfigured by VAUGHAN).

Two of the specimens examined have acrothoracican cirripede borings: one from MUSORSTOM 8 stn 988 (Fig. 20 i), the other being one of the three syntypes (USNM 20733).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch, Combe, and Field Banks; 600-730 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; Guyot Bougainville; 314-778 m. Elsewhere: Indonesia; Malaysia; northern New Zealand; Kermadec Ridge; Lord Howe Seamount Chain; Aitutaki Atoll, Cook Islands [not Chesterfield Islands, as incorrectly reported by CAIRNS (1995) and CAIRNS & ZIBROWIUS (1997) for *J. pachytheca*]; Hawaiian Islands; 271-1045 m.

Javania exserta sp. nov.

Figs 21 g-i

Desmophyllum sp. cf. *D. crista-galli* - WELLS, 1954: 470 [Not *Desmophyllum cristagalli* H. Milne Edwards and Haime, 1848].

Javania sp. - CAIRNS & ZIBROWIUS, 1997: 165, figs 22b-c.

MATERIAL EXAMINED/TYPES. — **Indonesia**. KARUBAR: stn 30, 2 paratypes (USNM 98919). — Stn 44, holotype (MNHN). — Stn 49, 2 paratype fragments (USNM 97498). — Stn 86, 1 paratype (MNHN).

Philippines. MUSORSTOM 1: stn 65, 1 paratype (MNHN).

Wallis and Futuna region. MUSORSTOM 7: stn 499, 1 paratype (USNM 98916). — Stn 513, 2 paratypes (MNHN). — Stn 514, 1 paratype (MNHN). — Stn 523, 2 paratypes (MNHN). — Stn 537, 1 paratype (USNM 98915). — Stn 538, 1 paratype (MNHN). — Stn 569, 1 paratype (MNHN).

Vanuatu. MUSORSTOM 8: stn 962, 1 paratype (MNHN). — Stn 964, 1 paratype (MNHN). — Stn 978, 1 paratype (USNM 98918). — Stn 1021, 5 paratypes (USNM 98917). — Stn 1030, 8 paratypes (MNHN). — Stn 1042, 2 paratypes (MNHN). — Stn 1060, 3 paratypes (MNHN). — Stn 1085, 1 paratype (MNHN).

Caroline Islands (Pelau). "Short drop off", 91 m, 1 fragment of a corallum, paratype (USNM 98956).

TYPE LOCALITY. — KARUBAR stn 44: 7°52'27"S, 132°48'24"E (south of Tanimbar Island), 291-295 m.

ETYMOLOGY. — The species name *exserta* (Latin *exsertus*, project or exsert) refers to the highly exsert S_{1-2} of this species.

DESCRIPTION. — Corallum ceratoid and straight, having a slightly flared calicular edge. Calice slightly elliptical: GCD:LCD = 1.05-1.20. Holotype 15.6 x 13.7 mm in CD, 33.8 mm in height, and 7.2 mm in PD. Calicular edge highly serrate, a tall, acute triangular apex corresponding to each S_{1-2}. Calicular edge between S_{1-2} of small specimens straight, but with increasing size becoming slightly convex or rounded, and in the largest specimens expressed as a low, obtuse, triangular apex corresponding to the S_3. Theca porcellaneous and usually white; however, specimens from KARUBAR stations pigmented a light purple-grey. Ridged C_{1-2} sometimes expressed within 0-3 mm of calicular edge.

Septa hexamerally arranged in 4 complete cycles (48 septa): $S_1>S_2>>S_3>S_4$. S_1 extremely exsert, in the holotype as much as 6.5 mm, but even in coralla of moderate size, 3-4 mm. Axial edges of S_1 straight and vertical, the 4 lateral S_1 almost meeting in centre of fossa. S_2 also quite exsert but only 1/2-2/3 that of the S_1, about 3/4 width of the S_1, and also less thick than the S_1. S_3 not exsert: rudimentary or absent near calicular edge,

increasing to about 3/4 width of S_2 lower in fossa. S_4 also nonexsert, 1/3-1/2 width of the S_3. Axial edges of S_{1-2} slightly sinuous. Fossa deep and narrow.

REMARKS. — *Javania exserta* is distinguished from the other three Recent species in the genus that have four cycles of septa [*J. cailleti* (Duchassaing & Michelotti, 1864); *J. pseudoalabastra* Zibrowius, 1974; and *J. fusca* (Vaughan, 1907)] by its relative septal exsertness: its S_1 being larger than its S_2, and its S_{3-4} being nonexsert.

Specimens from MUSORSTOM 8 stn 1085 and KARUBAR stn 86 contain acrothoracican cirripede borings.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 295-455 m. Vanuatu region: Anatom, Tanna, Efaté, Epi, and Malakula; 130-408 m. Elsewhere: Philippines; Arafura Sea south of Tanimbar Island; Pelau; Bikini, Marshall Islands; 91-291 m.

Genus ***RHIZOTROCHUS*** H. Milne Edwards & Haime, 1848

Rhizotrochus typus H. Milne Edwards & Haime, 1848

Fig. 22 a

Rhizotrochus typus H. Milne Edwards & Haime, *1848a: 282, pl. 8, fig. 16. — CAIRNS, 1989a: 79-81, pl. 41, figs f-j (synonymy); 1994: 81, pl. 35, figs a-c, pl. 40, figs h-i (synonymy). — CAIRNS & ZIBROWIUS, 1997: 161, figs 22d-e.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1021, 1 (USNM 98920). — Stn 1078, 1 (MNHN). — Stn 1131, 1 (MNHN).

TYPE LOCALITY. — Singapore, South China Sea (depth not given).

REMARKS. — Three specimens of this common, relatively shallow-water azooxanthellate are reported herein. The genus is distinguished from other genera in the region by having several cycles of discrete (free standing, not contiguous with corallum), hollow rootlets. *R. levidensis* Gardiner, 1899, known from nearby Loyalty Islands at 84 m, differs in having a much smaller corallum (GCD < 6 mm) and fewer septa (≤ 34). *R. typus* was recently redescribed and figured by CAIRNS (1989a).

DISTRIBUTION. — Vanuatu region: Efaté, Malakula, and Espiritu Santo; 130-194 m. Elsewhere: Indo-West Pacific from Red Sea to Japan; 20-1048 m (CAIRNS & ZIBROWIUS, 1997).

Rhizotrochus flabelliformis Cairns, 1989

Flabellum latum - Alcock, v.1902c: 31 [Not *F. latum* Studer, 1878].
Rhizotrochus flabelliformis Cairns, v*1989a: 81, pl. 41, figs k-l, pl. 42, figs b, d; 1995: 109-110, pl. 35, figs g-i, pl. 36, figs a-b, map 17.
"Rhizotrochus" flabelliformis - CAIRNS & ZIBROWIUS, 1997: 161-162.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 511, 1 (MNHN).

TYPE LOCALITY. — *"Siboga"* stn 105: 6°08'N, 121°19'E (Sulu Archipelago, Philippines), 275 m.

REMARKS. — One relatively small (GCD=24 mm), worn specimen is reported herein, still in the process of forming its edge rootlets. It is distinguished from all other corals in this region by having two massive rootlets, one on each corallum edge. It is best described and illustrated by CAIRNS (1995).

DISTRIBUTION. — Futuna; 400-450 m. Elsewhere: Philippines; Indonesia; New Zealand; 228-419 m (CAIRNS & ZIBROWIUS, 1997).

Genus *POLYMYCES* Cairns, 1979

Polymyces wellsi Cairns, 1991

Polymyces wellsi Cairns, *1991a: 22, pl. 8, figs f, i, pl. 9, figs a-b; 1995: 108-109, pl. 35, figs d-f, map 10. — CAIRNS & ZIBROWIUS, 1997: 160-161. — CAIRNS, 1998: 403-404.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 975, 1 (MNHN).

TYPE LOCALITY. — *"Johnson-Sea-Link"* stn 1916: 1°18.7'S, 89°48.8'W (Española, Galápagos), 545-562 m.

REMARKS. — One live specimen, with tissue preserved, is reported. This species is distinctive in having four asymmetrically arranged, contiguous rootlets, all four rootlets occurring on one side of the corallum. It is best described and illustrated by CAIRNS (1995).

DISTRIBUTION. — Vanuatu region: Tanna; 536-566 m. Elsewhere: Philippines; Indonesia; northwestern Australia; northeastern New Zealand; Kermadec Islands; Galápagos; 355-1165 m (CAIRNS & ZIBROWIUS, 1997).

Superfamily VOLZEIOIDEA Melnikova, 1974

Family GARDINERIIDAE Stolarski, 1996

Genus *GARDINERIA* Vaughan, 1907

Gardineria hawaiiensis Vaughan, 1907

Gardineria hawaiiensis Vaughan, v*1907: 65-66, pl. 4, fig. 1. — CAIRNS, 1984: 23; 1995: 110-111, map 13, pl. 36, figs c-f, i; 1998: 404. — STOLARSKI, v.1996: 348-350, figs 2F-G, 4A-I, 8A-C.
Gardineria musorstomica Cairns, v*1989a: 82-83, pl. 42, figs c, e-g.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1006, 1 (USNM 98921). — Stn 1011, 1 (MNHN). — Stn 1014, 1 (MNHN). — Stn 1067, 1 (MNHN).

TYPE LOCALITY. — *"Albatross"* stn 3991: 22°15'24"N, 159°23'15"W (Kauai, Hawaiian Islands), 497-541 m.

REMARKS. — This species is characterised by having a thick epithecal wall, and hexamerally arranged septa in four cycles and three size classes, the last cycle incomplete (24-44 septa). Larger specimens possess 6 P_2 and a rudimentary columella. *G. hawaiiensis* is best described and figured by STOLARSKI (1996).

DISTRIBUTION. — Vanuatu region: Erromango, Efaté, and Malakula; 366-574 m. Elsewhere: Philippines; New Caledonia (STOLARSKI, 1996); Norfolk Ridge; Kermadec Islands; Bay of Plenty, New Zealand; Western Australia; Hawaiian Islands; 142-602 m (CAIRNS, 1995).

Gardineria paradoxa (Pourtalès, 1868)

Fig. 22 b

Haplophyllia paradoxa Pourtalès, v*1868: 140-141.
Gardineria paradoxa - CAIRNS, 1979: 160-161, map 46, pl. 31, figs 4-6, 10 (synonymy). — STOLARSKI, v.1996: 348-350, figs 2C-E, 5A-G. — CAIRNS & ZIBROWIUS, 1997: 163, figs 21g-h.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: 1014, 1 (MNHN).

TYPE LOCALITY. — *"Bibb"* stn 22: 24°14'20"N, 80°59'40"W (Straits of Florida), 692 m.

REMARKS. — The single specimen reported herein measures 9.3 mm in CD and 36.6 mm in length, having a lateral thecal attachment for the basal 17 mm. It has 40 septa (20:20:40) and is very similar to the specimen reported by CAIRNS & ZIBROWIUS (1997) from the Banda Sea. *G. paradoxa* is distinguished from other congeners by having decamerally arranged septa, a strong lateral thecal attachment, and a heavily encrusted and worn looking corallum, even when the coral is collected alive.

DISTRIBUTION. — Vanuatu region: Efaté; 495-498 m. Elsewhere: Banda Sea; western Atlantic (Antilles); 91-700 m.

Suborder DENDROPHYLLIINA

Family DENDROPHYLLIIDAE Gray, 1847

Genus *BALANOPHYLLIA* Searles Wood, 1844

REMARKS. — There are approximately 58 valid Recent species of *Balanophyllia* worldwide, and the genus is badly in need of revision (CAIRNS, 1995: 118). There are several reasons for the confused state of taxonomy in this genus. First, the range of corallum variation is poorly known for most species, several species known only from their type specimens. In an extreme case [i.e., *B. corniculans* (Alcock, 1902a)], the species was based on one specimen that is now lost, and no figure of the holotype or indication of the type locality was included in the original description. Secondly, basally-broken corallites of other genera, such as *Rhizopsammia, Eguchipsammia, Cladopsammia*, and even *Dendrophyllia*, could be mistaken for a *Balanophyllia*, and the juvenile stage of all of these genera pass through a solitary *Balanophyllia*-like stage. Third, most species of *Balanophyllia* are provincial in distribution, endemic to one side of an ocean basin, and thus a large number of species have been described, making it difficult to do a comprehensive comparison of unidentified material. Although the Atlantic species have been revised (CAIRNS, 1977; ZIBROWIUS, 1980), there has been no comprehensive worldwide revision of the genus. A subgeneric division or a good dichotomous key would alleviate some of these difficulties. At this point, however, it is useful to compare specimens collected from a geographic region to others known from that region. For instance, there are 10 species known from the western Atlantic, 4 from the eastern Atlantic, 5 from the southwestern Indian Ocean, 4 from the northern Indian Ocean, 5 from eastern Australia, 3 from New Zealand, 5 from the Hawaiian Islands, 21 from the tropical western Pacific (including northwestern Western Australia), 3 from the eastern Pacific, and one from the Subantarctic. There appears to be little cross over of species between regions. For instance, there are no species in common between the eastern and western Atlantic, and the eastern Pacific fauna is also discrete; however, there are several species that have wider distributions in the tropical western Pacific and the Hawaiian Islands and/or Japan and/or New Zealand. Therefore, in identifying the specimens collected by MUSORSTOM 7 and 8, all species known from the western and central Pacific were considered, but, even so, I was only able to confidently identify about one-third of the specimens available as one of six of the more common species.

Balanophyllia desmophyllioides Vaughan, 1907

Fig. 22 c

Balanophyllia desmophyllioides Vaughan, v*1907: 149-150, pl. 45, fig. 1. — CAIRNS & ZIBROWIUS, 1997: 177-178, figs 23g-h.
Balanophyllia desmophylloides - CAIRNS, 1984: 26.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 496, 2 (MNHN). — Stn 500, 4 (MNHN). — Stn 502, 1 (MNHN). — Stn 509, 17 (USNM 98924). — Stn 512, 5 (MNHN). — Stn 524, 2 (MNHN). — Stn 538, 1 (MNHN). — Stn 589, 1 (MNHN). — Stn 601, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 964, 2 (MNHN). — Stn 969, 3 (USNM 98926). — Stn 988, 1 (USNM 98922). — Stn 1030, 1 (MNHN). — Stn 1065, 1 (USNM 98925). — Stn 1098, 4: 3 (MNHN), 1 (USNM 98923).
Lord Howe seamount chain. NZOI: stn I741, 9 (USNM 94366).

TYPE LOCALITY. — *"Albatross"* stn 4061: Hawaii, 44-152 m.

DIAGNOSIS. — Corallum straight, firmly attached, and flared distally. Calice elongate; calicular edge arched and constricted in centre, in some cases (Fig. 22 c) producing a division of the fossa. Costae well defined; thin epitheca often present basally. Septa hexamerally arranged in 5 cycles, coralla of GCD 11-12 having a complete fifth cycle; additional half-systems of septa may occur in elongate specimens (e.g., the holotype). S_{1-3} equal in size, pairs of S_5 fusing high in fossa before their flanking S_4. Lower axial edges of $S_{1-3, 5}$ coarsely dentate. Fossa deep; papillose columella small, elongate, and low.

REMARKS. — The species was recently redescribed and illustrated by CAIRNS & ZIBROWIUS (1997).

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch and Field Banks; 240-516 m. Vanuatu region: Anatom, Tanna, Efaté, Malakula, and Espiritu Santo; 190-372 m. Elsewhere: Hawaiian Islands; Philippines; Indonesia; Chesterfield Islands (reported herein); 95-658 m (CAIRNS & ZIBROWIUS, 1997).

Balanophyllia laysanensis Vaughan, 1907

Figs 22 d-e

Balanophyllia laysanensis Vaughan, v*1907: 150-151, pl. 45, figs 2a-b.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 962, 2 (MNHN). — Stn 963, 1 (MNHN). — Stn 965, 1 (USNM 98927).

TYPE LOCALITY. — *"Albatross"* stn 3937: 25°52'05"N, 171°46'47"W (Laysan Island, Hawaiian Islands), 238-271 m.

REMARKS. — Little can be added to the VAUGHAN's original description. The species can be characterised as having a straight, ceratoid corallum with a highly serrate calicular margin. The theca is highly porous and coarsely granular; costae are poorly defined, but the C_{1-2} are prominent. Septa are arranged in 4 complete cycles, pairs of S_4 bending toward but not quite fusing before their enclosed S_3 relatively low in fossa.
This is the first report of *B. laysanensis* subsequent to its original description.

DISTRIBUTION. — Vanuatu region: Anatom; 377-400 m. Elsewhere: Laysan, Hawaiian Islands; 238-271 m (= type locality).

Balanophyllia rediviva Moseley, 1881

Balanophyllia rediviva Moseley, v*1881: 193-194, pl. 15, figs 10-12. — CAIRNS & ZIBROWIUS, 1997: 181-182, figs 25d-f (synonymy).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 970, 1 (MNHN). — Stn 1077, 2 (USNM 98928). — Stn 1134, 2 (MNHN).

TYPE LOCALITY. — *"Challenger"* stn 192: 5°49'15"S, 132°14'15"E (Kai Islands, Banda Sea), 256 m.

REMARKS. — *Balanophyllia rediviva* was recently redescribed and figured by CAIRNS & ZIBROWIUS (1997). It is distinguished by having an elongate, subcylindrical corallum that often shows signs of rejuvenescence, the rejuvenated corallum often smaller in calicular diameter than the parent. Its costae (C_{1-3}) are also characteristically slightly ridged.

DISTRIBUTION. — Vanuatu region: Anatom, Malakula, and Espiritu Santo; 210-252 m. Elsewhere: Philippines; Indonesia; 90-256 m (CAIRNS & ZIBROWIUS, 1997).

Balanophyllia gemma (Moseley, 1881)

Thecopsammia gemma Moseley, v*1881: 195, pl. 15, figs 8a-b.
Balanophyllia gemma - CAIRNS & ZIBROWIUS, 1997: 179, figs 24g-i (synonymy).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1009, 2 (MNHN). — Stn 1015, 7: 5 (MNHN), 2 (USNM 98930). — Stn 1019, 2 (USNM 98929).

TYPE Locality. — *"Challenger"* stn 201: 7°03'N, 121°48'E (Sulu Sea), 187 m.

REMARKS. — *Balanophyllia gemma* was recently redescribed and the holotype illustrated by CAIRNS & ZIBROWIUS (1997). It is characterised by having a well-developed epitheca that covers most of the theca; low, equal costae; and a shallow fossa containing a discrete, swirled columella.

DISTRIBUTION. — Vanuatu region: Efaté; 397-430 m. Elsewhere: Philippines; Indonesia; 137-522 m (CAIRNS & ZIBROWIUS, 1997).

Balanophyllia gigas Moseley, 1881

Balanophyllia gigas Moseley, v*1881: 193. — WELLS, v.1984: 217, figs 5 (2-3). — CAIRNS, 1994: 83, pl. 35, figs j-l (synonymy); 1995: 119-120, pl. 40, figs f-h, map 7 (synonymy); 1998: 404. — CAIRNS & ZIBROWIUS, 1997: 182.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 977, 1 (MNHN).

TYPE LOCALITY. — Japan (depth unknown).

REMARKS. — *Balanophyllia gigas* is well described and figured by CAIRNS (1994, 1995), including an illustration of the holotype. The single specimen reported herein measures 24.5 x 21.5 mm in CD and 54.5 mm in height. WELLS' (1984) Pleistocene specimens from Vanuatu (USNM 71862) were re-examined and considered conspecific. *B. gigas* attains the largest size of all *Balanophyllia*, and usually has five cycles of septa, if not some S_6 in various half-systems.

DISTRIBUTION. — Vanuatu region: Tanna; 410-505 m; Late Pleistocene of Espiritu Santo (WELLS, 1984). Elsewhere: widely distributed in western Pacific from Hawaiian Islands to New Zealand and West Australia; 90-640 m (CAIRNS & ZIBROWIUS, 1997).

Balanophyllia crassitheca Cairns, 1995

Balanophyllia crassitheca Cairns, *1995: 120-121, map 18, pl. 40, fig. i, pl. 41, figs a-b.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 978, 1 (MNHN).

TYPE LOCALITY. — 37°17.0'S, 176°51.0'E (Rangatira Knoll, northwest of White Island, Bay of Plenty, New Zealand), 251-308 m.

REMARKS. — The single record reported herein does little more than extend the known distribution slightly to the north. The species is distinguished by having a very thick theca and crowded septa.

DISTRIBUTION. — Vanuatu region: Tanna; 408-413 m. Elsewhere: northeastern New Zealand; Lord Howe and Norfolk Islands; Kermadec Ridge; 190-508 m (CAIRNS, 1995).

Genus *ENDOPACHYS* H. Milne Edwards & Haime, 1848

Endopachys grayi H. Milne Edwards & Haime, 1848

Fig. 22 f

Endopachys grayi H. Milne Edwards & Haime, *1848b: 82-83, pl. 1, figs 2, 2a. — ZIBROWIUS & GRYGIER, 1985: 137 (New Caledonia). — CAIRNS, 1994: 84-85, pl. 36, figs e, h, pl. 37, fig. i (synonymy); 1995: 121-122, pl. 41, figs c-h, map 13 (synonymy); 1998: 405. — CAIRNS & ZIBROWIUS, 1997: 185-186.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 499, 1 (MNHN). — Stn 504, 1 (MNHN). — Stn 507, 1 (MNHN). — Stn 516, 1 (MNHN).

Vanuatu. MUSORSTOM 8: stn 967, 2 (USNM 98932). — Stn 969, 1 (MNHN). — Stn 976, 17 (MNHN). — Stn 1005, 1 (MNHN). — Stn 1016, 2 (MNHN). — Stn 1017, 1 cemented to a *Xenophora* shell (MNHN). — Stn 1018, 6 (MNHN). — Stn 1071, 3 (MNHN). — Stn 1085, 1 (USNM 98933). — Stn 1086, 6 (USNM 98934). — Stn 1134, 2 (USNM 98931).

TYPE LOCALITY. — Unknown.

REMARKS. — Most specimens of this commonly collected species are easily distinguished by having unattached, cuneiform-shaped coralla with prominent edge crests; asexual budding; and five cycles of septa. Its wide distribution may be due to its reproductive success, which employs two modes of asexual reproduction: transverse division and anthoblast production (= bud shedding)(see CAIRNS, 1989b). In the first case, once an attached anthocaulus reaches a height of about 7 mm and a GCD of 3.5-4.0 mm, it forms a crested anthocyathus that subsequently transversely divides from the anthocaulus (Fig. 22 f). The detached, free-living anthocyathus maintains the characteristic basal scar (greater diameter 3.5-4.0 mm) for a time but eventually heals its base, which becomes rounded. Each anthocyathus has the potential to form numerous buds (anthoblasts), which form at the calicular edge, usually adjacent to the edge crests. Only one other coral species is known to employ both asexual reproduction strategies, *Blastotrochus nutrix* H. Milne Edwards & Haime, 1848, a member of a different suborder.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 390-441 m. Vanuatu region: Anatom, Tanna, Erromango, Efaté, Espiritu Santo, and Malakula; 181-360 m. Elsewhere: widespread throughout tropical and warm temperate Indo-Pacific, from the southwestern Indian Ocean to the Gulf of California; 37-386 m (CAIRNS & ZIBROWIUS, 1997).

Genus *HETEROPSAMMIA* H. Milne Edwards & Haime, 1848

Heteropsammia cochlea (Spengler, 1781)

Madrepora cochlea Spengler, *1781: 240-248, figs A-D.

Heteropsammia cochlea - VERON & PICHON, 1980: 416-420, in part: figs 727, 729 (synonymy and description). — HOEKSEMA & BEST, 1991: 234-237, figs 24-28 (synonymy!). — CAIRNS, 1998: 406-408.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 494, 83 (MNHN). — Stn 495, 9 (USNM 98937). — Stn 496, 30 (USNM 98935). — Stn 504, 10 (MNHN). — Stn 509, 11 (USNM 98936). — Stn 512, 3 (MNHN). — Stn 516, 9 (MNHN).

Vanuatu. MUSORSTOM 8: stn 961, 1 (MNHN). — Stn 967, 1 (MNHN). — Stn 969, 1 (MNHN). — Stn 976, 1 (MNHN). — Stn 1072, 1 (MNHN).

TYPE LOCALITY. — Tranquebar, off southeastern India.

REMARKS. — The species is easily distinguished by its obligate symbiotic association with a sipunculid worm, which is housed in the base of the corallum and communicates with the environment through one large efferent pore in the base of the corallum and several smaller pores on the lower theca. It is similar in shape to

species of *Heterocyathus*, which also lives with an obligate sipunculid, but differs in having a porous upper theca, and septa that are arranged in a Pourtalès plan. *H. cochlea* is best described and figured by VERON & PICHON (1980) and HOEKSEMA & BEST (1991). Shallow-water representatives of this species are assumed to be zooxanthellate, whereas the deeper specimens must be azooxanthellate.

DISTRIBUTION. — Wallis and Futuna region: Futuna; 110-441 m. Vanuatu region: Anatom, Tanna, and Espiritu Santo; 110-622 m. Elsewhere: widespread throughout tropical Indo-West Pacific; 9-137 m, although depths have rarely been reported (HOEKSEMA & BEST, 1991).

Genus ***DENDROPHYLLIA*** Blainville, 1830

Dendrophyllia ijimai Yabe & Eguchi, 1934

Dendrophyllia ijimai Yabe & Eguchi, *1934b: 2026. — EGUCHI, 1965: 294, 2 figs; 1968: C65 (in part: pl. C16, figs 1-2, pl. C22, fig. 1)(synonymy). — CAIRNS & KELLER, 1993: 280, fig. 13G. — CAIRNS, 1995: 89, pl. 38, figs c, f (synonymy).

?Dendrophyllia subcornigera cylindrica Eguchi, *1968: C64-65, pl. C32, figs 1-2 [Not *D. subcornigera subcornigera* Eguchi, 1968].

Dendrophyllia subcornigera - WELLS, v.1984: 215-216, fig. 5 (4-5) [Not *D. subcornigera subcornigera* Eguchi, 1968].

Dendrophyllia sp. cf. *D. ijimai* - CAIRNS & ZIBROWIUS, 1997: 191-192, fig. 29e.

MATERIAL EXAMINED. — USGS stn 25715 (*Dendrophyllia subcornigera* of WELLS, 1984): figured specimen (USNM 71863), 12 branches (USNM 73976).

TYPE LOCALITY. — Unknown, but presumed to be from off Japan.

REMARKS. — *Dendrophyllia ijimai* belongs to the "first group" of *Dendrophyllia* species sensu CAIRNS (1995), this group characterised by having a robust axial corallite from which additional corallites bud at right angle. WELLS (1984) correctly identified the Vanuatu Pleistocene specimens as *D. subcornigera*, listing *D. ijimai* as a junior synonym, not realizing that *D. ijimai* was described earlier. The nominal subspecies of *D. subcornigera* is probably a junior synonym of *D. arbuscula* van der Horst, 1922 (see CAIRNS, 1995). *D. ijimai* was recently redescribed and figured by CAIRNS (1995).

DISTRIBUTION. — Vanuatu region: Pleistocene of Espiritu Santo (WELLS, 1984). Elsewhere: southwestern Indian Ocean to Japan; 10-366 m (CAIRNS, 1995).

Dendrophyllia arbuscula van der Horst, 1922

Dendrophyllia arbuscula van der Horst, v*1922: 53 (in part: *"Siboga"* stn 277, pl. 8, fig. 6). — CAIRNS, 1994: 90-91, pl. 38, figs i-l (synonymy); 1995: 125-126, pl. 43, figs e-f, map 15; 1998: 408-409. — CAIRNS & ZIBROWIUS, 1997: 192-193, figs 29a-c (lectotype designated).

Dendrophyllia horsti Gardiner & Waugh, v*1939: 237-238, pl. 2, figs 5-6.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1018, 4 colonies (USNM 98938). — Stn 1021, 1 colony (MNHN). — Stn 1030, 2 colonies and 2 branches (MNHN). — Stn 1058, 2 colonies and 1 branch (MNHN).

TYPE LOCALITY. — *"Siboga"* stns 260 and 277: Banda Sea, 45-90 m.

REMARKS. — *Dendrophyllia arbuscula* is the only species reported herein that belongs to *Dendrophyllia* "group 2" sensu CAIRNS (1995), i.e., species having relatively small, bushy colonies with irregular branching from a short, but robust axial corallite. It is distinctive in having a relatively shallow fossa with a well-developed columella that is often constricted into three lobes. It was recently redescribed and figured by CAIRNS (1994, 1995).

DISTRIBUTION. — Vanuatu region: Efaté and Malakula; 130-319 m. Elsewhere: Indo-West Pacific from southwestern Indian Ocean to Japan; 2-353 m (CAIRNS, 1998).

Dendrophyllia alcocki (Wells, 1954)

Sclerhelia alcocki Wells, v*1954: 465-466, pl. 177, figs 1-2.
Dendrophyllia alcocki - ZIBROWIUS, v.1974b: 570-573, figs 10-14. — CAIRNS, 1995: 126-127, pl. 43, figs g-i, pl. 44, figs a-b, map 3 (synonymy); 1998: 408, fig. 9g. — CAIRNS & ZIBROWIUS, 1997: 193.

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 506, 1 colony (MNHN). — Stn 514, 3 branches (USNM 98943).
Vanuatu. MUSORSTOM 8: stn 971, 4 colonies (MNHN). — Stn 977, 1 colony (MNHN). — Stn 978, 1 branch (MNHN). — Stn 980, 1 branch (MNHN). — Stn 982, 4 branches (MNHN). — Stn 983, 1 colony and 2 branches (USNM 98940). — Stn 988, 4 branches (USNM 98942). — Stn 1015, 2 branches (USNM 98939). — Stn 1019, 1 branch (USNM 98941). — Stn 1023, 2 branches (MNHN). — Stn 1095, 1 branch (MNHN). — Stn 1108, 1 branch (MNHN).

TYPE LOCALITY. — Bikini Atoll, Marshall Islands, 177-243 m.

REMARKS. — *Dendrophyllia alcocki* belongs to the "third group" of *Dendrophyllia* species sensu CAIRNS (1995), i.e., those species having dendroid coralla produced by sympodial branching. *D. alcocki* is further distinguished as having dense, spinose coenosteum (porous only near distal branch tips); three cycles of septa; and prominent P_2. It was recently redescribed and illustrated by CAIRNS (1995).

DISTRIBUTION. — Wallis and Futuna region: Futuna; 355-400 m. Vanuatu region: Anatom, Tanna, Efaté, and Espiritu Santo; 315-475 m. Elsewhere: Indo-West Pacific from Maldive Islands to New Zealand, including the Marshall Islands and South China Sea; 118-616 m (CAIRNS, 1998).

Genus *ENALLOPSAMMIA* Michelotti, 1871

Enallopsammia rostrata (Pourtalès, 1878)

Amphihelia rostrata Pourtalès, v*1878: 204, pl. 1, figs 4-5.
Dendrophyllia amphelioides Alcock, v*1902a: 112-113.
Enallopsammia rostrata - ZIBROWIUS, 1973: 44-45, pl. 2, figs 14-15. — CAIRNS, 1982: 57, pl. 18, figs 1-4 (synonymy); 1994: 92-93, pl. 39, figs d-f (synonymy); 1995: 127-128, pl. 44, figs c-f, map 5. — CAIRNS & ZIBROWIUS, 1997: 195.
Enallopsammia amphelioides - ZIBROWIUS, 1973: 45-46 (Tuamotu Archipelago).

MATERIAL EXAMINED. — **Wallis and Futuna region**. MUSORSTOM 7: stn 501, 5 nonrostrate branches (MNHN). — Stn 520, 2 rostrate branches (MNHN). — Stn 522, 3 rostrate branches (USNM 98947). — Stn 530, 1 nonrostrate branch (MNHN). — Stn 574, 2 rostrate colonies (MNHN).
Vanuatu. MUSORSTOM 8: stn 959, 4 nonrostrate branches (USNM 98945). — Stn 974, 3 nonrostrate branches (MNHN). — Stn 977, 3 nonrostrate colonies and 3 branches (MNHN). — Stn 1006, 2 nonrostrate branches (USNM 98946). — Stn 1015, 4 nonrostrate branches (MNHN). — Stn 1024, 1 nonrostrate colony and 2 branches (USNM 98944).

TYPE LOCALITY. — *"Blake"* stn 2: 23°14'N, 82°25'W (Straits of Florida), 1472 m.

REMARKS. — This widespread species varies in calicular diameter and the expression of the costoseptal rostrum (see CAIRNS, 1982, 1995). All Vanuatu specimens lack the costoseptal rostrum and have calices of intermediate size (2.6-3.5 mm GCD), whereas those from the Wallis and Futuna region represent rostrate and nonrostrate forms (see Material Examined). There seems to be no correlation between having a rostrum and GCD, the rostrate forms ranging from 2.3 (MUSORSTOM 7 stn 574) to 4.1 (MUSORSTOM 7 stn 530) mm in GCD. *E. rostrata* was recently redescribed and figured by CAIRNS (1994, 1995). It is easily distinguished from other colonial deep-water corals

from this region by having a flabellate colony with unifacially arranged corallites, the corallites often having a prominent costoseptal rostrum; and three cycles of normally inserted septa.

The corallum of one specimen from MUSORSTOM 7 stn 501 contained several acrothoracican crustacean borings.

DISTRIBUTION. — Wallis and Futuna region: Wallis and Futuna; Waterwitch Bank; 400-920 m. Vanuatu region: Anatom, Tanna, Erromango, and Efaté; 370-574 m. Elsewhere: cosmopolitan, except for eastern Pacific and off continental Antarctica; 110-2165 m (CAIRNS & ZIBROWIUS, 1997).

ACKNOWLEDGEMENTS

I would like to thank Bertrand RICHER DE FORGES (ORSTOM, Nouméa), Philippe BOUCHET (BIMM, Muséum national d'Histoire naturelle, Paris) and Alain CROSNIER, who collected the specimens used in this study. Alain CROSNIER provided too the support and encouragement to complete the study.

I also thank the following people, who generously loaned specimens used in the study and/or facilitated visits to their collection: Richard PREECE (University Museum of Zoology, Cambridge), Eric LAZO-WASEM (Yale Peabody Museum), Kei MORI [Institute of Geology and Paleontology, Tohoku (Imperial) University, Sendai], Maya BEST (Nationaal Natuurhistorisch Museum, Leiden), Sheila HALSEY (The Natural History Museum, London), and Peter BARTSCH (Zoologisches Museum, Berlin).

The scanning electron photomicrographs were taken in the SEM Laboratory, NMNH.

I am also grateful to Helmut ZIBROWIUS, who carefully reviewed an early draft of this manuscript.

REFERENCES

ALCOCK, A., 1893. — On some newly-recorded corals from the Indian seas. *Journal of the Asiatic Society of Bengal*, **62**(2): 138-149, pl. 5.

ALCOCK, A., 1898. — An account of the deep-sea Madreporaria collected by the Royal Indian marine survey ship Investigator. Calcutta: Trustees Indian Museum, 29 pp., 3 pls.

ALCOCK, A., 1902a. — Diagnoses and descriptions of new species of corals from the Siboga expedition. *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, (2)**7**: 89-115.

ALCOCK, A., 1902b. — Further diagnoses and descriptions of new species of corals from the Siboga expedition. *Tijdschrift der Nederlandsche Dierkundige Vereeniging*, (2)**7**: 116-123.

ALCOCK, A., 1902c. — Report on the deep-sea Madreporaria of the Siboga-Expedition. *Siboga-Expeditie Monographies*, (16a), 55 pp., 5 pls.

BASSETT-SMITH, P.W., 1890. — Report on the corals from the Tizard and Macclesfield Banks, China Sea. *Annals and Magazine of Natural History*, (6)**6**: 353-374, 443-458, pl. 12-14.

BEST, M.R.B., CAIRNS, S.D., & HOEKSEMA, B.W., in press. — UNESCO-IOC register of marine organisms: Coelenterata or Cnidaria: Class Hexacorallia: Order Scleractinia (Stony Corals). *Sixth International Conference on Coelenterate Biology (ICCB VI)*, Leiden. 21 pp.

BOSCHMA, H., 1923. — The Madreporaria of the Siboga expedition. Part 4. Fungia patella. *Siboga-Expeditie Monographies*, (16d): 1-20, pl. 9-10.

BOURNE, G. C., 1903. Some new and rare corals from Funafuti. *Journal of the Linnean Society of London* (Zoology), **29**: 26-37, 2 pls.

BOURNE, G. C., 1905. Report on the solitary corals collected by Professor Herdman, at Ceylon, in 1902. *Ceylon Pearl Oyster Fisheries., Supplementary Report*, (29): 187-242, 4 pls.

BRIGGS, J.C., 1974. — *Marine zoogeography*. New York: McGraw Hill. x + 475 pp.

CAIRNS, S.D., 1979. — The deep-water Scleractinia of the Caribbean Sea and adjacent waters. *Studies on the Fauna of Curaçao*, **67**(108), 341 pp., 40 pls.

CAIRNS, S.D., 1982. — Antarctic and subantarctic Scleractinia. *Antarctic Research Series*, **34**(1): 74 pp., 18 pls.

CAIRNS, S.D., 1984. — New records of ahermatypic corals (Scleractinia) from the Hawaiian and Line Islands. *Occasional Papers, Bernice P. Bishop Museum*, **25**(10), 30 pp., 5 pls.

CAIRNS, S.D., 1988. — *Cryptotrochus*, new genus and two new species of deep-water corals (Scleractinia: Turbinoliinae). *Proceedings of the Biological Society of Washington*, **101**(4): 709-716.

CAIRNS, S.D., 1989a. — A revision of the ahermatypic Scleractinia of the Philippine islands and adjacent waters. Part 1. Fungiacyathidae, Micrabaciidae, Turbinoliinae, Guyniidae, and Flabellidae. *Smithsonian Contributions to Zoology*, (486), 136 pp., 42 pls.

CAIRNS, S.D., 1989b. — Asexual reproduction in solitary Scleractinia. *Proceedings of the Sixth International Coral Reef Symposium*, **2**: 641-646.

CAIRNS, S.D., 1991a. — A revision of the ahermatypic Scleractinia of the Galápagos and Cocos Islands. *Smithsonian Contributions to Zoology*, (504), 44 pp., 12 pls.

CAIRNS, S. D., 1991b. — Catalog of the type specimens of stony corals (Milleporidae, Stylasteridae, Scleractinia) in the National Museum of Natural History, Smithsonian Institution. *Smithsonian Contributions to Zoology*, (514), 59 pp.

CAIRNS, S.D., 1994. — Scleractinia of the temperate North Pacific. *Smithsonian Contributions to Zoology*, (557), 150 pp., 42 pls.

CAIRNS, S.D., 1995. — The marine fauna of New Zealand: Scleractinia (Cnidaria: Anthozoa). *New Zealand Oceanographic Institute Memoirs*, **103**, 210 pp., 44 pls.

CAIRNS, S.D., 1997. — A generic revision and phylogenetic analysis of the Turbinoliidae (Cnidaria: Scleractinia). *Smithsonian Contributions to Zoology*, (591), 55 pp., 10 pls.

CAIRNS, S.D., 1998. — Azooxanthellate Scleractinia (Cnidaria: Anthozoa) of Western Australia. *Records of the Western Australian Museum*, **18**: 361-417, 9 pls.

CAIRNS, S.D. & KELLER, N.B., 1993. — New taxa and distributional records of azooxanthellate Scleractinia (Cnidaria, Anthozoa) from the tropical southwest Indian Ocean, with comments on their zoogeography and ecology. *Annals of the South African Museum*, **103**(5): 213-292.

CAIRNS, S.D. & PARKER, S.A., 1992. — Review of the recent Scleractinia (stony corals) of South Australia, Victoria and Tasmania. *Records of the South Australian Museum*, Monograph Series, (3): 82 pp., 18 pls.

CAIRNS, S.D. & WELLS, J.W., 1987. — Neogene paleontology in the northern Dominican Republic. 5. The suborders Caryophylliina and Dendrophylliina (Anthozoa: Scleractinia). *Bulletins of American Paleontology*, **93**(328): 23-43 (bibl.: 52-55), pl. 8-11.

CAIRNS, S.D. & ZIBROWIUS, H., 1997. — Cnidaria Anthozoa: Azooxanthellate Scleractinia from the Philippine and Indonesian regions. In: A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 16. *Mémoires du Muséum national d'Histoire Naturelle*, **172**: 27-243, including 29 pls.

CHEVALIER, J.-P., 1971. — Les Scléractiniaires de la Mélanésie Française, 1re partie. In: *Expédition Française sur les Récifs Coralliens de la Nouvelle-Calédonie*, **5**, 307 pp. 38 pls. Paris: Éditions de la Fondation Singer-Polignac.

CHEVALIER, J.-P., 1978. — Les coraux des Iles Marquises. *Cahiers du Pacifique*, **21**: 243-283, 4 pls.

CHEVALIER, J.-P., 1980. — La fauna corallienne de l'île Tubuaï (Archipel des Australes). *Cahiers de l'Indo-Pacifique*, **2**(3): 55-68.

DANA, J.D., 1846-1849. — Zoophytes. *United States exploring expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N.*, **7**, vii + 740 pp., 61 pls.

DENNANT, J., 1899. — Descriptions of two new species of corals from the Australian Tertiaries, 1. *Transactions and Proceedings and Report of the Royal Society of South Australia*, **23**: 112-122, pl. 2-3.

DENNANT, J., 1906. — Madreporaria from the Australian and New Zealand coasts. *Transactions of the Royal Society of South Australia*, **30**: 151-165, pl. 5-6.

DUNCAN, P.M., 1872. — On the structure and affinities of *Guynia annulata* Dunc., with remarks upon the persistence of Palaeozoic types of Madreporaria. *Philosophical Transactions of the Royal Society of London*, **162**(1): 29-40, pl. 1.

DUNCAN, P.M., 1873. — A description of the Madreporaria dredged up during the expeditions of H.M.S. "Porcupine" in 1869 and 1870. Part 1. *Transactions of the Zoological Society of London*, **8**(5): 303-344, pl. 39-49.

DUNCAN, P.M., 1876. — Notices of some deep-sea and littoral corals from the Atlantic Ocean, Caribbean, Indian, New-Zealand, Persian Gulf, and Japanese &c. seas. *Proceedings of the Zoological Society of London*, 1876: 428-442, pl. 38-41.

EGUCHI, M., 1965. — [Scleractinia]. In: T. UCHIDA *et al.* (eds), *New illustrated encyclopedia of the fauna of Japan*, Volume 1 [In Japanese] Tokyo: Hokuruyu-kan: 270-296, fig. 353-452.

EGUCHI, M., 1968. — *The hydrocorals and scleractinian corals of Sagami Bay collected by His Majesty the emperor of Japan*. Tokyo: Maruzen. xv + 221 pp, 70 pls.

ESPER, E.J.C., 1794. — Fortsetzungen der Pflanzenthiere, Vol. 1, parts 1-2, Nürnberg. 64 pp.

FAUSTINO, L.A., 1927. — Recent Madreporaria of the Philippine Islands. *Philippine Bureau of Science, Monograph*, (22): 310 pp., 100 pls.

GARDINER, J.S., 1899a. — On the solitary corals. In: A. WILLEY (ed.), *Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the years 1895-1896 and 1897*. Cambridge Univ. Press. **2** (11): 161-170, pl. 19-20.

GARDINER, J.S., 1899b. — On the turbinolid and oculinoid corals collected by the author in the South Pacific. *Proceedings of the Zoological Society of London*, 1899: 994-1000, pl. 62.

GARDINER, J. S., 1900. — On the anatomy of a supposed new species of *Coenopsammia* from Lifu. In: A. WILLEY (ed.), *Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the years 1895-1896 and 1897*. Cambridge Univ. Press. **4**: 359-380, pl. 34.

GARDINER, J.S., 1905. — Madreporaria. Parts 3. [Fungida] and 4. [Turbinolidae]. In: J.S. GARDINER (ed.), *The fauna and geography of the Maldive and Laccadive archipelagos, being an account of the work carried out and the collection made by an expedition during the years 1899 and 1900*. **2** (Supplement 1): 933-953, 953-957, pl. 89-93.

GARDINER, J.S. & WAUGH, P., 1939. — Madreporaria excluding Flabellidae and Turbinolidae. *The John Murray Expedition 1933-34, Scientific Reports*, **6**(5): 225-242, 2 pls.

GRAVIER, C., 1915. — Note préliminaire sur les Madréporaires recueillis au cours des croisières de la Princesse-Alice et de l'Hirondelle. *Bulletin de l'Institut Océanographique*, Monaco, **12**(304), 22 pp., 11 figs.

GRAVIER, C., 1920. — Madréporaires provenant des campagnes des yachts Princesse-Alice et Hirondelle II (1893-1913). *Résultats des Campagnes scientifique accomplies sur son yacht par Albert Ier, Prince Souverain de Monaco*, **55**, 123 pp., 16 pls.

GRYGIER, M.J., 1991. — Addition to the ascothoracidan fauna of Australia and South-east Asia (Crustacea, Maxillopoda): Synagogidae (part), Lauridae and Petrarcidae. *Records of the Australian Museum*, **43**: 1-46.

GRYGIER, M.J. & NEWMAN, W.A., 1985. — Motility and calcareous parts in extant and fossil Acrothoracica (Crustacea: Cirripedia), based primarily upon new species burrowing in the deep-sea scleractinian coral *Enallopsammia*. *Transactions of the San Diego Society of Natural History*, **21**: 1-22.

GRYGIER, M.J. & NOJIMA, S., 1995. — Petrarcid galls and Petrarcidae (Crustacea: Ascothoracida) in some scleractinian corals from Japan. *Galaxea*, **12**: 83-101, 20 figs.

GUERRIERO, A., D'AMBROSIO, M., ZIBROWIUS, H., & PIETRA, F., 1996. — Novel cholic-acid-type sterones of *Deltocyathus magnificus*, a deep-water scleractinian coral from the Loyalty Islands, SW Pacific. *Helvetica Chimica Acta*, **79**: 982-988.

HICKSON, S.J., 1903. — The horny membrane of *Neohelia porcellana*. *Nature*, 67(1737): 344.

HOEKSEMA, B.W. & BEST, M.B., 1991. — New observations on scleractinian corals from Indonesia: 2. Sipunculan-associated species belonging to the genera *Heterocyathus* and *Heteropsammia*. *Zoologische Mededelingen*, **65**(16): 221-245, 31 figs.

HORST, J.C. van, 1922. — The Madreporaria of the Siboga expedition. Part 3. Eupsammidae. *Siboga-Expeditie Monographies*, (16c): 46-75, pl. 1-8.

HORST, J.C. van, 1931. — Some solitary corals from the Indian Museum. Records of the Indian Museum, 33(1): 3-12, pl. 1-2.

HU, C.-H., 1987. — Unusual fossil corals from Hengchun Peninsula, southern Taiwan. *Memoirs of the Geological Society of China*, 8: 31-48, 3 pls.

INTERNATIONAL CODE OF ZOOLOGICAL NOMENCLATURE (ICZN), 1985. — W.D. RIDE (Chairman of editorial committee). *International Code of Zoological Nomenclature*, Third Edition, adopted by the XX General Assembly of the International Union of Biological Sciences. London: International Trust for Zoological Nomenclature. xx + 338 pp.

KELLER, N.B., 1974. — New data about some species of madreporarian corals of the genus *Flabellum*. [Russian, with English summary]. *Trudy Instituta Okeanologyi*, **98**: 199-212, 7 pls.

KELLER, N.B., 1976. — The deep-sea madreporarian corals of the genus *Fungiacyathus* from the Kuril-Kamchatka, Aleutian trenches and other regions of the World Ocean. [Russian, with English summary]. *Trudy Instituta Okeanologyi*, **99**: 30-44, pl. 1-3.

KELLER, N.B., 1981a. — The solitary madreporarian corals. In: A.P. KUZNETSOV & A.N. MIRONOV (eds), *Benthos of the submarine mountains Marcus-Necker and adjacent Pacific regions*. [In Russian]. Moscow: P.P. Shirshov Institute of Oceanology : 28-39, 2 pls.

KELLER, N.B., 1981b. — Interspecies variability of *Caryophyllia* (Madreporaria) in connection with their environment. [In Russian]. *Trudy Instituta Okeanologyi*, **115**: 14-25, 2 pls.

KELLER, N.B., 1982. — Some new data on madreporarian corals of the genus *Deltocyathus*. [Russian, with English summary]. *Trudy Instituta Okeanologyi*, **117**: 47-58, pl. 1-2.

LESSON, R.P., 1831. — *Illustrations de zoologie ou recueil de figures d'animaux peintes d'après nature*. Paris: A. Bertrand. 60 pls + text.

LINNAEUS, C., 1758. — *Systema naturae per regna tria naturae, secundum classes, ordines, genera, species*. Tomus I: Regnum animale. 10 ed. Stockholm. 824 pp.

MANNING, R.B., 1991. — Crustacea Decapoda: *Cecidocarcinus zibrowii*, a new deep-water gall crab (Cryptochiridae) from New Caledonia. In: A. CROSNIER (ed.). Résultats des Campagnes MUSORSTOM, Volume 9. *Mémoires du Muséum national d'Histoire Naturelle*, (A), **152**: 515-520, 3 figs.

MARENZELLER, E. von, 1888a. — Ueber das Wachsthum der Gattung *Flabellum* Lesson. *Zoologische Jahrbücher*, (Abtheilung für Systematik, Geographie und Biologie der Thiere), **3**(1): 25-50.

MARENZELLER, E. von, 1888b. — Ueber japanische Turbinoliden. *Annalen des K.-K. Naturhistorisches Hofmususeum Wien*, **3**: 15-22.

MARENZELLER, E. von, 1904. Steinkorallen. *Wissenschaftliche Ergebnisse der Deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899*, **7**(3): 261-318, pl. 14-18.

MARENZELLER, E. von, 1907. — Expeditionen S.M. Schiff Pola in das Rote Meer, nördliche und südliche Hälfte 1895/96 - 1897/98. Zoologische Ergebnisse 25. Tiefseekorallen. *Denkschriften der Mathematisch-Naturwissenschaftliche Klasse der Kaiserlichen Akademie der Wissenschaften*, **80**: 13-25.

MATTHEWS, S.C., 1973. — Notes on open nomenclature and on synonymy lists. *Paleontology*, **16**(4): 713-719.

MICHELIN, H., 1842. — Description d'une nouvelle espèce de zoophyte du genre Flabelline (*Flabellum*, Less.). *Revue de Zoologie*, 1842: 119.

MILNE EDWARDS, H. & HAIME, J., 1848a. — Recherches sur les polypiers. Deuxième mémoire. Monographie des Turbinolides. *Annales des Sciences Naturelles*, Zoologie, (3)**9**: 211-344, pl. 7-10.

MILNE EDWARDS, H. & HAIME, J., 1848b. — Recherches sur les polypiers. Troisième mémoire. Monographie des Eupsammides. *Annales des Sciences Naturelles*, Zoologie, (3)**10**: 65-114, pl. 1.

MILNE EDWARDS, H., HAIME, J., 1850. — Recherches sur les polypiers. Cinquième mémoire: Monographie des Oculinides. *Annales des Sciences Naturelles*, Zoologie, (3)13: 63-110, pl. 3-4.

MOSELEY, H.N., 1876. — Preliminary report to professor Wyville Thomson, F.R.S., director of the civilian staff, on the true corals dredged by H.M.S. Challenger in deep water between the dates Dec. 30th, 1870, and August 31st, 1875. *Proceedings of the Royal Society of London*, **24**(170): 544-569.

MOSELEY, H.N., 1880. — Description of a new species of simple coral (*Desmophyllum lamprotichum*). *Proceedings of the Zoological Society of London*, 1880: 41-42, 2 figs.

MOSELEY, H.N., 1881. — Report on certain hydroid, alcyonarian, and madreporarian corals procured during the voyage of H.M.S. Challenger, in the years 1873-1876. *Challenger Reports*, Zoology, **2**: 248 pp., 32 pls.

OWENS, J.M., 1994. — *Letepsammia franki*, a new species of deep-sea coral (Coelenterata: Scleractinia: Micrabaciidae). *Proceedings of the Biological Society of Washington*, **104**(4): 586-590.

PALLAS, P.S., 1766. — *Elenchus Zoophytorum*. Hagae Comitum: P. van Clef. xvi + 28 + 451 pp.

PONDER, W.F., 1983. — A revision of the Recent Xenophoridae of the world and the Australian fossil species (Mollusca: Gastropoda). *Memoirs of the Australian Museum*, Sydney, 17: 126 p., 42 figs.

POURTALÈS, L.F. de, 1867. — Contributions to the fauna of the Gulf Stream at great depths. *Bulletin of the Museum of Comparative Zoology*, **1**(6): 102-120.

POURTALÈS, L.F. de, 1868. — Contributions to the fauna of the Gulf Stream at great depths (2d series). *Bulletin of the Museum of Comparative Zoology*, **1**(7): 121-142.

POURTALÈS, L.F. de, 1878. — Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico... Corals. *Bulletin of the Museum of Comparative Zoology*, **5**(9): 197-212, pl. 1.

PRATT, E.M., 1900. — Anatomy of *Neohelia porcellana* (Moseley). In: A. WILLEY (ed.), *Zoological results based on material from New Britain, New Guinea, Loyalty Islands and elsewhere collected during the years 1895, 1896 and 1897*. Cambridge Univ. Press. **5**: 591-602, pl. 62-63.

RANDALL, R.H. & MYERS, R.F. 1983. — *Guide to the coastal resources of Guam*. Volume 2. The corals. Guam: University of Guam Press. 128 pp., 488 figs.

REHBERG, H., 1892. — Neue und wenig bekannte Korallen. *Abhandlungen aus dem Gebiete der Naturwissenschaften, Hamburg*, **12**(1): 50 pp., 4 pls.

RICHER DE FORGES, B. & MENOU, J.-L., 1993. — La campagne MUSORSTOM 7 dans la zone économique de Wallis et Futuna. Compte rendu et liste des stations. In: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 10. *Mémoires du Muséum national d'Histoire Naturelle*, **156**: 9-25, 17 figs.

RICHER DE FORGES, B., FALIEX, E., & MENOU, J.-L., 1996. — La campagne MUSORSTOM 8 dans l'archipel de Vanuatu. Compte rendu et liste des stations. In: A. CROSNIER (ed.), Résultats des campagnes MUSORSTOM, Volume 15. *Mémoires du Muséum national d'Histoire Naturelle*, **168**: 9-32, 16 figs.

SEMPER, C., 1872. — Ueber Generationswechsel bei Steinkorallen und über das M.-Edwards'sche Wachsthumsgesetz der Polypen (zugleich ein Beitrag zur Fauna der Philippinen). *Zeitschrift für Wissenschaftliche Zoologie*, **22**(2): 235-280, pl. 16-21.

SIEG, J. & ZIBROWIUS, H., 1989. — Association of a tube inhabiting tanaidacean, *Bifidia scleractinicola* gen.n., sp.n., with bathyal scleractinians of New Caledonia (Crustacea Tanaidacea - Cnidaria Scleractinia). *Mésogée*, **48**: 189-199.

SPENGLER, L., 1781. — Beskrivelse over et ganske besynderligt Corall-produkt, hvilket man, indtil dets Sloegt noermere bestemmes, kunde kalde en Snekke-Madrepore (*Madrepora cochlea*). *Nye Samling af det Kongelige Danske Videnskabers Selskabs Skrifter*, **1**: 240-248 [not seen].

SQUIRES, D.F., 1958. — The Cretaceous and Tertiary corals of New Zealand. *New Zealand Geological Survey, Paleontological Bulletin*, **29**: 107 pp. 16 pls.

SQUIRES, D.F., 1964. — New stony corals (Scleractinia) from northeastern New Zealand. *Records of the Auckland Institute and Museum*, **6**(1): 1-9, 2 pls.

SQUIRES, D.F. & KEYES, I.W., 1967. — The marine fauna of New Zealand: Scleractinian corals. *Bulletin of the New Zealand Department of Scientific and Industrial Research*, **185** [= New Zealand Oceanographic Institute Memoirs, 43]: 46 pp., 6 pls.

STOLARSKI, J., 1996. — *Gardineria* - a scleractinian living fossil. *Acta Palaeontologica Polonica*, **41**(4): 339-367, 11 figs.

STUDER, T., 1878. — Übersicht der Steinkorallen aus der Familie de Madreporaria aporosa, *Eupsammina* und *Turbinaria*, welche auf der Reise S.M.S. Gazelle um die Erde gesammelt wurden. *Monatsberichte der Königlichen Preussischen Akademie der Wissenschaften zu Berlin*, 1877: 625-655, pl. 1-4.

TIZZARD, R. N., MOSELEY, H. N., BUCHANAN, J. Y, & MURRAY, J., 1885. — Narrative. *Report on the Scientific Results of the Voyage of the H. M. S. Challenger during the Years 1873-76*, **1**(2): 510-1100, pls F-O.

UMBGROVE, J.H.F., 1950. — Corals from the Putjangan beds (Lower Pleistocene) of Java. *Journal of Paleontology*, **24**(6): 637-651, pl. 81-84.

VAUGHAN, T.W., 1907. — Recent Madreporaria of the Hawaiian Islands and Laysan. *Bulletin of the U. S. National Museum*, **59**, iv + 427 p., 96 pls.

VERON, J.E.N., & PICHON, M., 1980. — Scleractinia of Eastern Australia. Part 3. *Australian Institute of Marine Science, Monograph Series*, **4**: 1-422.

VERRILL, A.E., 1865. — Classification of polyps (extract condensed from a synopsis of the polypi of the North Pacific Exploring Expedition...). *Proceedings of the Essex Institute*, **4**: 145-152.

VERRILL, A.E., 1866. — Synopsis of the polyps and corals of the North Pacific Exploring Expedition, under Commander C. Ringgold and Captain John Rodgers, U.S.N., from 1853 to 1856. Collected by Dr. Wm. Stimpson, naturalist of the expedition. With description of some additional species from the west coast of North America. Part 3. Madreporaria. *Proceedings of the Essex Institute*, **5**: 17-50, pl. 1-2.

WELLS, J.W., 1954. — Recent corals of the Marshall Islands. *United States Geological Survey, Professional Paper*, (260-I): iv + 385-486, pl. 94-187.

WELLS, J. W., 1958. — Scleractinian corals. *B.A.N.Z. Antarctic Research Expedition, 1929-1931, Report* (Zoology and Botany), **6**(11): 257-275, 2 pls.

WELLS, J.W., 1977. — Eocene corals from Eua, Tonga. *United States Geol. Survey, Professional Paper*, (640-G): 1-9, pl. 1-3.

WELLS, J.W., 1984. — Notes on Indo-Pacific scleractinian corals. Part 10. Late Pleistocene ahermatypic corals from Vanuatu. *Pacific Science*, **38**(3): 205-219, 5 pls.

WHITELEGGE, T., 1898. — The Madreporaria of Funafuti. *Memoirs of the Australian Museum*, Sydney, **3**(6): 349-368.

YABE, H. & EGUCHI, M., 1932a. — A study of the recent deep-water coral fauna of Japan. *Proceedings of the Imperial Academy of Japan*, **8**(8): 387-390.

YABE, H. & EGUCHI, M., 1932b. — Notes on a fossil turbinolian coral, *Odontocyathus japonicus* nov. sp., from Segoe, near Tokaoka-machi, province of Hyuga. *Proceedings of the Imperial Academy of Japan*, **9**(3-4): 149-152, 1 pl.

YABE, H. & EGUCHI, M., 1934a. — Probable generic identity of *Stephanophyllia* Michelin and *Micrabacia* M. Edwards and J. Haime. *Proceedings of the Imperial Academy of Japan*, **10**(5): 278-281.

YABE, H. & EGUCHI, M., 1934b. — On some specific names of corals. *Animal and Plant*, **111**(11): 2026. [not seen, quoted from EGUCHI, 1965, 1968].

YABE, H. & EGUCHI, M., 1941. — Corals of Toyama Bay. *Bulletin of the Biogeographical Society of Japan*, **11**(12): 101-104.

YABE, H. & EGUCHI, M., 1942. — Fossil and recent simple corals from Japan. *Science Reports of the Tôhoku Imperial University*, (Ser. 2, Geology), **22**(2): 105-178, pl. 9-12.

YABE, H. & SUGIYAMA, T., 1936. — Some deep-water corals from the Palao Islands. *Proceedings of the Imperial Academy of Japan*, 12: 346-349.

ZIBROWIUS, H., 1973. — Révision des espèces actuelles du genre *Enallopsammia* Michelotti, 1871, et description de *E. marenzelleri*, nouvelle espèce bathyale à large distribution: Océan Indien et Atlantique Central (Madreporaria, Dendrophylliidae). *Beaufortia*, **21**(276): 37-54, 3 pls.

ZIBROWIUS, H., 1974a. — Scléractiniaires des Îles Saint-Paul et Amsterdam (Sud de l'Océan Indien). *Téthys*, **5**(4), 1973: 747-778, 3 pls.

ZIBROWIUS, H., 1974b. — Redescription of *Sclerhelia hirtella* from Saint Helena, South Atlantic, and remarks on Indo-Pacific species erroneously referred to the same genus (Scleractinia). *Journal of Natural History*, **8**(5): 563-575, 14 figs.

ZIBROWIUS, H., 1976. — *Les Scléractiniaires de la Méditerranée et de l'Atlantique nord-oriental.* Thèse Université Aix-Marseille, CNRS Archives originales 11.515, 302 pp., 106 pls, supplement of 29 maps.

ZIBROWIUS, H., 1980. — Les scléractiniaires de la Méditerranée et de l'Atlantique nord-oriental. *Mémoires de l'Institut Océanographique*, Monaco, **11**: 284 pp., 107 pls.

ZIBROWIUS, H., 1985. — Asexual reproduction by bud-shedding in shallow-water *Balanophyllia* of the tropical Indo-Pacific (Cnidaria: Scleractinia: Dendrophylliidae). *Proceedings of the Fifth International Coral Reef Congress*, **5**: 233-238, 1 pl.

ZIBROWIUS, H. & GILI, J.M., 1990. — Deep-water Scleractinia (Cnidaria: Anthozoa) from Namibia, South Africa, and Walvis Ridge, southeastern Atlantic. *Scientia Marina*, **54**(1): 19-46, 7 pls.

ZIBROWIUS, H. & GRYGIER, M.J., 1985. — Diversity and range of scleractinian coral hosts of Ascothoracida (Crustacea: Maxillopoda). *Annales de l'Institut Océanographique*, Paris, **61**(2): 115-138, 51 figs.

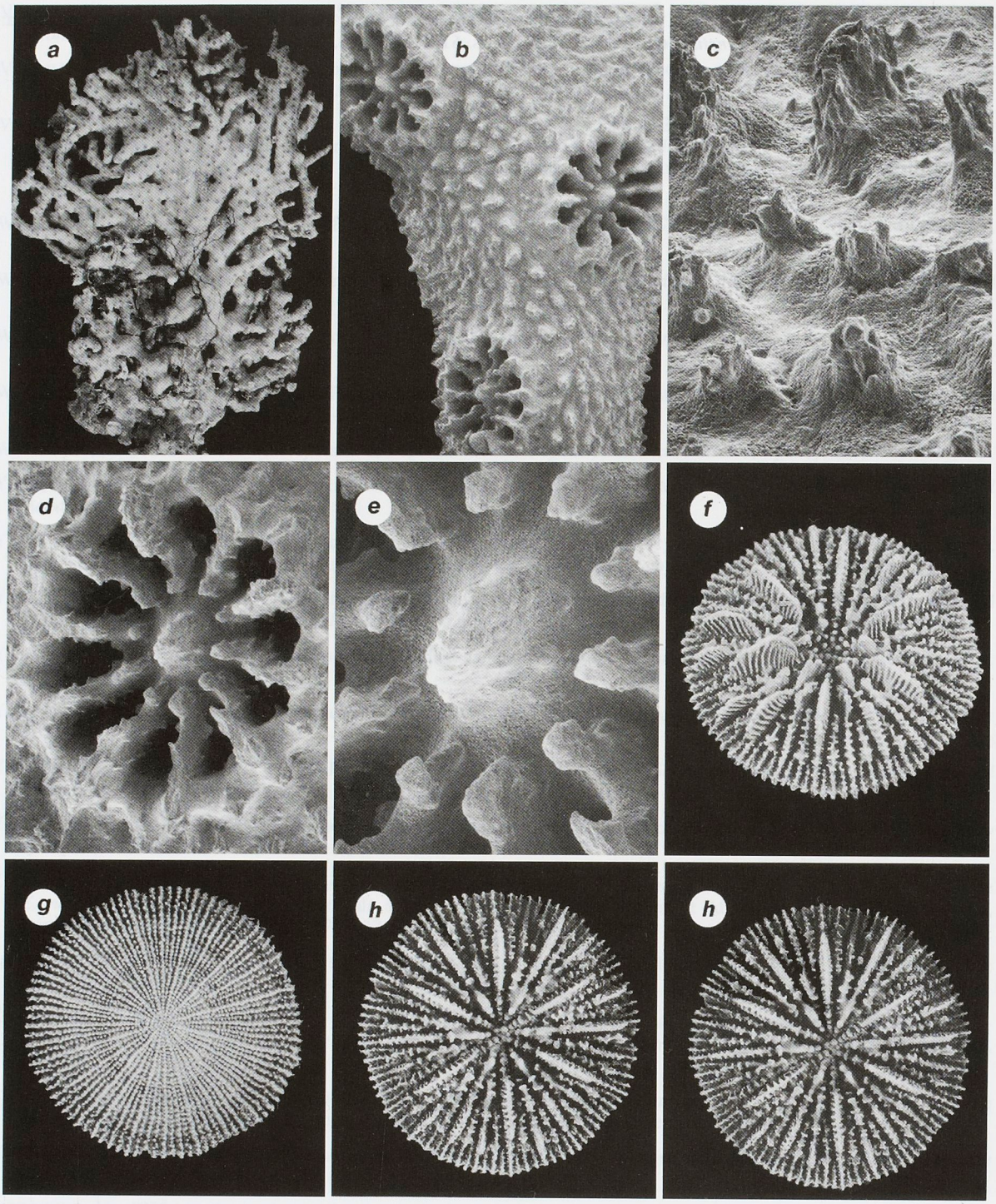


FIG. 1 a-e. — *Madracis kauaiensis*: **a**, MUSORSTOM 7 stn 509 (MNHN): a large colony, x 0.46. — **b-e**, MUSORSTOM 7 stn 509 (USNM 98541): **b**, branch with 3 corallites, x 15; **c**, coenosteal spines, x 115; **d**, calice, x 38; **e**, close up of columella and paliform lobes, x 100.

FIG. 1 f-h. — *Fungiacyathus sandoi*, holotype, MUSORSTOM 7 stn 538 (MNHN), oblique, basal, and stereo calicular views, all x 3.0.

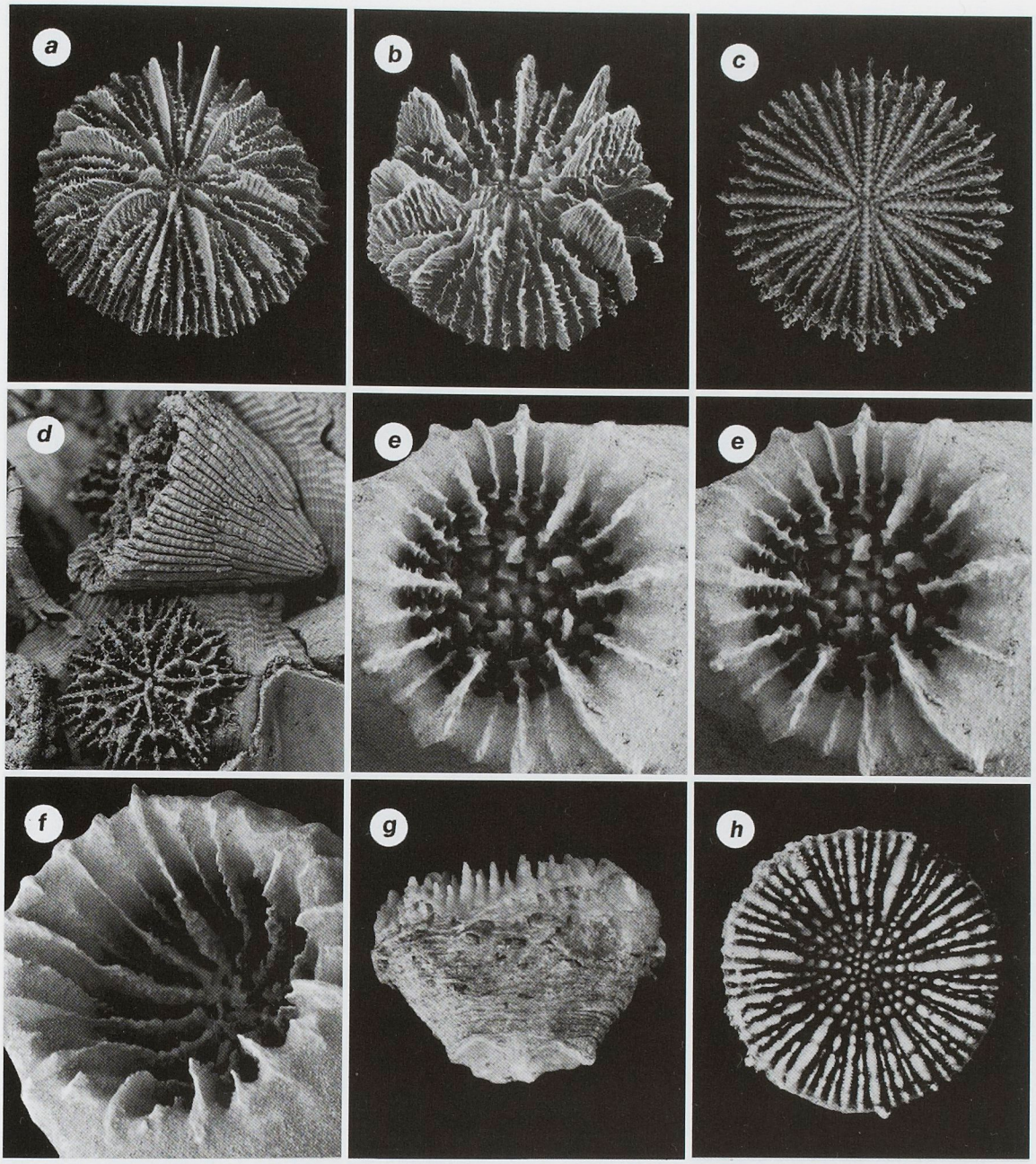


FIG. 2 a. — *Fungiacyathus paliferus*, MUSORSTOM 8 stn 1003 (MNHN), oblique calicular view, x 3.3.

FIG. 2 b-c. — *Fungiacyathus margaretae*: **b**, MUSORSTOM 7 stn 567 (MNHN), oblique calicular view, x 3.3. — **c**, MUSORSTOM 7 stn 565 (MNHN), granular base, x 3.1.

FIG. 2 d. — *Fungiacyathus variegatus*, MUSORSTOM 9 stn 963 (MNHN), corallum cemented to a *Xenophora* shell, along with a corallum of *Tropidocyathus labidus*, x 6.6

FIG. 2 e. — *Madrepora oculata* forma *formosa*, MUSORSTOM 7 stn 609 (USNM 98580), stereo view of a calice with asymmetrically arranged paliform lobes, x 23.

FIG. 2 f. — *Madrepora oculata* forma *tenuis*, MUSORSTOM 7 stn 552 (USNM 98548), calice lacking paliform lobes and columella, x 16.5.

FIG. 2 g-h. — *Anthemiphyllia pacifica*, MUSORSTOM 8 stn 1031 (MNHN), side and calicular views of a pedicellate corallum, x 3.9, x 4.3, respectively.

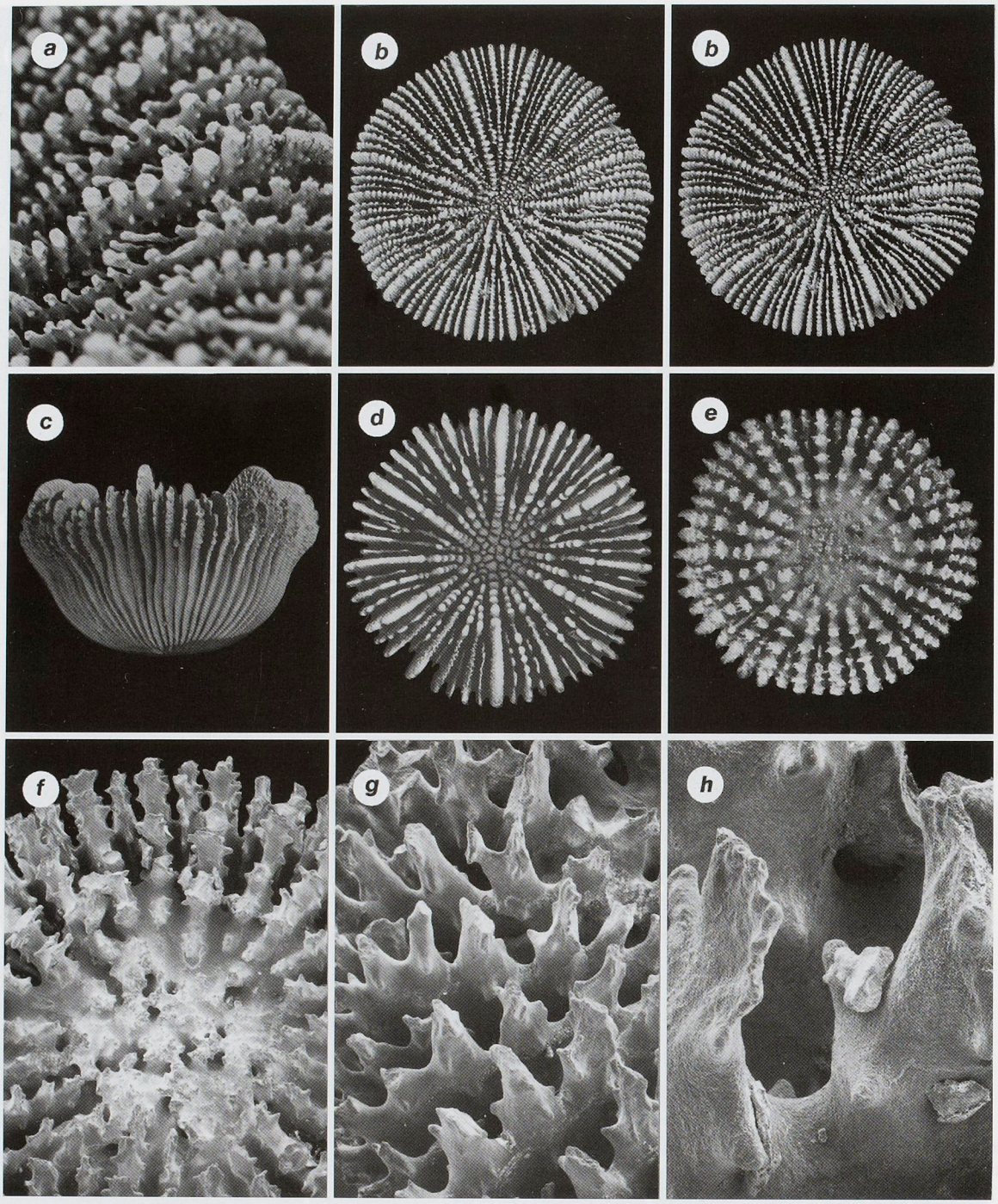


FIG. 3 a-b. — *Anthemiphyllia multidentata*, holotype, Cronulla (USNM 83010), detail of septal edge dentition and stereo calicular view, x 6.3, x 2.0, respectively.

FIG. 3 c-d. — *Anthemiphyllia macrolobata*, holotype, *Townsend Cromwell* stn 81-01-14 (USNM 60559), side and calicular views, both x 3.1.

FIG. 3 e-h. — *Anthemiphyllia patera costata*: **e**, MUSORSTOM 7 stn 586 (MNHN), calicular view of holotype, x 5.6. — **f-h**, paratype, MUSORSTOM 7 stn 594 (USNM 98555), calice and details of septal spines, x 11, x 24, x 75, respectively.

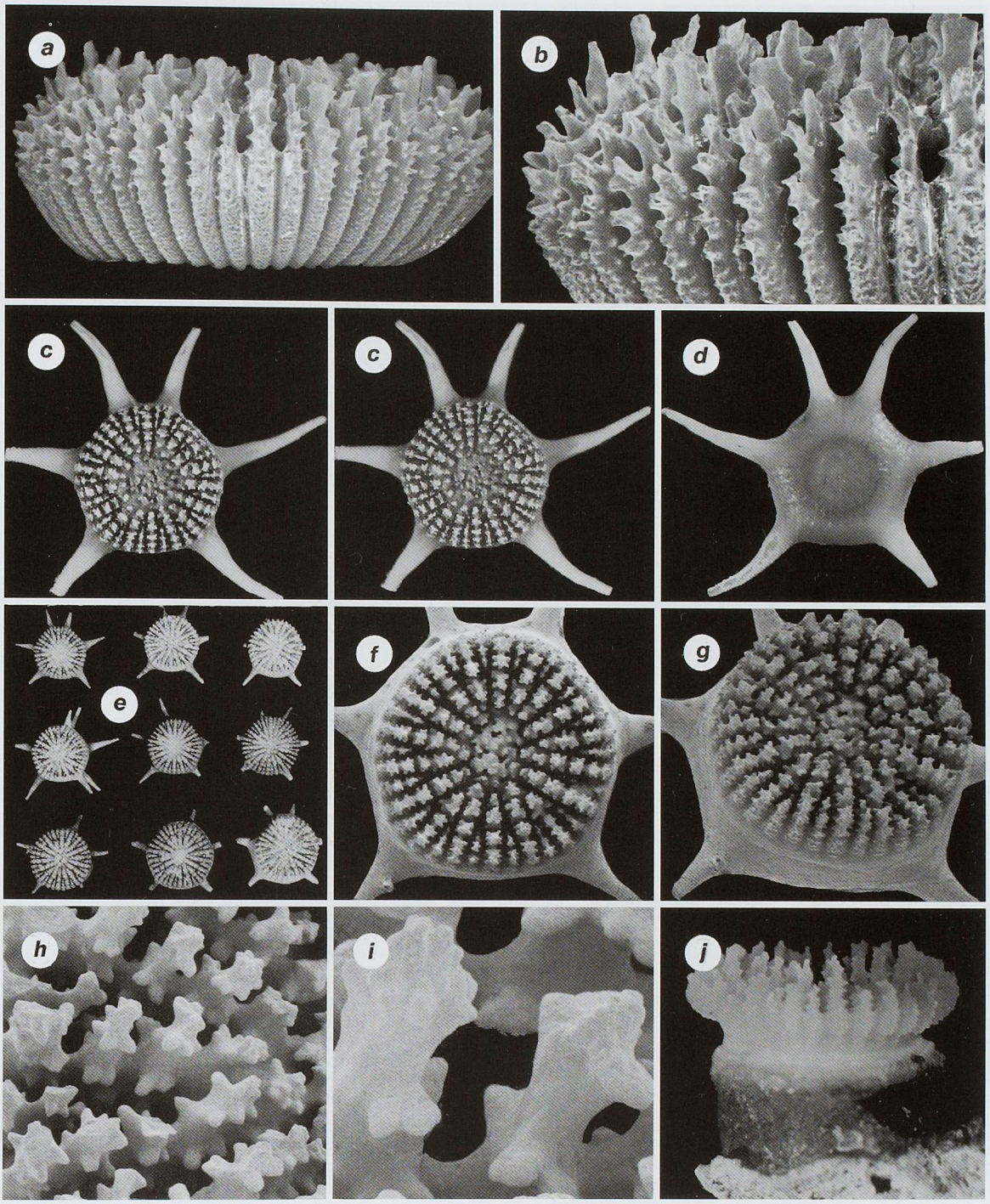


FIG. 4 a-b. — *Anthemiphyllia patera costata*, paratype, MUSORSTOM 7 stn 594 (USNM 98555), edge views of costal granulation, x 8.5, x 17.5, respectively.

FIG. 4 c-j. — *Anthemiphyllia spinifera*: **c-e**, MUSORSTOM 7 stn 605 (MNHN): **c-d**, stereo calicular and basal views of holotype, both x 5.0; **e**, 9 paratypes, x 2.0. — **f-i**, paratypes, MUSORSTOM 7 stn 610 (USNM 98570): **f-g**, calicular views, x 5.8, x 6.6, respectively; **h-i**, paratypes, septal spines, x 27, x 75, respectively. — **j**, paratype, MUSORSTOM 8 stn 1014 (MNHN), anthocyathus attached to its anthocaulus, x 9.5.

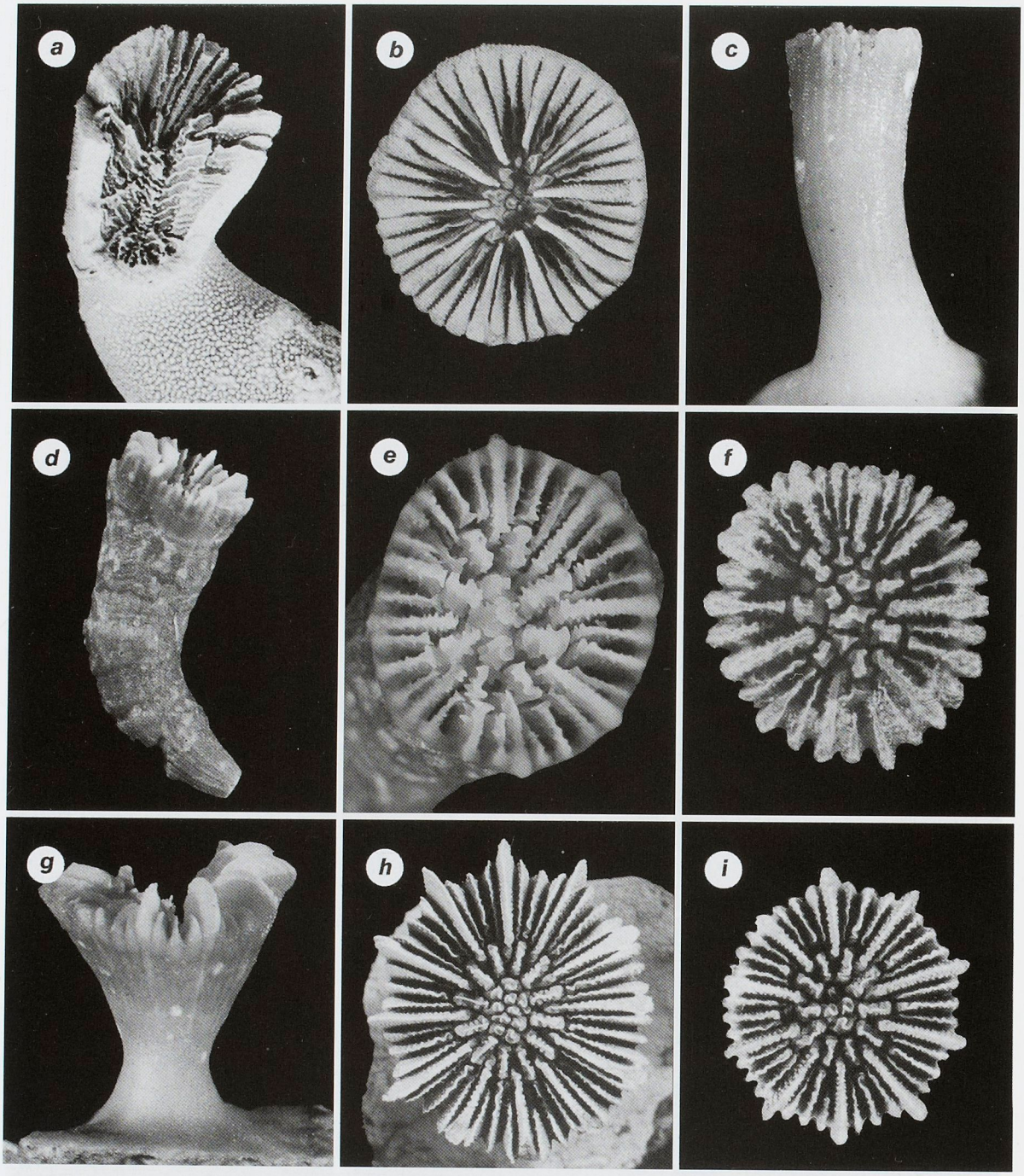


FIG. 5 a-b. — *Caryophyllia crosnieri*: **a**, MUSORSTOM 8 stn 974 (MNHN), broken corallum revealing ridged pali and deep fossa, x 6.7. — **b**, MUSORSTOM 8 stn 973 (MNHN), calice, x 5.0.

FIG. 5 c, f. — *Caryophyllia marmorea*, MUSORSTOM 7 stn 525 (MNHN), side and calicular views, x 6.7, x 15.2, respectively.

FIG. 5 d-e. — *Caryophyllia abrupta*, holotype, MUSORSTOM 7 stn 535 (MNHN), side and calicular views, x 2.6, x 6.6, respectively.

FIG. 5 g-i. — *Caryophyllia* sp. cf. *C. calveri*, MUSORSTOM 8 stn 1056 (MNHN): **g-h**, side and calicular views of corallum with 12 pali, x 4.1, x 5.0, respectively; **i**, calicular view of corallum with 10 pali, x 6.8.

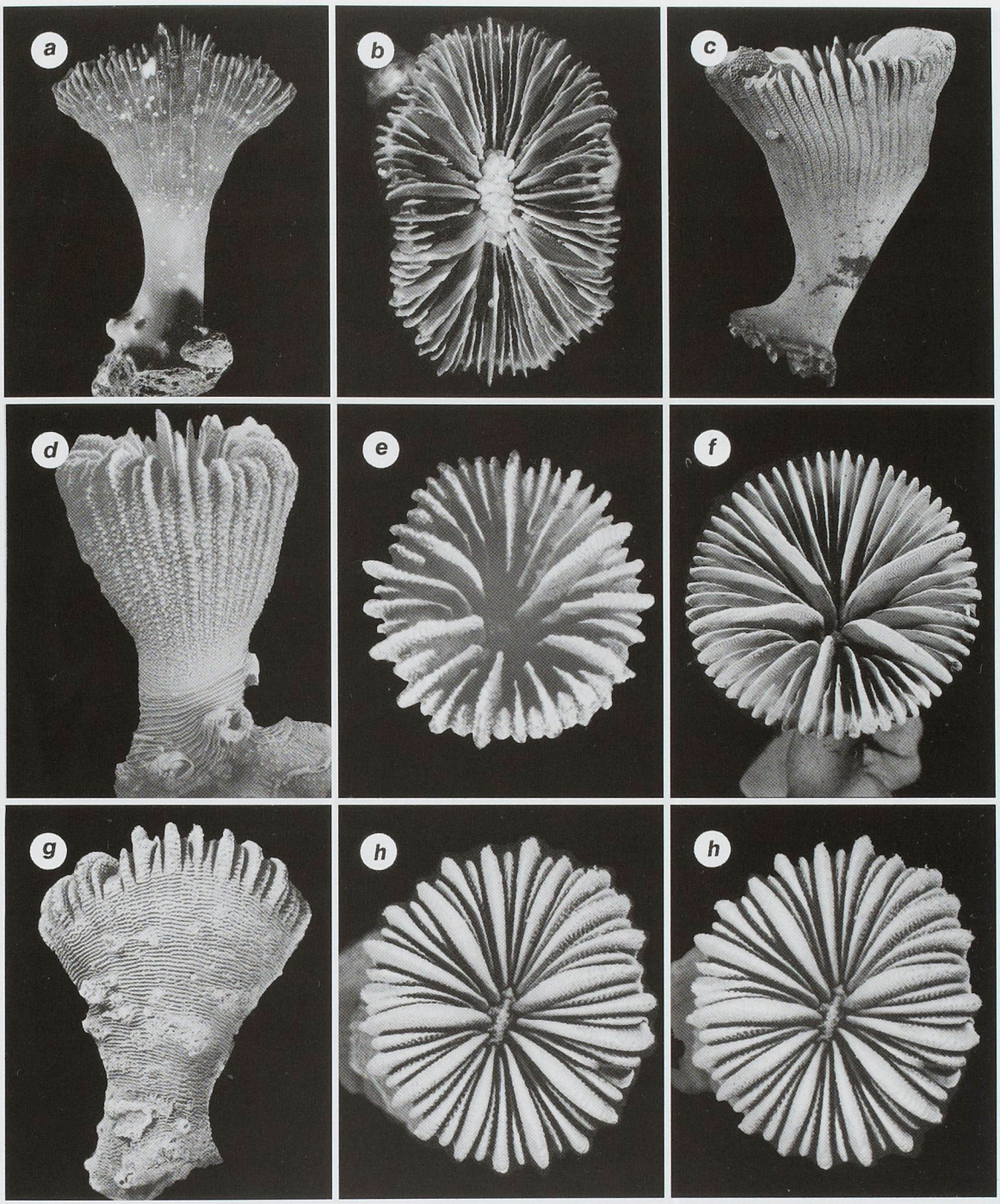


FIG. 6 a-b. — *Crispatotrochus rugosus*, MUSORSTOM 8 stn 1043 (MNHN), side and calicular views, x 1.4, x 2.0, respectively.

FIG. 6 c, f. — *Oxysmilia circularis*, MUSORSTOM 8 stn 977 (NMNH), side and calicular views, x 1.7, x 1.9, respectively.

FIG. 6 d-e. — *Oxysmilia epithecata*, holotype, MUSORSTOM 8 stn 1018 (MNHN), side and calicular views, x 5.3, x 6.3, respectively.

FIG. 6 g-h. — *Oxysmilia corrugata*, holotype, MUSORSTOM 8 stn 1030 (MNHN), side and stereo calicular views, x 4.1, x 4.9, respectively.

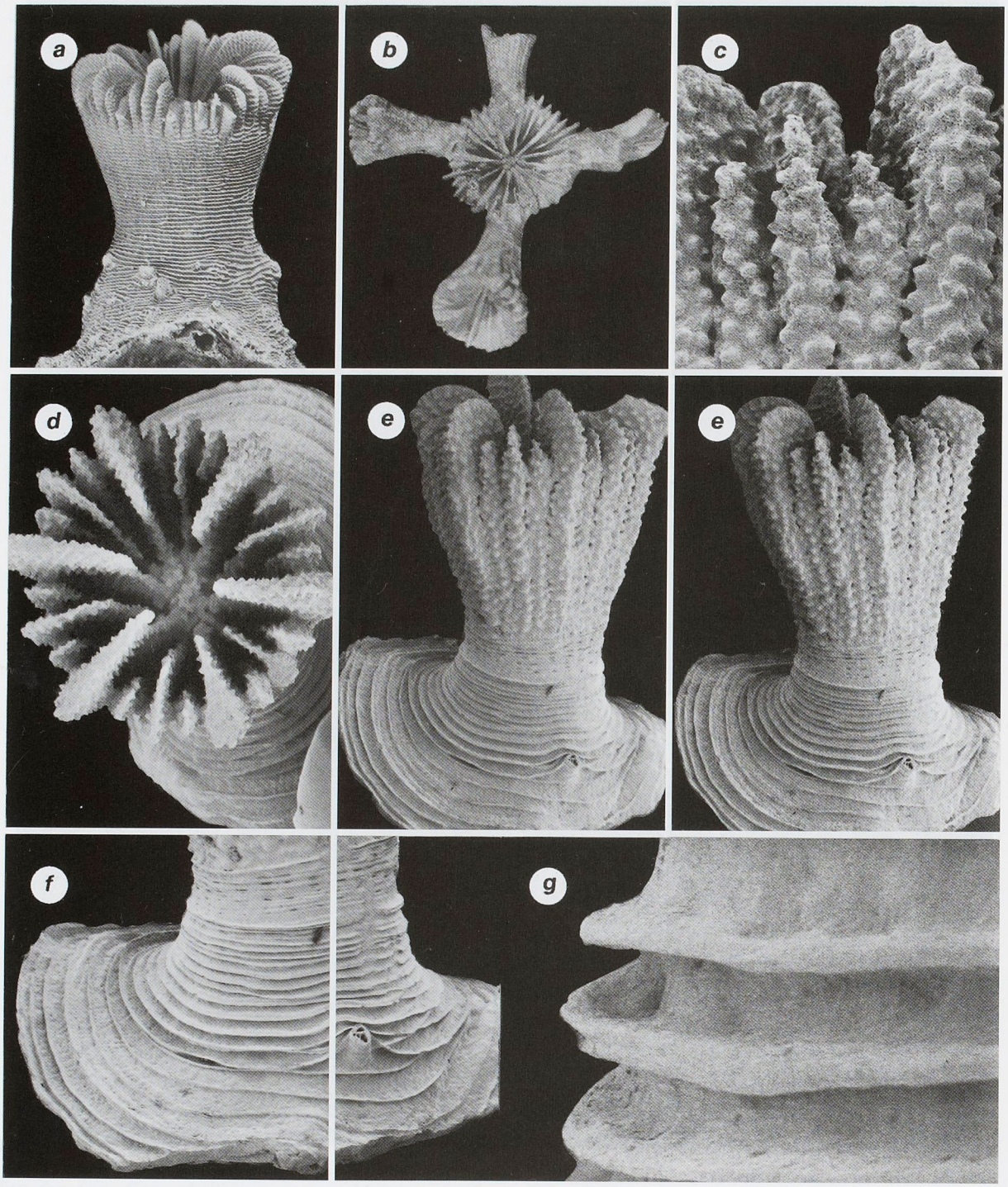


FIG. 7 a. — *Oxysmilia corrugata*, paratype, MUSORSTOM 8 stn 1030 (MNHN), side view showing thecal ridges, x 4.1.
FIG. 7 b-g. — *Oxysmilia epithecata*: **b**, paratype, MUSORSTOM 8 stn 1023 (NMNH), cluster of 5 corallites. — **c-g**, paratypes, MUSORSTOM 7 stn 496 (USNM 98626): **c**, costal granules near calice, x 41; **d-e**, calicular and stereo side views of same specimen, x 20, x 14.5, respectively; **f-g**, epithecal ridges on base of corallum, x 22, x 450, respectively.

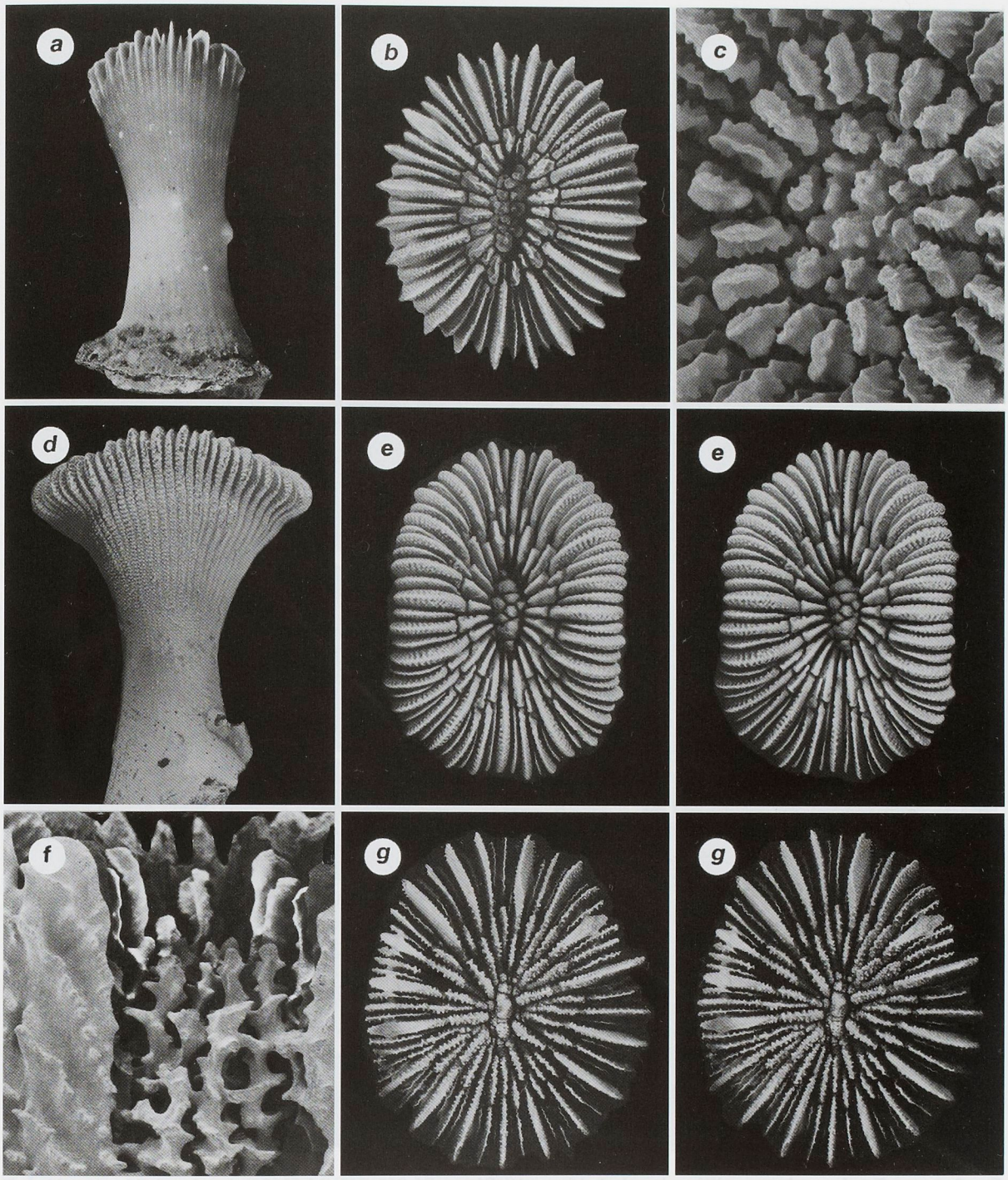


FIG. 8 a-b, f. — *Trochocyathus vasiformis*, MUSORSTOM 8 stn 977 (MNHN): **a-b**: side and calicular views, x 1.9, x 4.1, respectively; **c**, fracture revealing menianes on pali and twisted columellar elements, x 15.

FIG. 8 c. — *Bourneotrochus stellulatus*, MUSORSTOM 7 stn 509 (USNM 98708), palar ring and columella, x 25.

FIG. 8 d-e. — *Trochocyathus efateensis*, holotype, MUSORSTOM 8 stn 1019 (MNHN), side and stereo calicular views, x 2.8, x 3.4, respectively.

FIG. 8 g. — *Trochocyathus patelliformis*, holotype, HURL stn P5-063 (USNM 83026), stereo calicular view, x 2.4.

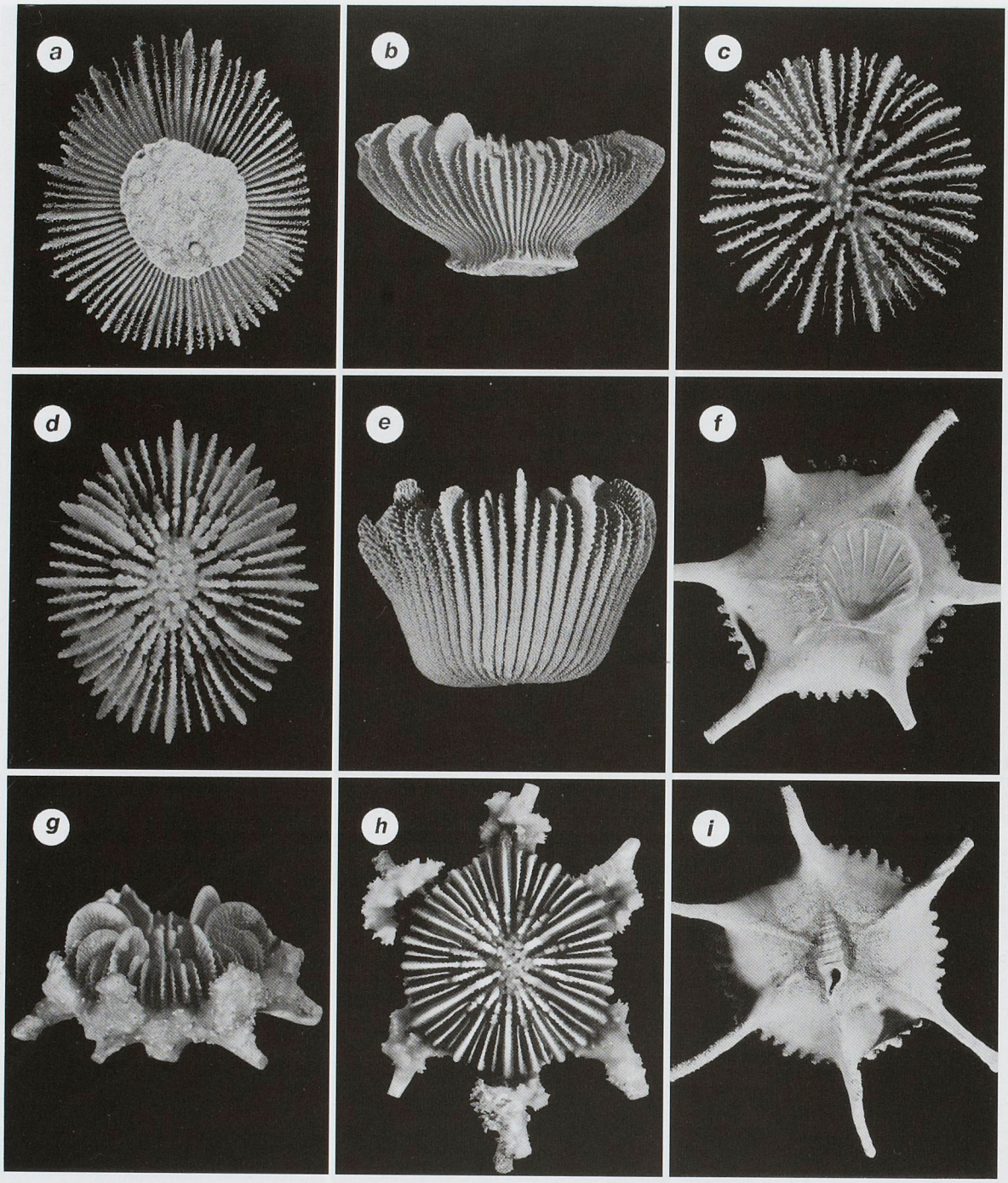


FIG. 9 a-c. — *Trochocyathus patelliformis*: **a-b**, holotype, HURL stn P5-063 (USNM 83026), basal and side views, x 2.4, x 2.2, respectively. — **c**, paratype, MUSORSTOM 8 stn 1111 (MNHN), juvenile calice, x 4.4.

FIG. 9 d-e. — *Trochocyathus discus*, MUSORSTOM 8 stn 1089 (MNHN), calicular and side views, x 3.8, x 3.4, respectively.

FIG. 9 f-i. — *Trochocyathus brevispina*: **f**, **i**, MUSORSTOM 8 stn 963 (MNHN), bases of coralla that were originally attached to a bivalve and a gastropod, x 2.7, x 3.0, respectively. — **g**, MUSORSTOM 8 stn 1004 (MNHN), side view of nodular proliferations on costal spines, x 2.9. — **h**, MUSORSTOM 8 stn 1003 (MNHN), calicular view of nodular proliferations on costal spines, x 2.8.

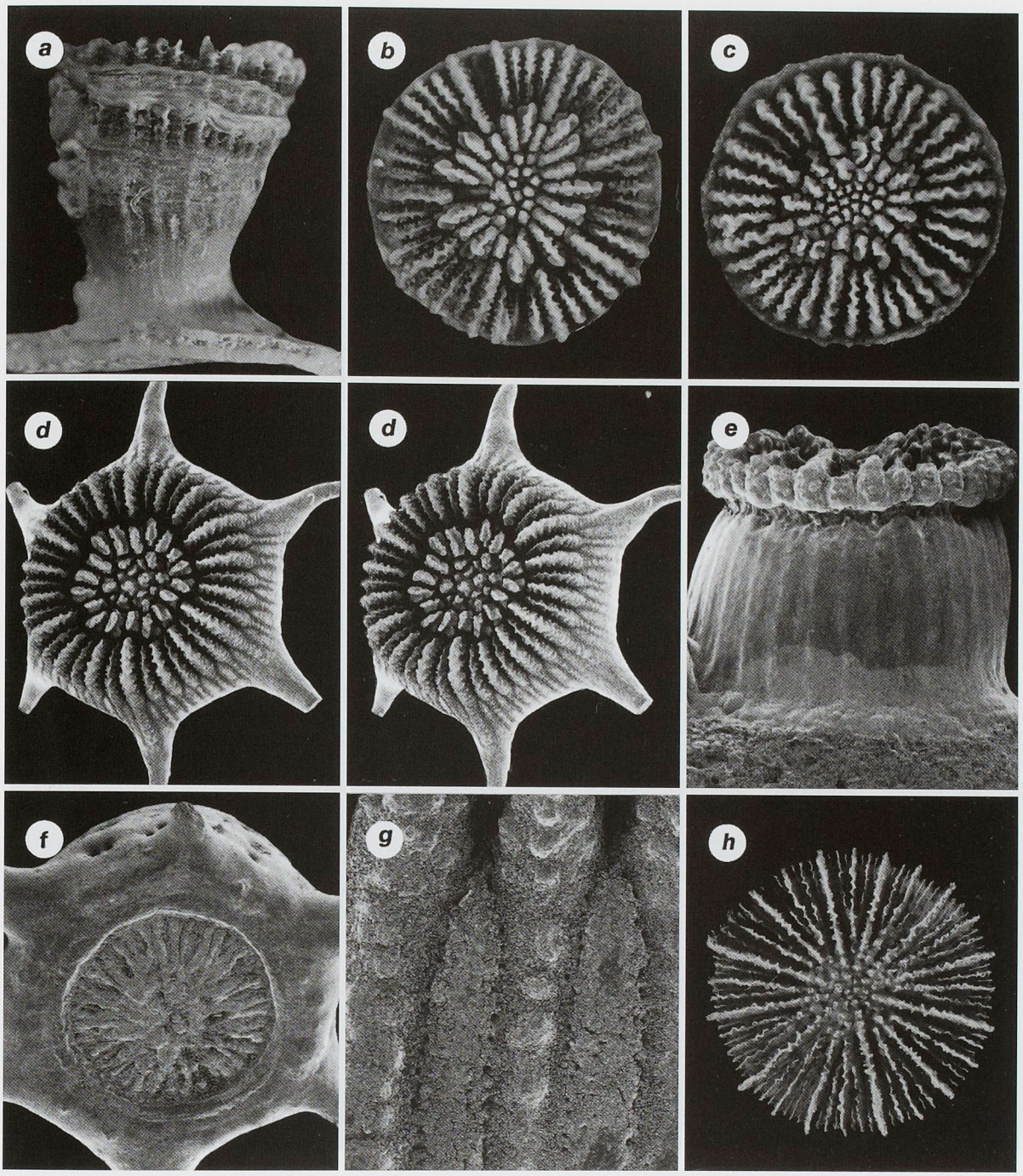


FIG. 10 a-c. — *Polycyathus octuplus*: **a-b**, holotype, MUSORSTOM 7 stn 494 (MNHN), side and calicular views, x 6.0, x 7.5, respectively. — **c**, paratype, MUSORSTOM 7 stn 504 (MNHN), calice of septamerally symmetrical corallum, x 7.5.

FIG. 10 d-g. — *Bourneotrochus stellulatus*: **d-e**, MUSORSTOM 7 stn 509 (USNM 98708): **d**, stereo oblique calicular view, x 6.5; **e**, anthocaulus with incipient anthocyathus attached, x 16. — **f-g**, MUSORSTOM 7 stn 511 (USNM 98704): **f**, basal scar resulting from transverse division, x 11; **g**, costae at calicular edge, x 54.

FIG. 10 h. — *Stephanocyathus regius*, MUSORSTOM 7 stn 509 (MNHN), juvenile corallum with 96 septa, x 2.9.

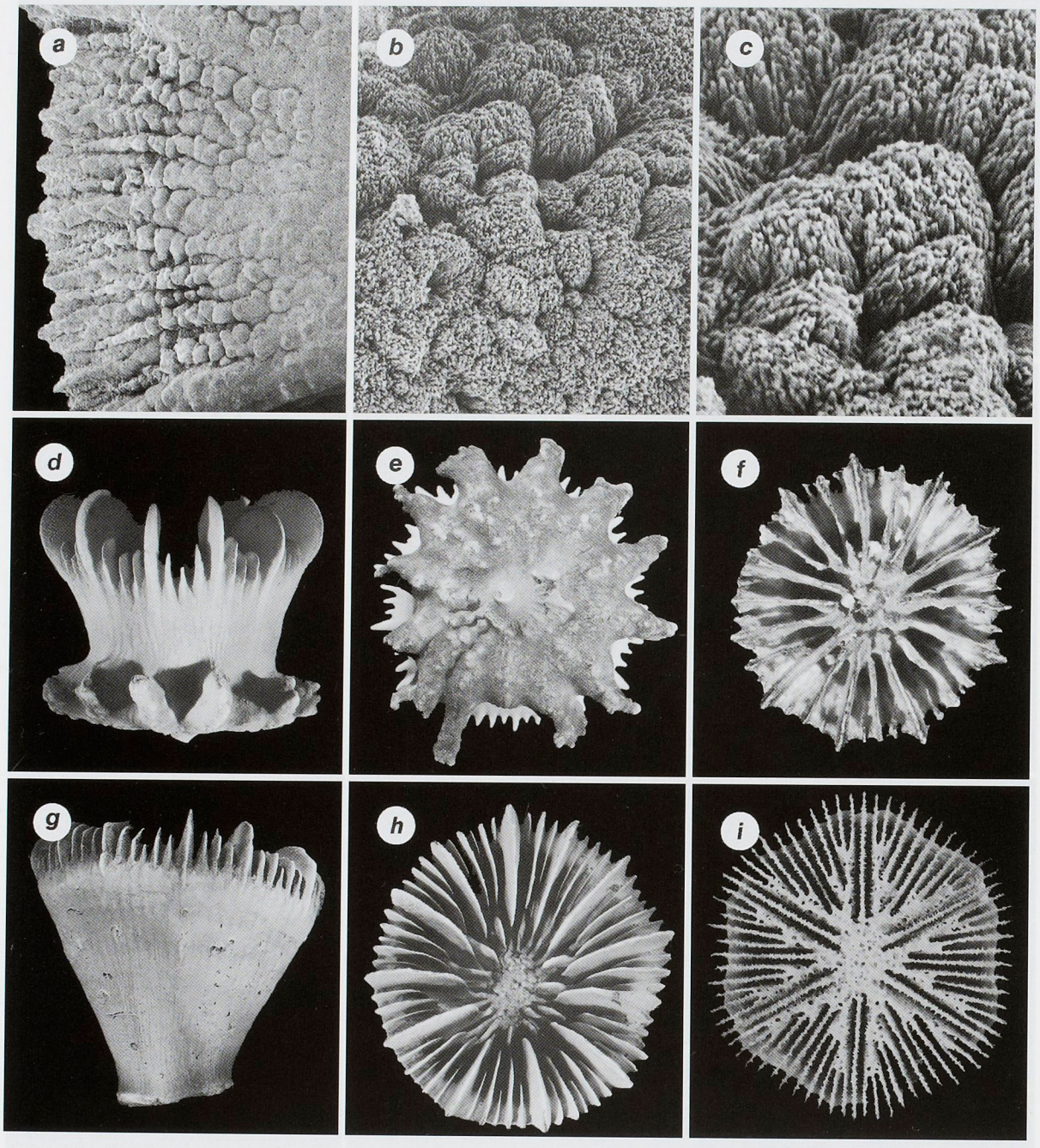


FIG. 11 a-c. — *Stephanocyathus regius*, MUSORSTOM 8 stn 1129 (USNM 98657), base of rapidly growing corallum showing progressive magnifications of tufts of fibres, x 20, x 580, x 1450, respectively.

FIG. 11 d-f. — *Stephanocyathus coronatus*: **d-e**, MUSORSTOM 8 stn 1125 (MNHN), side and basal views, both x 1.2. — **f**, MUSORSTOM 7 stn 622 (MNHN), juvenile "*flatiliseptis*" stage, x 3.8.

FIG. 11 g-h. — *Vaughanella concinna*, MUSORSTOM 7 stn 572 (MNHN), side and calicular views, x 1.6, x 1.7, respectively.

FIG. 11 i. — *Deltocyathus magnificus*, MUSORSTOM 8 stn 963 (MNHN), corallum with hexagonal outline, x 2.2.

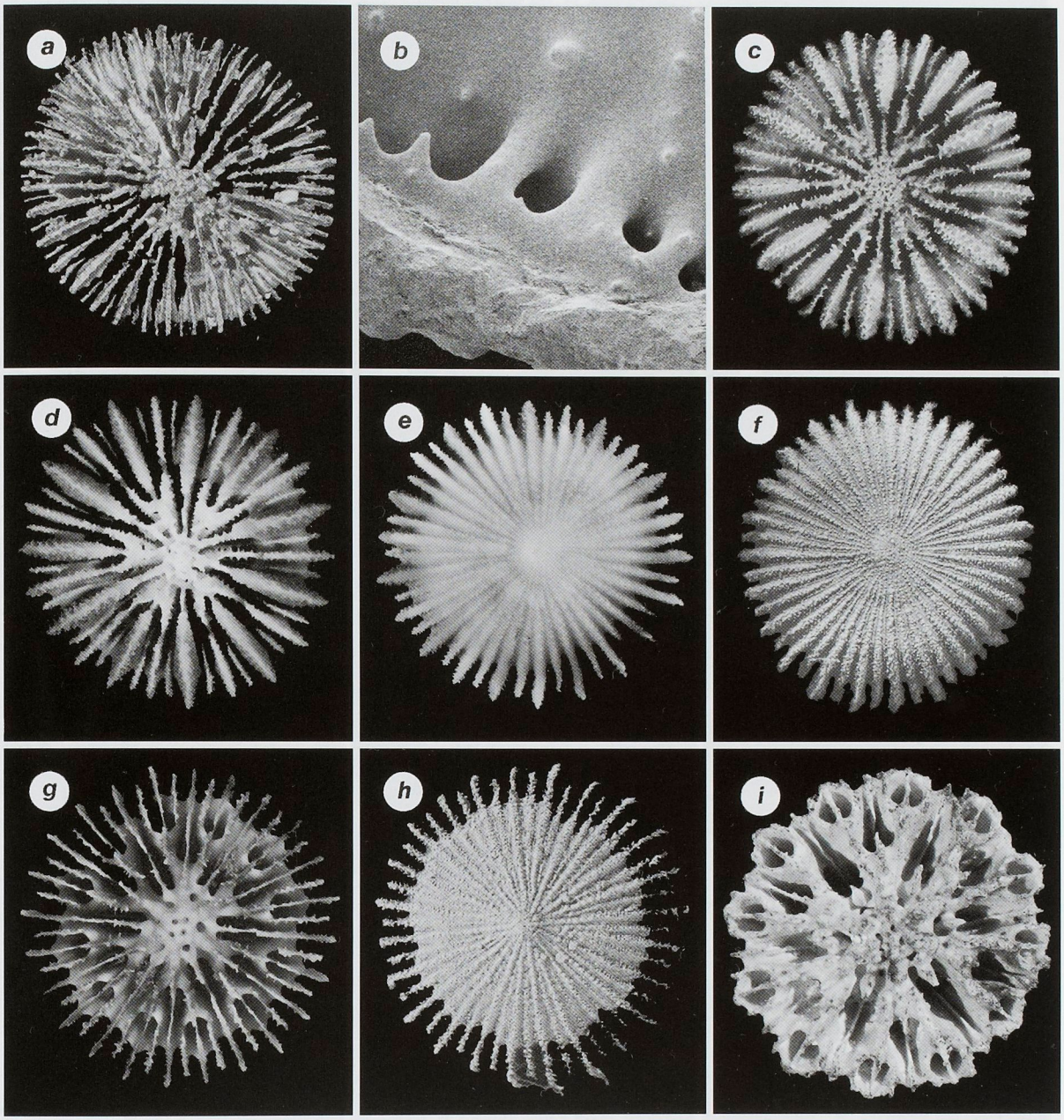


FIG. 12 a-b. — *Deltocyathus taiwanicus*: **a**, MUSORSTOM 7 stn 541 (MNHN), calicular view, x 3.2. — **b**, MUSORSTOM 7 stn 589 (USNM 98678), processes uniting S_4 to adjacent S_3, x 40.

FIG. 12 c-f. — *Deltocyathus crassiseptum*: **c**, **f**, paratype, MUSORSTOM 8 stn 978, calicular and basal views, both x 3.5. — **d-e**, holotype, MUSORSTOM 8 stn 980 (MNHN), calicular and basal views, both x 3.3.

FIG. 12 g-i. — *Deltocyathus cameratus*, MUSORSTOM 8 stn 1007 (MNHN): **g-h**, holotype, calicular and basal views, both x 3.5; **i**, paratype, worn corallum showing calicular chambers, x 4.6.

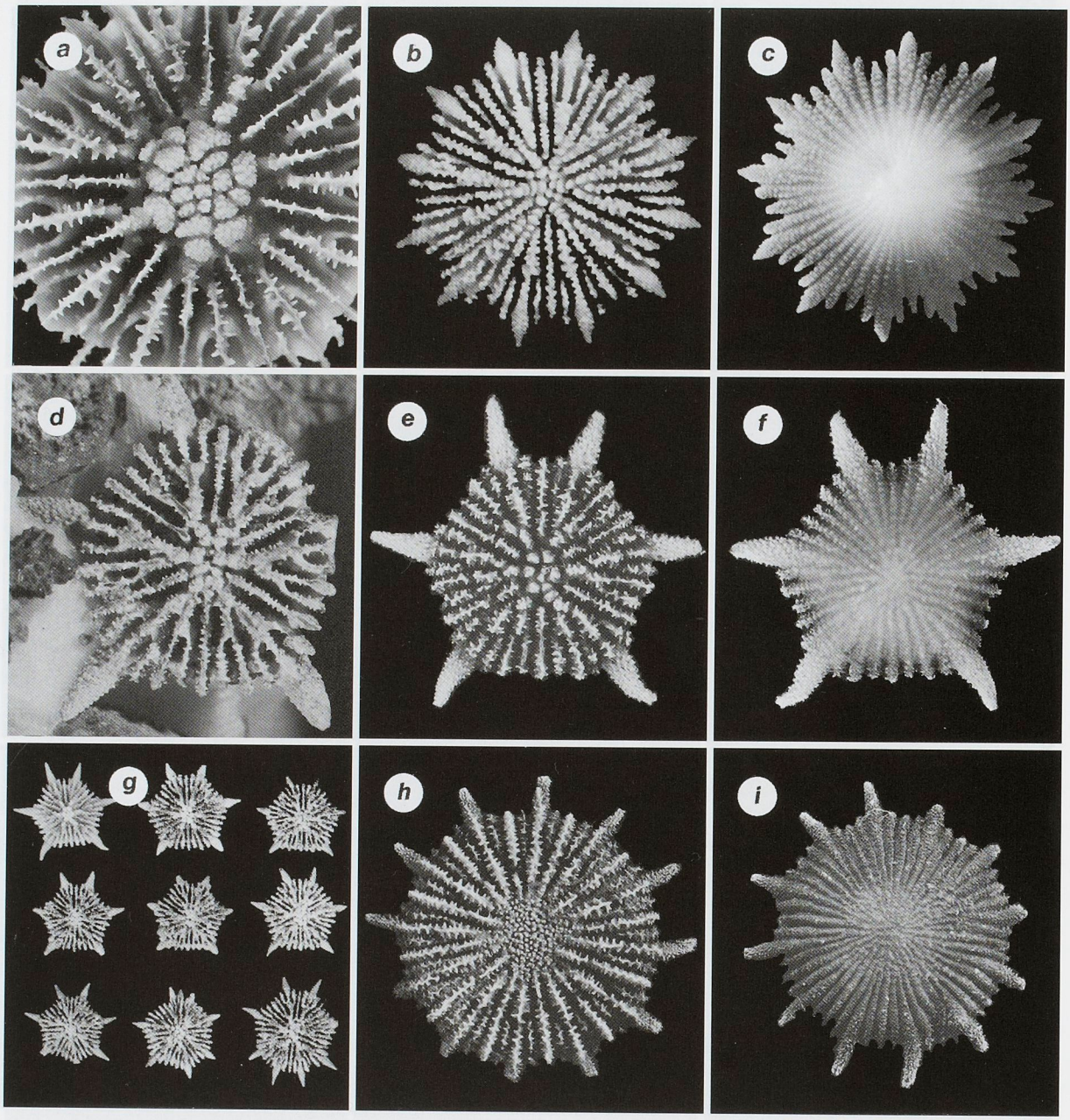


FIG. 13 a. — *Deltocyathus cameratus*, paratype, MUSORSTOM 8 stn 1036 (MNHN), specimen with ornately sculptured columella, x 5.5.

FIG. 13 b-c. — *Deltocyathus stella*, MUSORSTOM 7 stn 513 (MNHN), calicular and basal views, both x 4.7.

FIG.13 d-g. — *Deltocyathus heteroclitus*: **d**, MUSORSTOM 8 stn 1106 (MNHN), corallum cemented to a *Xenophora* shell, x 7.1. — **e-g**, MUSORSTOM 7 stn 514 (MNHN): **e-f**, calicular and basal views, both x 7.0; **g**, series of 9 specimens, those in lower row having 7 or 8 costal spines, x 2.3.

FIG. 13 h-i. — *Deltocyathus ornatus*, holotype, Lifu (Cambridge), calicular and basal views, both x 4.0.

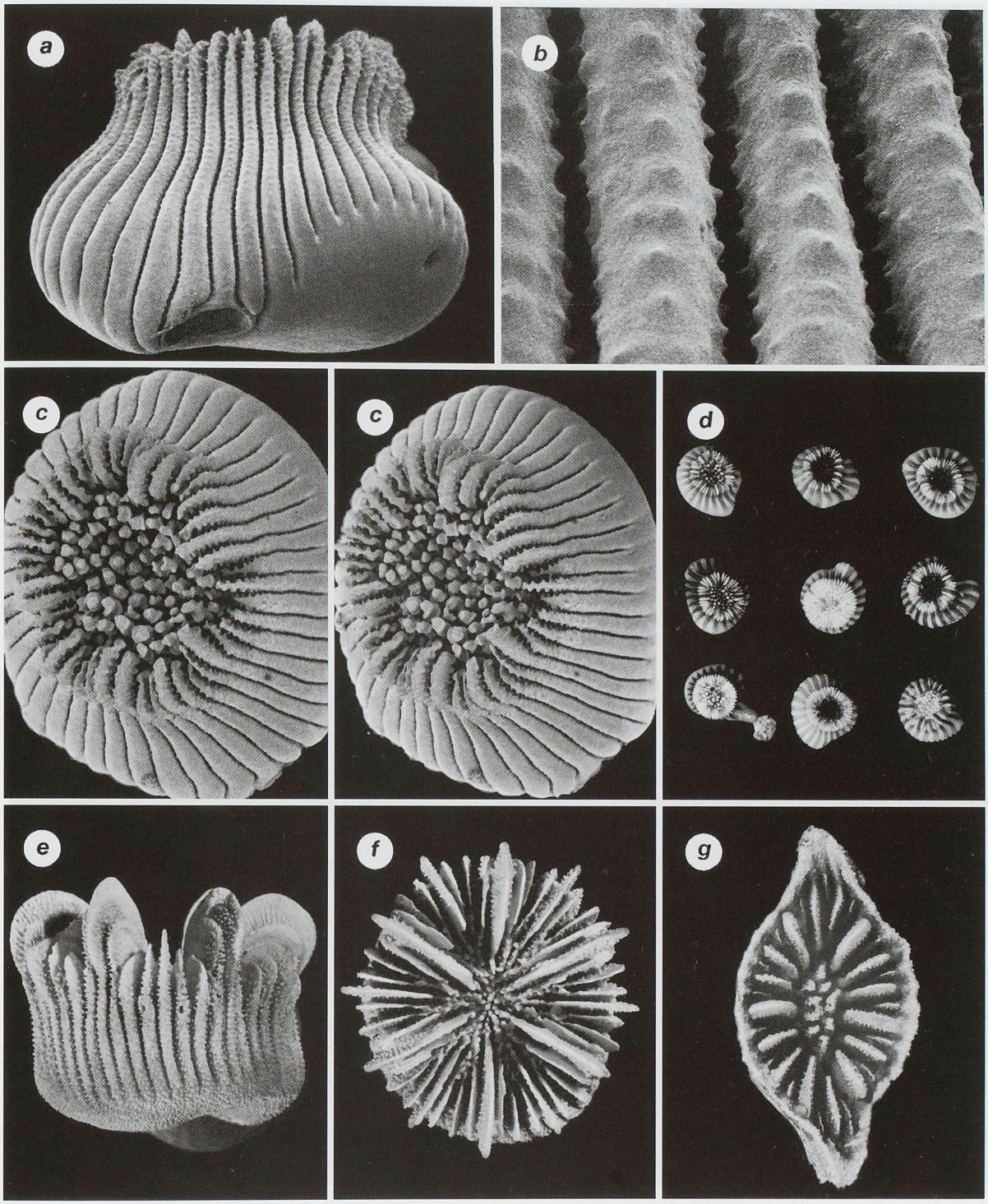


FIG. 14 a-d. — *Heterocyathus* sp. cf. *H. sulcatus*, MUSORSTOM 7 stn 513 (USNM 98712): **a**, side view showing sipunculid efferent pore, x 14; **b**, granules of costae, x 105; **c**, stereo calicular view, x 11; **d**, series of 9 coralla (MNHN), x 2.0.
FIG. 14 e-f. — *Heterocyathus alternatus*, MUSORSTOM 8 stn 1004 (MNHN), side and calicular views, both x 4.8.
FIG. 14 g. — *Conotrochus asymmetros*, holotype, MUSORSTOM 7 stn 496 (MNHN), calicular view, x 6.5.

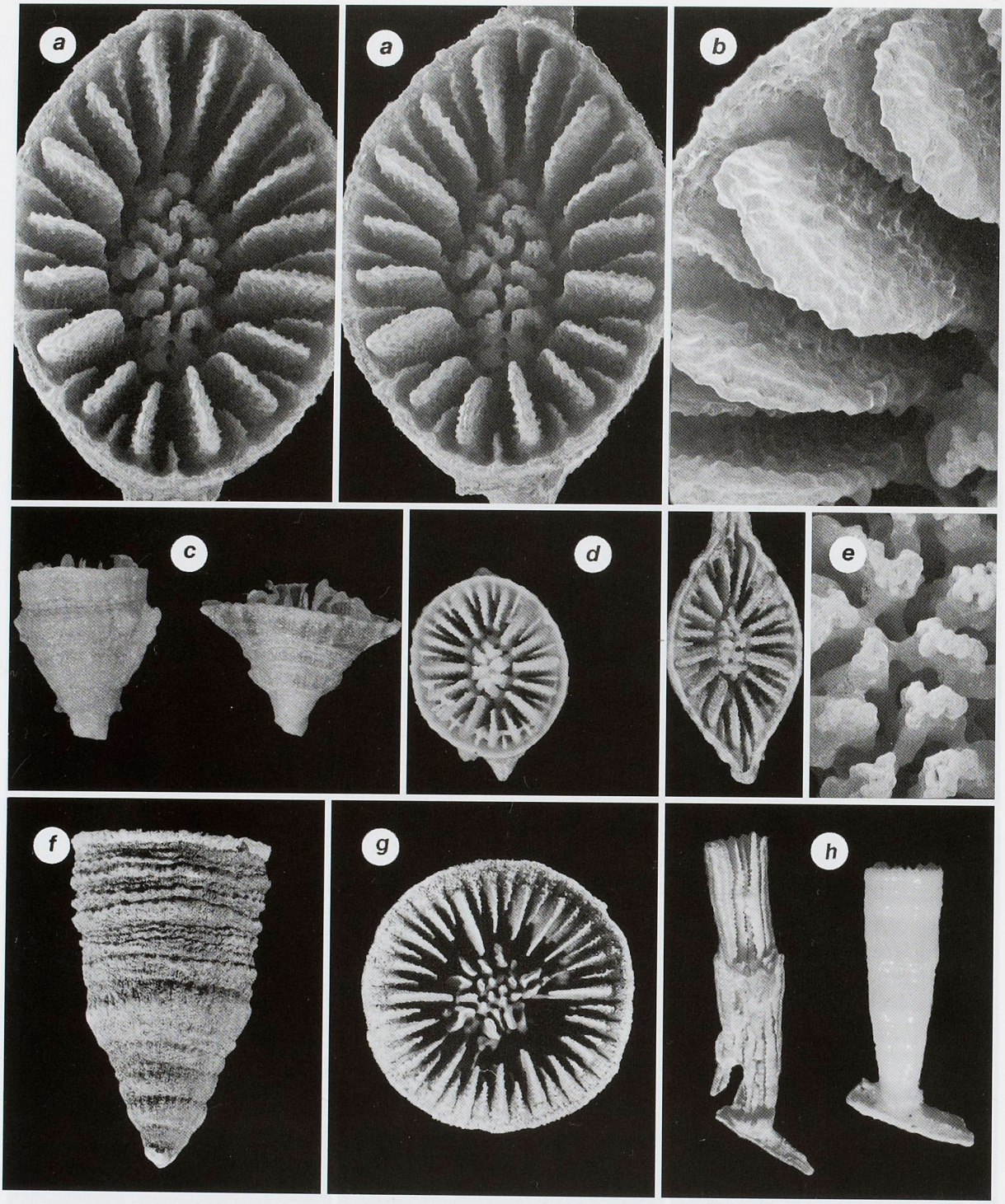


FIG. 15 a-e. — *Conotrochus asymmetros*, paratypes: **a-b**, **e**, MUSORSTOM 7 stn 495 (USNM 98735): **a**, stereo calicular view, x 14; **b**, inner calicular edge, x 37; **e**, columellar elements, x 35. — **c-d**, MUSORSTOM 7 stn 513 (MNHN), side and calicular views of coralla with and elliptical and an elongate calice, x 4.3, x 6.3, respectively.

FIG. 15 f-g. — *Lochmaeotrochus gardineri*, holotype, MUSORSTOM 8 stn 1036 (MNHN), side and calicular views, x 3.0, x 4.1, respectively.

FIG. 15 h. — *Aulocyathus juvenescens*, MUSORSTOM 8 stn 976 (MNHN), a longitudinally fractured and an intact specimen, x 3.3.

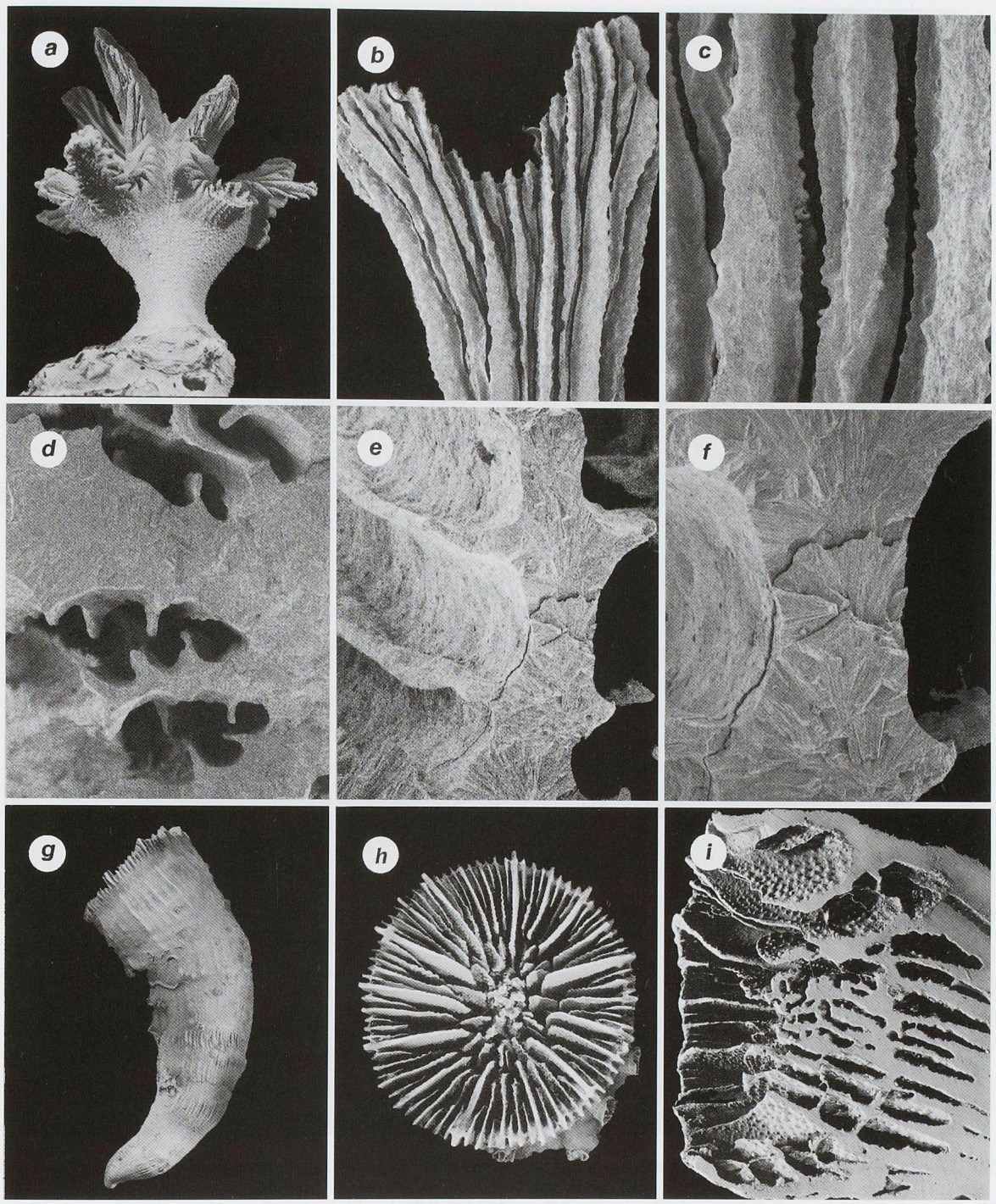


FIG. 16 a-f. — *Dactylotrochus cervicornis*, MUSORSTOM 7 stn 514: **a**, side view of corallum (MNHN), x 3.2; **b-e**, USNM 98746: **b**, bifurcated extension, x 11.8; **c**, 3 septa viewed from above, x 51; **d**, cross section of several septa showing alternation of adjacent menianes, x 74; **e-f**, higher magnification of menianes and fibre arrangement on broken surface, x 150, x 300, respectively.

FIG. 16 g-i. — *Asterosmilia gigas*, MUSORSTOM 7 stn 515 (MNHN): **g-h**, side and calicular views, x 0.8, x 1.7, respectively; **i**, longitudinal section revealing dissepiments in upper corallum, x 2.5.

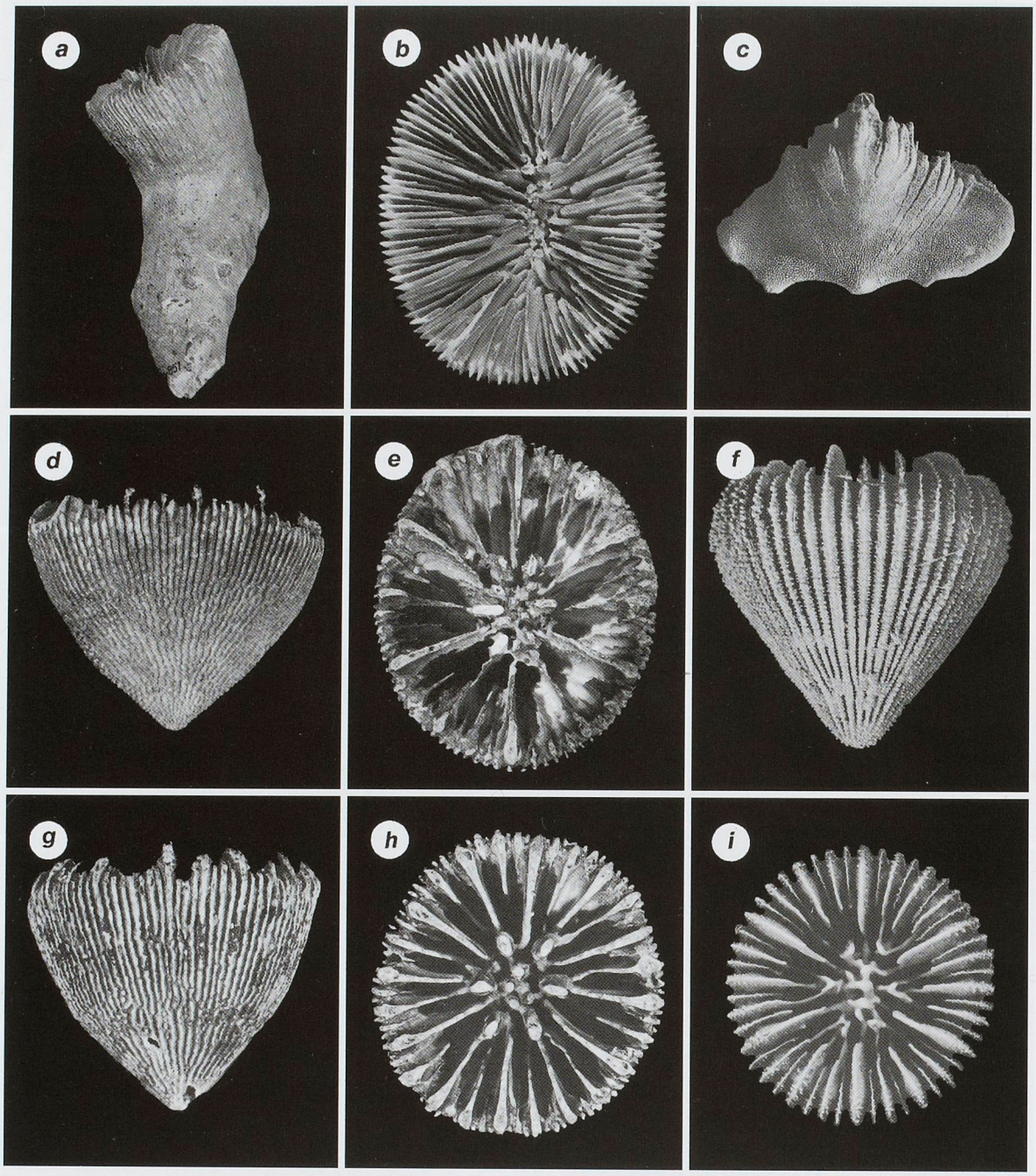


FIG. 17 a-b. — *Caryophyllia (= Asterosmilia) gigas*, holotype (BM 1939.7.20.851), side and calicular views, x 0.65, x 1.4, respectively.

FIG. 17 c. — *Tropidocyathus lessonii*, MUSORSTOM 8 stn 1016 (MNHN), side view of specimen with large edge crests, x 2.7.

FIG. 17 d-e. — *Pleotrochus venustus*, MUSORSTOM 8 stn 1114 (MNHN), side and calicular views, x 3.5, x 4.0, respectively.

FIG. 17 f, i. — *Cryptotrochus brevipalus*, holotype, MUSORSTOM 8 stn 1034 (MNHN), side and calicular views, x 4.5, x 4.3, respectively.

FIG. 17 g-h. — *Pleotrochus zibrowii*, MUSORSTOM 7 stn 637 (MNHN), side and calicular views, x 3.5, x 3.6, respectively.

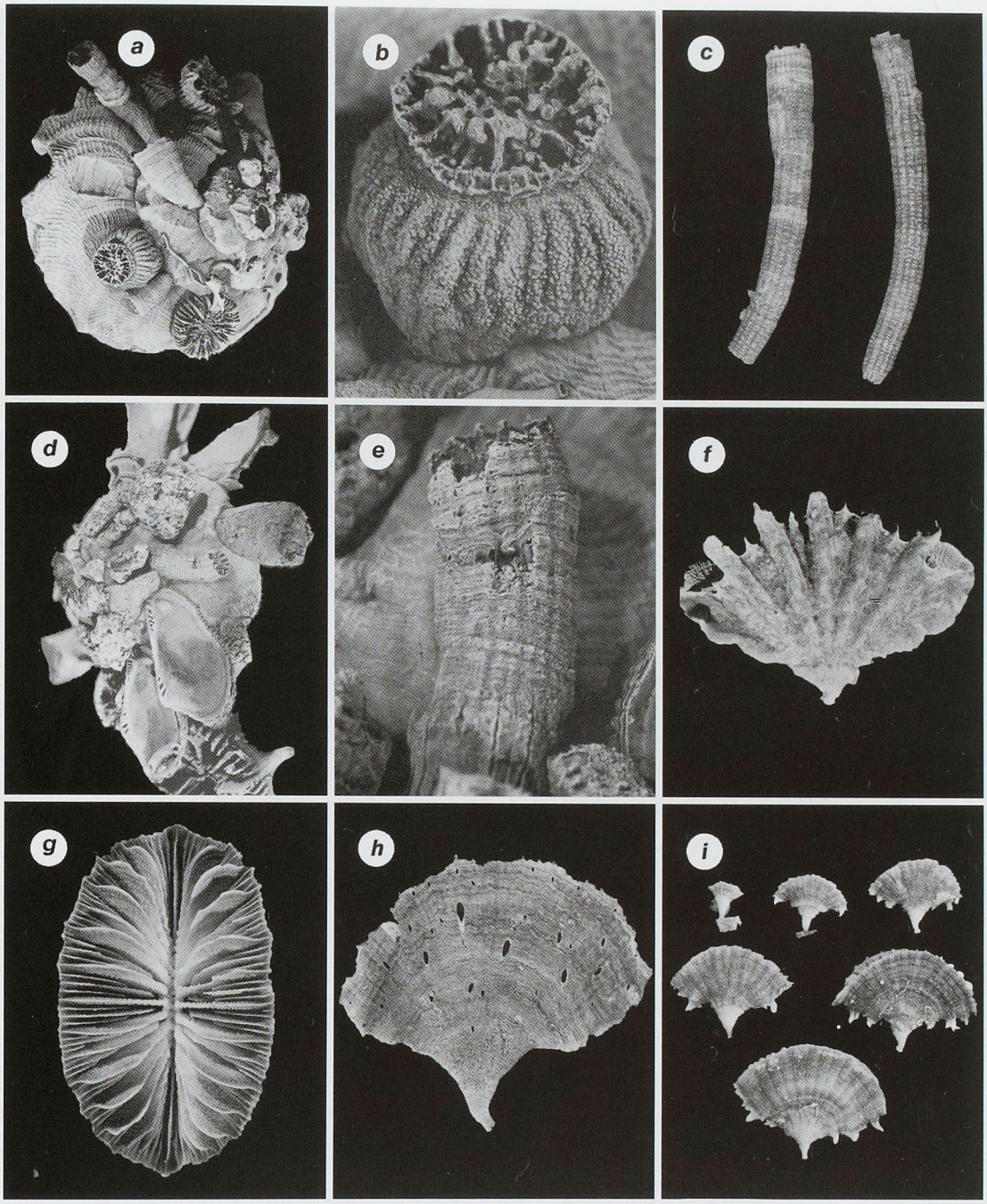


FIG. 18 a-b. — *Peponocyathus folliculus*, MUSORSTOM 8 stn 1088 (MNHN): **a**, specimen cemented to a *Xenophora* shell (*Trochocyathus discus* also attached on lower shell), x 1.5; **b**, oblique calicular view, x 9.5.

FIG. 18 c. — *Truncatoguynia irregularis*, MUSORSTOM 8 stn 967 (MNHN), 2 coralla, x 2.2.

FIG. 18 d-e. — *Temnotrochus kermadecensis*, MUSORSTOM 8 stn 963 (MNHN): **d**, specimen cemented to a *Xenophora* shell, x 1.8; **e**, side view, x 12.1.

FIG. 18 f. — *Flabellum deludens*, MUSORSTOM 7 stn 532 (MNHN), side view, x 1.4.

FIG. 18 g-i. — *Flabellum pavoninum* forma *coalitum* (MNHN): **g**, MUSORSTOM 8 stn 1102, calicular view, x 1.6; **h**, MUSORSTOM 8 stn 1004, side view showing acrothoracican burrows, x 2.2; **i**, series of 6 coralla showing ontogenetic development of edge spines, x 0.75.

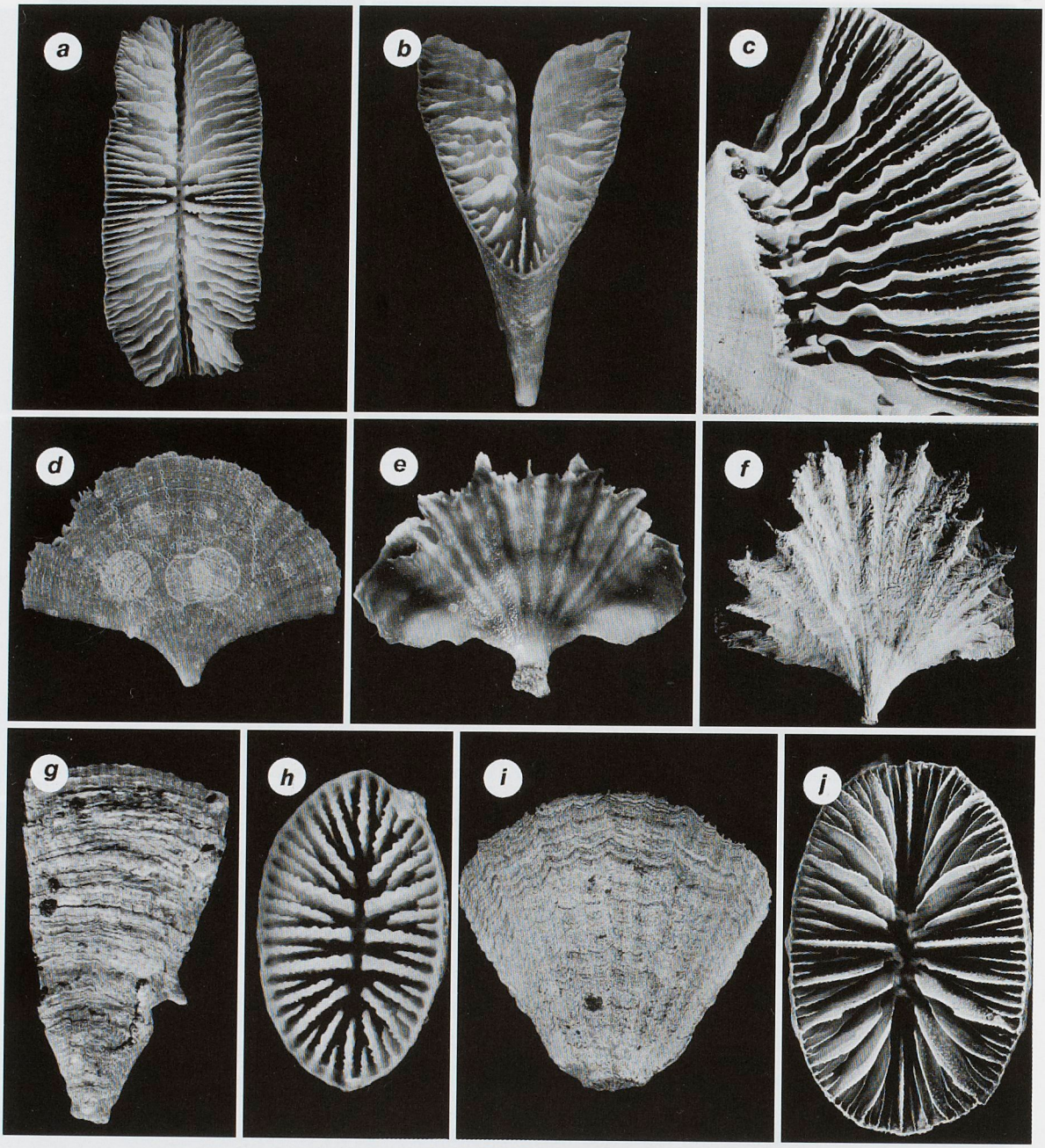


FIG. 19 a-d. — *Flabellum arcuatile*: **a-b**, **d**, holotype, NZOI stn I97 (NZOI H688), calicular edge, and side views, x 1.5, x 2.2, x 1.3, respectively. — **c**, paratype, MUSORSTOM 7 stn 535 (MNHN), broken corallum showing sinuosity of septal edges, x 2.5.

FIG. 19 e. — *Flabellum aotearoa*, MUSORSTOM 8 stn 1018 (MNHN), side view of juvenile corallum having large edge crests, x 3.0.

FIG. 19 f. — *Flabellum marcus*, MUSORSTOM 8 stn 1037 (MNHN), side view, x 1.3.

FIG. 19 g-h. — *Truncatoflabellum dens*, MUSORSTOM 8 stn 1060 (MNHN), side and calicular views, x 3.8, x 5.8, respectively.

FIG. 19 i-j. — *Truncatoflabellum stabile*, MUSORSTOM 8 stn 996 (MNHN), side and calicular views, x 1.7, x 2.1, respectively.

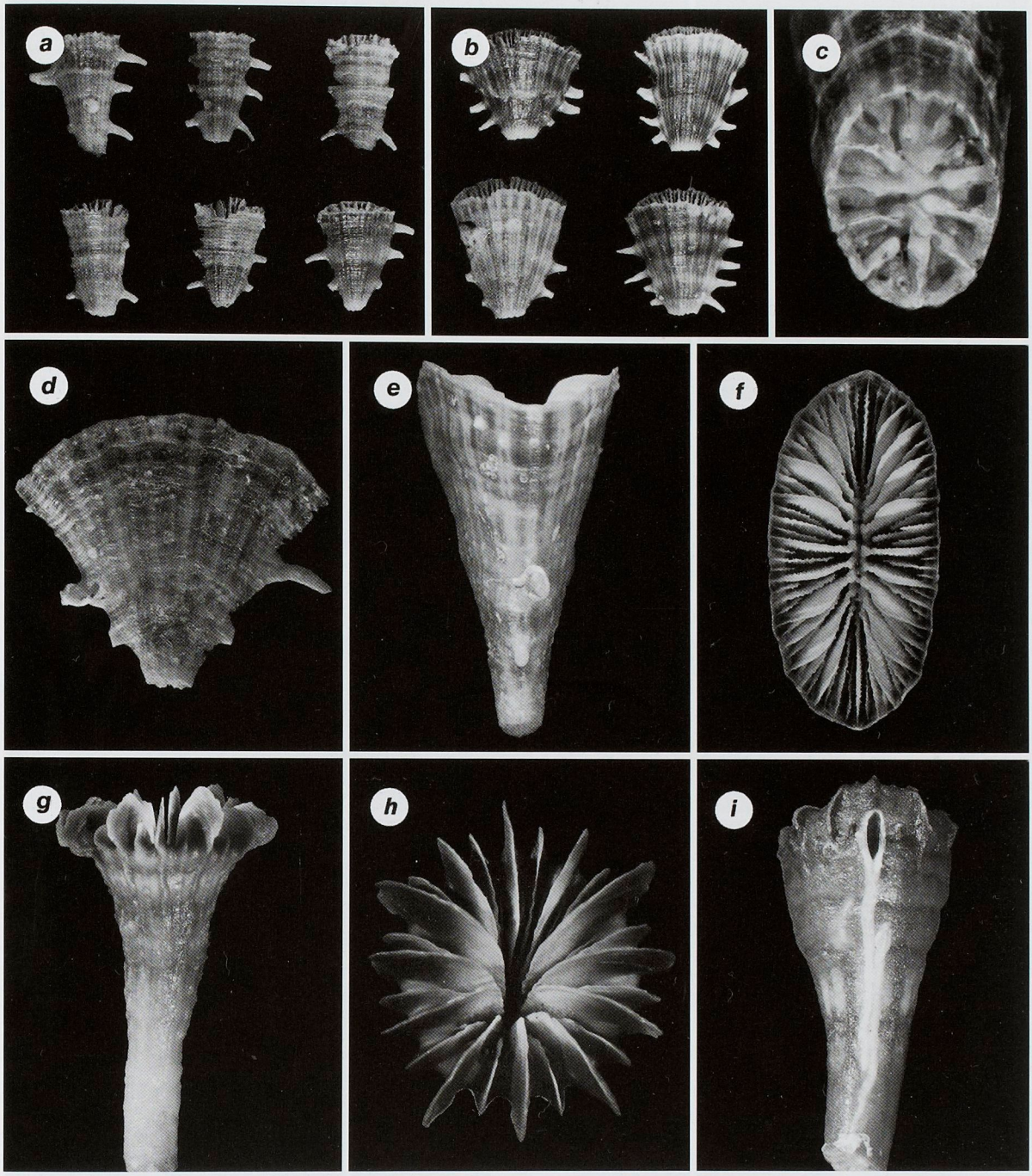


FIG. 20 a. — *Truncatoflabellum pusillum*, MUSORSTOM 8 stn 1097 (MNHN), series of 6 coralla, x 2.2.

FIG. 20 b. — *Truncatoflabellum angustum*, MUSORSTOM 8 stn 1018 (MNHN), series of 4 coralla, x 1.6.

FIG. 20 c-f. — *Truncatoflabellum vigintifarium* (MNHN): **c**, paratype, MUSORSTOM 8 stn 1106, basal scar of anthocyathus, x 9.0. — **d-f**, holotype, MUSORSTOM 8 stn 1098 (MNHN), side, edge, and calicular views, x 2.4, x 3.4, x 2.7, respectively.

FIG. 20 g-i. — *Javania fusca* (MNHN): **g-h**, MUSORSTOM 8 stn 1128 (MNHN), side and calicular views, x 2.9, x 4.2, respectively. — **i**, MUSORSTOM 8 stn 988 (MNHN), corallum with an acrothoracican burrow, x 4.6.

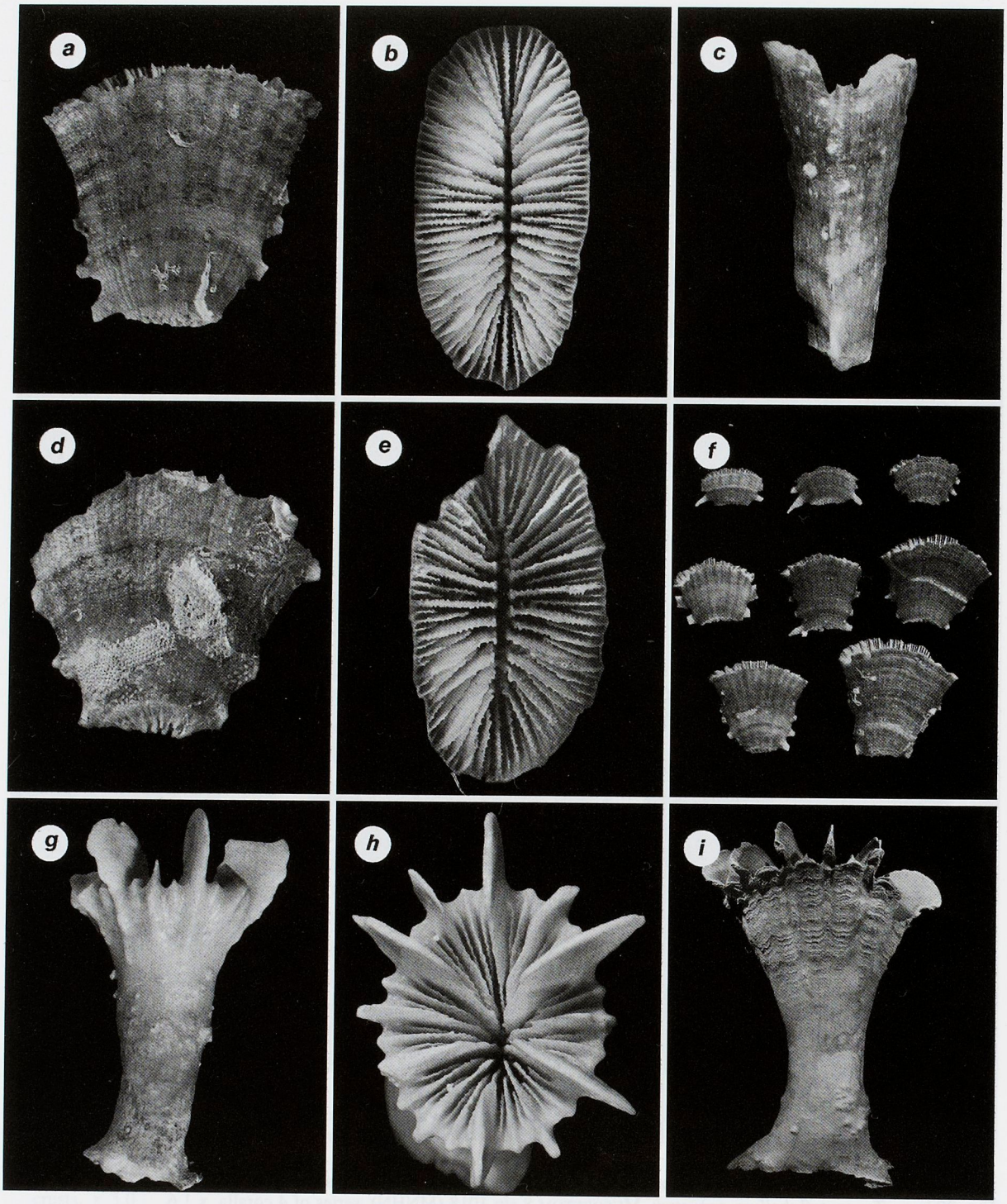


FIG. 21 a-f. — *Truncatoflabellum martensii*: **a-c**, **f**, MUSORSTOM 8 stn 1085 (MNHN): **a-c**, side, calicular, and edge views, x 2.2, x 2.9, x 2.4, respectively; **f**, series of 8 coralla showing ontogeny of anthocyathus, x 0.8. — **d-e**, holotype, Gazelle stn 40 (ZMB 1798), side and calicular views, x 2.2, x 2.8, respectively.

FIG. 21 g-i. — *Javania exserta* (MNHN): **g-h**, holotype, KARUBAR stn 44 (MNHN), side and calicular views, x 2.4, x 3.4, respectively. — **i**, paratype, MUSORSTOM 1 stn 65 (MNHN), side view, x 1.5.

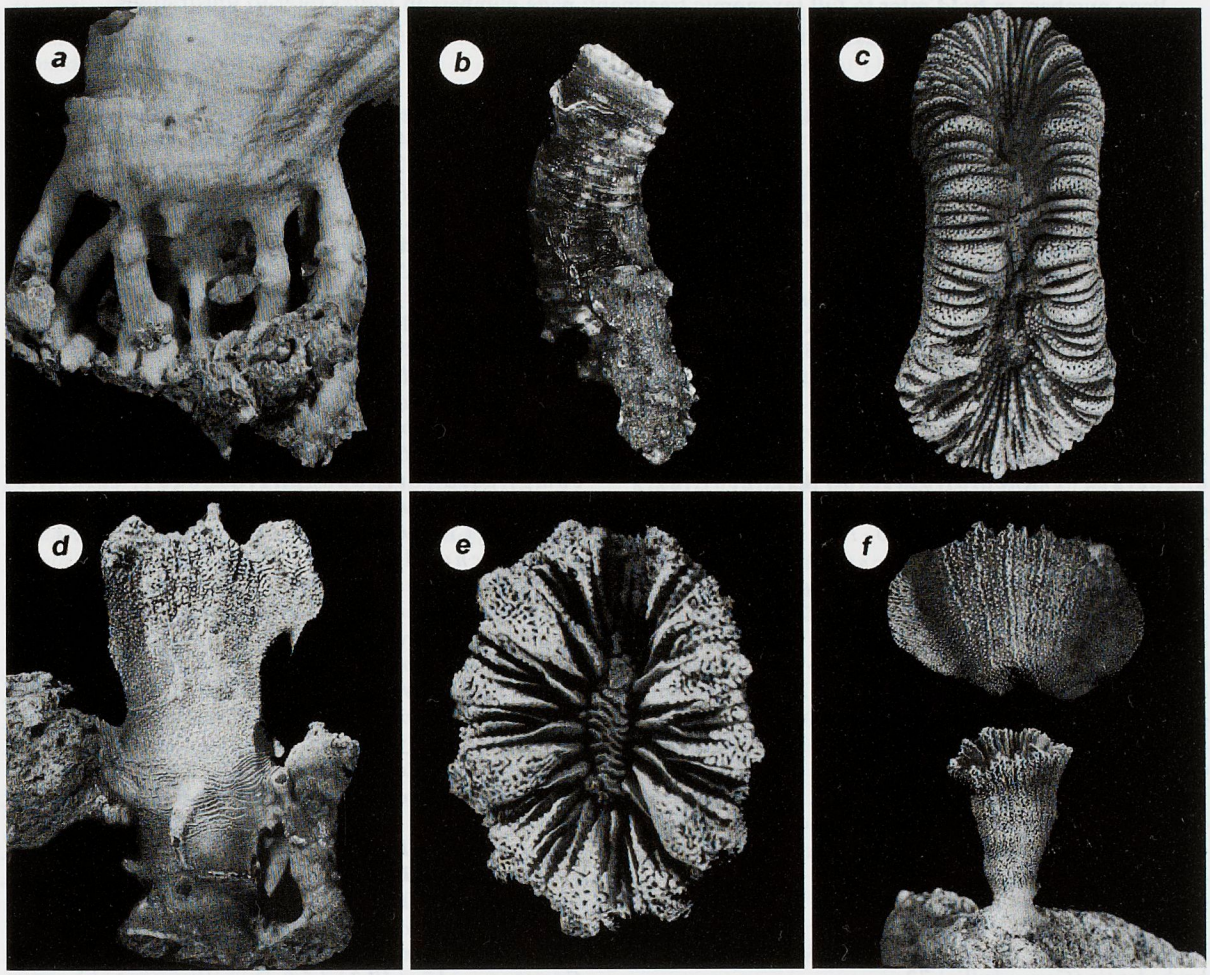


FIG. 22 a. — *Rhizotrochus typus*, MUSORSTOM 8 stn 1131 (MNHN), basal rootlets, x 2.2.
FIG. 22 b. — *Gardineria paradoxa*, MUSORSTOM 8 stn 1014 (MNHN), side view, x 1.6.
FIG. 22 c. — *Balanophyllia desmophyllioides*, MUSORSTOM 8 stn 1098 (MNHN), calice about to undergo intratentacular division, x 3.0.
FIG. 22 d-e. — *Balanophyllia laysanensis*, MUSORSTOM 8 stn 963 (MNHN), side and calicular views, x 3.7, x 5.3, respectively.
FIG. 22 f. — *Endopachys grayi*, MUSORSTOM 8 stn 976 (MNHN), anthocaulus and anthocyathus, x 2.8.

INDEX

Generic and subgeneric names used herein in combination with specific or subspecific names, or in citation, are given in parentheses. A slash (/) separates variant spellings; spellings retained herein in first position.

Taxa of generic and species level that receive full taxonomic treatment herein are in **bold**.

Page numbers in **bold** refer to full taxonomic treatment; page numbers in *italics* refer to illustrations.

Index does not include the station list (pages 32-43) and the geographic distribution Table 2 (pages 48-51).

***abrupta (Caryophyllia)* 71-72**, 113, *146*
abyssorum (Caryophyllia) 73
Acanthocyathus 76
***Acinocyathus* 84, 90**
***aculeatum (Flabellum, Truncatoflabellum)* 123**
***Alatotrochus* 108-109**
alberti (Caryophyllia) 74
***alcocki (Dendrophyllia, Sclerhelia)* 47, 136**
***alternatus (Heterocyathus)* 99-100**, *155*
***ambrosia (Caryophyllia)* 49, 75-76**
amphelioides (Dendrophyllia, Enallopsammia) 136
Amphihelia 106
andamanicus (Deltocyathus) 63, 67
angiostomum (Flabellum) 116, 117
***angustum (Truncatoflabellum)* 121**, *161*
***annulata (Guynia)* 48, 113-114**
***Anthemiphyllia* 63-69**, *143-144*
antillarum (Caryophyllia) 73
***aotearoa (Flabellum, Ulocyathus)* 117**, *160*
***apertum (Flabellum, Ulocyathus)* 118-119**
***Aplocyathus* 84-86**
***arbuscula (Dendrophyllia)* 133-134**
***arcuatile (Flabellum)* 114, 116-117**, *160*
arnoldi (Caryophyllia) 74
***Asterosmilia* 107-108**, *157*
***asymmetros (Conotrochus)* 101-102**, 114, *155-156*
atlantica (Caryophyllia) 74
atlanticus (Aulocyathus) 104
***Aulocyathus* 103-104**, *156*
australiensis (Peponocyathus) 111

***Balanophyllia* 47, 129-130**, *163*
barbadensis (Caryophyllia) 72
***Bathyactis* 57-58**, *163*
Blastotrochus 132
***Bourneotrochus* 84, 87-88**, *149, 151*
***brevipalus (Cryptotrochus)* 112**, *158*
***brevispina (Aplocyathus, Trochocyathus)* 85-86**, *150*
***brunneus (Conotrochus, Pleurocyathus)* 101**

cailetti (Javania) 127
calcar (Deltocyathus) 96
***calveri (Caryophyllia)* 73-74**, *146*
***cameratus (Deltocyathus)* 95**, *153-154*
***candeanum (Flabellum, Truncatoflabellum)* 123-124**
carolinensis (Cryptotrochus) 112
***Caryophyllia* 46, 49, 69-76**, 80, 107, *146*
caryophylloides (Trochocyathus) 82
catinata (Anthemiphyllia) 67
Ceratotrochus 77, 109
***cervicornis (Dactylotrochus, Tridacophyllia)* 106-107**, *157*
***circularis (Oxysmilia)* 78**, *147*
Citharocyathus 111
Cladopsammia 129
clavus (Caryophyllia) 46, 70
coalitum (Flabellum) 115, 116, *159*
***cochlea (Heteropsammia, Madrepora)* 132-133**
Coenopsammia 46
***complicata (Stephanophyllia)* 60**
***concinna (Vaughanella)* 49, 90-91**, *152*
***conicus (Citharocyathus, Notocyathus)* 48, 111**
***Conotrochus* 100-102**, *155-156*
***cooperi (Trochocyathus, Tropidocyathus)* 83-84**
corniculans (Balanophyllia) 129
cornuformis (Caryophyllia) 72
***coronatus (Odontocyathus, Platycyathus, Stephanocyathus)* 49, 89**, *152*
corrugata (Caryophyllia) 75
***corrugata (Oxysmilia)* 78-79**, *147-148*
***corrugatus (Deltocyathus)* 96, 98**
***costata (Anthemiphyllia)* 64, 66-67**, 68, *144-145*
***crassiseptum (Deltocyathus)* 94-95**, *153*
***crassitheca (Balanophyllia)* 103**
***Crispatotrochus* 76-77**, *147*
cristagalli (Desmophyllum) 105, 126
***crosnieri (Caryophyllia)* 70**, *146*
***Cryptotrochus* 112**, *158*
Culicia 46
Cyathoceras 76
Cyathohelia 61
***Cyathotrochus* 110-111**
cylindrica (Dendrophyllia) 133
Cryptotrochus 109

***Dactylotrochus* 106-107**, *157*
delicatum (Desmophyllum) 105
***Deltocyathoides* 111**
***Deltocyathus* 47, 48, 63, 67, 69, 87, 91-98**, 111, 114, *152-154*
***deludens (Flabellum, Ulocyathus)* 117**, 118, *159*

Dendrophyllia 47, 129, **133-134**
dens *(Flabellum,* ***Truncatoflabellum)*** **120**, 121, *160*
dentata/*dentatus* ***(Anthemiphyllia,*** *Discotrochus)* **63-65**, 66, 68
desmophyllioides/*desmophylloides* ***(Balanophyllia)*** **129-130**, *163*
Desmophyllum **104-105**, 124, 126
dianthus (Desmophyllum, *Madrepora)* **104-105**
diomedeae (Caryophyllia) **74**
diomedeae (Crispatotrochus) 76
Discotrochus 63, 67
discus (Trochocyathus) 48, 84, 113, *150, 159*

efateensis (Trochocyathus) **82,** *149*
Eguchipsammia 129
elongata (Caryophyllia) 70
Enallopsammia 46, 47, **134-135**
Endopachys 49, **132**, *163*
epithecata (Oxysmilia) **79**, *147-148*
exserta (Javania) **126-127**, *162*

flabelliformis (Rhizotrochus) **127**
Flabellum 46, 47, 110, **115-119**, 123, 124, 127, *159-160*
flatiliseptis (Sabinotrochus) 89, *152*
folliculus (Peponocyathus, *Stephanophyllia)* 48, 49, **113**, *159*
formosa (Cyathohelia, Madrepora, Sclerohelia) 61, *143*
formosissima (Letepsammia) 59
formosum (Truncatoflabellum) 122
formosus (Deltocyathus) 92
fragilis (Deltocyathus) 91
fragilis (Fungiacyathus) 46, 55, 57, 58
franki (Letepsammia) 59
frustum (Anthemiphyllia) 64
fulvus (Polycyathus) 87
Fungiacyathus 46, 48, **54-58**, *142-143*
funicolumna *(Ceratotrochus,* ***Conotrochus)*** **100-101**, 103
furanaensis (Polycyathus) 87
fusca (Javania, *Placotrochus)* **125-126**, *161*
gardineri (Lochmaeotrochus) **102-103**, *156*
Gardineria 126, **128-129**, *163*
gemma (Balanophyllia, *Thecopsammia)* **131**
gigas (Asterosmilia, *Caryophyllia, Rhizosmilia)* **107-108**, *157-158*
gigas (Balanophyllia) **131**
granulosus (Bathyactis, Fungiacyathus) **58**
grayi (Acanthocyathus, Caryophyllia) **76**
grayi (Endopachys) **132**, *163*
Guynia 48, **113-114**

Haplophyllia 128
hastatus *(Acinocyathus,* ***Aplocyathus,*** *Stephanocyathus,* ***Trochocyathus)*** **84-85**, 87
hawaiiensis (Caryophyllia) **69-70**
hawaiiensis (Gardineria) 126, **128**
hellena (Madracis) 46, 53-54
heteroclitus (Deltocyathus) 48, 69, 96, **97-98**, *154*
Heterocyathus **98-100**, *155*
Heteropsammia **132-133**
hodgsoni (Polycyathus) 87
hoffmeisteri (Flabellum, Ulocyathus) 118
horsti (Dendrophyllia) 133

Idiotrochus **112-113**
ijimai (Dendrophyllia) **133**
impensum (Flabellum) 116
inconstans (Truncatoflabellum) 119
interjecta (Madracis) 53
investigatoris (Discotrochus) 63
irregularis (Truncatoguynia) **114**, *159*
italicus (Deltocyathus) 95, 111
ixine (Odontocyathus, Stephanocyathus) 89

Javania **124-127**, *162*
javanus (Cryptotrochus) 112
juvenescens (Aulocyathus) **104**, *156*

kauaiensis (Madracis) **53-54**, *142*
kauaiensis (Madrepora) 61
kermadecensis (Temnotrochus) 48, **114-115**, *159*
kikutii (Idiotrochus, *Placotrochides)* **112-113**
knoxi (Flabellum) 116

labidus (Tropidocyathus) 48, **110**, *143*
Labyrinthocyathus **77**
lamellifera (Caryophyllia) **74-75**
lamprotichum *(Desmophyllum,* ***Javania)*** **124**, **125**
latum (Flabellum) 127
laysanensis (Balanophyllia) **130**, *163*
lessonii/*lessoni* *(Flabellum,* ***Tropidocyathus)*** **108**, *158*
Letepsammia **59**
levidensis (Rhizotrochus) 46, 127
limatulus *(Ceratotrochus,* ***Labyrinthocyathus)*** **77**
Lochmaeotrochus **102-103**, *156*
longispina (Aplocyathus, Trochocyathus) 85
Lophelia/*Lophohelia* 61, **105-106**

mabahithi (Caryophyllia) 72
macrolobata (Anthemiphyllia) **64**, **66**, *144*
maculatus (Trochocyathus) **81-82**
Madracis 46, **53-54**, *142*
Madrepora **61-62**, 105, 132, *143*
magnificus (Deltocyathus) 47, **91-92**, *152*
marcus (Flabellum, Ulocyathus) 46, **118**, *160*
margaretae (Bathyactis, Fungiacyathus) **57**, **58**, *143*
marigondoni (Polycyathus) 87
marmorea (Caryophyllia) **72-73**, *146*
martensii *(Flabellum,* ***Truncatoflabellum)*** **124**, *162*

matricidus (Aulocyathus) 104
***minutiseptum (Madrepora)* 61-62**
***mortenseni (Truncatoflabellum)* 122-123**
multicarinatus (Fungiacyathus) 55
multidentata (Anthemiphyllia) 64, **65**, *144*
musorstomica (Gardineria) 128

***neglecta (Stephanophyllia)* 59**, 60
Neohelia 46, 47, 62
norfolkensis (Polycyathus) 87
Notocyathus 48, **111**
nutrix (Blastotrochus) 132

***octonaria (Caryophyllia)* 71**, 72
octopali (Caryophyllia) 72
***octuplus (Polycyathus)* 86-87**, *151*
***oculata (Madrepora)* 61**, *143*
oculeus (Lochmaeotrochus) 103
***Oculina* 60**
***Odontocyathus* 89-90**, *152*
oreophila (Vaughanella) 90
***orientalis (Deltocyathoides**, Deltocyathus)* **111**
ornatus (Deltocyathus) 96, 97, **98**, *154*
Oulangia 46
***Oxysmilia* 78-79**, *147-148*

pachytheca (Javania) 125-126
pacifica (Anthemiphyllia) 64, **65-66**, *143*
pacifica (Caryophyllia) 46
pacificus (Fungiacyathus) 55, **56**
paliferus**/palifera* ***(Bathyactis, Fungiacyathus) 55, **57**, *143*
panda (Caryophyllia) 74
papuensis (Phyllangia) 46
***paradoxa (Gardineria**, Haplophyllia)* **128-129**, *163*
paripavoninum (Truncatoflabellum) 119, 124
***patelliformis* (Trochocyathus) 82-83**, *149-150*
patera (Anthemiphyllia) 64, 67
patagonichum (Flabellum) 118
paucipalata (Caryophyllia) 70
pavoninum (Flabellum) 46, 47, **115-116**, *159*
Peponocyathus 48, 49, 111, **113**, *159*
perculta (Caryophyllia) 73, 74
***pertusa (Lophelia**, Madrepora)* **105-106**
***philippinensis (Trochocyathus)* 81**
***phoenix (Truncatoflabellum)* 121**
Phyllangia 46
***pileus (Cyathotrochus**, Trochocyathus, Tropidocyathus)* **110-111**
Placotrochides 112
Placotrochus 125
Platytrochus 108
***Pleotrochus* 109**, *158*
***Polycyathus* 86-87**, *151*
polygona (Caryophyllia) 74
Polymyces 49, **128**
***porcellana (Madrepora**, Neohelia)* 46, 47, **62-63**
pourtalesi (Deltocyathus) 95
primordialis (Tridacophyllia) 106-107
profunda (Asterosmilia) 108
prolifera (Lophelia, Madrepora) 105
pseudoalabastra (Javania) 127
***pusillum (Truncatoflabellum)* 120**, 121, *161*

***quadragenaria (Caryophyllia)* 73-74**

raukawaensis (Flabellum) 118
***recidivus (Aulocyathus**, Ceratotrochus)* **103, 104**
***rediviva (Balanophyllia)* 130-131**
***regius (Stephanocyathus)* 88-89**, *151, 152*
Rhizopsammia 129
Rhizosmilia 81, **107**
Rhizotrochus 46, **127**, *163*
***rhombocolumna (Trochocyathus)* 81**
Rhombopsammia 59
***robusta (Rhizosmilia)* 107**
***rostrata** (Amphihelia, **Enallopsammia**)* 46, 47, **134-135**
***rotulus (Deltocyathus**, Trochocyathus)* **91-92**
rotundifolia (Oxysmilia) 78
***rubescens (Alatotrochus**, Platytrochus, Sphenotrochus)* **108-109**
***rubescens (Crispatotrochus**, Cyathoceras)* **76-77**
rugosa (Caryophyllia) 71, 72, 75
***rugosus (Crispatotrochus)* 77**, *147*

Sabinotrochus 89
sandoi (Fungiacyathus) 55, **56-57**, *142*
Sclerhelia/Sclerohelia 61, 134
scobinosa (Caryophyllia) 46, **75**
secta (Caryophyllia) 72
***semperi (Trochocyathus)* 83**
sibogae (Fungiacyathus) 54
sibogae (Stephanotrochus) 89
singularis (Madracis) 46, 53-54
smithii (Caryophyllia) 70
solida (Caryophyllia) 73
sp. A (Fungiacyathus) 55
Sphenotrochus 108
spinifera (Anthemiphyllia) 64, **67-69**, 97, *145*
***spinifera (Acinocyathus**, Odontocyathus, **Stephanocyathus** Stephanotrochus)* **90**
***stabile** (Flabellum, **Truncatoflabellum**)* 49, **119**, *160*
***stella (Deltocyathus)* 96-97**, *154*
***stellulatus (Bourneotrochus**, Deltocyathus)* 84, **87-88**, *149, 151*
Stephanocyathus 49, 84, **88-90**, *151-152*
***Stephanophyllia* 59-60**, 113
Stephanotrochus 89, 90
***stephanu (Bathyactis, Fungiacyathus)* 54**, **55**, 57
subcornigera (Dendrophyllia) 133
***sulcatus (Heterocyathus**, Stephanoseris)* **98-99**, 100, 114, *155*

suluensis (Deltocyathus) 91, **92**, 93

taiwanicus (Deltocyathus) **92-93**, *153*
Temnotrochus 48, **114-115**, *159*
tenuescens *(Desmophyllum,* ***Thalamophyllia)*** **105**
tenuicalyx (Trochocyathus) 81
tenuis (Lophohelia, Madrepora) 61, *143*
Tethocyathus 86
Thalamophyllia **105**
Thecopsammia 131
trapezoideum (Truncatoflabellum) 119
Tridacophyllia 106
Trochocyathus 48, **80-86**, 87, 110, *149-150, 159*
Tropidocyathus 48, **110**, *158*
Truncatoflabellum 49, 116, **119-124**, *160-162*
Truncatoguynia **114**, *159*
Tubastraea 46
typus (Rhizotrochus) **127**, *163*

Ulocyathus **117-119**

vanuatu *(Flabellum,* ***Truncatoflabellum)*** **123**
variabilis (Peponocyathus) 113
variegatus (Bathyactis, Fungiacyathus) 48, **58**, *143*
vasiformis (Trochocyathus) **80**, *149*
Vaughanella 49, **90-91**, *152*
vaughani (Deltocyathus) **93-94**
venustus *(Ceratotrochus, Cryptotrochus,* ***Pleotrochus)*** **109**, *158*
venustus (Notocyathus) 111
veroni (Bourneotrochus) 87
vigintifarium (Truncatoflabellum) **121-122**, *161*
virgatus (Tethocyathus, Trochocyathus) **86**
virgosa (Oculina) **60**
weberianus *(Odontocyathus, Stephanocyathus, Stephanotrochus)* **89-90**
wellsi (Polymyces) 49, **128**
willeyi (Coenopsammia) 46

Xenophora 48, 58, 60, 71, 88, 97, 111, 113, 114, 115, 120, *143, 159*

zibrowii *(Cryptotrochus,* ***Pleotrochus)*** **109**, 112, *158*
zopyros (Caryophyllia) 73

3

Entoproctes et Bryozoaires Cheilostomida (Pseudomalacostegomorpha et Cryptocystomorpha) des campagnes MUSORSTOM autour de la Nouvelle-Calédonie

Jean-Loup D'HONDT

Muséum national d'Histoire naturelle,
Laboratoire de Biologie des Invertébrés marins et Malacologie
U.R.A. 699 du C.N.R.S.
57, rue Cuvier, F - 75231 Paris Cedex 05

&

Dennis P. GORDON

National Institute of Water and Atmospheric Research (NIWA)
P.O. Box 14-901 Kilbirnie
Wellington, New Zealand

RÉSUMÉ

Cette étude concerne la systématique des Entoproctes et des Bryozoaires Cheilostomes (infra-ordre des Pseudomalacostégomorphes et des Cryptocystomorphes) recueillis lors de différentes campagnes océanographiques autour de la Nouvelle-Calédonie. Une nouvelle espèce d'Entoproctes du genre *Loxokalypus* est décrite, et 12 familles (dont une nouvelle), 27 genres (dont 2 nouveaux) et 40 espèces (dont 16 nouvelles) de Bryozoaires Cheilostomes sont recensées. Les nouveaux taxons de Bryozoaires créés ici sont la famille Bryopastoridae, les genres *Promicroa* et *Lamourouxia* et le sous-genre *Henrimilnella*. Une nouvelle clé de détermination des genres de Cellariidae est proposée. Outre les espèces précédentes, une nouvelle espèce du genre *Himantozoum* (Cheilostomes Cellularines) est décrite. Le genre *Pseudothyracella*, préalablement connu uniquement du Paléogène du nord-ouest de l'Europe et de l'Amérique du Nord, est représenté par une nouvelle espèce, actuelle. Treize genres et 19 espèces sont mentionnés pour la première fois de la faune néo-calédonienne.

HONDT, J.-L. D' & GORDON, D.P., 1999. — Entoproctes et Bryozoaires Cheilostomida (Pseudomalacostegomorpha et Cryptocystomorpha) des campagnes MUSORSTOM autour de la Nouvelle-Calédonie. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle,* **180**: 169-251. Paris ISBN 2-85653-520-8.

ABSTRACT

Entoprocta and Bryozoa Cheilostomida (Pseudomalacostegomorpha and Cryptocystomorpha) from the MUSORSTOM cruises around New Caledonia.

This study concerns the systematics of Entoprocta and Cheilostomate Bryozoa (infraorders Pseudomalacostegomorpha and Cryptocystomorpha) collected during various cruises around New Caledonia. One new entoproct species is described in the genus *Loxokalypus*, and 12 families (1 new), 27 genera (2 new), and 40 species (16 new) of Bryozoa are recorded. The new bryozoan taxa comprise the family Bryopastoridae, the genera *Lamourouxia* and *Promicroa* and the subgenus *Henrimilnella*. A new key is provided for the identification of genera of Cellariidae. A new species of the buguloidean bryozoan *Himantozoum* is also provided. The genus *Pseudothyracella*, previously known only from the Paleogene of Northwestern Europe and North America, is represented by a new, living species. Thirteen genera and 19 species are newly recorded in the New Caledonian fauna.

INTRODUCTION

Cette note s'inscrit dans le programme d'étude systématique des Bryozoaires Eurystomes (= Cténostomes + Cheilostomes) marins recueillis à grande profondeur lors des campagnes MUSORSTOM autour de la Nouvelle-Calédonie, la zone géographique prospectée incluant les îles Loyauté et Bellona. Le matériel correspondant, avec notamment les types des nouveaux taxons décrits, est déposé au Muséum national d'Histoire naturelle de Paris.

Les recherches sur les Cténostomes ont révélé l'existence sur place de 5 espèces profondes, dont 4 nouvelles pour la faune néo-calédonienne, appartenant à 5 genres (4 nouveaux pour la Nouvelle-Calédonie) et 4 familles (3 nouvelles pour la faune locale). Leur étude a été publiée conjointement à celle de trois des Sous-Ordres de Cheilostomes non-ascophores, les Malacostèges, les Scrupariines et en partie les Neocheilostomina (l'Infra-Ordre des Cellulariomorpha) par D'HONDT et GORDON (1996). Le présent travail concerne les deux autres Infra-Ordres des Neocheilostomina, les Pseudomalacostèges et les Cryptocystomorphes. Le Sous-Ordre des Inovicellatina est présent en Nouvelle-Calédonie, mais ne s'y rencontre que dans les eaux superficielles (D'HONDT, 1986), ce qui explique qu'il n'a pas été récolté lors des campagnes MUSORSTOM.

Les quatre Sous-Ordres précités correspondent aux "Anascina" ou "Anasca" des anciens auteurs, taxon artificiel et polyphylétique qui n'est plus actuellement utilisé que par souci de commodité, par opposition au cinquième Sous-Ordre des Cheilostomes, celui des Ascophorina. En effet, les Malacostèges et les Scrupariines, distincts entre eux, se différencient des autres Cheilostomes par leurs morphologie et anatomie larvaires et leur type de métamorphose (inconnue chez les Scrupariines) ; les Inovicellatina, dont les larves n'ont pas été décrites, sont morphologiquement très différentes des autres Bryozoaires par leur forme zoéciale ; quant aux Pseudomalacostèges, aux Cellularines et aux Cryptocystomorphes, qui se situent sur trois lignées évolutives morphologiquement distinctes à l'état adulte, ils présentent tous trois le même type larvaire et morphogénétique, qu'ils partagent également avec le dernier des Sous-Ordres des Cheilostomes, les Ascophorina. Cette observation a incité D'HONDT (1985) à inclure ces derniers dans les Neocheilostomina, alors que GORDON (1989) a préféré les maintenir comme Sous-Ordre distinct, considérant l'acquisition de l'asque comme un pas évolutif important. Ce dernier auteur a partagé les Ascophorina en 4 Infra-Ordres.

Les Ascophorina profondes de Nouvelle-Calédonie sont en cours d'étude très avancée, ayant actuellement donné lieu à plusieurs publications : GORDON (1988 et 1993), GORDON & BRAGA (1994), GORDON & D'HONDT (1991).

Les aires géographiques prospectées autour de la Nouvelle-Calédonie ont été récapitulées sur une carte publiée dans un précédent travail (D'HONDT & GORDON, 1996), à laquelle nous invitons le lecteur à se reporter ; les provenances des spécimens étudiés dans notre travail antérieur et dans celui-ci sont en effet les mêmes, les récoltes de matériel ayant été effectuées lors des mêmes campagnes (BIOCAL, CHALCAL 2, BIOGÉOCAL, MUSORSTOM 4, SMIB 3, MUSORSTOM 6, SMIB 4, CALSUB). Nous avons joint à cette étude la détermination de quelques espèces de Bryozoaires recueillies autour de l'archipel des Philippines, lors des missions MUSORSTOM 3 et ESTASE.

Les numéros des stations de récolte sont précédés, dans la liste ci-après, d'un code indiquant l'instrument de prélèvement : DC : drague Charcot ; DW : drague Warén ; CP : chalut à perche ; KG : carottier Usnel grande surface ; PL : soucoupe *"Cyanea"*.

Les abréviations utilisées pour désigner les établissements où sont déposés les échantillons étudiés sont :

MNHN : Muséum national d'Histoire naturelle, Paris.
NMNZ : National Museum of New Zealand, Wellington.
NZOI : New Zealand Oceanographic Institute, Wellington.

Lorsque le lieu de dépôt n'est pas mentionné, ceci implique que l'échantillon se trouve dans les collections du Muséum national d'Histoire naturelle.

Les noms des navires ainsi que celui des soucoupes sous-marines sont en italiques, entre guillemets.

Dans tout le travail, les mesures indiquées ont été effectuées sur 20 à 25 autozoécies arbitrairement choisies sur les échantillons étudiés.

LISTE DES STATIONS

Philippines

MUSORSTOM 3

Station CP 101. — 1.06.85, 14°00'S, 120°19'E, 194-196 m : *Carbasea* aff. *linguiformis*.
Station DR 117. — 3.06.85, 12°31,3'S, 120°39'E, 97-92 m : *Cellaria humilis*, *Parantropora laguncula*.
Station CP 139. — 6.06.85, 11°53'S, 122°15'E, 240-267 m : *Micropora equilateralis*.

ESTASE

Station DR 07. — 28.11.84, 05°56,79'N, 126°14,38'E, 890-450 m : *Mesostomaria strictoramae*.

Nouvelle-Calédonie

BIOCAL

Station DW 08. — 12.08.85, 20°34'S, 166°54'E, 435 m : *Melicerita alternans*, *Bryopastor pentagonus*.
Station CP 13. — 12.08.85, 20°18'S, 167°18'E, 3690-3740 m : *Columnella magna*.
Station DW 31. — 29.08.85, 23°07'S, 166°50'E, 850 m : *Pseudothyracella candelaber*, *Carbasea laterogranulata*.
Station DW 33. — 29.08.85, 23°09,71'S, 167°10,27'E, 675-680 m : *Mesostomaria strictoramae*.
Station DW 36. — 29.08.85, 23°08,64'S, 167°10,99'E, 625-650 m : *Mesostomaria strictoramae*, *Formosocellaria magnifica*, *Bryopastor crassus*.
Station DW 38. — 30.08.85, 22°59,74'S, 167°15,31'E, 360 m : *Cryptostomaria alata*, *Melicerita (Henrimilnella) articulata*, *Melicerita (Henrimilnella) laurifolia*, *Bryopastor pentagonus*, *Pseudothyracella candelaber*.
Station DW 41. — 30.08.85, 22°45,13'S, 167°11,74'E, 380 m : *Columnella vipera*, *Bryopastor crassus*.
Station DW 44. — 30.08.85, 22°47,30'S, 167°14,30'E, 440-450 m : Calloporidae indéterminable, *Bryopastor* sp. (*B. crassus* ?), *Bryopastor* sp. (*B. octogonos* ?).
Station DW 46. — 30.08.85, 22°53,27'S, 167°17,41'E, 570-610 m : *Concertina cultrata*, *Pseudothyracella candelaber*, *Quadricellaria bocki*, *Bryopastor pentagonus*.
Station DW 51. — 31.08.85, 23°05,27'S, 167°44,95'E, 700-680 m : *Carbasea laterogranulata*, *Pseudothyracella candelaber*, *Bryopastor crassus*.
Station CP 52. — 31.08.85, 23°05,79'S, 167°46,54'E, 600-540 m : *Columnella vipera*, *Mesostomaria strictoramae*, *Quadricellaria bocki*.
Station DW 53. — 1.09.85, 23°09,80'S, 167°42,57'E, 1005-975 m : *Columnella vipera*.
Station CP 54. — 1.09.85, 23°10,30'S, 167°42,55'E, 1000-950 m : *Columnella vipera*.
Station CP 55. — 1.09.85, 23°19,76'S, 167°30,46'E, 1175-1160 m : *Columnella vipera*.
Station CP 60. — 2.09.95, 24°01,45'S, 167°08,43'E, 1530-1480 m : *Columnella vipera*.
Station CP 62. — 2.09.85, 24°19,06'S, 167°48,65'E, 1395-1410 m : *Columnella vipera*, *Cryptostomaria alata*.
Station DW 65. — 3.09.85, 24°47,90'S, 168°09,09'E, 275-245 m : *Cranosina coronata*.
Station DW 66. — 3.09.85, 24°55,43'S, 168°21,68'E, 515-505 m : *Promicroa dubitata*, *Lamourouxia canaliculata*, *Syringotrema calobi*, Cellariidae *incertae sedis*, *Bryopastor pentagonus*.
Station CP 67. — 3.09.85, 24°55,44'S, 168°21,55'E, 500-510 m : Calloporidae *incertae sedis*, *Lamourouxia canaliculata*.

Station DW 70. — 4.09.85, 23°24,70'S, 167°53,65'E, 965-960 m : *Columnella vipera, Pseudothyracella candelaber.*
Station KG 71. — 4.09.85, 22°09,85'S, 167°32,70'E, 2099 m : *Lamourouxia canaliculata.*
Station CP 74. — 4.09.85, 22°14,06'S, 167°29,30'E, 1300 m : *Cryptostomaria alata.*
Station CP 75. — 4.09.95, 22°18,65'S, 167°23,30'E, 825-860 m : *Quadricellaria bocki, Cryptostomaria alata.*
Station KG 76. — 5.09.95, 22°21,09'S, 167°23,00'E, 880 m : *Columnella vipera.*
Station DW 77. — 5.09.85, 22°15,33'S, 167°15,40'E, 440 m : *Cryptostomaria alata.*
Station CP 78. — 5.09.85, 22°16,26'S, 167°15,53'E, 445-450 m : *Crateropora stiliformis.*
Station CP 84. — 6.09.95, 20°43,50'S, 166°54,03'E, 460 m : *Smittipora fenestrata.*
Station KG 103. — 8.09.85, 21°29,15'S, 166°19,98'E, 630 m : *Euginoma conica.*
Station CP 109. — 9.09.95, 22°10,03'S, 167°15,22'E, 495-515 m : *Pseudothyracella candelaber, Cryptostomaria alata.*

MUSORSTOM 4

Station DW 150. — 14.09.85, 19°07,5'S, 163°22,1'E, 110 m : *Parantropora laguncula.*
Station DW 151. — 14.09.85, 19°07,0'S, 163°22,0'E, 200 m : *Mesostomaria strictoramae.*
Station CP 153. — 14.09.85, 19°04,2'S, 163°21,2'E, 235 m : *Cryptostomaria alata.*
Station CP 172. — 19.09.85, 19°01,2'S, 163°16,0'E, 275-330 m : *Cryptostomaria alata.*
Station CC 175. — 17.09.85, 18°59,3'S, 163°17,5'E, 355 m : *Melicerita ejuncida, Cryptostomaria alata, Bryopastor pentagonus.*
Station DW 187. — 19.09.89, 19°08,3'S, 163°29,3'E, 65-120 m : *Nellia tenella.*
Station CP 216. — 29.09.85, 22°59,5'S, 167°22,0'E, 490-515 m : *Pseudothyracella candelaber.*
Station DW 220. — 29.09.85, 22°58,5'S, 167°38,3'E, 505-550 m : *Carbasea laterogranulata, Pseudothyracella candelaber.*
Station DW 221. — 29.09.85, 22°58,6'S, 167°36,8'E, 535-560 m : *Formosocellaria magnifica.*
Station DW 223. — 30.09.85, 22°57,0'S, 167°30,0'E, 545-560 m : *Himantozoum crassiavicularium.*
Station CP 236. — 2.10.85, 22°11,3'S, 167°15,0'E, 495-550 m : *Pseudothyracella candelaber.*
Station CP 238. — 2.10.85, 22°13,0'S, 167°14,0'E, 500-510 m : *Columnella vipera.*

CHALCAL 2

Station DW 81. — 31.10.86, 23°19,60' S, 168°03,40'E, 311 m : *Loxokalypus pedicellinoides.*

BIOGEOCAL

Station CP 205. — 8.04.87, 22°40,61'S, 166°28,01'E, 1350-1380 m : *Columnella vipera.*
Station KG 210. — 9.04.87, 22°44'S, 166°31'E, 1190 m : *Euginoma conica, Bryopastor challengeri.*
Station CP 214. — 9.04.87, 22°43,09'S, 166°27,19'E, 1665-1590 m : *Cellaria parafistulosa, Cellaria obliquidens.*
Station KG 219. — 10.04.87, 22°38,81'S, 166°33,63' E, 570 m : *Euginoma conica.*
Station KG 222. — 11.04.87, 22°44,62'S, 166°24,93'E, 1675 m : *Melicerita ejuncida.*
Station KG 227. — 12.04.87, 21°32,84'S, 166°23,85'E, 500 m : *Euginoma conica.*
Station CP 232. — 12.04.87, 21°33,81'S, 166°27,07'E, 760-790 m : *Melicerita ejuncida, Bryopastor challengeri, Bryopastor pentagonus.*
Station DW 253. — 16.04.95, 21°31,75'S, 16°28,73'E, 310-315 m : ? *Pseudolunularia* sp., *Callopora* (?) sp., *Bryopastor challengeri, Bryopastor octogonos.*
Station CP 260. — 17.04.87, 21°00,00'S, 166°58,34'E, 1820-1880 m : *Columnella magna* var. *armata.*
Station CP 265. — 18.04.87, 21°04,09'S, 167°00,40'E, 1760-1870 m : *Formosocellaria magnifica.*
Station KG 267. — 18.04.87, 21°02,20'S, 168°58,76'E, 1935 m : *Cellaria tenuirostris.*
Station CP 272. — 20.04.87, 21°00,04'S, 166°56,94' E, 1615-1710 m : *Formosocellaria magnifica.*
Station KG 275. — 20.04.87, 21°05,80'S, 166°53,14'E, 1959 m : *Nellia tenella.*
Station CP 290. — 27.04.87, 20°36,91'S, 167°03,34'E, 920-760 m : Cellariidae indéterminé.
Station DW 296. — 28.04.87, 20°38,35'S, 167°10,32'E, 1230-1270 m : *Pseudothyracella candelaber.*
Station CP 297. — 28.04.87, 20°38,64'S, 167°10,77'E, 1230-1240 m : *Columnella vipera, Pseudothyracella candelaber.*
Station DW 307. — 1.05.87, 20°35,38'S, 166°55,25'E, 470-480 m : Cellariidae indéterminable, *Quadricellaria bocki, Bryopastor challengeri, Bryopastor pentagonus, Bryopastor* sp., *Pseudothyracella candelaber.*
Station DW 313. — 2.05.87, 20°58,95'S, 166°59,04'E, 1640-1600 m : *Columnella vipera* (?), *Bryopastor challengeri.*

Station KG 316. — 2.05.87, 20°48,33'S, 166°53,29'E, 1660 m : *Euginoma conica.*

SMIB 3
Station DW 22. — 24.05.87, 22°58,85' S, 167°19,10'E, 503 m : *Mesostomaria strictoramae*, *Mesostomaria* sp.

CALSUB
Station PL 09. — 27.02.89, 20°53'S, 167°03'E, 256 m : *Alderina tuberosa.*

SMIB 4
Station DW 35. — 7.03.89, 24°54,4'S, 168°21,6'E, 520-525 m : *Syringotrema calobi.*
Station DW 37. — 7.03.89, 24°53,9'S, 168°22,3'E, 500-530 m : Calloporidae indéterminable, *Lamourouxia canaliculata.*
Station DW 38. — 7.03.89, 24°54,5'S, 168°22,0'E, 510 m : Calloporidae indéterminable.
Station DW 39. — 7.03.89, 24°56,2'S, 168°21,5'E, 525-560 m : *Crateropora stiliformis, Lamourouxia canaliculata.*
Station DW 55. — 9.03.89, 23°21,4'S, 168°04,5'E, 215-260 m : *Pseudothyracella candelaber.*
Station DW 60. — 9.03.89, 23°00,1'S, 167°21,6'E, 500-535 m : *Quadricellaria bocki.*

Îles Loyauté

MUSORSTOM 6
Station DW 396. — 13.02.89, 20°48,05'S, 16°00,59'E, 1400 m : *Columnella vipera.*
Station DW 421. — 16.09.89, 20°26,27'S, 166°40,17'E, 245 m : *Pseudothyracella candelaber, Crassimarginatella spathulata.*
Station KG 465. — 21.02.89, 21°04'S, 167°32'E, 480 m : *Cryptostomaria alata.*

ÉTUDE SYSTÉMATIQUE

EMBRANCHEMENT BRYOZOA Ehrenberg, 1831

Classe EURYSTOMATODA Marcus, 1938

Sous-Classe CHEILOSTOMONA Busk, 1852

Ordre EUCHEILOSTOMIDA d'Hondt, 1985

Sous-Ordre NEOCHEILOSTOMINA d'Hondt, 1985

Infra-Ordre CELLULARIOMORPHA Smitt, 1867

Superfamille BUGULOIDEA Gray, 1848

Famille BUGULIDAE Gray, 1848

Genre ***HIMANTOZOUM*** Harmer, 1923

ESPÈCE-TYPE. — *Bugula mirabilis* Busk, 1881.

Himantozoum crassiavicularium sp. nov.
Fig. 3 B-C, 20 A-D

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. MUSORSTOM 4 : stn DW 223, 545-560 m.

TYPE. — *Holotype* : Nouvelle-Calédonie, MUSORSTOM 4, stn DW 223, 545-560 m (MNHN-BRY-16404).

DIAGNOSE. — *Himantozoum* dont chaque autozoécie marginale du limbe zoarial est renflée distalement de façon à former une massue saillante vers l'extérieur. Cadre latéral des autozoécies marginales et centrales présentant de chaque côté, et sur toute sa longueur, une demi-douzaine d'épines. Aviculaires des autozoécies marginales

(latéraux) tronconiques, des autozoécies centrales (axiaux) ovalaires. Autozoécies marginales portant une longue épine distale. Extrémité distale interne des autozoécies marginales arrondie et décalée proximalement.

DESCRIPTION. — Le zoarium est dressé et plurisérié, ramifié dichotomiquement ; les branches sont trisériées à leur base, et peuvent comporter distalement jusqu'à 7 séries autozoéciales. Les autozoécies marginales diffèrent de celles de la région centrale du limbe zoarial. De chaque côté de ce dernier, les loges de la série marginale présentent une épine latérale externe, prolongeant l'angle distal, incurvée vers l'axe zoarial, et mesurant 0,55 mm de long. Elles sont distalement renflées, de façon à former une massue saillante vers l'extérieur ; elles mesurent 0,80 mm de long, pour une largeur de 0,30 mm distalement et 150 proximalement ; elles portent proximalement un aviculaire tronconique frontal de 0,18 mm de long ; leur cadre autozoécial longitudinal porte habituellement de chaque côté, sur toute sa longueur, de 5 à 7 épines irrégulières, mais parfois moins du côté externe. Leur région distale interne est arrondie et inerme ; elle n'est pas située au même niveau que l'angle externe, mais un peu décalée en direction proximale. Les autozoécies de la partie centrale ont une longueur de 0,60 mm et une largeur constante de 0,20 mm ; elles portent symétriquement, de chaque côté, une épine distale oblique et acérée, plus robuste en présence d'ovicelle ; de 5 à 7 épines latérales sont portées par chacun des bords longitudinaux du cadre autozoécial, et distribuées sur toute la longueur de celui-ci ; elles sont orientées irrégulièrement vers l'axe autozoécial. Les autozoécies axiales portent un aviculaire proximal médian long de 0,20 mm, de forme ovoïde régulière, parfois légèrement déprimé au centre de sa partie distale, isodiamétrique ou généralement un peu plus large proximalement (0,18 mm) que distalement (0,16 mm). L'ovicelle n'est portée que par une zoécie axiale ; en forme de casque très peu saillant, elle ne déborde que d'une centaine de microns en avant de l'autozoécie reproductrice : la partie distale de celle-ci, normalement arrondie, acquiert alors une forme plus allongée et anguleuse.

DISCUSSION. — Cette espèce présente sur les autozoécies de la partie centrale du limbe des épines latérales pointues, distribuées sur toute la longueur du cadre autozoécial ; elle partage ce caractère avec *Himantozoum (Himantozoum) dissimile* d'Hondt & Gordon, 1996, *Himantozoum (Thaminozoum) hispidum* d'Hondt & Gordon, 1996, et *Himantozoum (Beanodendria) elegans* d'Hondt & Gordon, 1996, trois espèces qui appartiennent comme elle à la faune néo-calédonienne. La nouvelle espèce décrite ici n'appartient pas au sous-genre *Beanodendria* d'Hondt & Gordon, 1996, car les processus spiniformes distaux ne portent pas d'aviculaires. Elle se différencie du sous-genre *Thaminozoum* d'Hondt & Gordon, 1996, par le fait que le cadre des autozoécies axiales n'y est spinigère que dans sa moitié proximale, que les épines latérales des autozoécies marginales n'y sont portées que par le seul bord interne du cadre autozoécial, et par la forme différente des aviculaires des autozoécies axiales. Elle se distingue de *H. dissimile* par le fait que le côté externe du cadre de ses autozoécies marginales porte des épines au même titre que le côté interne (les épines externes étant absentes chez *H. dissimile)*, et que les aviculaires des loges marginales de *H. dissimile* sont de forme dissymétrique, tandis que ceux de *H. crassiavicularium* sont symétriques. Les aviculaires latéraux de *H. crassiavicularium* sont identiques à ceux de *Dendrobeania pseudexilis* d'Hondt & Gordon, 1996, espèce appartenant à un genre très voisin, et dont le cadre autozoécial est inerme latéralement. L'élargissement distal des autozoécies marginales et l'effacement du bord distal interne de ces mêmes autozoécies caractérisent en outre *H. crassiavicularium.*

ÉTYMOLOGIE. — Du Latin, *crassus*, épais, en raison de l'épaisseur de l'aviculaire.

RÉPARTITION. — Nouvelle-Calédonie. Profondeur : 545-560 m.

Infra-Ordre PSEUDOMALACOSTEGOMORPHA d'Hondt, 1977

Superfamille CALLOPOROIDEA Norman, 1903

Famille CALLOPORIDAE Norman, 1903

Genre ***CRASSIMARGINATELLA*** Canu, 1900

ESPÈCE-TYPE. — *Membranipora crassimarginata* Hincks, 1880.

Crassimarginatella spathulata Gordon, 1984

Crassimarginatella spathulata Gordon, 1984 : 29, pl. 3 fig. B.

MATÉRIEL EXAMINÉ. — **Îles Loyauté**. MUSORSTOM 6 : stn DW 421, 245 m.

DESCRIPTION. — Le zoarium est encroûtant. Les dimensions des autozoécies varient considérablement, presque du simple au double : leur longueur de 0,43 à 0,85 mm, leur largeur de 0,41 à 0,52 mm, mais la plupart d'entre elles ont une longueur comprise entre 0,61 et 0,78 mm. L'opésie, de forme plus ou moins ovale, à bord proximal le plus souvent droit, a 0,62-0,78 mm de long et 0,24-0,42 mm de large. Le cryptocyste est étroit et granuleux. Il n'existe pas d'épines. L'ovicelle arrondie a 0,24 mm de haut et 0,40 mm de large ; la presque totalité de sa surface est occupée par une fenêtre arrondie distalement, droite proximalement. Un seul aviculaire a été observé ; long de 0,92 mm, il s'élargit progressivement vers son extrémité distale, arrondie et légèrement élargie en spatule ; la mandibule a une largeur de 0,31 mm à sa base et de 0,12 mm à son extrémité.

RÉPARTITION. — Îles Kermadec, îles Loyauté. Profondeur : 245-350 m.

REMARQUE. — Cet échantillon n'a pu être photographié, étant encroûtant sur un galet dont il ne pouvait être détaché.

Genre *ALDERINA* Norman, 1903

ESPÈCE-TYPE. — *Membranipora imbellis* Hincks, 1860.

Alderina tuberosa (Canu & Bassler, 1929)

Membraniporidra tuberosa Canu & Bassler, 1929 : 107.
Alderina tuberosa - GORDON, 1984 : 31, pl. 4 fig. E-F. — D'HONDT, 1986 : 701.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. CALSUB : stn PL 09, 256 m.

DESCRIPTION. — La longueur autozoéciale varie de 0,44 à 0,60 mm, et la largeur de 0,35 à 0, 51 mm. L'opésie ovale, plus étroite distalement que proximalement, mesure de 0,28 à 0,35 mm de long et de 0,23 à 0,32 mm de largeur maximale. Le cryptocyste est finement granuleux ; il porte proximalement, de chaque côté, un tubercule ovale, déprimé à sa partie supérieure, long de 0,06 à 0,09 mm. Il n'a été observé ni ovicelle, ni aviculaire.

DISTRIBUTION. — Philippines, Australie, Nouvelle-Zélande, Nouvelle-Calédonie. Profondeur : 10-350 m.

Genre *CRANOSINA* Canu & Bassler, 1933

ESPÈCE-TYPE. — *Membranipora coronata* Hincks, 1881.

Cranosina coronata (Hincks, 1881)

Membranipora coronata Hincks, 1881 : 147, pl. 10 fig. 1.
Setosellina coronata - HARMER, 1926 : 265-266, pl. 16 fig. 2-4.
Cranosina coronata - WINSTON & HEIMBERG, 1986 : 6, fig. 3-6. — HAYWARD, 1988 : 281-282. — CHIMONIDES & COOK, 1994 : 44-45.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL, stn DW 65, 245-275 m.

DESCRIPTION. — Le zoarium encroûtant est constitué d'autozoécies de formes très variables : losangiques, ovoïdes, hexagonales, fusiformes. Elles mesurent de 0,64 à 0,82 mm de long, 0,44 à 0,78 mm de large ; les dimensions de l'opésie varient considérablement, de 0,51 x 0,69 mm à 0,29 x 0,39 mm ; elle peut être circulaire, ovale, parfois à tendance triangulaire et plus étroite proximalement que distalement. Il n'a pas été observé d'ovicelles. Le gymnocyste périapertural est réduit. L'aviculaire, long de 0,11 à 0,13 mm, large de 0,18 à 0,22 mm, présente une mandibule sétiforme à bord denticulé, orientée obliquement vers l'arrière et incurvée vers l'axe zoarial, longue de 0,39-0,43 mm ; sa surface est granuleuse.

REMARQUE. — L'unique échantillon étudié n'a pas été photographié, ayant été endommagé en cours d'étude ; nous renvoyons donc à l'iconographie publié par HARMER d'une part et WINSTON et HEIMBERG d'autre part, dans les travaux cités en référence. L'espèce est nouvelle pour la faune néo-calédonienne.

RÉPARTITION. — Espèce largement distribuée dans les eaux tropicales, et notamment de l'Indo-Pacifique : îles Loyauté, Nouvelle-Calédonie, Australie, détroit de Torrès, une grande partie de l'Indonésie, île Maurice, Ceylan, mer de Chine, Venezuela. Profondeur : 3-275 m.

Genre ***PARANTROPORA*** Tilbrook, 1998

ESPÈCE-TYPE . — *Parantropora penelope* Tilbrook, 1998.

Parantropora laguncula (Canu & Bassler, 1929)

Fig. 3 E

Antropora marginella - HARMER, 1926 (*pars*) : 234, pl. 14 fig. 15 (*non* Hincks, 1884).
Membrendoecium lagunculum Canu & Bassler, 1929 : 96, pl. 6 fig. 6-11.
Antropora lagunculum - MAWATARI & MAWATARI, 1981 : 33.

MATÉRIEL EXAMINÉ. — **Philippines**. MUSORSTOM 3 : stn DR 117, 92-97 m.
Nouvelle-Calédonie. MUSORSTOM 4 : stn DW 150, 110 m.

REMARQUE. — TILBROOK (sous presse) a montré que cette espèce est présente du Japon aux Philippines et en Indonésie. *Parantropora* se distingue d'*Antropora* Norman, 1903, par la possession de petits septules pariétaux à la place des "pore-chambers" basaux, et la présence d'aviculaires vicariants spatulés et de grandes dimensions, dont la longueur dépasse celle des autozoécies.

RÉPARTITION. — Japon, Philippines, Indonésie, détroit de Torrès, Nouvelle-Calédonie. Profondeur : 0-110 m.

Genre ***CONCERTINA*** Gordon, 1986

ESPÈCE-TYPE. — *Concertina cultrata* Gordon, 1986.

Concertina cultrata Gordon, 1986

Concertina cultrata Gordon, 1986 : 27-28, fig. 11, pl. 2 fig. G-H.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 46, 570-610 m.

DESCRIPTION. — Le matériel consiste en un débris déchiré de limbe bistratifié, rigide, sans ovicelle, ni aviculaire, ni les coénozoécies caractéristiques. Les autozoécies, pentagonales ou hexagonales, à angles bien

marqués, ont une longueur de 0,88 à 1,15 mm et une largeur de 0,40 à 0,51 mm ; l'opercule mesure 0,11 mm de long et 0,21 mm de large.

REMARQUE. — En dépit du mauvais état de l'échantillon qui ne justifiait pas son illustration, l'un d'entre nous (D.P.G.) l'a identifié à une espèce auparavant décrite par lui-même, *C. cultrata*, de Nouvelle-Zélande et du plateau du *"Challenger"*, par 914-1386 m de profondeur. Ce genre est provisoirement classé dans la famille Calloporidae sur une suggestion de Miss Patricia L. COOK (in litt.).

Genre ***CALLOPORA*** Gray, 1848

ESPÈCE-TYPE. — *Flustra lineata* Linné, 1767.

Callopora (?) sp.

Fig. 3 D, 8 H-I

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOGÉOCAL : stn DW 253, 310-315 m.

DESCRIPTION. — La petite colonie encroûtante observée ne comporte qu'une seule ovicelle, en mauvais état de conservation, et aucun aviculaire, ce qui empêche toute détermination spécifique. Les autozoécies mesurent de 0,58 à 0,64 mm de long et de 0,51 à 0,77 mm de large. L'opésie ovale, entourée par un bourrelet granuleux très saillant, a 0,42-0,59 mm de long et 0,30-0,34 mm de large. La présence de diételles bien visibles et des bases d'une huitaine d'épines périopésiales, toutes brisées, nous incite à classer cette espèce dans le genre *Callopora*.

CALLOPORIDAE *incertae sedis*

Fig. 20 F-G

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie** : BIOCAL : stn CP 67, 500-510 m.

DESCRIPTION. — Le zoarium est encroûtant, de mono- à trisérié, constitué d'autozoécies régulièrement alternantes. Il n'a pas été observé d'aviculaires ni d'épines. Les autozoécies sont fusiformes, plus larges dans leur moitié distale que dans leur moitié proximale ; elles portent de chaque côté une diételle circulaire. L'unique ovicelle observée, hémiglobuleuse, est moins saillante que le bord distal de l'autozoécie qui la porte ; elle présente une area en forme de croissant bordant l'extrémité distale de l'opésie . La longueur autozoéciale varie de 0,74 à 0,83 mm, la largeur étant de 0,30-0,36 mm à l'avant, de 0,21 à 0,24 mm à l'arrière. L'opésie ovale a une longueur de 0,32-0,36 mm et une largeur de 0,20 à 0,22 mm ; l'orifice, en forme de D, a 0,10 mm de long et 0,14 mm de large. Le cryptocyste est bordé par un cadre zoécial élevé.

REMARQUE. — Les caractères diagnostiques sont insuffisants pour permettre une identification, même au niveau générique.

CALLOPORIDAE *incertae sedis*

Fig. 5 F

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 44, 440-450 m.
SMIB 4 : stn DW 37, 500-530 m. — Stn DW 38, 510 m.

DESCRIPTION. — Le zoarium, dépourvu d'ovicelles, d'aviculaires et d'épines, est encroûtant sur des tiges d'Hydraires ou des débris de coquilles. Les autozoécies des colonies de la campagne SMIB 4 sont souvent plus étroites proximalement, contrairement à celles de la campagne BIOCAL ; elles ont une longueur variant de 0,51 à 0,80 mm, une largeur de 0,24 à 0,38 mm du côté distal (de 0,21-0,23 du côté proximal), et présentent une opésie

longue, de 0,24-0,31 mm de large et de 0,24-0,38 mm de long. Le cryptocyste, profond et délimité par un cadre saillant, est surtout développé proximalement à l'opésie dont il entoure la région proximale en affectant la forme d'un croissant ; du côté proximal, il mesure de 0,08 à 0,14 mm de long.

REMARQUE. — Comme la précédente, cette espèce est indéterminable par insuffisance de caractères discriminatifs.

Genre *LAMOUROUXIA* nov.

ESPÈCE-TYPE. — *Lamourouxia canaliculata* sp. nov.

DIAGNOSE. — Calloporidae dressée à zoarium formant un limbe monostratifié irrégulièrement découpé, directement fixé au substrat. Paroi zoéciale latérale très épaisse dans sa région antérieure, et renfermant une succession linéaire de lacunes alvéolaires reliées par des canalicules capillaires. Ovicelle close par l'opercule autozoécial.

ÉTYMOLOGIE. — Ce genre est créé en hommage à la mémoire du bryozoologue français J.V.F. LAMOUROUX.

Lamourouxia canaliculata sp. nov.

Fig. 1 A-D, 3 A, 8 A-F, 15 D-E, 16 C-D, 19 A

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 66, 515-505 m. — Stn CP 67, 500-510 m. — Stn KG 71, 2099 m.
SMIB 4 : stn DW 37, 500-530 m. — Stn DW 39, 525-560 m.

TYPES. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn DW 66, 505-515 m (MNHN-BRY-16694).
Paratype : *Ibidem* (MNHN-BRY-16693).

DESCRIPTION. — Le zoarium, dressé, constitue un limbe de contours irréguliers, très rarement de côtés presque parallèles, affectant la forme générale d'un thalle d'algue ; il atteint 2 cm de haut. Unilaminaire, il est habituellement tri- à quadrisérié, mais comportant souvent 5 séries autozoéciales à l'approche d'une ramification. Une ramification est généralement bi- ou plus rarement trisériée à sa base ; fréquemment, elle s'élargit ensuite plus ou moins rapidement, mais elle peut parfois demeurer bisériée sur 2 à 3 mm avant de se ramifier et que les séries autozoéciales ne divergent. Ce limbe est fixé au substrat (des Spongiaires), sans l'intermédiaire de rhizoïdes ou d'un pédoncule, et non par sa base, mais directement par l'une de ses faces latérales. Celle-ci s'étend alors latéralement sur le support de façon à y former une brève sole encroûtante ; le zoarium s'étend largement, aussi bien vers le haut que vers le bas, de part et d'autre de ce point latéral d'insertion.

Les zoécies marginales du limbe sont soit triangulaires, soit très généralement quadrangulaires ; dans ce dernier cas, le côté externe est rectiligne ; les deux côtés internes convergent vers l'axe de la colonie, contribuant à faire largement déborder latéralement vers l'extérieur la partie distale de la loge ; le côté proximal délimite l'insertion de la zoécie sur la région distale de l'autozoécie marginale précédente. Le côté externe mesure de 0,50 à 0,70 mm ; celui qui sert de base d'insertion sur la zoécie proximale mesure de 0,10 à 0,16 mm ; les deux autres côtés sont de longueur très variable. L'autozoécie mesure de 0,67 à 0,70 mm de long et 0,38-0,40 mm de large.

Les autozoécies de la région centrale du limbe sont de forme plus régulière et symétrique que les zoécies marginales : linguiformes ou plus ou moins losangiques (dans ce cas à région distale arrondie) et à partie proximale anguleuse, s'insérant sur une brève longueur (0,20 mm au maximum) à la portion distale de l'autozoécie précédente. Leur largeur et leur longueur, très constantes, varient respectivement de 0,39 à 0,42 mm et autour de 0,70 mm ; quelques très rares autozoécies peuvent toutefois dépasser cette taille, et atteindre alors une longueur de 0,90 mm. L'orifice est tout à fait distal, ovale, petit, large de 0,12-0,13 mm et long de 0,085-0,115 mm. L'opercule est de couleur brune ; il mesure 0,26 mm de large et 0,15 mm de long ; son sclérite marginal est très

marqué. Le nombre de tentacules, non établi exactement, est de l'ordre de la quinzaine. Le bord du très étroit gymnocyste est orné de nombreuses petites crénulations très rapprochées et de même taille.

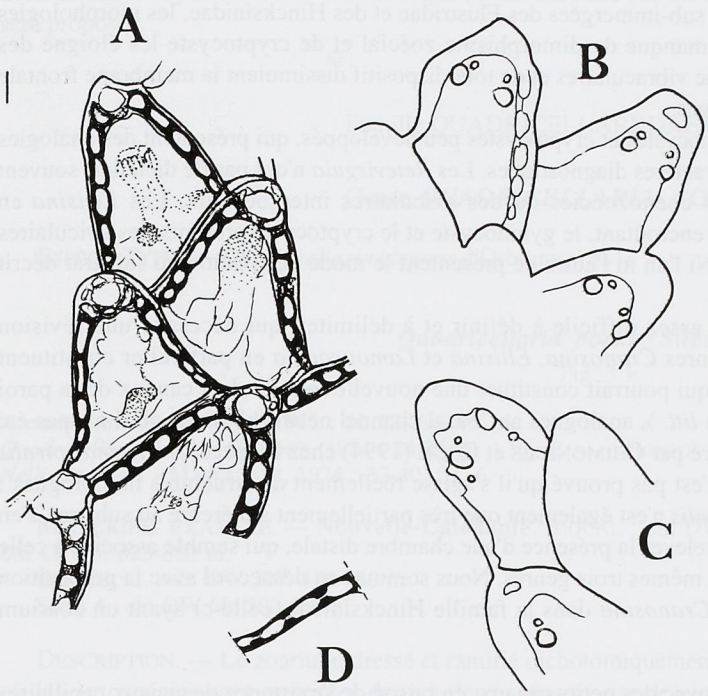


FIG. 1. — *Lamourouxia canaliculata* : **A**, Quelques autozoécies observées par transparence ; **B-C**, Quelques autozoécies en vue ventrale (schématique, indiquant l'emplacement des fenêtres) ; **D**, Détail des cavités alvéolaires se succédant à l'intérieur de la paroi. Échelle : 0,10 mm.

La frontale autozoéciale est membraneuse. La face basale présente de chaque côté une fenêtre non calcifiée bien visible, proximale à l'orifice, située dans l'alignement d'une demi-douzaine de très petites perforations alignées se succédant à faible distance des parois interzoéciales. Ces fenêtres sont ovales et mesurent 0,60 mm de long et 0,35-0,40 mm de large.

L'incubation s'effectue dans une ovicelle située à la partie distale de l'autozoécie reproductrice qu'elle recouvre ; l'autozoécie ovicellée mesure alors 0,98 mm de long. L'ovicelle est située dans le plan du zoarium, n'étant qu'à peine saillante en surface ; elle n'est donc pas hyperstomiale, mais constitue une expansion de la paroi distale de la zoécie en reproduction ; elle porte parfois à son extrémité distale un court aviculaire triangulaire d'orientation transversale. De forme triangulaire, elle mesure 0,34 mm de long et 0,37 mm de largeur à l'avant des opésiules. La cavité interne de l'ovicelle, en forme de cloche, longue de 0,25 mm et large de 0,30 mm, s'élargit en arc de cercle de 0,36 mm à sa partie proximale, et renferme dans sa concavité l'opercule (non recouvert par l'ovicelle). La partie distale de l'autozoécie, au-delà de la cavité d'incubation, forme une languette à extrémité arrondie, partiellement occupée par une cavité alvéolaire ovale, plus grande que celles décrites ci-après, puisque mesurant 0,06 mm de long et 0,10 mm de large.

Les parois autozoéciales des deux côtés distaux, l'interne comme l'externe, sont tout particulièrement épaisses. Elles renferment, de chaque côté, 5-6 cavités alvéolaires successives allongées et unisériées, et une cavité distale impaire, communiquant entre elles, chacune avec celle qui la précède et celle qui la suit, par des conduits capillaires, et qui ont probablement pour fonction d'alléger la colonie ; c'est en raison de l'existence de ce système de communications capillaires que nous ne pouvons assimiler ces cavités à des diételles. Ces cavités ont un diamètre constant de 0,06 mm et une longueur variant de 0,05 à 0,14 mm ; elles entourent aussi l'orifice autozoécial à la façon d'un collier. Limitées à la partie distale de l'autozoécie, elles sont absentes des parois de la région proximale, beaucoup plus fines. Les parties distales des autozoécies, celles dont les parois sont lacunaires, recouvrent les parties les plus proximales des autozoécies précédentes. La membrane frontale recouvre directement les cavités alvéolaires ; en revanche, le conduit capillaire qui assure la communication entre deux cavités successives traverse la cloison calcaire qui les sépare.

DISCUSSION. — Cette espèce, à frontale membraneuse, est un Bryozoaire du type pseudomalacostège. Elle ne présente toutefois ni gymnocyste proximal, ni cryptocyste, ce qui la différencie de la plupart des espèces actuellement rangées dans l'hétérogène famille Calloporidae chez laquelle l'un ou l'autre au moins de ces caractères est présent (cf. la diagnose réactualisée qu'en propose GORDON, 1984), et dont certains genres (*Ellisina*,

Retevirgula) possèdent comme elles des aviculaires associés aux ovicelles. Mais le genre *Lamourouxia* se caractérise par ailleurs par l'existence des lacunes alvéolaires pariétales communiquant par des canaux capillaires. L'absence des *"occlusor laminae"* écarte ce taxon des Chaperiidae, celle du processus épineux et de connections interzoéciales des Hiantoporidae, les ovicelles sub-immergées des Flustridae et des Hincksinidae, les morphologies zoariale et zoéciale des Farciminariidae ; le manque de dimorphisme zoécial et de cryptocyste les éloigne des Bryopastoridae ; l'absence d'onychocellaires, de vibraculaires et de tout dispositif dissimulant la membrane frontale l'écarte des autres familles de Pseudomalacostèges.

Les deux genres de Calloporidae, aux gymnocystes et cryptocystes peu développés, qui présentent des analogies avec cette espèce s'en écartent par plusieurs caractères diagnostiques. Les *Retevirgula* n'ont pas de diételles, souvent des tubes anastomotiques interzoéciaux, des coénozoécies ou des aviculaires interzoéciaux. Les *Ellisina* en paraissent plus proches, mais leur zoarium est encroûtant, le gymnocyste et le cryptocyste présents, les aviculaires interzoéciaux ; elles présentent des diételles. Ni l'un ni l'autre ne présentent le mode de fixation au substrat décrit ici, ni les cavités pariétales spécifiques.

Les Calloporidae constituent une famille assez difficile à définir et à délimiter, qui nécessite une révision d'ensemble ; selon P.L. COOK (*in litt.*), les genres *Cranosina*, *Ellisina* et *Lamourouxia* en particulier constituent un ensemble dont le statut est à définir, mais qui pourrait constituer une nouvelle famille. Les canaux de la paroi des *Lamourouxia* seraient, selon cet auteur (*in litt.*), analogues au "basal channel network" (mais où il n'a pas été observé de canaux capillaires), observé et figuré par CHIMONIDES et COOK (1994) chez l'espèce *Cranosina spiralis* décrite dans leur publication, mais en fait il n'est pas prouvé qu'il s'agisse réellement de structures homologues ; toutefois, il faut remarquer que *Cranosina spiralis* n'est également que très partiellement adhérente au substrat, s'en libérant en grande partie. Nous pouvons aussi relever la présence d'une chambre distale, qui semble associée à celle d'une cavité avicularienne subrostrale chez ces mêmes trois genres. Nous sommes en désaccord avec la proposition de CHIMONIDES et COOK de classer le genre *Cranosina* dans la famille Hincksinidae, celle-ci ayant un zoarium encroûtant, flustride.

ÉTYMOLOGIE. — Du Latin, *canaliculatus*, avec des petits canaux, en raison de l'existence de canaux capillaires dans l'épaisseur de la paroi.

RÉPARTITION. — Nouvelle-Calédonie, de 500 à 2099 m.

Famille *INCERTAE SEDIS* (P.L. COOK, *in litt.*)

? Genre ***PSEUDOLUNULARIA*** Cadée, Chimonides & Cook, 1989

ESPÈCE-TYPE. — *Pseudolunularia enigma* Cadée, Chimonides & Cook, 1989.

? ***Pseudolunularia*** sp.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOGÉOCAL : stn DW 253, 310-315 m.

DESCRIPTION. — L'unique petit zoarium recueilli (4 mm de diamètre) est aplati, discoïde et libre, formé d'autozoécies (linguiformes dans la partie centrale de la colonie, ovalaires et plus larges dans leur partie médiane à la périphérie de la colonie) de taille croissante vers l'extérieur, passant de 0,50 à 0,76 mm en longueur et de 0,24 à 0,40 mm en largeur ; le bord distal des autozoécies est arrondi. L'opésie est ovale, sans opésiules, et mesure de 0,23 à 0,39 mm de long et de 0,18 à 0,22 mm de large. En périphérie de la colonie, quelques zoécies vibraculaires triangulaires et effilées du côté proximal, longues de 0,80 à 1,15 mm et larges de 0,21-0,23 mm sont insérées entre les autozoécies. Elles portent une mandibule (fouet vibraculaire) longue de 0,14 à 2,6 mm, dont la partie libre du rachis mesure de 1,48 à 1,60 mm ; le rachis est rectiligne ; la mandibule ne porte ni denticules ni ailes. Il n'a pas été observé d'ovicelles. La face inférieure des autozoécies est généralement imperforée, seules les plus périphériques d'entre elles présentent une ou deux perforations.

REMARQUE. — Si notre identification est exacte compte tenu de l'état de l'échantillon, ce genre décrit de l'Indo-Pacifique oriental était encore inconnu de la faune néo-calédonienne. La colonie étudiée ici était trop jeune pour être déterminable, et partiellement endommagée ; aussi n'a-t'elle pas été figurée et aucune identification spécifique n'en sera proposée.

Famille QUADRICELLARIIDAE Gordon, 1984

Genre ***QUADRICELLARIA*** d'Orbigny, 1851

ESPÈCE-TYPE. — *Quadricellaria elegans* d'Orbigny, 1851.

Quadricellaria bocki (Silén, 1941)

Fig. 3 F

Acanthodesia bocki Silén, 1941 : 20-22, fig. 15-16.
Quadricellaria bocki - GORDON, 1984 : 24-25, pl. 1 fig. B. — D'HONDT, 1986 : 711.
Nelliella bocki - MAWATARI, 1974 : 37-40, fig. 6.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 46, 570-610 m. — Stn CP 52, 540-600 m. — Stn CP 75, 825-860 m.
BIOGÉOCAL : stn DW 307, 470-480 m.
SMIB 4 : stn DW 60, 500-535 m.

DESCRIPTION. — Le zoarium, dressé et ramifié dichotomiquement, est formé de longs entre-noeuds quadrisériés, où les autozoécies sont opposées deux à deux, séparés par des joints chitineux. Chaque entre-noeud porte sur chacune de ses faces de 4 à 6 autozoécies rectangulaires à côtés presque parallèles (un peu plus étroites proximalement), alternantes d'une face à l'autre, mesurant de 0,44 à 0,76 mm de long et de 0,155 à 0,190 mm de large. Les opésies, elles-mêmes de contours rectangulaires mais dont les angles proximaux sont en fait arrondis, mesurent de 0,22 à 0,34 mm de long et de 0,14 à 0,18 mm de large. Il n'a pas été observé d'aviculaires, ni d'ovicelles (celles-ci n'ont actuellement été observées que sur des spécimens de Nouvelle-Calédonie décrits par D'HONDT, 1986).

RÉPARTITION. — Japon, Nouvelle-Calédonie, Kermadec. Profondeur : 19-860 m.

Genre ***NELLIA*** Busk, 1852

ESPÈCE-TYPE. — *Cellaria tenella* Lamarck, 1816.

Nellia tenella (Lamarck, 1816)

Fig. 3 G

Nellia tenella Lamarck, 1816 : 135. — D'HONDT, 1979 : 17.
Nellia oculata Busk, 1852 : 18, pl. 64 fig. 6, pl. 65 bis fig. 4. — HARMER, 1926 : 240-245, fig. 3-4, pl. 14 fig. 18-20. — OSBURN, 1950 : 119-120, pl. 13 fig. 4. — COOK, 1968 : 156-157. — WINSTON & CHEETHAM, 1984 : 257-265.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. MUSORSTOM 4 : stn DW 187, 65-120 m.
BIOGÉOCAL : stn KG 275, 1959 m.

DESCRIPTION. — Le zoarium arborescent est ramifié dichotomiquement et quadrisérié ; il est constitué d'entre-noeuds quadrisériés séparés par des joints chitineux cylindriques. Les autozoécies, rectangulaires, alternent d'une

série longitudinale à l'autre et sont opposées deux à deux. Il n'existe pas d'épines. La surface frontale est occupée sur les 3/4 de sa longueur par une opésie à côtés presque parallèles et à extrémités arrondies. Il existe une paire de minuscules aviculaires pairs proximaux à l'opésie. La longueur autozoéciale à mi-longueur des entre-noeuds est de 0,48-0,53 mm, la largeur de 0,18-0,21 mm.

RÉPARTITION. — Une grande partie des mers chaudes du globe : toute l'Indonésie, Australie, Nouvelle-Calédonie, Ceylan, côtes atlantique et pacifique des U.S.A., Antilles, côte ouest africaine, de 0 à 150 m. La récolte de cette espèce à grande profondeur (1959 m), lors de la campagne BIOGÉOCAL, est donc très surprenante, sinon suspecte.

Famille FLUSTRIDAE Fleming, 1828

REMARQUE. — Famille nouvelle pour la faune néo-calédonienne.

Genre *CARBASEA* Gray, 1848

ESPÈCE-TYPE. — *Flustra carbasea* Ellis & Solander, 1786.

Carbasea aff. linguiformis Harmer, 1926

Carbasea linguiformis Harmer, 1926 : 249-250, fig. 7, pl. 15 fig 5.

MATÉRIEL EXAMINÉ. — **Philippines**. MUSORSTOM 3 : stn CP 101, 195 m.

DESCRIPTION. — Le matériel consiste en quelques fragments de zoarium unistratifié, formés de 5 à 7 autozoécies à côtés presque parallèles, seulement un peu plus élargies selon les cas, soit distalement, soit à mi-longueur ; ces autozoécies sont très épaisses, ce qui par un effet trompeur de perspective donne faussement l'impression que le zoarium est bordé par des coénozoécies latérales. Le cryptocyste est étroit, et l'orifice distal est subterminal. La région proximale des autozoécies est symétrique par rapport à l'axe longitudinal et s'étend, en forme de queue de poisson, latéralement de part et d'autre de la région distale de l'autozoécie précédente. La longueur autozoéciale varie de 0,75 à 1,02 mm, la largeur de 0,32 à 0,41 mm. Il n'existe pas d'aviculaires ni d'épines. L'ovicelle globuleuse, en forme de ventouse médicale, longue de 0,37-0,40 mm, a une largeur maximale, dans sa partie ampulliforme, de 0,36-0,38 mm ; elle est endotochoïdale, incluse dans la partie proximale de l'autozoécie qui la suit distalement dans la même file longitudinale.

DISCUSSION. — La clé de détermination des genres de Flustridae publiée par D'HONDT et REDIER (1977), modifiée par D'HONDT (1983), ne laisse aucun doute sur l'appartenance de ces échantillons au genre *Carbasea*. L'absence de zoarium complet ne permet pas de déterminer avec certitude à quelle espèce ils appartiennent, mais le fait qu'ils proviennent d'une colonie laciniée conduit à les attribuer à *C. linguiformis* Harmer, 1926, dont les zoécies ont la même morphologie. *C. linguiformis* n'est actuellement connue que par un seul échantillon de Nouvelle-Guinée, dragué à 411 m de profondeur. La présence de cette espèce aux Philippines, par 195 m de profondeur, est donc tout à fait plausible.

Carbasea laterogranulata sp. nov.

Fig. 4 A, C

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 31, 850 m. — Stn DW 51, 680-700 m. MUSORSTOM 4 : stn DW 220, 505-550 m.

TYPE. — *Holotype* : Nouvelle-Calédonie, BIOCAL, stn DW 31, 850 m (MNHN-BRY-16686).

DIAGNOSE. — *Carbasea* à autozoécies de grandes dimensions (environ 1 mm de long pour 0,6 mm de large), à zoarium monostratifié, à parois latérales externes rendues rugueuses par la présence sur la totalité de leur longueur de plusieurs centaines de petites verrues granuleuses.

DESCRIPTION. — Le zoarium lacinié est dressé et unilaminaire, non ramifié, ni lobé, sans portion basale encroûtante sur un substrat ; il mesure 8 cm de long pour 6 mm de large ; formé de 1 à 9 séries autozoéciales, il est fixé au support par un faisceau cylindrique de rhizoïdes. Les autozoécies sont de grande taille, ovoïdes, arrondies distalement, tronquées proximalement, et de dimensions très homogènes ; leur longueur ne varie que de 1,15 à 1,20 mm, leur largeur de 0,62 à 0,68 mm. L'opercule, tout à fait distal, mesure 0,12 mm de long et 0,41 mm de large. Les bords latéraux externes des autozoécies marginales sont ornés d'innombrables petites verrues granuleuses, généralement un peu plus longues que larges, de 0,02 à 0,03 mm de longueur, donnant à cette surface latérale une apparence de râpe. Le bord distal externe des autozoécies marginales est saillant vers l'extérieur, formant un socle sur lequel vient s'insérer la partie proximale de l'autozoécie suivante.

DISCUSSION. — Morphologiquement, cette espèce rappelle *Carbasea indivisa* (Busk, 1852), mais les zoariums de cette dernière ont tendance à acquérir une morphologie cupuliforme, ce qui n'est pas le cas ici. Les autozoécies de *C. laterogranulata* sont plus grandes, bien que de même forme. La principale caractéristique de la nouvelle espèce décrite ici réside dans l'aspect très particulier, granuleux, de l'ornementation des bords latéraux externes des autozoécies marginales du zoarium ; *C. indivisa* présente aussi des granulations superficielles, mais celles-ci sont portées par la face dorsale des autozoécies et non par les faces latérales.

ÉTYMOLOGIE. — Du Latin, *latus*, côté, et *granulata*, qui a des grains, en raison de la présence de nombreuses petites verrues portées par les bords latero-externes des zoécies marginales.

RÉPARTITION. — Nouvelle-Calédonie, de 505 à 850 m.

Famille FARCIMINARIIDAE Busk, 1852

Genre ***COLUMNELLA*** Levinsen, 1914

ESPÈCE-TYPE. — *Columnaria borealis* Levinsen, 1909.

Columnella magna (Busk, 1884)

Fig. 4 F-G

Farciminaria magna Busk, 1884 : 49-50, pl. 5 fig. 1.
Levinsenella magna - HARMER, 1926 : 402. — HASTINGS, 1943 : 393-394.
Columnella magna - D'HONDT, 1975 : 563; 1981a : 13. — HAYWARD & COOK, 1979 : 67, fig. 9A. — HAYWARD, 1981 : 29-300, fig. 6. — GORDON, 1986 : 26, pl. 2 fig. C-D.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn CP 13, 3690-3740 m (forme typique).
BIOGÉOCAL : stn CP 260 , 1820-1880 m (var. *armata*).

DESCRIPTION. — Le zoarium est dressé, quadrisérié, et ramifié dichotomiquement. La longueur autozoéciale varie de 1,40 à 1,95 mm, la largeur de 0,27 à 0,49 mm. Les bords latéraux de l'autozoécie sont parallèles sur la plus grande partie de la longueur, la loge ne s'élargissant qu'au niveau de l'opésie ou parfois brièvement à mi-longueur ; il n'existe pas d'épines. L'ovicelle globuleuse a 0,60 mm de long et 0,70 mm de large ; elle est ornée de fines lignes d'apparence granuleuse, convergeant vers l'orifice. Les zoécies de la station CP 13 sont toutes inermes ; la plupart de celles de la station CP 260 présentent l'aviculaire caractéristique de la variété *armata*, décrite et figurée par BUSK (1884), différenciant cette variété de la forme typique ; cet aviculaire partiellement dressé, long de 0,20 mm, possède une petite opésie circulaire distale de 0,80 mm de diamètre, portant une petite mandibule hémicirculaire de 0,50 mm de long.

RÉPARTITION. — Océan Atlantique occidental et oriental, sauf régions polaires et sub-polaires ; Kermadec, bassin de Tasmanie, banc de Bellona ; Heard ; Afrique du Sud ; côte est-africaine. Profondeur : 680-5340 m.

REMARQUES. — Genre et espèce signalés pour la première fois de Nouvelle-Calédonie. HARMER (1926) a mis en doute la validité de la variété *armata*, ayant aussi trouvé des aviculaires sur le spécimen original de la forme typique. En fait la situation est plus complexe. L'aviculaire est peu fréquent chez les spécimens sud-africains étudiés par HAYWARD et COOK (1979) et chez ceux des campagnes de la *"Galathea"* de provenances diverses examinés par HAYWARD (1981), sans que cet auteur ne précise s'il existe ou non des différences en fonction des provenances géographiques. GORDON (1986) n'en a pas observés dans son matériel des Kermadec. Dans un même prélèvement, D'HONDT (1975) a trouvé simultanément des colonies portant des aviculaires sur pratiquement toutes les autozoécies, et d'autres qui en étaient complètement dépourvues ; dans une autre étude (D'HONDT, 1981a), les colonies appartenaient selon les localités soit à la forme typique, soit à la variété *armata* ; D'HONDT en concluait qu'il était impossible, dans l'état actuel des connaissances, de décider si la présence ou l'absence de l'aviculaire étaient des constantes génétiques ou des caractères réversibles liés à l'environnement. En fait, le faisceau des observations actuelles suggèrerait plutôt que les deux hypothèses soient simultanément plausibles ; dans certaines localités, la présence ou l'absence de l'aviculaire pourraient être des caractères génétiquement fixés dans la population, alors qu'il pourrait exister une variabilité individuelle obéissant aux lois de la génétique dans d'autres populations.

Columnella vipera sp. nov.

Fig. 4 E, 5 A-B, 20 E

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 41, 380 m. — Stn CP 52, 540-600 m. — Stn DW 53, 975-1005 m. — Stn CP 54, 950-1000 m. — Stn CP 55, 1160-1175 m. — Stn CP 60, 1530-1480 m. — Stn CP 62, 1395-1410 m. — Stn DW 70, 960-965 m. — Stn KG 76, 880 m.

MUSORSTOM 4 : stn CP 238, 500-510 m.

BIOGÉOCAL : stn CP 205, 1350-1380 m. — Stn CP 297, 1230-1240 m. — Stn DW 313, 1600-1640 m (?).

Îles Loyauté. — MUSORSTOM 6 : stn DW 396, 1400 m.

TYPES. — *Holotype* : BIOCAL, stn DW 41, 380 m (MNHN-BRY-16581).

Paratypes : BIOCAL, stn CP 54, 950-1000 m (MNHN-BRY-16593) ; stn CP 55, 1160-1175 m (MNHN-BRY-16584) ; stn DW 70, 960-965 m (MNHN-BRY-16600). — BIOGÉOCAL, stn CP 205, 1350-1380 m (MNHN-BRY-16588). — MUSORSTOM 6, stn DW 396, 1400 m (MNHN-BRY-16595).

DIAGNOSE. — *Columnella* à zoécies avicullariennes localisées à la base des ramifications zoariales, sur les arêtes internes des branches (quadrisériées) ; cet aviculaire peut être unique et alors situé à la partie proximale de l'arête, ou il peut exister plusieurs aviculaires sur une même arête. Les aviculaires, non saillants, sont inclus dans la partie proximale d'une autozoécie ; cette région proximale est séparée par une constriction du reste de l'autozoécie, et affecte plus ou moins nettement la forme d'une tête de reptile du genre *Vipera*. Mandibule avicularienne incluse dans le plan de la frontale. Ovicelle occupant tout l'intérieur d'une coénozoécie incluse dans le zoarium.

DESCRIPTION. — Le zoarium arborescent, quadrisérié et ramifié dichotomiquement, est fixé au substrat par un faisceau de rhizoïdes issus d'une région discoïde de 0,10 mm de diamètre de la partie proximale de certaines des autozoécies. A la base de la colonie, ces rhizoïdes sont soudés de façon à constituer un axe rigide et rectiligne atteignant 3 cm de haut et 3 mm de large, et engainant les autozoécies les plus proximales. Les autozoécies, inermes et peu calcifiées, sont linguiformes ou presque rectangulaires et alors à grands côtés sub-parallèles, parfois tendant vers une morphologie pisciforme ; leur bord antérieur est arrondi, le bord postérieur légèrement incurvé ; elles mesurent de 0,20 à 0,30 mm de large (pour les plus larges, à la base des branches) et de 0,80 à 1,12 mm de long ; l'opercule hémicirculaire a 0,28 mm de long et 0,22-0,24 mm de large. Une coénozoécie pyriforme, à parois épaisses, sépare les branches nées de chaque ramification ; sa longueur varie selon les cas de 0,50 à 1,12 mm, sa largeur distalement de 0,40 à 0,50 mm, proximalement de 0,12 à 0,16 mm ; elle est précédée par

une minuscule autozoécie. Il arrive qu'à l'approche des ramifications les autozoécies aient une forme plus irrégulière, avec un côté externe rectiligne et un côté interne formant un angle saillant vers l'axe zoarial.

L'ovicelle est renflée par rapport au plan de la colonie ; de contours presque carrés ou ampulliformes - elle est alors légèrement rétrécie du côté proximal (de 0,60 mm distalement et de 0,50 mm proximalement, par exemple) - à bords latéraux presque parallèles mais à côté distal arrondi vers l'avant, elle est fermée par l'opercule autozoécial. Elle est immergée dans une coénozoécie hexagonale dont elle occupe pratiquement tout l'intérieur, et qui est située distalement par rapport à l'autozoécie reproductrice ; cette coénozoécie a 0,74 mm de long et 0,55 mm de largeur maximale. L'ovicelle elle-même a une longueur de 0,48-0,60 mm et une largeur de 0,45-0,60 mm ; sa surface présente une très discrète réticulation convergeant vers l'orifice. Deux zoécies avicullariennes encadrent la partie distale de la coénozoécie incluant l'ovicelle ; elles sont allongées, quadrangulaires et plus ou moins losangiques, longues de 0,80 à 0,82 mm et larges de 0,20 mm dans leur portion la plus renflée ; la mandibule, comparable à celle décrite ci-après dans le cas des aviculaires normaux, est située très proximalement et orientée vers la région distale.

Chaque aviculaire porte une mandibule hémicirculaire dirigée distalement. Non saillant, situé dans le plan de la frontale, il est inclus dans la courte région proximale d'une autozoécie, qui en apparaît comme un diverticule séparé par une constriction simulant un cou ; il est situé sur l'une des deux arêtes internes de chacune des deux branches issues d'une ramification ; parfois seules les autozoécies les plus proximales portent de tels aviculaires, mais il arrive souvent que plusieurs autozoécies successives d'une même série longitudinale présentent leur aviculaire sur une même arête. Les diverticules proximaux aviculifères ont, souvent très nettement, la forme d'une tête de serpent de la famille des Viperidae ; ils mesurent de 0,50 à 0,80 mm de long et de 0,30 à 0,36 mm de largeur maximale, la mandibule ayant une longueur de 0,11 à 0,12 mm de long et de 0,22 à 0,24 mm de large. Les aviculaires les plus proximaux d'une même bifurcation ne sont pas situés au même niveau sur les deux branches opposées. Très exceptionnellement, ces aviculaires peuvent manquer sur certaines arêtes.

DISCUSSION. — Le mode d'insertion de la zoécie avicularienne, immergée dans un diverticule proximal d'une autozoécie, et non saillante à l'extérieur, est unique dans ce genre. Ce diverticule a par surcroît une forme très particulière, et la forme de la mandibule avicularienne est elle-même inhabituelle dans ce genre. La localisation des aviculaires sur les arêtes internes des branches zoariales est, elle aussi, caractéristique.

ÉTYMOLOGIE. — Le nom spécifique est évocateur de la morphologie du diverticule autozoécial aviculifère, dont les contours rappellent ceux d'une tête de reptile ophidien du genre *Vipera*.

RÉPARTITION. — Nouvelle-Calédonie et îles Loyauté, de 380 à 1640 m.

Famille BRYOPASTORIDAE nov.

DIAGNOSE. — Zoarium dressé, en forme de baguette et non ramifié, ou articulé et ramifié, portant des rhizoïdes à sa base. Axe et branches à quatre faces, cylindriques, et / ou en forme de lentilles bilaminaires ; zoécies alternantes. Cryptocyste zoécial bien développé, déprimé ; gymnocyste absent. Opésie occupant approximativement la moitié de la longueur zoéciale ; chaque angle disto-latéral est parfois creusé d'une dépression ménagée pour le muscle d'occlusion. Pas d'épines orales. Aviculaires vicariants, identiques aux autozoécies mais avec de grandes mandibules, ou absents. Incubation des embryons interne dans des autozoécies, ou à l'intérieur de zoécies femelles très développées ou de structures ovicelliennes endozoéciales. Ancestrula enracinée, ressemblant à une autozoécie, mais de plus petites dimensions.

Nous proposons l'insertion dans cette famille, connue du Maestrichtien à l'époque actuelle, des genres suivants : *Bryopastor* Gordon, 1982, *Dioptropora* Marsson, 1887, *Escharinella* d'Orbigny, 1851, *Monticellaria* Voigt, 1987, *Pseudothyracella* Labracherie, 1975, et *Thyracella* Voigt, 1930 . Il n'est pas à exclure que les genres actuels *Acanthodesiomorpha* d'Hondt, 1981a et *Cookinella* d'Hondt, 1981a puissent aussi trouver place dans cette famille ; mais comme ils sont encore incomplètement connus, nous avons jugé prématuré de les y inclure.

REMARQUES. — Les genres inclus dans la famille Bryopastoridae sont caractérisés, aussi bien par leur port dressé et leur enracinement que par leurs zoécies dépourvues d'épines orales, l'absence d'aviculaires adventifs et d'ovicelles hyperstomiales. Les affinités du genre encroûtant *Hagenowinella* Canu, 1900, du Maestrichtien, chaperiidé présumé (GORDON, 1982), avec les bryopastoridés du même Maestrichtien, sont incertaines. Les Bryopastoridae et *Hagenowinella* pourraient toutes deux être issues d'ancêtres onychocellidiens. Le genre chaperiidien néo-zélandais *Patsyella* Brown, 1948, présent du Miocène Supérieur à l'époque actuelle, semble ne présenter qu'une ressemblance superficielle avec les bryopastoridés - l'une au moins des espèces qu'il renferme a des épines articulées.

ÉTYMOLOGIE. — Famille créée à partir du genre *Bryopastor* préexistant, dont les colonies de l'espèce-type, recourbées à leur partie supérieure, ont la forme d'une canne de berger.

Genre ***BRYOPASTOR*** Gordon, 1982

ESPÈCE-TYPE. — *Heterocella pentagona* Canu & Bassler, 1929.

Bryopastor challengeri Gordon, 1982

Fig. 4 D

Bryopastor challengeri Gordon, 1982 : 20, fig. 9 D-E ; 1986 : 40, pl. 10 fig. B-C.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOGÉOCAL : stn KG 210, 1190 m. — Stn CP 232, 760-790 m. — Stn DW 253, 310-315 m. — Stn DW 307, 470-480 m. — Stn DW 313, 1600-1640 m.

DESCRIPTION. — Le zoarium est vinculariiforme, dressé et arqué ; il est quadrisérié, les autozoécies alternant par paires opposées. Les fragments étudiés, effilés à leur partie proximale, ne comportent que des autozoécies inermes ; ils présentent des loges femelles ou à joints, comparables à celles décrites par GORDON (1982), mais pas d'aviculaires. La longueur autozoéciale varie de 0,78 à 0,94 mm, la largeur de 0,42 à 0,56 mm. L'opésie a des côtés parallèles sur une partie de sa longueur et se rétrécit proximalement ; pour une longueur de 0,24 mm, elle a une largeur proximalement de 0,70-0,80 mm et distalement de 0,17 mm. Les orifices de passage des muscles occluseurs sont visibles distalement à l'orifice, un de chaque côté. Le cryptocyste, développé proximalement et distalement à l'opésie, a une surface granuleuse. Les *occlusor laminae* se présentent comme deux crêtes calcaires convergeant distalement.

RÉPARTITION. — Nouvelle-Zélande (plateau du *"Challenger"*, à l'est du détroit de Cook). Espèce nouvelle pour la Nouvelle-Calédonie. Profondeur : de 310 à 1640 m.

Bryopastor octogonos sp. nov.

Fig. 5 C-D

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 44, 440-450 m (échantillon érodé, identification incertaine).
BIOGÉOCAL : stn DW 253, 310-315 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOGÉOCAL, stn DW 253, 310-315 m (MNHN-BRY-16649).

DIAGNOSE. — *Bryopastor* à zoarium cylindrique constitué de 8 séries longitudinales d'autozoécies. *Occlusor laminae* très rapprochés, délimitant une étroite fente à bords parallèles, précédant un élargissement proximal de forme ovale. Opésie grande (0,32-0,40 mm de long) et nettement plus longue que large, occupant environ un tiers de la surface frontale.

DESCRIPTION. — Le zoarium, robuste et non ramifié, de section cylindrique, est formé de 8 séries alternantes d'autozoécies, les séries diamétralement opposées se correspondant deux à deux. Chaque autozoécie est partagée en deux parties sensiblement d'égale longueur, une distale portant l'opésie, une proximale correspondant essentiellement au cryptocyste et se rétrécissant graduellement en direction proximale. La longueur autozoéciale varie de 1,1 à 1,2 mm, la largeur de 0,55-0,60 mm distalement et de 0,32 à 0,39 mm proximalement. Les limites interzoéciales sont saillantes. L'opésie mesure 0,32-0,40 mm de long et 0,20-0,26 mm de large. Les gros orifices triangulaires des muscles occluseurs sont situés en position disto-latérale par rapport à l'orifice, très proches de celui-ci. Les *occlusor laminae* forment des lames presque parallèles, très rapprochées l'une de l'autre, ne laissant entre elles qu'une mince fente longitudinale ; ils se touchent proximalement, avant de s'écarter pour ménager entre eux un élargissement de forme ovale, allongé, deux à trois fois plus large que la fente qui les sépare distalement. Il n'a été observé ni de zoécies femelles, ni à joints. Le cryptocyste est orné de fines granulations espacées.

DISCUSSION. — Le nombre des séries autozoéciales longitudinales distingue cette espèce de la plupart des autres du genre. *B. challengeri* et *B. tongensis* sont quadrisériées, *B. pentagonus* quintisériée, exceptionnellement hexasériée. Les deux autres espèces de *Bryopastor* à zoarium octosérié, *B. crassus* et *B. elongatus*, ont respectivement la première une disposition très différente des *occlusor laminae* (voir plus loin), la seconde des opésies proportionnellement de très petite taille et des loges présumées femelles démesurément allongées.

ÉTYMOLOGIE. — Du Latin, *octogonos*, qui a huit angles, les branches du zoarium comportant huit angles en section transversale.

RÉPARTITION. — Nouvelle-Calédonie, de 310 à 450 m.

Bryopastor pentagonus (Canu & Bassler, 1929)

Fig. 5 G, 6 A-B

Heterocella pentagona Canu & Bassler, 1929 : 111-112, pl. 9 fig. 13-16.
Bryopastor pentagonus - GORDON, 1982 : 18-20, fig. 9 A, F.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 08, 435 m. — Stn DW 38, 360 m. — Stn DW 46, 570-610 m. — Stn DW 66, 505-515 m.
MUSORSTOM 4 : stn CC 175, 355 m.
BIOGÉOCAL : stn 232, 760-790 m. — Stn DW 307, 470-480 m.

DESCRIPTION. — Le zoarium arborescent est constitué de 5 séries alternantes d'autozoécies longues de 0,72 à 1,00 mm et larges de 0,37 à 0,41 mm distalement, 0,27 à 0,30 mm proximalement, arrondies à leur extrémité distale (nous n'avons pas observé sur notre matériel de portions à 6 séries). L'opésie, qui déborde sur la moitié proximale de l'autozoécie, est tantôt régulièrement ovale, tantôt à côtés presque parallèles (et dans ce cas à bords proximal droit et distal arrondi) ; elle mesure de 0,12 à 0,16 mm de large et de 0,28 à 0,31 mm de long. Les petits orifices des muscles occluseurs sont circulaires, et situés disto-latéralement à l'opésie, à proximité du bord de celle-ci. Le cryptocyste est finement granuleux.

RÉPARTITION. — Philippines, Nouvelle-Zélande. Espèce nouvelle pour la faune néo-calédonienne. Profondeur : 310-790 m.

Bryopastor crassus sp. nov.

Fig. 6 C-D

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn. DW 36, 650 m. — Stn DW 41, 380 m. — Stn DW 44, 440-450 m. — Stn DW 51, 680-700 m.

TYPES. — *Holotype* : BIOCAL, stn DW 36, 650 m (MNHN-BRY-16660).
Paratype : BIOCAL, stn DW 51, 680-700 m (MNHN-BRY-16664).

DIAGNOSE. — *Bryopastor* à zoarium robuste de section hexagonale. *Occlusor laminae* formant une fente longitudinale large, plus ou moins nettement triangulaire, plus large proximalement que distalement.

DESCRIPTION. — *Bryopastor* à zoarium robuste (jusqu'à 1,4 mm de diamètre) de section hexagonale, formé de longues autozoécies spatuliformes de 0,99-1,30 mm de long et larges de 0,64-0,82 mm. L'opésie triangulaire, à angle mousse dirigée distalement, est longue de 0,28-0,40 mm et large à sa base de 0,20-0,29 mm et à son sommet de 0,035-0,050 (exceptionnellement jusqu'à 0,10) mm. Les orifices des muscles occluseurs sont situés de part et d'autre de la région distale de l'opésie, et débordent distalement au-delà de son extrémité. Les *occlusor laminae*, qui constituent deux lames planes se rejoignant distalement, sont plus ou moins écartés proximalement ; ils déterminent entre eux une fente de forme nettement triangulaire, parfois presque équilatérale, et se rétrécissant graduellement en direction distale ; leur écartement à la base varie selon les colonies. Quelques autozoécies un peu plus longues que leurs voisines (1,20 mm contre 1,00-1,06 mm), à opésies régulièrement ovales, longues de 0,60 mm et larges de 0,40 mm, sont présumées femelles (elles sont les plus nombreuses à la station DW 51). Cryptocyste orné de denses petites granulations subglobuleuses.

DISCUSSION. — La morphologie de la fente déterminée par les *occlusor laminae* est typique. Le zoarium de cette espèce est par ailleurs régulièrement hexagonal, caractère qui n'est connu, dans le genre *Bryopastor*, que dans certaines portions de colonies de *B. pentagonus*, espèce dont les colonies sont habituellement de section pentagonale et dont les *occlusor laminae* se présentent sous la forme de crêtes.

ÉTYMOLOGIE. — Du Latin, *crassus*, épais, en raison de l'épaisseur des colonies.

RÉPARTITION. — Nouvelle-Calédonie, de 380 à 700 m de profondeur.

Bryopastor sp.
Fig. 6 E

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOGÉOCAL : stn DW 307, 470-480 m.

DESCRIPTION. — Les autozoécies mesurent 0,82-0,85 mm de long et 0,40-0,42 mm de large distalement, 0,30-0,34 mm proximalement ; leur opésie a 0,30 mm de large et 0,32-0,35 mm de long. Sur l'un des fragments zoariaux étudiés existe une grande autozoécie isolée, présumée femelle, longue de 1,24 mm et large de 0,66 mm du côté distal, de 0,50 mm du côté proximal ; son opésie mesure 0,56 mm de long et 0,54 mm de large.

REMARQUE. — Vu l'état d'érosion du matériel, l'identification générique est elle-même douteuse.

Genre ***PSEUDOTHYRACELLA*** Labracherie, 1975

ESPÈCE-TYPE. — *Pseudothyracella pulchella* Labracherie, 1975.

DIAGNOSE COMPLÉTÉE. — Zoarium arborescent candelabriforme, ramifié dichotomiquement, densément recouvert de rhizoïdes. Zoarium dichotomiquement ramifié, chacune des deux branches principales étant constituée de petits entre-noeuds portant chacun distalement vers l'intérieur un très long entre-noeud non ramifié. Joints peletonnés. Autozoécies peu alternantes, parfois presque au même niveau d'une série à l'autre. Zoécies femelles beaucoup plus grandes que les autozoécies normales.

Pseudothyracella candelaber sp. nov.
Fig. 5 E, H ; 12 J ; 13 B-E ; 14 ; 18 A-D ; 19 B-D

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 31, 850 m. — Stn DW 38, 360 m. — Stn DW 46, 570-610 m. — Stn DW 51, 700-680 m. — Stn DW 70, 965-960 m. — Stn CP 109, 495-515 m.

MUSORSTOM 4 : stn CP 216, 490-515 m. — Stn DW 220, 505-550 m. — Stn CP 236, 495-550 m.
BIOGÉOCAL : stn DW 296, 1230-1270 m. — Stn CP 297, 1230-1240 m. — Stn DW 307, 470-480 m.
SMIB 4 : stn DW 55, 215-260 m.
Îles Loyauté. MUSORSTOM 6 : stn DW 421, 245 m.
Nouvelle-Zélande. West Norfolk Ridge. Wanganella Bank : stn BS 886, 29.01.1981 : 32°35,3'S, 167°41,8'E, 437-422 m (NMNZ). — Three Kings Ridge : stn U582, 31°52,0'S, 172°26,5'E, 1058-988 m (NZOI).

TYPES. — Nouvelle-Calédonie. *Holotype* : BIOCAL, stn DW 46, 570-610 m (MNHN-BRY-16406). *Paratypes* : BIOCAL, stn DW 70, 960-965 m (MNHN-BRY-16429) ; stn CP 109, 495-515 m (MNHN-BRY-16427).

DIAGNOSE. — *Pseudothyracella* actuelle à zoarium robuste et joints chitineux pelotonnés, à autozoécies de forme régulièrement hexagonale mesurant environ 0,80 mm de long, à opésie distale ovale à tendance quadrangulaire presque deux fois plus longue que large. Zoécies femelles à bords latéraux parallèles, droits, à opésie ovale, une fois et demie plus grande qu'une autozoécie normale. Zoécies avicularienes de même longueur que les autozoécies, mais nettement élargies proximalement, et avec un cryptocyste en occupant la moitié de la longueur, presque deux fois plus large que celui des autozoécies normales.

DESCRIPTION. — Le zoarium, dressé et ramifié dichotomiquement, atteint 10 cm de haut ; il comporte six séries longitudinales de loges et a des contours hexagonaux, parfois presque circulaires, en section transversale. D'une partie inférieure, formée de quelques entre-noeuds successifs séparés par des joints chitineux pelotonnés, partent deux ramifications principales formant entre elles un angle très ouvert ; chacune de ces deux ramifications est constituée par une chaîne de courts entre-noeuds "primaires", longs de 4-7 mm, eux-mêmes séparés les uns des autres par des joints pelotonnés. Chacun de ces entre-noeuds porte à son extrémité distale, séparé aussi par un joint pelotonné, un entre-noeud "secondaire" extrêmement allongé et non ramifié, de longueur décroissante de la partie proximale de la colonie (où il atteint la longueur de 6,4 cm) vers la partie distale ; ainsi tous les entre-noeuds "secondaires" issus d'une même branche principale atteignent-ils sensiblement le même niveau. Toutes les branches "secondaires" étant dirigées verticalement et parallèlement à l'axe du zoarium, chacune des deux branches principales et ses ramifications se présente donc comme un peigne à dents de longueur décroissante vers le haut, et symétrique d'un peigne analogue par rapport à l'axe longitudinal ; l'ensemble de la colonie affecte donc une forme de candélabre, comme certaines espèces de Bifaxarioidea. Le diamètre des entre-noeuds est de 1,4 mm.

Les entre-noeuds qui constituent la partie basale de la colonie sont plus aplatis que les autres entre-noeuds. Ils sont recouverts par un feutrage de longs rhizoïdes longitudinaux, issus au nombre de un ou deux par loge des parties proximo-frontales des autozoécies les plus inférieures. Les branches principales sont elles-mêmes bordées, de chaque côté, par un épais feutrage de rhizoïdes.

Les autozoécies sont hexagonales ; elles alternent, mais le décalage d'une série zoéciale à l'autre est peu marqué ; elles mesurent de 0,77 à 0,84 mm de long et de 0,38 à 0,42 mm de large ; leur opésie, de forme ovale à tendance quadrangulaire, a 0,36-0,38 mm de haut et 0,18-0,22 mm de large ; il n'y a pas de denticules aperturaux ; l'opercule a 0,16-0,18 mm de long et 0,28-0,30 mm de large ; le cryptocyste est très finement et peu densément granuleux, les tubercules étant plus serrés latéralement que proximalement. Les zoécies femelles sont assez nombreuses, et exceptionnellement contiguës sur deux séries zoéciales alternantes ; leur longueur varie de 0,81 à 1,40 mm et leur largeur de 0,38 à 0,60 mm à la base ; leur opésie occupe un peu plus des 2/3 de la longueur autozoéciale, le cryptocyste, granuleux et incurvé, mesurant de 0,20 à 0,45 mm de long ; le bord interne du cryptocyste est finement denticulé. L'aviculaire est long de 0,81 à 0,85 mm ; il est arrondi et plus étroit (0,35 mm) à son extrémité distale, élargi dans sa partie proximale (0,68 mm) ; celle-ci, dont les contours ont une forme sensiblement hexagonale, présente parfois des processus spiniformes pointés distalement au-dessus de l'orifice de passage du muscle de la mandibule. La mandibule avicularienne ressemble à un opercule autozoïdal.

DISCUSSION. — Le genre *Pseudothyracella* a été défini par LABRACHERIE (1975) pour une espèce de Bryozoaires fossiles de l'Eocène inférieur nord-aquitanien (Cabanac, Gironde), *P. pulchella*, genre auquel l'auteur rattache aussi une espèce nord-américaine du Paléocène d'Arkansas dont l'opésie est plus proximale que chez l'espèce-type et la nouvelle espèce décrite ici, *P. midwayanica* (Canu & Bassler, 1920). Chez *P. pulchella*, les

autozoécies sont moins régulièrement hexagonales que chez *P. candelaber*, dont l'opésie est par ailleurs plus large. VOIGT (1987) a redécrit *P. pulchella*, dont les aviculaires et les zoécies reproductrices diffèrent de ceux de *P. candelaber*, et décrit ou réétudié en outre trois autres espèces fossiles du genre *Pseudothyracella* provenant du Montien de Mons. Le matériel étudié par ces différents auteurs n'étant constitué que de fragments d'entre-noeuds dissociés, sur lesquels aucun joint n'avait été conservé, ils ne pouvaient avoir une vue d'ensemble des colonies, et c'est pour cette raison que tous les ont classées dans la famille Onychocellidae. Chez *P. ciplyensis* Voigt, 1987, les contours autozoéciaux sont plus parallèles et les opésies petites ; *P. mucronata* (Meunier & Pergens, 1886) a une petite opésie étroite et rectangulaire bien plus large que haute et des pores frontaux ; chez *P. vandenbroecki* (Meunier & Pergens, 1886), il existe des ovicelles globuleuses saillantes.

REMARQUES. — Ce genre n'était jusqu'à présent connu qu'à l'état fossile et de la seule Europe occidentale ; il est pour la première fois trouvé dans la faune actuelle, et dans une région très éloignée de celle d'où des spécimens fossiles étaient connus. Ces récoltes permettent enfin de connaître la morphologie zoariale des *Pseudothyracella*, que la simple étude des fragments jusqu'à présent connus ne permettait pas d'imaginer, et de les ranger dans leur famille légitime.

ÉTYMOLOGIE. — Du Latin, *candelaber*, candélabre, afin de rappeler la forme des colonies de cette espèce.

RÉPARTITION. — Nouvelle-Calédonie, îles Loyauté, Nouvelle-Zélande, de 215 à 1270 m.

Infra-Ordre CRYPTOCYSTOMORPHA Silén, 1942

Famille ONYCHOCELLIDAE Jullien, 1882

Genre ***SMITTIPORA*** Jullien, 1882

ESPÈCE-TYPE. — *Vincularia abyssicola* Smitt, 1873.

Smittipora fenestrata sp. nov.

Fig. 7 A-D, F

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn CP 84, 460 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn CP 84, 460 m (MNHN-BRY-16604).

DIAGNOSE. — *Smittipora* à zoarium rétéporiforme, les orifices autozoéciaux ne s'ouvrant que sur la face frontale. Présence de nombreuses zoécies avicullariennes de mêmes dimensions que les autozoécies, à mandibule aliforme et rachis lisse.

DESCRIPTION. — Le zoarium est monostratifié, les orifices autozoéciaux étant portés par la seule face frontale du zoarium ; la face frontale est concave (cette morphologie zoariale suggère à tort que le matériel étudié était initialement encroûtant, et avait été détaché d'un substrat rétéporiforme ; il n'en est rien, puisque la face dorsale des colonies vivantes porte des organismes épibiontes, dont des colonies encroûtantes d'autres espèces de Bryozoaires). La colonie est constituée d'autozoécies et de zoécies avicullariennes, ces dernières étant plus nombreuses sur les bords des "mailles" déterminées par le substrat. Les zoécies avicullariennes occupent dans la colonie l'emplacement qui aurait normalement dû être dévolu à une autozoécie ; elles ont la même longueur (0,46-0,60 mm) et parfois la même largeur (0,29-0,42 mm), mais sont généralement un peu plus étroites ; elles portent une mandibule aliforme, dont les deux lobes, longs de 0,24 mm et sensiblement en forme de quarts de cercle (de 0,14 mm de rayon), sont symétriques par rapport à un rachis lisse qui atteint 0,40 mm de longueur. Il n'a pas été observé

d'ovicelles. Les autozoécies ont une opésie de 0,19 à 0,22 mm de long et de large ; ovale, elle est souvent plus large proximalement ; son bord proximal est plus ou moins rectiligne. Le cryptocyste, granuleux, a le même aspect chez les autozoécies et les zoécies avicullariennes ; celui des autozoécies mesure de 0,12 à 0,20 mm de long.

DISCUSSION. — La morphologie zoariale, rétéporiforme, est unique dans le genre *Smittipora*. Le rachis de l'aviculaire est dépourvu de dents, contrairement à *S. cordiformis* Harmer, 1926. Cette nouvelle espèce se rapproche, par la morphologie des deux types zoéciaux, du groupe d'espèces affines, toutes encroûtantes, constitué des *S. abyssicola* (Smitt, 1867), *S. levinseni* (Canu & Bassler, 1928) et *C. harmeriana* (Canu & Bassler, 1929), discuté par MARCUS (1953), COOK (1964, 1985), WINSTON et HEIMBERG (1986) et HAYWARD (1988).

ÉTYMOLOGIE. — Du Latin, *fenestratus*, garni de fenêtres, en raison des nombreuses perforations du zoarium.

RÉPARTITION. — Nouvelle-Calédonie, à 460 m de profondeur.

Famille MICROPORIDAE Gray, 1848

Genre ***MICROPORA*** Gray, 1848

ESPÈCE-TYPE. — *Flustra coriacea* Johnston, 1847.

Micropora equilateralis sp. nov.

Fig. 7 G, 9 F, 19 E

MATÉRIEL EXAMINÉ. — **Philippines**. MUSORSTOM 3 : stn CP 139, 240-267 m.

TYPE. — *Holotype* : Philippines. MUSORSTOM 3, stn CP 139, 240-267 m (MNHN-BRY-16607).

DIAGNOSE. — *Micropora* à aviculaire en forme de triangle équilatéral, orienté selon le grand axe de l'autozoécie, distal par rapport à l'orifice, inconstant, à angle pointé distalement. Pas d'épines. Opésiules petites, au nombre d'une paire, et proportionnellement très postérieures.

DESCRIPTION. — Le zoarium encroûtant est formé d'autozoécies ovales, de 0,30-0,32 mm de long et de 0,18-0,22 mm de large, séparées par des murailles saillantes. Elles ne présentent qu'une seule paire d'opésiules, circulaires, proportionnellement très postérieures, puisque situées aux 2/5 de la longueur autozoéciale en partant de l'extrémité distale. L'aviculaire, d'orientation axiale, distal à l'orifice, à pointe dirigée vers l'autozoécie suivante, est inconstant ; il a la forme d'un triangle équilatéral de 0,12 mm de hauteur ; il fait toujours défaut en présence d'ovicelle. L'orifice, en forme de segment de cercle, a une largeur de 0,11-0,12 mm et une longueur de 0,10-0,11 mm chez les zoécies ovicellées, de 0,07 mm chez les zoécies non ovicellées. Le cryptocyste est finement et uniformément perforé. Proximo-latéralement à l'orifice, le cadre latéral s'épaissit en bourrelets latéraux peu marqués. L'ovicelle, granuleuse, mesure 0,18 mm de long comme de large.

DISCUSSION. — L'orientation et la forme de l'aviculaire caractérisent cette espèce. Chez les autres espèces du genre, il est soit complètement absent, soit orienté plus ou moins obliquement en direction proximale ou distale. Contrairement à plusieurs autres espèces de la région indo-pacifique (*M. coriacea*, *M. elegans*), elle est dépourvue d'épines. Ses opésiules, dont il n'existe qu'une seule paire (contrairement à *M. gracilis* et à *M. variperforata*), sont petites et très postérieures (contrairement à certaines formes de *M. mortenseni* à opésiules très marquées).

ÉTYMOLOGIE. — Du Latin *aequilateralis*, pour rappeler la forme en triangle équilatéral des aviculaires.

RÉPARTITION. — Philippines, à 240-267 m de profondeur.

Genre *PROMICROA* nov.

ESPÈCE-TYPE. — *Promicroa dubitata* sp. nov.

DIAGNOSE. — Microporidae arborescente, bisériée, dont les deux séries autozoéciales sont portées par la même face du zoarium ; zoarium ramifié, sans joints ni aviculaires ; autozoécies à deux paires d'opésiules disto-latérales successives de chaque côté ; ovicelles granuleuses finement perforées.

Le genre étant monospécifique, les diagnoses générique et spécifique seront provisoirement confondues.

ÉTYMOLOGIE. — Anagramme du nom générique *Micropora*.

Promicroa dubitata sp. nov.

Fig. 4 B, 7 E

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 66, 515-505 m.
Nouvelle-Zélande. Au nord des îles Norfolk, stn G4, 28°25'S, 167°15'E, 831 m (NZOI).

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn DW 66, 505-515 m (MNHN-BRY-16607).

DESCRIPTION. — Le zoarium, arborescent et bisérié, ramifié dichotomiquement, sans joints, est constitué de deux séries alternantes d'autozoécies pisciformes longues de 0,55-0,60 mm et larges de 0,22-0,26 mm, portées par la même face du zoarium et obliques l'une par rapport à l'autre. Chaque autozoécie porte, de chaque côté, deux opésiules successives, longues, la plus distale de 0,045-0,050 mm et la plus proximale de 0,030-0,035 mm. La plus distale est située au 1/3 de la longueur autozoéciale en partant de l'extrémité distale. Le cryptocyste porte une demi-douzaine de perforations éparses. Les bourrelets latéraux pré-aperturaux sont très peu marqués. Il n'existe pas d'aviculaires. Les ovicelles ont une surface granuleuse et présentent de nombreuses perforations minuscules, éparses sur leur surface ; elles présentent aussi une lame calcaire frontale en forme de Y, à branches très larges ; l'une de ces branches est axiale et se situe sur la partie proximale de l'ovicelle, les deux autres branches sont latérales et longent le bord distal de l'orifice en encadrant l'anter. L'orifice, de forme semi-lunaire, a 0,06 mm de long et 0,14 mm de large. Le côté latéral des zoécies porte, presque à la limite de la face dorsale, une rangée de 4 pores aréolaires équidistants.

DISCUSSION. — Cette espèce présente les caractères de la famille Microporidae (avec laquelle PRENANT et BOBIN, 1966, ont fusionné les Calpensiidae, les critères discriminatifs entre elles leur paraissant flous), qui réunit des genres encroûtants, avec ou sans aviculaires, dressés, cupuliformes ou claviformes avec joints ; les ovicelles sont absentes ou endozoéciales, le cryptocyste très étendu et l'opésie petite, les opésiules distales étant ouvertes ou fermées, l'opercule plus ou moins hémicirculaire.

Cette nouvelle espèce ne trouve place dans aucun des genres préexistants, et c'est pour cette raison qu'elle est décrite sous un nouveau taxon de rang générique. Le nombre des opésiules, le port de la colonie et à un moindre degré l'ornementation de l'ovicelle (présentant de nombreuses petites perforations, caractère qui dans ce genre n'est présenté que par une seule espèce, *M. santacruzana* Soule, Soule & Chaney, 1995) écartent cette espèce des *Micropora*. Nous limiterons la discussion ci-après aux genres de Microporidae qui ont un port dressé, et qui ne sont pas qu'encroûtants par définition. *Monsella* Canu, 1900, formé d'une succession de segments séparés par des entre-noeuds, s'en différencie en outre par la présence d'une lame calcaire frontale délimitant des opésiules très allongées et extrêmement étroites ; le genre *Microporina* est pourvu de joints, d'aviculaires, et d'une seule paire d'opésiules. Chez les *Poricellaria*, que BASSLER (1953) incluait parmi les Calpensiidae et qui appartiennent à présent à la famille Poricellariidae, le zoarium est quadrisérié, mais les autozoécies portent comme ici deux paires d'opésiules.

ÉTYMOLOGIE. — Du Latin, *dubitatus*, douteux, en raison des affinités incertaines de l'espèce.

RÉPARTITION. — Nouvelle-Calédonie, Nouvelle-Zélande, à 505-831 m de profondeur.

Famille ASPIDOSTOMATIDAE Jullien, 1888

Genre ***CRATEROPORA*** Levinsen, 1909

ESPÈCE-TYPE. — *Crateropora falcata* Levinsen, 1909.

REMARQUE. — Genre nouveau pour la faune néo-calédonienne.

Crateropora stiliformis sp. nov.
Fig. 9 A-E, 20 H-K

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn CP 78, 445-450 m.
SMIB 4 : stn DW 39, 525-560 m.

TYPES. — *Holotype* : Nouvelle-Calédonie. SMIB 4, stn DW 39, 525-560 m (MNHN-BRY-16668).
Paratype : BIOCAL, stn CP 78, 445-450 m (MNHN-BRY-16669).

DIAGNOSE. — *Crateropora* présentant un aviculaire latéral impair extrêmement allongé, parallèle au cadre zoécial, styliforme et incurvé vers l'orifice, arrondi à son extrémité. La partie distale du cadre zoécial se renforce de façon à former une paire de cornes au-dessus de l'opercule, orientées en direction proximale. Ovicelle formant une sorte de visière. Présence d'épines distales chez les jeunes autozoécies.

DESCRIPTION. — Le zoarium encroûtant est formé d'autozoécies plus ou moins irrégulièrement hexagonales, parfois à 7 côtés ; pour la colonie de SMIB 4, elles sont longues de 1,30 mm (en périphérie de la colonie) à 0,90 mm (dans la partie centrale), larges de 0,70 à 1,20 mm ; pour celle de Biocal, elles mesurent 1,80 -1,95 mm de long et 0,74-0,84 mm de large. Chez la colonie où les zoécies sont les plus grandes, l'ovicelle est très saillante et forme de chaque côté, au-dessus de l'opercule, une corne robuste dirigée vers la région proximale. Le cadre zoécial, très épaissi distalement, a une largeur de 0,50-0,80 mm ; il est nettement rétréci latéralement et en avant de l'orifice. L'ovicelle, subglobuleuse, se présente comme une visière saillante à l'extrémité distale de l'autozoécie, en forme de croissant, large de 0,60 mm et longue de 0,30-0,34 mm. La région de la face frontale délimitée par le bord distal et le tube opésiulaire, de forme ovale, mesure 0,20 mm de long et 0,30 mm de large. Le cryptocyste, finement et densément granuleux, est finement poré, et s'enfonce vers la région distale. Il n'existe pas d'épines. Le tube opésiulaire forme latéralement un processus, délimitant de chaque côté, entre lui et le bord de l'opésie, un très court sinus marginal en forme de U. L'opercule mesure 0,23-0,24 mm de large. Sur les plus jeunes zoécies, les bases de quelques épines (3-5), cassées à leur niveau d'insertion, sont distribuées distalement au péristome ; ces épines sont absentes chez les plus grandes autozoécies. Les aviculaires sont inconstants. Une zoécie sur trois porte un aviculaire étroit et très allongé, styliforme, peu ou modérément incurvé vers l'orifice, longeant extérieurement le cadre zoécial ; il a une longueur de 0,54 à 0,19 mm et une largeur de 0,12 mm à la base, de 0,07 mm à l'extrémité. Sur une unique zoécie, il a en plus été observé un aviculaire plus large et plus incurvé, long de 0,30 mm, en position latéro-distale par rapport à l'orifice, et sensiblement perpendiculaire à l'axe autozoécial longitudinal. Chez deux des plus jeunes autozoécies, l'aviculaire impair était plus spatuliforme et arrondi distalement.

DISCUSSION. — La forme caractéristique des aviculaires, étroits et allongés, constitue le principal caractère diagnostique de cette espèce. Elle rappelle *C. falcata* Levinsen, 1909, par la forme générale de ses autozoécies et par celle de l'extrémité du tube polypidien en arrière de l'opésie. La forme des aviculaires évoque celle décrite chez *C. expansa* Harmer, 1926, mais chez cette dernière espèce ils sont pairs, plus courts, parfois spatulés. Il n'est pas impossible que la colonie figurée par GORDON (1985) et provenant des Kermadec, sur laquelle il n'avait pas observé d'aviculaires et qu'il avait mentionnée sous le nom de *C. falcata*, appartienne en fait à cette espèce.

ÉTYMOLOGIE. — Du Latin, *stilus*, style et *formis*, en forme de, du fait de l'existence d'aviculaires étroits et allongés.

RÉPARTITION. — Nouvelle-Calédonie, entre 445-450 et 525-560 m de profondeur.

Famille CELLARIIDAE Fleming, 1828

Genre ***CELLARIA*** Ellis & Solander, 1786

ESPÈCE-TYPE. — *Cellaria sinuosa* Hassall, 1840.

Cellaria parafistulosa sp. nov.
Fig. 8 G, 17 D-E

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOGÉOCAL : stn 214, 1665-1590 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOGÉOCAL, stn 214, 1665-1590 m (MNHN-BRY-16417).

DIAGNOSE. — *Cellaria* à joints tubulaires, à entre-noeuds fusiformes et aréolation losangique, à zoécies aviculariennes en forme de D. Pore ovicellien de forme variable : arrondi aux extrémités de l'entre-noeud, il prend de plus en plus une forme de croissant en se rapprochant de la région centrale, pour délimiter chez les ovicelles mûres de la partie centrale n'ayant pas encore pondu une plaque obturatrice hémicirculaire granuleuse, hérissée en périphérie ; cette plaque est cassée après la ponte et le pore ovicellien acquiert alors une forme oblique et dissymétrique. Frontale densément granuleuse, les granulations étant plus éparses dans la région immédiatement proximale à l'orifice. Frontale un peu déprimée par rapport au cadre autozoécial. Cadre autozoécial se confondant avec les limites interzoéciales, sauf à mi-longueur où, bien que très rapprochés, ils sont distincts sur une brève distance. "Orifice" commun à l'ouverture autozoéciale et à l'opésie (accolées distalement comme chez tous les Cellariidae) présentant une paire proximale de condyles articulaires de l'opercule, et une paire de denticules distaux.

DESCRIPTION. — Le zoarium est cellariiforme, dressé et ramifié dichotomiquement, les entre-noeuds grêles étant séparés par des joints chitineux, jaunes chez les jeunes branches, brun-noir chez les plus âgées. Les entre-noeuds sont fusiformes, renflés en leur milieu, région où sont localisées les zoécies reproductrices. Ces dernières mesurent 0,42-0,44 mm de long et 0,27-0,29 mm de large, contre 0,45-0,90 mm et 0,22-0,26 mm pour les autozoécies normales. Celles-ci sont pratiquement losangiques ; lorsqu'elles tendent vers la forme hexagonale, les côtés latéraux sont très courts, sinon quasiment inexistants. Leur cadre se confond avec les limites interzoéciales ; ce cadre n'est distinct du bord zoécial que sur une très courte distance, à mi-longueur de l'autozoécie, où il en est (très peu) écarté. Les limites interzoéciales sont surélevées par rapport à la frontale, mais sans former une muraille verticale (comme chez *C. fistulosa*). Leurs orifices ont 0,130-0,145 mm de large et de 0,80-0,90 mm de long, et présentent une paire de denticules proximaux (condyles) et une paire de denticules distaux. Les zoécies aviculariennes sont en forme de D à côté arrondi situé en position distale ; elles ont de 0,185 à 0,195 mm de large et de 0,115 à 0,120 mm de long ; elles portent une mandibule dont le bord proximal est droit ou faiblement incurvé et le bord distal nettement arrondi, qui mesure de 0,11 à 0,12 mm de large et 0,07-0,08 mm de long. La longueur d'un entre-noeud varie de 4 à 5,5 mm. La surface frontale des autozoécies est densément et uniformément granuleuse, sauf dans la région proximale à l'orifice où ces granulations sont plus clairsemées.

Les ovicelles, longues de 0,13-0,14 mm, présentent un pore de forme variable selon leur position sur la partie renflée de l'entre-noeud. Aux deux extrémités de la partie renflée, le pore est parfaitement circulaire et symétrique, et a 0,05 mm de diamètre. Lorsqu'il est situé en position plus centrale sur l'entre-noeud, ce pore s'élargit, acquiert

d'abord la forme de croissant peu ouvert et symétrique par rapport à l'axe longitudinal, puis s'élargit, et mesure alors 0,065 mm de long et 0,08 mm de large.

Dans sa région centrale de l'entre-noeud, le pore ovicellien est en forme de croissant très ouvert ; il affecte la forme d'une fente en croissant, longue et étroite, et délimite ainsi une plaque calcaire qui l'obture presque complètement ; cette plaque est hémicirculaire, a une surface densément granuleuse, les granulations situées en périphérie lui donnant un aspect hérissé. Sur quelques autozoécies de la région centrale, celles supposées avoir pondu, cette plaque est cassée ; l'orifice ovicellien est alors oblique et dissymétrique et mesure de 0,05-0,06 mm de diamètre.

DISCUSSION. — Cette espèce ressemble morphologiquement beaucoup à l'espèce européenne *Cellaria fistulosa* (Linné, 1758) (Fig. 17 A-C) ; seul leur examen en microscopie électronique à balayage permet de les différencier. L'étude d'exemplaires de *C. fistulosa*, recueillis en mai 1996 au large de l'île de Batz (Roscoff), montre que chez eux la surface frontale n'est que faiblement granuleuse et que les granulations sont éparses ; elles sont essentiellement localisées proximalement et dans la région des angles distaux. Sur une grande partie de la longueur de la loge, le cadre zoécial et les limites interzoéciales sont nettement distants les uns des autres ; le cadre forme une fine muraille verticale continue et bien visible qui entoure la face frontale. La région proximale à l'orifice est lisse. Les autozoécies ont une tendance hexagonale plus marquée, les côtés latéraux étant bien développés, sans atteindre toutefois l'importance qu'ils peuvent avoir chez les *Cellaria* du "type hexagonal vrai" de PRENANT et BOBIN (1966) chez lequel les hexagones ne sont pas en contact dans une même file longitudinale. La forme des pores ovicelliens est beaucoup moins variable que chez *C. parafistulosa* ; le pore est ovale, à tendance parallélépipédique, lorsque l'ovicelle est associée à un aviculaire, de forme triangulaire avec angle distal dans les autres cas ; il mesure alors 0,10 mm de long et 0,80-0,85 mm de large à sa base ; il n'a jamais une forme de croissant et ne délimite jamais de plaque granuleuse.

ÉTYMOLOGIE. — Du Grec, *para*, près, pour rappeler combien cette espèce est proche de l'espèce de LINNÉ, *fistulosa*.

RÉPARTITION. — Nouvelle-Calédonie, à 1590-1665 m de profondeur.

Cellaria tenuirostris Busk, 1852

Cellaria tenuirostris Busk, 1852 : 17-18, pl. 63 fig. 4. — GORDON, 1984 : 58, pl. 18 fig. B ; 1986 : 74, pl. 29 fig. C-E.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOGÉOCAL : stn KG 267, 1935 m.

DESCRIPTION. — Le zoarium dressé et quadrisérié est constitué d'entre-noeuds de 0,30-0,40 mm séparés par des joints peu apparents. Les autozoécies, étroites et allongées, ont 0,60-0,82 mm de long et 0,20 mm de large à l'avant ; hexagonales à bord distal arrondi, elles se rétrécissent graduellement vers leur région proximale ; leur cadre zoécial est très saillant. L'orifice autozoécial, long de 0,10 mm et large de 0,14 mm, est sensiblement en forme de D, mais son côté proximal n'est pas rectiligne, mais incurvé ; il existe une paire de denticules proximaux (condyles). La frontale est presque lisse. Situées sur une portion plus renflée du zoarium, les ovicelles se présentent sous la forme de bonnets granuleux et renflés de 0,12 x 0,12 mm, avec une fente étroite proximalement ; la zoécie portant l'ovicelle est un peu plus large (0,30 mm) que les autozoécies normales. Un seul aviculaire a été observé, large de 0,28 mm et long de 0,68 mm ; il est inséré à la place habituelle d'une autozoécie ; sa mandibule, triangulaire et effilée, a 0,32 mm de long et 0,135 mm de large à sa base.

REMARQUES. — Ce matériel est conforme à la description de l'espèce, mais s'en différencie par l'étroitesse des entre-noeuds. *Cellaria tenuirostris* a été illustrée a plusieurs reprises par l'un des auteurs de ce travail (D.P.G.), et nous renvoyons à l'iconographie qu'il en a publiée. Cette espèce est nouvelle pour la faune de la Nouvelle-Calédonie.

RÉPARTITION. — Iles Bonin, îles Chatham, détroit de Cook, Nouvelles Galles du Sud, Nouvelle-Calédonie, Nouvelle-Zélande. Profondeur : 100-1935 m.

Cellaria humilis Moyano, 1983

Fig. 7 H, 10 A

Cellaria humilis Moyano, 1983 : 7, fig. 15-17. — Gordon, 1984 : 58, pl. 18 fig. A ; 1986 : 76.

Matériel examiné. — **Philippines**. Musorstom 3 : stn DR 117, 92-97 m.

Description. — Le matériel étudié consiste en fragments non ramifiés de zoarium dressés, étroits et quadrisériés. Les autozoécies, allongées, hexagonales ou pisciformes, ont une longueur de 0,66-0,78 mm et une largeur de 0,28-0,42 mm à leur extrémité distale (arrondie) et de 0,08-0,14 mm à leur extrémité proximale (en forme de queue de poisson) ; leur surface est lisse. L'orifice autozoécial est très antérieur ; long de 0,065 mm, il a une largeur de 0,075-0,14 mm et présente une paire de denticules proximaux (condyles) ; le bord proximal est à peine arqué vers l'avant. Le cadre zoécial est saillant et suit assez régulièrement les limites autozoéciales ; il est plus atténué proximalement où il dessine deux arêtes convergeantes mais n'entrant pas en contact. L'ovicelle globuleuse a un diamètre de 0,12 mm ; elle porte un pore en croissant, très étroit, de 0,35-0,40 mm de haut, parallèle au bord distal de l'orifice. Un rhizoïde s'implante parfois au milieu de la face frontale ; d'autres rhizoïdes constituent un faisceau à la base de la colonie. Il n'a pas été observé d'aviculaires.

Discussion. — Les caractères observés concordent avec ceux mentionnés par Moyano (1983) et Gordon (1984), qui font état de la présence d'aviculaires. Aucun de ces deux auteurs ne mentionne l'existence de condyles péristomiaux chez *C. humilis* (Gordon en signale la présence dans sa définition du genre) ; les échantillons étudiés ici en présentent, mais ils sont très discrets. Il serait donc intéressant de les rechercher sur les spécimens étudiés par Moyano et Gordon.

Répartition. — Chili, Kermadec, par 350 m. Espèce nouvelle pour la faune des Philippines, à 92-97 m de profondeur.

Cellaria obliquidens sp. nov.

Fig. 15 A-C

Matériel examiné. — **Nouvelle-Calédonie**. Biogéocal : stn 214, 1665-1590 m.

Type. — *Holotype* : Nouvelle-Calédonie. Biogéocal, stn 214, 1665-1590 m (MNHN-BRY-16417 bis).

Diagnose. — *Cellaria* à entre-noeuds cunéiformes, très élargis distalement. Orifice autozoécial à bords proximal et distal rectilignes, présentant une paire de condyles proximaux, orientés obliquement vers l'extérieur, et une paire de denticules distaux.

Description. — Le zoarium robuste est constitué d'entre-noeuds larges, s'élargissant régulièrement du simple à près du triple de leur partie proximale à leur partie distale, non claviformes, pouvant comporter jusqu'à 7 séries autozoéciales en examen frontal, et séparés par des joints chitineux. Les autozoécies, régulièrement alternantes, hexagonales, à cryptocyste granuleux (un peu moins densément proximalement à l'orifice), sont longues de 0,53 à 0,56 mm et larges de 0,22 à 0,26 mm. L'orifice a une forme presque rectangulaire, ses bords proximal et distal étant droits, mais à angles arrondis ; il mesure 0,135 mm de large et 0,085 mm de long ; il présente deux paires de condyles : deux denticules distaux larges et émoussés, deux condyles proximaux un peu plus fins, orientés vers l'extérieur. Proximalement, le bord de l'orifice présente de chaque côté une profonde incisure. Aucun aviculaire n'a été observé. Le pore ovicellien est porté directement sur le bord distal de l'autozoécie ; il a une forme de croissant, accentuée par la présence d'une paire d'incisures proximo-latérales ; la longueur est de 0,045 mm et sa largeur de 0,085 mm.

DISCUSSION. — La morphologie des entre-noeuds, la forme très particulière de l'orifice avec ses deux bords proximal et distal rectilignes, et l'orientation des condyles proximaux caractérisent cette espèce.

ÉTYMOLOGIE. — Du Latin, *obliquus*, oblique et *dens*, dent, les condyles aperturaux proximaux étant orientés obliquement vers l'extérieur.

RÉPARTITION. — Nouvelle-Calédonie, à 1590-1665 m de profondeur.

REMARQUES GÉNÉRALES SUR LE GENRE *CELLARIA*

Le réexamen, à l'occasion de cette étude, de nombreux spécimens de *Cellaria* nous a remémoré une précédente conversation avec notre collègue Hugo I. MOYANO, à qui nous sommes redevables d'importantes études sur les Cellariidae, et qui avait attiré l'attention de l'un des auteurs de ce travail (J.-L. d'H.) sur l'hétérogénéité de ce genre. Les espèces regroupées dans le genre *Cellaria* se répartissaient en effet en deux groupes, caractérisés par deux types différents de ramifications zoariales, qui avaient déjà été analysés et discutés par BUSK (1884 : 84) : celles à joints tubuleux (*tubulatae*) et celles à joints pelotonnés (*nodatae*), caractères qu'il a corrélés avec l'aréolation frontale (rhomboïdale chez les *tubulatae*, hexagonale vraie chez les *nodatae*). Mais HASTINGS (1947) a toutefois montré que cette corrélation n'était pas aussi stricte que ne le pensait BUSK, que des espèces présentant des joints différents pouvaient être plus affines entre elles qu'avec des espèces du même modèle de joints, et que les joints ultérieurement pelotonnés et rigides se formaient de façon identique chez les jeunes colonies des deux types. Aussi, bien qu'il serait *a priori* très tentant de scinder le genre *Cellaria* en genres distincts caractérisés par leur mode de ramification zoariale, nous avons préféré y renoncer en référence aux remarques formulées par HASTINGS.

Genre ***FORMOSOCELLARIA*** d' Hondt, 1981

ESPÈCE-TYPE. — *Formosocellaria magnifica* (Busk, 1884).

Formosocellaria magnifica (Busk, 1884)

Fig. 10 C

Salicornaria magnifica Busk, 1884 : 93-95, pl. 12 fig. 4, 6.
Formosocellaria abyssicola d'Hondt, 1981a : 20-22 ; 1983 : 85.
Formosocellaria magnifica - D'HONDT & SCHOPF, 1984 : 931.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 36, 625-650 m.
MUSORSTOM 4 : stn DW 221, 535-560 m.
BIOGÉOCAL : stn CP 265, 1760-1870 m. — Stn CP 272, 1615-1710 m.
Mer de Tasmanie. New Zealand Oceanographic Institute : stn U202, 28.09.1982, 33°43,7'S, 160°16,2'E, 3480-3543 m (NZOI).

DESCRIPTION. — Les échantillons étudiés ici correspondent parfaitement aux spécimens décrits par D'HONDT (1981) sous le nom de *Formosocellaria abyssicola*, à la description desquels nous renvoyons, et qui ont ultérieurement été comparés au matériel-type de BUSK prêté par le British Museum. Il n'a pas été observé d'ovicelles sur le matériel étudié ici. La colonie est fixée au substrat par un faisceau basal de rhizoïdes. La bifurcation du zoarium s'effectue du même côté de la colonie. Les condyles aperturaux sont absents.

RÉPARTITION. — Cette espèce n'était jusqu'à présent connue que de l'Atlantique intertropical, par 587-4749 m de profondeur. Les présentes récoltes ont été effectuées entre ces limites bathymétriques et jusqu'à 535 m, mais dans une région du globe (Nouvelle-Calédonie et mer de Tasmanie) qui en est très éloignée, ce qui suggère l'existence probable de localités intermédiaires.

Genre *EUGINOMA* Jullien, 1882

ESPÈCE-TYPE. — *Euginoma vermiformis* Jullien, 1882.

Euginoma conica Gordon, 1986

Fig. 10 D

Euginoma conica Gordon, 1986 : 76, pl. 30 fig. E.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn KG 103, 630 m.
BIOGÉOCAL : stn KG 210, 1190 m. — Stn KG 219, 570 m. — Stn KG 227, 500 m. — Stn KG 316, 1660 m.

DESCRIPTION. — Le zoarium s'achève à sa base par un tube chitineux de 2,1 mm de diamètre, dont le sommet constitue un manchon autour de la partie inférieure effilée et calcifiée de la colonie ; ce tube, très plissé, a l'aspect d'un péristome de *Nolella gigantea*. La colonie est conique, à pointe (ancestrula) dirigée vers le bas ; elle ne mesure que de 1 à 2 mm de haut. Les autozoécies, pentagonales, sont alternantes, les plus grandes mesurant 0,40 mm de large et 0,36 mm de haut. Leur orifice, presque circulaire, est en forme de D, un peu plus large (0,12 mm) que long (0,10 mm). Il n'existe pas d'aviculaires ni de denticules aperturaux. Le cryptocyste, finement granuleux, a lui aussi une forme de D. Sur les échantillons étudiés ici, le cadre zoécial est moins prononcé proximalement que sur la photographie publiée par GORDON (1986).

RÉPARTITION. — A l'est du détroit de Cook, plateau du *"Challenger"*, entre 1457 et 3347 m. Espèce nouvelle pour la faune néo-calédonienne, à moindre profondeur (500-1660 m).

Genre *SYRINGOTREMA* Harmer, 1926

ESPÈCE-TYPE. — *Syringotrema auriculatum* Harmer, 1926.

Syringotrema calobi sp. nov.

Fig. 10 E-G

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 66, 510 m.
SMIB 4 : stn DW 35, 520-525 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn DW 66, 510 m (MNHN-BRY-16435).

DIAGNOSE. — *Syringotrema* à orifice autozoécial élargi transversalement, et de forme ovale ou en croissant.

DESCRIPTION. — Le zoarium, dressé et ramifié sans joints, est fixé au substrat par des rhizoïdes issus de sa base ; il est quadrisérié, les files autozoéciales étant disposées en spirale autour de l'axe. La longueur autozoéciale varie de 0,45 à 0,56 mm, la largeur de 0,28 à 0,32 mm. L'orifice, médian, est en forme de croissant peu ouvert, parfois pratiquement ovale ; il est large de 0,19-0,21 mm et long de 0,40 à 0,65 mm ; son bord proximal est légèrement arqué, et correspond à l'extrémité du tube apertural. Le cadre opésial est très saillant et crénelé ; de forme générale losangique, mais arrondi distalement, il a une longueur de 0,28-0,31 mm et une largeur de 0,24-0,255 mm. Il n'a pas été observé d'ovicelles et il n'existe pas d'aviculaires. La ramification est très ouverte ; la zoécie axiale à la base d'une ramification est un peu plus grande que les autres.

DISCUSSION. — Ce genre était jusqu'à présent monospécifique pour *S. auriculatum*, espèce indonésienne dont l'orifice est régulièrement ovale et l'opésie arrondie proximalement.

ÉTYMOLOGIE. — Le nom spécifique *calobi* est une anagramme de BIOCAL.

RÉPARTITITON. — Nouvelle-Calédonie, entre 510 et 525 m de profondeur.

Genre *MESOSTOMARIA* Canu & Bassler, 1927

ESPÈCE-TYPE. — *Mesostomaria strictoramae* Canu & Bassler, 1927.

Mesostomaria strictoramae Canu & Bassler, 1927

Fig. 5 I, 10 B

Mesostomaria strictoramae Canu & Bassler, 1927 : 4-5, pl. 1 fig. 3 ; 1929 : 176-177. — GORDON, 1984 : 59, pl. 18 fig. F.

MATÉRIEL EXAMINÉ. — **Philippines**. ESTASE : stn DR 07, 890-450 m.
Nouvelle-Calédonie. BIOCAL : stn DW 33, 675-680 m. — Stn DW 36, 625-650 m. — Stn CP 52, 600-540 m.
MUSORSTOM 4 : stn DW 151, 200 m.
SMIB 3 : stn. DW 22, 503 m.

DESCRIPTION. — Le zoarium cylindrique et non articulé, dressé et ramifié dichotomiquement (bien que de façon irrégulière), est fixé au substrat par des rhizoïdes, issus de la partie proximale de certaines autozoécies. Trois rangées d'autozoécies sont visibles de chaque côté ; non alternantes, régulièrement disposées côte à côte au même niveau, elles sont hexagonales et mesurent habituellement de 0,58 à 0,70 mm de long et de 0,46 à 0,53 mm (exceptionnellement 0,59 mm) de large. L'orifice, presque circulaire, a néanmoins son bord proximal presque rectiligne ; sa largeur est normalement de 0,14-0,16 mm (exceptionnellement jusqu'à 0,20 mm), et sa longueur de 0,13-0,15 mm. Il n'existe pas de denticules aperturaux, ni de mucron, ni d'aviculaires. Les zoécies ovicellées sont plus grandes que les autozoécies normales, ayant une longueur de 0,80-0,85 mm et une largeur de 0,78-0,80 mm ; toutes les ovicelles observées étaient brisées, seul en restait le fond, orné d'une réticulation longitudinale ; leur longueur est comprise entre 0,44 et 0,55 mm, leur largeur entre 0,31 et 0,37 mm ; elles semblent être endotochoïdales et subglobuleuses. L'opercule est incliné, sa région distale étant enfoncée par rapport au plan de la frontale. La surface autozoéciale est granuleuse.

DISCUSSION. — La seule espèce qui puisse être confondue avec celle-ci, *M. atlantica* (Busk, 1884), présente un zoarium aplati.

RÉPARTITION. — Philippines, Sabah ; Kermadec. Genre et espèce nouveaux pour la faune néo-calédonienne. Profondeur : 200-890 m.

Mesostomaria sp.

Fig. 11 A-D

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. SMIB 3, stn DW 22, 503 m.

DESCRIPTION. — Non alternantes, les autozoécies sont disposées en rangées parallèles et sont situées au même niveau ; elles mesurent 0,58-0,66 mm de long et 0,54-0,59 mm de large ; l'orifice hémicirculaire, en position centrale, a 0,12 mm de long et 0,22 mm de large. La surface frontale est ornée d'une granulation fine et homogène ; juste proximalement à l'opésie, le cryptocyste présente une striation longitudinale serrée et dense, sur une longueur d'une cinquantaine de microns. Les autozoécies portant des ovicelles sont un peu plus grandes ; longues de 0,80-0,85 mm, elles sont larges de 0,78-0,80 mm. Les ovicelles, toutes partiellement détruites, semblent avoir été hémiglobuleuses et endotochoïdales et présentent au fond une réticulation longitudinale, elles mesurent 0,44-0,55 mm de large et 0,31-0,37 mm de long. L'opercule est incliné vers l'extérieur, et sa région distale semble déprimée par rapport au plan de la frontale. Il n'existe pas d'aviculaires.

Genre ***CRYPTOSTOMARIA*** Canu & Bassler, 1927

ESPÈCE-TYPE. — *Cryptostomaria crassatina* Canu & Bassler, 1927.

Cryptostomaria alata sp. nov.

Fig. 6 G, 11 E-G, 16 A-B

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 38, 360 m. — Stn CP 62, 1395-1410 m. — Stn CP 74, 1300 m. — Stn DW 77, 440 m. — Stn CP 109, 495-515 m.
MUSORSTOM 4 : stn CP 153, 235 m. — Stn CP 172, 275-330 m. — Stn CC 175, 355 m.
Îles Loyauté. MUSORSTOM 6 : stn KG 465, 480 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL : stn DW 77, 440 m (MNHN-BRY-16425).

DIAGNOSE. — *Cryptostomaria* à surface autozoéciale parcourue par une fine striation longitudinale serrée. Cadre zoécial élevé, surtout autour de l'orifice de chaque côté duquel il forme souvent une aile arrondie.

DESCRIPTION. — Le zoarium est dressé, cylindrique, subquadrangulaire en section, non articulé mais présentant souvent des renflements au niveau des bifurcations ; ses branches ont une épaisseur de 0,5 à 0,8 mm. Il est composé de 4 séries d'autozoécies alternantes et opposées deux à deux. La longueur autozoéciale varie de 0,80 à 0,91 mm, la largeur maximale de 0,40 à 0,44 mm ; l'opésie a une longueur de 0,28-0,36 mm et une largeur dans sa partie déprimée de 0,40 à 0,80 mm. Le cadre autozoécial est très saillant latéralement, formant de chaque côté une crête sur environ les 2/3 distaux de la loge, et s'élevant de part et d'autre de l'orifice de façon à y former une aile calcaire réticulée et arrondie à son sommet, et se resserrant ensuite proximalement à l'orifice ; chacune de ces ailes atteint une hauteur de 0,18-0,24 mm chez les zoécies jeunes, mais sont parfois très érodées chez les autozoécies âgées. Le cryptocyste est plus ou moins fusiforme, déprimé par rapport au cadre, et horizontal dans sa partie proximale (le cadre zoécial est donc beaucoup plus en relief que les limites interzoéciales). Les faces frontale et surtout latérales sont parcourues par des rides longitudinales sinueuses, fines et serrées, reliées par une réticulation transversale très discrète. L'orifice autozoécial a une largeur de 0,115-0,12 mm et une longueur de 0,13-0,14 mm ; il ne présente ni denticules ni cardelles. Les aviculaires remplacent des autozoécies dans la continuité du zoarium ; ils sont rares, losangiques et atteignant 0,70 mm de longueur ; leur opercule triangulaire a 0,10 mm de long et 0,20 mm de large ; il est situé au centre, sa région distale est renflée, et il présente un petit cryptocyste hémicirculaire de 0,24 mm de diamètre. Des rhizoïdes sont parfois issus des parties proximales de zoécies, notamment dans les parties âgées ; ils finissent par former un feutrage pratiquement continu à la base des colonies, et adhèrent au substrat. L'ovicelle est hémiglobuleuse, en forme de petite visière recourbée en avant de l'orifice, à bord proximal presque droit, légèrement proéminent dans sa partie centrale ; elle dissimule parfois, en partie, l'orifice autozoécial qui est situé dans un plan oblique ; elle mesure 0,16 mm de long et 0,11 mm de large ; son pore est allongé transversalement. En présence d'ovicelle, les ailes latéropéristomiales paires débutent en arrière du pore ovicellien.

Les jeunes colonies sont fixées par des faisceaux de rhizoïdes sur les branches d'autres zoariums, en les entourant d'un véritable lacis. Les péristomes sont plus saillants chez les colonies jeunes que chez les âgées ; les crêtes frontales du cadre zoécial se rapprochent proximalement à l'orifice, avant de se réécarter ensuite.

DISCUSSION. — Cette espèce est la seule du genre à présenter un cadre autozoécial aussi développé, notamment de chaque côté de l'orifice où il forme des ailes bien développées ; le resserrement très marqué de ce cadre, proximalement à l'orifice, est unique à l'intérieur du genre. La forme de l'ovicelle caractérise aussi cette espèce. L'ornementation autozoéciale est très différente de celle présentée dans le genre voisin *Stomhypselosaria* , dont GORDON (1984 : 18) a illustré la surface tuberculeuse.

ÉTYMOLOGIE. — Du Latin, *alatus*, ailé, en raison de la forme des crêtes latérales à l'orifice de la loge.

DISTRIBUTION. — Nouvelle-Calédonie, îles Loyauté, par 235-1410 m de profondeur.

Genre *MELICERITA* H. Milne Edwards, 1836

REMARQUE. — D'origine britannique et né en Belgique, Henri Milne EDWARDS, a signé toutes ses publications sous le double nom MILNE EDWARDS (sans trait d'union), probablement pour se distinguer de son frère William. Il a choisi le nom de MILNE EDWARDS, dès 1826, pour tout ce qui concerne son état civil (consulter à ce sujet, la note très bien documentée de J. FOREST, 1996).

Sous-Genre *MELICERITA sensu stricto*

ESPÈCE-TYPE. — *Melicerita charlesworthii* Morris, 1843.

REMARQUES. — Nous retiendrons comme définition du sous-genre nominatif la diagnose complétée qui en a été publiée par GORDON (1986 : 76). Ce sous-genre n'avait pas encore été mentionné de Nouvelle-Calédonie.

Melicerita (Melicerita) ejuncida Gordon, 1986

Fig. 10 H-I

Melicerita ejuncida Gordon, 1986 : 77-78, pl. 31 fig. D-E.

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. MUSORSTOM 4 : stn CC 175, 355 m. BIOGÉOCAL : stn KG 222, 1675 m. — Stn CP 232, 760-790 m.

DESCRIPTION. — Le zoarium est aplati, dressé et ramifié dichotomiquement, d'une largeur de 0,48 à 0,84 mm. Les autozoécies hexagonales sont disposées en quatre séries transversales non alternantes, donc situées parallèlement les unes aux autres et au même niveau ; leur longueur (0,96-0,98 mm) et leur largeur (0,37-0,41 mm) sont peu variables. Le cadre zoécial délimite une surface de 0,60-0,70 mm de long et 0,20-0,22 mm de large. L'ovicelle apparaît comme un bombement distal à l'autozoécie, d'un diamètre de 0,14 mm, portant un pore arrondi de 0,035-0,040 mm de long et 0,080 mm de large. Le cryptocyste et les parois latérales sont granuleux. L'opésie a sensiblement les mêmes dimensions que l'orifice ; en forme de D, elle a 0,17-0,20 mm de long et 0,20 mm de large à la base. Le bord proximal de l'orifice porte un large processus (0,14 mm de large), délimité par deux profondes indentations latérales. Il n'a pas été observé d'aviculaires.

RÉPARTITION. — Nouvelle-Zélande (plateau du *"Challenger"* à l'est du détroit de Cook). Espèce nouvelle pour la faune néo-calédonienne. Profondeur : 132-1675 m.

Melicerita (Melicerita) alternans sp. nov.

Fig. 12 A-D, 13 A

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 08, 435 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn DW 08, 435 m (MNHN-BRY-16437).

DIAGNOSE. — *Melicerita* à zoarium formé de verticilles successifs de deux et de trois autozoécies, alternant l'un avec l'autre. Autozoécies reproductrices situées en position axiale dans les verticilles de 3 loges. Les orifices autozoéciaux sont, dans le cas des verticilles à deux autozoécies, disposés obliquement et situés dans l'angle distal interne. Pas d'aviculaires.

DESCRIPTION. — Les portions de zoarium étudiées constituent de petits éléments dressés et aplatis, longuement ovales, dépourvus de joints. Chacun de ces éléments est constitué par une succession régulière de verticilles de deux et de trois autozoécies, situées côte à côte au même niveau et accolées sur toute leur longueur.

Les autozoécies des verticilles, constitués de deux loges, sont longues de 0,66-0,70 mm et larges de 0,77-0,80 mm. L'orifice autozoécial hémicirculaire, long de 0,10 mm et large de 0,16 mm, est oblique ; son rebord

distal arrondi, dirigé vers l'extérieur, est situé dans l'angle distal interne, sans déborder l'axe longitudinal ; il porte du côté proximal, rectiligne, deux petits condyles réunis par une lame calcaire. Le côté antérieur de la loge dessine une ligne brisée, avec un angle proximal bien marqué, dans lequel est partiellement contenu l'opercule. Le cryptocyste est granuleux. Il n'existe pas d'aviculaires.

Les autozoécies des verticilles de trois loges sont elles aussi accolées sur toute leur longueur et donc non alternantes. Leur longueur varie de 0,80 à 0,84 mm, leur largeur de 0,17-0,20 mm pour les latérales, 0,37-0,41 mm pour l'axiale. Les latérales sont plus étroites dans leur partie centrale, plus saillantes vers l'extérieur à leurs deux extrémités ; leur orifice est oblique vers l'extérieur, le rebord proximal étant tourné vers l'axe zoarial. L'axiale est de forme hexagonale, et un peu plus étroite dans sa partie médiane qu'à ses deux extrémités ; l'orifice, central et symétrique par rapport à l'axe longitudinal, en forme de D aplati, est situé au quart de la longueur en partant de l'extrémité distale. Seules des zoécies axiales des verticilles de 3 sont susceptibles d'être ovicellées ; elles sont alors un peu plus grandes que leurs homologues non ovicellées (longueur : 0,86 mm ; largeur : 0,50 mm). L'ovicelle, en forme de large croissant (0,61 mm de large et 0,36 mm de long), est endotochoïdale, très faiblement renflée en surface, et seulement visible par transparence ; elle présente une très fine réticulation transversale du côté proximal. Le pore ovicellien, ovale, a 0,90 mm de long et 0,24 mm de large. Il n'existe pas d'aviculaires. Un même segment peut porter plusieurs autozoécies axiales ovicellées, séparées l'une de l'autre par un verticille de deux loges non reproductrices.

DISCUSSION. — Cette espèce se différencie de toutes les autres *Melicerita* connues par sa disposition régulière en verticilles alternant de 2 et 3 autozoécies en vue frontale. La présence d'une ovicelle coiffant seulement la zoécie axiale des verticilles de trois est unique dans le genre.

ÉTYMOLOGIE. — Du Latin, *alternans*, alternant, pour rappeler la disposition des loges en verticilles successifs, respectivement formés de 2 et 3 zoécies, se succédant en alternance.

RÉPARTITION. — Nouvelle-Calédonie, à 435 m de profondeur.

Sous-Genre ***HENRIMILNELLA*** nov.

ESPÈCE-TYPE. — *Henrimilnella articulata* sp. nov.

DIAGNOSE. — Colonie dressée, bistratifiée, aplatie, constituée de petits éléments ; autozoécies hexagonales, groupées en séries alternantes. Limites interzoéciales très peu saillantes. Orifice hémicirculaire (incliné vers l'extérieur sur les autozoécies marginales) présentant une paire de condyles aperturaux proximaux et une paire de denticules distaux. Cryptocyste lisse, ou très finement granuleux. Pas d'aviculaires.

DISCUSSION. — Ce sous-genre se différencie des *Melicerita* (subgn. *Melicerita*) par la morphologie de ses éléments ; ils sont en forme de bâtonnets, à extrémité distale arrondie et extrémité proximale effilée, la possession constante de zoécies alternantes, la discrétion des limites interzoéciales, l'existence de deux paires de condyles aperturaux et un cryptocyste pratiquement lisse. La non-observation d'individus en reproduction ne permet pas d'élargir la discussion, mais il n'est pas à exclure qu'une meilleure connaissance de cette espèce, ainsi que de la suivante qui en est très affine, à partir de spécimens plus complets, justifie en fait pour elles la création d'un nouveau genre.

ÉTYMOLOGIE. — Ce sous-genre est dédié à la mémoire d'Henri MILNE EDWARDS, en souvenir de ses recherches anatomiques et écologiques sur les Bryozoaires marins.

Melicerita (Henrimilnella) articulata sp. nov.

Fig. 12 F-G

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 38, 360 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn DW 38, 360 m (MNHN-BRY-16443).

DIAGNOSE. — *Melicerita* (*Henrimilnella*) trisériée. Zoarium petit et en forme de baguette.

DESCRIPTION. — Les morceaux de zoarium étudiés se présentent comme de petites baguettes trisériées à bords parallèles, aplaties et non ramifiées, plus étroites et effilées à leur extrémité inférieure. Il n'a été observé ni ovicelles ni aviculaires. Les séries d'autozoécies sont alternantes ; celles de la file axiale ont leurs orifices symétriques par rapport à l'axe longitudinal, celles des latérales ont leurs orifices légèrement obliques vers l'extérieur et moins distaux que les précédentes. Le cryptocyste est plat, presque lisse. Les autozoécies axiales mesurent de 0,52 à 0,56 mm de long pour une largeur de 0,28-0,30 mm ; les limites interzoéciales ne sont pas saillantes ; elles sont hexagonales à bord antérieur arrondi, un peu plus effilées à l'arrière (jusqu'à 0,16 mm). L'orifice est très antérieur (il est situé dans le quart ou le cinquième distal de l'autozoécie) ; son bord proximal est droit, et présente une paire de condyles proximaux et une paire de denticules distaux ; il est long de 0,08 mm et large de 0,12 mm. Les autozoécies latérales ont un bord externe droit et un bord interne présentant à mi-longueur un angle dirigé vers l'axe autozoécial.

DISCUSSION. — Cette espèce se différencie de la suivante par la trisériation de son zoarium, l'emplacement de l'orifice autozoécial et le parallélisme sur une grande longueur de ses articles.

ÉTYMOLOGIE. — Du Latin, *articulata*, articulé, chaque fragment ayant la forme d'un article d'appendice d'arthropodes.

RÉPARTITION. — Nouvelle-Calédonie, à 360 m de profondeur.

Melicerita (Henrimilnella) laurifolia sp. nov.

Fig. 12 H-I

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. BIOCAL : stn DW 38, 360 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. BIOCAL, stn DW 38, 360 m. (MNHN-BRY-16443 bis).

DIAGNOSE. — *Melicerita (Henrimilnella)* à large zoarium quadrisérié, en forme de feuille, à extrémités arrondies et à côtés presque parallèles.

DESCRIPTION. — Les morceaux de zoarium étudiés sont larges et aplatis, non ramifiés, et ont des côtés pratiquement parallèles et des extrémités arrondies à large rayon de courbure ; leur extrémité inférieure présente un léger rétrécissement. Comme pour l'espèce précédente, il n'est pas à exclure qu'il corresponde au point d'insertion d'un joint, et il serait donc *a priori* impossible de préciser si le matériel décrit ici correspond à des portions isolées d'un zoarium, ou à une colonie entière ; mais la première hypothèse semble peu probable, puisque les opercules autozoéciaux, eux-mêmes chitineux, sont parfaitement conservés. Il n'existe pas d'aviculaire et aucune ovicelle n'a été observée. Les séries autozoéciales, alternantes, sont au nombre de 4 ; l'orifice hémicirculaire en est situé au tiers de la longueur en partant de la région distale ; il présente une paire de condyles proximaux et une paire de denticules distaux. Les autozoécies sont hexagonales ; celles appartenant aux deux séries de la partie centrale du zoarium sont longues de 0,41 à 0,44 mm, larges de 0,49 à 0,56 mm, et leur orifice, symétrique par rapport à l'axe zoarial longitudinal, mesure 0,08 mm de long et 0,12 mm de large ; la série marginale, de chaque côté, est formée d'autozoécies de 0,39-0,41 mm de long et de 0,52-0,60 mm de large, dont l'orifice a les mêmes dimensions que pour les autozoécies centrales mais est incliné vers l'extérieur. La surface frontale est lisse et les limites interzoéciales presque indiscernables.

DISCUSSION. — Cette espèce se différencie de la précédente, dont elle partage la localité-type, par la largeur et l'aplatissement de ses éléments, la quadrisériation de son zoarium et la position très antérieure de l'orifice autozoécial.

ÉTYMOLOGIE. — Du Latin, *laureus,* de laurier, et *folium*, feuille, en apposition, chaque fragment ayant la forme des outils préhistoriques connus sous le nom de "feuilles de laurier".

RÉPARTITION. — Nouvelle-Calédonie, à 360 m de profondeur.

CELLARIIDAE *incertae sedis*

Plusieurs spécimens de Cellariidae figurant dans la collection étudiée étaient trop incomplets pour être déterminables, même au niveau générique ; l'un d'eux, trop érodé pour pouvoir être décrit, est simplement figuré : BIOGÉOCAL, stn DW 307, 470-480 m (Fig. 6 F). Les autres feront ci-après l'objet d'une brève description :

1 - BIOCAL, stn DW 66

Fig. 12 E, 13 F-G

L'unique fragment de zoarium, non ramifié, est aplati et dépourvu de joints. Il présente deux séries d'autozoécies sur chacune de ses faces, alternantes sur chaque face comme dos à dos. La longueur autozoéciale varie de 0,70 à 0,73 mm, la largeur à l'avant de 0,30 à 0,32 mm, à l'arrière de 0,20 à 0,24 mm. L'orifice hémicirculaire a 0,08 mm de haut et 0,12 mm de large ; le bord proximal est droit ; il existe deux condyles proximaux et deux denticules distaux, non réunis par une lame calcaire. Le côté externe des autozoécies est rectiligne, le côté interne formant à mi-longueur un angle vers l'axe zoarial. Il n'existe ni aviculaires ni ovicelles. La surface frontale est finement et régulièrement granuleuse.

Cet échantillon ressemble beaucoup à une *Euginoma*, dont il possède de nombreux caractères, mais pas suffisamment pour qu'il soit possible d'en faire une analyse complète. Les *Euginoma* ne présentent pas de denticules aperturaux, ce qui les différencie de l'espèce étudiée ici. La forme du seul fragment possédé évoque celle rencontrée chez les *Henrimilnella* (voir ci-dessus), identification générique que confirmerait la présence des deux paires de denticules aperturaux, mais nous estimons préférable de ne pas donner de détermination générique à partir d'un seul et très petit spécimen.

2 - BIOGÉOCAL, stn CP 290

Le zoarium robuste a 1,2 mm de section. Il présente des autozoécies longues de 0,96-1,20 mm et larges de 0,57-0,61 mm. La frontale est nettement déprimée par rapport aux limites interzoéciales ; le cadre frontal est peu visible. L'orifice autozoécial est arrondi proximalement comme distalement et ne présente pas de condyles ; l'opercule, en forme de D, a 0,48 mm de long et 0,37 mm de large. L'ovicelle, long de 0,30 mm et large de 0,50 mm, possède un pore en croissant large de 0,40 mm, d'une longueur totale de 0,16 mm (dont 0,10 mm pour le pore seul). L'aviculaire rappelle beaucoup celui des *Pseudothyracella candelaber* ; long de 0,60 mm et large de 0,50 mm, il porte une mandibule de 0,60 mm de long et de 0,34 mm de large, arrondie à son extrémité distale, et soutenue par un sclérite triangulaire. Perdu en cours de préparation, ce spécimen n'a pu être photographié.

CLÉ ACTUALISÉE DE DÉTERMINATION DES GENRES ET DES SOUS-GENRES DE LA FAMILLE CELLARIIDAE

(N.B. - Les *Henrimilnella*, dont nous ignorons si les individus étudiés correspondent à des zoariums complets ou à des colonies incomplètes, sont considérées ici comme ayant un zoarium non articulé).

1. Zoarium non articulé **6**
— Zoarium présentant des entre-noeuds, séparés soit par des fractures, des discontinuités, ou des rétrécissements des files zoéciales, soit par des joints chitineux ; dans les cas où la ramification n'est pas articulée, des branches adventives peuvent être fixées par des rhizoïdes sur certains entre-noeuds **2**

2. Entre-noeuds séparés par des joints chitineux ou des fractures ; zoarium cylindrique ramifié dichotomiquement à autozoécies alternantes **3**
— Entre-noeuds délimités par des discontinuités ou des rétrécissements dans les files zoéciales ; parfois des ramifications latérales adventives fixées par des faisceaux de rhizoïdes ; autozoécies non alternantes, étroitement accolées au même niveau **4**

3. Joints marqués par une simple fracture ; orifices autozoéciaux nettement plus longs que larges ; bord proximal de l'orifice très arqué ; petites zoécies avicullariennes quadrangulaires à mandibule triangulaire ..... ***PARACELLARIA*** Moyano, 1969
— Entre-noeuds séparés par des joints chitineux ; orifices autozoéciaux plus larges que longs, ou de mêmes dimensions ; bord proximal de l'orifice rectiligne ou à peine arqué ; joints cylindriques de type tubuleux plus ou moins visibles ..... ***CELLARIA*** Ellis & Solander, 1786

4. Entre-noeuds séparés par des fractures ou des rétrécissements entourés ou non de tubes chitineux **5**
— Entre-noeuds non séparés par des rétrécissements ou des fractures, mais certaines branches peuvent porter latéralement des ramifications adventives fixées par des rhizoïdes. Petit aviculaire triangulaire à extrémité arrondie, inséré symétriquement par rapport à l'axe longitudinal de l'autozoécie proximale ; orifice hémicirculaire, à deux condyles proximaux et deux dents distales très discrètes..... ***NEOCELLARIAEFORMA*** d'Hondt, 1984

5. Orifices autozoéciaux plus ou moins quadrangulaires ; petits aviculaires interzoéciaux obliques à mandibule hémicirculaire ; présence de deux condyles aperturaux proximaux et de deux dents distales ..... ***CELLARIAEFORMA*** Rogick, 1956
— Orifices autozoéciaux de forme variable ; gros aviculaires rhomboïdaux interzoéciaux à mandibule triangulaire ; présence de deux condyles aperturaux proximaux reliés par une lame calcaire .... ***SWANOMIA*** Hayward & Thorpe, 1989 (= *MAWSONIA* Livingstone)

6. Zoarium (disjoint ?) constitué de petits éléments non ramifiés, en bâtonnets ou ovalaires ; deux paires de denticules aperturaux, une proximale et une distale ; zoécies alternantes ; orifice incliné vers l'intérieur sur les autozoécies marginales ..... ***HENRIMILNELLA*** subgn. nov.
— Zoarium ramifié cylindrique ou aplati ; condyles aperturaux et dents au nombre d'une ou de deux paires, ou absents ; zoécies alternantes ou non ; orifices inclinés ou non **7**

7. Ovicelles présentant des orifices latéraux en plus de l'orifice axial ; zoarium flabelliforme ; autozoécies en files longitudinales alternantes ; aviculaires interzoéciaux spatuliformes ; des condyles aperturaux proximaux ..... ***LARVAPORA*** Moyano, 1970
— Ovicelles ne présentant qu'un seul orifice, exceptionnellement susceptible d'être trilobé ; zoarium cylindrique ou aplati ; autozoécies en files longitudinales alternantes ou en couronnes radiaires ; aviculaires interzoéciaux variables, parfois absents, jamais spatuliformes ; condyles aperturaux présents ou absents **8**

8. Base du zoarium formée par une succession de nodules alternant deux à deux, chacun d'entre eux émettant une ou plusieurs branches zoariales ; orifice hémicirculaire ; termen peu saillant ..... ***DUBIOCELLARIA*** d'Hondt & Schopf, 1984
— Base du zoarium jamais formée d'une succession de nodules émettant chacun une ou plusieurs branches ; orifice et développement du termen variables **9**

9. Orifice autozoécial transversal, ovale ou en forme de croissant peu marqué ; termen formant des murailles saillantes ..... ***SYRINGOTREMA*** Harmer, 1926
— Orifice en forme de D ou de croissant bien marqué ; termen généralement peu élevé (sauf chez les *Atelestozoum*) **10**

10. Zoarium aplati et bilaminaire, parfois foliacé **11**
— Zoarium conique (certaines *Euginoma*) ou cylindrique, parfois un peu aplati mais dans ce cas jamais complètement bilaminaire **13**

11. Autozoécies planes, disposées en rangées transversales ; aviculaires vicariants ou absents ; opésies présentant des incisions latérales de part et d'autre d'une lame ; ovicelle formant un épaississement en avant de l'orifice **12**
— Autozoécies immergées au fond de profondes dépressions délimitées par le cadre du termen ; aviculaires absents ; opésie présentant un long processus proximal médian ; ovicelle inconnue ..... ***ATELESTOZOUM*** Harmer, 1926

12. Pas d'aviculaires ; condyles fusionnés avec une lame aperturale proximale ; orifices obliques sur tout le zoarium ..... ***PSEUDOCELLARIA*** Livingstone, 1928

— Des aviculaires vicariants, habituellement portés sur les bords de la colonie ; des condyles aperturaux proximaux et des denticules distaux ; orifices obliques sur les bords du zoarium ..... ***MELICERITA*** H. Milne Edwards, 1836

13. Aviculaires et autozoécies de mêmes dimensions ; mandibules avicullariennes sensiblement hémicirculaires et à implantation médiane ; des condyles opésiaux proximaux ; autozoécies disposées en spirale ..... ***STEGINOCELLARIA*** David & Pouyet, 1986
— Pas d'aviculaires ; denticules opésiaux présents ou absents **14**

14. Ovicelle non différenciée ; pas de denticules opésiaux ; pore ovicellien perforant la partie distale de l'autozoécie et séparé d'elle par une crête ..... ***EUGINOMA*** Jullien, 1882
— Ovicelle différenciée, soit distalement à l'orifice comme un bombement simulant un bonnet, soit comme une hétérozoécie en forme de pain de sucre réticulé égale à au moins la moitié de la surface d'une autozoécie normale **15**

15. Ovicelle en forme de pain de sucre réticulé, égale à au moins la surface d'une autozoécie normale ; pas de denticules opésiaux ; zoarium cylindrique ; autozoécies non alternantes longitudinalement mais réunies en couronnes radiaires .....
..... ***FORMOSOCELLARIA*** d'Hondt, 1981
— Ovicelle apparaissant comme un bombement en forme de bonnet distalement à l'orifice autozoécial ; condyles opésiaux présents ou absents **16**

16. Autozoécies disposées de manière spirale sur les branches zoariales **17**
— Autozoécies disposées en couronnes radiaires autour des branches zoariales ; condyles opésiaux présents ou absents ..... ***CRYPTOSTOMARIA*** Canu & Bassler, 1927

17. Opésie à l'extrémité distale du cryptocyste ; orifice ovicellien étroit et transversal ; denticules opésiaux présents ou absents .....
..... ***STOMHYPSELOSARIA*** Canu & Bassler, 1927
— Opésie au centre du cryptocyste ; orifice ovicellien large et transversal ; pas de denticules opésiaux ..... ***MESOSTOMARIA*** Canu & Bassler, 1927

REMARQUE. — Cette clé n'inclut pas quatre genres exclusivement fossiles (les trois premiers du Crétacé, le quatrième du Tertiaire) appartenant à la famille Cellariidae, tous les critères diagnostiques utilisables n'y ayant pas été observés (denticules, pores ovicelliens, lame interdenticulaire, morphologie avicularienne) :

- *Dimorphocellaria* Voigt, 1930 : zoarium articulé, cylindrique ; séries autozoéciales alternantes ; aviculaires vicariants ; ovicelle endotochoïdale ; existence de deux types autozoéciaux, se caractérisant par une forme différente de l'orifice (l'un d'entre eux pouvant correspondre à des gonozoïdes).

- *Hemistylus* Voigt, 1928 : zoarium articulé, cylindrique ; séries autozoéciales alternantes ; orifices autozoéciaux portés sur une seule des faces zoariales (comme chez les *Euginoma*).

- *Escharicellaria* Voigt, 1924 : zoarium bilaminaire dichotome inarticulé ; aviculaires vicariants ; opésie en forme de D allongé et presque hémicirculaire.

- *Paramawsonia* Androsova, 1972 : zoarium cylindrique, dont il n'est pas certain qu'il soit articulé, à zoécies disposées en séries longitudinales alternantes et aviculaires vicariants à rostre triangulaire. Il n'est pas à exclure que l'unique espèce actuellement rangée dans ce genre, tel qu'il a été délimité par HAYWARD et RYLAND (1993), entre en fait dans le genre *Cellaria*.

Embranchement ENTOPROCTA Nitsche, 1870

Famille LOXOKALYPODIDAE Emschermann, 1972

Genre ***LOXOKALYPUS*** Emschermann, 1972

ESPÈCE-TYPE. — *Loxokalypus socialis* Emschermann, 1972.

Loxokalypus pedicellinoides sp. nov.

Fig. 2 A-C

MATÉRIEL EXAMINÉ. — **Nouvelle-Calédonie**. CHALCAL 2 : stn DW 81, 311 m.

TYPE. — *Holotype* : Nouvelle-Calédonie. CHALCAL 2 : stn DW 81, 311 m (MNHN-BRY-16706).

DIAGNOSE. — *Loxokalypus* à pédoncule long, fin et isodiamétrique, 3 à 4 fois plus long que l'ensemble calice-tentacules rétractés.

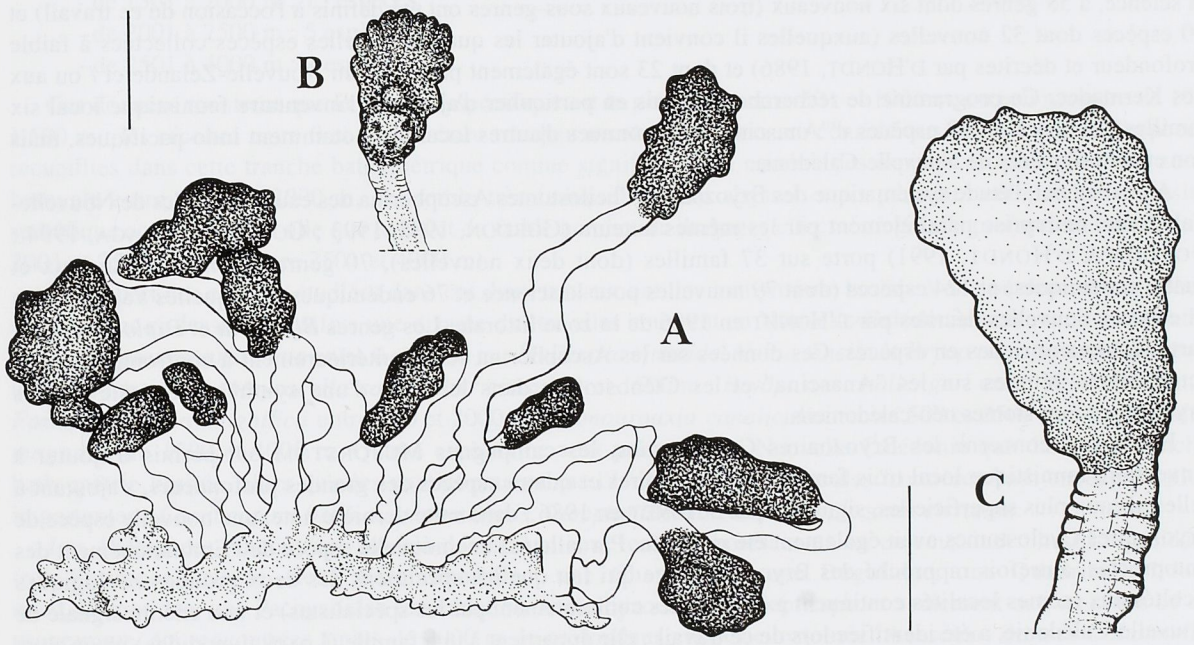


FIG. 2. — *Loxokalypus pedicellinoides* : **A**, Zoarium. Échelle : 0,2 mm ; **B**, Calice. Echelle : 0,2 mm ; **C**, Détail de l'ornementation superficielle d'un pédoncule. Échelle : 0,1 mm.

DESCRIPTION. — L'unique petite colonie recueillie est formée d'une douzaine de zoïdes séparés, issus d'une sole basale commune ; elle ne comporte aucun stade de bourgeonnement de jeune individu. Cette sole a 0,11 mm de long et 0,10 mm de large. Les zoïdes ne présentent pas de cloison, ni entre le calice et le pédoncule, ni entre celui-ci et la sole basale ; ils atteignent une hauteur de 0,95-1 mm. Les pédoncules, insérés côte à côte, ont un diamètre de 0,05 mm et une hauteur de 0,95-1 mm. Les tentacules, au nombre d'une huitaine, sont rétractés à l'intérieur du calice chez tous les individus ; leur panache y a, selon les échantillons, une hauteur de 0,14 à 0,20 mm (0,29-0,32 mm avec les tentacules rétractés). Ce calice, cupuliforme, a 0,10-0,11 mm de hauteur et de diamètre. L'état de conservation du matériel ne permet pas d'en donner une description plus complète.

DISCUSSION. — Le genre *Loxokalypus* était jusqu'à présent monospécifique pour *L. socialis*, espèce uniquement connue des îles de la Reine Charlotte, sur la côte pacifique du Canada, dans la région de Vancouver. Les deux espèces se différencient par la longueur et le diamètre des pédoncules. Chez l'espèce-type du genre, le pédoncule est sensiblement de la même longueur que le calice.

ÉTYMOLOGIE. — Du latin *pedicelloides*, en raison de la ressemblance morphologique des individus de cette espèce avec ceux des *Pedicellina*, autre genre d'Entoproctes (solitaires).

RÉPARTITION. — Nouvelle-Calédonie, à 311 m de profondeur.

CONCLUSIONS ET REMARQUES GÉNÉRALES

Les deux études que nous avons consacrées aux Bryozoaires Cheilostomes "Anascina" profonds, récoltés lors des campagnes océanographiques françaises dans les parages de la Nouvelle-Calédonie (D'HONDT & GORDON, 1996 ; présente publication) ont permis un accroissement considérable de nos connaissances sur les faunes bathyale et abyssale de cette région. Les échantillons recueillis appartiennent à 25 familles, dont une nouvelle pour la science, à 53 genres dont six nouveaux (trois nouveaux sous-genres ont été définis à l'occasion de ce travail) et 90 espèces dont 32 nouvelles (auxquelles il convient d'ajouter les quatre nouvelles espèces collectées à faible profondeur et décrites par D'HONDT, 1986) et dont 23 sont également présentes en Nouvelle-Zélande et / ou aux îles Kermadec. Ce programme de recherche a permis en particulier d'ajouter à l'inventaire faunistique local six familles, 26 genres et 43 espèces d'"Anascina" déjà connues d'autres localités, notamment indo-pacifiques, mais non encore signalées de Nouvelle-Calédonie.

Actuellement, l'étude systématique des Bryozoaires Cheilostomes Ascophorina des eaux profondes de Nouvelle-Calédonie, entreprise parallèlement par les mêmes auteurs (GORDON, 1988, 1993 ; GORDON & BRAGA, 1994 ; GORDON & D'HONDT, 1991) porte sur 37 familles (dont deux nouvelles), 70 genres (dont 16 nouveaux et quatre endémiques) et 124 espèces (dont 79 nouvelles pour la science et 76 endémiques), auxquelles s'ajoutent les 11 espèces nouvelles décrites par D'HONDT en 1986 de la zone littorale. Les genres *Bifaxaria* et *Diplonotos* sont particulièrement riches en espèces. Ces données sur les Ascophorina seront ultérieurement à confronter à celles actuellement réunies sur les "Anascina" et les Cténostomes dans le cadre d'une synthèse générale sur les Bryozoaires Eurystomes néo-calédoniens.

En ce qui concerne les Bryozoaires Cténostomes, les campagnes MUSORSTOM ont permis d'ajouter à l'inventaire faunistique local trois familles, quatre genres et quatre espèces des grandes profondeurs, s'ajoutant à celles, d'eaux plus superficielles, signalées par D'HONDT en 1986 ; dans cette dernière note, une nouvelle espèce de Bryozoaires Cyclostomes avait également été nommée. Par ailleurs, une nouvelle espèce de l'Embranchement des Entoproctes, autrefois rapproché des Bryozoaires (ce qui fait que les spécimens des deux groupes zoologiques récoltés aux mêmes localités continuent à être étudiés conjointement par les spécialistes) et non encore signalé de Nouvelle-Calédonie, a été identifiée lors de ce travail ; elle appartient à une famille (Loxokalypodidae) jusqu'alors monogénérique et monospécifique, uniquement connue jusqu'à présent de la région nord-ouest pacifique.

Plusieurs genres de Bryozoaires Eurystomes, trouvés à proximité de la Nouvelle-Calédonie à l'occasion de ce programme de recherche, n'étaient connus que de l'Atlantique : les Cheilostomes *Nordgaardia* et *Formosocellaria*,

les Cténostomes *Aethozoon* et *Pachyzoon*. Les espèces de ces deux genres recueillies ici appartiennent elles-mêmes à la faune de l'océan Atlantique, ce qui laisse espérer la découverte ultérieure de localités intermédiaires.

Un certain nombre de genres récoltés autour de la Nouvelle-Calédonie sont réputés cosmopolites, et leur présence dans la faune de cette région est parfaitement logique : *Notoplites* (9 espèces et sous-espèces recueillies dans le cadre de ce programme), *Caberea*, *Cornucopina*, *Camptoplites*, *Beania*, *Himantozoum*, *Membranipora*. En revanche, d'autres très répandus dans l'Indo-Pacifique sont pauvrement représentés en Nouvelle-Calédonie : *Dendrobeania*, *Menipea*. Certains y présentent une grande diversité spécifique : *Himantozoum*, *Crateropora*, *Bryopastor*. Par ailleurs, un genre fossile y a été pour la première fois retrouvé à l'état vivant (*Pseudothyracella*). Sont endémiques de cette région, dans l'état actuel de nos connaissances, les genres *Candoscrupocellaria*, *Candomenipea* et *Astoleiosalpinx* définis par D'HONDT et GORDON (1996). Le nombre des espèces appartenant aux genres *Bryopastor* et *Crateropora* est presque triplé. Le genre *Notoplites*, représenté par 11 espèces dans les parages de la Nouvelle-Calédonie, est celui qui y présente la plus grande diversité spécifique.

Quelques-unes des espèces figurant dans le matériel étudié ont une large distribution géographique, soit au niveau mondial (*Bugulella gracilis* : Irlande et Indo-Pacifique ; *Scrupocellaria delilii* et *S. spatulata* : toutes les mers chaudes, et dans tous les cas à faible profondeur, inférieure à 100 m) ; d'autres sont, soit uniquement connues des régions australes (*Menipea patagonica* à une profondeur inhabituelle, cf. D'HONDT & GORDON, 1996), soit largement réparties dans l'Indo-Pacifique (*Euoplozoum cirratum*, *Notoplites scutatus*, *Canda clypeata*, *Caberea lata*, *C. glabra*, *C. darwini*, *Amastigia rudis*, *Cornucopina bella* et *Beania discodermiae*, c'est-à-dire presque uniquement des Cellularines), n'étaient pas encore connues de la région néo-calédonienne et les présentes récoltes permettent d'élargir leur aire de distribution.

Si nous considérons les espèces récoltées en fonction de leurs distributions bathymétriques, les données peuvent être regroupées comme suit :

- de 0 à 100 m : 15 espèces,
- de 101 à 500 m : 31 espèces,
- de 501 à 1000 m : 48 espèces,
- de 1001 à 1500 m : 15 espèces,
- de 1501 à 2000 m : 15 espèces,
- de 2001 à 2500 m : 5 espèces,
- de 2501 à 4000 m : 4 espèces.

Ces données montrent que la diversité spécifique est la plus riche entre 501 et 1000 m, un peu moindre de 101 à 500 m ; les récoltes entre 0 et 100 m étant très peu nombreuses, nous ne considérons pas le nombre d'espèces recueillies dans cette tranche bathymétrique comme significatif. Le nombre des espèces est plus réduit en zone bathyale entre 1000 et 2000 m, et semble très faible en milieu abyssal, mais peut-être cette faible diversité spécifique constatée n'est-elle que le reflet du faible nombre de dragages effectués à grande profondeur (trois entre 2001 et 2500 m, trois entre 2501 et 4000 m).

La plupart des espèces étudiées dans ces deux travaux ont une bathymétrie limitée à une ou deux des tranches déterminées ci-dessus. Toutefois une dizaine d'entre elles couvrent en Nouvelle-Calédonie trois ou quatre d'entre elles : *Cryptostomaria alata* entre 0 et 1500 m ; *Melicerita ejuncida*, *Nellia tenella* et *Bryopastor pentagonus* entre 0 et 2000 m ; *Pseudothyracella candelaber* entre 101 et 1500 m ; *Bryopastor challengeri* entre 101 et 2000 m ; *Formosocellaria magnifica* entre 500 et 2000 m ; *Lamourouxia canaliculata* entre 500 et 2500 m ; *Columnella magna* entre 1500 et 4000 m. Quatre espèces ne sont présentes en Nouvelle-Calédonie que dans une tranche bathymétrie limitée, alors qu'elles sont connues dans l'Indo-Pacifique entre des frontières bathymétriques plus importantes : *Cornucopina bella*, *C. moluccensis*, *Camptoplites lineatus*, *Euoplozoum cirratum*.

Les 18 espèces rencontrées au-delà de 1000 m sont toutes arborescentes ou en coussinet : huit Cellariidae, trois Scrupocellariidae, deux Farciminariidae, une Chaperiidae, une Bugulidae, une Quadricellariidae, une Calloporidae, une Pachyzoidae (émendation de Pachyzoontidae). Sept espèces seulement ont, au cours de ce programme, été rencontrées à plus de 2000 m de profondeur : les Cheilostomes "Anascina" dressés *Columnella magna*, espèce typique de la faune abyssale (D'HONDT, 1981b), *Lamourouxia canaliculata* (nouvelle espèce), *Penemia crassospina* (genre de création récente et à bathymétrie peu étudiée) et *Notoplites cassiduloides*, *Cornucopina* sp. et *Dendrobeania pseudexilis* (appartenant à des genres comportant déjà plusieurs espèces

profondes), ainsi que le Cténostome en coussinet *Pachyzoon atlanticum*. Il convient d'ajouter à cette liste *Formosocellaria magnifica*, récoltée vers 3500 m en mer de Tasmanie, lors d'une campagne du New Zealand Oceanographic Institute.

Seules quelques espèces sont communes aux faunes de Nouvelle-Calédonie et des îles Kermadec : *Crassimarginatella spathulata*, *Concertina cultrata*, *Bryopastor challengeri*, *Melicerita ejuncida*, *Notoplites longispinosus* et *Penemia ignota* (?), qui ne sont connues que de ces deux régions géographiques, et *Caberea darwini*, *C. glabra*, *Notoplites obliquidens*, *Amastigia rudis*, *Cornucopina geniculata*, *C. moluccensis*, *Bugulella gracilis*, *Quadricellaria tenuis*, *Cellaria tenuirostris*, *Beania discodermiae*, *Alderina tuberosa* et *Leiosalpinx australis*, dont la distribution géographique est plus étendue. Si l'on excepte les espèces présentes simultanément en Atlantique et en Nouvelle-Calédonie sans localités intermédiaires (*Aethozoon pellucidum*, *Pachyzoon atlanticum* et à un moindre degré *Formosocellaria magnifica*), deux seulement des espèces étudiées dans ces deux travaux ont une très large distribution géographique : l'espèce abyssale *Columnella magna*, qui ne fait défaut que dans les eaux polaires et sub-polaires, et une espèce largement présente dans l'infra-littoral des eaux tempérées et chaudes, *Nellia tenella*, dont les seules récoltes profondes ont été effectuées en Nouvelle-Calédonie.

REMERCIEMENTS

Les photographies illustrant cette publication ont été réalisées, les unes en Nouvelle-Zélande directement par l'un des co-auteurs (D.P.G.) - grossissements indiqués sur les pages de légendes -, les autres en France sur un appareil différent par le deuxième auteur (J.L.D'H.) avec l'aide de Mme D. GUILLAUMIN (Centre d'Accueil de Microscopie Électronique de l'Université Pierre et Marie Curie - Paris VI) - échelles figurant sur les planches photographiques - ; elles ont été assemblées par Mme M.-J. D'HONDT qui a également effectué les figures 1-2. Nous leur adressons l'expression de notre vive gratitude. Nous remercions sincèrement Miss Patricia L. COOK (Bendigo) et le Dr P.J. HAYWARD (Swansea) pour les informations qu'ils nous ont transmises et leurs remarques constructives concernant ce travail.

Les recherches de l'un des auteurs (D.P.G.) ont été financées par la New Zealand Foundation for Research, Science & Technology (Contrat CO 1421).

RÉFÉRENCES

ANDROSOVA, E.I., 1972. — Bryozoaires Cheilostomes (Anasca) de l'Antarctique et du Subantarctique. *In* : Résultats biologiques de l'Expédition Antarctique Soviétique 1955-1958, 4. *Issledovaniya Faunei Morei*, **6** (14) : 35-84 (en russe).

BASSLER, R.S., 1953. — Bryozoa. Part G. *In* : R.C. MOORE (ed.), Treatise on Invertebrate Paleontology, Geological Society of America and University of Kansas Press, New York, XIII + 253 p.

BROWN, D.A., 1948. — Six new Recent and Tertiary genera of cheilostomatous Polyzoa from New Zealand. *Annals and Magazine of Natural History*, ser. 12, **1** : 108-122.

BUSK, G., 1852. — Catalogue of marine Polyzoa in the collection of the British Museum. Cheilostomata, **1** : I-VIII + 1-54, pl. 1-68. Trustees of the British Museum (Natural History), London.

BUSK, G., 1881. — Notes on a peculiar form of a Polyzoa closely allied to *Bugula* (*Kinetoskias*, Kor. & Dan.). *Quarterly Journal of Microscopical Science,* **21**: 1-14, pl. 1-2.

BUSK, G., 1884. — Report on the Polyzoa collected by H.M.S. *Challenger* during the years 1873-1876. Part 1. - The Cheilostomata. *Report of the scientific Results of the Voyage of H.M.S. Challenger*, Zool., **10** (30) : I-XXIV + 1-216, 36 pl.

CADEE, G.C., CHIMONIDES, P.S. & COOK, P.L., 1989. — *Pseudolunularia* gen. n., (Cheilostomata), a lunulitiform bryozoan from the Indo-West Pacific. *Zoologica Scripta*, **18** (1) : 43-48.

CANU, F., 1900. — Révision des Bryozoaires du Crétacé figurés par d'Orbigny. Deuxième partie. Cheilostomata. *Bulletin de la Société géologique de France*, sér. 3, **28** (3-4) : 334-463, pl. 4-7.

CANU, F. & BASSLER, R.S., 1920. — North American Early Tertiary Bryozoa. *Bulletin of the United States National Museum*, **106**, vol. 1 : I-XX + 1-879 ; vol. 2, 162 pl.

CANU, F. & BASSLER, R.S., 1927. — Classification of the Cheilostomatous Bryozoa. *Proceedings of the United States National Museum*, **69** (14), 42 p., 1 pl.

CANU, F. & BASSLER, R.S., 1928. — Fossil and Recent Bryozoa of the Gulf of Mexico Region. *Proceedings of the United States National Museum*, **72** (14), 199 p., 34 pl.

CANU, F. & BASSLER, R.S., 1929. — Bryozoa of the Philippine Region. *Bulletin of the United States National Museum*, **100** : I-XI + 1-685, 94 pl.

CANU, F. & BASSLER, R.S., 1933. — The bryozoan fauna of the Vincentown Limesand. *Bulletin of the United States National Museum*, **165** : 1-108, pl. 1-21.

CHIMONIDES, P.J. & COOK, P.L., 1994. — Notes on the genus *Cranosina* (Bryozoa, Cheilostomida). *Zoologica Scripta*, **23** (1) : 43-49.

COOK, P.L., 1964. — Polyzoa from West Africa. 1. Notes on the Steganoporellidae, Thalamoporellidae and Onychocellidae (Anasca, Coilostega). *Annales de l'Institut océanographique*, **41** (2) : 43-79.

COOK, P.L., 1968. — Bryozoa (Polyzoa) from the coast of tropical West Africa. *Atlantide Report*, **10** : 115-262, pl. 8-11.

COOK, P.L., 1985. — Bryozoa from Ghana : a preliminary survey. *Annales du Musée royal de l'Afrique Centrale (Sciences zoologiques)*, **238**, 315 p.

DAVID, L. & POUYET, S., 1986. — Bryozoaires abyssaux des campagnes Safari (Océan Indien). *Annales de l'Institut océanographique de Monaco*, n.s., **62** (2) : 141-191.

EHRENBERG, G.C., 1831. — *Symbolae physicae, seu icones et descripciones corporum naturalium novorum. Pars Zoologica*, 1 : *Animalia evertebrata exclusis insectis, Phytozoa Polypi*, 7 p., 1 pl. Berlin.

ELLIS, J. & SOLANDER, D., 1786. — The natural history of many curious and uncommon Zoophytes, collected from various parts of the globe, XII + 208 p, 63 pl. B. White & Son, P. Elmsly, London.

EMSCHERMANN, P., 1972. — *Loxokalypus socialis* gen. et sp. nov. (Kamptozoa, Loxokalypodidae fam. nov.), ein neuer Kamptozoentyp aus dem nördlichen Pazifischen Ozean. Ein Vorschlag zur Neufassung der Kamptozoensystematik. *Marine Biology*, **12** (3) : 237-254.

FLEMING, J., 1828. — A history of British animals, exhibiting their descriptive characters and systematical arrangement of the genera and species of quadrupeds, birds, reptiles, fishes, Mollusca, and Radiata of the United Kingdom, xxiii + 565 p. Bell & Bradfute, Edinburgh.

FOREST, J., 1996. — Henri Milne Edwards (23 October 1800-29 July 1885). *Journal of Crustacean Biology*, **16** (1) : 208-213.

GORDON, D.P., 1982. — The genera of the Chaperiidae (Bryozoa). *New Zealand Journal of Zoology*, **9** (1) : 1-23.

GORDON, D.P., 1984. — The marine fauna of New Zealand : Bryozoa : Gymnolaemata from the Kermadec Ridge. *Memoirs. New Zealand Oceanographic Institute*, **91** : 1-198.

GORDON, D.P., 1985. — Additional species and records of Gymnolaemate Bryozoa from the Kermadec region. *NZOI Records*, **4** (14) : 159-183.

GORDON, D.P., 1986. — The Marine Fauna of New Zealand : Bryozoa : Gymnolaemata (Ctenostomata and Cheilostoma Anasca) from the Western South Island Continental Shelf and Slope. *Memoirs. New Zealand Oceanographic Institute*, **95** : 1-121.

GORDON, D.P., 1988. — The bryozoan families Sclerodomidae, Bifaxariidae and Urceoliporidae and a novel type of frontal wall. *New Zealand Journal of Zoology*, **15** : 249-290.

GORDON, D.P., 1989. — The Marine Fauna of New Zealand : Bryozoa : Gymnolaemata (Cheilostomida Ascophorina) from the Western South Island Continental Shelf and Slope. *Memoirs. New Zealand Oceanographic Institute*, **97** : 1-157.

GORDON, D.P., 1993. — Bryozoa : The ascophorine infraorders Cribriomorpha, Hippothoomorpha and Umbonulomorpha. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 11. *Mémoires du Muséum national d'Histoire naturelle*, **158** : 299-347.

GORDON, D.P. & BRAGA, G., 1994. — Bryozoa : Living and fossil species of the catenicellid subfamilies Ditaxiporinae Stach and Vasignyellinae nov. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 12. *Mémoires du Muséum national d'Histoire naturelle*, **161** : 55-85.

GORDON, D.P. & HONDT, J.-L. D', 1991. — Bryozoa : The Miocene to Recent family Petalostegidae. Systematics, affinities, biogeography. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 8. *Mémoires du Muséum national d'Histoire naturelle*, **151** : 91-123.

GRAY, J.E., 1848. — List of the specimens of British animals in the collection of the British Museum. Part I. Centroniae and radiated animals, XIII + 173 p. (91-151). Trustees of the British Museum (Natural History).

HARMER, S.F., 1923. — On Cellularine and other Polyzoa. *Journal of the Linnean Society of London*, **35** : 293-361.

HARMER, S.F., 1926. — The Polyzoa of the Siboga Expedition. Part 2. Cheilostomata Anasca. *Siboga-Expeditie*, Monogr., (28b) : I-VIII + 181-501, pl. 13-34.

HASSALL, A.H., 1840. — Catalogue of Irish Zoophytes. *Annals and Magazine of Natural History*, **6** : 166-175.

HASTINGS, A.B., 1943. — Polyzoa (Bryozoa) 1. Scrupocellariidae, Epistomiidae, Farciminariidae, Bicellariellidae, Aeteidae, Scruparidae. *"Discovery" Reports,* **22** : 301-510.

HASTINGS, A.B., 1946 (1947). — Notes on Polyzoa (Bryozoa). — III. On some Species of *Cellaria*, with Remarks on G. Busk's Grouping of the Species of this Genus. *Annals and Magazine of Natural History*, ser. 11, **13**: 217-241.

HAYWARD, P.J., 1981. — The Cheilostomata (Bryozoa) of the deep sea. *Galathea Reports*, **15** : 21-68, pl. 5.

HAYWARD, P.J., 1988. — Mauritian cheilostome Bryozoa. *Journal of Zoology*, (215) : 269-356.

HAYWARD, P.J. & COOK, P.L., 1979. — The South African Museum's *Meiring Naude* Cruises. Part 9. Bryozoa. *Annals of the South African Museum*, **79** (4) : 43-130.

HAYWARD, P.J. & RYLAND, J.S., 1993. — Taxonomy of six Antarctic anascan Bryozoa. *Antarctic Science*, **5** (2) : 129-136.

HAYWARD, P.J. & THORPE, J.P., 1989. — Membraniporoidea, Microporoidea and Cellarioidea (Bryozoa, Cheilostomata) collected by Discovery Investigations. *Journal of Natural History*, **23** : 913-959.

HINCKS, T., 1860. — Descriptions of new Polyzoa from Ireland. *Quarterly Journal of Microscopical Science*, ser. 2, **8** : 275-280.

HINCKS, T., 1880. — A history of the British marine Polyzoa, vol. 1, 601 p., vol. 2, 83 pl. J. van Voorst, London.

HINCKS, T., 1881. — Contributions towards a general history of the marine Polyzoa. IV. Foreign Membraniporina. *Annals and Magazine of Natural History*, ser. 5, **7** : 147-161.

HINCKS, T., 1884. — Contributions towards a general history of the marine Polyzoa. XII. Polyzoa from India (coast of Burmah). XIII. Polyzoa from Victoria and Western Australia. *Annals and Magazine of Natural History*, ser. 5, **13** : 356-369.

HONDT, J.-L. D', 1975. — Bryozoaires Cténostomes et Cheilostomes (Cribrimorphes et Escharellidae exceptés) provenant des dragages de la campagne océanographique Biaçores du "Jean-Charcot". *Bulletin du Muséum national d'Histoire naturelle, Paris,* sér. 3, (299), Zool. 209 : 553-600.

HONDT, J.-L. D', 1977. — Valeur systématique de la structure larvaire et des particularités de la morphogenèse post-larvaire chez les Bryozoaires Gymnolaemates. *Gegenbaurs morphologisches Jahrbuch*, **123** (3) : 463-483.

HONDT, J.-L. D', 1979. — Révision des Bryozoaires de Lesueur et Péron conservés dans les collections du Muséum National d'Histoire Naturelle de Paris. *Bulletin trimestriel de la Société géologique de Normandie et des Amis du Muséum du Havre*, **66** (3) : 11-24.

HONDT, J.-L. D', 1981 a. — Bryozoaires Cheilostomes bathyaux et abyssaux provenant des campagnes océanographiques américaines (1969-1972) de l'"Atlantis II", du "Chain" et du "Knorr" (Woods Hole Oceanographic Institution). *Bulletin du Muséum national d'Histoire naturelle, Paris,* sér. 4, **3**, section A (1) : 5-71.

HONDT, J.-L. D', 1981 b. — Les Bryozoaires Eurystomes abyssaux. *Comptes rendus sommaires des Séances de la Société de Biogéographie*, **58** (1) : 30-48.

HONDT, J.-L. D', 1983. — Nouvelle contribution à l'étude des Bryozoaires Eurystomes bathyaux et abyssaux de l'océan Atlantique. *Bulletin du Muséum national d'Histoire naturelle, Paris*, sér. 4, **5**, section A (1) : 73-99.

HONDT, J.-L. D', 1984. — Nouvelle contribution à la connaissance des Bryozoaires marins des Terres Australes françaises. *Comité national français des Recherches Antarctiques*, **55** : 95-116.

HONDT, J.-L. D', 1985. — Contribution à la systématique des Bryozoaires Eurystomes. Apports récents et nouvelles propositions. *Annales de Sciences Naturelles (Zoologie)*, sér. 13, **7** : 1-12.

HONDT, J.-L. D', 1986. — Bryozoaires de Nouvelle-Calédonie et du plateau des Chesterfield. *Bulletin du Muséum national d'Histoire naturelle, Paris*, sér. 4, **8**, section A (4) : 697-756.

HONDT, J.-L. D', & GORDON, D.P., 1996. — Bryozoa : Cténostomes et Cheilostomes (Cellularines, Scrupariines et Malacostèges) des campagnes MUSORSTOM autour de la Nouvelle-Calédonie. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 15. *Mémoires du Muséum national d'Histoire naturelle*, **168** : 55-123.

HONDT, J.-L. D', & REDIER, L., 1977. — Bryozoaires récoltés lors des campagnes d'été 1972 et 1974 aux Iles Kerguelen (Cténostomes, Cheilostomes sauf Cribrimorphes, Entoproctes). *Comité national français des Recherches Antarctiques*, **42** : 215-236.

HONDT, J.-L. D', & SCHOPF, T.J.M., 1984. — Bryozoaires des grandes profondeurs recueillis lors des campagnes océanographiques de la Woods Hole Oceanographic Institution de 1961 à 1968. *Bulletin du Muséum national d'Histoire naturelle, Paris*, sér. 4, **6**, section A (4) : 907-973.

JOHNSTON, G., 1847. — A history of the British Zoophytes. 2e édition, vol. 1 : I-XVI +1-488; vol. 2, pl. 1-74. John van Voorst, Londres.

JULLIEN, J., 1882 (1883). — Bryozoaires. Espèces draguées dans l'océan Atlantique en 1881. *Bulletin de la Société zoologique de France*, **7** : 497-529.

JULLIEN, J., 1888. — Bryozoaires. *In* : Mission scientifique du Cap Horn 1882-1883, 6 (Zoologie, 3ème part.) : 1-92, 15 pl. Gauthier-Villars, Paris.

LABRACHERIE, M., 1975. — Sur quelques Bryozoaires de l'Eocène Inférieur nord-aquitanien. *Revista española de Micropaleontología*, **7** (1) : 127-164.

LAMARCK, J.B.P.A. de, 1816. — Histoire Naturelle des Animaux sans Vertèbres. Tome Second, 568 p. Verdière, Paris.

LEVINSEN, G.M.R., 1909. — Morphological and systematic studies in the Cheilostomatous Bryozoa, 431 p. National Forfatteres Forlag, Fr. Bagge, Copenhague.

LEVINSEN, G.M.R., 1914. — Conspectus Faunae Groenlandicae. Bryozoa, Endoprocta, Pterobranchia, og Enteropneusta. *Meddelser om Grönland*, **23** : 545-634.

LINNÉ, C., 1758. — *Systema Naturae per Regna tria Naturae, secundum Classes, Ordines, Genera, Species*. Tome 1 : *Regnum Animale*. 10ème Ed., 824 p. Laurentii Salvii, Holmiae.

LINNÉ, C., 1767. — *Systema Naturae per Regna tria Naturae, secundum Classes, Ordines, Genera, Species*. Tome 1 : *Regnum Animale*. 12ème Ed., part. 1 : 1-532 et part. 2 : 533-1327. Laurentii Salvii, Holmiae.

LIVINGSTONE, A., 1928. — The Bryozoa. *In* : Scientific Reports. Mawson's Australian Antarctic Expedition 1911-1914, Ser. C, Zool. Bot., **9** (1) : 5-94.

MARCUS, E., 1938. — Briozoarios marinhos Brasileiros - II. *Bolétim de Faculdade de Filosofía, Ciencias e Letras, Universidade de Sao Paulo, Zoología* , **1** : 1-137, pl. 1-29.

MARCUS, E., 1953. — Notas sobre Briozoos marinhos Brasileiros. *Arquivos do Museo Nacional*, **42** : 273-342, pl. 1-8.

MARSSON, TH., 1887. — Die Bryozoen der weissen Schreibkreide der Insel Rügen. *Paläeontologische Abhandlungen, Berlin*, **4**, Heft 1, 112 p, 10 pl.

MAWATARI, S., 1974. — Studies on Japanese Anascan Bryozoa. 3. Division Malacostega (1). *Bulletin of the National Science Museum, Tokyo* , **17** (1) : 17-52, 3 pl.

MAWATARI, S. & MAWATARI, S.F., 1981. — Studies on Japanese anascan Bryozoa 6. Division Malacostega (4). *Bulletin of Liberal Arts & Sciences Courses, School of Medecine, Nihon University*, **9** : 23-61.

MEUNIER, A. & PERGENS, E., 1886. — Les Bryozoaires du système Montien (Eocène inférieur) : 1-14, pl. 1-3. Louvain.

MILNE EDWARDS, H., 1836. — Sur un nouveau genre de Polypiers fossiles, de la famille des Eschariens, nommé Mélicerite. *Annales de Sciences Naturelles (Zoologie)*, sér. 2, **6** : 345-347.

MORRIS, J., 1843. — A catalogue of British fossils, comprising all the genera and species hitherto described; with references to the geological distribution and to the localities in which they have been found. x + 222 p. Van Voorst, London.

MOYANO, H.I., 1969. — Bryozoa colectados por la expedición antarctica chilena 1964-1965. III. Familia Cellariidae Hincks, 1880. *Boletín de la Sociedad de Biología de Concepción*, **41** : 41-77.

MOYANO, H.I., 1970. — Una familia, tres géneros y una especie nuevos para la Antarctica (Bryozoa Cheilostomata). *Cahiers de Biologie Marine*, **11** : 153-166.

MOYANO, H.I., 1983. — Southern Pacific Bryozoa : a general view with emphasis on Chilean species. *Gayana*, **46** : 1-45.

NITSCHE, H., 1870. — Beiträge zur Kenntnis der Bryozoen. *Zeitschrift für wissenschaftliche Zoologie*, **20** : 13-36.

NORMAN, A.M., 1903. — Notes on the Natural History of East Finmark, Polyzoa. *Annals and Magazine of Natural History*, ser. 7, **11** : 567-598, pl. 13.

ORBIGNY, A. D', 1851. — Recherches zoologiques sur la classe des Mollusques Bryozoaires. *Annales de Sciences Naturelles (Zoologie)*, **3** (16) : 292-339.

OSBURN, R.C., 1950. — Bryozoa of the Pacific coast of America. Part 1, Cheilostomata-Anasca. *In* : Allan Hancock Pacific Expedition, **14** (1) : 1-269. University of Southern California Press.

PRENANT, M. & BOBIN, G., 1966. — Bryozoaires, deuxième partie. Chilostomes Anasca. *Faune de France*, **68**, 647 p. Fédération française des Sociétés de Sciences Naturelles, Paris.

ROGICK, M.D., 1956. — Bryozoa of the United States Navy's 1947-1948 Antarctic Expedition, I-IV. *Proceedings of the United States National Museum*, **105** (3358) : 221-317.

SILÉN, L., 1941. — Cheilostomata Anasca (Bryozoa) collected by Prof. Dr. Sixten Bock's expedition to Japan and the Bonin Islands 1914. *Arkiv för Zoologi*, **334** (12) : 1-130, pl. 1-9.

SILÉN, L., 1942. — Origin and development of the cheilo-ctenostomatous stem of Bryozoa. *Zoologiska Bidrag från Uppsala*, **22** : 1-59.

SMITT, F., 1867. — Kritisk Förteckniing öfver Skandinaviens Hafs-Bryozoer. Part 2. *Ofversigt af Kongliga Vetenskaps-Akademiens Handlingar*, **23** : 395-533.

SMITT, F., 1873. — Floridan Bryozoa, collected by Count L.F. de Pourtales. *Kongliga Svenska Vetenskaps-Akademiens Handlingar*, **10** (11) : 1-20, pl. 1-4 ; **11** (4) : 1-83, pl. 1-13.

SOULE, D.F., SOULE, J.D. & CHANEY, H.W., 1995. — Taxonomic Atlas of the Benthic Fauna of the Santa Maria Basin and Western Santa Barbara Channel. *Irene McCulloch Foundation Monograph Series*, **2** : 1-344.

TILBROOK, K.J., 1998. — The species of *Antropora* Norman, 1903 (Bryozoa : Cheilostomatida), with the description of a new genus in the Calloporoidea. *Records of the South Australian Museum*, **32**, sous presse.

VOIGT, E., 1924. — Bryozoenfauna der subherzynen Kreidemulde. *Paläontologische Zeitschrift*, C (2) : 93-247.

VOIGT, E., 1928. — Neue artikulierte cheilostome Bryozoen aus einem Kreidegeschiebe obersenonen Alters von Cöhten in Anhalt. *Zeitschrift für Geschiebeforschung*, **4** (3) : 105-114.

VOIGT, E., 1930. — Morphologische und stratigraphische Untersuchung der Bryozoenfauna des nordwestlichen Deutschland. *Leopoldina*, **6** : 1-39.

VOIGT, E., 1987. — Die Bryozoen des Klassischen Dano Montiens von Mons (Belgien). *Mémoires pour servir à l'explication des cartes géologiques et minières de la Belgique*, **17** (3), 163 p. Service Géologique de Belgique, Bruxelles.

WINSTON, J.E. & CHEETHAM, A.H., 1984. — The Bryozoan *Nellia tenella* as a Living Fossil. *In* : ELDREDGE & STANLEY (eds), Living fossils : 257-265. Springer Verlag, New-York.

WINSTON, J.E. & HEIMBERG, B.F., 1986. — Bryozoans from Bali, Lombok, and Komodo. *American Museum Novitates*, (2847) : 1-49.

PHOTOGRAPHIES

FIGURE 3

A : *Lamourouxia canaliculata,* holotype (x 66).
B : *Himantozoum crassiavicularium*, holotype. Quelques autozoécies (aréa en place).
Échelle : 0,10 mm. *a* : aviculaire ; *flèche* : orifice ovicellien.
C : *Himantozoum crassiavicularium*, holotype. Disposition des épines frontales. Échelle : 0,07 mm.
D : *Callopora* (?) sp. Quelques autozoécies. BIOGEOCAL, stn DW 253. Échelle : 0,10 mm.
E : *Parantropora laguncula*. Quelques autozoécies. Échelle : 0,10 mm.
F : *Quadricellaria bocki*. Ramification zoariale. Échelle : 0,10 mm.
G : *Nellia tenella*. Ramification zoariale. BIOGEOCAL, stn KG 275. Échelle : 0,10 mm.

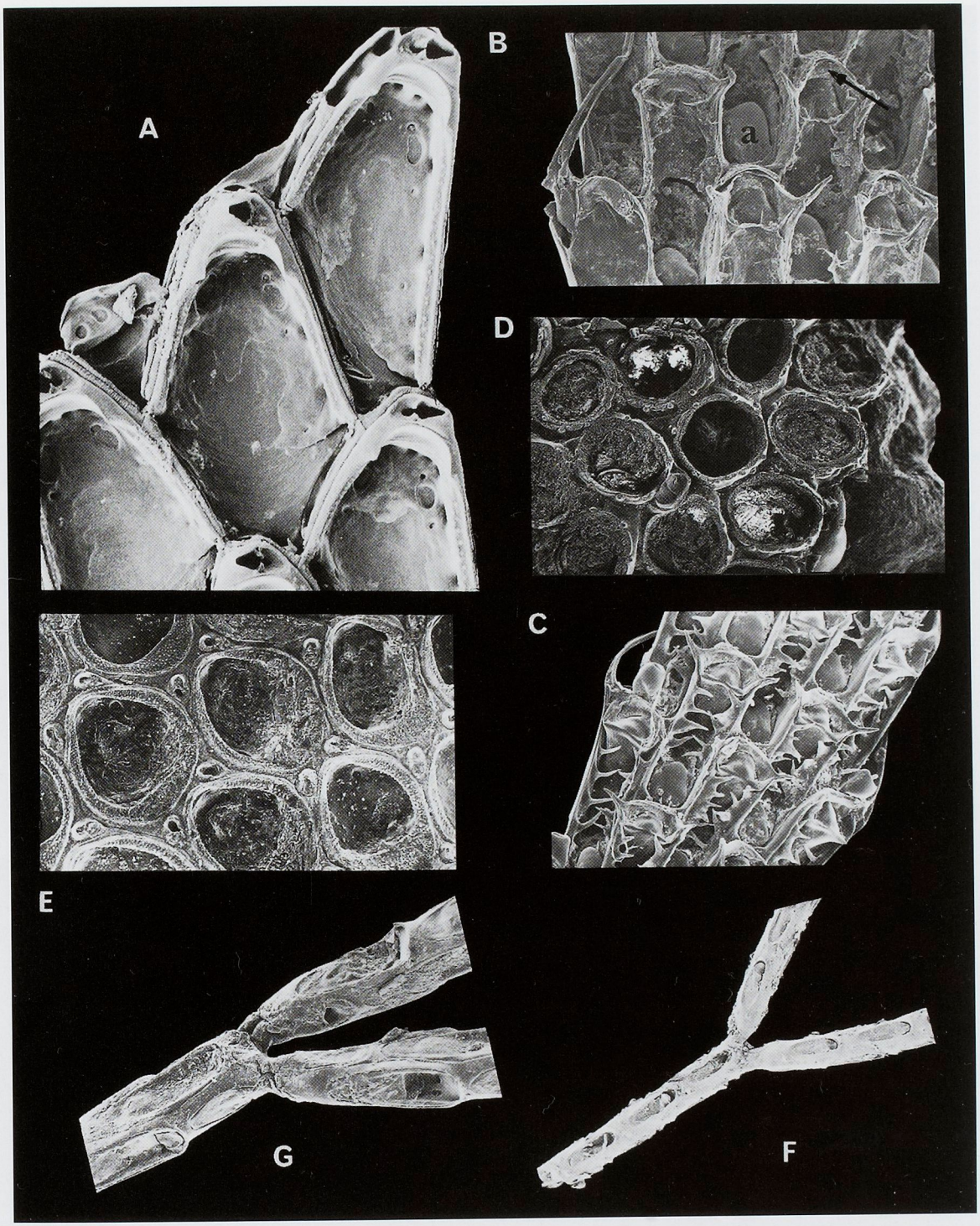

A
B
a
D
C
E
G
F

FIGURE 4

A : *Carbasea laterogranulata*, holotype. Portion de zoarium. Échelle : 1 mm.
B : *Promicroa dubitata*. Trois autozoécies et deux aviculaires (x 94).
C : *Carbasea laterogranulata*, holotype. Détail de la région latérale d'une autozoécie. Échelle : 0,10 mm.
D : *Bryopastor challengeri*. Portion de zoarium. Échelle : 0,10 mm.
E : *Columnella vipera*, holotype. Ramification zoariale. Échelle : 0,10 mm.
F : *Columnella magna*. Autozoécies ovicellées. BIOCAL, stn CP 13. Échelle : 1 mm.
G : *Columnella magna*. Autozoécies non ovicellées (vue frontale). BIOCAL, stn CP 13. Échelle : 0,10 mm.

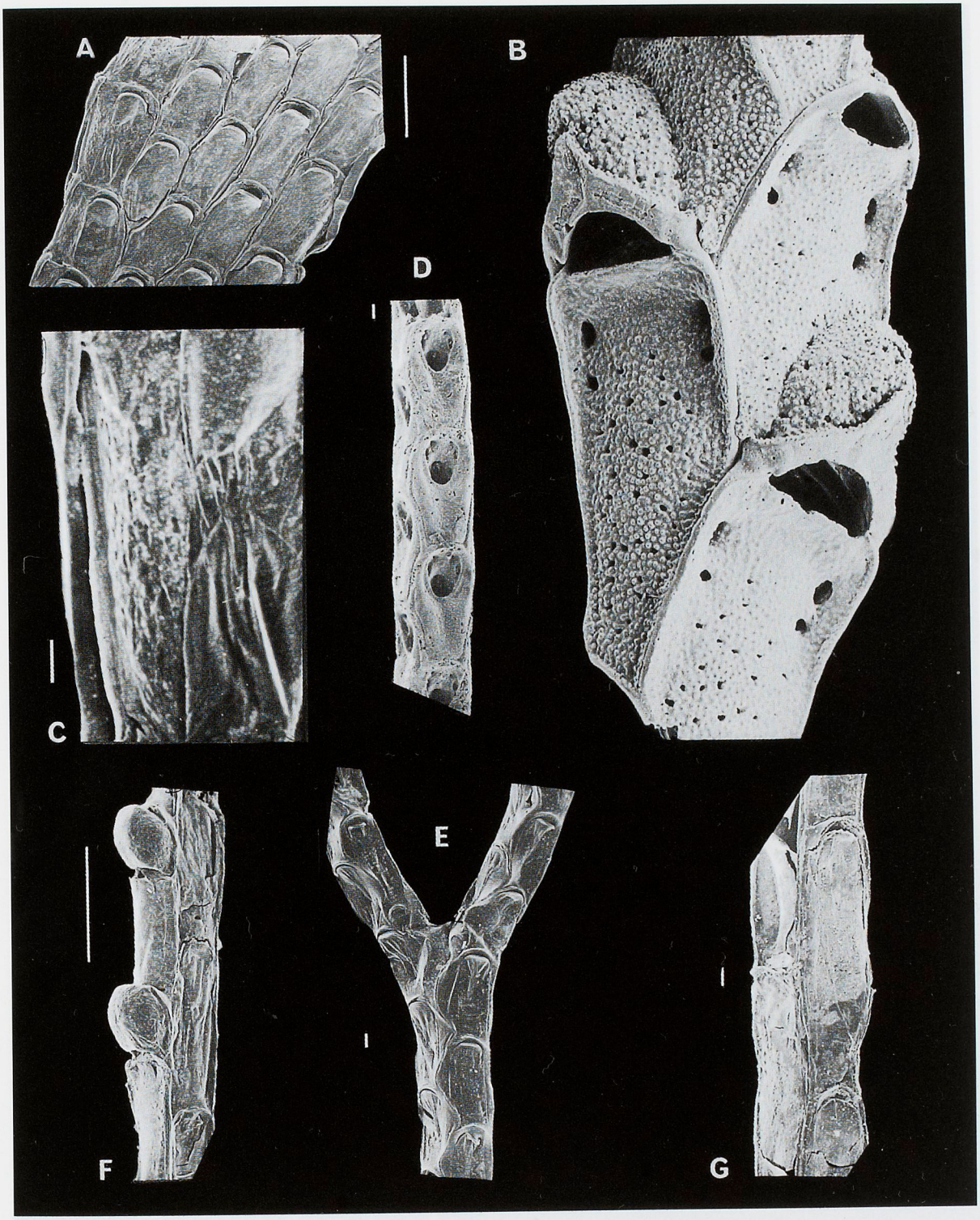

A
B
C
D
E
F
G

FIGURE 5

A : *Columnella vipera*, holotype. Détail des aviculaires. Échelle : 0,10 mm.
B : *Columnella vipera*, holotype. Disposition des aviculaires. Échelle : 0,10 mm.
C : *Bryopastor octogonos*, holotype. Une autozoécie. Échelle : 0,10 mm.
D : *Bryopastor octogonos*, holotype. Portion de zoarium. Échelle : 1 mm.
E : *Pseudothyracella candelaber*, holotype. Portion de zoarium (érodé). Échelle : 1 mm.
F : Calloporidae *incertae sedis*. Quelques autozoécies. BIOCAL, stn DW 44. Échelle : 0,10 mm.
G : *Bryopastor pentagonus*. Portion de zoarium. BIOCAL, stn DW 46. Échelle : 1 mm.
H : *Pseudothyracella candelaber*, holotype. Quelques autozoécies (érodées). Échelle : 0,10 mm.
I : *Mesostomaria strictoramae*. Ornementation frontale d'une autozoécie. BIOCAL, stn CP 52. Échelle : 0,13 mm.

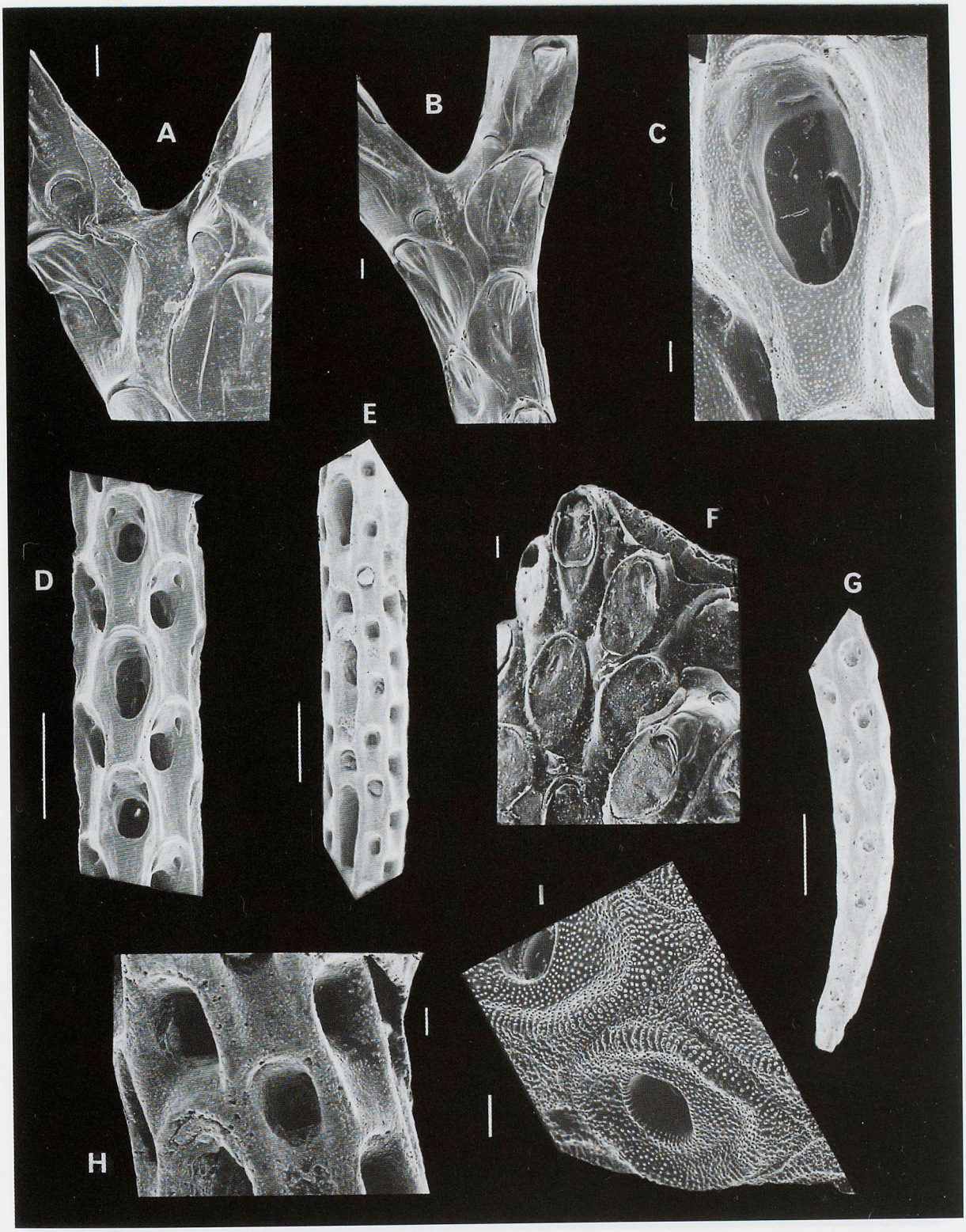

A
B
C
D
E
F
G
H
I

FIGURE 6

A : *Bryopastor pentagonus*. Quelques autozoécies. BIOCAL, stn DW 46. Échelle : 0,10 mm.
B : *Bryopastor pentagonus*. Une autozoécie. BIOCAL, stn DW 46. Échelle : 0,10 mm.
C : *Bryopastor crassus*, holotype. Une autozoécie. Échelle : 0,10 mm.
D : *Bryopastor crassus*, holotype. Fragment de zoarium. Échelle : 1 mm.
E : *Bryopastor* sp. Fragment de zoarium. BIOGEOCAL, stn DW 307. Échelle : 1 mm.
F : Cellariidae *incertae sedis*. Quelques autozoécies. BIOGEOCAL, stn DW 307. Échelle : 0,10 mm.
G : *Cryptostomaria alata*, holotype. Portion d'une ramification zoariale (x 27).

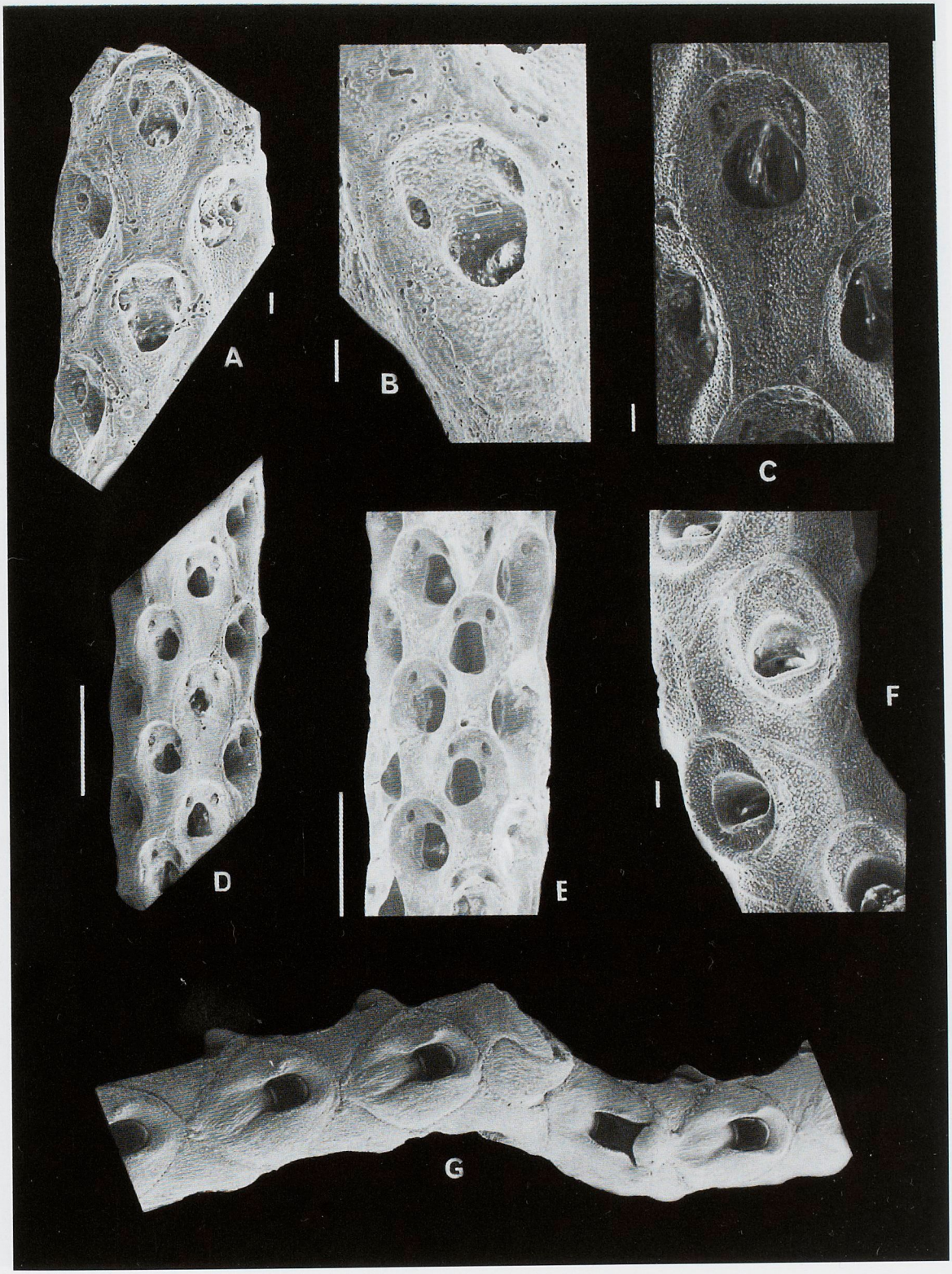

A
B
C
D
E
F
G

FIGURE 7

A : *Smittipora fenestrata*, holotype. Portion de zoarium. Échelle : 0,10 mm.
B : *Smittipora fenestrata*, holotype. Quelques zoécies. Échelle : 0,10 mm.
C : *Smittipora fenestrata*, holotype. Quelques zoécies (aréa présente, aviculaires ouverts). Échelle : 0,10 mm.
D : *Smittipora fenestrata*, holotype. Un aviculaire fermé. Échelle : 0,10 mm.
E : *Promicroa dubitata*, holotype. Fragment de zoarium (aréa présente). Échelle : 0,10 mm.
F : *Smittipora fenestrata,* holotype. Quelques autozoécies et un aviculaire (opésie ovale) (x 76).
G : *Micropora equilateralis*, holotype. Quelques autozoécies. Échelle : 0,10 mm.
H : *Cellaria humilis*. Zoarium. MUSORSTOM 3, stn DR 117. Échelle : 1 mm.

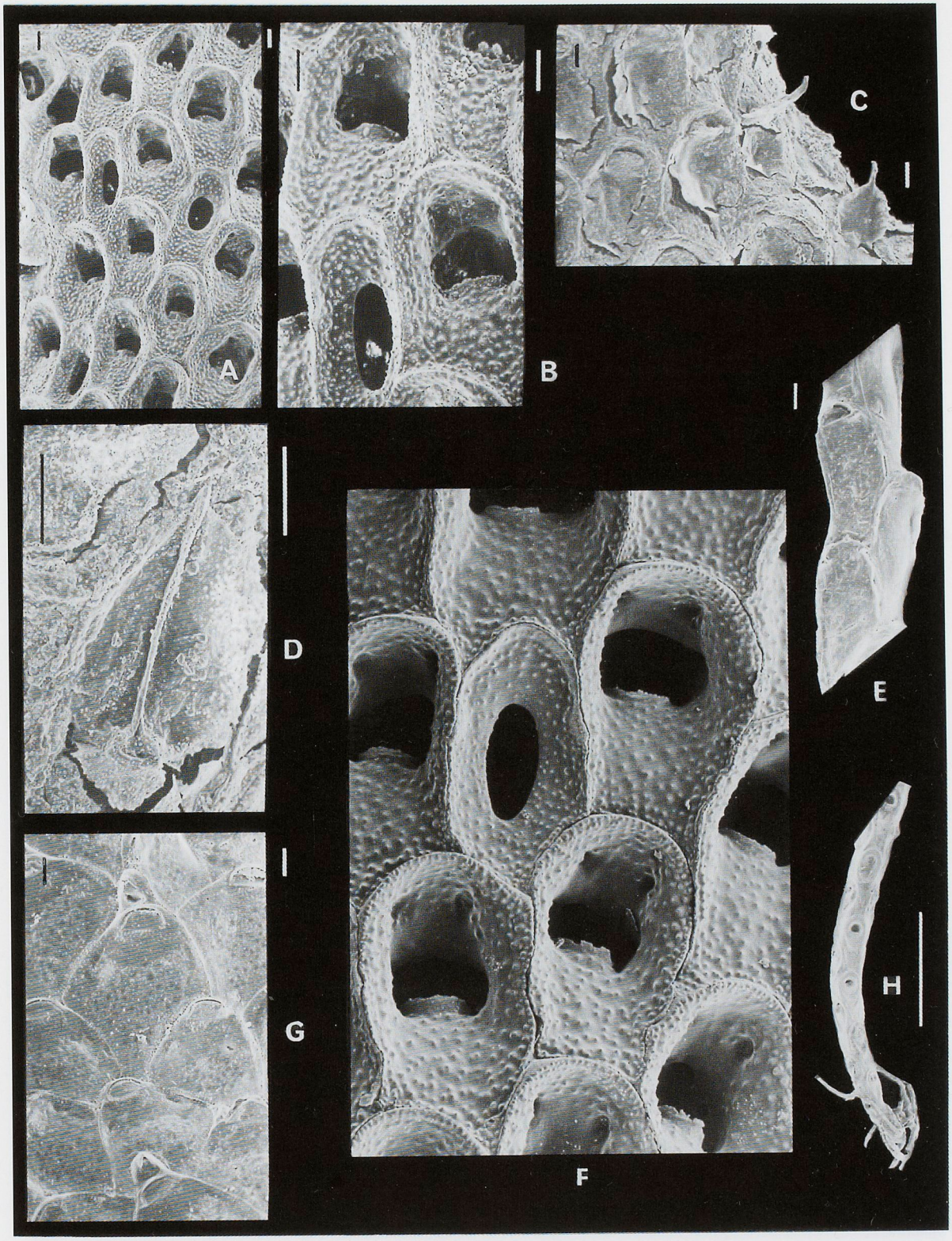

A
B
C
D
E
F
G
H

FIGURE 8

A : *Lamourouxia canaliculata*, holotype. Portion de zoarium. Échelle : 1 mm.
B : *Lamourouxia canaliculata*, holotype. Région latérale du zoarium, avec une ovicelle. Échelle : 0,10 mm.
C : *Lamourouxia canaliculata*, holotype. Autozoécie ovicellée. Échelle : 0,10 mm.
D : *Lamourouxia canaliculata*, holotype. Autozoécies non ovicellées. Échelle : 0,10 mm.
E : *Lamourouxia canaliculata*, holotype. Groupe d'autozoécies (alvéoles pariétaux visibles). Échelle : 0,10 mm.
F : *Lamourouxia canaliculata*, holotype. Bord crénelé de l'opésie. Échelle : 0,010 mm.
G : *Cellaria parafistulosa*, holotype. Une autozoécie. Échelle : 0,10 mm.
H : *Callopora* (?) sp. Portion de zoarium. BIOGEOCAL, stn DW 253. Échelle : 0,10 mm.
I : *Callopora* (?) sp. Deux autozoécies. BIOGEOCAL, stn DW 253. Échelle : 0,10 mm.

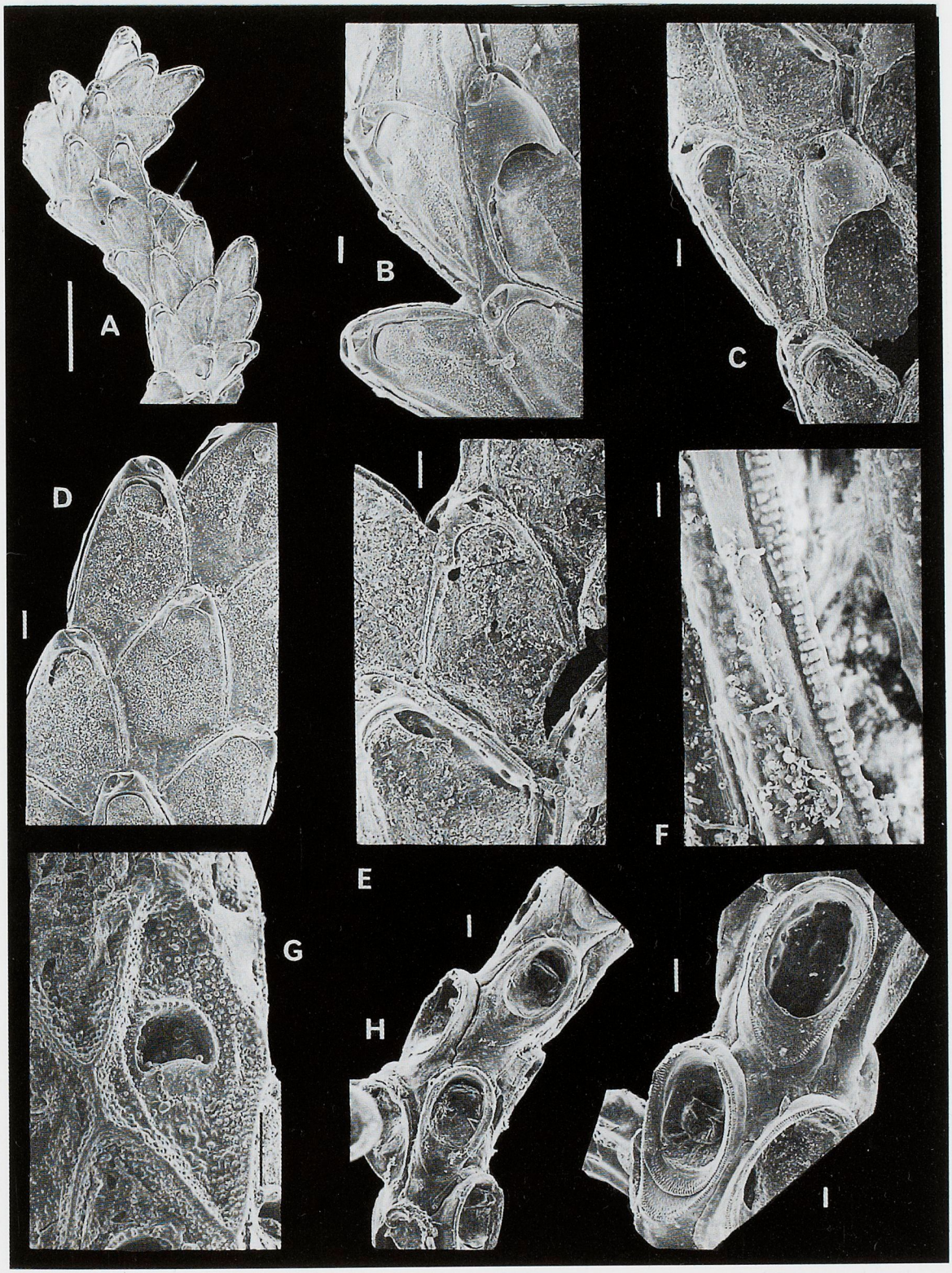

A
B
C
D
E
F
G
H
I

FIGURE 9

A : *Crateropora stiliformis*, holotype. Portion de zoarium. Échelle : 1 mm.
B : *Crateropora stiliformis*, holotype. Une autozoécie. Échelle : 0,10 mm.
C : *Crateropora stiliformis*, holotype. Autozoécie ovicellée. Échelle : 0,10 mm.
D : *Crateropora stiliformis*, holotype. Portion de zoarium. Échelle : 1 mm.
E : *Crateropora stiliformis*, holotype. Autozoécies et aviculaires. Échelle : 0,10 mm.
F : *Micropora equilateralis*, holotype (x 161).

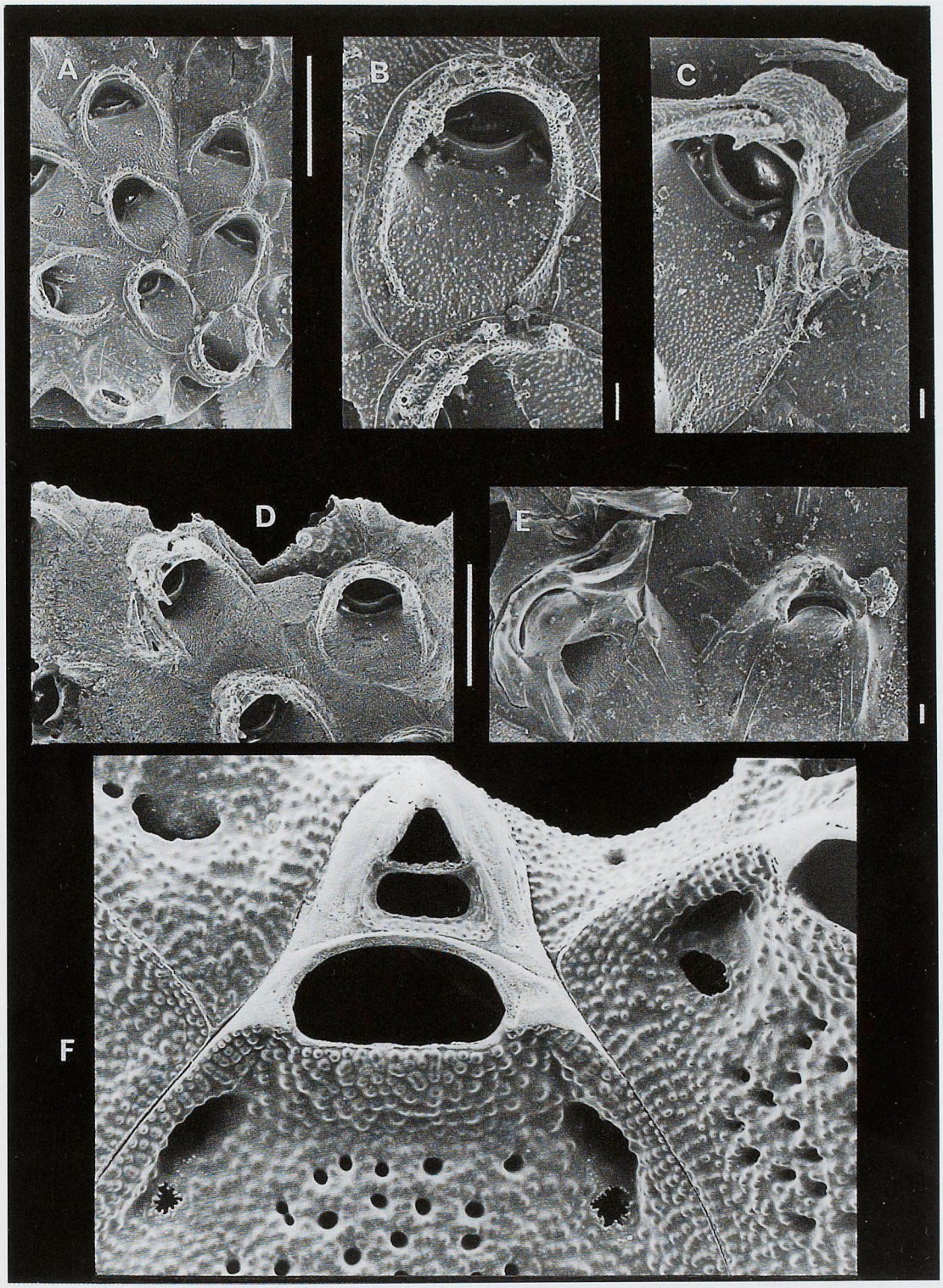

A
B
C
D
E
F

FIGURE 10

A : *Cellaria humilis*. Une autozoécie. MUSORSTOM 3, stn DR 117. Échelle : 0,10 mm.
B : *Mesostomaria strictoramae*. Ramification zoariale. BIOCAL, stn CP 52. Échelle : 0,10 mm.
C : *Formosocellaria magnifica*. Quelques autozoécies. Échelle : 0,10 mm.
D : *Euginoma conica*. Zoarium. Échelle : 0,10 mm.
E : *Syringotrema calobi*, holotype. Portion de zoarium. Échelle : 0,10 mm.
F : *Syringotrema calobi*, holotype. Une autozoécie. Échelle : 0,10 mm.
G : *Syringotrema calobi*, holotype. Orifice autozoécial et ornementation frontale. Échelle : 0,10 mm.
H : *Melicerita ejuncida*. Une autozoécie. Échelle : 0,10 mm.
I : *Melicerita ejuncida*. Portion de zoarium. Échelle : 0,10 mm.

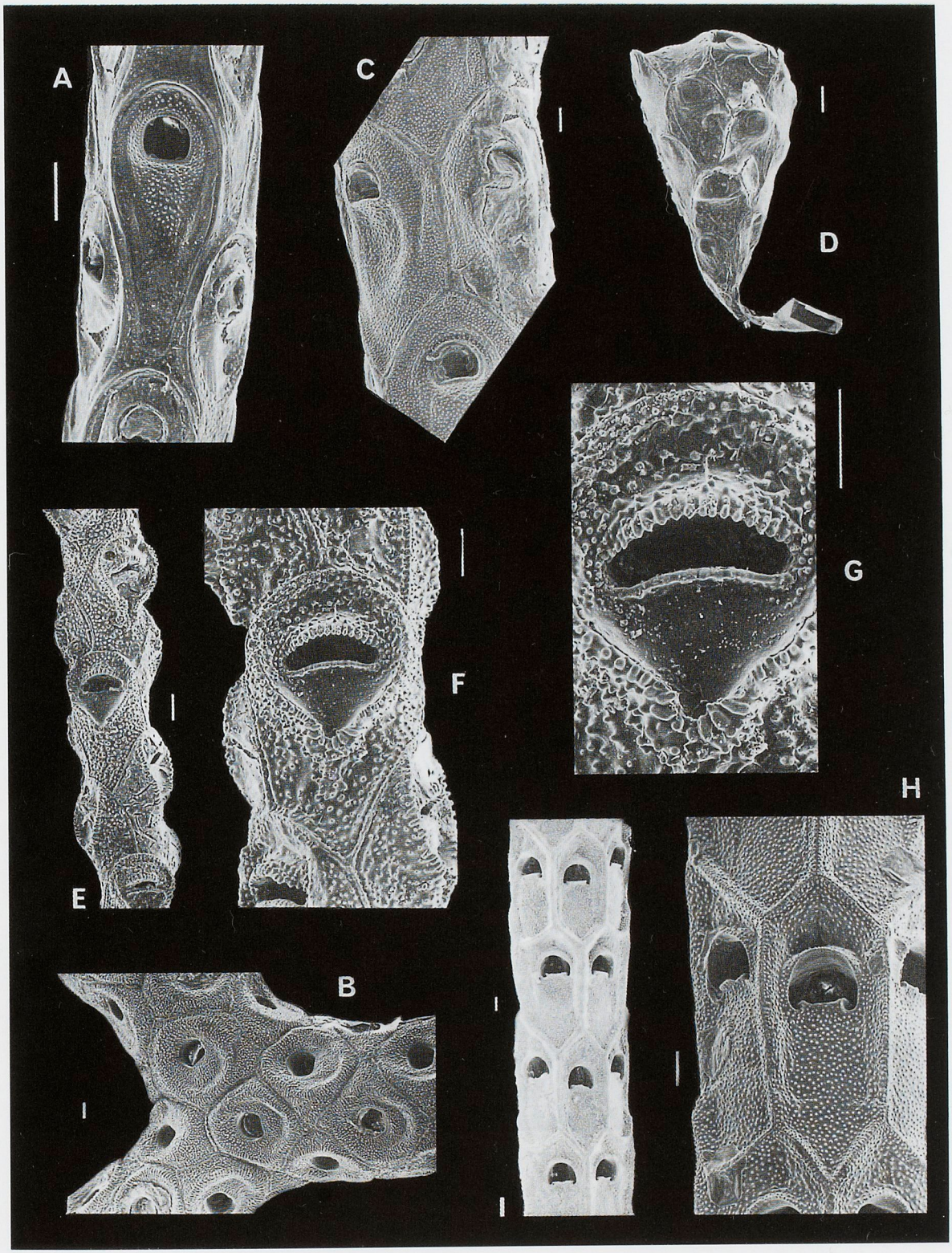

A
C
D
G
H
E
F
B

FIGURE 11

A : *Mesostomaria* sp. Portion de zoarium. SMIB 3, stn DW 22. Échelle : 1 mm.
B : *Mesostomaria* sp. Détail de la photographie précédente. Échelle : 0,10 mm.
C : *Mesostomaria* sp. Autozoécie ovicellée. SMIB 3, stn DW 22. Échelle : 0,10 mm.
D : *Mesostomaria* sp. Autozoécie non ovicellée. SMIB 3, stn DW 22. Échelle : 0,10 mm.
E : *Cryptostomaria alata*, holotype. Ramification zoariale. Échelle : 1 mm.
F : *Cryptostomaria alata*, holotype. Une autozoécie de l'axe du zoarium. Échelle : 0,10 mm.
G : *Cryptostomaria alata*, holotype. Autozoécie de la base d'une ramification. Échelle : 0,10 mm.

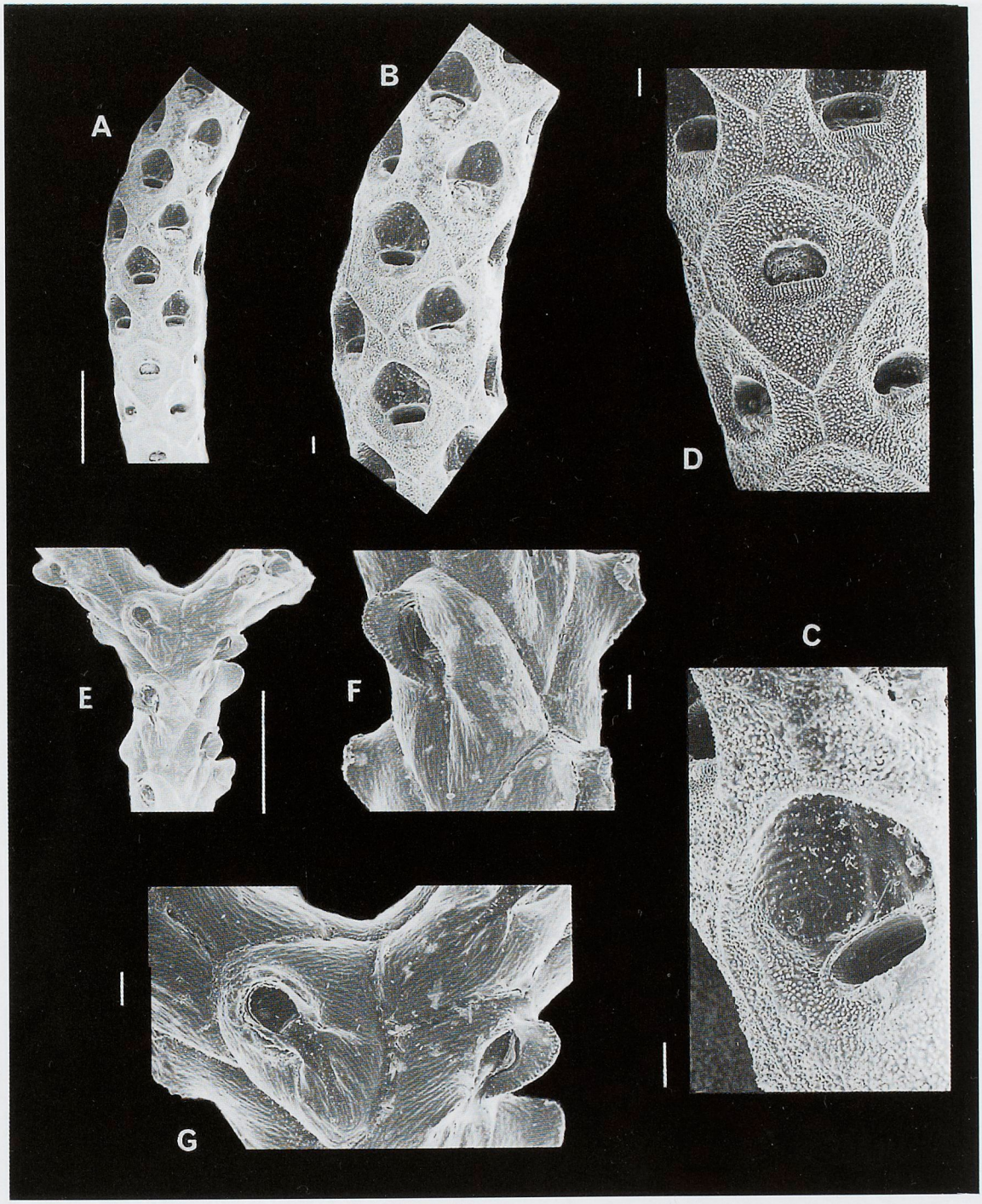

A
B
D
E
F
C
G

FIGURE 12

A : *Melicerita alternans*, holotype. Zoarium. Échelle : 1 mm.
B : *Melicerita alternans*, holotype. Portion de zoarium. Échelle : 0,10 mm.
C : *Melicerita alternans*, holotype. Zoécies latérales. Échelle : 0,10 mm.
D : *Melicerita alternans*, holotype. Une autozoécie ovicellée. Échelle : 0,10 mm.
E : Cellariidae *incertae sedis*. Détail de la surface frontale. BIOCAL, stn DW 66. Échelle : 0,01 mm.
F : *Melicerita* (*Henrimilnella*) *articulata*, holotype. Zoarium. Échelle : 1 mm.
G : *Melicerita* (*Henrimilnella*) *articulata*, holotype. Quelques autozoécies. Échelle : 0,10 mm.
H : *Melicerita* (*Henrimilnella*) *laurifolia*, holotype. Zoarium. Échelle : 1 mm.
I : *Melicerita* (*Henrimilnella*) *laurifolia*, holotype. Quelques autozoécies. Échelle : 0,10 mm.
J : *Pseudothyracella candelaber*, holotype. Portion de zoarium. Échelle : 10 mm.

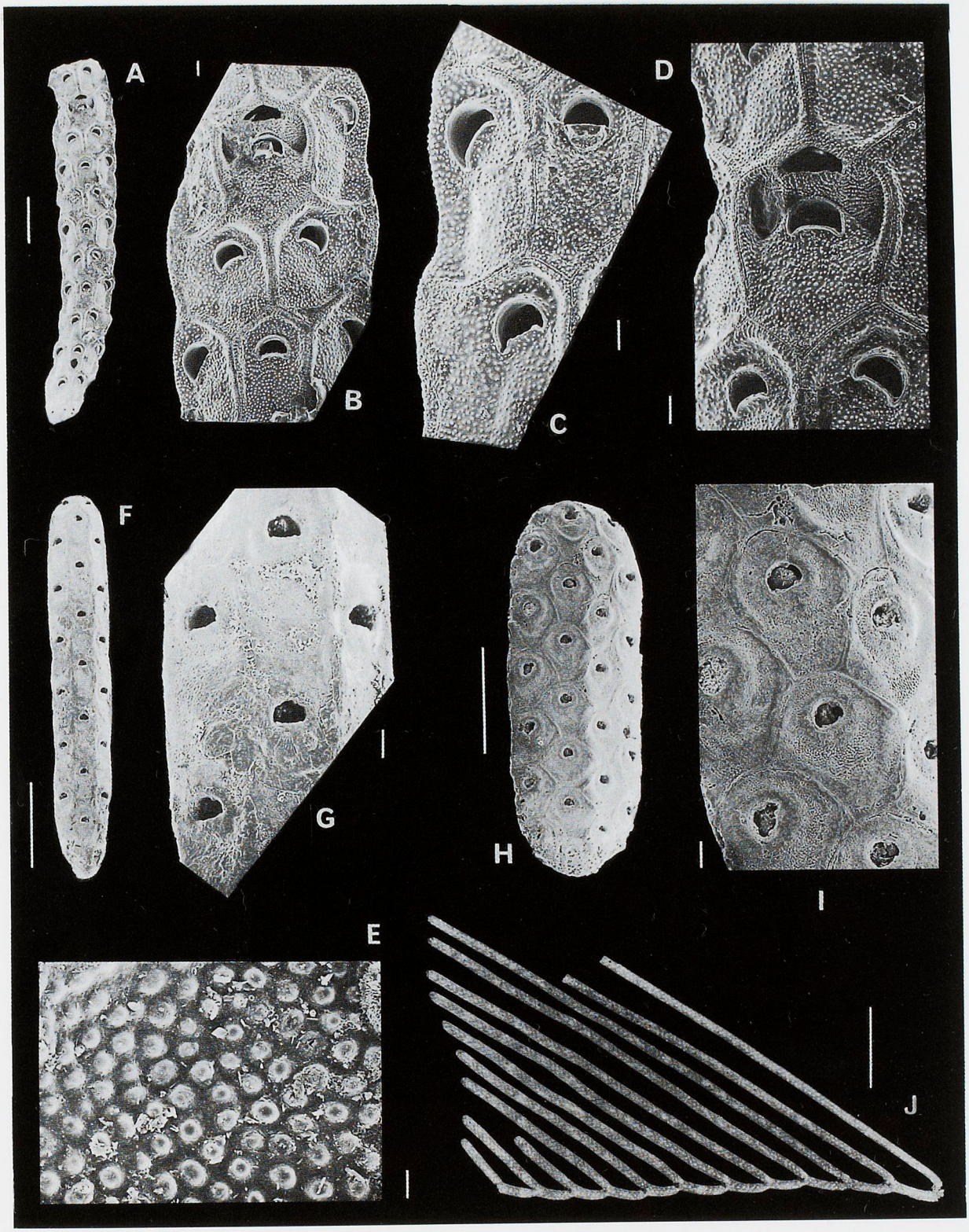
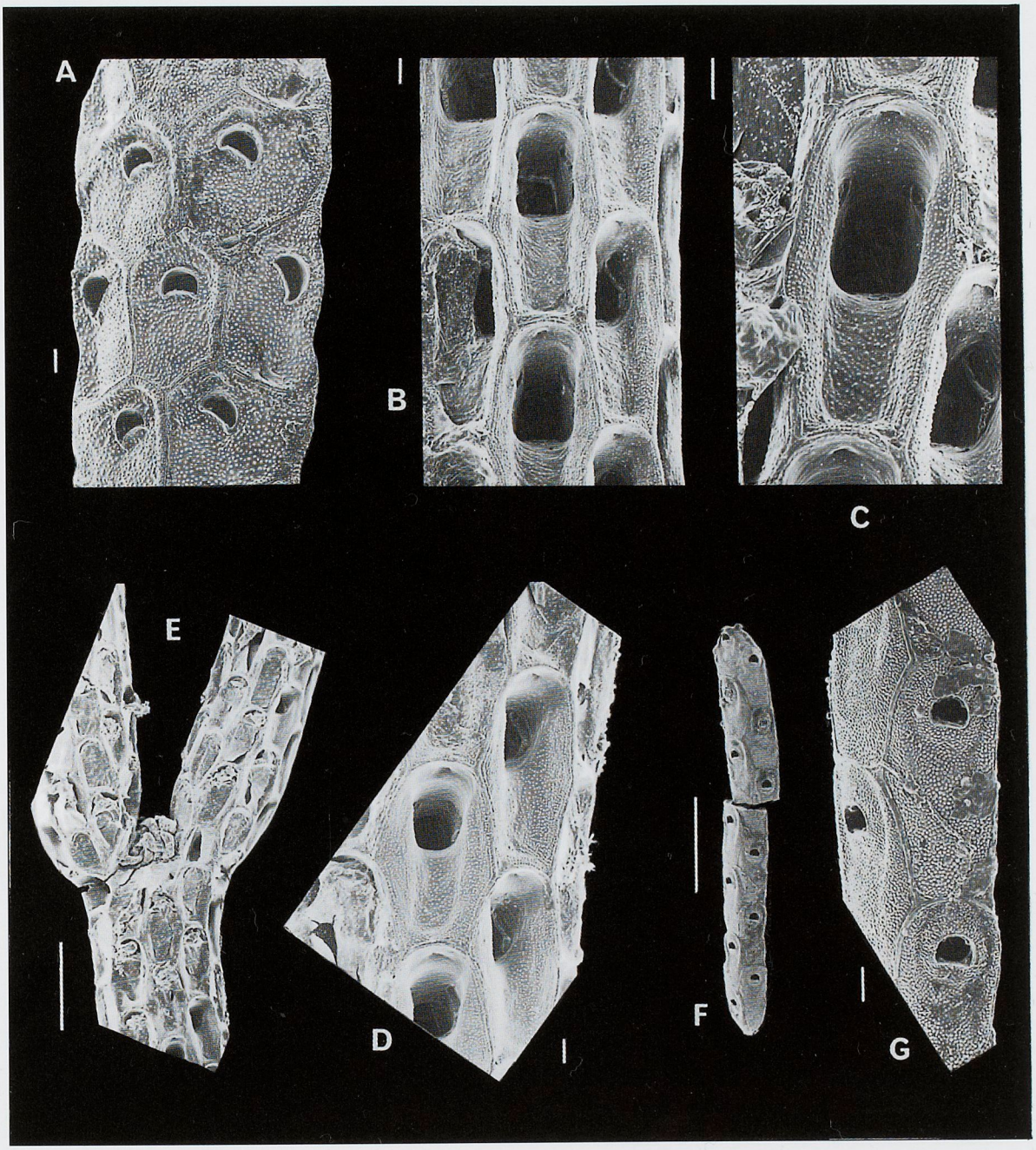

A
B
C
D
E
F
G
H
I
J

FIGURE 13

A : *Melicerita alternans*, holotype. Quelques autozoécies. Échelle : 0,10 mm.
B : *Pseudothyracella candelaber*, holotype. Portion de zoarium. Échelle : 0,10 mm.
C : *Pseudothyracella candelaber*, holotype. Une autozoécie. Échelle : 0,10 mm.
D : *Pseudothyracella candelaber*, holotype. Quelques autozoécies. Échelle : 0,10 mm.
E : *Pseudothyracella candelaber*, holotype. Ramification zoariale. Échelle : 1 mm.
F : Cellariidae *incertae sedis*. Zoarium. BIOCAL, stn DW 66. Échelle : 1 mm.
G : Cellariidae *incertae sedis*. Quelques autozoécies. BIOCAL, stn DW 66. Échelle : 0,10 mm.


A
B
C
D
E
F
G

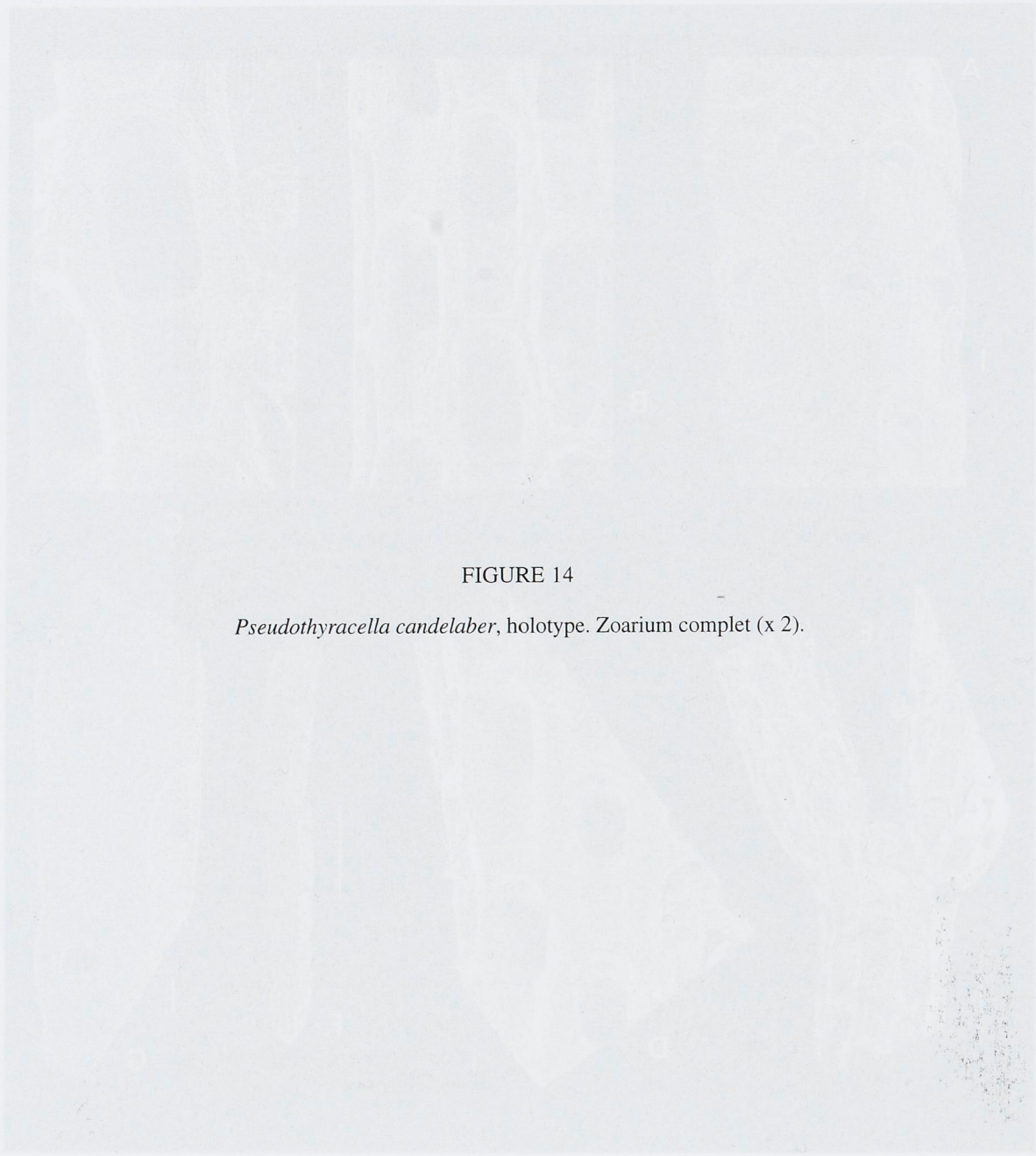


FIGURE 14

Pseudothyracella candelaber, holotype. Zoarium complet (x 2).

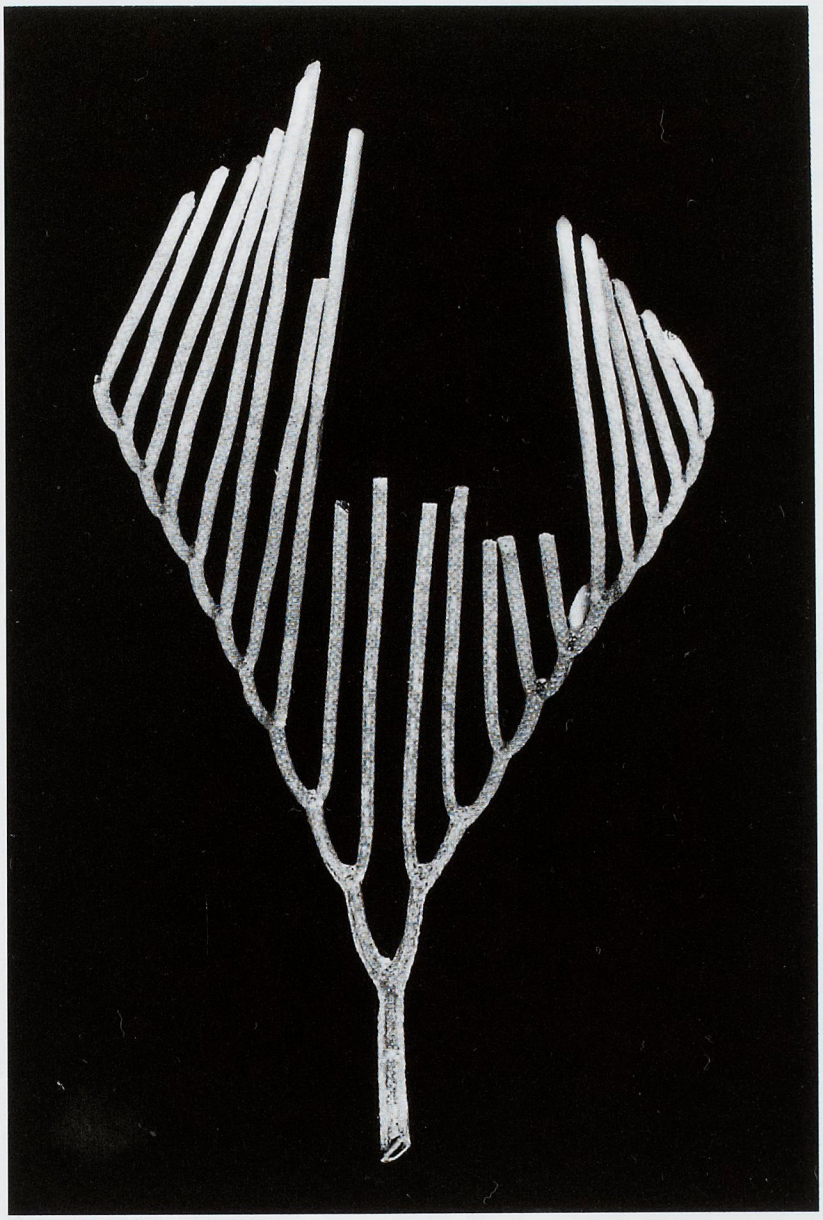


FIGURE 15

A : *Cellaria obliquidens*, holotype. Quelques autozoécies, l'une présentant un pore ovicellien (x 85).
B : *Cellaria obliquidens*, holotype. Orifice autozoécial surmonté d'un pore ovicellien (x 300).
C : *Cellaria obliquidens*, holotype. Entre-noeud (avec départ de deux ramifications) en vue apicale (x 81).
D : *Lamourouxia canaliculata*, holotype. Cavités alvéolaires intra-pariétales de la partie distale de l'autozoécie ; aviculaire distal (x 233).
E : *Lamourouxia canaliculata*, holotype. Ovicelle portant l'aviculaire distal (x 160).

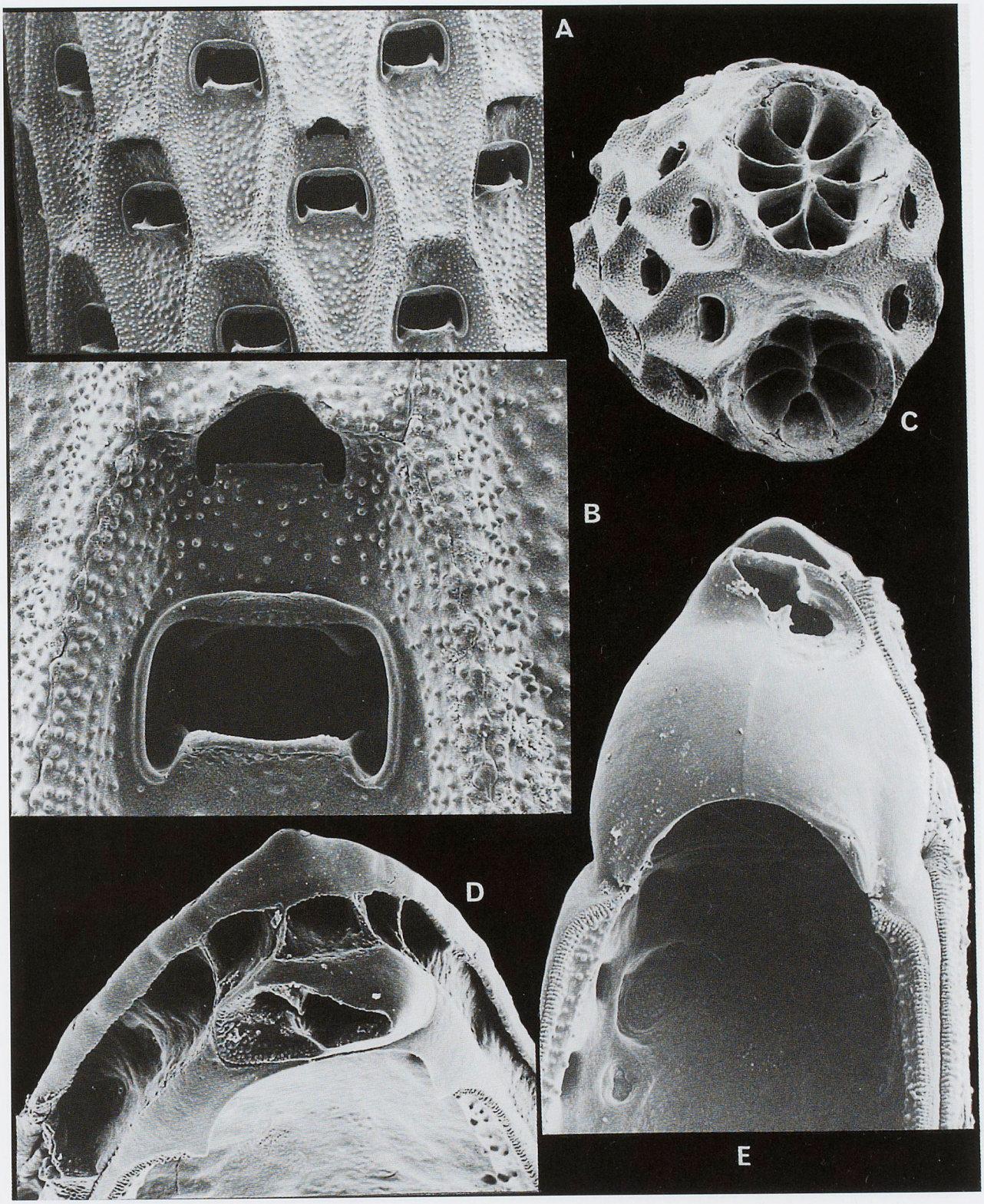

A
B
C
D
E

FIGURE 16

A : *Cryptostomaria alata*. Quelques autozoécies. BIOCAL, CP 74 (x 50).
B : *Cryptostomaria alata*. Deux autozoécies, la plus proximale ovicellée. MUSORSTOM 6, stn KG 465 (x 54).
C : *Lamourouxia canaliculata*, holotype. Intérieur de la partie distale d'une autozoécie ovicellée (x 190).
D : *Lamourouxia canaliculata*, holotype. Partie distale d'une autozoécie non ovicellée, surmontée d'un aviculaire (x 380).

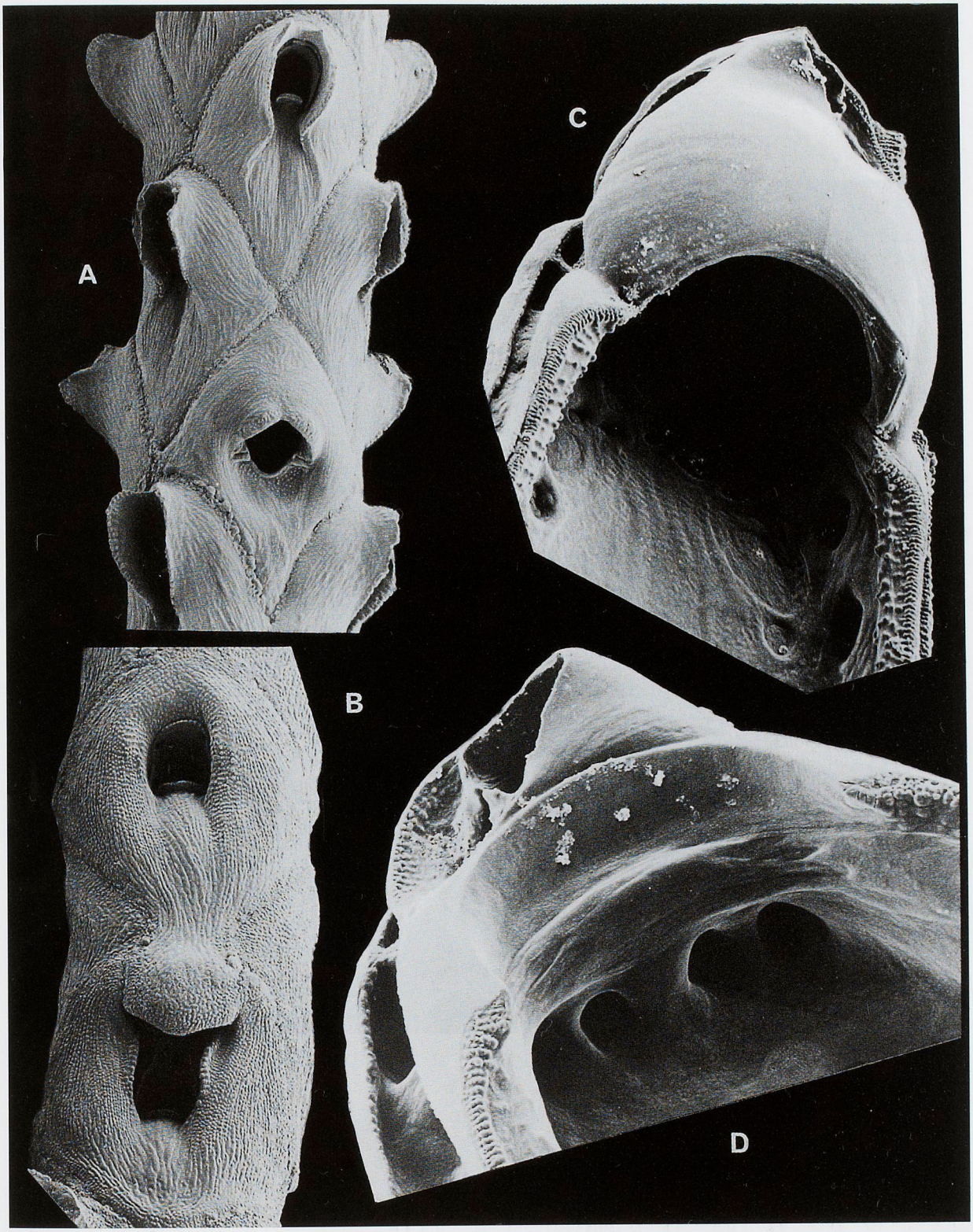

A
B
C
D

FIGURE 17

A : *Cellaria fistulosa* (Roscoff, pour comparaison). Portion de zoarium, avec un aviculaire et quelques pores ovicelliens (x 54).
B : *Cellaria fistulosa* (Roscoff, pour comparaison). Quelques autozōécies avec pores ovicelliens âgés. Noter le relief du cadre autozoécial (x 125).
C : *Cellaria fistulosa* (Roscoff, pour comparaison). Aviculaire et pore ovicellien immature, à la limite des portions fertile et stérile de l'entre-noeud (x 195).
D : *Cellaria parafistulosa*, holotype. Aviculaire et pore ovicellien âgé (x 46).
E : *Cellaria parafistulosa*, holotype. Portion de zoarium avec un aviculaire et des pores ovicelliens. Noter le faible relief du cadre autozoécial (x 85).

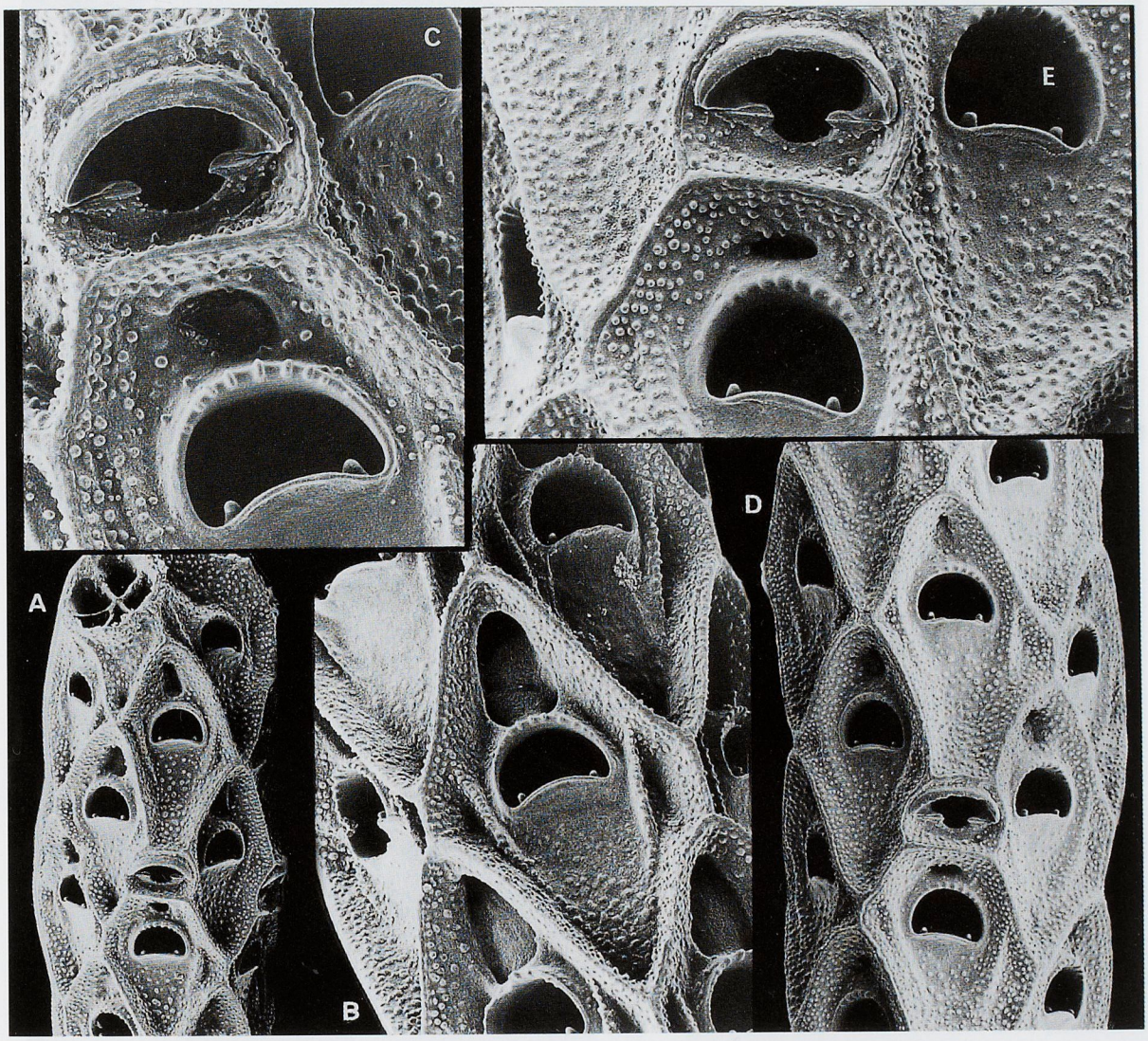

C
E
A
B
D

FIGURE 18

A : *Pseudothyracella candelaber*. NZOI (NIWA). Portion ramifiée du zoarium avec joints peletonnés (x 12).

B : *Pseudothyracella candelaber*. NZOI (NIWA). Deux branches zoariales avec autozoécies, zoécies femelles (très large opésie) et aviculaires (x 13).

C : *Pseudothyracella candelaber*. NZOI (NIWA). Un aviculaire (noter la présence des processus spiniformes proximaux) surmontant distalement une zoécie femelle (très large opésie) (x 51).

D : *Pseudothyracella candelaber*. NZOI (NIWA). Un aviculaire (x 159).

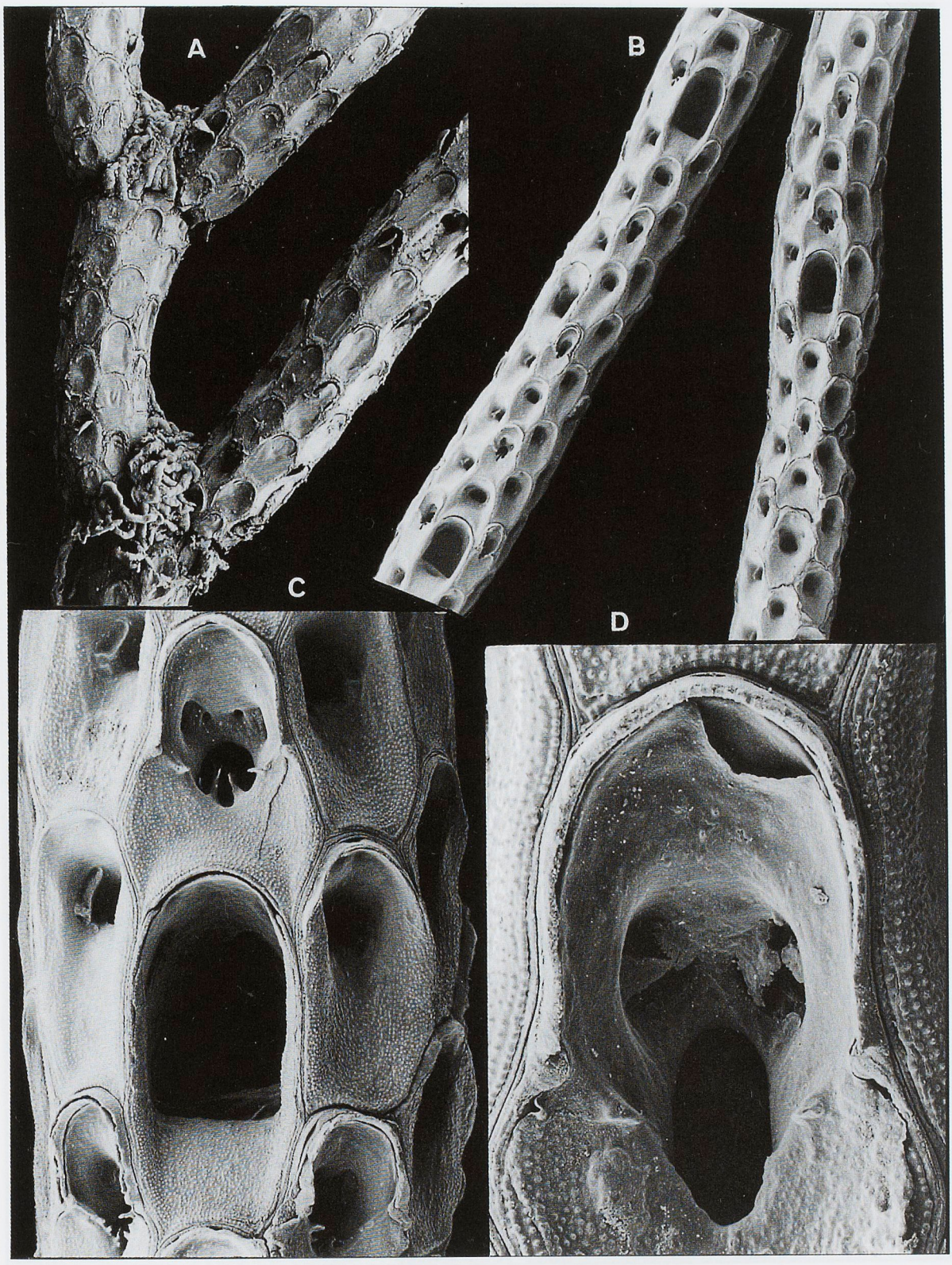

A
B
C
D

FIGURE 19

A : *Lamourouxia canaliculata*, holotype. Cavités alvéolaires de la paroi (x 137).
B : *Pseudothyracella candelaber*. Processus épineux proximaux submandibulaires d'un aviculaire. NMNZ, stn U 582 (x 201).
C : *Pseudothyracella candelaber*. Mandibule avicularienne. NMNZ, stn U 582 (x 108).
D : *Pseudothyracella candelaber*. Bord interne du cryptocyste d'un zoïde femelle. NMNZ, stn U 582 (x 214).
E : *Micropora equilateralis*, holotype. Une autozoécie ovicellée et un aviculaire (x 95).

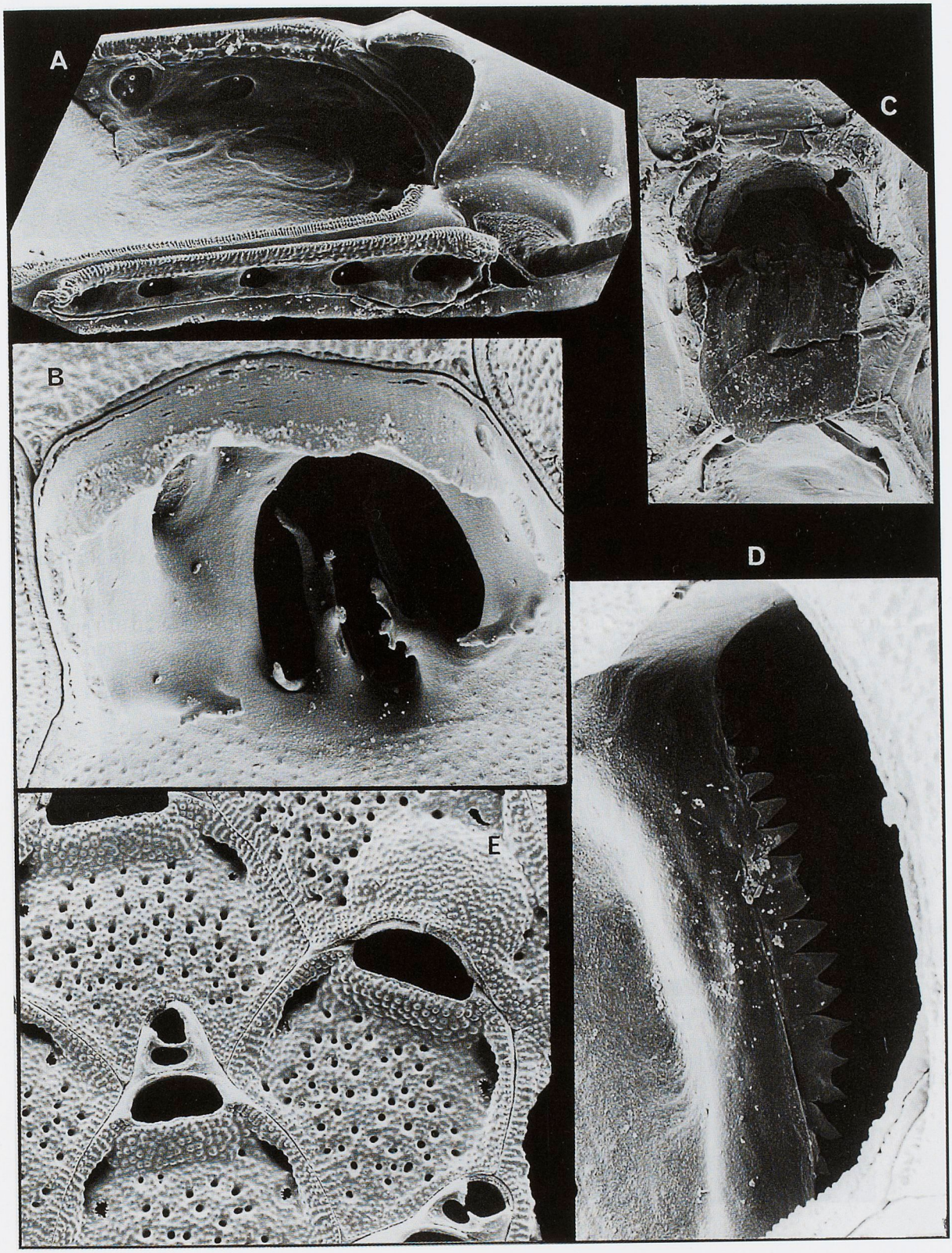
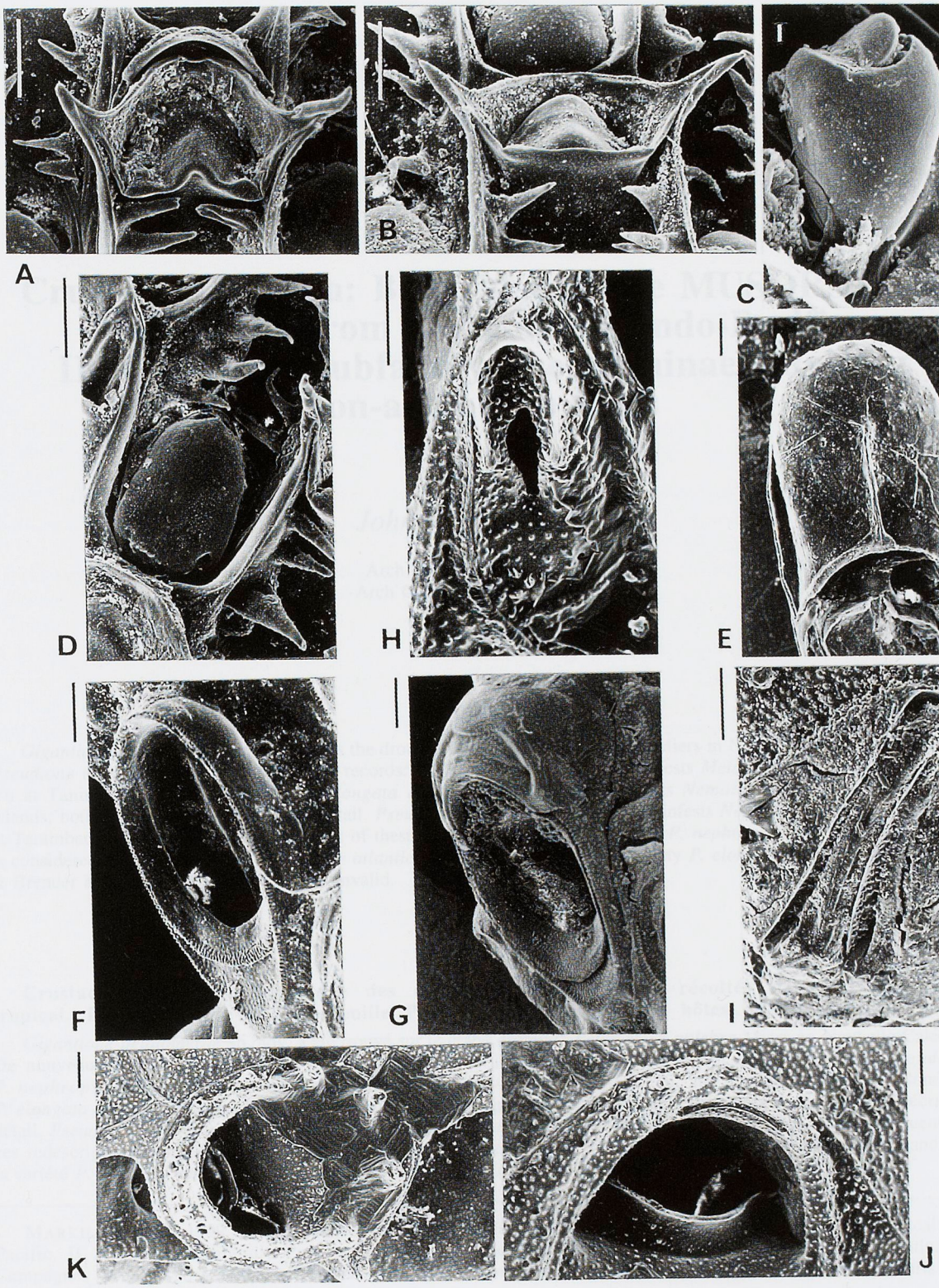

A
B
C
D
E

FIGURE 20

A : *Himantozoum crassiavicularium*, holotype. Région distale d'une autozoécie ovicellée. Échelle : 0,10 mm.
B : *Himantozoum crassiavicularium*, holotype. Région distale d'une autozoécie non ovicellée. Échelle : 0,10 mm.
C : *Himantozoum crassiavicularium*, holotype. Aviculaire d'une autozoécie latérale. Échelle : 0,010 mm.
D : *Himantozoum crassiavicularium*, holotype. Aviculaire d'une autozoécie axiale. Échelle : 0,10 mm.
E : *Columnella vipera*, holotype. Ovicelle. Échelle : 0,10 mm.
F : Calloporidae *incertae sedis*. Une autozoécie. Échelle : 0,10 mm.
G : Calloporidae *incertae sedis*. Ovicelle. Échelle : 0,10 mm.
H : *Crateropora stiliformis*, holotype. Cicatrice avicularienne. Échelle : 0,10 mm.
I : *Crateropora stiliformis*, holotype. Aviculaire en place. Échelle : 0,10 mm.
J : *Crateropora stiliformis*, holotype. Région distale d'une autozoécie. Échelle : 0,10 mm.
K : *Crateropora stiliformis*, holotype. Ancestrula. Échelle : 0,10 mm.


A
B
C
D
H
E
F
G
I
K
J



4

Crustacea Isopoda: Bopyridae in the MUSORSTOM collections from the tropical Indo-Pacific. II. Species in subfamily Pseudioninae infesting non-anomuran hosts

John C. MARKHAM

Arch Cape Marine Laboratory
Arch Cape, Oregon 97102-0105
USA

ABSTRACT

Gigantione petalomerae sp. nov. infests the dromiid crab *Petalomera pulchra* Miers in New Caledonia. Two species of *Pseudione* show new host and geographic records: *P. nephropsi* Shiino, 1951, infests *Metanephropsis velutinus* Chan & Yu at Tanimbar Islands, Indonesia; *P. elongata elongata* (Hansen, 1897) infests *Nematocarcinus* sp. in Chesterfield Islands; both species are redescribed in detail. *Pseudione tanimbarensis*, sp. nov. infests *Nephropsis sulcata* Macpherson at Tanimbar Islands, Indonesia. As a result of these redescriptions, the subspecies *P. nephropsi atlantica* Bourdon, 1971, is considered a separate species, *Pseudione atlantica* Bourdon, 1971, and the variety *P. elongata* var. *normalis* Nierstrasz & Brender à Brandis, 1931, is considered invalid.

RÉSUMÉ

Crustacea Isopoda : Bopyridae des collections MUSORSTOM récoltés dans l'Indo-Pacifique tropical. II. Espèces de la sous-famille Pseudioninae infestant des hôtes non anomuriens.

Gigantione petalomerae sp. nov. a été trouvé sur le crabe dromiide *Petalomera pulchra* Miers en Nouvelle-Calédonie. De nouveaux hôtes et de nouvelles localisations géographiques sont mentionnés pour deux espèces de *Pseudione* : *P. nephropsi* Shiino, 1951, trouvée sur *Metanephropsis velutinus* Chan & Yu, aux îles Tanimbar, en Indonésie et *P. elongata elongata* (Hansen, 1897) sur *Nematocarcinus* sp. aux îles Chesterfield; ces deux espèces sont redécrites en détail. *Pseudione tanimbarensis* sp. nov. infeste *Nephropsis sulcata* Macpherson aux îles Tanimbar. Des conséquences de ces redescriptions sont l'élévation au rang d'espèce de la sous-espèce *P. nephropsi atlantica* Bourdon, 1971, tandis que la variété *P. elongata* var. *normalis* Nierstrasz & Brender à Brandis, 1931, est considérée comme non valide.

MARKHAM, J. C., 1999. — Crustacea Isopoda: Bopyridae in the MUSORSTOM collections from the tropical Indo-Pacific. II. Species in subfamily Pseudioninae infesting non-anomuran hosts. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle,* **180**: 253-265. Paris ISBN 2-85653-520-8.

The extensive collections of ORSTOM, housed in the Muséum national d'Histoire naturelle (designated MNHN), contain many uncatalogued and unidentified bopyrid isopods, parasites of numerous different decapod crustaceans. This report, one of a continuing series, deals with a small part of that material.

FAMILY BOPYRIDAE Rafinesque

SUBFAMILY PSEUDIONINAE Codreanu

Gigantione petalomerae sp. nov.

Fig. 1

"Bopyrid."— McLAY, 1993: 166 [Chesterfield Islands; infesting *Petalomera pulchra* Miers].

MATERIAL EXAMINED. — **Chesterfield Islands**. CHALCAL 1: stn. DC 53, 21°19.5'S, 158°55.3'E, 60 m, 24.07.1984. Infesting *Petalomera pulchra* Miers, host det. C. L. McLAY: 1 ♀, holotype; 1 ♂, allotype (MNHN Ep-888).

DESCRIPTION. — *Holotype female* (Fig. 1A-I): Length 6.9 mm, maximal width 6.8 mm, head length 1.8 mm, head width 2.4 mm, pleon length 2.8 mm. Body outline nearly circular, body axis distorted only 18°; all body regions and segments distinct (Fig. 1A).

Head subrectangular, about 2/3 embedded in pereon. Short frontal lamina not quite extended to sides of head; small anterolateral flaps projecting slightly form each side of head. Dorsal surface produced into 2 large low lobes. Antennae fairly large, extending beyond anterior margins of head, of 3 and 5 articles respectively. Barbula (Fig. 1B) with single terete projection on each side and triangular lobe in center. Maxilliped (Fig. 1C) suboval, its anterior article much larger than posterior one and marginally fringed by dense setae.

Pereon largely enclosing both head and pleon, rounded on both sides but bulging outward slightly more on long side, broadest across pereomere 4. Coxal plates well-developed on both sides of all pereomeres, those on long sides very long and slender and reflexed over dorsal surfaces of pereomeres; those opposite somewhat broader and angled to extend forward along sides of pereomeres. Indistinct dorsolateral bosses on long sides of some pereomeres. Oostegites almost completely enclosing brood pouch, but not tightly pressed onto each other. Oostegite 1 (Fig. 1D-E) with much larger anterior plate, deep groove separating it from posterior region externally; internal ridge bearing 5 long slender flexible projections along lateral half, nothing on medial half. Pereopods 1-4 on long side visible dorsally along side of body, others hidden in dorsal view, all of about same size (Fig. 1F-G) and with all articles present; pereopod 7 much more setose, its basis produced into prominent lobe along flexor margin.

Pleon of 6 distinct pleomeres, each produced into lateral plates on both sides; lateral plates on longer sides basally constricted into falcate points, lanceolate ones opposite extending out from slender sides of pleomeres without constriction. Sixth pleomeres also produced into slender lateral plates. All pleonal appendages visible only in posterior view (Fig. 1H): 5 pairs of biramous pleopods (Fig. 1I) with deeply digitate margins; they and minute biramous uropods tightly clustered inside cavity formed by lateral plates.

Allotype male (Fig. 1J-N): Length 4.7 mm, maximal width 1.7 mm, head length 0.7 mm, head width 1.1 mm, pleonal length 1.4 mm. All body regions and segments distinctly separated. Minute splotchy eyes near posterolateral corners of head; tiny scattered pigment spots on dorsal surfaces of some pereomeres and of first pleomere (Fig. 1J-K).

Head trapezoidal, broadest at posterior margin but narrower than pereomere 1. Antennae (Fig. 1L) of 3 and 5 articles, respectively; antenna 1 quite reduced, but antenna 2 extending beyond margins of head on both sides.

Pereon broadest across pereomere 5, tapering slightly both ways from there. Pereopods (Fig. 1M-N) all equally developed and about same size, with all articles distinct; propodi somewhat larger and dactyli sharper posteriorly. Pereopods moderately covering much of ventral surface of pereon without extending beyond sides.

Pleon (Fig. 1N) of 6 distinct pleomeres, tapering slightly posteriorly; margins sparsely setose. Five pairs of irregularly lengthened uniramous flaplike pleopods, progressively smaller posteriorly. Pair of large uniramous uropods extending prominently rearward at end of body.

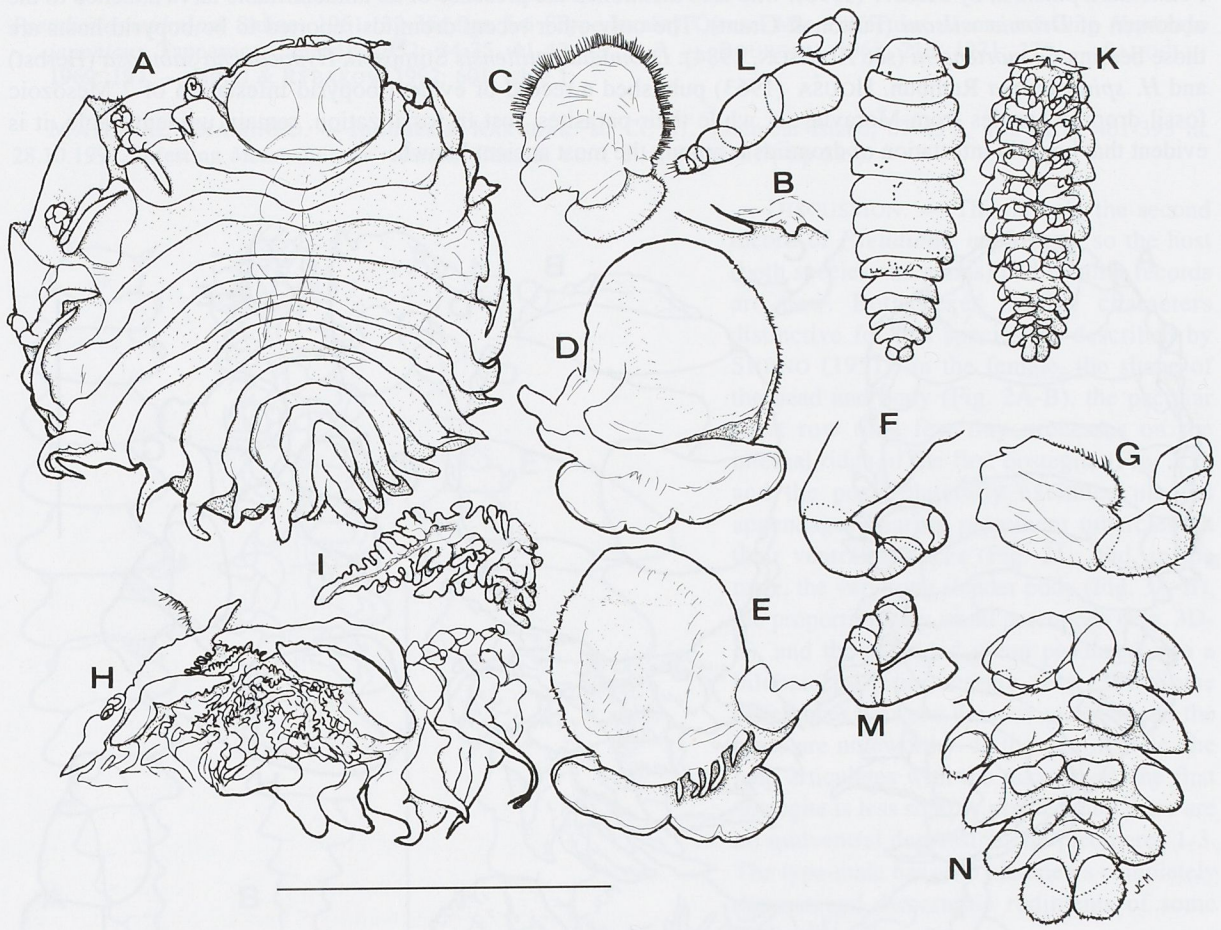


FIG. 1. — *Gigantione petalomerae*, sp. nov., A-I, holotype female; J-N, allotype male. **A**, dorsal view. **B**, barbula, right side. **C**, right maxilliped. **D**, right oostegite 1, external view. **E**, same, internal view. **F**, right pereopod 1. **G**, right pereopod 7. **H**, pleon, ventral view. **I**, right pleopod 2. **J**, dorsal view. **K**, ventral view. **L**, left antennae. **M**, left pereopod 1. **N**, right pereopod 7 and pleon in ventral view.
Scale: 2.5 mm for B-F, I; 5.0 mm for A, H, J-L; 10.0 mm for M-N; 16.7 mm for F-G.

ETYMOLOGY. — Specific name *petalomerae*, genitive singular of generic name of the host of the new species.

DISCUSSION. — The genus *Gigantione* contains 12 previously described species, as discussed by MARKHAM (1994). Three of the species are parasites of thalassinideans, the others infesting diverse brachyurans. For now, I am retaining the genus in the subfamily Pseudioninae, although some of its characters indicate that its placement in the Ioninae, the typical parasites of the Brachyura, might be more appropriate. Regardless, it belongs among the least differentiated bopyrid genera. The new species, *G. petalomerae*, is most similar to *G. mortenseni* Adkison (1984), from the Gulf of Mexico and eastern Florida, U. S. A., which is, interestingly, the only other bopyrid species known to infest recent dromiid crabs. The diagnostic differences between these 2 species are that the female of *G. mortenseni* has a more elaborate barbula, a proportionately longer first oostegite and coxal plates more nearly alike on opposite sides; its male has a more extended head, a rather sharply tapered pleon, pleopods and uropods more distinctly bilobate and the latter more extended. In presenting a new generic diagnosis of *Gigantione*

(MARKHAM, 1994), I did not mention the structure of the seventh pereopods of the females, whose bases are characteristically expanded into lobes along the flexor margins, as seen also in *G. petalomera* (Fig. 1G).

The type-specimens of *G. petalomerae* were first recorded without identification in the report on its host, *Petalomera pulchra*, by McLAY (1993), who also mentioned the presence of an unidentifiable larva attached to the abdomen of *Dromia wilsoni* (Fulton & Grant). The only other recent dromiids reported to be bopyrid hosts are those bearing *G. mortenseni* (see ADKISON, 1984): *Dromidia antillensis* Stimpson, *Hypoconcha sabulosa* (Herbst) and *H. spinosissima* Rathbun. HOUŠA (1963) published a record of evident bopyrid infestation of 2 Mesozoic fossil dromiid species from Moravia, so, while their parasites, lost in fossilization, remain unidentifiable, it is evident that bopyrid infestation of dromiids is among the most ancient known.

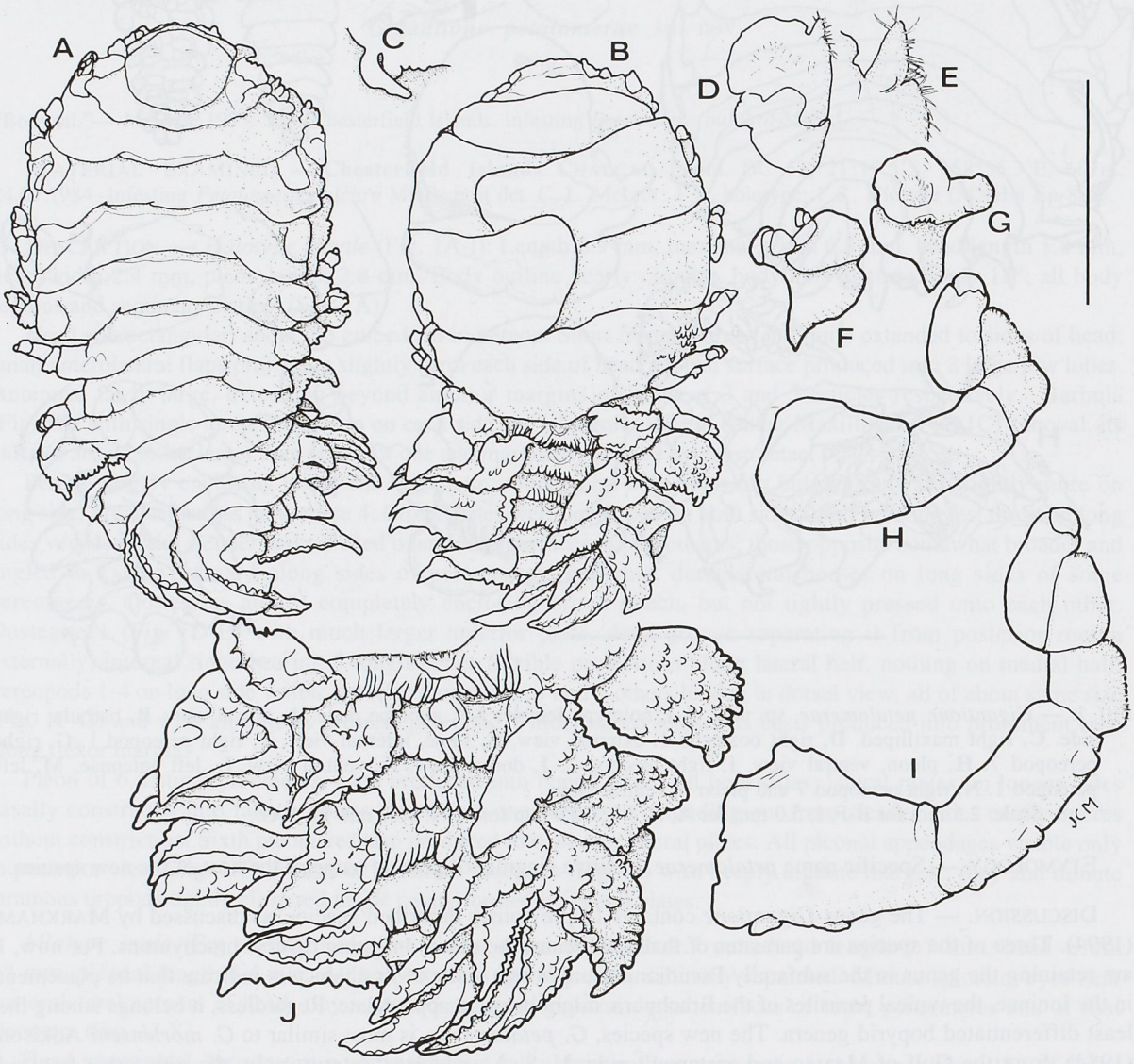


FIG. 2. — *Pseudione nephropsi* Shiino, 1951, reference female. **A**, dorsal view. **B**, ventral view. **C**, right side of barbula. **D**, right maxilliped. **E**, palp of same. **F**, right oostegite 1, external view. **G**, same, internal view. **H**, right pereopod 1. **I**, right pereopod 7. **J**, pleon in ventral view.
Scale: 1.8 mm for E, H-I; 5.4 mm for C-D; 5.9 mm for J; 10.8 mm for A-B, F-G.

Pseudione nephropsi Shiino, 1951

Figs 2-3

Pseudione nephropsi Shiino, 1951: 32-36; figs 5-6 [Type-locality Owase, Mie Prefecture, Japan; infesting *Nephrops japonicus* Tapparone-Canefri]; 1952: 34-35, 41-42; 1972: 7. — BOURDON, 1968: 216; 1971: 375. — ŞADOĞLU, 1969: 197. — HØEG & RYBAKOV, 1992: 601, table 1.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: st. CC 41, Tanimbar Island, 07°45'S, 132°42'E, 401-393 m, 28.10.1991. Infesting *Metanephrops velutinus* Chan & Yu: 1 ♀, 1 ♂ (MNHN-Ep 889).

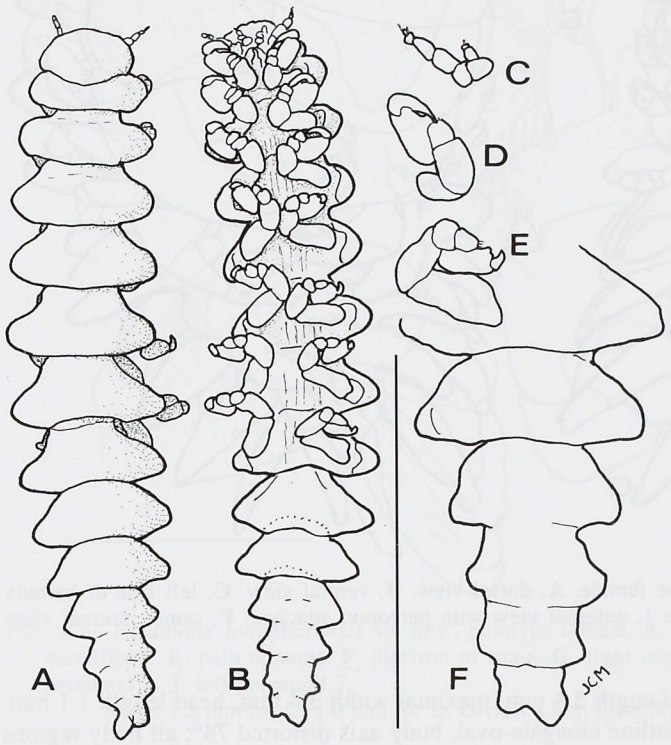


FIG. 3. — *Pseudione nephropsi* Shiino, 1951, reference male. **A**, dorsal view. **B**, ventral view. **C**, right antennae. **D**, right pereopod 1. **E**, left pereopod 7. **F**, pleon in ventral view.

Scale: 2.6 mm for C-F; 5.0 mm for A-B.

DISCUSSION. — This is only the second record of *Pseudione nephropsi*, so the host (both species and genus) and locality records are new. Both sexes display characters distinctive for this species, as described by SHIINO (1951): in the female, the shape of the head and body (Fig. 2A-B), the peculiar short row of a few tiny processes on the internal ridge of the first oostegite (Fig. 2G), and the posterolaterally extended pleonal appendages bearing prominent tubercles on their ventral surfaces (Fig. 2J); and, in the male, the very long slender body (Fig. 3A-B), the proportionately small pereopods (Fig. 3D-E), and the extended pleon produced into a bilobate posterior margin (Fig. 3F). Some differences between the new material and the types are noteworthy. In the type-female, the palp articulates with the maxilliped, the first oostegite is less sharply pointed, and there are no midventral depressions on pleomeres 1-3. The type-male has all 6 pleomeres completely distinct and discernible rudiments of some pleopods.

BOURDON (1971) described the subspecies *Pseudione nephropsi atlantica* as a parasite of *Nephropsis atlantica* (Norman) from the Congo. In presenting a tabulation of the characters by which his new subspecies differed from the typical one, BOURDON (1971) observed that it possibly deserved separate species status. In particular, the lack of tubercles on the pleonal appendages of the female sets it off enough for such status. Accordingly, I am here considering *Pseudione atlantica* Bourdon, 1971, a separate species and thus not using any subspecific designation for the new material of *Pseudione nephropsi*.

Pseudione tanimbarensis sp. nov.

Figs 4-6

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: st. CP 81, Tanimbar Islands, 09°34'54"S, 131°01'49"E, 199-206 m, 4.11.1991. Infesting *Nephropsis sulcata* Macpherson, host det. T.-Y. CHAN: 1 ♀, holotype; 1 ♂ (damaged), allotype (MNHN-Ep 891).

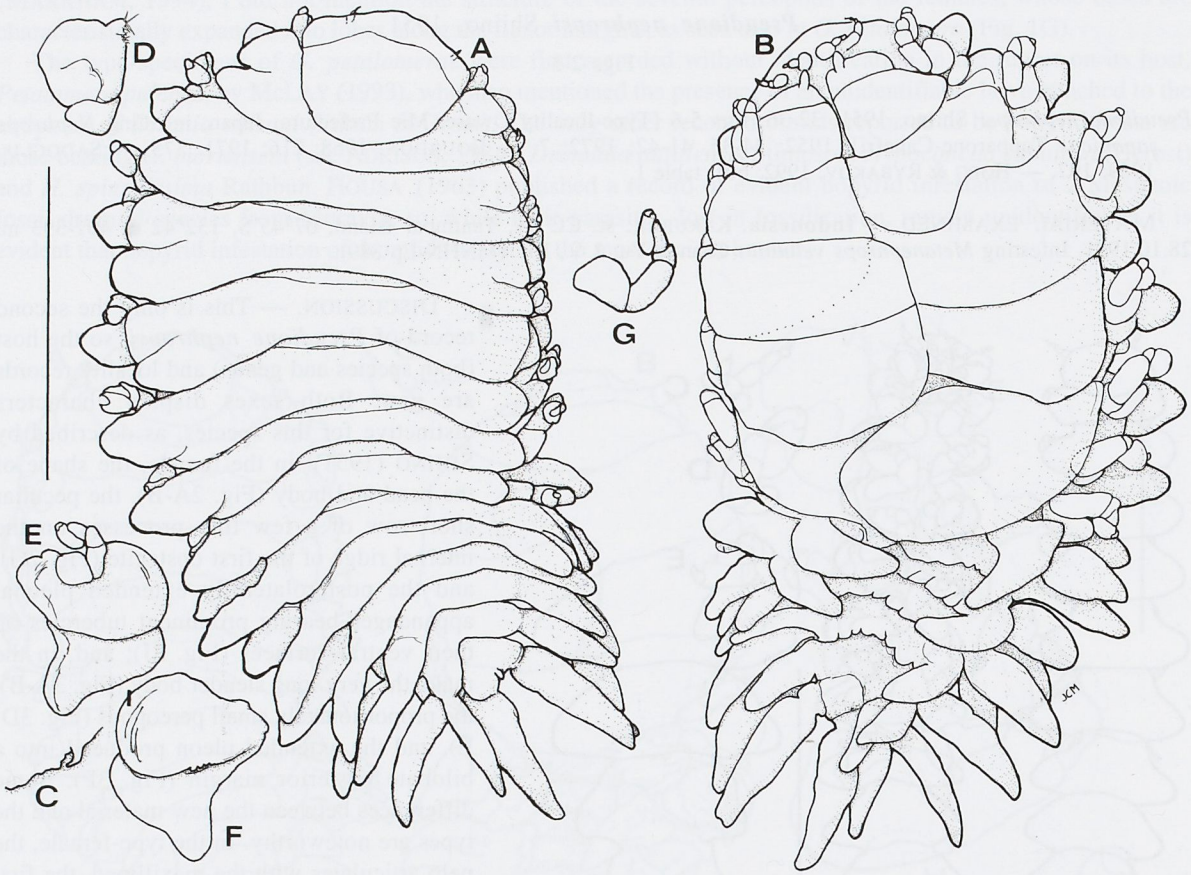


FIG. 4. — *Pseudione tanimbarensis* sp. nov., holotype female. **A**, dorsal view. **B**, ventral view. **C**, left side of barbula. **D**, left maxilliped, external view. **E**, left oostegite 1, external view with pereopod attached. **F**, same, internal view. **G**, right pereopod 7. Scale: 2.5 mm.

DESCRIPTION. — Holotype female (Figs 4-5). Length 5.4 mm, maximal width 3.4 mm, head length 1.1 mm, head width 1.4 mm, pleon length 2.0 mm. Body outline elongate-oval, body axis distorted 74°; all body regions and segments distinct (Fig. 4A-B).

Head suboval, deeply set into pereon. Fully developed frontal lamina completely covering front of head, but not extending beyond its sides. Antennae reduced, only antennae 2 reaching margins of head, of 3 and 8 articles respectively (Fig. 5A-B). Barbula (Fig. 5C) with small angled outer projection and broadly lobate inner projection on each side and irregularly lobed margins in center. Maxilliped (Fig. 5D) subtriangular, its anterior article much larger then posterior one; nonsegmented articulating palp (Fig. 5E) just lateral to anteromedial corner of maxilliped and barely extending beyond its front, its margin and adjacent corner of maxilliped bearing sparse long setae; plectron (Fig. 5F) acutely angled but not prominent, its tip bearing minute setae. No eyes visible.

Pereon surrounding head laterally, doubly oval, tapering both ways from pereomere 3, then abruptly broader across pereomere 5 and tapering from there through pleon. Small coxal plates well-developed on both sides of pereomeres 1-4, those on long sides prominent and laterally extended. Dorsolateral projections on both sides of pereomeres 1-3 and prominent on long sides of pereomeres 5 and 6. Oostegites completely enclosing brood pouch. Oostegite 1 (Fig. 5G-H) with anterior and posterior plates equally long, latter slightly concave posteriorly; internal ridge entire except for some tiny lobes near center. Pereopods extending laterally and visible dorsally along sides of body, all with all articles distinct and bases lobate, their bases and ischia progressively larger posteriorly (Fig. 5I-J).

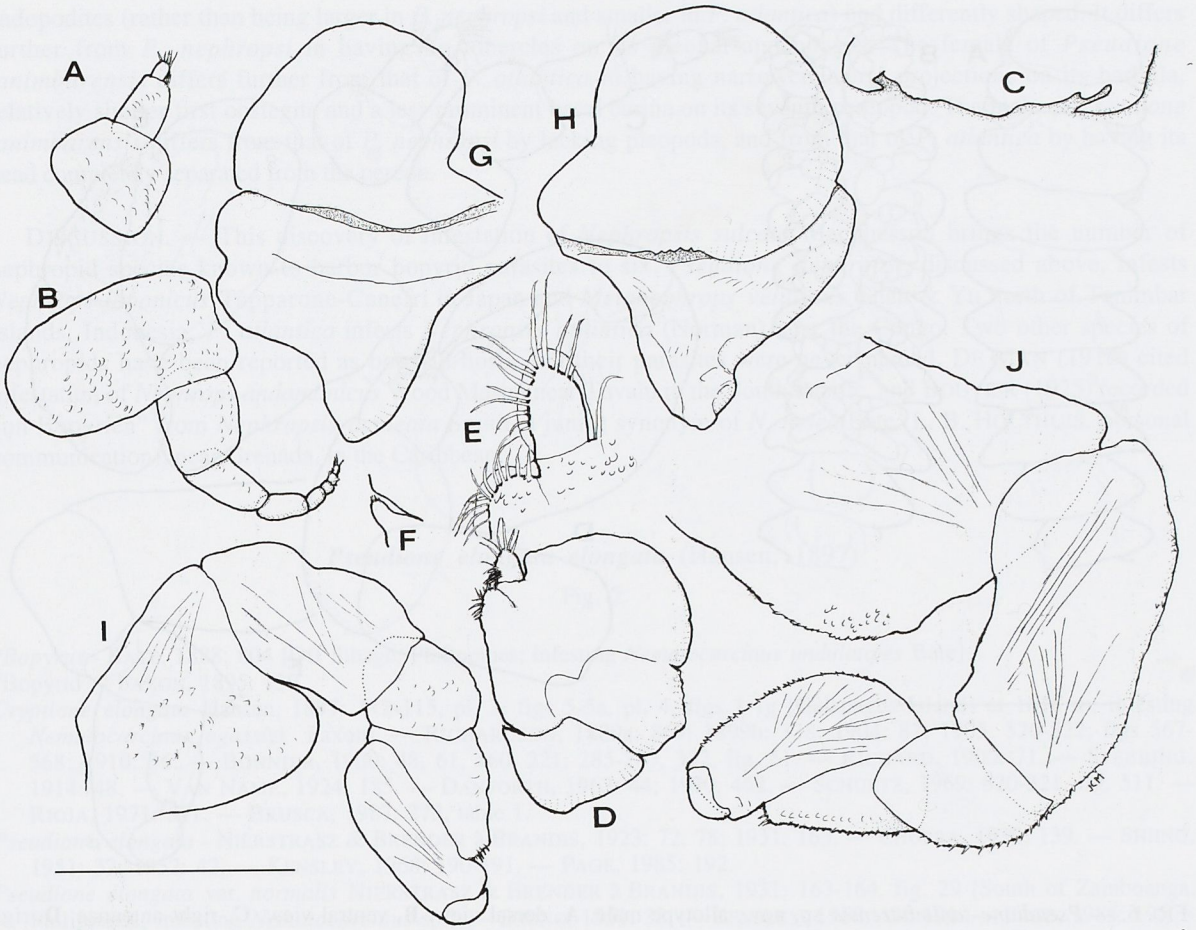


FIG. 5. — *Pseudione tanimbarensis* sp. nov., holotype female. **A**, right antenna 1. **B**, left antenna 2. **C**, barbula. **D**, right maxilliped. **E**, palp of same. **F**, plectron of same. **G**, right oostegite 1, external view. **H**, same, internal view. **I**, left pereopod 1. **J**, left pereopod 7.
Scale: 1.2 mm for C; 1.0 mm for D, G-H; 0.4 mm for others.

Pleon greatly extended, of 6 distinct broad, anteriorly convex pleomeres; pleomeres 1-5 each produced into long slender lateral plates on both sides, deeply separated by basal constriction on long sides but slightly overlapping opposite. Five pairs of biramous pleopods, their endopodites lanceolate and reaching far laterally, their endopodites falcately curved and extending rearward. Pleomere 6 heart-shape, with tiny posterior anal cone and lanceolate uniramous pleopods similar to but larger than lateral plates and extending far posteriorly.

Allotype male (Fig. 6): Length 3-4 mm (uncertain because of damage), maximal width 0.9 mm, head length 0.4 mm, head width 0.7 mm, pleonal length unknown. All body regions and segments distinctly separated. Sides of body nearly parallel (Fig. 6A-B).

Head suboval, broadest just before posterior margin and narrower than pereon. Antennae (Fig. 6C) of 3 and 6 articles, respectively; antennae 2 extending beyond margins of head on both sides. No eyes.

Pereon broadest across pereomere 3, but only slightly so; all pereomeres deeply separated by anterolateral indentations. Pereopods (Fig. 6D-F) all equally developed, decreasing slightly in overall size and markedly in dactylus size posteriorly; all carpi and meri fused, other articles distinct. Pereopods moderately covering much of ventral surface of pereon without extending beyond sides.

Pleon of at least 3 distinct pleomeres, total number uncertain because of missing posterior region, pleon tapering slightly posteriorly. Evidently no pleopods or midventral projections. Status of uropods unknown.

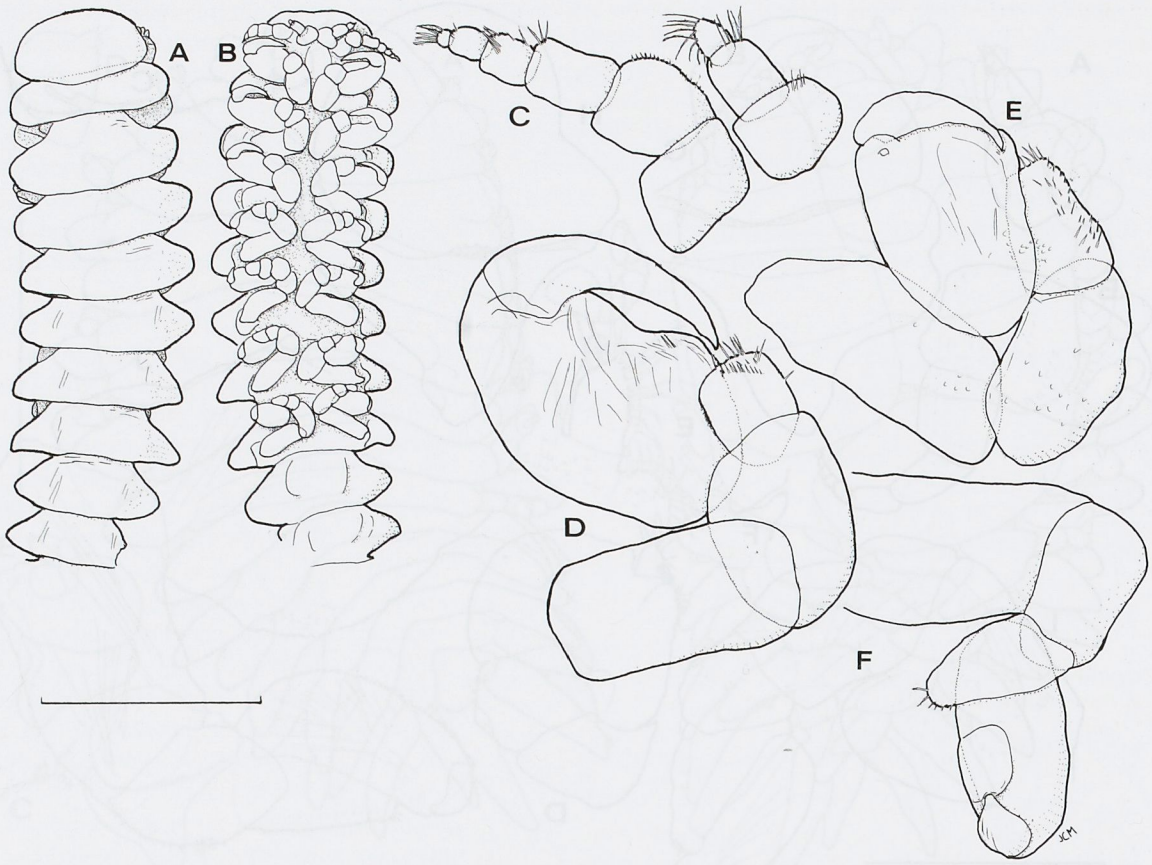


FIG. 6. — *Pseudione tanimbarensis* sp. nov., allotype male. **A**, dorsal view. **B**, ventral view. **C**, right antennae. **D**, right pereopod 1. **E**, right pereopod 3. **F**, right pereopod 7.
Scale: 1.2 mm for A-B; 0.2 mm for C-F.

ETYMOLOGY. — Specific name *tanimbarensis*, derived from name of type locality, Tanimbar Islands.

DISCUSSION. — *Pseudione tanimbarensis* belongs to that small group of species infesting hosts in the family Nephropidae, in host selection as well as morphology and probable lineage. It would be considered a third subspecies of *Pseudione nephropsi* Shiino, 1951, considered above, if I were not raising the second subspecies to specific rank as *Pseudione atlantica* Bourdon, 1971. Characters that *Pseudione tanimbarensis* shares with those two species are, in the female: body much longer than wide; sides of head completely embedded in pereon, with frontal lamina across whole anterior but not along sides at all; no eyes; palp on or next to anteromedial corner of maxilliped and extending little or none beyond it; 2 pairs of lateral projections on barbula, though inner pair much reduced; first oostegite with only short row of small lobes on internal ridge and falcately pointed posterolateral projection; brood pouch completely enclosed; meri and carpi of pereopods fused; pleon extended far posteriorly; pleomeres deeply separated laterally and produced into extended slender lateral plates; first pleomere wider than last pereomere; reduced sixth pleomere heart-shape, plainly visible dorsally; large pleopodal endopodites curved to extend rearward. Males of the three species share these characters: body long and slender; head suboval, much broader than long, lacking eyes; antennae 2 extending beyond margins of head; pereomeres and pleomeres deeply separated laterally; first pereopods larger and with more sharply pointed dactyli than others. The female of *Pseudione tanimbarensis* differs from the other two species in being much more distorted and having its coxal plates placed laterally, not dorsally, and in having all pleopodal endopodites about the same size as their respective

endopodites (rather than being larger in *P. nephropsi* and smaller in *P. atlantica*) and differently shaped. It differs further from *P. nephropsi* in having no tubercles on its pleonal appendages. The female of *Pseudione tanimbarensis* differs further from that of *P. atlantica* in having narrower lateral projections on its barbula, relatively shorter first oostegite and a less prominent basal carina on its seventh pereopod. The male of *Pseudione tanimbarensis* differs from that of *P. nephropsi* by lacking pleopods, and from that of *P. atlantica* by having its head completely separated from the pereon.

DISCUSSION. — This discovery of infestation of *Nephropsis sulcata* Macpherson brings the number of nephropid species known to harbor bopyrid parasites to six. *Pseudione nephropsi*, discussed above, infests *Nephrops japonicus* Tapparone-Canefri in Japan and *Metanephrops velutinus* Chan & Yu north of Tanimbar Islands, Indonesia; *P. atlantica* infests *Nephropsis atlantica* (Norman) near the Congo. Two other species of nephropids have been reported as bopyrid hosts, but their parasites were never named. DE MAN (1916) cited infestation of *Nephrops andamanicus* Wood Mason near Tuvalu in the South Pacific, and BOUVIER (1925) recorded "un Bopyrien" from *Nephropsis aculeata* Smith, a junior synonym of *N. rosea* Bate (L. B. HOLTHUIS, personal communication), near Grenada, in the Caribbean.

Pseudione elongata elongata (Hansen, 1897)

Fig. 7

?*Bopyrus* - BATE, 1888: 804 [Off Sibago, Philippines; infesting *Nematocarcinus undulatipes* Bate].
"Bopyrid" - FAXON, 1895: 159.
Cryptione elongata Hansen, 1897: 112-115, pl. 3, figs 5-5a, pl. 4, figs 1-1g [Galapagos Islands at 1618 m; infesting *Nematocarcinus agassizi* Faxon]. — RICHARDSON, 1889a: 869; 1899b: 338; 1904: 87; 1905: 520-522; figs 567-568; 1910: 36. — BONNIER, 1900: 48, 61, 160, 221, 285-287, 332, fig. 51. — RICHARD, 1900: 71. — STEBBING, 1914: 48. — VAN NAME, 1924: 185. — DANFORTH, 1963: 44; 1970: 462. — SCHULTZ, 1969: 320-321, fig. 511. — RIOJA, 1971: 511. — BRUSCA, 1987: 273, table 1.
Pseudione elongata - NIERSTRASZ & BRENDER à BRANDIS, 1923: 72, 78; 1931: 163. — CHOPRA, 1930: 139. — SHIINO, 1951: 32; 1952: 42. — KENSLEY, 1968: 190-191. — PAGE, 1985: 192.
Pseudione elongata var. *normalis* NIERSTRASZ & BRENDER à BRANDIS, 1931: 163-164, fig. 29 [South of Zamboanga, Philippines; infesting *Nematocarcinus* sp.]. — SHIINO, 1951: 32. — KENSLEY, 1968: 190-191. — PAGE, 1985: 195.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: st. CC 384, 19°42.40'S, 158°50.80'E, 772-776 m, 21.10.1986. Infesting *Nematocarcinus* sp.: 13 ♀, 16 ♂ (of which 2 immature), 1 cryptoniscan larva (MNHN-Ep 890).

DESCRIPTIVE NOTES. — Female body outline and proportions (Fig. 7A-B) as in type, as well as configuration of barbula (Fig. 7E), shape of maxilliped (Fig. 7F), first oostegite (Fig. 7I), posterior dorsal margins of pereomeres, proportions of articles of pereopods (Fig. 7K-L) and orientation of pleonal appendages. Female's frontal lamina separated as in *normalis* form, maxilliped palp (Fig. 7G) shorter, internal ridge of oostegite 1 (Fig. 7J) more elaborate than in type. One of other females with maxilliped (not drawn) lacking projection next to palp as in female drawn, so more like that of type. One female with knobs on pleopods 1 and 2 (not drawn); two other females (Fig. 7M-N) with uropods more like those of holotype than one drawn in detail.

Male (Fig. 7O-P) proportionately slightly broader than type male and with head separated as in *normalis* form; matching type-male in general body shape and head shape, size and structure of antennae (Fig. 7Q-R), pereopods (Fig. 7S-T), midventral tubercles (Fig. 7P) and pleonal appendages (Fig. 7P, U). Immature male (Fig. 7V-W) with pereopods proportionately longer, midventral tubercles absent and pleopods greatly reduced.

One of the hosts (Fig. 7X) had an anterior opening into the swelling of the branchiostegite revealing the female inside. In the lot examined, there were 15 infested specimens of *Nematocarcinus* sp. Of these, 8 were infested dextrally and 7 sinistrally. Two of the parasites were missing; of the 13 females present, each was accompanied by at least 1 male, 2 mature males were with 1 female, 1 mature and 2 immature males were with another female, and 1 mature male and a cryptoniscan larva were with yet another female.

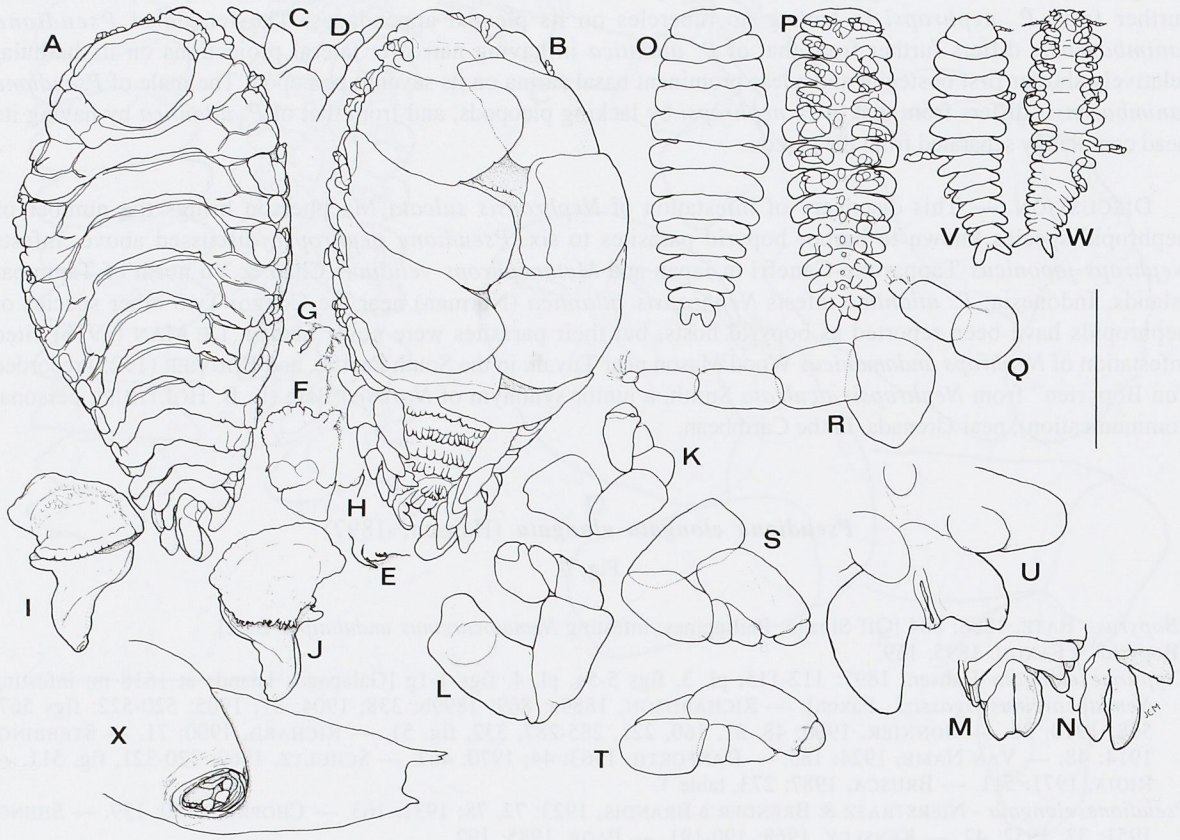


FIG. 7. — *Pseudione elongata elongata* (Hansen, 1897), A-L, reference female; M, second female; N, third female; O-U, reference male; V-W, immature male; X, fourth female on host *Nematocarcinus* sp. **A**, dorsal view. **B**, ventral view. **C**, right antenna 1. **D**, left antenna 2. **E**, right side of barbula. **F**, right maxilliped. **G**, palp of same. **H**, plectron of same. **I**, right oostegite 1, external view. **J**, same, internal view. **K**, right pereopod 1. **L**, right pereopod 7. **M**, end of pleon in dorsal view. **N**, same. **O**, dorsal view. **P**, ventral view. **Q**, right antenna 1. **R**, right antenna 2. **S**, left pereopod 1. **T**, left pereopod 7. **U**, end of pleon, ventral view. **V**, same, dorsal view. **W**, ventral view. **X**, parasite in host's branchial chamber.

Scale: 0.2 mm for Q-R; 0.4 mm for S-U; 1.2 mm for C-D, K-L, V-W; 2.5 mm for G-H, O-P; 5.0 mm for A-B, E-F, I-J, M-N; 10.0 mm for X.

SYSTEMATIC REMARKS. — The specimens mentioned by BATE (1888) seem never to have been identified, though their locality and host make it likely that they represented *P. elongata*. FAXON (1895) cited the specimens subsequently described as the types of *P. elongata*. HANSEN (1897) provided a very detailed description of this species, based on a single pair. He placed it in the new genus *Cryptione*, for which he gave no diagnosis, stating only that "...it is necessary to institute ... new genera. – a result with which I am rather dissatisfied, not being sure that they will all prove valid." NIERSTRASZ & BRENDER À BRANDIS (1923) synonymized *Cryptione* with *Pseudione*, with which action I agree, though most subsequent authors disregarded this generic transfer. NIERSTRASZ & BRENDER À BRANDIS (1931) described the new variety, *Pseudione elongata* var. *normalis*, which they considered to differ from the typical form mainly because its male had the head separated from its first pereomere, as is typical in the genus *Pseudione*; I am disregarding that varietal name, while noting that all of the males examined here also show such a separation. RIOJA (1971), in a catalog of species from Latin America, said that *P. elongata* was known from Acapulco, on Mexico's Pacific coast, but he cited no source for that record, nor do I know of any. BRUSCA (1987), in a list of the fauna of the Galapagos Islands, called it endemic to that

archipelago, thus overlooking the record of NIERSTRASZ & BRENDER à BRANDIS (1931) from the Philippines. And in an account of the Bopyridae of the eastern Pacific (MARKHAM, 1992), I accidentally omitted it despite its occurrence in the Galapagos. KENSLEY (1968) described the new subspecies *Pseudione elongata africana*, a parasite of *Nematocarcinus longirostris* Bate off southwestern South Africa. Thus this account deals with the typical subspecies, though this is the first time it has been so cited.

ACKNOWLEDGMENTS

Sincerest thanks are extended to Alain CROSNIER for sorting the ORSTOM collections and putting them at my disposal, and for arranging and hosting my visit to the Muséum national d'Histoire Naturelle and to Bertrand RICHER DE FORGES who collected many of the specimens. The financial support of the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM) is gratefully acknowledged. Colin MCLAY provided information about the host of *Gigantione petalomerae* sp. nov. An anonymous reviewer provided valuable suggestions that led to improvements in the manuscript. The late Mrs W. A. MARKHAM provided facilities at the Arch Cape Marine Laboratory, of which this is publication number 27.

LITERATURE CITED

ADKISON, D. L., 1984. — Two new species of *Gigantione* Kossmann (Isopoda: Epicaridea: Bopyridae) from the western North Atlantic. *Proceedings of the Biological Society of Washington*, **97**: 761-772.

BATE, C. S., 1888. — Report on the Crustacea Macrura dredged by H. M. S. Challenger during the years 1873-1876. *Report of the scientific Results of the Voyage of H.M.S. Challenger 1873-76*, Zoology, **24**: i-xc, 1-918, pls 1-150.

BONNIER, J., 1900. — Contribution à l'étude des épicarides. Les Bopyridae. *Travaux de la Station biologique de Wimereux*, **8**: 1-476.

BOURDON, R., 1968. — Les Bopyridae des mers européennes. *Mémoires du Muséum national d'Histoire naturelle*, nouvelle série (A), **50** (2): 77-424.

BOURDON, R., 1971. — Épicarides nouveaux pour la côte occidentale d'Afrique équatoriale. *Bulletin de l'Institut français d'Afrique Noire*, (A), **33**: 371-391.

BOUVIER, E. L., 1925. — Les macroures marcheurs. Reports on the results of dredging, under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877-78), in the Caribbean Sea (1878-79), and along the Atlantic coast of the United States (1880), by the U. S. Coast Survey Steamer "Blake.", Lieut.-Com. C.D. Sigsbee, U.S.N., and Commander J.R. Bartlett, U.S.N., commanding. *Memoirs of the Museum of Comparative Zoology, Harvard College*, **47** (5): 399-472, 11 pls.

BRUSCA, R. C., 1987. — Biogeographic relationships of Galapagos marine isopod crustaceans. *Bulletin of Marine Science*, **41** (2): 268-281.

CHOPRA, B., 1930. — Further notes on bopyrid isopods parasitic on Indian Decapoda Macrura. *Records of the Indian Museum*, **32** (2): 113-147, pls 4-6.

DANFORTH, C. G., 1963. — First record of a Hawaiian shore bopyrid (Isopoda: Bopyridae). *Journal of Parasitology*, **49** (5): 847-850.

DANFORTH, C. G., 1970. — Epicaridea (Isopoda) of Hawaii. *Bulletin of the Southern California Academy of Sciences*, **69**: 27-31.

DE MAN, J. G., 1916. — The Decapoda of the Siboga Expedition. Part III. Families Eryonidae, Palinuridae, Scyllaridae and Nephopsidae. *Siboga-Expeditie Monograph*, 39a^2: 1-122, 4 pls.

FAXON, W., 1895. — Reports on an exploration off the west coasts of Mexico, Central and South America, and off the Galapagos, in charge of Alexander Agassiz, by the U. S. Fish Commission Steamer "Albatross", during 1891, Lieut.-Commander Z.L. Tanner, U.S.N., commanding. XV. The stalk-eyed Crustacea. *Memoirs of the Museum of Comparative Zoology, Harvard College*, **18** : 1-292, pl. A-K + 1-56, 1 map.

HANSEN, H. J., 1897. — Reports on the dredging operations off the west coast of Central America to the Galapagos Islands, to the west coast of Mexico, and in the Gulf of California, in charge of Alexander Agassiz, carried on by the U. S. Fish Commission Steamer *Albatross* during 1891, Lieut.- Commander Z. L. Tanner, U. S. Navy, commanding. XXII. The Isopoda. *Bulletin of the Museum of Comparative Zoology, Harvard College*, **31** (5): 96-129, 6 pls.

HØEG, J. T. & RYBAKOV, A. V., 1992. — Revision of the Rhizocephala Akentrogonida (Cirripedia), with a list of all the species and a key to the identification of families. *Journal of Crustacean Biology*, **12**: 600-609.

HOUŠA, V., 1963. — Parasites of Tithonian decapod crustaceans (Stramberk, Moravia.). *Ústřed. Ústavu Geologie, Sborník* (Odd. Palent.), **28**: 101-114, 2 pls.

KENSLEY, B., 1968. — *Pseudione elongata africana*, a new subspecies of bopyrid isopod from the west coast of the Cape Peninsula, South Africa. *Crustaceana*, **15**: 188-192.

MARKHAM, J. C., 1992. — The Isopoda Bopyridae of the eastern Pacific – Missing or just hiding? *Proceedings of the San Diego Society of Natural History*, **17**: 1-4.

MARKHAM, J. C., 1994. — Crustacea Isopoda: Bopyridae in the MUSORSTOM collections from the tropical Indo-Pacific I. Subfamilies Pseudioninae (in part), Argeiinae, Orbioninae, Athelginae and Entophilinae. In: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 12. *Mémoires du Muséum national d'Histoire naturelle*, **161**: 225-253.

McLAY, C.L., 1993. — Crustacea Decapoda: The sponge crabs (Dromiidae) of New Caledonia and the Philippines with a review of the genera. In: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 10. *Mémoires du Muséum national d'Histoire naturelle*, **156**: 111-251.

NIERSTRASZ H. F., & G. A. BRENDER à BRANDIS, 1923. — Die Isopoden der Siboga-Expedition. II. Isopoda Genuina. I. Epicaridea. *Siboga-Expeditie Monograph*, 32b: 57-121, pls 4-9.

NIERSTRASZ H. F., & G. A. BRENDER à BRANDIS, 1931. — Papers from Dr. Th. Mortensen's Pacific Expedition 1914-16. LVII. Epicaridea II. *Videnskabelige Meddelelser fra Dansk Naturhistorisk Forening i København*, **91**: 147-226, pl. 1.

PAGE, R. D. M, 1985. — Review of the New Zealand Bopyridae (Crustacea: Isopoda: Epicaridea). *New Zealand Journal of Zoology*, **12**: 185-212.

RICHARD, J., 1900. — Essai sur les Crustacés considérés dans leurs rapports avec l'hygiène, la médecine et la parasitologie. Lille: Le Bigot Frères. 85 pp.

RICHARDSON, H., 1899a. — Key to the isopods of the Pacific coast of North America, with descriptions of twenty-two new species. *Proceedings of the United States National Museum*, **21**: 815-869.

RICHARDSON, H., 1899b. — Key to the isopods of the Pacific coast of North America, with descriptions of twenty-two new species. *Annals and Magazine of Natural History*, (7) **4**: 157-187, 260-277, 321-338.

RICHARDSON, H., 1904. — Contributions to the Natural History of the Isopoda. *Proceedings of the United States National Museum*, **27**: 1-89.

RICHARDSON, H., 1905. — A monograph on the isopods of North America. *Bulletin of the United States National Museum*, **54**: i-lii + 1-727.

RICHARDSON, H., 1910. — Marine isopods collected in the Philippines by the U. S. Fisheries steamer *Albatross* in 1907-8. *Bureau of Fisheries Documents*, (736): 1-44.

RIOJA, E., 1971. — Clase IV. Los crustáceos (Crustacea). Pp. 470-554. In: CENDERO, L., editor: Zoología Hispanoamericana - Invertebrados. México, D. F.: Editorial Porrua, S. A.

ŞADOĞLU, P., 1969. — Variations in eye degeneration and pigment in some parasitic isopods during their life cycle. *Pubblicazioni della Stazione Zoologica di Napoli*, **37**: 173-209.

SCHULTZ, G. A., 1969. — How to know the marine isopod crustaceans. Dubuque, Iowa: Wm. C. Brown Company. vii + 359 pp.

SHIINO, S. M., 1951. — Some bopyrid parasites found on the decapod crustaceans from the waters along Mie Prefecture. *Report of the Faculty of Fisheries, Prefectural University of Mie*, **1**: 26-40.

SHIINO, S. M., 1952. — Phylogeny of the family Bopyridae. *Annual Report of the Prefectural University of Mie* (Section 2, Natural Science), **1**: 33-56. [In Japanese with English Summary].

SHIINO, S. M., 1972. — [The Epicaridea (list of species) from Japan]. *Kansai Shizenkagaku*, **24**: 7-10. [In Japanese].

STEBBING, T. R. R., 1914. — South African Crustacea. (Part VII of S. A. Crustacea, for the Marine Investigations in South Africa). *Annals of the South African Museum*, **15**: 1-55, 12 pls.

VAN NAME, W. G., 1924. — Isopods from the Williams Galapagos Expedition. *Zoologica*, **5** (18): 181-210, pls 8-19.

5

Crustacea Decapoda: Revision of *Pasiphaea sivado* (Risso, 1816) and related species, with descriptions of one new genus and five new species (Pasiphaeidae)

Ken-Ichi HAYASHI

National Fisheries University
P.O. Box 3 Yoshimi, Shimonoseki
759-65 Japan

ABSTRACT

The study of many samples collected by MUSORSTOM cruises, deposited in the Muséum national d'Histoire naturelle, as well as the reexamination of types and published specimens reveal that *Pasiphaea sivado* (Risso, 1816) and the related species, *P. propinqua* de Man, 1916, *P. japonica* Omori, 1976, *P. marisrubri* Iwasaki, 1989 and *P. nudipeda* Burukovsky, 1993, belong to one group. All are characterized by a terminal spine on the sixth abdominal somite and a branchial reduction. However, *P. nudipeda* is entirely devoid of arthrobranchia, has unarmed first pereiopods and three pairs of spines on the posterior margin of telson and has to be separated; a new genus *Alainopasiphaea* is proposed for it. The other species mentioned above, except *P. marisrubri,* bear three arthrobranchiae from the fourth to sixth thoracic somites. *P. marisrubri* and five new species found in the MUSORSTOM material and belonging in this group have four pleurobranchiae from the fourth to seventh thoracic somites. On the other hand, *P. propinqua*, *P. japonica* and *P. sivado* have one more, but rudimentary, pleurobranchia on the eighth somite. A key for all these species is provided.

RÉSUMÉ

Crustacea Decapoda: Révision de *Pasiphaea sivado* (Risso, 1816) et des espèces qui lui sont proches. Description d'un genre et cinq espèces nouveaux (Pasiphaeidae).

L'étude de nombreuses récoltes, rassemblées lors des campagnes MUSORSTOM et déposées au Muséum national d'Histoire naturelle, et le réexamen de types ou de spécimens publiés montrent que *Pasiphaea sivado* (Risso, 1816) et les espèces proches, *P. propinqua* de Man, 1916, *P. japonica* Omori, 1976, *P. marisrubri* Iwasaki, 1989 et *P. nudipeda* Burukovsky, 1993, appartiennent à un même groupe qui se caractérise par la présence d'une épine distale sur le sixième segment abdominal et une réduction des branchies. Toutefois *P. nudipedia* est totalement dépourvue d'arthrobranchies et a des premiers péréiopodes sans épine et trois paires d'épines sur le bord postérieur du telson; il convient de la séparer; pour elle, un nouveau genre *Alainopasiphaea* est proposé. Les autres espèces mentionnées ci-dessus, à l'exception de *P. marisrubri*, possèdent trois arthrobranchies réparties sur les segments thoraciques 4-6. *P. marisrubri* et cinq espèces nouvelles, trouvées dans le matériel MUSORSTOM et appartenant au groupe considéré ici, possèdent quatre pleurobranchies réparties sur les segments thoraciques 4-7. Enfin, *P. propinqua*, *P. japonica* et *P. sivado* ont une pleurobranchie supplémentaire, mais rudimentaire, sur le segment thoracique 8. Une clé d'identification pour toutes ces espèces est proposée.

HAYASHI, K.-I., 1999. — Crustacea Decapoda: Revision of *Pasiphaea sivado* (Risso, 1816) and related species, with descriptions of one new genus and five new species (Pasiphaeidae). *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*, **180**: 267-302. Paris ISBN 2-85653-520-8.

INTRODUCTION

The genus *Pasiphaea* is a large group, containing nearly 60 species (BURUKOVSKY & ROMENSKY, 1987; BURUKOVSKY, 1996). A world wide review of the genus has not been completed, and several species have been left unclear as to their specific status. Amongst them are the type species of the genus, *P. sivado* (Risso, 1816) and related species.

P. sivado was reported from both the Atlantic Ocean and the Indo-West Pacific region. However, specimens from Japanese waters were shown to be a different species, *P. japonica* Omori, 1976, and Red Sea specimens were referred to another different species, *P. marisrubri* Iwasaki, 1989. Some specimens from other localities described under that name have not been reexamined in detail, such as those recorded in WOOD MASON & ALCOCK (1893) and in KENSLEY (1977), both from the Indian Ocean.

All these species are easily distinguished by having a terminal spine on the sixth abdominal somite. Two other species, *P. propinqua* de Man, 1916, and *P. nudipeda* Burukovsky, 1993, have such a spine. All these species share some other important characters with one another and therefore, probably constitute a natural group: the *P. sivado* species group. One of the important characters of this group is the branchial reduction, which has not been drawn attention to as a means of distinguishing between species in the genus *Pasiphaea*.

Many pasiphaeids collected from various areas by several MUSORSTOM cruises are referred to seven species belonging to the *P. sivado* species group and including five new species. An another species, close to this group but entirely devoid of arthrobranchiae, seems to have to be separated from it; for this species I propose a new genus *Alainopasiphaea*.

The specimen size is indicated by the carapace length (CL), not including the rostrum. The specimens examined are preserved at the following institutions: Muséum national d'Histoire naturelle, Paris (MNHN), Forschungsinstitut Senckenberg, Frankfurt (SMF), National Fisheries University, Shimonoseki (NFU), South African Museum (SAM), Zoologisch Museum, Amsterdam (ZMA) and Zoological Museum of the Moscow State University (MMSU).

SYSTEMATIC ACCOUNT

Genus ***ALAINOPASIPHAEA*** nov.

DEFINITION. — Small pasiphaeids. Rostrum short, triangular with pointed apex, arising behind anterior margin of carapace. Carapace not carinated and smooth dorsally, with branchiostegal spine only. Abdomen not carinated dorsally. Posterior margin of telson truncated with three pairs of spines. Mandible without palp. Fourth pereiopod shorter than third and fifth. No arthrobranchia on third maxilliped. No arthrobranchiae but four pleurobranchiae present on fourth to seventh thoracic somites.

ETYMOLOGY. — The genus name *Pasiphaea* with the prefix Alain, the first name of a French carcinologist, Alain CROSNIER of the ORSTOM who is much involved in editing the results of the MUSORSTOM cruises.

REMARKS. — The new genus is related to the genus *Pasiphaea*, from which it is distinguished by such characters as the simple branchial formula, having four pleurobranchiae only and no arthrobranchiae at all, the unarmed first pereiopod and three pairs of spines on the posterior margin of the telson.

A full set of the branchial components of the genus *Pasiphaea* is five pleurobranchiae from the fourth to the eighth thoracic somites and three arthrobranchiae from the fourth to sixth thoracic somites. The reduction of the branchial formulae is shown in some species, especially in *P. sivado* and related species, but then three arthrobranchiae are always present, without exception. The posterior margin of the telson is usually armed with eight or more spines in *Pasiphaea*, and is very variable in shape and armature. The completely unarmed first pereiopod, with even no posterodistal spine on the basis, is also shown in a few species of the genus *Pasiphaea*.

The present genus contains a single species, *Alainopasiphaea nudipeda* (Burukovsky, 1993) described in detail below.

Alainopasiphaea nudipeda (Burukovsky, 1993) new comb.

Figs 1-3

Pasiphaea sp. α - DE MAN, 1920: 9, pl. 1, fig. 3-3o.
Pasiphaea nudipeda Burukovsky, 1993: 35, fig. 1, 8-13; 1996, 843 (list).

MATERIAL EXAMINED. — **Mozambique**. *"Vitiaz"*: stn 2631, 25°28.0'S, 35°08'E, 535-490 m, 23.11.1988: 1 ♀ holotype (MMSU 1/84269).

Madagascar. *"Vauban"*: Trawl 89, 21°18'S, 43°17.4'E, 620 m, 26.11.1973: 1 ♂ 11.5 mm (MNHN-Na 13370). — Trawl 90, 21°24.5'S, 43°13.5'E, 640-720 m, 26.11.1973: 1 ovig. ♀ 10.9 mm (MNHN-Na 13371).

Indonesia. *Mollucas*: *"Siboga"*: stn 148, 0°17.6'S, 129°14.5'E, 10.08.1899: 1 juv. 4.6 mm (ZMA).

DIAGNOSIS. — Shell not fragile. Rostrum small, apex not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus developed. Abdominal somites dorsally rounded. First pereiopod unarmed on merus, ischium and basis, posterodistal angle of basis not spiniform. Merus of second pereiopod with single spine, ischium unarmed, basis unarmed, posterodistal spine small. Ischium of third pereiopod without spinules. Arthrobranchiae absent. Pleurobranchiae on fourth to seventh thoracic somites. Ovigerous female about 10 mm.

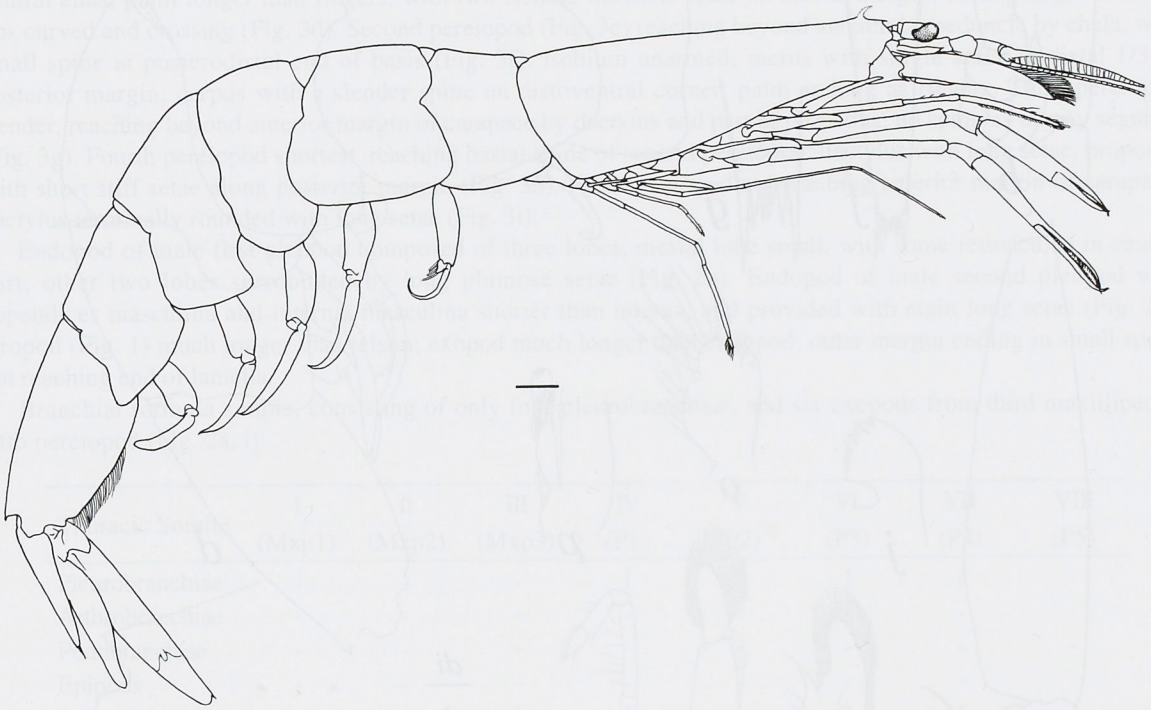


FIG. 1. — *Alainopasiphaea nudipeda* (Burukovsky, 1993), ♂ 11.5 mm (MNHN-Na 13370), Madagascar. Scale = 1 mm.

DESCRIPTION. — Rostrum small and short, hardly reaching halfway between base of rostrum and anterior margin of carapace, though apex missing in male (Figs. 1, 2c) and entirely broken in female. Branchiostegal spine small situated just inside anterior margin of carapace. No middorsal carina on carapace. Branchiostegal sinus distinct (Fig. 2c).

All abdominal somites dorsally smooth, without carinae and spines (Fig. 2d). Sixth abdominal somite 1.8 times as long as fifth somite and 1.9 times as long as deep; terminal spine extending straight backward; posterolateral margin with small convexity just below spine; ventrodistal corner with small concavity near distal end (Fig. 2e). Telson 0.6 times as long as sixth somite, dorsally with shallow groove, but almost flat near

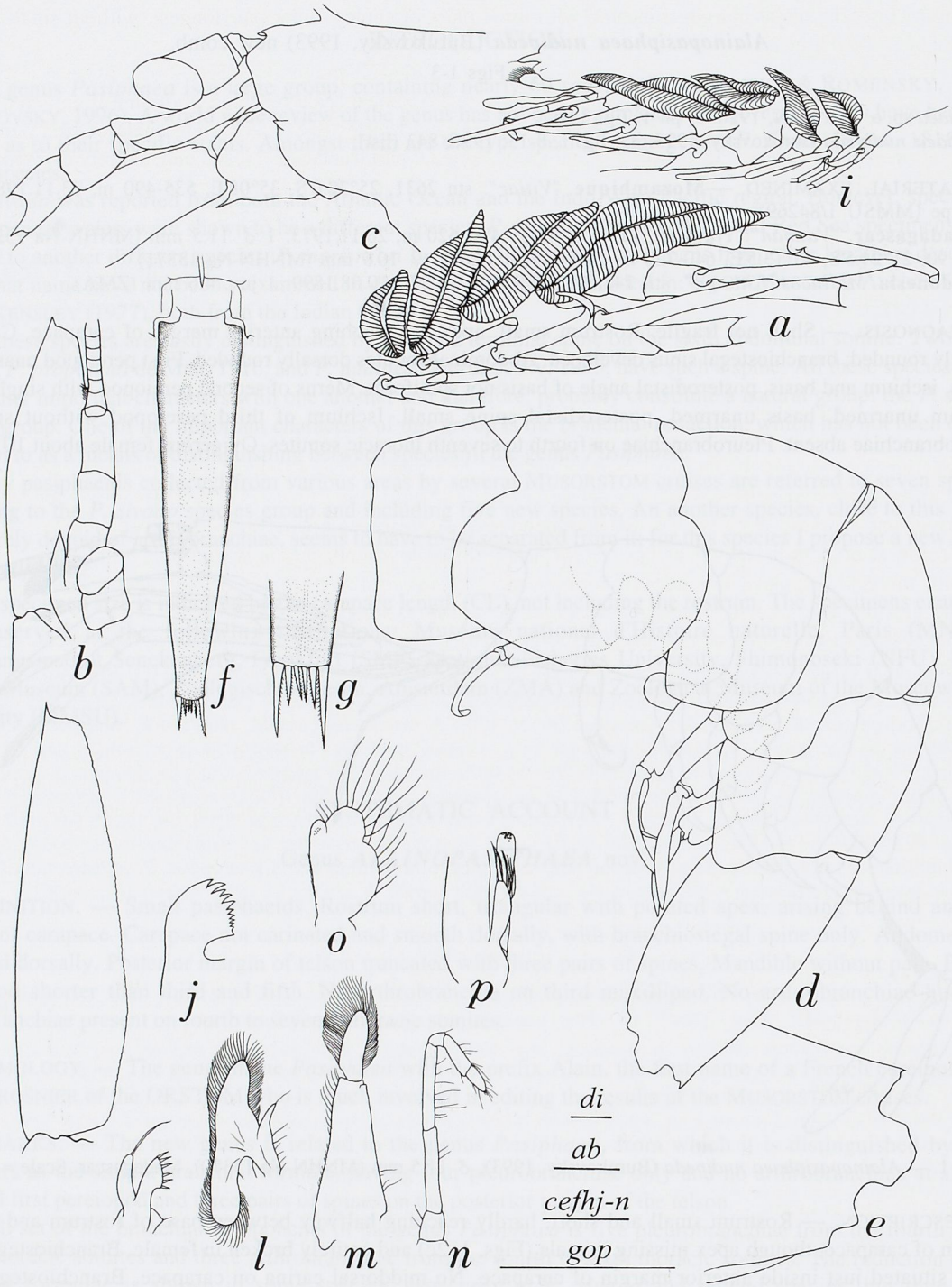


FIG. 2. — *Alainopasiphaea nudipeda* (Burukovsky, 1993), **a-b**, holotype, ♀ 12 mm (MMSU, 1/84269), Mozambique; **c e, i-n**, ovig. ♀ 10.9 mm (MNHN-Na 13371); **f-h, o-p**, ♂ 11.5 mm (MNHN-Na 13370), both from Madagascar.

a, i, branchial chamber; **b**, eye, antennule and antennal scale, dorsal view; **c**, anterior part of body; **d**, abdomen; **e**, distal end of sixth somite; **f**, telson; **g**, distal end of telson; **h**, antennal scale; **j**, mandible; **k**, maxillula; **l**, maxilla; **m**, first maxilliped; **n**, second maxilliped; **o**, first pleopod; **p**, second pleopod. Scales = 1 mm.

midlength (Fig. 2f); distal margin truncated with three pairs of spines, outer pair longest, without small seta on base; inner two pairs nearly equal in length (Fig. 2g).

Eyes well developed; cornea spherical in lateral view and well pigmented (Fig. 2b-c). Stylocerite slightly shorter than first segment of antennular peduncle (Fig. 2b). Antennal scale reaching midpoint of enlarged part of antennular flagellum (Fig. 1), 3.8 times as long as wide, and shorter (0.88-0.92) than chela of first pereiopod; outer margin evenly convex, and ending in small tooth; lamellar part truncated at distal end, entirely overreached by distolateral tooth (Fig. 2b, h). Basicerite with slender spine on lower distal corner (Fig. 2c).

Mouth-parts illustrated, not apparently different from those of the genus *Pasiphaea*, but slightly more simple in structure. Mandible provided with about 10 strong teeth along mesial margin of incisor process; palp absent (Fig. 2j). Proximal endite of maxillula small, triangular, with short simple seta; distal endite armed with six acute teeth; endopod oblong, with stout simple seta on distal end (Fig. 2k). Maxilla composed of well developed endopod and large scaphognathite (Fig. 2l). First maxilliped provided with elongated lamellar part, articulated distally; no incision present on the outer margin of basal part (Fig. 2m). Second maxilliped simple pediform; epipod and exopod absent (Fig. 2n). Third maxilliped long, reaching slightly beyond antennal scale (Fig. 1); distal segment about twice as long as penultimate segment; exopod well developed (Fig. 3a).

First pereiopod (Fig. 3b) reaching beyond antennular peduncle by chelae (Fig. 1); basis not ending in spiniform process (Fig. 3c); ischium and merus unarmed on posterior margin; carpus short, with spine on distodorsal and ventral ends; palm longer than fingers, with two slender movable setae on mesial margin; cutting edges toothed, tips curved and crossing (Fig. 3d). Second pereiopod (Fig. 3e) reaching beyond antennular peduncle by chela, with small spine at posterodistal end of basis (Fig. 3f); ischium unarmed; merus with single spine at distal 1/3 of posterior margin; carpus with a slender spine on distoventral corner; palm as long as fingers. Third pereiopod slender, reaching beyond anterior margin of carapace by dactylus and part of propodus; no spinules on any segment (Fig. 3g). Fourth pereiopod shortest, reaching basial spine of second pereiopod; dactylus with long setae, propodus with short stiff setae along posterior margin (Fig. 3h). Fifth pereiopod not reaching anterior margin of carapace; dactylus terminally rounded with long setae (Fig. 3i).

Endopod of male first pleopod composed of three lobes, mesial lobe small, with some retinaculae in central part; other two lobes surrounded by long plumose setae (Fig. 2o). Endopod of male second pleopod with appendices masculina and interna; masculina shorter than interna, and provided with eight long setae (Fig. 2p). Uropod (Fig. 1) much longer than telson; exopod much longer than endopod; outer margin ending in small spine, not reaching end of lamella.

Branchial formula simple, consisting of only four pleurobranchiae, and six exopods from third maxilliped to fifth pereiopod (Fig. 2a, i):

Thoracic Somite	I (Mxp1)	II (Mxp2)	III (Mxp3)	IV (P1)	V (P2)	VI (P3)	VII (P4)	VIII (P5)
Pleurobranchiae	-	-	-	1	1	1	1	-
Arthrobranchiae	-	-	-	-	-	-	-	-
Podobranchiae	-	-	-	-	-	-	-	-
Epipods	-	-	-	-	-	-	-	-
Exopods	-	-	1	1	1	1	1	1

SIZE. — The holotype is 12 mm CL (BURUKOVSKY, 1993). The MUSORSTOM material are slightly smaller than the holotype. The carapace length is 11.5 mm CL in male and 10.9 mm in ovigerous female. Eggs are large and relatively few in number, 1.47 x 0.95 mm. The *"Siboga"* specimen is immature, its carapace length is only 4.6 mm.

REMARKS. — The present species was recently described by BURUKOVSKY (1993), based on a single female collected from the western Indian Ocean. Although six spines on the posterior margin of the telson and the unarmed first pereiopod were shown in the original description, the simple branchial formula was neither mentioned nor figured by BURUKOVSKY (1993). Very recently I could examine the holotype, in which



FIG. 3. — *Alainopasiphaea nudipeda* (Burukovsky, 1993), **a-b**, **e**, **g-i**, ♂ 11.5 mm (MNHN-Na 13370) ; **c-d**, **f**, ovig. ♀ 10.9 mm (MNHN-Na 13371), both from Madagascar.

a, third maxilliped; **b**, first pereiopod; **c**, basal part of first pereiopod; **d**, chela of first pereiopod in inner view; **e**, second pereiopod; **f**, basal part of second pereiopod; **g**, third pereiopod; **h**, fourth pereiopod; **i**, fifth pereiopod. Scales = 1 mm.

unfortunately the carapace was entirely missing, but confirmed these characters (Fig. 2a-b). The MUSORSTOM specimens agree well with the holotype and show no apparent sexual dimorphism.

I could also examine the small specimen that DE MAN (1920) named *Pasiphaea* sp. α. This is a juvenile, only 4.6 mm in carapace length, and probably identical with the present species in having the following characters: The branchial formula is the same as in the present species, only four pleurobranchiae are recognized in the branchial chamber. The first pereiopod is entirely unarmed on the posterior margin of merus, ischium and basis. The distal end of basis bears no spine. The merus of the second pereiopod is armed with one spine at distal third of the posterior margin; the distal end of the basis bears a small spine.

Some minor discrepancies between the MUSORSTOM and *"Siboga"* specimens are present. The branchiostegal sinus is ill defined and the spine on the basicerite is small in the *"Siboga"* specimen, and the ventral surface of palm of the first pereiopod is provided with a single seta near the finger articulation, while two setae, one near the finger articulation and the other on the midlength of palm, are observed in the MUSORSTOM specimens. Obviously these differences depend largely on the immaturity of the *"Siboga"* specimen.

DISTRIBUTION. — The present specimens were collected from two localities near Madagascar at depths of 620-720 m. The holotype was obtained from off Mozambique at depths of 535-490 m. The *"Siboga"* specimen was obtained from Indonesia.

Genus ***PASIPHAEA*** Savigny, 1816

Pasiphaea sivado species group

DEFINITION. — Small and moderately sized pasiphaeids. Rostrum short, triangular with pointed apex, arising behind anterior margin of carapace. Dorsal margin of carapace smooth in most species but carinate anteriorly in some species. Branchiostegal spine present. Posterior margin of telson truncate, slightly convex or slightly concave, with four pairs of spines. Mandible without palp. Fourth pereiopod shorter than third and fifth pereiopods. No arthrobranchia on third maxilliped. Three arthrobranchiae from fourth to sixth thoracic somites and four or five pleurobranchiae present on fourth to seventh or eighth thoracic somites, pleurobranchia on eighth somite, if present, always rudimentary.

Pasiphaea sivado and related species have the following characters: 1) size small to moderate, 2) carapace usually not carinate dorsally, 3) first to fifth abdominal somites not carinated dorsally, 4) a terminal spine present on sixth abdominal somite only, 5) distal margin of telson not forked, with four pairs of spines, 6) pleurobranchia on eighth thoracic somite absent or rudimentary, and 7) three arthrobranchiae present on fourth to sixth thoracic somites.

The general morphology of the species of this group resembles each other, as set out below.

Rostrum small, triangular process situated at middorsal line slightly inside carapace. Small branchiostegal spine situated on or just inside anterior margin of carapace.

First to fifth somites smooth dorsally, unarmed. Sixth somite less than twice as long as fifth and less than twice as long as deep. Telson shorter than sixth somite, usually with longitudinal groove dorsally. Distal margin of telson truncate or convex, with four pairs of spines; outer pair longest, usually with small accessory seta on their base; inner pairs shorter than outer, gradually decreasing in size.

Eye well developed; cornea spherical or semispherical in lateral view, well-pigmented. Stylocerite not reaching or just reaching distal margin of first segment of antennular peduncle; dorsal margin ending in small point in lateral view. Antennal scale overreaching enlarged part of antennular flagellum, about four times as long as wide; outer margin more or less convex; outerdistal tooth projecting beyond lamella. Basicerite armed with slender spine on lower distal corner.

Mouth-parts of typical shape. Mandible with several strong teeth along mesial margin of incisor process. Maxillula comparatively large; proximal endite small, obliquely truncate distally with one or few short simple setae; distal endite with several acute teeth; endopod oblong, with stout simple seta on mesial margin near distal end.

Maxilla with well developed endopod and large scaphognathite. First maxilliped with elongated lamellar part, articulated distally. Second maxilliped simple, pediform; epipod and exopod absent. Third maxilliped long, reaching slightly beyond antennal scale; distal segment about twice as long as penultimate segment; exopod well developed.

All pereiopods with well developed exopods, but no epipods. First pereiopod usually reaching beyond distal end of antennular peduncle by entire chela; carpus short, sharply pointed on dorsal and ventral ends; palm slightly longer than fingers, usually with two slender movable setae on mesial margin; fingers slender, their cutting edges toothed; tips curved, crossing one another. Second pereiopod similar to first pereiopod in shape and length; carpus with slender distoventral spine only; finger nearly as long as palm, strongly curved at distal part. Third pereiopod slender, reaching beyond anterior margin of carapace by dactylus and a part of propodus; all segments usually unarmed. Fourth pereiopod shortest, reaching basial spine of second pereiopod only; dactylus provided with rather long setae on posterior margin; propodus with short stiff setae along posterior margin. Fifth pereiopod reaching distal margin of carpus of third pereiopod; dactylus broad and rounded distally, with several long setae.

Endopod of male first pleopod with two or three lobes, mesial lobe small, with some retinaculae in central part; outer lobe surrounded by long plumose setae. Endopod of male second pleopod with appendices masculina and interna; masculina usually shorter than interna, with many long setae. Uropod elongate; exopod much longer than endopod, outer margin with small distal spine, as long as or overreaching lamella.

REMARKS. — The genus *Pasiphaea* contains many species which together show a wide range of morphological variation. Of these the type species of the genus, *P. sivado*, and other related species, such as *P. propinqua* de Man, 1916, *P. japonica* Omori, 1976, and *P. marisrubri* Iwasaki, 1989, were reported to be very similar in shape and size. They differ from the other members of *Pasiphaea* in having a terminal spine on the dorsal margin of the sixth abdominal somite. Five other new species related to *P. sivado* were found in the MUSORSTOM material. They prove to share some important characters with the above mentioned species, in addition to the terminal spine on the sixth abdominal somite. They constitute a single natural group, the *P. sivado* species group, which maybe in the future will be recognized as a distinct subgenus of the genus *Pasiphaea*.

The terminal spine on the sixth abdominal somite is the most apparent and useful character, by which this species group is readily distinguished from the other species groups. This character does not easily change in shape and size, and is less likely to be damaged than the tips of rostrum, telson and uropodal exopods, when specimens suffer damage. In some species such as *P. truncata* Rathbun, 1906 and *P. longitaenia* Kensley, Tranter & Griffin, 1987, the dorsal margin of the sixth abdominal somite is produced as a "pointed end", not as a true spine. The lateral aspect of the pointed end somewhat resembles that of a true spine, but spine and pointed end are easily recognized from each other in dorsal view. The true spine is slender and needle-like, especially not broadened at base, but the pointed end is triangular in shape with a broad base.

There are some species provided with a posterodorsal spine on other abdominal somites as well as on the sixth somite, for example *P. orientalis* Schmitt, 1931, *P. hoplocerca* Chace, 1940 and *P. semispinosa* Holthuis, 1951. They are excluded from this species group, because they do not share the above mentioned characters.

It has been emphasized that main specific characters of the genus *Pasiphaea* were the spination of the first and second pereiopods and the shape of the telson end (BURUKOVSKY & ROMENSKY, 1987; BURUKOVSKY, 1996). They are indeed important, but the branchial differences seem to be almost neglected in this genus. The species of this species group, such as *P. sivado*, *P. japonica*, and *P. propinqua*, have the same branchial formula, three arthrobranchiae from the fourth to sixth thoracic somites and four normal and one rudimentary pleurobranchiae from the fourth to eighth thoracic somites. This formula, however, differs from those of other remaining species, in which the last pleurobranchia is normal, not reduced. Among the MUSORSTOM materials are five new species, which bear different and more reduced branchial formulae.

Branchial reduction, therefore, occurs in every species of the *P. sivado* species group. The condition is not uniform, though there are always three arthrobranchiae, and the species are roughly divided into two groupings: five species bear only four pleurobranchiae and three have five pleurobranchiae, of which the last one is always rudimentary, bearing only a few gill lamellae. It differs in form from the miniature or undeveloped gill, often seen in the immature specimens of other large-sized species of the genus.

On the other hand, *Pasiphaea* species without the terminal spine on the sixth somite have three well-developed arthrobranchiae from the fourth to sixth thoracic somites and five normal pleurobranchiae are also present on all

thoracic somites. The last pleurobranch is never reduced, having usually the same shape as those of preceding somites. *Pasiphaea* species with terminal spines on two or three abdominal somites, even if a spine is present on the sixth somite, never show branchial reduction, and have a complete set of gills.

These two groupings within the *Pasiphaea* species group based on branchial differences coincide rather well with a pattern of spination of the first and second pereiopods. Each basis of the first and second pereiopods always ends in a well-developed posterodistal spine in both groupings. The meri are armed with a series of spines, but their arrangements are rather different from each other. There are less than ten spines on the first pereiopod and less than 17 spines on the second pereiopod in the first grouping, while in the second grouping usually more than ten spines on the first pereiopod and usually more than 15 spines on the second pereiopod. *P. sivado* is an exception, though it has the branchial formula of the second grouping, the spination is less than ten on the first pereiopod, and less than 15 spines on the second pereiopod.

The basis and ischium does not show such pattern of the spination, and the presence or absence of the spine(s) seem to be constant, though numbers are always variable. There is an exception with the ischium of *P. gracilis* sp. nov., in which one female from the northern South Pacific is armed with one spine on the left side but unarmed on the right side.

The rostrum is shown to be rather variable in shape depending on growth, or presence or absence of ellobiopsid parasites, but its general morphology is still useful for almost all species. As pointed out by BURUKOVSKY & ROMENSKY (1987) and BURUKOVSKY (1996), the form of the branchial sinus is important and may be constant, though it is rather difficult to observe, because the ventral margin of carapace is often softened and folded inwards.

Pasiphaea sivado has been reported several times from various seas. Records from other areas than the Atlantic Ocean, were partly checked and proved to be different species (OMORI, 1976 and IWASAKI, 1989) and the remaining records are now reexamined from the specimens concerned or from the published references. Now, *P. sivado* s.s. is restricted in its distribution to the northeastern Atlantic Ocean and Mediterranean Sea. Including the five new species described here, the *Pasiphaea sivado* species group includes the following nine members:

P. debitusae sp. nov. (? = *Pasiphaea sivado* Wood Mason, 1892 and *Pasiphaea sivado* Wood Mason & Alcock, 1893),
P. fragilis sp. nov.,
P. gracilis sp. nov. (? = *Pasiphaea* sp. β de Man, 1920),
P. japonica Omori, 1976 (= *Pasiphaea* aff. *sivado* Crosnier, 1976 and *Pasiphaea sivado* Kensley, 1977),
P. laevis sp. nov.,
P. marisrubri Iwasaki, 1989,
P. philippinensis sp. nov.,
P. propinqua de Man, 1916,
P. sivado (Risso, 1816).

These species are distinguished from each other in the key presented below.

Key to the *Pasiphaea sivado* species group

1. Four pleurobranchiae present **2**
— Five pleurobranchiae present, though that on last thoracic somite rudimentary **7**

2. Basis of second pereiopod with 2-7 spines, excluding terminal spine **3**
— Basis of second pereiopod without spines **4**

3. Rostrum slender and short, not reaching halfway between base of rostrum and anterior margin of carapace. Ischium of third pereiopod with 1-4 spinules .....
..... ***P. marisrubri*** Iwasaki, 1989
— Rostrum short, but reaching beyond halfway between base of rostrum and anterior margin of carapace. Ischium of third pereiopod unarmed . ***P. philippinensis*** sp. nov.

4. Rostrum short and small. Ischium of second pereiopod with spine ..... ***P. debitusae*** sp. nov.
— Rostrum medium or long. Ischium of second pereiopod usually unarmed **5**

5. Shell fragile. Terminal spine of sixth abdominal somite extending slightly upwards ..... ***P. fragilis*** sp. nov.
— Shell not fragile. Terminal spine of sixth abdominal somite extending straight backwards **6**

6. Branchiostegal sinus absent or obscure. Rostrum long with wide base ..... ***P. laevis*** sp. nov.
— Branchial sinus present. Rostrum medium with narrow base ..... ***P. gracilis*** sp. nov.

7. Sixth abdominal somite sharply carinate dorsally. Posterior margin of telson slightly convex ..... ***P. propinqua*** De Man, 1916
— Sixth abdominal somite not carinate dorsally. Posterior margin of telson truncate **8**

8. Merus of first pereiopod with 1-8 spines, merus of second pereiopod with 5-15 spines ... ***P. sivado*** (Risso, 1816)
— Merus of first pereiopod with 5-12 spines, merus of second pereiopod with 14-23 spines ..... ***P. japonica*** Omori, 1976

Pasiphaea marisrubri Iwasaki, 1989

Fig. 4

Pasiphaea marisrubri Iwasaki, 1989: 178, figs 1-2.
Pasiphaea marisrubrae - BURUKOVSKY, 1996: 843 (list).
? *Pasiphaea sivado* - BALSS, 1915: 17. Not Risso, 1816.
Pasiphaea sivado - CALMAN, 1939: 185. Not Risso, 1816.

MATERIAL EXAMINED. — **Central Red Sea**. *"Sonne"*: stn So-02/43-TAP, 21°14.80'N, 37°15.40'E, 0-220 m, 18.10.1977: 7 ♂ 7.1-10.0 mm, 1 ovig. ♀ 10.8 mm, 6 ♀ 6.6-11.4 mm (paratypes, SMF 17545).
"Meteor": stn M5/193-Ku, 19°24.3'N, 38°31.2'E, 696-705 m, 28.02.1987: 4 ♀ 9.1-12.7 mm (SMF 17999).

DIAGNOSIS. — Shell moderately firm. Rostrum small, spine-like, not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus developed. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 5-12 spines on merus and unarmed on basis except for a posterodistal spine. Second pereiopod with 14-23 spines on merus, and unarmed on ischium; unarmed on basis except for a posterodistal spine. Ischium of third pereiopod with two or three spinules on posterior margin. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae from fourth to seventh thoracic somites.

SIZE. — The holotype is a male, 10.0 mm in CL and the allotype an ovigerous female, 11.2 mm. The smallest ovigerous female is 9.4 mm in CL. The egg size is 1.2 x 0.8 mm (IWASAKI, 1989).

REMARKS. — The species is well described by IWASAKI (1989). The branchial formula of this species was confirmed by the examination of paratypes and other materials deposited at the Forschungsinstitut Senckenberg, Frankfurt. No trace of a pleurobranch is present on the eighth thoracic somite (Fig. 4b).

The distinctions between the present species and *P. philippinensis* sp. nov. are mentioned under the account of the latter species. As shown by IWASAKI (1989), the rostrum is small and short, and the distal spine on the basicerite is more slender (Fig. 4a). Moreover *P. marisrubri* always bears two or three spinules on the posterior margin of the ischium of the third pereiopod, which is an unique character of this species (Fig. 4c-d).

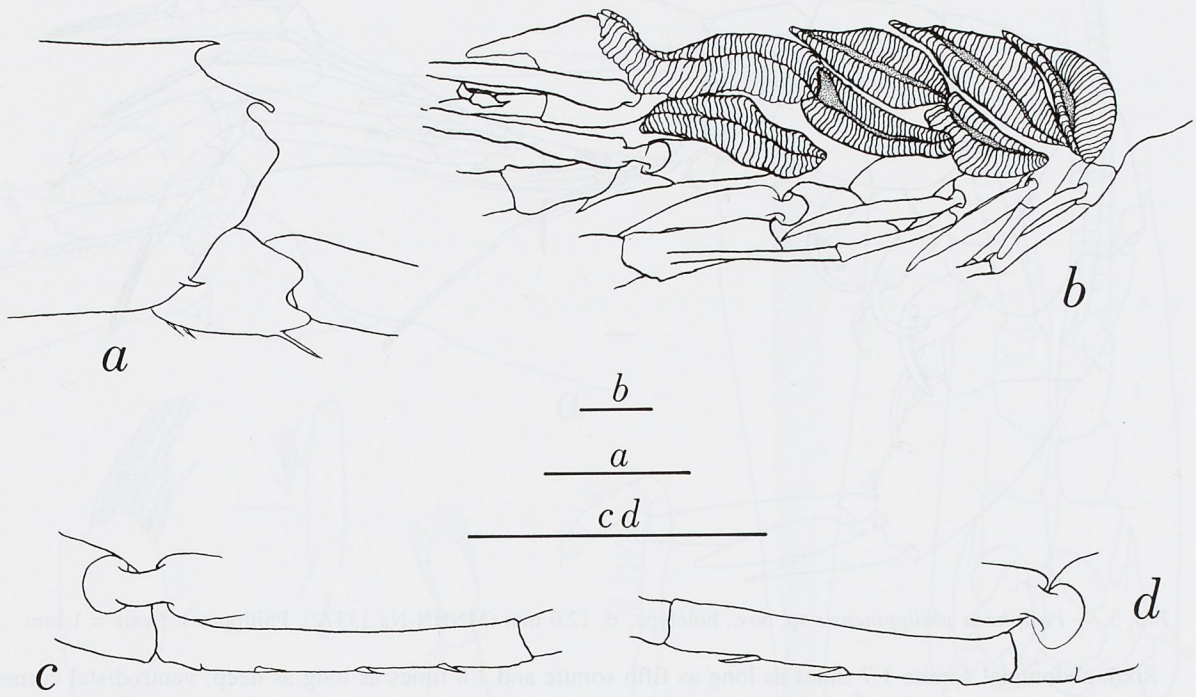


FIG. 4. — *Pasiphaea marisrubri* Iwasaki, 1989, paratypes: **a**, ♀ 9.7 mm ; **b-d**, ♀ 11.4 mm, both from Red Sea (SMF 17545, part).

a, anterior part of body; **b**, branchial chamber; **c**, basal part of right third pereiopod; **d**, basal part of left third pereiopod. Scales = 1 mm.

References to *P. sivado* based on Red Sea specimens (BALSS, 1915 and CALMAN, 1939) have already been reviewed by IWASAKI (1989).

DISTRIBUTION. — Only known from the Red Sea (IWASAKI, 1989).

Pasiphaea philippinensis sp. nov.

Figs 5-7

MATERIAL EXAMINED. — **Philippines**. MUSORSTOM 2: stn CP 25, 13°39'N, 120°43'E, 520-550 m, 23.11.1980: 1 ♂ 12.0 mm (MNHN-Na 13372).

TYPE MATERIAL. — The unique specimen, a male 12,0 mm CL (MNHN-Na 13372), is the holotype.

DIAGNOSIS. — Shell not fragile. Rostrum moderate, not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus obscure. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 9 spines on merus and 1 spine on basis excluding posterodistal spine. Second pereiopod with 16-17 spines on merus, 1 spine on ischium and 4-5 spines on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae on fourth to seventh thoracic somites.

DESCRIPTION. — Rostrum short, directed obliquely forwards, reaching halfway between base of rostrum and anterior margin of carapace. Carapace with branchiostegal sinus hardly developed (Figs 5, 6a).

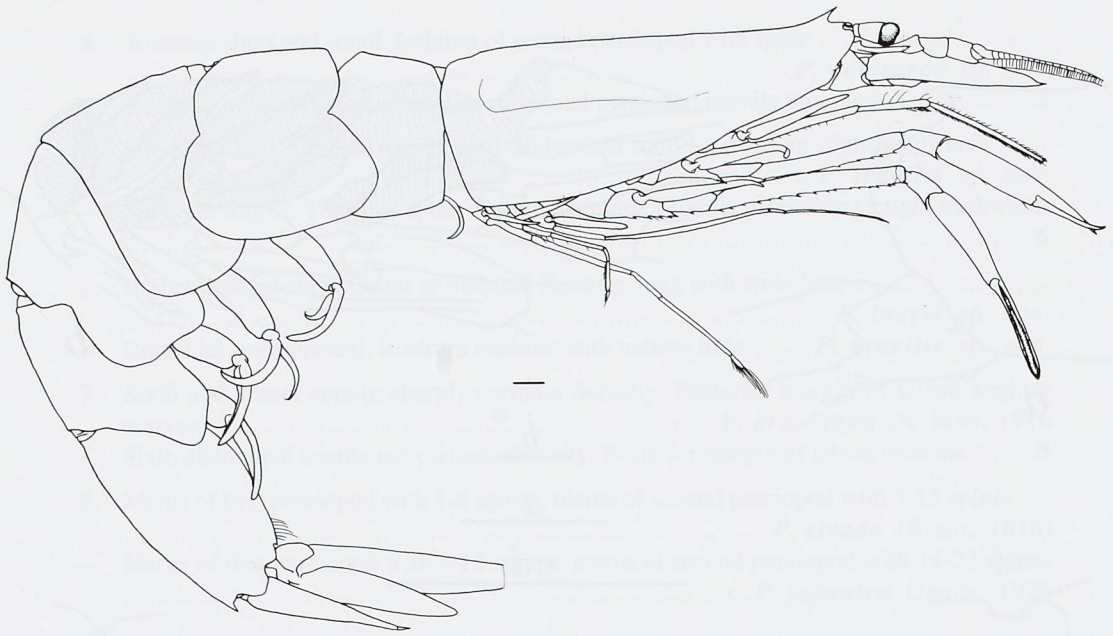


FIG. 5. — *Pasiphaea philippinensis* sp. nov., holotype, ♂ 12.0 mm (MNHN-Na 13372), Philippines. Scale = 1 mm.

Sixth abdominal somite 1.7 times as long as fifth somite and 1.8 times as long as deep; ventrodistal corner with small convexity with minute spine (Fig. 6c). Telson 0.7 times as long as sixth somite, dorsally with shallow groove extending for almost entire length (Fig. 6d); distal margin slightly convex with probably four pairs of spines, outer pair longest, without small seta on base; inner two pairs nearly equal in length (Fig. 6e).

Stylocerite shorter than first segment of antennular peduncle (Fig. 6b). Antennal scale 4.0 times as long as wide, and shorter (0.93) than chela of first pereiopod; basicerite articulated with slender spine on lower distal corner (Fig. 6a). Mouth-parts showing typical shape of genus (Figs 6f-j, 7a).

First pereiopod with spine at posterodistal end of basis (Fig. 7b, c); ischium unarmed and merus with nine spines on posterior margin; chela typical shape, with two movable setae on mesial margin (Fig. 7d). Basis of second pereiopod with large spine at posterodistal end and four or five spines on posterior margin (Fig. 7e-f); ischium with one spine on midlength of posterior margin; merus with 16 or 17 spines on posterior margin. No spinules on ischium of third pereiopod (Fig. 7g). Fourth and fifth pereiopods typical shape for genus (Fig. 7h, i).

Endopod of male first pleopod composed of two lobes, mesial lobe small, with some retinaculae in central part; other lobe large, surrounded by long plumose setae (Fig. 6k). Endopod of male second pleopod of typical shape for the group; appendix masculina with ten long setae (Fig. 6l).

Branchial formula as follows:

Thoracic Somite	I (Mxp1)	II (Mxp2)	III (Mxp3)	IV (P1)	V (P2)	VI (P3)	VII (P4)	VIII (P5)
Pleurobranchiae	-	-	-	1	1	1	1	-
Arthrobranchiae	-	-	-	1	1	1	-	-
Podobranchiae	-	-	-	-	-	-	-	-
Epipods	-	-	-	-	-	-	-	-
Exopods	-	-	1	1	1	1	1	1

Pleurobranchiae present on fourth to seventh thoracic somites, eighth somite with no pleurobranch. Arthrobranchiae present on fourth to sixth thoracic somites. All pereiopods with well developed exopods, but without epipods or podobranchiae.

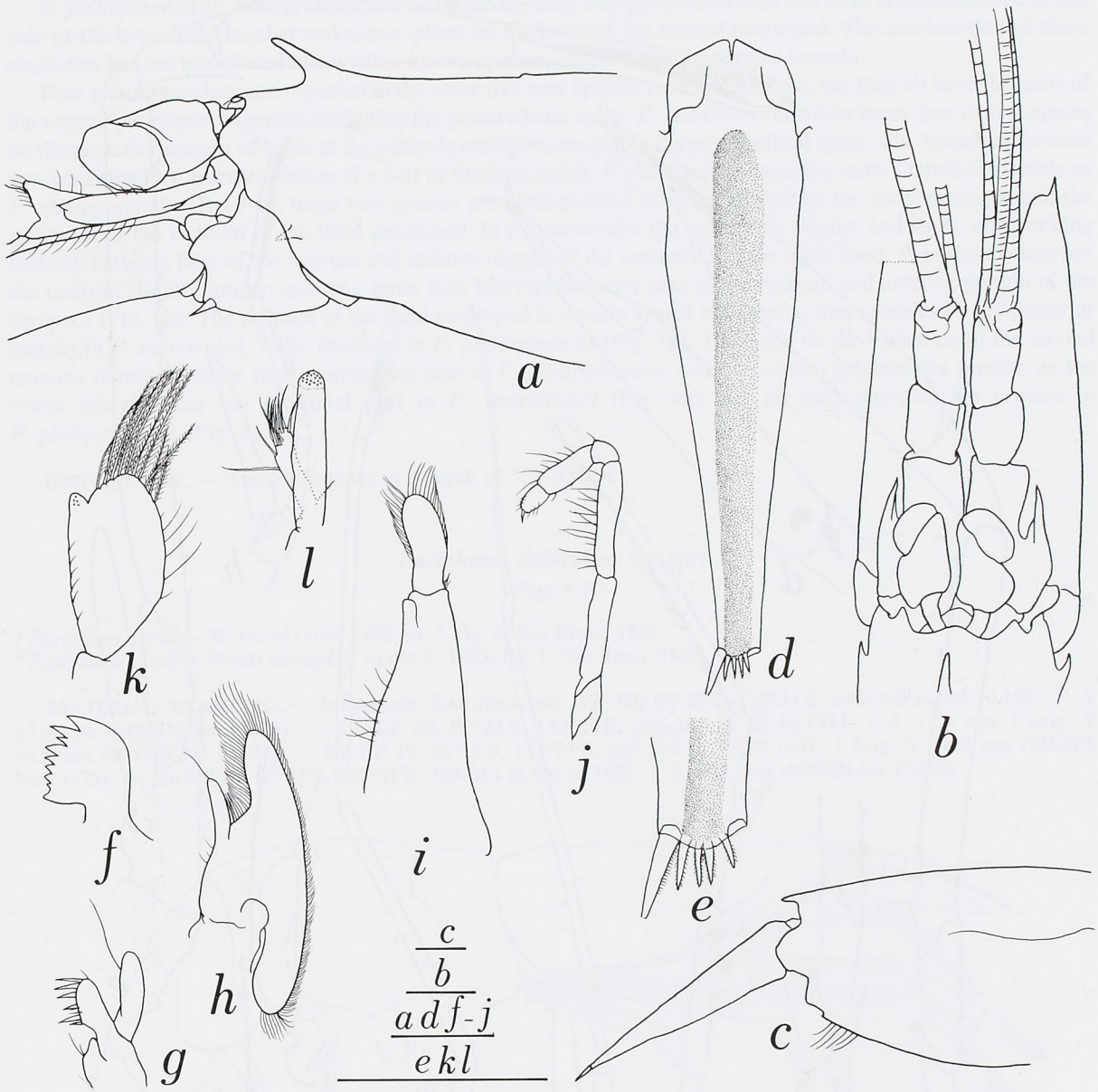


FIG. 6. — *Pasiphaea philippinensis* sp. nov., holotype, ♂ 12.0 mm (MNHN-Na 13372), from the Philippines. **a**, anterior part of body in lateral view; **b**, same in dorsal view; **c**, distal end of sixth abdominal somite and telson in lateral view; **d**, telson in dorsal view; **e**, distal end of telson; **f**, mandible; **g**, maxillula; **h**, maxilla; **i**, first maxilliped; **j**, second maxilliped; **k**, first pleopod; **l**, appendices masculina and interna. Scales = 1 mm.

ETYMOLOGY. — The specific name, *philippinensis*, refers to the type locality, Philippine waters.

SIZE. — The unique specimen, the holotype male, is 12.0 mm CL.

REMARKS. — The holotype is slightly damaged, distal three segments and the distal part of merus of the left first pereiopod, distal three segments of the right second pereiopod, and outer distal spine of the uropodal exopod are missing. However, this species is very clear in its specific status and readily distinguished from other species.



FIG. 7. — *Pasiphaea philippinensis* sp. nov., holotype, ♂ 12.0 mm (MNHN-Na 13372), Philippines.

a, third maxilliped; **b**, first pereiopod; **c**, basal part of first pereiopod; **d**, chela of first pereiopod in inner view; **e**, second pereiopod; **f**, basal part of second pereiopod; **g**, third pereiopod; **h**, fourth pereiopod; **i**, fifth pereiopod. Scale = 1 mm.

P. philippinensis sp. nov. is characterized by having only four pleurobranchiae and three arthrobranchiae in one side of the branchial chamber and some spines on the basis of the second pereiopod. The combination of these characters has not been found in any other known species, except for *P. marisrubri* Iwasaki.

Four pleurobranchiae are recorded in the other five new species mentioned below, but they all have the basis of the second pereiopod unarmed, excluding the posterodistal spine. *P. marisrubri* however bears four or five spines on the posterior margin of basis of the second pereiopod, excluding the posterodistal spine. The branchial formula was confirmed by an examination of a part of the type series. *P. marisrubri* shows the same branchial formula as *P. philippinensis*. However, these two species are distinguished from each other by the rostrum shape, and the spination of the ischium of the third pereiopod. In *P. marisrubri* the rostrum is slender and short, not reaching halfway between base of the rostrum and anterior margin of the carapace. On the other hand, *P. philippinensis* has the rostrum slightly longer, reaching more than halfway between base of the rostrum and anterior margin of the carapace (Fig. 6b). The ischium of the third pereiopod is usually armed with one to four spinules on the posterior margin in *P. marisrubri*, while unarmed in *P. philippinensis* (Fig. 7g). The spine on the basicerite of the second antenna is more slender in *P. marisrubri* than in *P. philippinensis*, and one or two spinules are present on the lower margin near the proximal part in *P. marisrubri* (Fig. 4a), but no such spinules are present in *P. philippinensis* (Fig. 6a).

DISTRIBUTION. — The Philippines at a depth of 520-550 m.

Pasiphaea debitusae sp. nov.

Figs 8-10

? *Pasiphaea sivado* - WOOD MASON, 1892, pl. 3, fig. 6. Not Risso, 1816.
? *Pasiphaea sivado* - WOOD MASON & ALCOCK, 1893, fig. 1. Not Risso, 1816.

MATERIAL EXAMINED. — **Indonesia**. KARUBAR: stn DW 08, 05°20'S, 132°31'E, 358-360 m, 23.10.1991: 1 ♀ 13.9 mm (MNHN-Na 13373). — Stn CP 09, 05°23'S, 132°29'E, 368-389 m, 23.10.1991: 1 ♂ 13.8 mm, 2 ovig. ♀ 14.8 mm (MNHN-Na 13374). — Stn CP 19, 05°15'S, 133°01'E, 605-576 m, 25.10.1991: 1 ovig. ♀ 14.0 mm (MNHN-Na 13375). — Stn CP 27, 05°33'S, 132°51'E, 304-314 m, 26.10.1991: 1 ♀ 10.1 mm (MNHN-Na 13376).

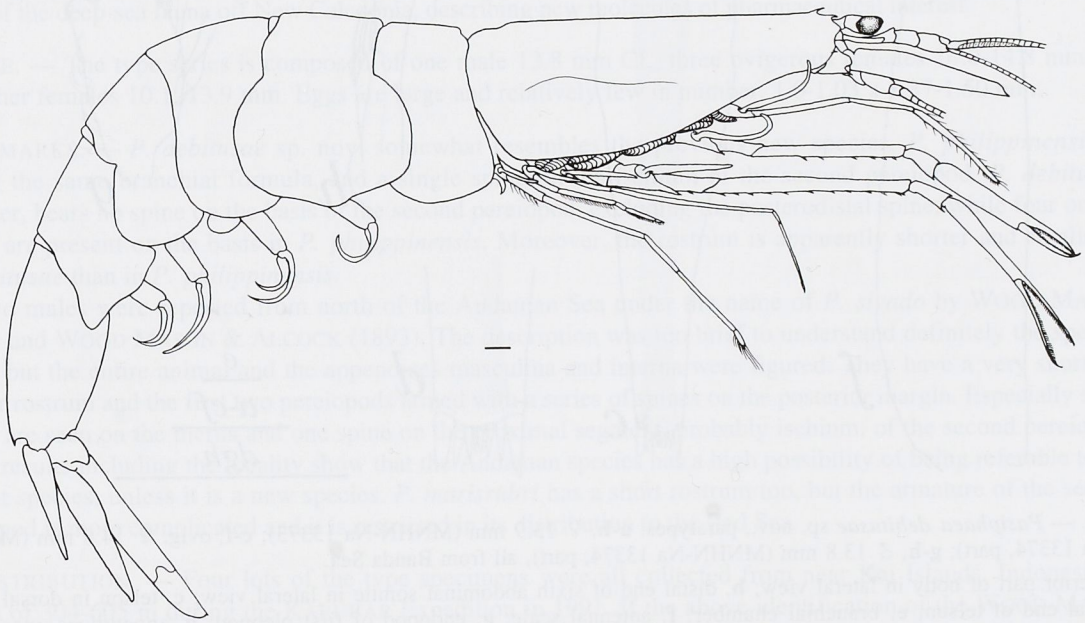


FIG. 8. — *Pasiphaea debitusae* sp. nov., holotype, ovig. ♀ 14.0 mm (MNHN-Na 13375), Banda Sea. Scale = 1 mm.

TYPE MATERIAL. — The ovigerous female (14,0 mm, MNHN-Na 13375) collected at the station CP 19 of KARUBAR cruise is the holotype. All the other specimens are paratypes.

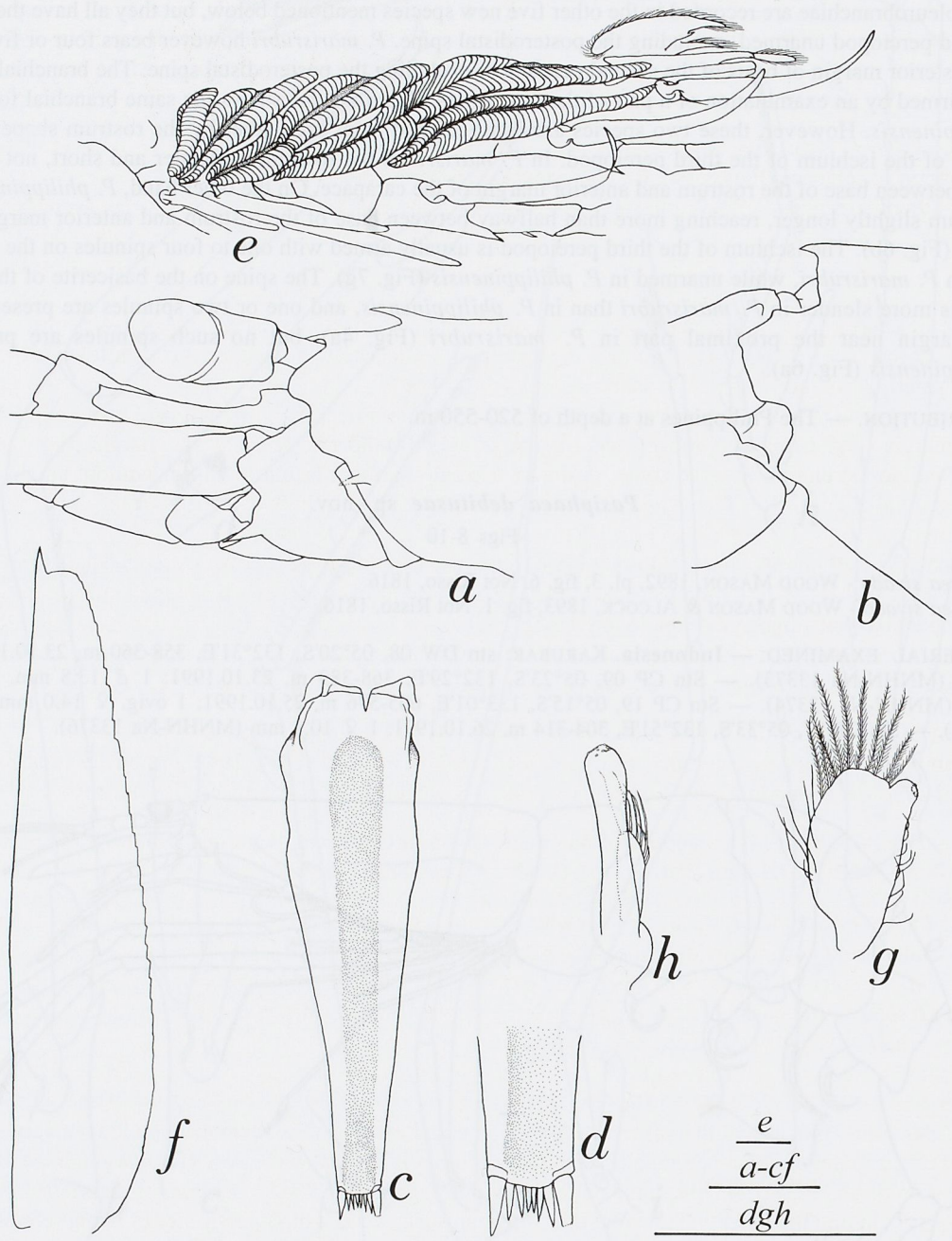


FIG. 9. — *Pasiphaea debitusae* sp. nov., paratypes: **a-b**, ♀ 13.9 mm (MNHN-Na 13373); **c-f**, ovig. ♀ 14.8 mm (MNHN-Na 13374, part); **g-h**, ♂ 13.8 mm (MNHN-Na 13374, part), all from Banda Sea.

a, anterior part of body in lateral view; **b**, distal end of sixth abdominal somite in lateral view; **c**, telson in dorsal view; **d**, distal end of telson; **e**, branchial chamber; **f**, antennal scale; **g**, endopod of first pleopod; **h**, appendices masculina and interna. Scales = 1 mm.

DIAGNOSIS. — Shell not fragile but not hard. Rostrum small spine-like, not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus obscure. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 4-8 spines on merus and unarmed on basis excluding posterodistal spine. Second pereiopod with 9-12 spines on merus, a single spine on ischium and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae from fourth to seventh thoracic somites. Ovigerous females 14-15 mm.

DESCRIPTION. — Rostrum small, like short spine, hardly reaching halfway between base of rostrum and anterior margin of carapace (Figs 8, 9a). Branchiostegal sinus hardly developed (Fig. 9a).

Sixth abdominal somite 1.7-2.0 times as long as fifth somite and 1.9-2.0 times as long as deep; ventrodistal corner shallowly convex distally (Fig. 9b). Telson 0.6-0.7 times as long as sixth somite, dorsally grooved without interruption (Fig. 9c); distal margin truncate with four pairs of spines, outer pair longest, without small seta on base; innermost pair shortest, two intermediate pairs nearly of equal length (Fig. 9d).

Stylocerite shorter than first segment of antennular peduncle (Fig. 9a). Antennal scale 4.1-4.8 times as long as wide, and shorter (0.91-0.95) than chela of first pereiopod; basicerite with slender spine on lower distal corner (Fig. 9a). Mouth-parts showing typical shape of genus (Fig. 10a-f).

First pereiopod with spine at posterodistal end of basis; ischium unarmed; merus with four to eight spines on posterior margin (Fig. 10g); palm longer than fingers, with two slender setae on mesial margin (Fig. 10h). Basis of second pereiopod ending in large spine, posterior margin unarmed; ischium with or without single spine on posterior margin (Figs 8, 10i); merus with 9 to 14 spines on posterior margin (Fig. 10i). No spinules on ischium of third pereiopod (Fig. 10j). Fourth and fifth pereiopods typical shape for genus (Fig. 10k-l).

Endopod of male first pleopod composed of two lobes, mesial lobe small, with some retinaculae in central part; outer lobe surrounded by long plumose setae (Fig. 8g). Endopod of male second pleopod similar to preceding species; appendix masculina with seven long setae (Fig. 8h).

Branchial formula same as preceding species. Pleurobranchiae present on fourth to seventh thoracic somites, no pleurobranchia on eighth thoracic somite. Arthrobranchiae on fourth to sixth somites (Fig. 9e).

ETYMOLOGY. — From the family name of Cécile DEBITUS, biochemist at ORSTOM, who was in charge of the programm SMIB (Substances Marines d'Intérêt Biologique) from 1986 to 1996 and busily took part in the study of the deep-sea fauna off New Caledonia, describing new molecules of pharmaceutical interest.

SIZE. — The type series is composed of one male 13.8 mm CL, three ovigerous females 14.0-14.8 mm and two other females 10.1, 13.9 mm. Eggs are large and relatively few in number, 1.0-1.03 x 1.37-1.50 mm.

REMARKS. — *P. debitusae* sp. nov. somewhat resembles the previous new species, *P. philippinensis*, in having the same branchial formula, and a single spine on the ischium of the second pereiopod. *P. debitusae*, however, bears no spine on the basis of the second pereiopod, excluding the posterodistal spine, while four or five spines are present on the basis in *P. philippinensis*. Moreover, the rostrum is apparently shorter and smaller in *P. debitusae* than in *P. philippinensis*.

Two males were reported from north of the Andaman Sea under the name of *P. sivado* by WOOD MASON (1892) and WOOD MASON & ALCOCK (1893). The description was too brief to understand definitely the specific status, but the entire animal and the appendices masculina and interna were figured. They have a very short and slender rostrum and the first two pereiopods armed with a series of spines on the posterior margin. Especially some spines are seen on the merus and one spine on the proximal segment, probably ischium, of the second pereiopod. These results including the locality show that the Andaman species has a high possibility of being referable to the present species, unless it is a new species. *P. marisrubri* has a short rostrum too, but the armature of the second pereiopod is more complicated and it is restricted in its distribution to the Red Sea.

DISTRIBUTION. — Four lots of the type specimens were all collected from near Kai Islands, Indonesia, at depths of 304-605 m during the KARUBAR Expedition in 1991. If the above identification of the WOOD MASON specimens is correct, the distribution range of the species can be extended to the Andaman Sea.



FIG. 10. — *Pasiphaea debitusae* sp. nov., paratype, ♂ 13.8 mm (MNHN-Na 13374, part), from Banda Sea.
a, mandible; **b**, maxillula; **c**, maxilla; **d**, first maxilliped; **e**, second maxilliped; **f**, third maxilliped; **g**, first pereiopod; **h**, chela of first pereiopod in inner view; **i**, second pereiopod; **j**, third pereiopod; **k**, fourth pereiopod; **l**, fifth pereiopod. Scale = 1 mm.

Pasiphaea fragilis sp. nov.

Fig. 11

MATERIAL EXAMINED. — **Loyalty Islands**. MUSORSTOM 6: stn CP 438, 20°23.0'N, 166°20.1'E, 780 m, 18.02.1989: 1 ♂ 10.8 mm (MNHN-Na 13377), 1 ♀ 10.9 mm (MNHN-Na 13378).

TYPE MATERIAL. — The male (10.8 mm, MNHN-Na 13377) collected at the station CP 438 of MUSORSTOM 6 cruise is the holotype. The female collected at the same station is a paratype.

DIAGNOSIS. — Shell fragile. Rostrum small, not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus developed. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 6-9 spines on merus and unarmed on basis excluding posterodistal spine. Second pereiopod with 9-12 spines on merus, unarmed on ischium, and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae on fourth to seventh thoracic somites. Specimens about 11 mm.

DESCRIPTION. — Rostrum short, not reaching halfway between base of rostrum and anterior margin of carapace. Branchiostegal sinus shallow, but distinct (Fig. 11a).

Sixth abdominal somite 1.7 times as long as fifth somite and 1.8 times as long as deep; ventrodistal corner with shallow convexity and with small pointed process; terminal spine angled slightly upwards (Fig. 11b). Telson 0.7 times as long as sixth somite, with shallow groove extending dorsally without interruption (Fig. 11c); distal margin slightly convex, probably with four pairs of spines (Fig. 11d).

Stylocerite shorter than first segment of antennular peduncle. Antennal scale 3.8-4.2 times as long as wide, and shorter (0.89) than chela of first pereiopod; outerdistal spine overreaching lamella (Fig. 11e); basicerite with slender spine on lower distal corner. Mouth-parts not apparently different from those of other species (Fig. 11f).

First pereiopod with spine at posterodistal end of basis; ischium unarmed; merus with six to nine spines on posterior margin (Fig. 11g). Basis of second pereiopod ending in spine, posterior margin unarmed; ischium unarmed; merus with 9 to 12 spines on posterior margin (Fig. 11h). No spinules on ischium of third pereiopod (Fig. 11i).

Endopods of male first and second pleopods similar to those of preceding species (Fig. 11 l-m).

Branchial formula same as preceding species, pleurobranchiae from fourth to seventh thoracic somites and arthrobranchiae on fourth to sixth thoracic somites.

ETYMOLOGY. — The specific name, *fragilis*, is based on the very fragile condition of the shell.

SIZE. — The male, holotype, is 10.8 mm CL; the female, paratype, 10.9 mm.

REMARKS. — *P. fragilis* sp. nov. belongs to the subgroup having four pleurobranchiae and three arthrobranchiae, and is morphologically related to *P. gracilis* sp. nov. in the shape of rostrum and branchiostegal sinus. The shell is fragile and the terminal spine of the sixth abdominal somite is angled slightly upwards in *P. fragilis*. Moreover, the meral spination of the first two pereiopods is slightly less in *P. fragilis*. Six spines in *P. fragilis* and seven to nine spines in *P. gracilis* on the first pereiopod and 9 to 12 spines in *P. fragilis* and 13 or 14 spines on the second pereiopod in *P. gracilis*.

The spination of the distal margin of the telson is probably four pairs in the present species; in the holotype only seven spines remains, but the left half bears four spines, their arrangement is similar to those of other species. On the other hand, there are nine spines in the paratype, four regular spines present on the right half, five spines on left half, in which the inner two are more slender than others.

DISTRIBUTION. — The two type specimens were collected from one station in New Caledonian waters at a depth of 780 m.

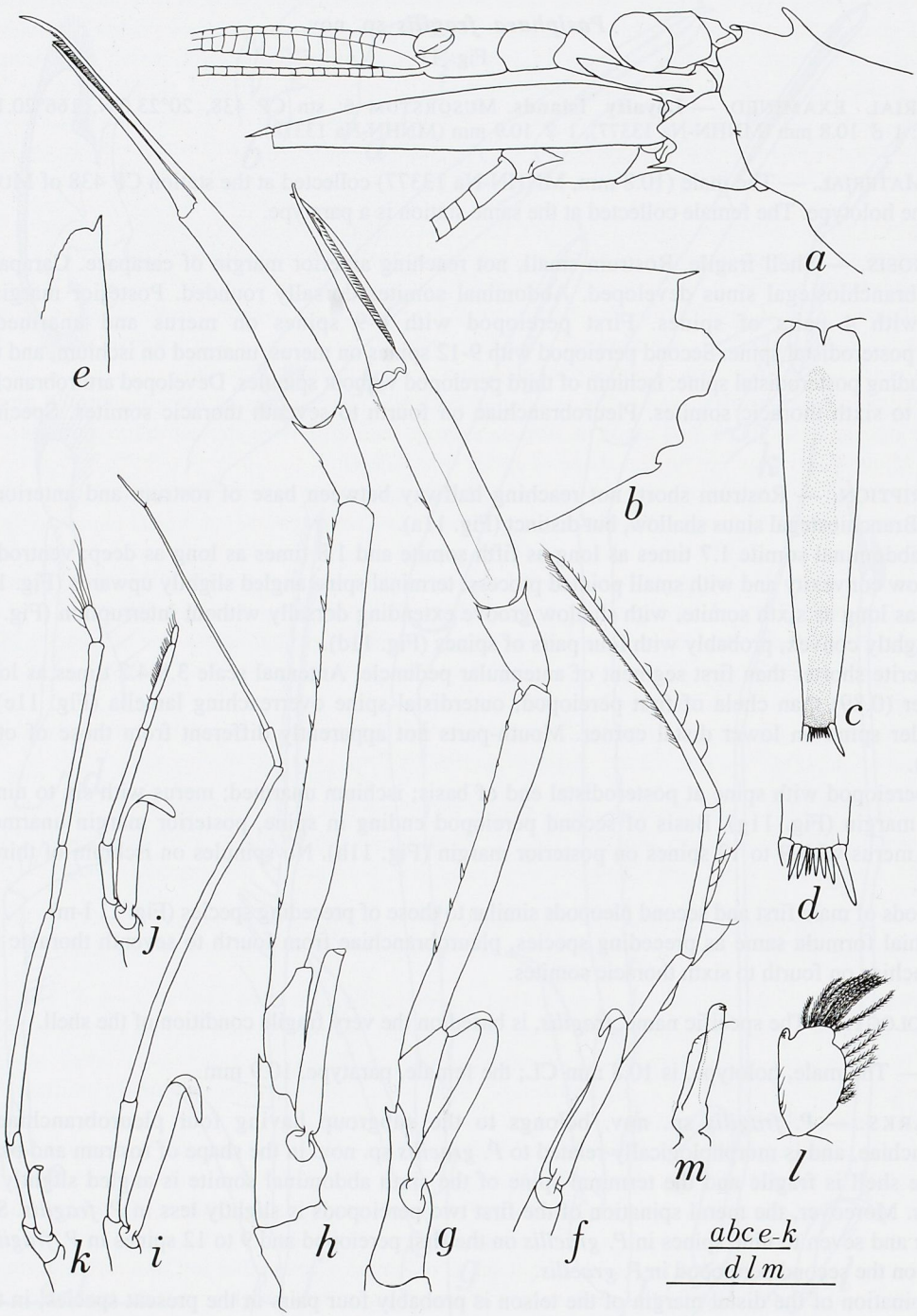


FIG. 11. — *Pasiphaea fragilis* sp. nov.: **a-b**, **e-m**, holotype, ♂ 10.8 mm (MNHN-Na 13377); **c-d**, paratype, ♀ 10.9 mm (MNHN-Na 13378), both from Central Pacific Ocean.

a, anterior part of body in lateral view; **b**, distal end of sixth abdominal somite in lateral view; **c**, telson in dorsal view; **d**, distal end of telson; **e**, apex of antennal scale; **f**, third maxilliped; **g**, first pereiopod; **h**, second pereiopod; **i**, third pereiopod; **j**, fourth pereiopod; **k**, fifth pereiopod; **l**, endopod of first pleopod; **m**, appendices masculina and interna. Scales = 1 mm.

Pasiphaea laevis sp. nov.

Figs 12-14

MATERIAL EXAMINED. — **Indonesia**. *Makassar Strait*. CORINDON 2: stn CH 214, 00°31'N, 117°50'E, 595 m: 1 ♀ 11.9 mm (MNHN-Na 13379).

Moluccas. KARUBAR: stn CP 35, 06°08'S, 132°45'E, 390-502 m, 27.10.1991: 1 ovig. ♀ 12.3 mm (MNHN-Na 13380).

TYPE MATERIAL. — The ovigerous female (12.3 mm, MNHN-Na 13380) collected at the station CP 35 of KARUBAR cruise is the holotype. The other female (11.9 mm, MNHN-Na 13379) is a paratype.

DIAGNOSIS. — Shell not fragile. Rostrum long and broad based, nearly overreaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus very indistinct. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 7-9 spines on merus and unarmed on basis excluding posterodistal spine. Second pereiopod with 12-13 spines on merus, unarmed on ischium and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae from fourth to seventh thoracic somites. Ovigerous female with carapace length of 12 mm.

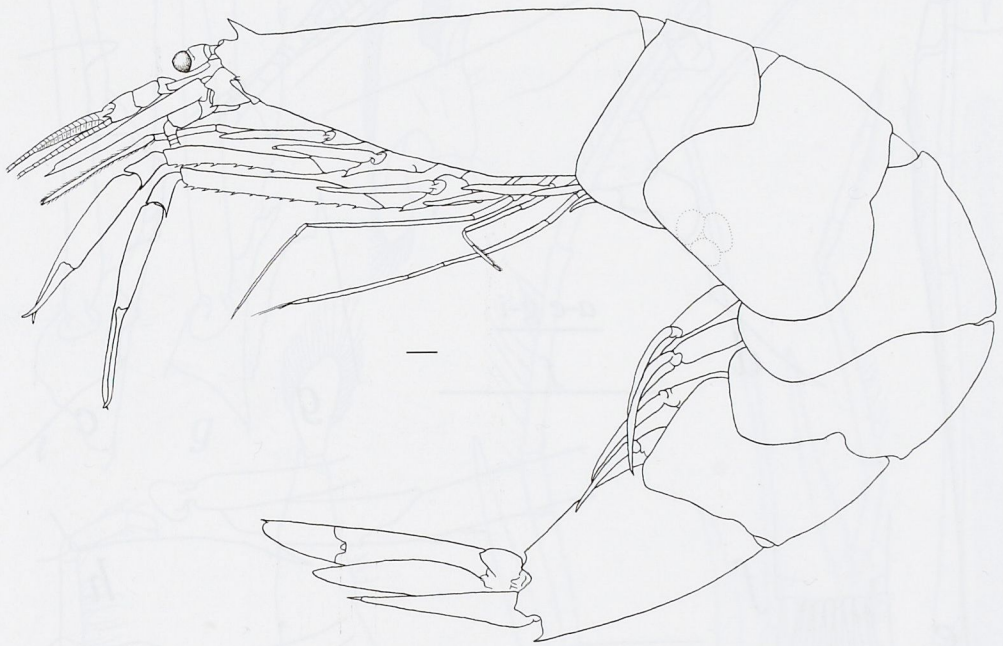


FIG. 12. — *Pasiphaea laevis* sp. nov., holotype, ovig. ♀ 12.3 mm (MNHN-Na 13380), Banda Sea. Scale = 1.0 mm.

DESCRIPTION. — Rostrum long, with broad base, reaching or overreaching anterior margin of carapace (Figs. 12, 13a-b). Branchiostegal sinus indistinct, without apparent excavation (Fig. 13a, b).

Sixth abdominal somite 1.8 times as long as fifth somite and 1.8 times as long as deep; ventrodistal corner shallowly convex, with minute spine (Fig. 13c-d). Telson 0.7 times as long as sixth somite, with groove dorsally, but with groove almost disappearing around midlength (Fig. 13e); distal margin truncate, with four pairs of spines, outer pair longest, with small seta on base (Fig. 13f).

Stylocerite slightly shorter than first segment of antennular peduncle (Fig. 13a-b). Antennal scale 3.8-4.0 times as long as wide, and as long as chela of first pereiopod; outerdistal spine rather long, entirely

overreaching lamella (Fig. 13g); basicerite with slender spine on lower distal corner. Mouth-parts showing no apparent difference from other species (Fig. 14a-f).

First pereiopod with extremely large spine on posterodistal end of basis; ischium unarmed; merus with 7 to 9 spines on posterior margin (Figs 13h, 14g); palm of typical shape with two movable setae on mesial margin (Fig. 14h). Basis of second pereiopod ending in spine, posterior margin unarmed; ischium unarmed; merus with

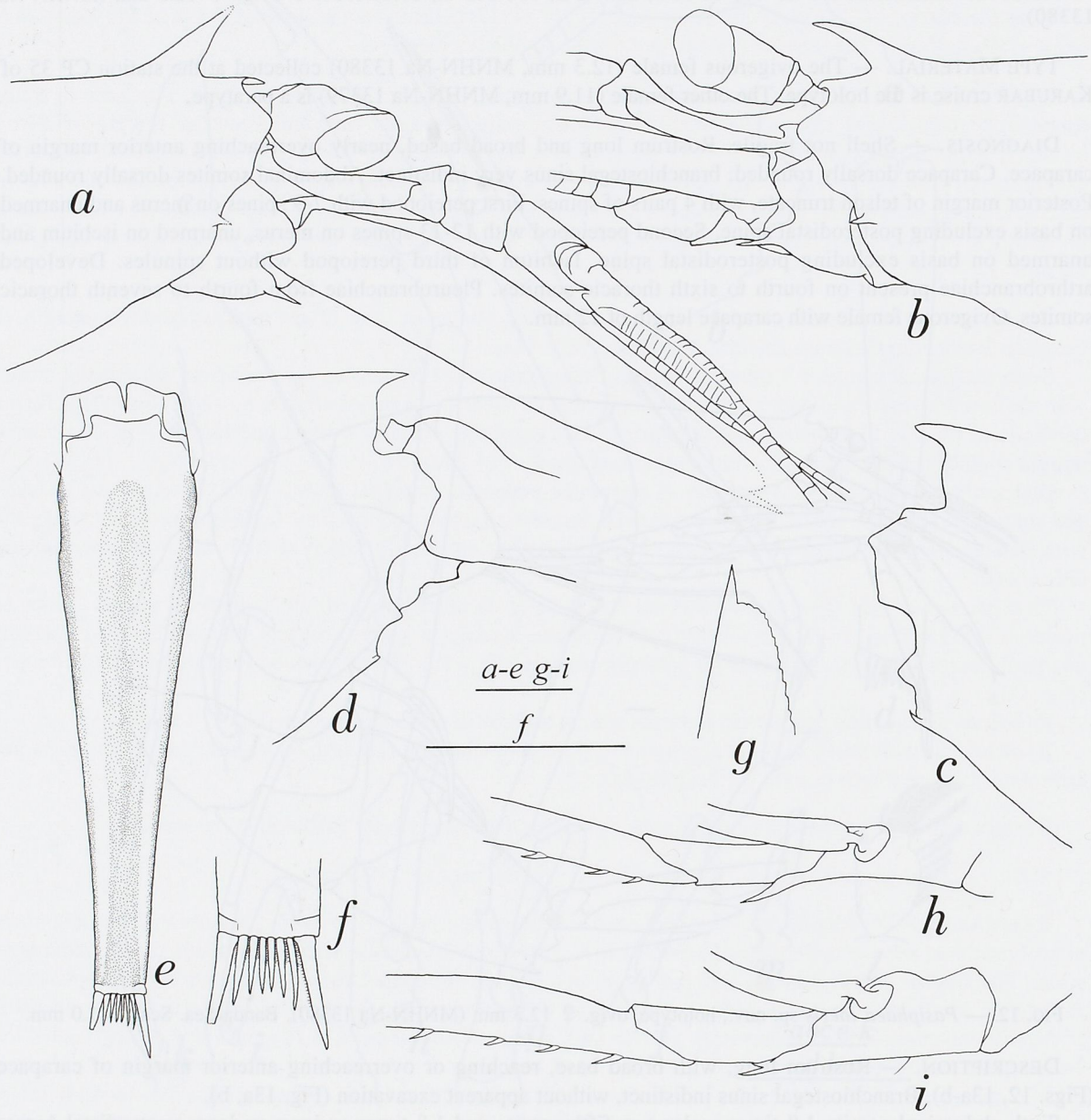


FIG. 13. — *Pasiphaea laevis* sp. nov.: **a**, **c**, **e-f**, holotype, ovig. ♀ 12.3 mm (MNHN-Na 13380), Banda Sea; **b**, **d**, **g-i**, paratype, ♀ 11.9 mm (MNHN-Na 13379), Indonesia.

a-b, anterior part of body in lateral view; **c-d**, distal end of sixth abdominal somite in lateral view; **e**, telson in dorsal view; **f**, distal end of telson; **g**, distal apex of antennal scale; **h**, basal part of first pereiopod; **i**, basal part of second pereiopod. Scales = 1 mm.



FIG. 14. — *Pasiphaea laevis* sp. nov., paratype, ♀ 11.9 mm (MNHN-Na 13379), Indonesia.

a, mandible; **b**, maxillula; **c**, maxilla; **d**, first maxilliped; **e**, second maxilliped; **f**, third maxilliped; **g**, first pereiopod; **h**, chela of first pereiopod in inner view; **i**, second pereiopod; **j**, third pereiopod; **k**, fourth pereiopod; **l**, fifth pereiopod. Scale = 1 mm.

12 or 13 spines on posterior margin (Figs 13i, 14i). No spinules on ischium of third pereiopod (Fig. 14j). Fourth and fifth pereiopods same as other member of the *P. sivado* species group (Fig. 14k, l).

Four pleurobranchiae and three arthrobranchiae on one side of the branchial chamber. Branchial formula same as *P. marisrubri* and *P. fragilis* sp. nov. described above.

ETYMOLOGY. — The specific name, *laevis*, refers to the smooth ventral margin of carapace.

SIZE. — The ovigerous female, holotype, is 12.3 mm CL, the non-ovigerous female, 11.9 mm. Eggs are numerous in number, 0.8-0.9 x 1.2-1.3 mm in size.

REMARKS. — *P. laevis* sp. nov. has the same branchial formula as *P. marisrubri* and the preceding new species *P. fragilis*, but is distinguished from those species by the long rostrum and no branchiostegal sinus on the carapace.

The present new species shows the same meristic value of the spination of the first two pereiopods as *P. fragilis* sp. nov. and *P. gracilis* sp. nov. However, in latter two new species the branchiostegal sinus is more or less defined. Moreover, the shell is distinctly fragile in *P. fragilis* and the rostrum and antennal scale is comparatively shorter in *P. gracilis*.

DISTRIBUTION. — The holotype was collected near Kai Islands, Indonesia, at a depth of 390-502 m, and the paratype was from Makassar Strait, at a depth of 595 m.

Pasiphaea gracilis sp. nov.

Figs 15-17

? *Pasiphaea* sp. β - DE MAN, 1920: 11, pl. 1, fig. 4-4g, pl. 2, fig. 4h-4p.

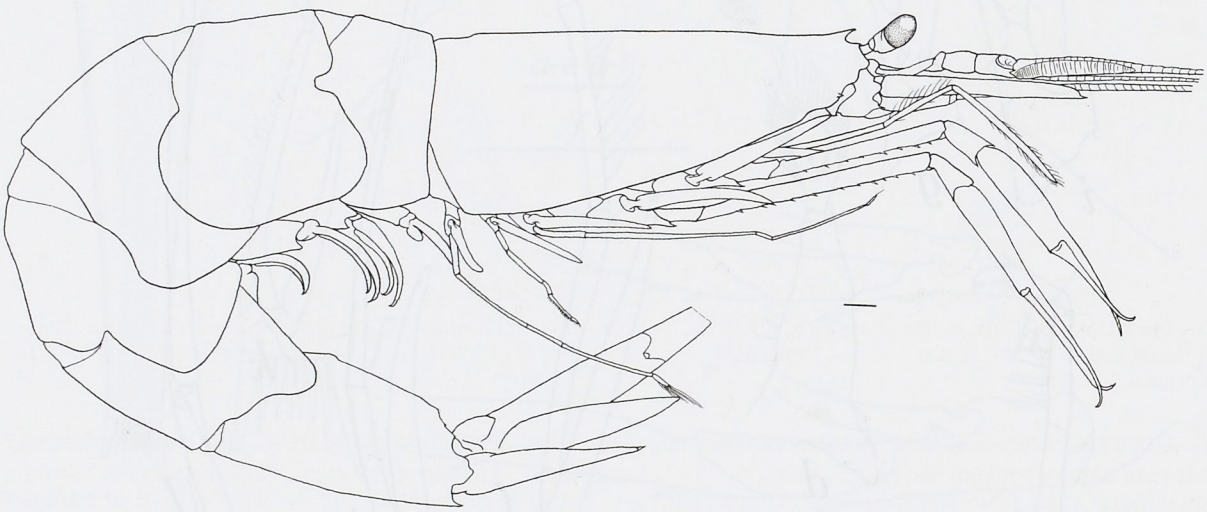


FIG. 15. — *Pasiphaea gracilis* sp. nov., holotype, ♂ 12.3 mm (MNHN-Na 13382), New Caledonia. Scale = 1 mm.

MATERIAL EXAMINED. — **Chesterfield Islands**. MUSORSTOM 5: stn DW 313, 22°24.31'S, 159°32.53'E, 780-930 m, 13.10.1986: 1 ♀ 12.0 mm (MNHN-Na 13381).

New Caledonia. BIOCAL: stn CP 31, 23°08'S, 166°51'E, 850 m, 29.08.1985: 1 ♂ 12.3 mm (MNHN-Na 13382), 1 ♀ 14.0 mm (MNHN-Na 13383).

Wallis and Futuna Islands. MUSORSTOM 7: stn DW 620, 12°34'S, 178°11'W, 1280 m, 28.05.1992: 1 ♂ 6.3 mm (MNHN-Na 13384). — Stn CP 627, 11°54'S, 179°31'W, 597-600 m, 29.05.1992: 3 ♂ 8.6-10.0 mm, 1 ♀ 9.1 mm (MNHN-Na 13385). — Stn CP 628, 11°53'S, 179°32'W, 625-650 m, 29.05.1992: 4 ♂ 9.6-11.8 mm, 5 ♀ 10.0-11.1 mm (MNHN-Na 13386).

Indonesia. *"Siboga"*: stn 105, off Sulu Islands, 6°8'N, 121°19'E, 275 m, 4.07.1899: 1 juv. 5.8 mm (ZMA).

TYPE MATERIAL. — The male (12.3 mm, MNHN-Na 13382) collected at the station CP 31 of BIOCAL cruise is the holotype. All the other specimens, except the *"Siboga"* one, are paratypes.

DIAGNOSIS. — Shell not fragile. Rostrum small, not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus developed. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 7-9 spines on merus, unarmed on basis excluding posterodistal spine. Second pereiopod with 11-13 spines on merus, usually unarmed on ischium and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae on fourth to seventh thoracic somites. Females 12-14 mm.

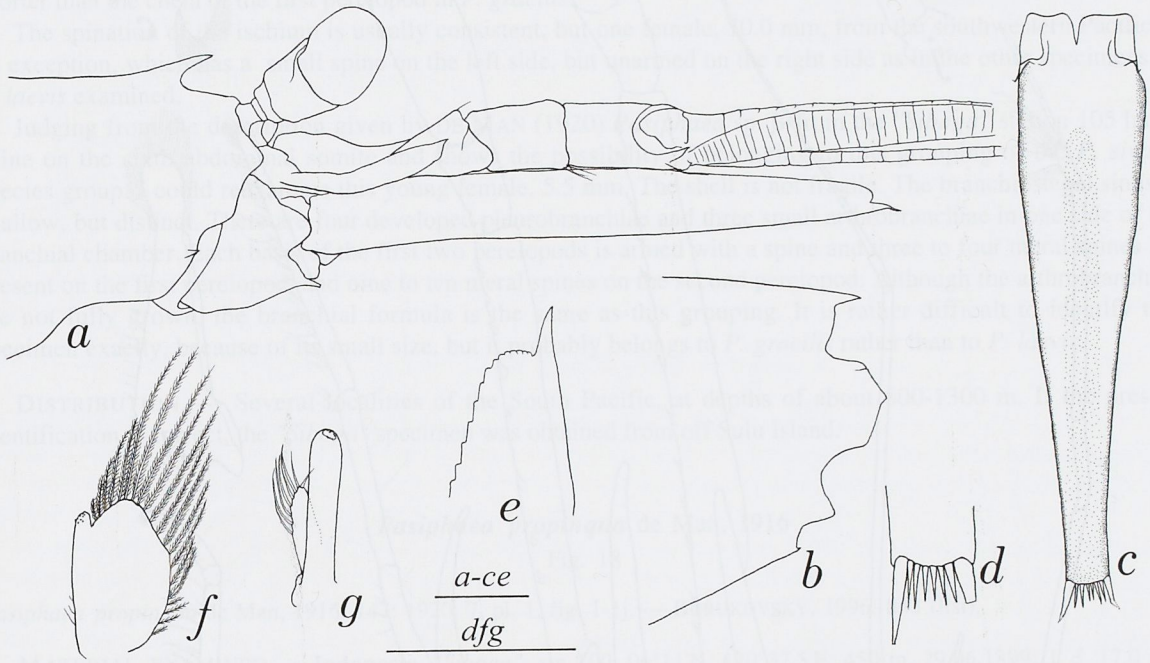


FIG. 16. — *Pasiphaea gracilis* sp. nov., holotype, ♂ 12.3 mm (MNHN-Na 13382), New Caledonia.
a, anterior part of body in lateral view; **b**, distal end of sixth abdominal somite in lateral view; **c**, telson in dorsal view; **d**, distal end of telson; **e**, distal apex of antennal scale; **f**, endopod of first pleopod; **g**, appendices interna and masculina. Scales = 1.0 mm.

DESCRIPTION. — Rostrum rather variable in length, comparatively short, usually just reaching halfway between base of rostrum and anterior margin of carapace (Figs 15, 16a). Branchiostegal sinus shallow, but distinct (Fig. 16a).

Sixth abdominal somite 1.7 times as long as fifth somite and 1.8 times as long as deep; ventrodistal corner with shallow convexity, with small pointed process (Fig. 16b). Telson 0.7 times as long as sixth somite, with shallow groove dorsally without interruption; distal margin truncate with probably four pairs of spines (Fig. 16c); outer pair longest, without small seta on base (Fig. 16d).

Stylocerite shorter than first segment of antennular peduncle. Antennal scale 3.8-4.2 times as long as wide, and shorter (0.85-0.95) than chela of first pereiopod; outerdistal spine slightly curved outward, overreaching lamella (Fig. 16e). Mouth-parts not apparently different from those of other species (Fig. 17a-f).



FIG. 17. — *Pasiphaea gracilis* sp. nov., paratype, ♂ 11.3 mm (MNHN-Na 13386), South Pacific Ocean near Wallis Island. **a**, mandible; **b**, maxillula; **c**, maxilla; **d**, first maxilliped; **e**, second maxilliped; **f**, third maxilliped; **g**, first pereiopod; **h**, second pereiopod; **i**, third pereiopod; **j**, fourth pereiopod; **k**, fifth pereiopod. Scale = 1 mm.

First pereiopod with spine at posterodistal end of basis; ischium unarmed; merus with four to ten spines on posterior margin (Fig. 17g). Basis of second pereiopod ending in spine, posterior margin unarmed; ischium usually unarmed; merus with 9 to 14 spines on posterior margin (Fig. 17h). No spinules on ischium of third pereiopod (Fig. 17i). Fourth and fifth pereiopods of typical shape for the genus (Fig. 17j-k).

Endopods of male first and second pleopods similar to those of preceding species (Fig. 16f, g).

Branchial formula same as preceding species. Arthrobranchiae present on fourth to sixth somites, no pleurobranchia on eighth thoracic somite (Fig. 9e).

ETYMOLOGY. — The specific name, *gracilis*, refers to the slender shape of the species.

SIZE. — The type series is composed of nine males, 8.6-13.6 mm and eight non-ovigerous females, 9.1-14.0 mm.

REMARKS. — *P. gracilis* sp. nov. resembles the preceding new species, *P. laevis*, in having the same spination of the first two pereiopods, and the shell not fragile but the branchial sinus is distinct and the antennal scale is shorter than the chela of the first pereiopod in *P. gracilis*.

The spination of the ischium is usually consistent, but one female, 10.0 mm, from the southwestern Pacific is an exception, which has a small spine on the left side, but unarmed on the right side as in the other specimens of *P. laevis* examined.

Judging from the description given by DE MAN (1920) *Pasiphaea* sp. β from the *"Siboga"* station 105 has a spine on the sixth abdominal somite and shows the possibility of belonging to this grouping of the *P. sivado* species group. I could reexamine this young female, 5.5 mm. The shell is not fragile. The branchiostegal sinus is shallow, but distinct. There are four developed pleurobranchiae and three small arthrobranchiae in one side of the branchial chamber. Each basis of the first two pereiopods is armed with a spine and three to four meral spines are present on the first pereiopod, and nine to ten meral spines on the second pereiopod. Although the arthrobranchiae are not fully grown, the branchial formula is the same as this grouping. It is rather difficult to identify this specimen exactly, because of its small size, but it probably belongs to *P. gracilis* rather than to *P. laevis*.

DISTRIBUTION. — Several localities of the South Pacific, at depths of about 600-1300 m. If the present identification is correct, the *"Siboga"* specimen was obtained from off Sulu Island.

Pasiphaea propinqua de Man, 1916

Fig. 18

Pasiphaea propinqua de Man, 1916: 147; 1920: 7, pl. 1, fig. 1-1j. — BURUKOVSKY, 1996: 843 (list).

MATERIAL EXAMINED. — **Indonesia**. *"Siboga"*: stn 100, 06°11'N, 120°37.5'E, 450 m, 29.06.1899: 1 ♂ 17.0 mm (holotype, ZMA 102505).

Philippines. MUSORSTOM 2: stn CP 38, 12°53.5'N, 122°26.6'E, 1650 m, 25.11.1980: 1 ♀ 12.8 mm (MNHN-Na 13387).

TYPE-MATERIAL. — The male (17.0 mm, ZMA 102505) collected at the station 100 of the *"Siboga"* Expedition, is the holotype.

DIAGNOSIS. — Shell not fragile. Rostrum long, probably reaching anterior margin of carapace. Carapace dorsally carinated on anterior 1/3, rounded posteriorly; branchiostegal sinus obscure. First to fifth abdominal somites dorsally rounded, sixth somite sharply carinated dorsally. Posterior margin of telson convex, with 4 pairs of spines. First pereiopod with 10-12 spines on merus and unarmed on basis excluding posterodistal spine. Second pereiopod with 16-18 spines on merus, and unarmed on ischium, and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae from fourth to eighth thoracic somites, that on eighth somite rudimentary. Holotype male 17 mm, and additional female 12.8 mm.

DESCRIPTION. — Rostrum probably not short, reaching more than halfway between base of rostrum and anterior margin of carapace (Fig. 18a). Branchiostegal sinus indistinct (Fig. 18a).

Sixth abdominal somite 1.7 times as long as fifth somite and 1.9 times as long as deep; ventrodistal corner with shallow convexity, and with a small pointed process (Fig. 18b). Telson 0.6 times as long as sixth somite, deeply grooved dorsally with clear longitudinal ridges lateral to groove (Fig. 18c); a rather high process proximal

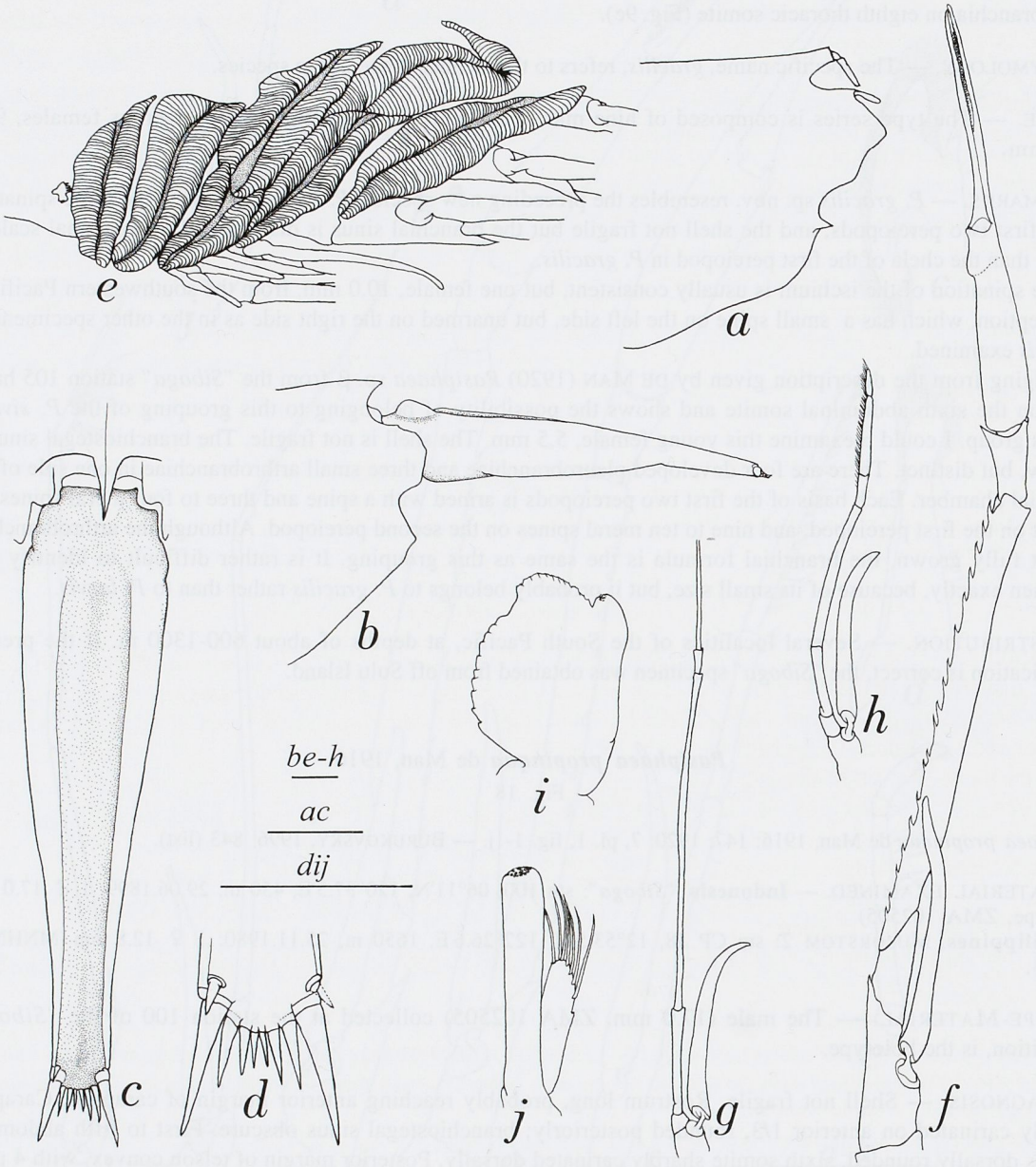


FIG. 18. — *Pasiphaea propinqua* de Man, 1916: **a**, **c-d**, ♀ 12.8 mm (MNHN-Na 13387), the Philippines; **b**, **e-j**, holotype, ♂ 17.0 mm (ZMA 102505), Sulu Sea.

a, anterior part of carapace in lateral view; **b**, distal end of sixth abdominal somite in lateral view; **c**, telson in dorsal view; **d**, distal end of telson; **e**, branchial chamber; **f**, second pereiopod; **g**, third pereiopod; **h**, fourth pereiopod; **i**, endopod of first pleopod; **j**, appendices interna and masculina. Scales = 1 mm.

to base of groove (Fig. 18b); distal margin convex with four pairs of spines like other species of the *P. sivado* species group, but with a pair of large additional seta near base of outer spines (Fig. 18d).

Stylocerite falling short of end of first segment of antennular peduncle. Antennal scale 3.6 times as long as wide, and 1.2 times as long as chela of first pereiopod. Mouth-parts not apparently different from those of other species.

First pereiopod with spine at posterodistal end of basis; ischium unarmed; merus with 12 to 14 spines on posterior margin. Basis of second pereiopod ending in spine, posterior margin unarmed; ischium unarmed; merus with 16 to 18 spines on posterior margin (Fig. 18f). Third to Fifth pereiopods similar to those of other species (Fig. 18g-h). No spinules on ischium of third pereiopod (Fig. 18g).

Endopod of first pleopod of holotype composed of three lobes, though entirely without setae; mesial lobe small, with a very few retinaculae in central part (Fig. 18i). Endopod of second pleopod of holotype similar to preceding species; appendix masculina with some, probably less than ten, long setae (Fig. 18j).

Distribution of branchiae, epipods, and exopods as follows:

Thoracic Somite	I (Mxp1)	II (Mxp2)	III (Mxp3)	IV (P1)	V (P2)	VI (P3)	VII (P4)	VIII (P5)
Pleurobranchiae	-	-	-	1	1	1	1	r
Arthrobranchiae	-	-	-	1	1	1	-	-
Podobranchiae	-	-	-	-	-	-	-	-
Epipods	-	-	-	-	-	-	-	-
Exopods	-	-	1	1	1	1	1	1

Eighth thoracic somite with pleurobranchia, but always rudimentary, only a very small piece, with a few short papilla-like lamellae (Fig. 18e).

SIZE. — The male holotype is 17.0 mm CL, the present additional female, 12.8 mm.

REMARKS. — The present species was based on a single male type, described in detail (DE MAN, 1920), which was fortunately reexamined. The branchial formula and the spination of the sixth abdominal somite are the same as in *P. sivado*, having a rudimentary pleurobranchia on the eighth thoracic somite, and a well-developed spine on the posterior end of the dorsal margin of the sixth somite (Fig. 18b).

As mentioned by DE MAN (1920), *P. propinqua* has the carapace anteriorly carinated, the sixth abdominal somite entirely carinated, and the telson with convex end. Moreover there is a well developed process at the beginning of the dorsal groove of the telson. The groove is deeper and is better defined than that of other species by distinct longitudinal ridges on both sides. These characters apparently separate *P. propinqua* from all other members of the *P. sivado* species group. The present female specimen from the Philippines agrees well with the holotype in these unique characters.

The rostrum is mostly missing in the holotype. In the additional specimen it is also broken, but some distal parts remain attached to the rostrum base, which shows that it is probably not short, but long, extending nearly to the anterior margin of carapace. The branchiostegal spine is almost marginal (Fig. 18a), at least the dorsal margin of the spine is apparently continuous with the anterior margin of the carapace in both specimens examined.

In the holotype, the meri of the second pereiopods are armed with 16 spines on the right side and 18 spines on the left side, with 17 spines on both sides in the additional material. The ischium and the basis are unarmed on both sides, except for the posterodistal spine on the basis in both specimens.

The pleopods of the holotype have retained their shape, though they are now mostly without setae, and they do not differ from those of the other species of the *P. sivado* species group.

DISTRIBUTION. — Sulu Sea, at depth of 450 m (type locality). The subsequent specimen was found in one haul from Philippine waters at a depth of 1650 m. This haul contained two pasiphaeids, both however were thought to have been entangled in the net during the rising of the net (CROSNIER personal communication).

Pasiphaea sivado (Risso, 1816)

Fig. 19

Restricted synonymy

Alpheus sivado Risso, 1816: 93, pl. 3, fig. 4.

Pasiphaea savignyi H. Milne Edwards, 1837: 426.

Pasiphaea brevirostris H. Milne Edwards, 1837: 426.

Pasiphaea sivado - H. Milne Edwards, 1837: 426. — Bell, 1853: 312, with fig. — Heller, 1863: 243, pl. 8, figs 4-6. — Kemp, 1910: pl. 4, fig. 12. — Pesta, 1914: figs 22-23; 1918: 64, figs 19-20. — Zariquiey Alvarez, 1957: 4, figs 1-4, pls 1-3; 1968: 70, fig. 30. — Smaldon, 1979: 26, fig. 6. — Sivertsen & Holthuis, 1956: 29. — Omori, 1976: 254, figs 3-5. — Burukovsky & Romensky, 1987: 58 (list). — Iwasaki, 1989: 199. — Holthuis, 1993: 28, fig. 9. — Burukovsky, 1996: 843 (list).

Pasiphaea Sivado - de Man, 1920, pl. 1, figs 2, 2a.

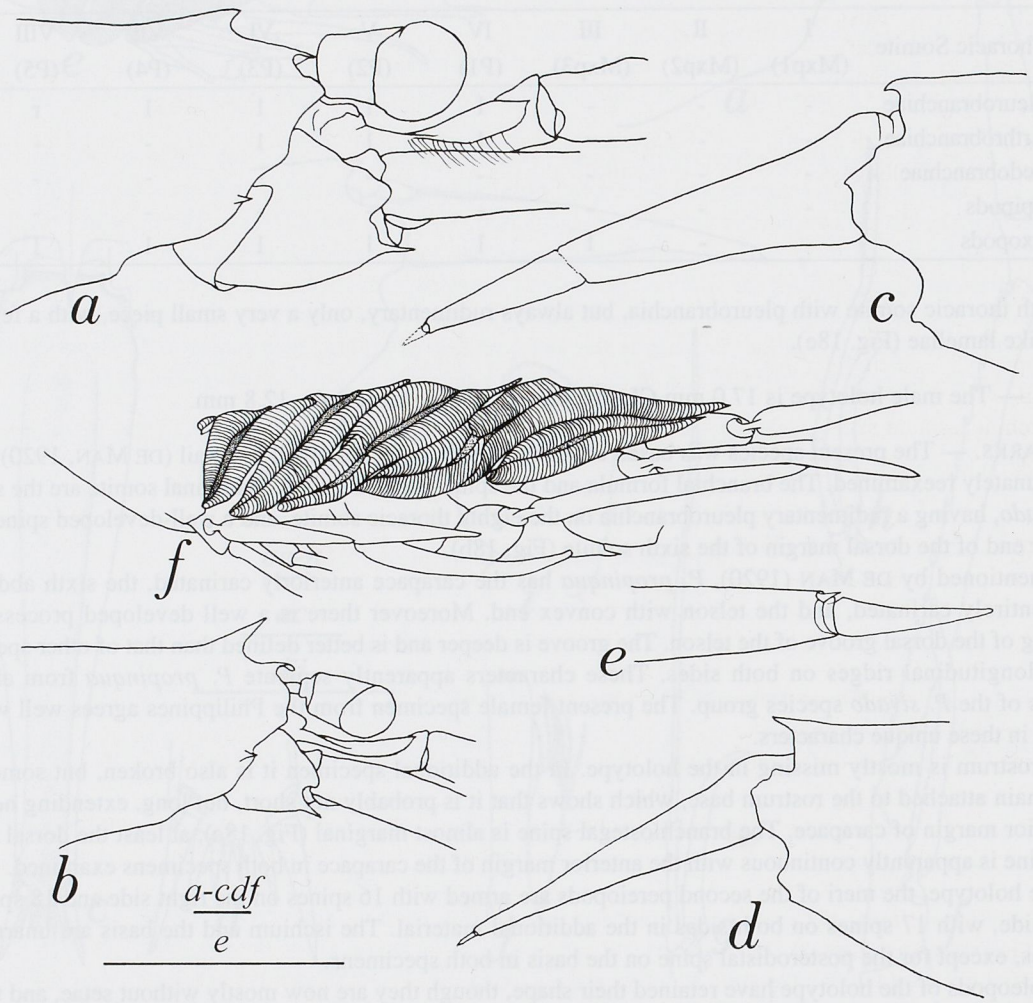


Fig. 19. — *Pasiphaea sivado* (Risso, 1816): **a**, **c**, ♂ 23.9 mm (MNHN-Na 13389, part); **b**, **d**, ♂ 14.4 mm (MNHN-Na 13389, part); **e**, ovig. ♀ 18.6 mm (MNHN-Na 13388, part); **f**, ♀ 14.3 mm (MNHN-Na 1834, part). a-d, from West Mediterranean Sea; e-f, from Ibero-Moroccan Gulf.

a-b, anterior part of body in lateral view; **c-d**, distal part of sixth abdominal somite and telson in lateral view; **e**, distal part of telson in lateral view; **f**, branchial chamber. Scales = 1 mm.

MATERIAL EXAMINED. — **Ibero-Moroccan Gulf**. *"Talisman"*, 36°36'N, 07°26'W, Dredge, 440 m, 25.08.1883: 3 ♂ 13.6-18.6 mm; 9 ♀ 13.2-17.2 mm (MNHN-Na 1834).

BALGIM: stn CP 89, 34°20'N, 07°18'W, 719-724 m, 7.06.1984: 1 ♂ 22.4 mm; 3 ovig. ♀ 17.9-19.4 mm (MNHN-Na 13388).

Mediterranean Sea. *Alboran Sea*. BALGIM: stn CP 119, 35°50'N, 05°13'W, 483-551 m, 13.06.1984: 2 ♂ 14.4, 23.9 mm; 7 ♀ 10.9-14.3 mm (MNHN-Na 13389).

DIAGNOSIS. — Shell not fragile. Rostrum not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus shallow. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 2-7, usually 4-5 spines on merus and unarmed on basis excluding posterodistal spine. Second pereiopod with 9-13, usually 9-11, spines on merus, unarmed on ischium, and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae on fourth to eighth thoracic somites, that on eighth somite rudimentary. Ovigerous females 18-20 mm.

DESCRIPTION. — Rostrum rather high, variable in length, usually reaching halfway between base of rostrum and anterior margin of carapace. Branchiostegal sinus shallow, but quite distinct (Fig. 19a-b).

Sixth abdominal somite compressed but not carinated dorsally, 1.5-1.9 times as long as fifth somite and 1.7-2.0 times as long as deep; ventrodistal corner slightly convex, ending in minute spine (Fig. 19c-d). Telson 0.7-0.8 times as long as sixth somite, with shallow and broad groove dorsally; distal margin truncated with four pairs of spines, outer pair longest, with small spine-like seta at base (Fig. 19e).

Stylocerite almost reaching first segment of antennular peduncle (Fig. 19a-b). Antennal scale 3.6-4.1 times as long as wide, and slightly shorter than chela of first pereiopod. Mouth-parts showing typical shape of group.

First pereiopod with large spine at posterodistal end of basis; ischium unarmed; merus with two to seven spines on posterior margin; palm 1.1-1.4 times as long as finger. Basis of second pereiopod ending in large spine; ischium unarmed; merus with 9 to 13 spines on posterior margin.

Endopod of male first pleopod composed of two lobes like other species mentioned above. Endopod of male second pleopod of typical shape of group; appendix masculina with many long setae.

Branchial formula same as *P. propinqua*. Fifth pleurobranchia on eighth thoracic somite always rudimentary (Fig. 19f).

SIZE. — Local variation in size is present, but the maximum overall size is 100 mm, usually not more than 80 mm (SMALDON, 1979). The males examined are 13.6-23.9 mm CL, the ovigerous females are 17.9-19.4 mm CL, and non-ovigerous females are 13.2-17.2 mm. Eggs are large, 1.0 x 1.8 mm in size, and relatively few in number.

REMARKS. — *P. sivado* is the best known and the representative species of the genus as well as this species group, having a pleurobranchia on the eighth thoracic somite, though it is rudimentary even in the largest male and the ovigerous females examined, as first pointed out by KEMP (1910).

OMORI (1976) showed that the present species is distinguished from *P. japonica* Omori by the comparative length of the antennal scale and the spination of the meri of the first and second pereiopods. The present Atlantic specimens of *P. sivado* have the antennal scale always shorter than the chela of the first pereiopod (0.86-0.98), and fewer spines on the meri of the first and second pereiopods (less than eight on the first, less than 14 on the second), while the Japanese specimens of *P. japonica* have the antennal scale usually longer than the chela of the first pereiopod and more than eight spines on the merus of the first pereiopod and more than 15 spines on the merus of the second pereiopod.

As already shown by DE MAN (1920), an accessory seta is present on the base of the outer pair of spines on the telson end. It is as large as that of *P. marisrubri*, but may probably be more easy to detach in *P. sivado* (IWASAKI, 1989).

DISTRIBUTION. — This well known species is now restricted to the Atlantic Ocean from Norway southwards to the Morocco coast and the Mediterranean Sea (SMALDON, 1979).

Pasiphaea japonica Omori, 1976

Fig. 20

Pasiphaea sirado (sic) - BALSS, 1914: 20.
Pasiphaea sivado - KIKUCHI, 1932: 2. — YOKOYA, 1933: 14. — KUBO, 1965: 605, with fig. — AIZAWA, 1974: 28. — KENSLEY, 1977: 32, fig. 10A. Not Risso, 1816.
Pasiphaea japonica Omori, 1976: 250, figs 1-8. — BURUKOVSKY & ROMENSKY, 1987: 58 (list). — BURUKOVSKY, 1993: 38, figs 2, 14-19; 1996: 843 (list).
Pasiphaea aff. *sivado* - CROSNIER, 1976: 231. Not Risso, 1816.

MATERIAL EXAMINED. — **Madagascar**. *"Vauban"*: Trawl 30, 12°40.0'S, 48°09.5'E, 595-605 m, 13.09.1972: 1 ovig. ♀ 18.3 mm; 3 ♀ 13.0-20.0 mm (MNHN-Na 13390). — Trawl 49, 15°18.3'S, 46°10.3'E, 500-550 m, 8.11.1972: 1 ♂ 13.8 mm (MNHN-Na 13391). — Trawl 59, 23°26.0'S, 43°29.6'E, 600-610 m, 27.02.1973: 1 ♂ 15.3 mm; 1 ovig. ♀ 15.3 mm; 1 ♀ 14.9 mm (MNHN-Na 13392). — Trawl 60, 23°36.5'S, 43°28.8'E, 710 m, 27.02.1973: 5 ovig. ♀ 15.0-21.0 mm; 2 ♀ 15.0, 16.6 mm (MNHN-Na 13393). — Trawl 65, 23°35.0'S, 43°28.6'E, 740-760 m, 29.02.1973: 2 ovig. ♀ 17.5 mm; 1 ♀ 16.7 mm (MNHN-Na 13394).

"FAO 60": stn Chalutage 73/60, 21°17'S, 43°23'E, 490-530 m, 6.06.1973: 1 ♂ 20.2 mm (MNHN-Na 13395). — Stn Chalutage 73/70, 15°18'S, 46°15'E, 600-650 m, 25.06.1973: 1 ♀ 15.6 mm (MNHN-Na 13396). — Stn Chalutage 73/94, 25°24'S, 46°58'E, 300 m, 12.08.1973: 1 ovig. ♀ 19.9 mm (MNHN-Na 13397). — Stn Chalutage, 22°15.7'S, 43°01.5'E, 750-810 m, 29.11.1973: 1 ♀ 18.0 mm (MNHN-Na 13398).

Réunion. Le Port, P. GUÉZÉ leg.: 1 ♀ 16.5 mm (MNHN-Na 6910).

South Africa. *"Meiring Naude"*: stn SM63, 27°10.5'S, 33°14.5'E, 140-0 m, 19.05.1976: 2 ♀ 10.0, 14.6 mm (SAM A15153). — Stn SM85, 27°59.5'S, 34°40.8'E, 550 m, Agassiz Trawl, 22.05.1976: 2 ♀ 12.4 mm (SAM A15152).

Indonesia. KARUBAR: stn CP 09, 05°23'S, 132°29'E, 368-389 m, 23.10.1991: 1 ♂ 26.3 mm; 2 ♀ 22.1, 26.2 mm (MNHN-Na 13399).

Japan. Toyama Bay, off Miwa, set net, July 1975, N. HORII leg.: 1 ovig. ♀ ca. 17 mm; 1 ♀ 16.2 mm (NFU Cat. No. 530-2-613).

East China Sea. *"Nansei Maru"*, 30.10.1976, Kagoshima Prefectural Fisheries Experimental Station leg.: 2 ♂ 14.4, 15.0 mm; 3 ovig. ♀ 14.0-16.0 mm; 7 ♀ 13.8-16.7 mm (NFU Cat. No. 530-2-1352).

DIAGNOSIS. — Shell moderately firm. Rostrum short, not reaching anterior margin of carapace. Carapace dorsally rounded; branchiostegal sinus shallow. Abdominal somites dorsally rounded. Posterior margin of telson truncate, with 4 pairs of spines. First pereiopod with 5-12 spines on merus and unarmed on basis excluding posterodistal spine. Second pereiopod with 14-23 spines on merus, unarmed on ischium, and unarmed on basis excluding posterodistal spine. Ischium of third pereiopod without spinules. Developed arthrobranchiae present on fourth to sixth thoracic somites. Pleurobranchiae on fourth to eighth thoracic somites, that on eighth somite rudimentary. Ovigerous females 15-22 mm.

DESCRIPTION. — Rostrum small, reaching halfway between base of rostrum and anterior margin of carapace. Branchiostegal sinus shallow (Fig. 20a).

Sixth abdominal somite compressed but not carinated dorsally, 1.4-1.9 times as long as fifth somite and 1.7-2.1 times as long as deep; ventrodistal corner uniformly convex, ending usually in minute spine (Fig. 20b). Telson 0.6-0.7 times as long as sixth somite; dorsal groove very shallow at proximal half and prominent in distal part; distal margin truncated with four pairs of spines, outer pair longest, with small seta on base (Fig. 20c).

Stylocerite reaching nearly to first segment of antennular peduncle (Fig. 20a). Antennal scale 3.5-4.5 times as long as wide, and 1.1 times as long as finger of first pereiopod. Mouth-parts showing typical shape of genus.

First pereiopod with large spine at posterodistal end of basis; ischium unarmed (Fig. 20e); merus with 5 to 12 spines on posterior margin; palm 1.1 times as long as finger. Basis of second pereiopod ending in large spine; ischium unarmed (Fig. 20f); merus with 14 to 23 spines on posterior margin.

Endopods of male first and second pleopods (Fig. 20g-h) similar to those of *P. sivado*.

Branchial formula same as in *P. sivado* and *P. propinqua*. Eighth thoracic somite with a rudimentary pleurobranchia only (Fig. 20d).

SIZE. — The males are 13.8-26.3 mm CL and the ovigerous females, 15.3-26.2 mm. Eggs are large, 1.0 x 1.6 mm in size, and relatively few in number.

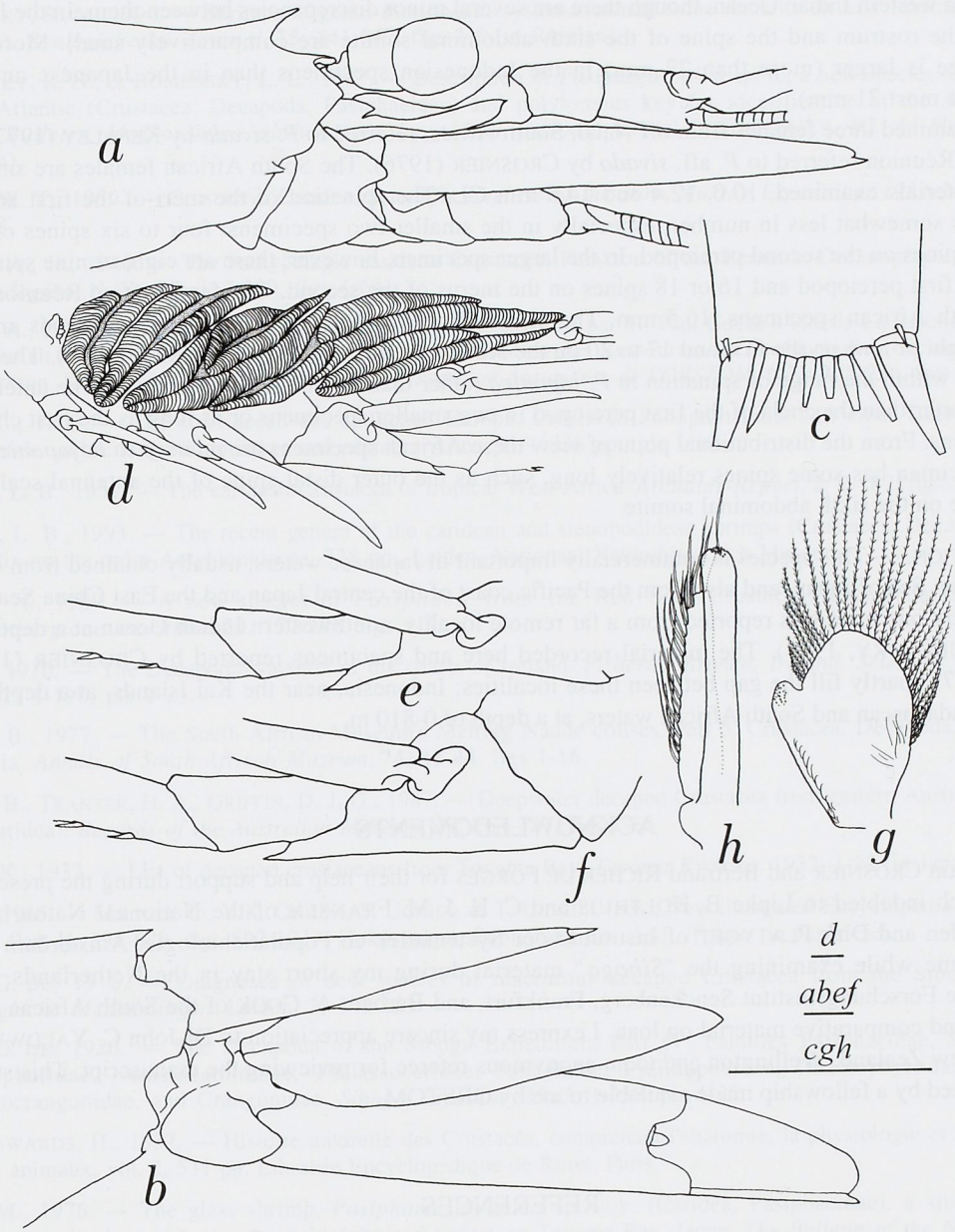


FIG. 20. — *Pasiphaea japonica* Omori, 1976: **a-b**, ♀ 22.1 mm (MNHN-Na 13399, part) ; **c**, **g-h**, ♂ 26.3 mm (MNHN-Na 13399, part); **d**, ovig. ♀ 21.0 mm (MNHN-Na 13393, part); **e-f**, ♀ 26.2 mm (MNHN-Na 13399, part). All from Indonesia, except d which is from Madagascar.

a, anterior part of body in lateral view; **b**, distal part of abdomen in lateral view; **c**, distal end of telson; **d**, branchial chamber; **e**, basal part of first pereiopod; **f**, basal part of second pereiopod; **g**, endopod of first pleopod; **h**, appendices interna and masculina. Scales = 1 mm.

REMARKS. — From the branchial formula the present species belongs to the *P. sivado* and *P. propinqua* groupings. From *P. propinqua* it clearly differs in having the dorsal surface of the sixth abdominal somite smooth. OMORI (1976) has already recorded the differences between *P. sivado* and the Japanese specimens of *P. japonica*. I could not find any distinctive differences between the Japanese specimens and the present additional material from

Indonesia and western Indian Ocean, though there are several minor discrepancies between them. In the Indonesian specimens, the rostrum and the spine of the sixth abdominal somite are comparatively small. Moreover, the specimen size is larger (more than 22 mm) in the Indonesian specimens than in the Japanese and African specimens (at most 21 mm).

I have examined three females from off Natal, South Africa, referred to *P. sivado* by KENSLEY (1977) and one female from Réunion referred to *P.* aff. *sivado* by CROSNIER (1976). The South African females are smaller than the other materials examined, 10.0, 12.4 and 14.6 mm CL. The spination of the meri of the first and second pereiopods is somewhat less in number, especially in the smaller two specimens: four to six spines on the first and 8 to 12 spines on the second pereiopod. In the larger specimen, however, there are eight or nine spines on the merus of the first pereiopod and 16 or 18 spines on the merus of the second. One female from Réunion is larger than the South African specimens, 16.5 mm. The meral spines on the first and second pereiopods are slightly numerous, eight or nine on the first and 17 to 20 on the second, as mentioned by CROSNIER (1976). These values, however, fall within the range of spination in *P. japonica* rather than within that of *P. sivado*. The antennal scale is slightly shorter than the chela of the first pereiopod in two smaller specimens or as long as the first chela in the large specimens. From the distributional point of view these African specimens are referred to *P. japonica*, though the large specimen has some spines relatively long, such as the outer distal spine of the antennal scale and the terminal spine on the sixth abdominal somite.

DISTRIBUTION. — This species is commercially important in Japanese waters, usually obtained from 40-120 m in Toyama Bay, Sea of Japan, and also from the Pacific coast of the central Japan and the East China Sea (OMORI, 1976). Recently one male was reported from a far remote locality, southwestern Indian Ocean at a depth of 430-350 m (BURUKOVSKY, 1993). The material recorded here and specimens reported by CROSNIER (1976) and KENSLEY (1977) partly fill the gap between these localities; Indonesia, near the Kai Islands, at a depth of 368-389 m and Madagascan and South African waters, at a depth of 0-810 m.

ACKNOWLEDGMENTS

I thank Alain CROSNIER and Bertrand RICHER DE FORGES for their help and support during the present study. I am also much indebted to Lipke B. HOLTHUIS and C. H. J. M. FRANSEN of the Nationaal Natuurhistorisch Museum, Leiden and Dirk PLATVOET of Instituut voor Systematiek en Populatiebiologie, Amsterdam for their assistance to me while examining the *"Siboga"* material during my short stay in the Netherlands. Michael TÜRKAY of the Forschungsinstitut Senckenberg, Frankfurt, and Barbara A. COOK of the South African Museum sent me type and comparative material on loan. I express my sincere appreciation to Dr John C. YALDWYN of the Museum of New Zealand, Wellington and to an anonymous referee for reviewing the manuscript. This study was largely supported by a fellowship made available to me by ORSTOM.

REFERENCES

AIZAWA, Y., 1974. — Ecological studies of micronektonic shrimps (Crustacea, Decapoda) in the western North Pacific. *Bulletin of the Ocean Research Institute, University of Tokyo*, (6): 1-84, figs 1-44.

BALSS, H., 1914. — Ostasiatische Decapoden. II. Die Natantia und Reptantia. *Abhandlungen der Mathematisch-Physikalischen Klasse der K. Bayerischen Akademie der Wissenschaften*, Supplement 2, **10**: 1-101, fig 1-51, pl. 1.

BALSS, H., 1915. — Expeditionen S. M. Schiff "Pola" in das Rote Meer, nördliche und südliche Hälfte 1895/96-1897/98, Zoologische Ergebnisse 30. Die Decapoden des Roten Meeres I. Die Macruren. *Denkschriften Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschftliche Klasse*, **91**: 1-38, figs 1-30.

BELL, T., 1853. — A history of the British stalk-eyed Crustacea, lxv + 386 pp., John van Voorst, London.

BURUKOVSKY, R. N., 1993. — Shrimps of genus *Pasiphaea* (Crustacea, Decapoda, Pasiphaeidae) from the western part of the Indian Ocean. *Bulleten Moskovskogo obshchestva Ispytatelei prirody*. Otadel biologicheskii, **98**: 33-40, figs 1-2 (in Russian).

BURUKOVSKY, R. N., 1996. — Shrimps of genus *Pasiphaea*: systematics and some remarks on new findings (Decapoda, Caridea). *Zoologicheskii Zhurnal*, **75**: 841-847, figs 1-5 (in Russian).

BURUKOVSKY, R. N., & ROMENSKY, L. L., 1987. — Description of *Pasiphaea balssi* sp. n., a new species of shrimp from South Atlantic (Crustacea, Decapoda, Pasiphaeidae) and polytomous key for identification of the shrimps in the genus. *Bulleten Moskovskogo obshchestva Ispytatelei prirody*. Otadel biologicheskii, **92**: 51-60, figs 1-4 (in Russian).

CALMAN, W. T., 1939. — Crustacea: Caridea. *Scientific Reports of the John Murray Expedition, 1933-34*, **6**: 183-224, fig. 1-8.

CHACE, F. A., Jr., 1940. — The bathypelagic caridean Crustacea. Plankton of the Bermuda Oceanographic Expeditions. IX. *Zoologica*, N. Y., **25**: 117-209, figs 1-64.

CROSNIER, A., 1976. — Données sur les Crustacés Décapodes capturés par M. Paul Guézé à l'île de La Réunion lors d'essais de pêche en eau profonde. In: Biologie marine et Exploitation des Ressources de l'océan Indien occidental. Colloque Commerson. La Réunion 16-24 octobre 1973. *Travaux et documents de l'ORSTOM*, (47): 225-256, figs 1-9, 2 pls.

HELLER, C., 1863. — Die Crustaceen des südlichen Europa. Crustacea Podophthalmia. Mit einer Übersicht über die horizontale verbreitung sämmtlicher europäischer Arten, xi + 336 pp., pls 1-10.

HOLTHUIS, L. B., 1951. — The caridean Crustacea of tropical West Africa. *Atlantide-Report*, **2**: 7-187, figs 1-34.

HOLTHUIS, L. B., 1993. — The recent genera of the caridean and stenopodidean shrimps (Crustacea, Decapoda): with an appendix on the order Amphionidacea, 328 pp., Leiden, Nationaal Natuurhistorisch Museum.

IWASAKI, N., 1989. — A new species of *Pasiphaea* from the Red Sea (Crustacea: Decapoda: Pasiphaeidae). *Senckenbergiana maritima*, **20**: 177-186, figs 1-3.

KEMP, S., 1910. — The Decapoda Natantia of the coasts of Ireland. *Fisheries Branch, Ireland, Scientific Investigations*, 1908, **1**: 1-190, pls 1-23.

KENSLEY, B., 1977. — The South African Museum's Meiring Naude cruises. Part 5. Crustacea, Decapoda, Reptantia and Natantia. *Annals of South African Museum*, **74**: 13-44, figs 1-16.

KENSLEY, B., TRANTER, H. A., GRIFFIN, D. J. G., 1987. — Deepwater decapod Crustacea from eastern Australia (Penaeidae and Caridea). *Records of the Australian Museum*, **39**: 263-331, figs 1-25.

KIKUCHI, K., 1932. — List of decapod crustaceans from Toyama Bay. *Toyama Kyouiku*, 1932: 1-23 (in Japanese).

KUBO, I., 1965. — Macrura. In: Y.K. OKADA, S. UCHIDA & T. UCHIDA (eds), New illustrated Encyclopedia of the fauna of Japan. Part II: 591-629, figs 892-1031, Hokuryukan, Publishing Co., Ltd., Tokyo (in Japanese).

MAN, J. G. DE, 1916. — Diagnoses of new species of macrurous decapod Crustacea from the Siboga-Expedition. *Zoologische Mededelingen*, Leiden, **2**: 147-151.

MAN, J. G. DE, 1920. — The Decapoda of the Siboga Expedition, Part IV. Families Pasiphaeidae, Stylodactylidae, Hoplophoridae, Nematocarcinidae, Thalassocaridae, Pandalidae, Psalidopodidae, Gnathophyllidae, Processidae, Glyphocrangonidae, and Crangonidae. *Siboga Expeditie*, **39a3**: 1-318, pls 1-25.

MILNE EDWARDS, H., 1837. — Histoire naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux, vol. 2, 531 pp. Librairie Encyclopédique de Roret, Paris.

OMORI, M., 1976. — The glass shrimp, *Pasiphaea japonica* sp. nov. (Caridea, Pasiphaeidae), a sibling species of *Pasiphaea sivado*, with notes on its biology and fishery in Toyama Bay, Japan. *The Bulletin of the National Science Museum*, Series A (Zoology), **2**: 249-266, figs 1-9.

PESTA, O., 1914. — Die auf den Terminfahrten S. M. Schiff "Najade" erbeuteten Decapoden Sergestes, Lucifer und Pasiphaea. *Sitzungsberichte der Kaiserlichen Akademie der Wissenschaften. Mathematisch-naturwissenschaftliche Classe*, **123** (1): 1-31, figs 1-25, 1 pl.

PESTA, O., 1918. — Die Decapodenfauna der Adria: x + 500 pp., pl. 1, Leipzig.

RATHBUN, M., 1906. — The Brachyura and Macrura of the Hawaiian Islands. *Bulletin of the United States Fish Commission*, 1903, **23**: 827-930, figs 1-79, pls 1-24.

RISSO, A., 1816. — Histoire naturelle des Crustacés des environs de Nice: 175 pp., pls 1-3, Paris.

SCHMITT, W., 1931. — Two new species of shrimp from the Straits of Formosa. *Lingnan Science Journal*, **10**: 265-268, pl. 32.

SIVERTSEN, E., & HOLTHUIS, L. B., 1956. — Crustacea Decapoda (the Penaeidae and Stenopodidea excepted). *Report on the Scientific Results of the "Michael Sars" North Atlantic Deep-sea Expedition, 1910*, **5**: 1-54, figs 1-32, pl. 1-4.

SMALDON, G., 1979. — British coastal shrimps and prawns: 126 pp., Academic Press, London, New York, San Francisco.

WOOD MASON, J., 1892. — Illustrations of the zoology of the H. M. Indian marine surveying steamer "Investigator". Crustacea, pt. 1, pls 1-5, Calcutta.

WOOD MASON, J., & ALCOCK, A., 1893. — On the results of deep-sea dredging during the season 1890-91. Natural history notes from H. M. Indian marine survey steamer 'Investigator', Commander R. F. Hoskyn, R.N., commanding. *Annals and Magazine of Natural History*, **11** (6): 161-172, pls 10-11.

YOKOYA, Y., 1933. — On the distribution of decapod crustaceans inhabiting the continental shelf around Japan, chiefly based upon the materials collected by S.S. Soyo Maru, during the year 1923-30. *Journal of the College of Agriculture, Tokyo Imperial University*, **12**: 1-226, figs 1-71.

ZARIQUIEY ALVAREZ, R., 1957. — Las Pasiphaeas del Mediterráneo occidental. Decápodos españoles XIII, *Trabajos del Museo de Zoologia, Barcelona*, nueva serie Zoologica, **2** (5): 1-31, figs 1-4, pls 1-3.

ZARIQUIEY ALVAREZ, R., 1968. — Crustáceos decápodos ibéricos. *Investigación Pesquera*, **32**: 1-510, figs 1-164.

6

Crustacea Decapoda: A review of the species of the genus *Parapagurus* Smith, 1879 (Parapaguridae) from the Pacific and Indian Oceans

Rafael LEMAITRE

Department of Invertebrate Zoology
National Museum of Natural History
Smithsonian Institution
Washington, D.C. 20560, USA

ABSTRACT

A review of the deep-water hermit crab species of the genus *Parapagurus* Smith, 1879 from the Indian and Pacific Oceans is presented based on abundant samples obtained during French expeditions to the New Caledonia region, and supplemented with extensive material deposited in various major museums and institutions throughout the world. A total of 14 species were found to occur in the Indian and Pacific Oceans. Of these seven are new, *P. richeri* sp. nov., *P. furici* sp. nov., *P. stenorhinus* sp. nov., *P. saintlaurentae* sp. nov., *P. janetae* sp. nov., *P. foraminosus* sp. nov., and *P. wolffi* sp. nov.; and three, *P. abyssorum* (Filhol, 1885), *P. bouvieri* Stebbing, 1910, and *P. andreui* Macpherson, 1984, include parts of the Atlantic Ocean in their distribution. The new species are fully described and illustrated; all previously known species are diagnosed or in the case of one obscurely defined species, *P. holthuisi* Lemaitre, 1989, redescribed. Information on morphological variations is included for the most abundant species, and a key to aid in the identification of all 14 species is given. Of the seven new species, *P. richeri* sp. nov. and *P. furici* sp. nov., were found in the New Caledonia region but are also distributed elsewhere in the Indo-Pacific; *P. saintlaurentae* sp. nov. and *P. stenorhinus* sp. nov., have been found exclusively in the Indian Ocean; and *P. janetae* sp. nov., *P. foraminosus* sp. nov., and *P. wolffi* sp. nov., exclusively in the eastern Pacific. As result of this study, the genus now contains 17 species, of which *P. pilosimanus* Smith, 1879, *P. nudus* (A. Milne-Edwards, 1891), and *P. alaminos* Lemaitre, 1986, are so far known only from the Atlantic Ocean. The bathymetric distribution of all species in the genus is summarized.

RÉSUMÉ

Crustacea Decapoda: Révision des espèces du genre *Parapagurus* Smith, 1879 (Parapaguridae) des océans Indien et Pacifique.

Une révision des bernard-l'ermite du genre *Parapagurus* Smith, 1879, des océans Indien et Pacifique est présentée. Elle est basée sur les nombreuses récoltes faites durant diverses expéditions françaises dans la région de la Nouvelle-Calédonie, complétées par un abondant matériel se trouvant dans divers grands Muséums et Institutions à travers

LEMAITRE, R., 1999. — Crustacea Decapoda: A review of the species of the genus *Parapagurus* Smith, 1879 (Parapaguridae) from the Pacific and Indian Oceans. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire Naturelle*, **180**, 303-378. Paris ISBN: 2-85653-520-8.

le monde. Au total, 14 espèces ont été répertoriées dans les océans Indien et Pacifique. Sept d'entre elles sont nouvelles : *P. richeri* sp. nov., *P. furici* sp. nov., *P. stenorhinus* sp. nov., *P. saintlaurentae* sp. nov., *P. janetae* sp. nov., *P. foraminosus* sp. nov., et *P. wolffi* sp. nov.; et trois, *P. abyssorum* (Filhol, 1885), *P. bouvieri* Stebbing, 1910, et *P. andreui* Macpherson, 1984, sont également présentes dans certaines parties de l'océan Atlantique. Les espèces nouvelles sont décrites en détail et figurées, tandis qu'une diagnose est fournie pour les espèces déjà connues, sauf dans le cas de *P. holthuisi* Lemaitre, 1989, qui, insuffisamment définie jusquà présent, est redécrite. Des informations sur la variabilité des espèces sont fournies pour les plus abondantes d'entre elles. Par ailleurs une clé d'identification couvrant les 14 espèces est proposée. Parmi les sept nouvelles espèces *P. richeri* sp. nov. et *P. furici* sp. nov. ont été trouvées dans la région néo-calédonienne mais également ailleurs dans l'Indo-Pacifique; *P. saintlaurentae* sp. nov. et *P. stenorhinus* sp. nov. n'ont été récoltées que dans l'océan Indien, et *P. janetae* sp. nov., *P. foraminosus* sp. nov., et *P. wolffi* sp. nov., que dans le Pacifique oriental. Après cette révision, le genre *Parapagurus* comprend 17 espèces, parmi lesquelles *P. pilosimanus* Smith, 1879, *P. nudus* (A. Milne-Edwards, 1891), et *P. alaminos* Lemaitre, 1986, ne sont encore connues que de l'océan Atlantique. La distribution bathymétrique de toutes les espèces du genre est indiquée.

INTRODUCTION

Among the hermit crab species of the family Parapaguridae currently classified in ten genera (see LEMAITRE, 1996), those of the genus *Parapagurus* Smith, 1879 are particularly difficult to define. The genus was revised by LEMAITRE (1989) and restricted to a group of ten very similar and morphologically variable species, including the type of the genus, *P. pilosimanus* Smith, 1879. Species of this genus frequently live symbiotically with members of the Anthozoa (zoanthids), typically have broad distributions, and are found at depths greater than 1000 m, deeper than most other parapagurids. Morphologically, *Parapagurus* species are characterized primarily by the presence of gills consisting of series of four filamentous or flattened branches arranged along the axis, reduced ocular peduncles and corneae, considerable elongation of antennular and antennal peduncles, palm of right cheliped with rounded mesial and lateral faces, and presence in males of well developed paired first and second pleopods (gonopods). Six species occur in the Atlantic Ocean and have been discussed in detail by LEMAITRE (1986, 1989, 1990): *P. pilosimanus*, *P. abyssorum* (Filhol, 1885a), *P. nudus* (A. Milne-Edwards, 1891), *P. alaminos* Lemaitre, 1986, *P. bouvieri* Stebbing, 1910, and *P. andreui* Macpherson, 1984. Of these, *P. andreui* and *P. bouvieri* have been reported also from the southwestern Indian Ocean (LEMAITRE, 1990). One species, *P. latimanus* Henderson, 1888, known until now only from off New Zealand, was discussed by LEMAITRE and MCLAUGHLIN (1992). However, the remaining species of the genus, believed to be distributed exclusively in the Indo-Pacific or eastern Pacific, have remained poorly defined.

During a study of the extensive parapagurid material obtained by various French expeditions to New Caledonia and adjacent waters, two very abundant species of *Parapagurus* suspected to be new were found. Comparison with types and numerous supplemental specimens of previously known species deposited in many museums and institutions, confirmed that the two species from New Caledonia were undescribed. The study of numerous specimens deposited in museums and institutions also revealed the existence of four additional undescribed species that had been confounded with previously known species, or in some cases misidentified. In light of the striking similarities observed among species of this genus, and their frequent high degree of overlap in their ranges of morphological variations, it became clear that descriptions of the new species required detailed comparisons with other species from the Indo-Pacific and eastern Pacific regions. Given that most of the previously known species were poorly defined, it was necessary to present a review of all species of the genus from the entire Indian and Pacific Oceans.

As result of this study, 14 species of *Parapagurus* are now recognized from the Pacific and Indian Oceans, seven of which are new. Of the 14, nine are found in the Indo-Pacific, three of which are present in the New Caledonia region, and five exclusively in the eastern Pacific. The new species are described, and those previously known are diagnosed. One obscurely defined species, *P. holthuisi* Lemaitre, 1989, is redescribed; the name of this species was proposed by LEMAITRE (1989) as a replacement for *P. abyssorum* Henderson, 1888, which is a junior homonym of *P. abyssorum* (Filhol, 1885a). Figures are included for all species based on specimens examined during this study or, in some cases, on published illustrations. In the case of species where abundant material has been

available, a section on morphological variations is included. A key to all the species that occur in the Pacific and Indian Oceans is presented as an aid in the identification, and is designed to be used in combination with the descriptive text and illustrations.

Species of *Parapagurus* are in most cases distinguished by a number of subtle diagnostic characters. Particularly useful are characters derived from the ocular and antennal acicles, ambulatory legs, propodal rasp of fourth pereopod, exopod of uropods, and telson. Some species can be separated also by marked differences in the proportions of the segments (i.e., merus, propodus, dactyl) of the ambulatory legs or those of the left exopod of the uropods. In addition, the relative size or proportions of other structures, such as the shield, and ocular and antennular peduncles, can frequently be helpful in determining the identity of specimens. In contrast, other structures, such as the mouthparts, are virtually identical in all species, and only minor differences can be observed in the number of setae on the distal end of the endopod of the maxillule, or number of teeth of the crista dentata of the third maxilliped. However, only a limited number of specimens have been dissected, and whether or not these differences are stable cannot be assured. A full set of mouthparts is illustrated as an example for only one species, *P. richeri* sp. nov.

The right chelipeds of *Parapagurus* species from the Pacific and Indian Oceans exhibit a range of morphological variations very similar to those described for the Atlantic representatives of the genus (LEMAITRE, 1986, as the *P. pilosimanus* complex). Especially prevalent on this cheliped is variability in the dimension and sometimes armature of segments, which is attributable to size and sexual dimorphism. Such variability makes characters derived from this cheliped virtually useless for diagnostic purposes at the specific level. The often striking elongation of carpus and palm is a predictable condition that has been observed in virtually every species in which enough specimens of different sizes are available. The spines on the surfaces of carpus and palm of this cheliped are frequently smaller, and less densely arranged, in larger males.

The general hermit crab terminology used in this study follows MCLAUGHLIN (1974), with the exception of the condition of the fourth pereopod, where *subchelate* is used following the definition of MCLAUGHLIN (1997: 435). Terms for parapagurid morphology are used according to the definitions provided by LEMAITRE (1989), although the second and third pereopods are here referred to as the *first and second ambulatory legs* respectively. The type of gill in species of *Parapagurus* has previously been described as trichobranchiate (e.g., SMITH, 1882; DE SAINT LAURENT, 1972; LEMAITRE, 1989). Recently, however, MCLAUGHLIN and DE SAINT LAURENT (1998: 161, fig. 1) have shown that gill type is not determined by shape of the gill elements, but by the arrangement and insertion of the elements on the rachis of the gill, and pointed out that there are many types of true trichobranch and phyllobranch gills. In true trichobranchiate gills the tubular elements are inserted in order or disorder around the axis, or in regular transverse rows along the axis. Accordingly, the gills in species of *Parapagurus*, which consist of series of four filamentous elements arranged around the axis (see LEMAITRE, 1989: 8, fig. 2L-M), are not true trichobranchiae. MCLAUGHLIN and DE SAINT LAURENT (1998) defined the term *"quadriserial"* for a gill structure equivalent to LEMAITRE's (1989) "trichobranchiate" and "intermediate" conditions used for the Parapaguridae. The term "quadriserial" is adopted here to describe the gills of *Parapagurus* species, and is considered a type of phyllobranch gill.

The measurements used for different structures are defined in Fig. 1, and should be taken to the nearest 0.1 mm. In the MATERIAL EXAMINED sections, one measurement indicative of size, i.e. length of shield, is included following the number and sex of specimens. The section on SIZE RANGE for each species is based on the materials used for this study as well as from all available materials previously reported by LEMAITRE (1986, 1989, 1990, 1997) and LEMAITRE and MCLAUGHLIN (1992).

The shape of the scales on the propodal rasp of the fourth pereopod is of considerable diagnostic importance. The shape of the scales as well as the number of rows of scales can best be observed in a ventrolateral view. Almost invariably, the proximal portion of the rasp exhibits more rows than the distal portion; it is the number of rows on the distal portion that is most useful in the identification of specimens. Examples of *ovate*, *conical*, and *lanceolate* scales are shown in Fig. 2 (see also micrographs in LEMAITRE, 1986: 534, fig. 5). The ovate (Fig. 2a-b) and conical (Fig. 2c) type of scales are easily distinguished; the lanceolate scales (Fig. 2d-e) are narrow, and terminate in curved margins tapering to a pointed or blunt end.

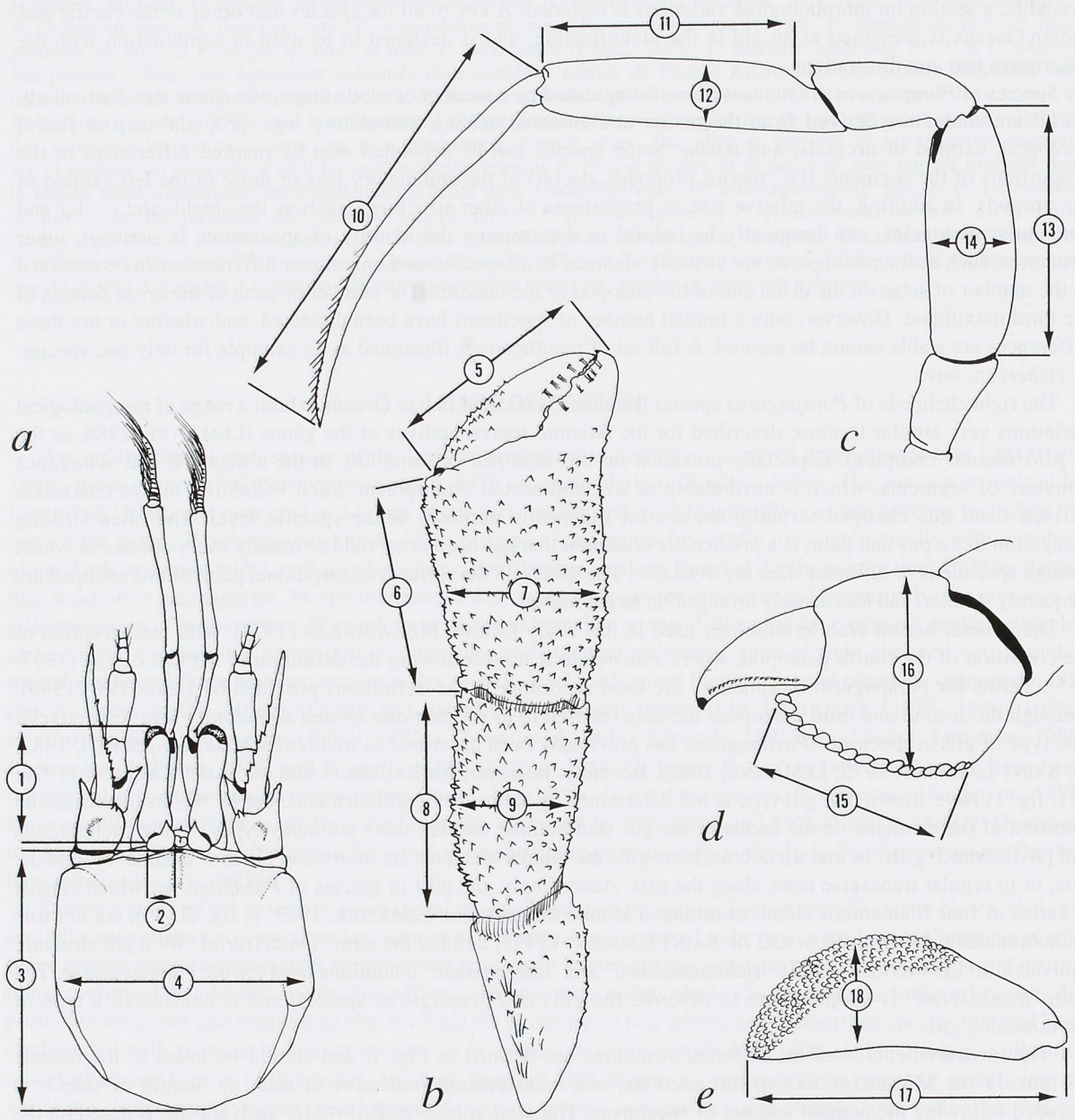


FIG. 1. — Diagrammatic *Parapagurus*, showing measurements used in text. **a**, shield and cephalic appendages: 1, ocular peduncle length; 2, ocular acicle width; 3, shield length; 4, shield width. **b**, cheliped: 5, dactyl length (from proximal end to tip of dactyl); 6, palm length; 7, palm width (maximum); 8, carpus length; 9, carpus width (maximum). **c**, ambulatory leg: 10, dactyl length; 11, propodus length (dorsal margin, excluding proximal portion curving down to carpus); 12, propodus height; 13, merus length; 14, merus height. **d**, propodus and dactyl of fourth pereopod: 15, propodal rasp length; 16, propodus height. **e**, left exopod of uropods: 17, exopod length; 18, exopod width.

The core of the materials used for this study remain deposited in the Muséum national d'Histoire naturelle, Paris (MNHN), the National Museum of Natural History, Smithsonian Institution, Washington D.C. (USNM), and the Zoologisk Museum, Copenhagen (ZMK). However, numerous other materials, including types, deposited in other museums and institutions throughout the world were also used, and are abbreviated as follows:

AM. — Australian Museum, Sydney, Australia.
CBM. — Natural History Museum and Institute, Chiba, Japan.
ICM. — Instituto de Ciencias del Mar (formerly Instituto de Investigaciones Pesqueras), Barcelona, Spain.
IORAN. — Institute of Oceanology, Russian Academy of Sciences.
LACM. — Natural History Museum of Los Angeles County, USA.
MCZ. — Museum of Comparative Zoology, Harvard University, Cambridge, Massachusetts, USA.
NHM. — The Natural History Museum [formerly British Museum (Natural History)], London, England.
NMV. — National Museum of Victoria, Melbourne, Australia.
NMNZ. — Museum of New Zealand Te Papa Tongarewa (formerly National Museum of New Zealand), Wellington.
NTOU. — National Taiwan Ocean University, Keelung, Taiwan.
QM. — Queensland Museum, Brisbane, Australia.
SAM. — South African Museum, Cape Town.
SAMA. — South Australian Museum, Adelaide, Australia.
SIO. — Scripps Institute of Oceanography Invertebrate Collection, University of California, San Diego, USA.
SMF. — Senckenberg Museum, Frankfurt a. M., Germany.
ZMA. — Zoölogisch Museum, Amsterdam, The Netherlands.
ZMUM. — Zoological Museum, Moscow State University.
ZRC. — Zoological Reference Collection, Department of Zoology, National University of Singapore.

Other abbreviations used are: immat, immature (sex undetermined); ♂, male(s); ♀, female(s); stn, station; CP, Waren dredge; DW, beam trawl; CC, shrimp trawl; JCU, James Cook University, Townsville, Australia; NZOI, New Zealand Oceanographic Institute (now part of National Institute of Water and Atmospheric Research), Wellington.

The specimens examined are listed by geographic area, and within areas by cruise, vessel, and station number. Information on stations is listed following the format of the original cruise data, that is, longitudes and latitudes are cited in degrees and decimals, or degrees and fractions of minutes, all depths are cited in meters.

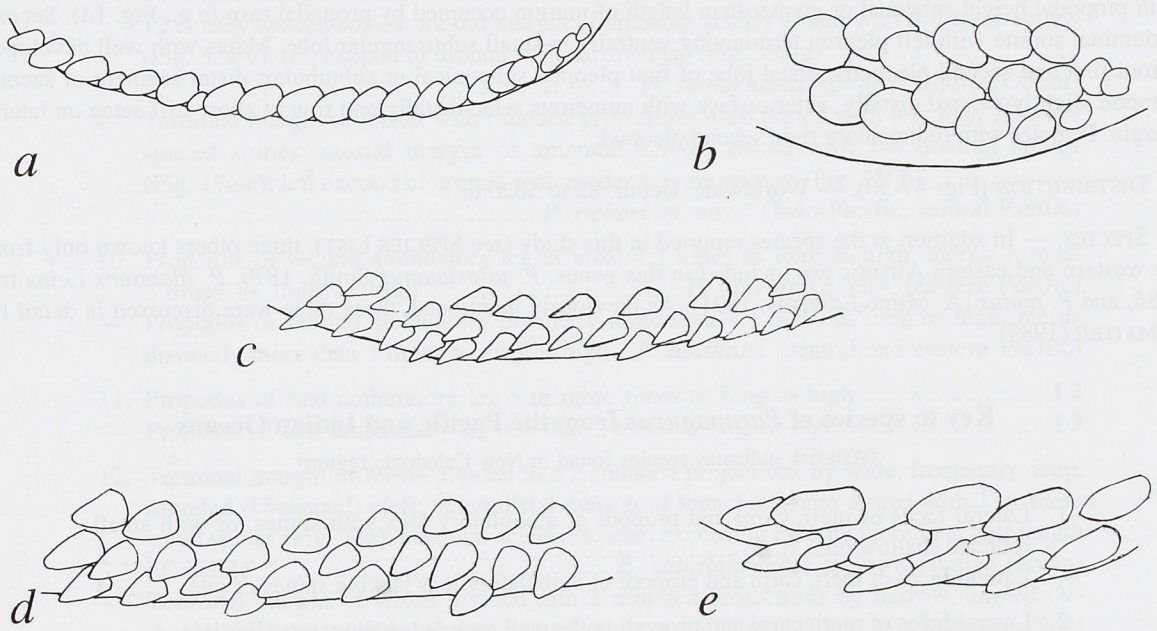


FIG. 2. — Portion of propodal rasp of fourth pereopod, showing examples of shapes of scales referred to in text: **a-b**, ovate; **c**, conical; **d-e**, lanceolate. (a, lateral view; b-e, ventrolateral view).

SPECIES LIST

(Asterisk indicates species found in New Caledonia region)

P. latimanus Henderson, 1888*
P. abyssorum (Filhol, 1885a)
P. bouvieri Stebbing, 1910
P. andreui Macpherson, 1984
P. microps de Saint Laurent, 1972
P. benedicti de Saint Laurent, 1972
P. holthuisi Lemaitre, 1989
P. richeri sp. nov.*
P. furici sp. nov.*
P. saintlaurentae sp. nov.
P. stenorhinus sp. nov.
P. janetae sp. nov.
P. foraminosus sp. nov.
P. wolffi sp. nov.

SYSTEMATIC ACCOUNT

Family PARAPAGURIDAE Smith, 1882

Genus *PARAPAGURUS* Smith, 1879

Parapagurus Smith, 1879: 50. — DE SAINT LAURENT, 1972: 101 (in part). — LEMAITRE, 1989: 11, fig. 2A-C, L-M.

TYPE SPECIES. — *Parapagurus pilosimanus* Smith, 1879 by monotypy. Gender: masculine.

DIAGNOSIS. — Eleven pairs of quadriserial gills, lacking vestigial pleurobranchiae on last thoracic somite; gills each consisting of series of 4 long filamentous or flattened branches arranged along axis. Shield usually well calcified. Ocular peduncles (including corneae) typically half or less than half length of shield; corneae at most weakly dilated. Antennal peduncles and acicles distinctly overreaching ocular peduncles. Fourth segment of antennal peduncle unarmed. Epistomial spine, when present, short and straight. Right cheliped elongate; palm rounded mesially and laterally. Left cheliped well calcified. Ambulatory legs long, dactyls curved. Fourth pereopod with propodal height subequal or greater than length of margin occupied by propodal rasp (e.g., Fig. 1d). Second abdominal somite with left pleuron terminating ventrally in small subtriangular lobe. Males with well developed paired first and second pleopods; distal lobe of first pleopod subconical or subtubular; distal segment of second pleopod slightly twisted distally, anterior face with numerous setae distally and row of short stiff setae on lateral margin. Females with rudimentary right second pleopod.

DISTRIBUTION (Figs 47-50). — Worldwide. Depth: 82 to 5020 m.

SPECIES. — In addition to the species reported in this study (see SPECIES LIST), three others known only from the western and eastern Atlantic are included in this genus, *P. pilosimanus* Smith, 1879, *P. alaminos* Lemaitre, 1986, and *P. nudus* (A. Milne-Edwards, 1891). As previously mentioned, these three were discussed in detail by LEMAITRE (1989).

Key to species of *Parapagurus* from the Pacific and Indian Oceans

(Asterisk indicates species found in New Caledonia region)

1. Lateral faces of meri, carpi and propodi of ambulatory legs with spines, or with small rounded shallow pits **2**
— Lateral faces of meri, carpi and propodi of ambulatory legs lacking spines or pits **4**

2. Lateral faces of meri, carpi and propodi with small rounded shallow pits (Fig. 41) .... ***P. foraminosus*** sp. nov. (eastern Pacific)
— Lateral faces of meri, carpi and propodi lacking pits, with spines **3**

3. Anterodistal margin of branchiostegite armed with small spines; propodal rasp of fourth pereopod consisting of 2 or 3 rows of lanceolate scales .... ***P. abyssorum*** (Atlantic; western and southeastern Pacific)
— Anterodistal margin of branchiostegite unarmed; propodal rasp of fourth pereopod consisting of 1 row (at least distally) of ovate scales ..... ***P. microps*** (eastern Pacific)

4. Lateral faces of meri of ambulatory legs weakly calcified medially, weak calcification more pronounced on second (Fig. 7d-f); length of ocular peduncles (including corneae) distinctly more than half length of shield .... ***P. bouvieri*** (southeastern Atlantic; Indo-Pacific)
— Lateral faces of meri of ambulatory legs well calcified; length of ocular peduncles (including corneae) half or less length of shield **5**

5. Ventral margins of meri of ambulatory legs armed with spines (stronger on second leg) **6**
— Ventral margins of meri of ambulatory legs unarmed **7**

6. Dorsal margins of carpi of ambulatory legs armed with spines (Fig. 45); propodal rasp of fourth pereopod with 1 row of ovate scales (at least distally); shield about as broad as long; ocular acicles terminating in simple spine .... ***P. wolffi*** sp. nov. (eastern Pacific)
— Dorsal margins of carpi of ambulatory legs unarmed; propodal rasp of fourth pereopod with 2-4 rows of ovate scales (at least distally); shield distinctly broader than long; ocular acicles most frequently terminating in bifid spine ..... ***P. benedicti*** (eastern Pacific)

7. Propodal rasp of fourth pereopod consisting of ovate scales (Fig. 2a-b) **8**
— Propodal rasp of fourth pereopod consisting of conical (Fig. 2c) or lanceolate (Fig. 2d-e) scales **11**

8. Left exopod of uropods broad, 2.3 times or less as long as broad **9**
— Left exopod of uropods elongate, more than 2.3 times as long as broad **10**

9. Terminal margin of telson with rounded projections each armed with more than 12 closely-spaced spines; mesial margin of antennal acicles armed with 5-8 weak spines (Fig. 32a-b); left exopod of uropod with narrow rasp (Fig. 35e-g) .... ***P. stenorhinus*** sp. nov. (Indian Ocean)
— Terminal margin of telson with rounded projections each armed with less than 12 well-spaced spines; mesial margin of antennal acicles armed with 1-8 distinct spines (Fig. 19a-c); left exopod of uropod with moderately broad rasp (Fig. 23f,h) .... ***P. richeri*** sp. nov.* (Indo-Pacific; central Pacific)

10. Propodus of second ambulatory leg at most 4.3 times as long as high, merus at most 3 times as long as high ..... ***P. janetae*** sp. nov. (eastern Pacific)
— Propodus of second ambulatory distinctly more than 4.3 times as long as high, merus distinctly more than 3 times as long as high . ***P. holthuisi*** (central and eastern Pacific)

11. Propodus of first ambulatory leg 5 or more times as long as high **12**
— Propodus of first ambulatory leg less than 5 times as long as high **13**

12. Terminal margin of telson divided into 2 rounded projections by wide, frequently deep, rounded (U-shaped) cleft; anterodistal margin of branchiostegite armed with 1 or more small spines (Fig. 28e); antennal acicles slender, exceeding eyes by more than half length of acicle ..... ***P. saintlaurentae*** sp. nov. (Indian Ocean)
— Terminal margin of telson divided into 2 rounded projections by narrow, angled (V-shaped) cleft; anterodistal margin of branchiostegite unarmed (Fig. 24b); antennal acicles moderately slender, exceeding eyes by half or less than half length of acicle .... ***P. furici*** sp. nov.* (Indo-Pacific)

13. Propodi of first and second ambulatory legs more than 4 times as long as high; mesial margin of antennal acicles unarmed ..... ***P. andreui*** (southeastern Atlantic; southwestern Indian Ocean)

— Propodi of first and second ambulatory legs less than 4 times as long as high; mesial margin of antennal acicles armed with up to 6 small spines ..... ***P. latimanus**** (Indo-Pacific)

Parapagurus latimanus Henderson, 1888

Figs 3, 47-48

Parapagurus latimanus Henderson, 1888: 91, pl. 9, fig. 2 (type locality: *"Challenger"*, stn 167A, New Zealand). — Murray, 1895: 597. — Alcock, 1905: 172. — Gordan, 1956: 338 (lit.). — Lemaitre, 1986: 526; 1989: 11; 1997: 575. — Lemaitre & McLaughlin, 1992: 762, fig. 9.

Parapagurus pilosimanus pilosimanus - de Saint Laurent, 1972: 102 (in part, see Remarks).

Parapagurus pilosimanus latimanus - de Saint Laurent, 1972: 103, pl. 1, fig. 5.

?*Parapagurus pilosimanus* - Takeda, 1982: 65, unnumbered color fig. (see Remarks).

Material examined.

Japan. RV *"Tansei-Maru"*: off Taito-saki, Boso Peninsula, 35°07.8'N, 140°49'E, 400-416 m, 26.04.1995, coll. T. Komai: 1 ov. ♀ 13.3 mm (CBM-ZC 2038).

Indonesia. *"Galathea"*, stn 453, Makassar Strait, 3°65'S, 118°26'E, 2034 m, 24.08.1951: 1 ♂ 6.6 mm (ZMK).

New Caledonia. Bathus 3: stn CP 844, 23°06'S, 166°45'E, 908 m, 1.12.1993: 1 ♂ 6.6 mm, 2 ov. ♀ 4.0, 4.1 mm (MNHN-Pg 5575).

Volsmar: stn DW 25, 22°22,80'S, 171°21,50'E, 940 m, 4.06.1989: 1 ov. ♀ 6.6 mm (MNHN-Pg 5576).

Vanuatu. Musorstom 8: stn CP 1075, 15°33'S, 167°27'E, 956-944 m, 4.10.1994: 1 ♂ 5.6 mm (MNHN-Pg 5579).

Wallis and Futuna. Musorstom 7: stn CP 564, 11°46.1'S, 178°27.4'W, 1015-1020 m, 20.05.92: 1 ♂ 11.2 mm (MNHN-Pg 5577). — Stn DW 620, 12°34.4'S, 178°11.0'W, 1280 m, 28.05.92: 1 ♂ 10.3 mm (MNHN-Pg 5578).

Australian region. *New South Wales*. FRV *"Kapala"*: stn K77-23-12, E of Broken Bay, 33°35-33'S, 152°00-02'E, 823 m, 8.12.1977: 1 ♀ 9.0 mm (AM P52737); Stn K80-20-06, between Sydney and Newcastle, 33°38'S, 152°02'E, 960-988 m, 9.12.1980, coll. R.T. Springthorpe: 1 ♂ 5.5 mm (AM P40411); Stn K83-12-02, E of Eden, 37°36'S, 150°21'E, 860-960 m, 26.09.1983: 1 ♂ 7.8 mm (AM P40396). — ORV *"Franklin"*: stn Slope 58, 56 km ENE of Nowra, 34°43.95'S, 151°14.74'E, 1009-817 m, 22.10.1988: 1 ♂ 7.9 mm, 1 ♀ 7.8 mm (NMV J44913), 2 ♂ 4.8, 4.9 mm, 1 ♀ 6.3 mm, 1 ov. ♀ 7.5 mm (USNM 276125).

Tasmania. ORV *"Franklin"*: stn Slope 81, 48 km ENE of Cape Tourville, 42°00.25'S, 148°43.55'E, 1264 m, 30.10.1988, coll. G.C.B. Poore: 1 ♀ 7.2 mm (NMV J40403).

Tasman Sea. ORV *"Franklin"*: Fro 05/89 stn 17, Lord Howe Rise, 29°42.06'S, 159°48.31'E, 2450 m, 3.05.1989: 1 ♂ 5.7 mm (AM P40432).

Great Australian Bight. *"Galathea"*: stn 554, 37°28'S, 138°55'E, 1320-1360 m, 5.12.1951: 4 ♂ 3.3-9.5 mm, 5 ♀ 6.3-7.5 mm (ZMK); 1 ♀ 8.2 mm (ZMK). — *"Dmitry Mendeleev"*: stn DM 1373, 33°49-46'S, 127°9-27'E, 1080-1100 m, 28.02.1976: 6 ♂ 5.6-10.0, 2 ♀ 5.2, 7.3 mm, 2 ♀ ov. 7.0, 8.0 mm (AM P21966), 3 ♂ 5.7-10.0 mm (NMV J16194). — FV *"Saxon Progress"*: ~120 nautical miles (222.2 km) SW of Cape Adieu, 33°58'S, 131°22'E, 1000 m, Nov 1989, coll. D.W. Leenan: 1 ♂ 7.0 mm [in zoanthid *Epizoanthus incrustatus* (Duben & Koren)] (SAMA C5823). — FV *"Longra III"*: stn 84, ~120 nautical miles (222.2 km) SSE of Euda, 33°37'S, 129°53'E, 930-1030 m, 17.04.1990, coll. K. Gowlett-Holmes: 1 ♂ 14.8 mm (in zoanthid *E. paguriphilus* Verrill) (SAMA C5824), 1 ♀ 11.9 mm (in zoanthid *E. incrustatus*) (SAMA C5825).

New Zealand. *"Shinkai Maru"*: cruise II, stn 77, northern Chatham Rise, 42°47.5'S, 178°22.0'E, 939-920 m, 15.11.1975: 1 ♂ 8.9 mm (NMNZ Cr 3198). — RV *"Acheron"*: stn BS 353, 37°30'S, 179°22'E, 1134-1207 m, 7.02.1974: 1 ♂ 15.9 mm (NMNZ Cr 3202), 1 ♀ 7.6 mm (NMNZ Cr 8431), 1 ♂ 9.6 mm, 1 ♀ 9.1 mm, 1 ov. ♀ 12.2 mm (NMNZ Cr 8477). — RV *"Tangaroa"*: BS 690, stn R48, 37°22.1'S, 178°26.9'E, 2027-1952 m, 18.01.1979: 1 ♂ 8.9 mm (NMNZ Cr 3200); BS 760, stn R118, ~22 km E of Alderman Islands, 36°57.3'S, 176°21.5'E, 803-846 m, 24.01.1979: 2 ov. ♀ 11.5, 12.2 mm (NMNZ Cr 3199); BS 771, stn R129, ~39 km E of Portland Island, Mahia Peninsula, 39°15.4'S, 178°19.3'E, 413-453 m, 26.01.1979: 1 ov. ♀ 11.0 mm (NMNZ Cr 3201). — RV *"James Cook"*: stn J6/12/81, SE of East Cape, 37°46.3'S, 178°57.4'E, 829-928 m, 16.04.1981: 1 ♂ 11.6 mm (NMNZ Cr 8484); Stn J19/9/84, Challenger Plateau, 40°06.3'S, 167°57.9'E, 960-982 m, 13.11.1984: 1 ♂ 8.2 mm, 1 ov. ♀ 8.3 mm (NMNZ Cr 8452); Stn J19/011/84, Challenger Plateau, 40°03.2'S, 167°53.3'E, 912-940 m, 13.11.1984: 2 ♂ 10.3, 13.4 mm (NMNZ Cr 8447); Stn J9/42/89, 39°29.5'S, Ritchie Bank, Hawkes Bay, 178°18.9'E, 823-870 m, 27.09.1989: 1 ♂ 15.8 mm (NMNZ Cr 8485); Stn J9/49/89, E of Ritchie Bank, 39°32.8'S, 178°16.5'E, 880-857 m, 29.09.1989: 1 ♂ 10.6 mm

(NMNZ Cr 8453). — FV *"Kalinovo"*: stn K/40/81, near Antipodes Islands, 40°51.5'S, 176°57.9'E, 1125-1150 m, 28.11.1981: 2 ♂ 8.5, 10.0 mm (NMNZ Cr 8429). — RV *"Washington"*: stn Rock Dredge 41(D5), 34°28.8'S, 178°52.3'E, 2500 m, 12.02.1986: 1 ov. ♀ 12.2 mm (SIO C9546). — FV *"Arrow"*: stn A01/37/87, Ritchie Bank, Harkes Bay, 39°24.5'S, 178°19.9'E, 921-981 m, 26.06.1987: 1 ov. ♀ 10.9 mm (NMNZ Cr. 4819); Stn A01/41/87, 39°38.5'S, 178°19.9'E, 906-924 m, 26.06.1987: 1 ♂ 13.0 mm (NMNZ Cr 4820). — FV *"Cordella"*: stn C01/23/88, N of Chatham Islands, 42°48.1'S, 176°47.7'E, 975-974 m, 16.07.1988: 2 ov. ♀ 11.0, 11.1 mm (NMNZ Cr 6052). — FV *"Amaltal Explorer"*: stn AEX 2/11/89, N of Antipodes Islands, 48°31.56'S, 179°03.11'E, 660-675 m, 20.11.1989: 1 ♂ 16.0 mm (NMNZ Cr 8425).

Western Indian Ocean. Off Kenya. *"Galathea"*: stn 241, 4°00'S, 41°27'E, 1510 m, 15.3.1951: 1 ♂ 8.9 mm (ZMK).

TYPES. — *Holotype*: ♂ 6.6 mm, New Zealand, *"Challenger"*, stn 167A, 18 m (depth questionable, see LEMAITRE & MCLAUGHLIN, 1992: 764), 27.06.1874 (NHM 1888:33).

DIAGNOSIS. — Shield (Fig. 3a) about as broad as long, dorsal surface well calcified; lateral projections broadly rounded. Rostrum broadly rounded, with short mid-dorsal ridge. Ocular peduncles (including corneae) less than half length of shield, inflated basally; width of cornea about same as distal width of ocular peduncle. Ocular acicles subtriangular, terminating in simple strong spine (rarely bifid on one or both sides). Antennular peduncle exceeding eyes by nearly entire length of penultimate segment; lateral face of basal segment with statocyst lobe having subrectangular distal lobe armed with 2 spines, and 1 spine proximally. Antennal peduncle (Fig. 3b) exceeding eyes by nearly entire length of fifth antennal segment; flagellum with numerous setae 1-4 flagellar articles in length; acicle straight or weakly curved in dorsal view, exceeding distal margin of cornea by half length of acicle, with proximal half of mesial margin armed with 1 to 6 small blunt to sharp spines or tubercles (acicle rarely unarmed). Epistomial spine usually absent. Sternite of third maxillipeds with strong spine on each side of midline. Left cheliped (Fig. 3c) well calcified, densely setose; carpus with irregular row of small spines or tubercles on dorsal margin. Ambulatory legs (Fig. 3e-f) with meri, carpi and propodi unarmed except for small dorsodistal spine on each carpus; meri each about 3.3 (first leg) or 2.9 (second leg) times as long as high. Anterior lobe of sternite of second ambulatory legs subsemicircular, setose, armed with small subterminal tubercle or spine. Fourth pereopod (Fig. 3g-h) with propodal rasp consisting of 2 (rarely 3) often irregular rows of lanceolate or conical scales. Fifth pereopod with propodal rasp less than half length of propodus. Telson and uropods (Fig. 3i-j) asymmetrical. Terminal margin of telson divided into 2 rounded projections by angled (V-shaped) cleft; rounded projections armed distally with moderately long, evenly-spaced corneous spines (approximately 15 to 26 left, 8 to 13 right), spines on left side frequently extending anteriorly nearly to midlength of lateral margin of telson. Left exopod (Fig. 3i) of uropod elongate, about 2.8 to 3.0 times as long as broad; with broad rasp.

SIZE RANGE. — Males, SL 3.3 to 16.0 mm. Females 5.2 to 11.9 mm. Ovigerous females 4.0 to 13.3 mm.

VARIATIONS. — The spines on the dorsomedian surface of the palm of the right cheliped can be arranged irregularly, or frequently in more or less straight rows.

HABITAT. — Usually found living in shelters formed by zoanthids, probably species of *Epizoanthus* [e.g. *E. paguriphilus* Verrill, *E. incrustatus* (Duben & Koren)].

DISTRIBUTION (Figs 47-48). — Indo-Pacific: Japan; Indonesia; New Caledonia region; southern Australia; New Zealand. Western Indian Ocean: off Kenya. Depth: 400 to 2500 m.

AFFINITIES. — This species resembles *P. andreui* and to a lesser extent *P. pilosimanus*. The three are usually found living in shelters associated with zoanthids (*Epizoanthus* spp.). There are differences in distribution and morphology among the three. *Parapagurus latimanus* occurs in the Indo-Pacific, *P. andreui* in the southeastern Atlantic and southwestern Indian Ocean, and *P. pilosimanus* only in the Atlantic. Morphological characters that differentiate *P. latimanus* from *P. andreui* can be found in the antennal acicles (armed in *P. latimanus*, unarmed in *P. andreui*); the scales of the propodal rasp of the fourth pereopod (lanceolate in *P. latimanus*, conical in *P. andreui*); and the meri of the ambulatory legs (2.9 to 3.3 times as long as high in *P. latimanus*, 3.5 to 4 times as long as high in *P. andreui*). The shape of the telson can serve to separate *P. latimanus* from both *P. andreui* and

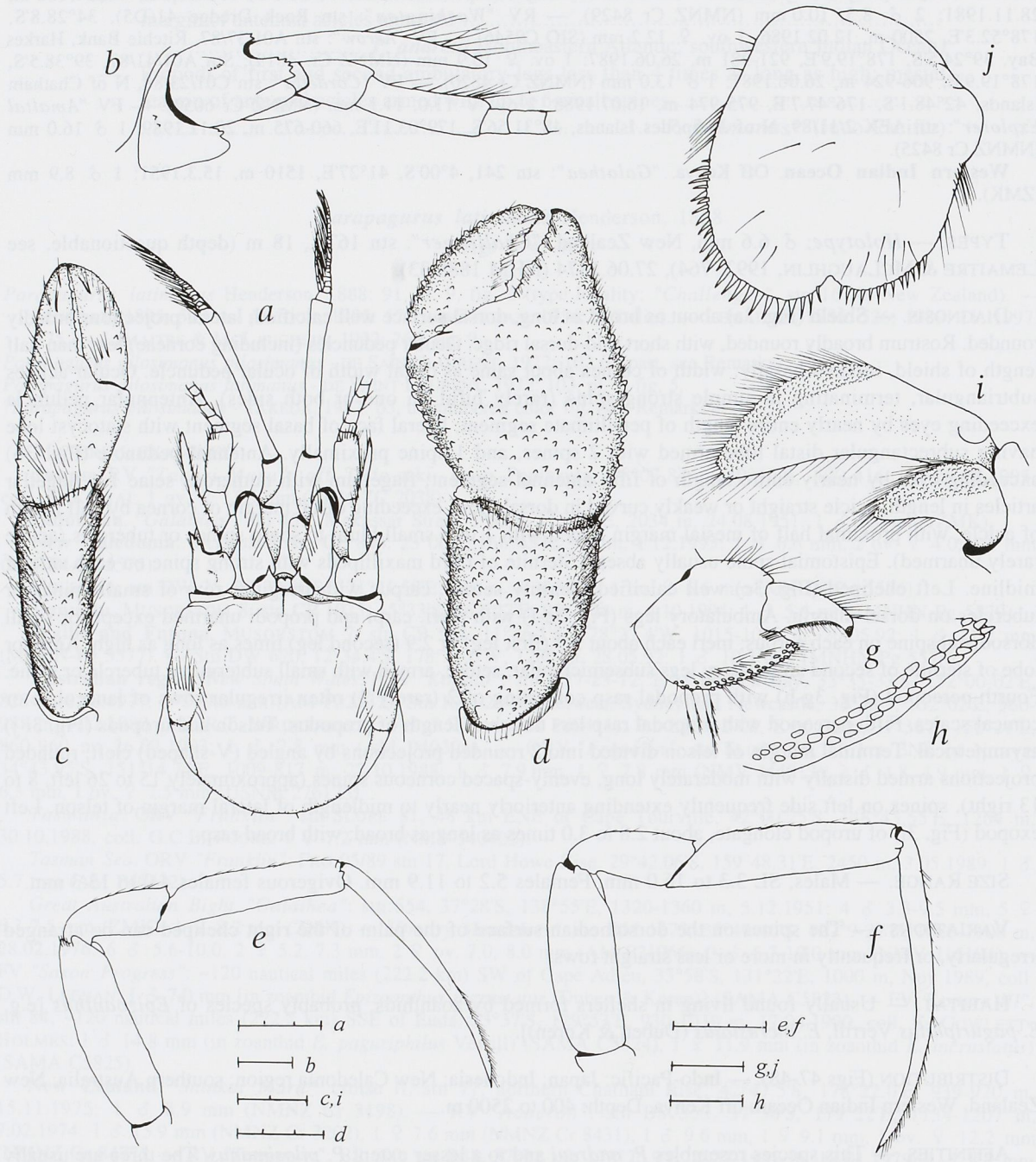


FIG. 3. — *Parapagurus latimanus* Henderson, 1888, *"Eltanin"*, stn 2198, 43°48'S, 174°24'W: ♂ 7.5 mm (USNM 256845). **a**, shield and cephalic appendages; **b**, right antennal peduncle, lateral view; **c**, left chela and carpus (most setae omitted); **d**, right chela and carpus (setae omitted); **e**, right first ambulatory leg, lateral view; **f**, right second ambulatory leg, lateral view; **g**, propodus and dactyl of right fourth pereopod, lateral view; **h**, propodal rasp of same (setae omitted), ventrolateral view; **i**, left exopod and endopod of uropods, dorsal view; **j**, telson, dorsal view.

Scales equal 3 mm (a), 1 mm (b), 2 mm (c,i), 3 mm (d), 5 mm (e-f), 1 mm (g,j), and 0.5 mm (h). (From LEMAITRE & MCLAUGHLIN, 1992).

P. pilosimanus. The terminal margin of the telson is divided into two asymmetrical rounded projections by a broad cleft in *P. latimanus* and *P. andreui*; the terminal margin is divided into two symmetrical rounded projections by a narrow cleft in *P. pilosimanus*.

REMARKS. — DE SAINT LAURENT (1972: 103) questionably included the western Indian Ocean in the distribution of *Parapagurus pilosimanus pilosimanus*, based on material from the *"Galathea"* expedition collected at stn 241, off Kenya. That material has been examined and found to represent *P. latimanus*.

TAKEDA (1982) published a color photo of a specimen identified as *Parapagurus pilosimanus*. However, as previously mentioned, that species occurs only in the Atlantic Ocean (LEMAITRE, 1989). TAKEDA's specimen has not been available for examination, and from the photograph alone, the identity of the specimen cannot be determined with certainty. It is questionably assigned to *P. latimanus*.

Parapagurus abyssorum (Filhol, 1885a)

Figs 4-6, 47, 49-50

Parapagurus pilosimanus - SMITH, 1884: 354 (in part); 1886: 607 (in part). — A. MILNE-EDWARDS & BOUVIER, 1892a: 1 (in part); 1892b: 204 (in part). (See Remarks).
Pagurus abyssorum Filhol, 1885a: 152, fig. 1; 1885b: 131, fig. 41. (See Remarks).
Parapagurus abyssorum - HENDERSON, 1888: 87 (in part), not pl. 9, fig. 2 (= *Parapagurus holthuisi* Lemaitre, 1989). — WOOD-MASON & ALCOCK, 1891: 199. — ALCOCK, 1894: 242. — MURRAY, 1896: 388 (in part). — GORDAN, 1956: 337 (lit.). (See Remarks).
Parapagurus abyssorum var. *scabra* Henderson, 1888: 89, pl. 9, fig. 3. — MURRAY, 1895: 257. — ALCOCK, 1905: 172. — GORDAN, 1956: 338 (lit.).
Parapagurus pilosimanus Var. *Scabra* - A. MILNE-EDWARDS & BOUVIER, 1892a: 2.
Parapagurus scabra - A. MILNE-EDWARDS & BOUVIER, 1892a: 13.
Parapagurus pilosimanus var. *abyssorum* - A. MILNE-EDWARDS & BOUVIER, 1892a: 13; 1892b: 205; 1899: 55, pl. 1, fig. 1; 1900: 191, pl. 24, figs 4-6. — ALCOCK, 1905: 172. — GORDAN, 1956: 338 (lit.).
?*Parapagurus pilosimanus* - PORTER, 1906: 129. — HAIG, 1955: 17. (See Remarks).
Parapagurus pilosimanus Var. *Abyssorum* - NOBRE, 1931: 201, fig. 110; 1936: 126, fig. 103.
Parapagurus pilosimanus scaber - DE SAINT LAURENT, 1972: 102, pl. 1, fig. 3; 1985: 475. — MIYAKE, 1978: 72 (lit.); 1982: 196 (lit.). (See Remarks).
Parapagurus scaber - LEMAITRE, 1986: 533, figs 1G-H, 3F-J, 4I-J, 5G-H, 6A-C,K-L, 7D,H-I, 8F-G, 9C.
Parapagurus abyssorum - LEMAITRE, 1989: 30, figs 5D-E, 12-14; 1990: 220. — INGLE, 1993: 19.
Not *Parapagurus pilosimanus abyssorum* - FAXON, 1895: 68 (= *Parapagurus foraminosus* sp. nov., see Remarks under that new species).

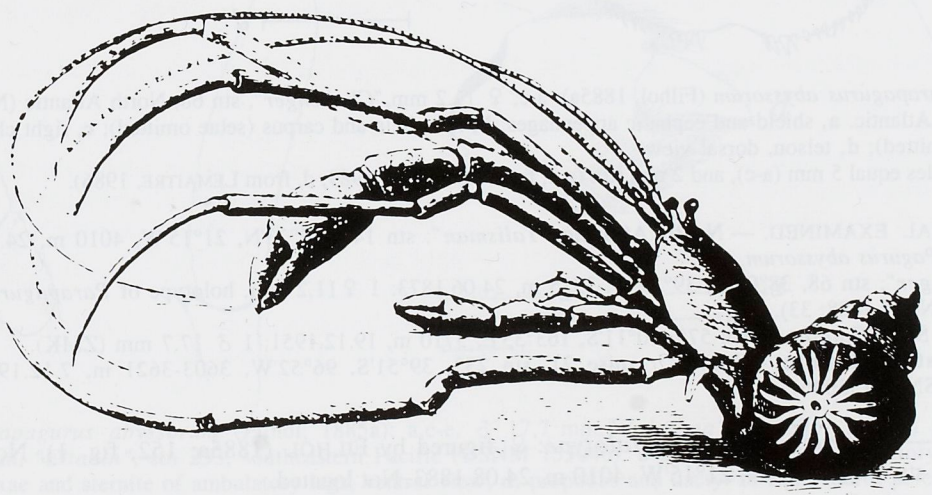


FIG. 4. — *Parapagurus abyssorum* (Filhol, 1885a): ♀ holotype figured by FILHOL (1885a: 132, fig. 1).

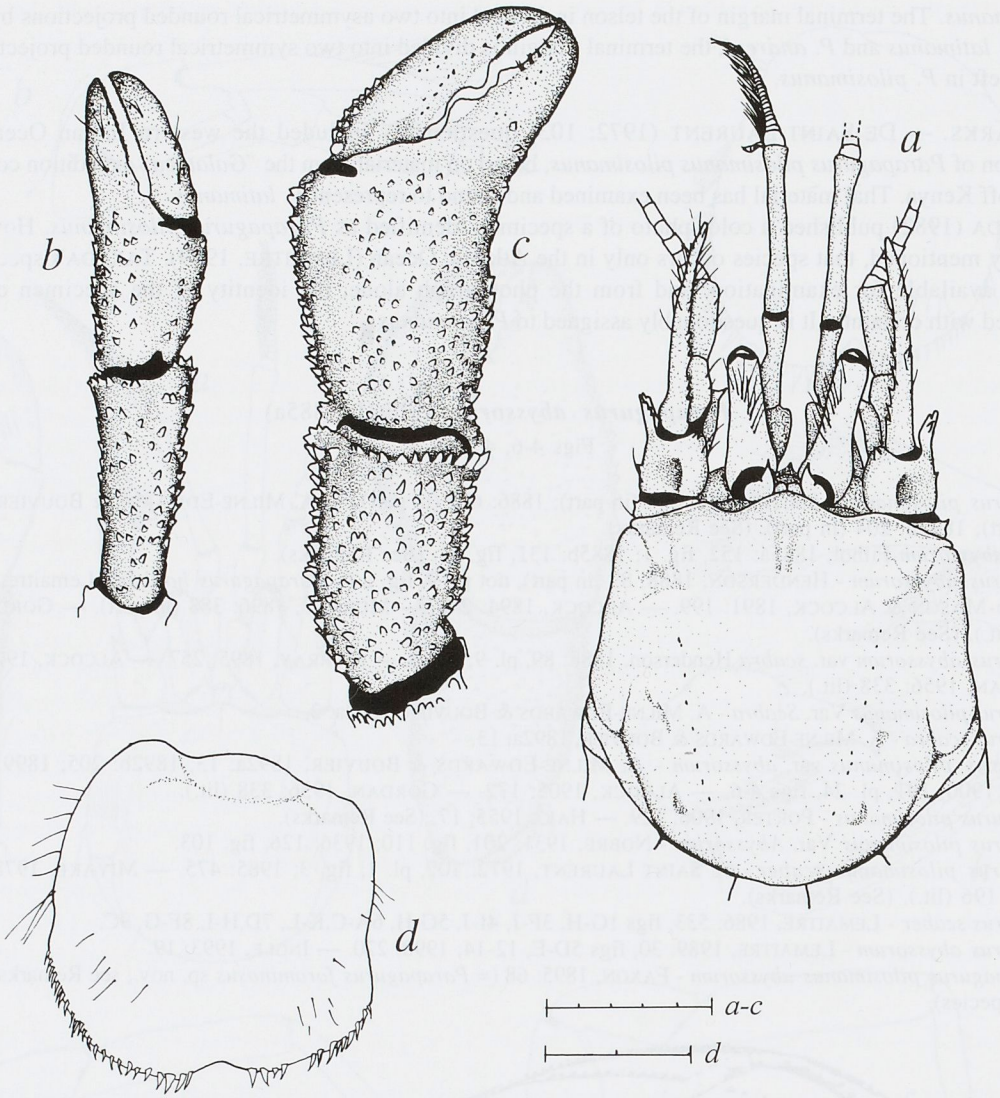


FIG. 5. — *Parapagurus abyssorum* (Filhol, 1885a): a-c, ♀ 11.2 mm,*"Challenger"*, stn 68, North Atlantic (NHM 1888:33); d, North Atlantic. **a**, shield and cephalic appendages; **b**, left chela and carpus (setae omitted); **c**, right chela and carpus (setae omitted); **d**, telson, dorsal view.

Scales equal 5 mm (a-c), and 2 mm (d). (a-c, from LEMAITRE, 1989; d, from LEMAITRE, 1986).

MATERIAL EXAMINED. — **North Atlantic**. *"Talisman"*: stn 148, 42°23'N, 21°15'W, 4010 m, 24.08.1883: 1 ♀, holotype of *Pagurus abyssorum*.

"Challenger": stn 68, 38°03'N, 39°19'W, 3915 m, 24.06.1873: 1 ♀11,2 mm, holotype of *Parapagurus abyssorum* var. *scabra* (NHM 1888: 33).

Tasman Sea. *"Galathea"*: stn 575, 40°11'S, 163°35'E, 3710 m, 19.12.1951: 1 ♂ 17.7 mm (ZMK).

Southeastern Pacific. *"Eltanin"*: cruise 21, stn 233, 39°51'S, 96°52'W, 3603-3621 m, 7.12.1965: 2 ♂ 6.6, 11.3 mm (USNM 155046).

TYPES. — *Pagurus abyssorum*. *Holotype*: ♀ figured by FILHOL (1885a: 152, fig. 1), North Atlantic, *"Talisman"*, stn 148, 42°23'N, 21°15'W, 4010 m, 24.08.1883. Not located.

Parapagurus abyssorum var. *scabra*. *Holotype*: ♀ 11,2 mm, North Atlantic, *"Challenger"*, stn 68, 38°03'N, 39°19'W, 3915 m, 24.06.1873 (NHM 1888: 33).

DIAGNOSIS. — Shield (Fig. 5a) about as broad as long, dorsal surface well calcified; lateral projections broadly rounded. Rostrum broadly subtriangular, rounded distally and with low mid-dorsal ridge. Anterodistal margin of the branchiostegite armed with small spines. Ocular peduncles (including corneae) less than half length of shield, inflated basally; width of cornea about same as distal width of ocular peduncle. Ocular acicles subtriangular, terminating in strong simple spine. Antennular peduncle exceeding distal margin of cornea by nearly entire length of penultimate segment; lateral face of basal segment with statocyst lobe having subrectangular distal lobe armed with 1 or more small spines, and 1 spine proximally. Antennal peduncle exceeding distal margin of cornea by nearly entire length of fifth antennal segment; flagellum with few setae about 1 flagellar article in length or less; acicle nearly straight in dorsal view, exceeding distal margin of cornea by half or more than half length of acicle, mesial and dorsomesial distal margin armed with 5-25 small spines. Epistomial spine usually absent. Sternite of third maxillipeds with strong spine on each side of midline. Left cheliped (Fig. 5b) well calcified, with moderately dense setation; carpus with tubercles or spines on lateral and dorsal faces. Ambulatory legs (Fig. 6a-b) very spinose; dactyls each with dorsal row of small spines; meri, carpi, and propodi each armed on mesial, lateral,

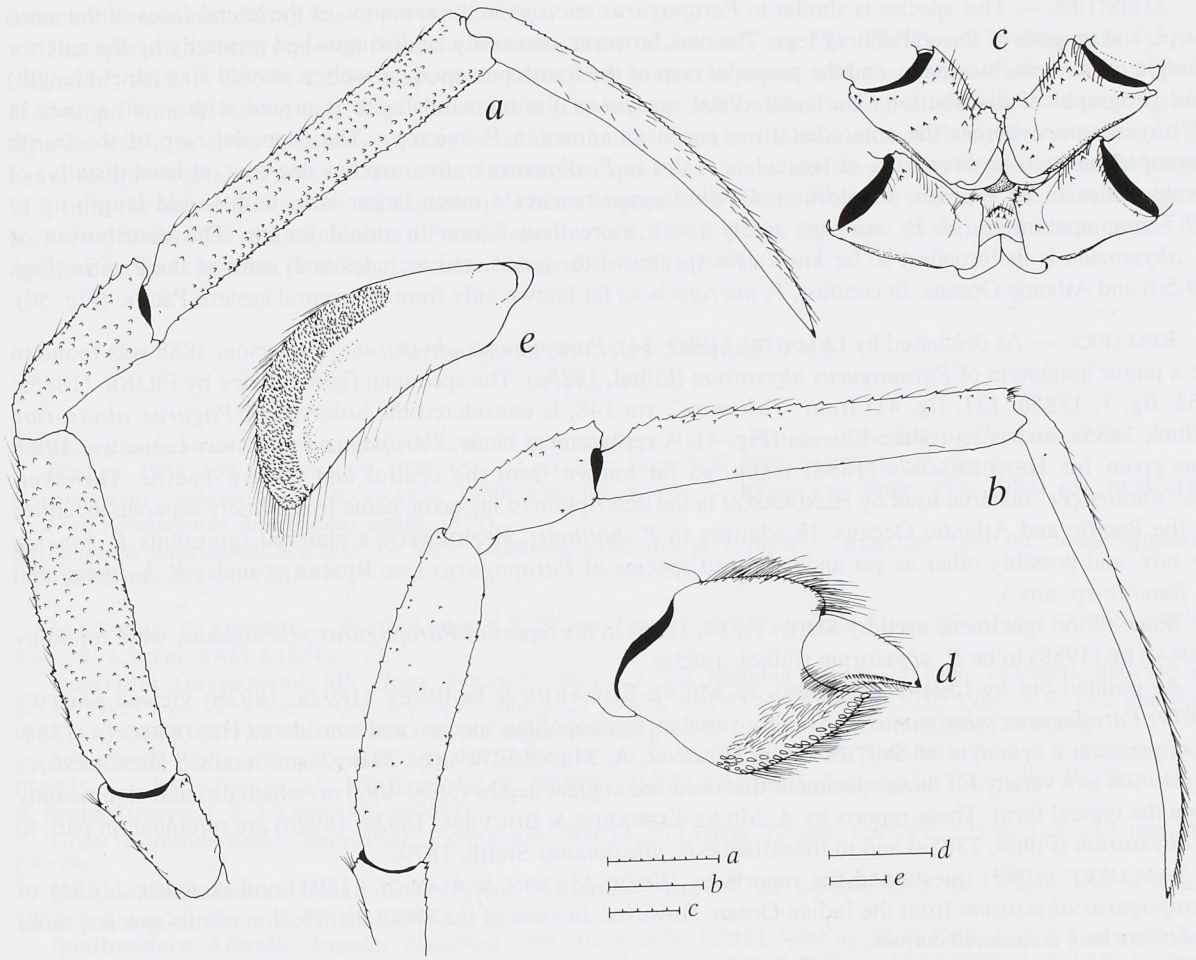


FIG. 6. — *Parapagurus abyssorum* (Filhol, 1885a): a,c-e, ♂ 17.7 mm,*"Galathea"*, stn 575, Tasman Sea (ZMK); d, ♂ 6.6 mm, *"Eltanin"*, stn 233, southeastern Pacific (USNM 155046). **a-b**, right second ambulatory leg, lateral view; **c**, coxae and sternite of ambulatory legs, ventral view; **d**, propodus and dactyl of right fourth pereopod, lateral view; **e**, left exopod of uropods, dorsal view.

Scales equal 10 mm (a), 3 mm (b), 5 mm (c), 2 mm (d), and 1 mm (e).

dorsal, and ventral faces with numerous small spines (less numerous in small specimens SL < 7.0 mm, e.g., Fig. 6b); meri each about 4.1 (first leg) or 3.5 (second leg) times as long as high. Anterior lobe of sternite of second ambulatory legs (Fig. 6c) subsemicircular, setose, armed with 1-5 small subterminal spines. Fourth pereopod (Fig. 6d) with propodal rasp consisting of 2-3 irregular rows of lanceolate scales. Fifth pereopod with propodal rasp less than half length of propodus. Telson (Fig. 5d) and uropods asymmetrical. Terminal margin of telson divided into 2 rounded projections by shallow, rounded (U-shaped) cleft; rounded projections armed distally with short corneous spines. Left exopod (Fig. 6e) of uropod elongate, 2.2 to 2.8 times as long as broad; with broad rasp.

SIZE RANGE. — Males, SL 7.4 to 17.7 mm. Females 7.3 to 13.5 mm. Ovigerous females 8.0 to 13.8 mm.

DISTRIBUTION (Figs 47, 49-50). — North Atlantic, including northeastern coast of the United States; in the eastern Atlantic, from the Azores to Cape Verde Islands. In the western and southeastern Pacific known only from single specimens, one from the Tasman Sea and one from approximately 1930 km west of Chile. Depth: 2500 to 4360 m.

AFFINITIES. — This species is similar to *Parapagurus microps* in the spination of the lateral faces of the meri, carpi, and propodi of the ambulatory legs. The two, however, can easily be distinguished primarily by the anterior margin of the branchiostegite, and the propodal rasp of the fourth pereopod, as well as overall size (shield length) and geographical distribution. The anterodistal margin of the branchiostegite is armed with small spines in *P. abyssorum*, whereas the anterodistal margin lacks spines in *P. microps*. The propodal rasp of the fourth pereopod has two or three rows of lanceolate scales in *P. abyssorum*; the rasp has one row (at least distally) of ovate scales in *P. microps*. In addition, *P. abyssorum* reaches a much larger size, with shield length up to 17.7 mm; specimens of *P. microps* rarely reach more than 8 mm in shield length. The distribution of *P. abyssorum* is the broadest so far known for species of the genus, and includes both sides of the Pacific (Figs 49-50) and Atlantic Oceans. In contrast, *P. microps* is so far known only from the central eastern Pacific (Fig. 50).

REMARKS. — As discussed by LEMAITRE (1989: 34), *Parapagurus abyssorum* Henderson, 1888 was found to be a junior homonym of *Parapagurus abyssorum* (Filhol, 1885a). The specimen figured twice by FILHOL (1885a: 152, fig. 1; 1885b: 131, fig. 41) from *"Talisman"*, stn 148, is considered the holotype of *Pagurus abyssorum* Filhol, 1885a, and is reproduced herein (Fig. 4). A replacement name, *Parapagurus holthuisi* Lemaitre, 1989, was given for HENDERSON's (1888) taxon, so far known from the central and eastern Pacific. However, the *"Challenger"* material used by HENDERSON in the description of his taxon came from widely separate localities in the Pacific and Atlantic Oceans. In addition to *P. holthuisi*, HENDERSON's material represents *P. janetae* sp. nov. and possibly other as yet undetermined species of *Parapagurus* (see REMARKS under *P. holthuisi* and *P. janetae* sp. nov.).

Some of the specimens used by SMITH (1884, 1886) in his report of *Parapagurus pilosimanus,* were found by LEMAITRE (1989) to be *P. abyssorum* (Filhol, 1885a).

As pointed out by LEMAITRE (1989), A. MILNE-EDWARDS & BOUVIER (1892a, 1892b) viewed SMITH's (1879) *Parapagurus pilosimanus* as a highly variable, cosmopolitan species, and considered HENDERSON's (1888) *P. abyssorum* a synonym of SMITH's taxon. However, A. MILNE-EDWARDS & BOUVIER retained HENDERSON's *abyssorum* as a variety for those specimens that occurred at great depths (3650-4060 m) which differed significantly from the typical form. These reports by A. MILNE-EDWARDS & BOUVIER (1892a, 1892b) are referable, in part, to *P. abyssorum* (Filhol, 1885a) and to the Atlantic *P. pilosimanus* Smith, 1879.

LEMAITRE (1989) questioned the reports by WOOD-MASON & ALCOCK (1891) and ALCOCK (1894) of *Parapagurus abyssorum* from the Indian Ocean. However, in view of the broad distribution of this species, those reports are here considered correct.

PORTER (1906) reported *Parapagurus pilosimanus* Smith, 1879, from Los Vilos, Chile, in the eastern Pacific. PORTER, however, expressed some doubt in his identification, which was later questioned by HAIG (1955) because the specimens did not come from deep-water. Furthermore, SMITH's species is now known to occur only in the Atlantic (LEMAITRE, 1989). Unfortunately PORTER's material has not been available for examination and he did

not provide sufficient information to ascertain the identity of his material. If PORTER's material is indeed of a species of *Parapagurus*, it most likely could represent any of three species known to occur in the area, i.e. *P. abyssorum* (Filhol, 1885a), *P. holthuisi* Lemaitre, 1989, or *P. janetae* sp. nov.

In HAIG's (1955) aforementioned publication on the Anomura from Chile, she included *Parapagurus pilosimanus* from off Port Otway and Juan Fernández Islands, based on HENDERSON's (1888) *"Challenger"* material reported as *Parapagurus abyssorum* Henderson, 1888 (= *P. holthuisi*). HAIG (1955) considered HENDERSON's (1888) *P. abyssorum* a synonym of SMITH's (1879) *P. pilosimanus*. Examination of HENDERSON's (1888) material, however, has shown that the single specimen obtained by the *"Challenger"* from Port Otway actually is *P. janetae* sp. nov., and the specimens from Juan Fernández Islands represent *P. holthuisi*.

Based on the literature, GORDAN (1956) listed *Parapagurus abyssorum*, and *P. abyssorum* var. *abyssorum*, and as such refer to *P. holthuisi* Lemaitre, 1989, and *P. abyssorum* (Filhol, 1885a) respectively.

DE SAINT LAURENT (1972) included the Indo-Pacific in the distribution of *Parapagurus pilosimanus scaber* [= *P. abyssorum* (Filhol, 1885a)], but did not list any specimens or indicate exact localities. MIYAKE (1978, 1982), based on DE SAINT LAURENT (1972), listed *P. p. scaber* from Japan, without examining any specimens. Although *P. abyssorum* could possibly occur in Japan, no specimens have been found from this region in any of the collections examined during this or previous studies.

The specimens here reported from the Tasman Sea (*"Galathea"*, stn 575, ZMK) and southeastern Pacific (*"Eltanin"*, stn 233, USNM 155046), appear in all respects to be conspecific with *Parapagurus abyssorum* (Filhol, 1885a), previously known only from the Atlantic (LEMAITRE, 1989). The finding of specimens at such widely separate localities gives this species a very broad distribution, even by the standards of *Parapagurus* species. The minor morphological variations seen in the Tasman Sea specimen can be attributed to its large size (shield length 17.7 mm, the largest known for this species). When compared with other available material, the morphology of both the Tasman Sea and southeastern Pacific specimens fall well within the range of variations documented for this species by LEMAITRE [1986 (as *P. scaber* Henderson, 1888), 1989].

Parapagurus bouvieri Stebbing, 1910

Figs 7, 47, 49

Parapagurus bouvieri Stebbing, 1910: 357, pl. 17 (Crustacea pl. 43). — BALSS, 1924: 768. — GORDAN, 1956: 338. — FÜLLER, 1958: 164. — KENSLEY, 1974: 65. — LEMAITRE 1986: 526; 1989: 11; 1990: 223, fig. 2.

Parapagurus pilosimanus - BARNARD, 1950: 450, fig. 83a-b. — KENSLEY, 1969: 153; 1974: 65; 1977: 161. (Not *Parapagurus pilosimanus* Smith, 1879).

Parapagurus pilosimanus bouvieri - DE SAINT LAURENT, 1972: 103, pl. 1, fig. 4. — KENSLEY, 1981: 34. — MACPHERSON, 1983a: 12; 1983b: 472.

MATERIAL EXAMINED. — **South Africa**. S.S. *"Pieter Faure"*: stn 153, Buffalo River, NW 1/2W, 19 miles, 549 m: 1 ov. ♀ 6.3 mm (SAM A1524).

Australia. *Queensland*. MV *"Iron Summer"*: shot 1-7, off Moreton Island, 27°13'S, 153°00'E, 500-540 m, 2-3.10.1982: 1 ov. ♀ 8.2 mm (QM W16517); shot 2, 27°19'9"S, 153°53'47"E, 600 m, 10.05.1983: 1 ♂ 15.2 mm (QM W14337); shot 3, 27°12'83"S, 153°52'87"E, [no depth recorded], 10.05.1983: 1 ♂ 12.1 mm (QM W14333).

New South Wales. FRV *"Kapala"*: stn K77-23-10, 33°11'S, 152°24'E, 732 m, 7.12.1977: 5 ♂ 8.5-12.1 mm (AM P52735). — RV *"Tangaroa"*: NZOI stn U219, 32°59'S, 152°33.5'E, 381-444 m, 9.10.1982, colls. W. PONDER & R. SPRINGTHORPE: 1 ♀ 3.9 mm (AM P40417).

Great Australian Bight. "Endeavour" EXPEDITION 1909-14: S of Eucla, 33°30'S, 129°28'E, 823 m: 1 ♂ 13.1 mm (AM P52736).

Southwestern Indian Ocean. *South Africa. "Galathea"*: stn 197, off Durban, 29°57'S, 31°26'E, 495 m, 14.02. 1951: 3 ♂ 4.2-7.0 mm, 1 ♀ 7.8 mm (ZMK).

Southeastern Atlantic. *Angola. "Galathea"*: stn 101, 8°50'S, 12°32'E, 990 m, 12.12.1950: 1 ♂ 6.7 mm (ZMK).

South Africa. "Pickle": stn 1483, off Cape Peninsula, 34°06'S, 17°53'E, 247 m, 13.12.1929: 2 ♂ 12.0, 12.2 mm (ZMK).

TYPES. — *Lectotype*: ov. ♀ 6.3 mm (selected by LEMAITRE, 1990: 223), South Africa, S.S. *"Pieter Faure"*, stn 153, Buffalo River, NW 1/2W, 19 miles, 549 m (SAM A1524).

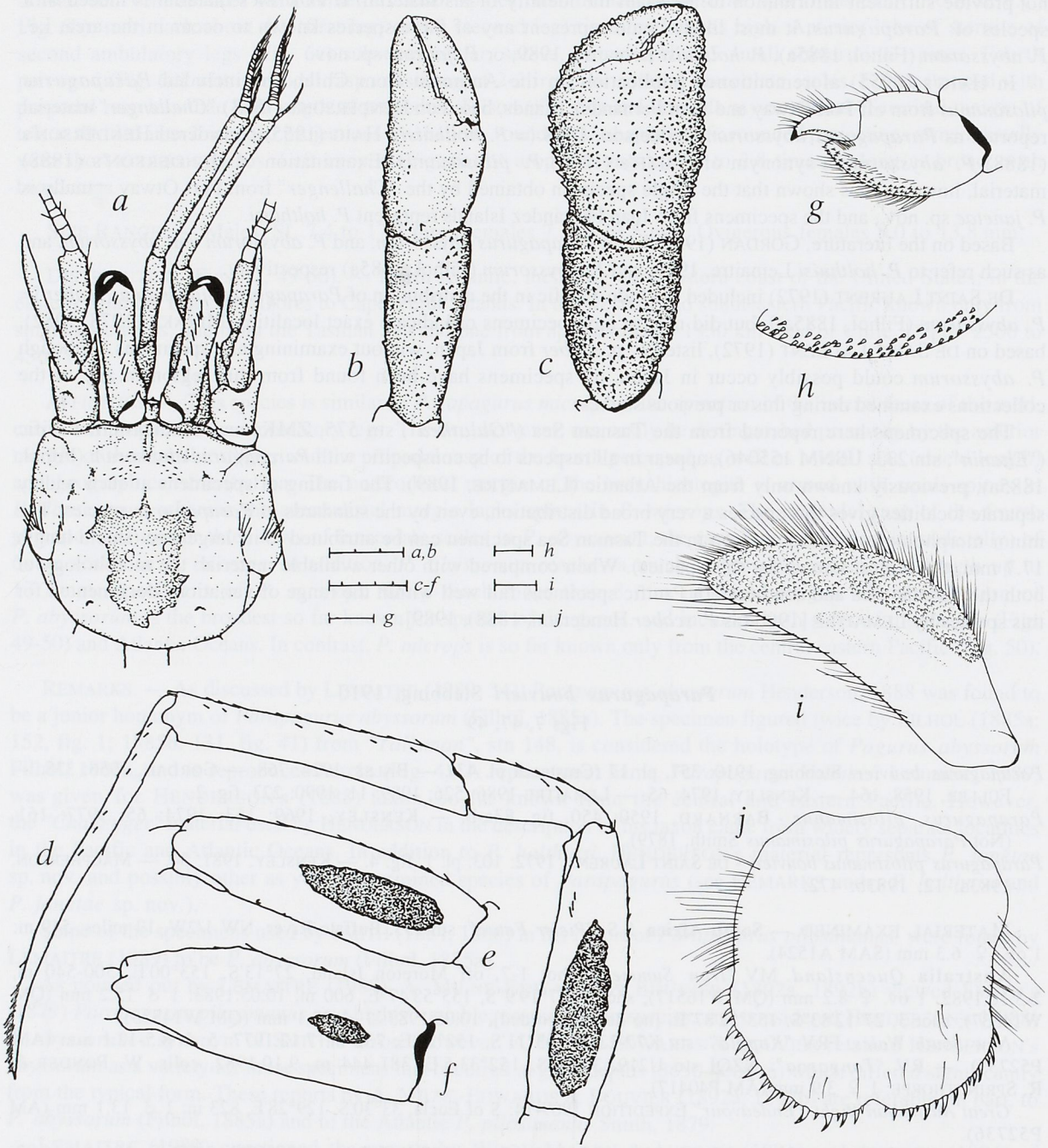


FIG. 7. — *Parapagurus bouvieri* Stebbing, 1910. a-h, southeastern Atlantic: a-c, ♂ 8.2 mm; d, ♂ 10.8 mm; e-f, ov. ♀ 10.0 mm; i-j, ♂ 12.1 mm, Australia, Queensland (QM W14333). **a**, shield and cephalic appendages; **b**, left chela and carpus (setae omitted); **c**, right chela and carpus (setae omitted); **d**, left first ambulatory leg, lateral view; **e**, merus of left first ambulatory leg, lateral view; **f**, merus of left second ambulatory leg, lateral view; **g**, propodus and dactyl of left fourth pereopod, lateral view; **h**, propodal rasp of same (setae omitted), ventrolateral view; **i**, left exopod of uropods, dorsal view; **j**, telson, dorsal view.

Scales equal 3 mm (a-b), 5 mm (c-f), 1 mm (g), 0.5 mm (h), 1 mm (i), and 0.5 mm (j). (a-g, from LEMAITRE, 1990).

DIAGNOSIS. — Shield (Fig. 7a) about as broad as long, dorsal surface well calcified or weakly calcified medially; lateral projections broadly rounded. Rostrum broadly subtriangular, rounded distally; with short mid-dorsal ridge. Ocular peduncles more than half length of shield, weakly inflated basally; width of cornea about same or slightly more than distal width of ocular peduncle. Ocular acicles subtriangular, terminating in strong simple spine (rarely bifid). Antennular peduncle exceeding distal margin of cornea by half length of penultimate segment; lateral face of basal segment with statocyst lobe having subrectangular distal lobe armed with 1 or 2 spines, and 1 spine proximally. Antennal peduncle exceeding distal margin of cornea by at most half length of fifth segment; flagellum with setae 1 to 2 flagellar articles in length; acicle weakly curved in dorsal view, exceeding distal margin of cornea by at most half length of acicle, mesial margin armed with 5 to 10 small spines. Epistomial spine usually present. Sternite of third maxillipeds with strong spine on each side of midline. Left cheliped (Fig. 7b) well calcified, densely setose; carpus with irregular rows of small spines on dorsal margin. Ambulatory legs (Fig. 7d-f) with meri, carpi and propodi unarmed except for small dorsodistal spine on each carpus; meri each about 3.5 (first leg) or 2.9 (second leg) times as long as high, with lateral and mesial faces weakly calcified medially (weak calcification more pronounced on second leg; Fig. 7d-e). Anterior lobe of sternite of second ambulatory legs subsemicircular, setose, armed with small subdistal spine. Fourth pereopod (Fig. 7g-h) with propodal rasp consisting of 2 or 3 rows of conical scales. Fifth pereopod with propodal rasp less than half length of propodus. Telson (Fig. 7j) and uropods asymmetrical. Terminal margin of telson divided into 2 rounded projections by shallow, rounded (U-shaped) cleft; rounded projections armed distally with alternating short and long corneous spines (approximately 15 to 20 left, 10 to 17 right). Left exopod (Fig. 7i) of uropod elongate, about 3.0 times as long as broad; with broad rasp.

SIZE RANGE. — Males, SL 4.0 to 15.2 mm. Females 3.9 to 11.0 mm. Ovigerous females 6.3 to 12.2 mm.

COLOR (from BARNARD, 1950: 451, as *Parapagurus pilosimanus*). — "Body pinkish, basal joints of chelipeds with reddish patches, 2nd and 3rd legs red, with a conspicuous white band along the upper and lower margins, cornea dark crimson, antenna 1 pink with white band along upper margin of last peduncular joint, antenna 2 pink."

VARIATIONS. — The weakly calcified area on the lateral and mesial faces of the meri of the ambulatory legs usually can be recognized by a dark, brownish coloration. The area is often slender, and occasionally is absent on the first leg.

HABITAT. — Usually found living in shelters formed by zoanthid species, probably *Epizoanthus* sp.

DISTRIBUTION (Figs 47, 49). — Southeastern Atlantic and southwestern Indian Ocean: off Angola to South Africa, and northward to off Natal. Western Pacific: Australia. Depth: 247 to 990 m.

REMARKS. — This species can be distinguished from all others in the genus by the weak calcification (usually marked by a dark, brown area) present on the lateral and mesial faces of the meri of the ambulatory legs, and the greater development of the ocular peduncles. In *P. bouvieri*, the length of the ocular peduncles (including corneae) is distinctly more than half the length of the shield, whereas in all other species of *Parapagurus* the ocular peduncles are half or less than half the length of the shield. The reduction of the ocular peduncles in *P. bouvieri* has not been as strong as in other species of the genus, and is a condition that can perhaps be attributed to the relatively shallower depth range at which this species lives compared to other species in the genus (Fig. 47). In other crustaceans, a reduction of eyes with increasing depth has also been documented (e.g., MENZIES *et al.*, 1973; MARSHALL, 1979), and is an evolutionary trend that evidently has occurred independently in many groups.

Parapagurus andreui Macpherson, 1984

Figs 8-9, 47, 49

Parapagurus andreui Macpherson, 1984: 81, figs 24-27. — LEMAITRE, 1986: 526; 1989: 11; 1990: 221, fig. 1. — LEMAITRE & MCLAUGHLIN, 1992: 763.

MATERIAL EXAMINED. — **Southeastern Atlantic**. VALDIVIA 1: stn P-5, Valdivia bank, 25°34.5'S, 6°04'E, 930-933 m, 17.05.1983: 1 ♂ 14.4 mm, 1 ov. ♀ 14.8 mm, paratypes (USNM 240164).

Western Indian Ocean. *La Réunion. "Marion Dufresne"*: cruise MD32, stn CP 103, 20°41.6'S, 54°56.8'E, 2950-2970 m, 29.08.1982: 2 ♂ 12.2, 14.2 mm (MNHN-Pg 5646).

South Africa. "Galathea": stn 190, off Durban, 29°42'S, 33°19'E, 2720 m, 3.02.1951: 1 ♂ (damaged) 9.5 mm (ZMK).

TYPES. — All from Valdivia Bank. *Holotype*: ov. ♀ 14.0 mm, VALDIVIA 1: stn P-4, 25°32'S, 6°06.9'E, 904-959 m (ICM-D 204/1991). *Paratypes*: 1 ♂, 1 ov. ♀, VALDIVIA 1: stn P-4, 25°32'S, 6°06.9'E, 904-959 m (ICM). — 4 ♂, 4 ov. ♀ (ICM); 1 ♂ 14.4 mm, 1 ov. ♀ 14.8 mm (USNM 240164), VALDIVIA 1: stn P-5, 25°34.5'S, 6°04'E, 933 m, 17.05.1983. — 1 ♂, VALDIVIA 1: stn P-9, 25°35'S, 6°09.3'E, 922 m (ICM). — 4 ♂, 3 ♀, 3 ov. ♀, VALDIVIA 1: stn P-10, 25°29.3'S, 6°07.5'E, 900-915 m (ICM).

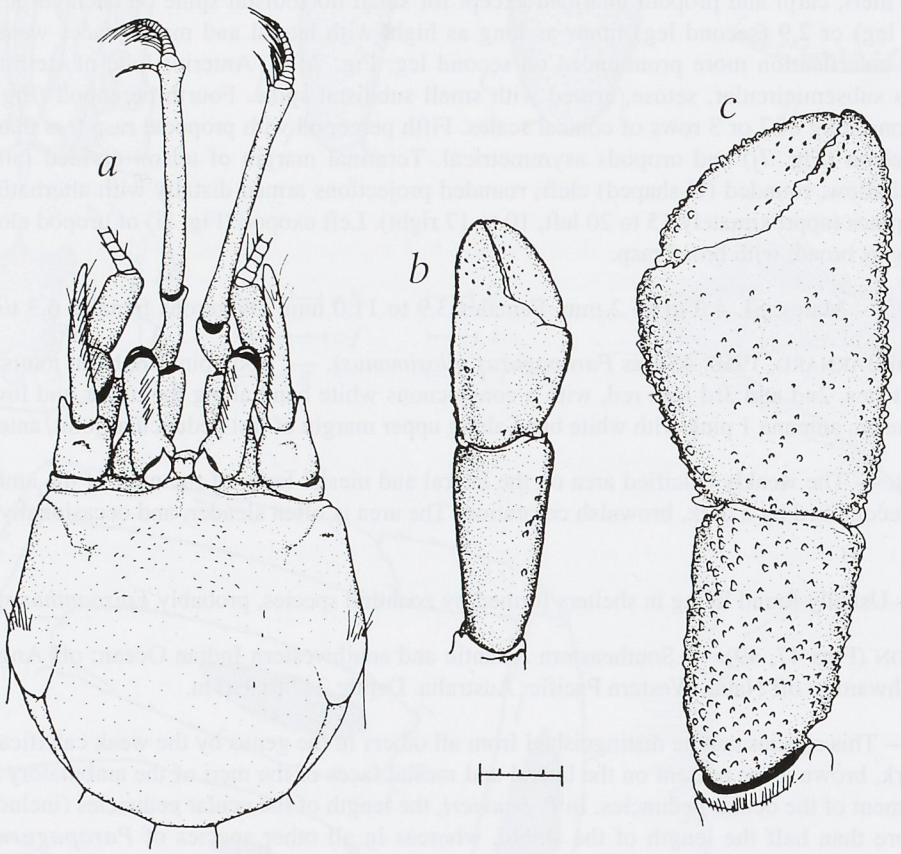


FIG. 8. — *Parapagurus andreui* Macpherson, 1984, southeastern Atlantic: **a**, shield and cephalic appendages; **b**, left chela and carpus (setae omitted); **c**, right chela and carpus (setae omitted).
Scale equals 4 mm. (From LEMAITRE, 1990).

DIAGNOSIS. — Shield (Fig. 8a) about as broad as long, dorsal surface well calcified or with weakly calcified areas medially; lateral projections broadly rounded. Rostrum broadly subtriangular, rounded distally; with short mid-dorsal ridge. Anterolateral margin of branchiostegite unarmed. Ocular peduncles less than half length of shield, inflated basally; width of cornea about same as distal width of ocular peduncle. Ocular acicles subtriangular, terminating in simple strong spine (rarely bifid). Antennular peduncle exceeding distal margin of cornea by nearly entire length of penultimate segment; lateral face of basal segment with statocyst lobe having subrectangular distal lobe armed with 1 or 2 spines, and 1 spine proximally. Antennal peduncle exceeding distal margin of cornea by

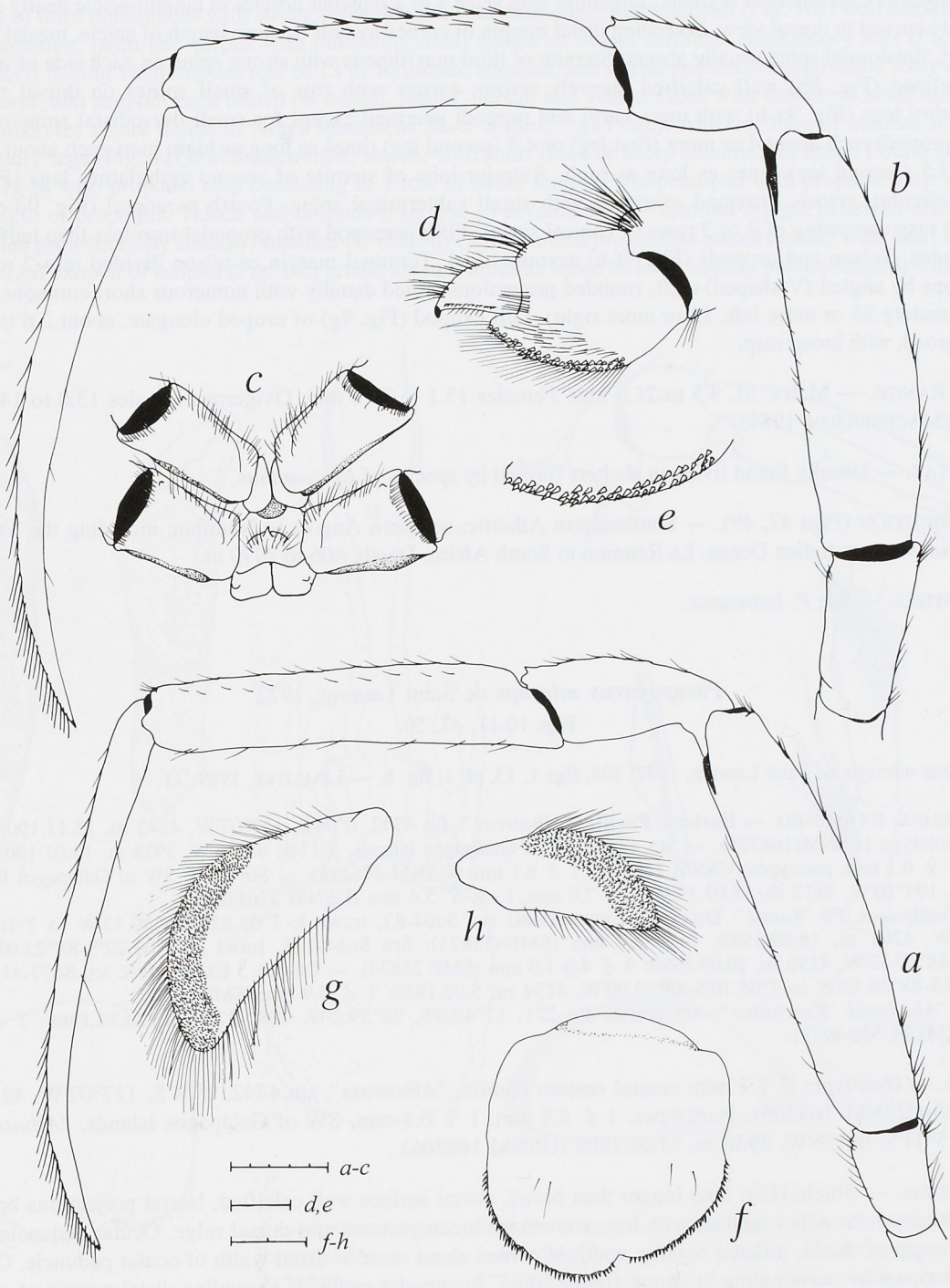


FIG. 9. — *Parapagurus andreui* Macpherson, 1984, western Indian Ocean, La Réunion, *"Marion Dufresne"*, stn CP 103: ♂ 14.2 mm (MNHN-Pg 5646). **a**, left first ambulatory legs, lateral view; **b**, left second ambulatory leg, lateral view; **c**, coxae and sternites of ambulatory legs, ventral view; **d**, propodus and dactyl of left fourth pereopod, lateral view; **e**, propodal rasp of same (setae omitted), ventrolateral view; **f**, telson, dorsal view; **g-h**, left (g) and right (h) exopod of uropods, dorsal view. Scales equal 5 mm (a-c), 1 mm (d), 0.5 mm (e), and 2 mm (f-h).

entire length of fifth antennal segment; flagellum with setae 1 to 2 flagellar articles in length; acicle nearly straight or weakly curved in dorsal view, exceeding distal margin of cornea by half or more length of acicle, mesial margin unarmed. Epistomial spine usually absent. Sternite of third maxillipeds with strong spine on each side of midline. Left cheliped (Fig. 8b) well calcified, densely setose; carpus with row of small spines on dorsal margin. Ambulatory legs (Fig. 9a-b) with meri, carpi and propodi unarmed except for small dorsodistal spine on each carpus; propodi each about 4 or more (first leg) or 4.5 (second leg) times as long as high; meri each about 4 (first leg) or 3.5 (second leg) times as long as high. Anterior lobe of sternite of second ambulatory legs (Fig. 9c) subsemicircular, setose, unarmed or armed with small subterminal spine. Fourth pereopod (Fig. 9d-e) with propodal rasp consisting of 2 or 3 rows of conical scales. Fifth pereopod with propodal rasp less than half length of propodus. Telson and uropods (Fig. 9f-h) asymmetrical. Terminal margin of telson divided into 2 rounded projections by angled (V-shaped) cleft; rounded projections armed distally with numerous short corneous spines (approximately 25 or more left, 15 or more right). Left exopod (Fig. 9g) of uropod elongate, about 2.6 times as long as broad; with broad rasp.

SIZE RANGE. — Males, SL 9.5 to 21.0 mm. Females 13.1 to 20.0 mm. Ovigerous females 13.0 to 14.4 mm or more (MACPHERSON, 1984).

HABITAT. — Usually found living in shelters formed by species of *Epizoanthus*.

DISTRIBUTION (Figs 47, 49). — Southeastern Atlantic: southern Angola to Namibia, including the Valdivia Bank. Southwestern Indian Ocean: La Réunion to South Africa. Depth: 406 to 2970 m.

AFFINITIES. — See *P. latimanus*.

Parapagurus microps de Saint Laurent, 1972

Figs 10-11, 47, 50

Parapagurus microps de Saint Laurent, 1972: 104, figs 1, 13, pl. 1, fig. 8. — LEMAITRE, 1989: 11.

MATERIAL EXAMINED. — **Eastern Pacific**. *"Albatross"*: stn 4742, 0°04'S, 117°07'W, 4243 m, 15.11.1905: 1 ♂ 8.7 mm, holotype (USNM 168305). — Stn 4717, SW of Galápagos Islands, 5°11'S, 98°56'W, 3938 m, 13.01.1905: 1 ♂ 5.8 mm, 1 ♀ 6.1 mm, paratypes (USNM 168306), 1 ♂ 6.1 mm (USNM 276115). — Stn 4721, SW of Galápagos Islands, 8°07'30"S, 104°10'W, 3812 m, 15.01.1905: 1 ♀ 7.0 mm, 1 ov. ♀ 5.4 mm (USNM 276116).

S of Galápagos. FS *"Sonne"*. DISCOL 2 EXPEDITION: stn So64-83, trawl 4, 7°08.83'S-88°30.13'W to 7°10.65'S-88°29.00'W, 4261 m, 16.09.1989: 1 ♂ 7.7 mm (SMF 23873); Stn So64-115, trawl 5, 7°01.22'S-88°23.07'W to 7°08.68'S-88°20.37'W, 4196 m, 20.09.1989: 5 ♂ 4.0-7.0 mm (SMF 23874). — DISCOL 3 EXPEDITION: stn So77-41, trawl 7, 7°08.58'S-88°26.10'W to 7°05.70'S-88°27.00'W, 4154 m, 5.02.1989: 1 ♂ 4.9 mm (SMF 23875).

Perú. *"Akademik Kurchatov"*: 4th cruise, stn 271, 17°42.0'S, 78°59.2'W, 3080-2710 m, 20.10.1968: 2 ♂ 5.0, 6.7 mm (ZMUM Ma-4979).

TYPES. — *Holotype*: ♂ 8.7 mm, central eastern Pacific, *"Albatross"*, stn 4742, 0°04'S, 117°07'W, 4243 m, 15.11.1905 (USNM 168305). *Paratypes*: 1 ♂ 5.8 mm, 1 ♀ 6.1 mm, SW of Galápagos Islands, *"Albatross"*, stn 4717, 5°11'S, 98°56'W, 3938 m, 13.01.1905 (USNM 168306).

DIAGNOSIS. — Shield (Fig. 10a) longer than broad, dorsal surface well calcified; lateral projections broadly rounded. Rostrum broadly rounded; with low, sometimes inconspicuous mid-dorsal ridge. Ocular peduncles less than half length of shield, inflated basally; width of cornea about same as distal width of ocular peduncle. Ocular acicles subtriangular, terminating in strong simple spine. Antennular peduncle exceeding distal margin of cornea by full length of penultimate segment; lateral face of basal segment with statocyst lobe having subrectangular distal lobe armed usually with 1 small spine, and 1 spine proximally. Antennal peduncle (Fig. 10b) exceeding distal margin of cornea by half length of fifth antennal segment; flagellum with scattered setae about 1 to 2 flagellar articles in length; acicle nearly straight in dorsal view, exceeding distal margin of cornea by 0.3 to 0.5 length of acicle, mesial margin unarmed or with 1-3 small spines proximally. Epistomial spine usually present.

Sternite of third maxillipeds with strong spine on each side of midline. Left cheliped (Fig. 10c) well calcified, with sparse setation; palm and carpus with numerous small spines on dorsal surfaces. Ambulatory legs (Fig. 11a-e) with dactyl having ventromesial row of 13 to 16 minute spinules, and dorsal and dorsomesial distal rows of setae; meri, carpi, and propodi each armed on mesial, lateral, dorsal, and ventral faces with numerous small spines and sharp tubercles (more dense in larger specimens SL > 8 mm, Fig. 11a,c). Anterior lobe of sternite of second ambulatory legs (Fig. 11f) subsemicircular, setose, with short blunt or sharp subterminal spine. Fourth pereopod (Fig. 11g-h) with propodal rasp consisting of 1 row of ovate scales. Fifth pereopod with propodal rasp less than half length of propodus. Telson and uropods (Fig. 10e-g) asymmetrical. Terminal margin of telson divided into 2 rounded projections by shallow, rounded (U-shaped) cleft; rounded projections armed distally with short corneous spines. Left exopod of uropod (Fig. 10f) broad, about 2 times as broad as long, usually paddle-shaped; with narrow rasp.

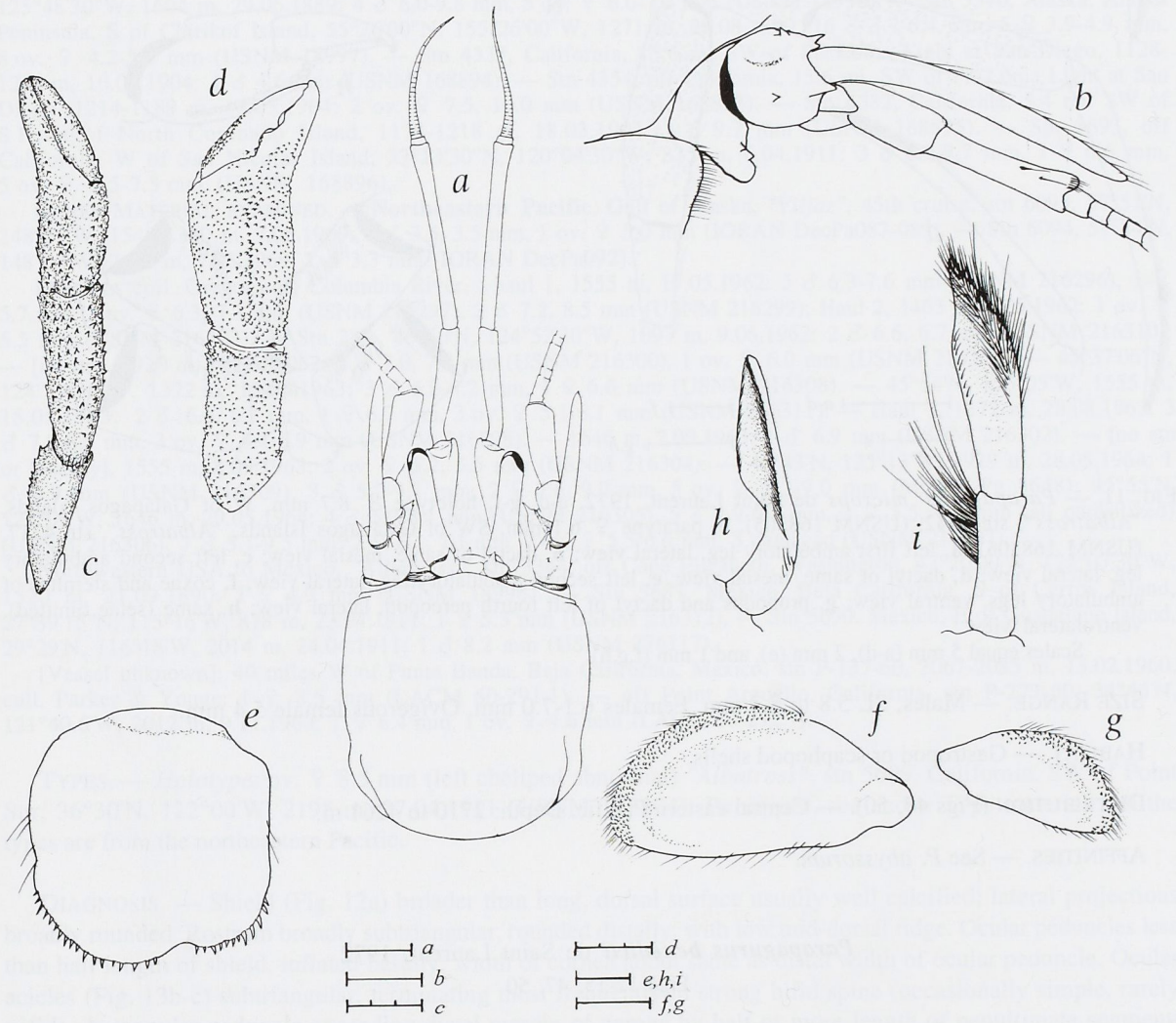


FIG. 10. — *Parapagurus microps* de Saint Laurent, 1972. a-g, holotype ♂ 8.7 mm , W of Galápagos Islands, *"Albatross"*, stn 4742 (USNM 168305); h-i, ♂ 6.1 mm, SW of Galápagos Islands, *"Albatross"*, stn 4717 (USNM 276115). **a**, shield and cephalic appendages; **b**, right antennal peduncle, lateral view; **c**, left cheliped (setae omitted); **d**, right chela and carpus (setae omitted); **e**, telson, dorsal view; **f-g**, left (f) and right (g) exopod of uropods, dorsal view; **h**, male left first pleopod; **i**, male left second pleopod.

Scales equal 1 mm (a-b,f-g), 3 mm (c-d), and 0.5 mm (e,h-i). (a,d, from DE SAINT LAURENT, 1972).

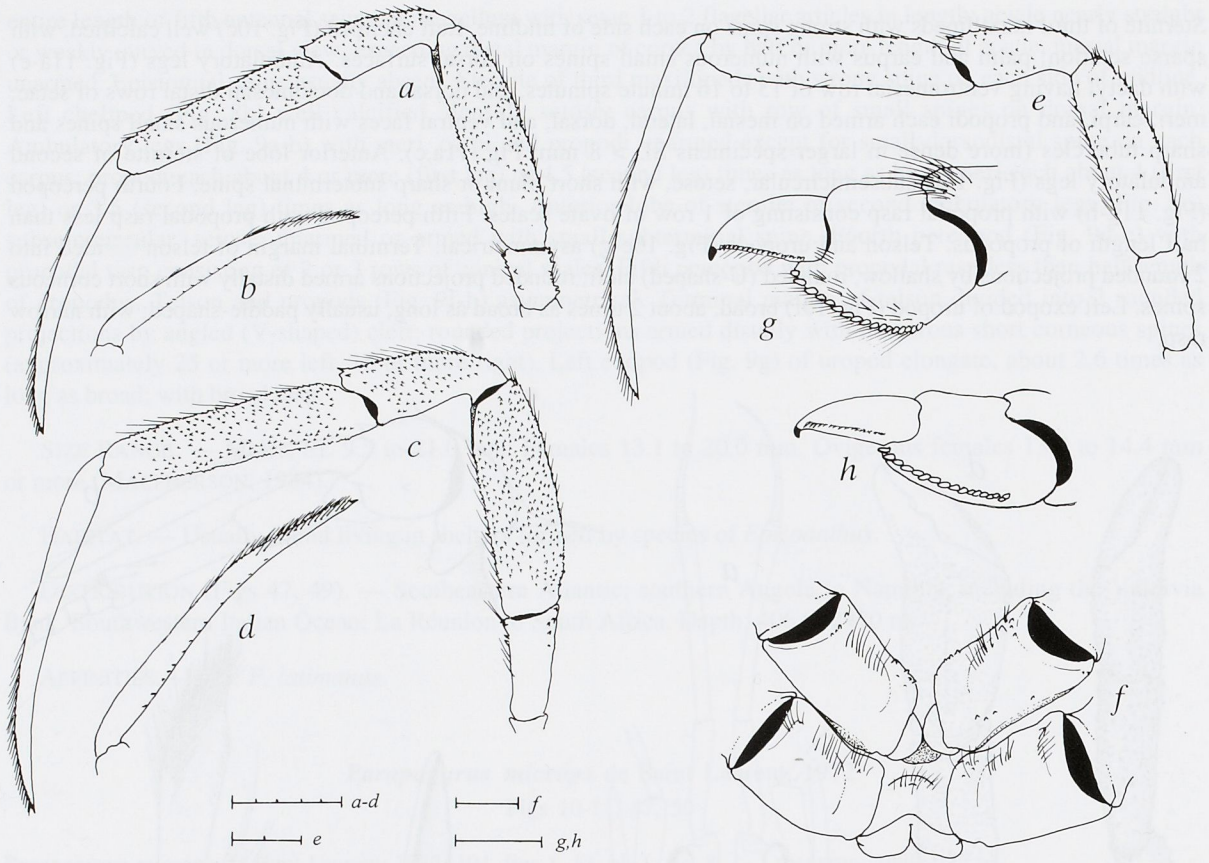


FIG. 11. — *Parapagurus microps* de Saint Laurent, 1972. a-d, g-i, holotype ♂ 8.7 mm, W of Galápagos Islands, *"Albatross"*, stn 4742, (USNM 168305); e, paratype ♀ 6.1 mm, SW of Galápagos Islands, *"Albatross"*, stn 4717, (USNM 168306). **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, left second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, left second ambulatory leg, lateral view; **f**, coxae and sternites of ambulatory legs, ventral view; **g**, propodus and dactyl of left fourth pereopod, lateral view; **h**, same (setae omitted), ventrolateral view.

Scales equal 5 mm (a-d), 2 mm (e), and 1 mm (f,g,h).

SIZE RANGE. — Males, SL 5.8 to 8.7 mm. Females 6.1-7.0 mm. Ovigerous female 5.4 mm.

HABITAT. — Gastropod or scaphopod shells.

DISTRIBUTION (Figs 47, 50). — Central eastern Pacific. Depth: 2710 to 4261 m.

AFFINITIES. — See *P. abyssorum*.

Parapagurus benedicti de Saint Laurent, 1972

Figs 12-15, 47, 50

Parapagurus sp. indet. - RATHBUN, 1904: 162; 1910: 162.

Parapagurus armatus - REINHART, 1944: 56, fig. 7A. — REISCHMAN, 1959: 409 (nomen nudum, see Remarks).

?*Parapagurus pilosimanus* - MAKAROV, 1938: 223, fig. 74; 1941: 139; 1962: 212, fig. 74. — VINOGRADOV, 1950: 240 (key), pl. 27, fig. 113. — BIRSHTEIN & VINOGRADOV, 1951: 60. — KOBJAKOVA, 1958: 221 (list). — BIRSHTEIN & ZARENKOV, 1972: 442 (see Remarks).

Parapagurus pilosimanus benedicti de Saint Laurent, 1972: 103, pl. 1, fig. 6. — McLaughlin, 1974: 371, figs 100-101. — Hart, 1982: 108, fig. 38.
Parapagurus benedicti - Lemaitre, 1989: 11.
Not *Parapagurus armatus* - Ross, 1967: 306 [= *Sympagurus trispinosus* (Balss, 1911), see Remarks].

Material examined. Type Material. — **Northeastern Pacific**. *Holotype*: ov. ♀ 8.5 mm (left cheliped abnormal, see Variations and abnormalities), *"Albatross"*, stn 5699, California, SW of Point Sur, 36°30'N, 122°00'W, 2195 m, 27.04.1911: (USNM 168304).

Probable paratypes (see Remarks). *"Albatross"*: stn 2839, California, Channel Islands, North of San Clemente Island, 33°08'00"N, 118°40'00"W, 757 m, 8.05.1888: 1 ♂ 8.7 mm (USNM 18992). — Stn 2860, Canada, British Columbia, Queen Charlotte Island, Kunghit Island, S of Cape St. James, 51°23'00"N 130°34'00"W, 1602 m, 31.08.1888: 1 ♂ 9.4 mm (USNM 18993). — Stn 2923, California, San Diego, 32°40'30"N, 117°31'30"W, 1503 m, 19.01.1889: 1 ♂ 8.2 mm, 3 ov. ♀ 6.0-7.5 mm (USNM 18994). — Stn 2928, California, San Diego, 32°47'30"N, 118°10'00"W, 763 m, 23.01.1889: 6 ♂ 5.2-8.1 mm, 1 ov. ♀ 6.1 mm (USNM 18995). — Stn 3074, Washington, Sea Lion Rocks, 47°22'00"N, 125°48'30"W, 1604 m, 29.06.1889: 4 ♂ 6.0-9.8 mm, 5 ov. ♀ 6.0-7.2 mm (USNM 18996). — Stn 3340, Alaska, Alaska Peninsula, S of Chirikof Island, 55°26'00"N, 155°26'00"W, 1271 m, 29.08.1890: 16 ♂ 3.7-6.4 mm, 5 ♀ 3.9-4.9 mm, 8 ov. ♀ 4.2-5.8 mm (USNM 18997). — Stn 4337, California, 15.6 mi SW of Pt. Loma Light at San Diego, 1128-1244 m, 10.03.1904: 1 ♂ 4.6 mm (USNM 168894). — Stn 4354, off California, 15.6 mi. SW of Pt. Loma Light at San Diego, 1214-1189 m, 14.03.1904: 2 ov. ♀ 7.5, 10.0 mm (USNM 168893). — Stn 4382, California, 5.4 mi. SW of S Point of North Coronado Island, 1174-1218 m, 18.03.1904: 1 ♂ 9.7 mm (USNM 168895). — Stn 5693, off California, W of San Nicolas Island, 33°13'30"N, 120°04'30"W, 825 m, 6.04.1911: 3 ♂ 6.1-9.7 mm, 1 ♀ 6.6 mm, 5 ov. ♀ 5.5-7.5 mm (USNM 168896).

Other Material examined. — **Northeastern Pacific**. Gulf of Alaska, *"Vitjaz"*, 45th cruise: stn 6093, 57°51'N, 148°57'W, 1540-1340 m, 7.05.1969: 2 ♂ 3.5, 3.5 mm, 1 ov. ♀ 5.0 mm (IORAN DecPa087-089). — Stn 6094, 57°44'N, 148°37'W, 2400 m, 7.05.1969: 1 ♂ 3.3 mm (IORAN DecPa092).

Pereyra coll.: Oregon, off Columbia River, : haul 1, 1555 m, 17.05.1962: 3 ♂ 6.3-7.6 mm (USNM 216296), 1 ♀ 5.7 mm, 2 ov. ♀ 6.3, 7.3 mm (USNM 216297), 2 ♂ 7.2, 8.5 mm (USNM 216299); Haul 2, 1463 m, 7.05.1962: 1 ov. ♀ 5.5 mm (USNM 216303). — Stn 23A, 45°50'N, 124°52'30"W, 1097 m, 9.06.1962: 2 ♂ 6.6, 6.7 mm (USNM 216310). — [no stn], 1920 m, 10.06. 1962: 2 ♂ 7.0, 7.8 mm (USNM 216300), 1 ov. ♀ 6.0 mm (USNM 216301). — 45°37'06"N, 124°54'36"W, 1372 m, 15.05.1963: 3 ♂ 6.0-8.2 mm, 1 ♀ 6.6 mm (USNM 216308). — 45°54'N, 125°05'W, 1555 m, 15.05.1963: 2 ♂ 6.6, 6.7 mm, 1 ♀ 6.7 mm, 3 ov. ♀ 5.1-6.1 mm (USNM 216311). — Haul 1, 1372 m, 28.08.1963: 3 ♂ 7.0-8.5 mm, 3 ov. ♀ 5.4-6.9 mm (USNM 216298). — 1646 m, 2.09.1963: 1 ♂ 6.9 mm (USNM 216302). — [no stn or locality], 1555 m, 8.09.1963: 2 ov. ♀ 5.2, 5.5 mm (USNM 216304). — 45°43'N, 125°13'W, 1929 m, 28.05.1964: 1 ♂ 9.9 mm (USNM 216309), 3 ♂ 5.2-9.1 mm, 2 ♀ 7.6, 9.0 mm, 5 ov. ♀ 5.2-9.0 mm (MNHN-Pg 5648); 45°55'N, 125°09'W, 1646 m, 29.05.1964: 4 ♂ 5.2-8.1 mm (USNM 216305), 5 ♂ 4.9-6.7 mm, 2 ♀ 5.5, 6.0 mm (all parasitized) (USNM 216306), 7 ♂ 5.1-9.5 mm, 2 ♀ 6.1, 7.1 mm, 7 ov. ♀ 5.5-6.6 mm, 3 damaged (USNM 216307).

Northwestern USA to Mexico. *"Albatross"*: stn 3344, off Cape Elizabeth, Washington, 47°20'00"N, 125°07'30"W, 1520 m, 21.09.1890: 1 ♀ 4.9 mm (USNM 18998). — Stn 5687, Mexico, Baja California, S of Cerros Island, 27°39'15"N, 115°16'W, 878 m, 23.04.1911: 1 ♀ 5.3 mm (USNM 216312). — Stn 5690, Mexico, E of Guadalupe Island, 29°29'N, 116°18'W, 2014 m, 24.04.1911: 1 ♂ 8.2 mm (USNM 276117).

[Vessel unknown]: 40 miles W of Punta Banda, Baja California, Mexico, stn P-137-60, 2067-2085 m, 13.02.1960, coll. Parker & Yonge: 1 ♀ 8.5 mm (LACM 60-291.1). — off Point Arguello, California, stn P-273-60, 34°46'N, 121°40.6'W, 2012 m, 9.11.1960: 1 ♀ 6.4 mm, 1 ov. ♀ 4.6 mm (LACM 60-292.1).

Types. — *Holotype*: ov. ♀ 8.5 mm (left cheliped abnormal) *"Albatross"*, stn 5699, California, SW of Point Sur, 36°30'N, 122°00'W, 2195 m, 27.04.1911 (USNM 168304). *Paratypes*, see above Type material. All the types are from the northeastern Pacific.

Diagnosis. — Shield (Fig. 12a) broader than long, dorsal surface usually well calcified; lateral projections broadly rounded. Rostrum broadly subtriangular, rounded distally; with low mid-dorsal ridge. Ocular peduncles less than half length of shield, inflated basally; width of cornea about same as distal width of ocular peduncle. Ocular acicles (Fig. 13b-c) subtriangular, terminating most frequently in strong bifid spine (occasionally simple, rarely trifid). Antennular peduncle exceeding distal margin of cornea by half or more length of penultimate segment; lateral face of basal segment with statocyst lobe having subrectangular distal lobe armed with 1-3 small spines, and 1 spine proximally. Antennal peduncle (Fig. 13a) exceeding distal margin of cornea by about 0.6 length of fifth antennal segment; flagellum with scattered short setae about 1 flagellar article in length or less; second segment with dorsolateral distal angle produced into strong, broad multifid spine usually with somewhat concave dorsal

face; first segment with 1-4 spines on lateral face; acicle weakly curved in dorsal view, exceeding distal margin of cornea by 0.3 to 0.5 length of acicle, mesial margin armed with 4-12 small spines (2 or 3 spines in small specimens SL 4.0 mm). Epistomial spine usually present, simple or occasionally bifid. Sternite of third maxillipeds with strong spine on each side of midline. Left cheliped (Fig. 12c) well calcified, with dense setation on carpus and chela; palm armed with irregular rows of spines on dorsolateral and dorsomesial faces; carpus with numerous spines on dorsal surface. Ambulatory legs (Figs 12e, 14a-d) with dactyls each having ventromesial row of 8 to 12 minute spinules, and dorsal and dorsomesial distal rows of setae; lateral and mesial faces of segments smooth, except for scattered short setae; first leg with ischium and merus (Fig. 14a,c) armed with irregular rows of small spines on ventral margins; second leg with merus armed with irregular row of small spines (less distinct and numerous than on first leg) on ventral margin (Fig. 14b,d), ischium unarmed or with a few small blunt spines on

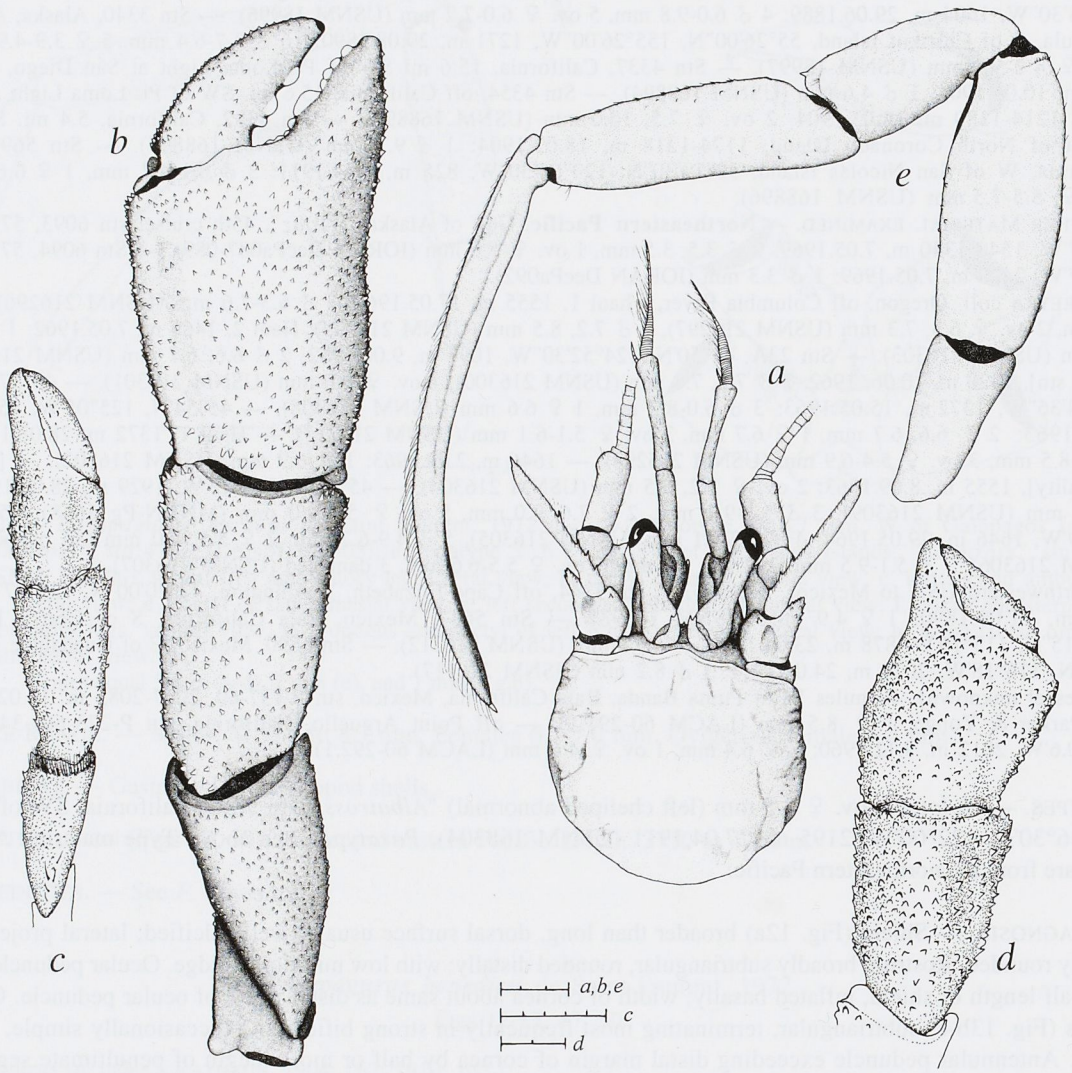


FIG. 12. — *Parapagurus benedicti* de Saint Laurent, 1972. a-b,e, NE Pacific; c, ov. ♀ 10.0 mm, NE Pacific, *"Albatross"*, stn 4354, (USNM 168893); d, holotype ov. ♀ 8. 5 mm, NE Pacific, *"Albatross"*, stn 5699 (USNM 168304). **a**, shield and cephalic appendages; **b**, right cheliped (setae omitted); **c**, left cheliped (setae omitted); **d**, left cheliped of holotype (setae omitted); **e**, left second ambulatory leg, lateral view.

Scales equal 3 mm (a-b,e), 5 mm (c), and 2 mm (d). (a,b,e, from MCLAUGHLIN, 1974).

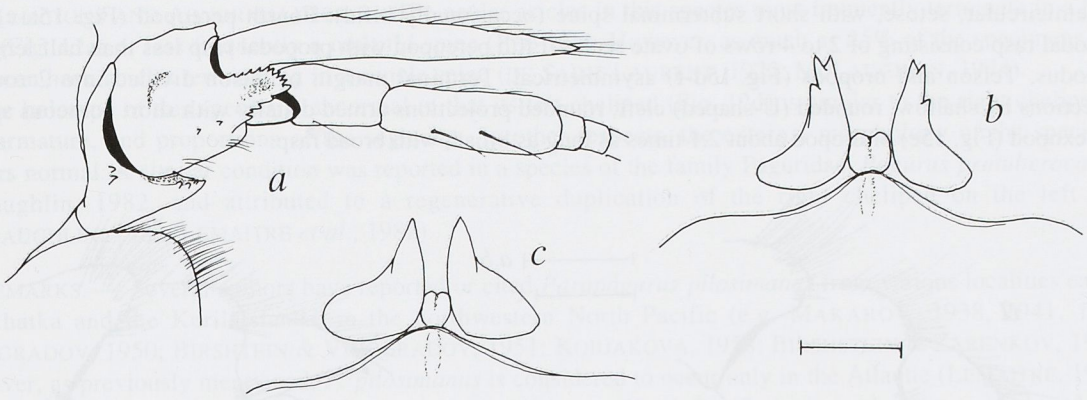


FIG. 13. — *Parapagurus benedicti* de Saint Laurent, 1972, NE Pacific. a-b, ♀ 7.3 mm, off Columbia River (USNM 216297); c, ov. ♀ 5.5 mm (USNM 216304). **a**, right antennal peduncle, lateral view; **b-c**, ocular acicles and rostrum, dorsal view.

Scale equals 1 mm.

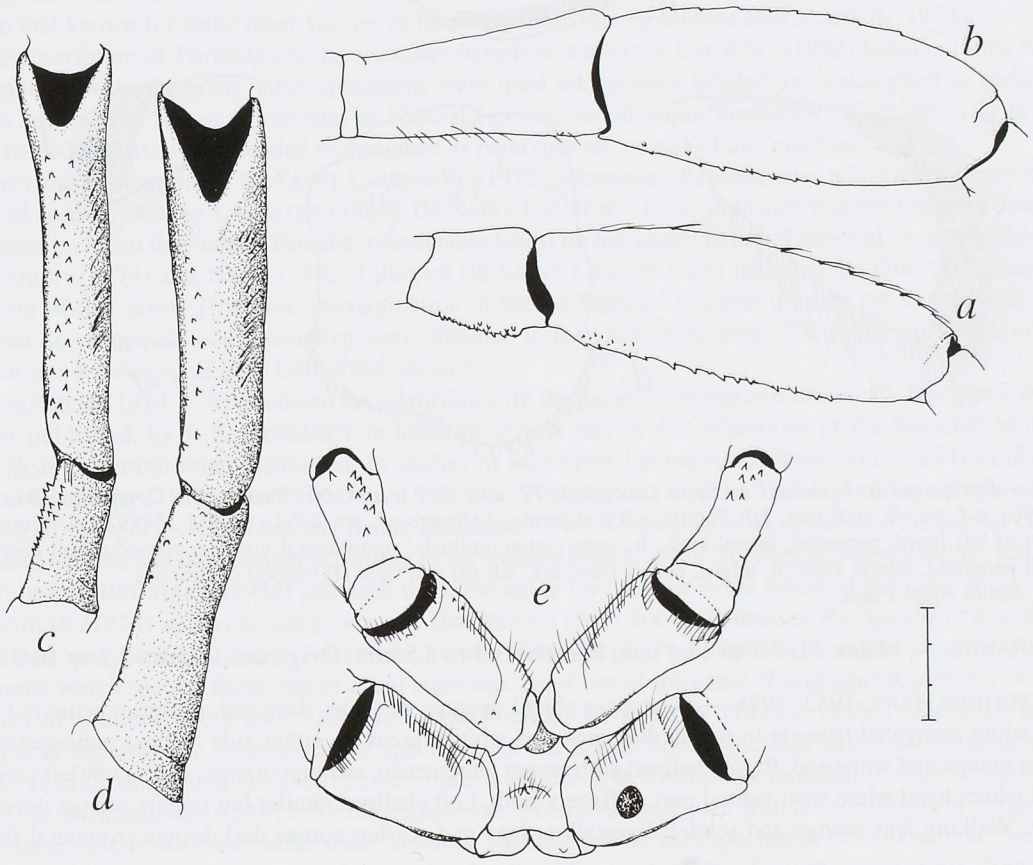


FIG. 14. — *Parapagurus benedicti* de Saint Laurent, 1972, ov. ♀ 10.0 mm, NE Pacific, off California, *"Albatross"*, stn 4354, (USNM 168893): **a-b**, ischium and merus of right first (a) and second (b) ambulatory legs, lateral view; **c-d**, same of first (c) and second (d) ambulatory legs, ventral view; **e**, coxae and sternites of ambulatory legs, ventral view (ischia shown for first legs).

Scale equals 3 mm.

ventral margin distally. Anterior lobe of sternite of second ambulatory legs (Fig. 14e) with anterior lobe subsemicircular, setose, with short subterminal spine (occasionally bifid). Fourth pereopod (Fig. 15a-c) with propodal rasp consisting of 2 to 4 rows of ovate scales. Fifth pereopod with propodal rasp less than half length of propodus. Telson and uropods (Fig. 15d-f) asymmetrical. Terminal margin of telson divided into 2 rounded projections by shallow, rounded (U-shaped) cleft; rounded projections armed distally with short corneous spines. Left exopod (Fig. 15e) of uropod about 2.1 times as long as broad, with broad rasp.

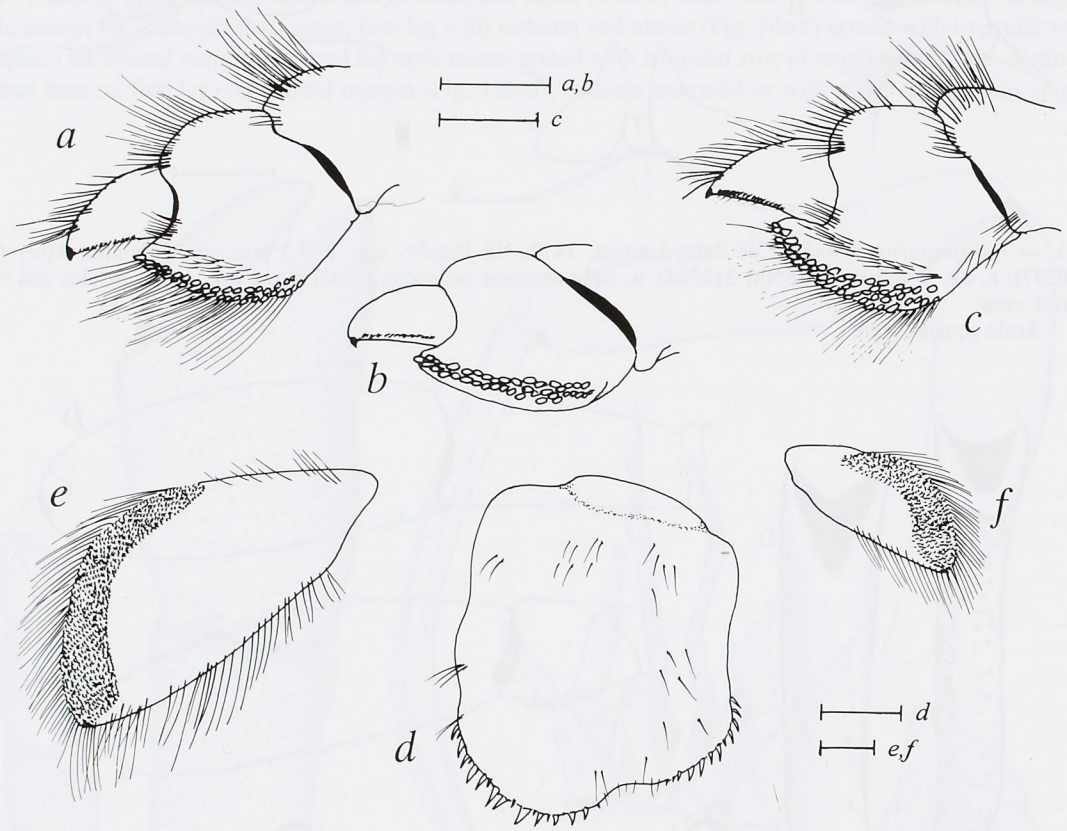


FIG. 15. — *Parapagurus benedicti* de Saint Laurent, 1972. a-b, ♂ 7.6 mm, NE Pacific, off Columbia River (USNM 216296); c-f, ov. ♀ 10.0 mm, NE Pacific, off California, *"Albatross"*, stn 4354 (USNM 168893). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fourth pereopod, lateral view; **d**, telson, dorsal view; **e-f**, left (e) and right (f) exopod of uropods.
Scales equal 1 mm.

SIZE RANGE. — Males, SL 3.7 to 13.4 mm. Females 3.9 to 8.5 mm. Ovigerous females 4.2 to 10.0 mm.

COLOR (from HART, 1982: 108). — "Carapace shield opaque, the sides deep red, posterior wine-red with an opaque, white elongated triangle in the cardiac area and whitish areas on either side of this; pubescence white. Abdomen orange and white-red. Right cheliped with cream pubescence; ischium orange; merus scarlet; carpus pale pink and white; hand white with ventral part of fingers pink. Left cheliped similar but fingers orange dorsally and ventrally. Walking legs orange and scarlet. Eyestalk orange and scarlet; cornea dark brown. Antennal flagellum orange."

HABITAT. — Gastropod shells with or without actinian entirely covering shell.

DISTRIBUTION (Figs 47, 50). — Northeastern Pacific: from Alaska to Baja California; possibly northwestern Pacific (see Remarks). Depth: 757 to 2400 m.

VARIATIONS AND ABNORMALITIES. — The ocular acicles in this species most frequently terminate in a bifid spine (Fig. 12a) or less frequently a multifid spine (Fig. 13b). However, as much as 25% of the specimens in a series can have acicles terminating in a simple spine (DE SAINT LAURENT, 1972; MCLAUGHLIN, 1974).

The holotype of this species is abnormal in that its left cheliped (Fig. 12d) is similar to the right cheliped in size, armature, and proportions of the segments. In other respects, the external morphology of the specimen appears normal. A similar condition was reported in a species of the family Paguridae, *Pagurus protuberocarpus* McLaughlin, 1982, and attributed to a regenerative duplication of the right cheliped on the left side (MCLAUGHLIN, 1982; LEMAITRE *et al.*, 1982).

REMARKS.—- Several authors have reported or cited *Parapagurus pilosimanus* from various localities east of Kamchatka and the Kuril Islands, in the northwestern North Pacific (e.g. MAKAROV, 1938, 1941, 1962; VINOGRADOV, 1950; BIRSHTEIN & VINOGRADOV, 1951; KOBJAKOVA, 1958; BIRSHSTEIN & ZARENKOV, 1972). However, as previously mentioned, *P. pilosimanus* is considered to occur only in the Atlantic (LEMAITRE, 1989). The specimens reported by these authors from the northwestern North Pacific have not been examined, and their identity cannot be established with certainty based on the information included in their publications. No reports of other *Parapagurus* species are known from the norhwestern North Pacific, north of Japan. The specimens reported by these authors might represent *P. benedicti*, the only species so far known to occur in the extreme northeastern portion of the North Pacific (see Fig. 50). It is possible that this species might have an amphi-Pacific distribution similar to that known for some other species of hermit crabs in the region (see MCLAUGHLIN, 1974).

In her description of *Parapagurus pilosimanus benedicti*, DE SAINT LAURENT (1972) listed only the holotype for her taxon. Evidently many other specimens were used which were labeled and catalogued as paratypes in museums such as the National Museum of Natural History, Smithsonian Institution, Washington. It is unclear whether DE SAINT LAURENT intended to designate as paratypes all, or part of this material.

As previously mentioned, DE SAINT LAURENT's (1972) subspecies *Parapagurus pilosimanus benedicti* was elevated to specific rank by LEMAITRE (1989). DE SAINT LAURENT (1972) indicated that the southern distribution of this taxon included the Gulf of Panamá, presumably based on her examination of material from the *"Albatross"*. MCLAUGHLIN (1974) and HART (1982) followed DE SAINT LAURENT and included the Gulf of Panamá in the distribution of this taxon. However, reexamination of the *"Albatross"* material used by DE SAINT LAURENT has shown that no specimens of *P. benedicti* were obtained in the Gulf of Panamá. The southernmost record so far known for this species is off Baja California, Mexico.

MCLAUGHLIN (1974: 378) discussed the confusion with the name *"Parapagurus armatus"*. This name was used, but never published, by J. E. BENEDICT in labeling several lots in the collections of the National Museum of Natural History, Smithsonian Institution. In studies of rhizocephalan parasites, REINHARD (1944) examined the specimens labeled by J. E. BENEDICT, and used the name *"Parapagurus armatus"* in a legend for his figure (fig. 7A) of the host of his species *Angulosaccus tenuis* Reinhard, 1944. No diagnosis was given for the hermit crab host, so the name became a nomen nudum according to the International Code of Zoological Nomenclature. REISCHMAN (1959) followed REINHARD (1944) and used the same name for the host in his report of the same rhizocephalan. MCLAUGHLIN (1974) also concluded correctly that ROSS' (1967: 306) reference to *Parapagurus armatus* from Pemba Strait, near Zanzibar, did not refer to the eastern North Pacific *P. pilosimanus benedicti*, but she was unable to determine which species ROSS' report could represent. Ross' use of the name *"Parapagurus armatus"* was based on studies of actinians from the *"Valdivia"* Expedition by CARLGREN (1928a, 1928b) who used the name *Parapagurus armatus* var. *trispinosus* for specimens of the hermit crab associated with *Isadamsia cancrisocia* Carlgren, 1928a, collected at stn 246, Pemba Strait. It appears that CARLGREN intended to refer to *Parapagurus arcuatus* var. *trispinosa* Balss, 1911, for the hermit crab specimens associated with his specimens of *I. cancrisocia*, and mistakenly used *"armatus"* rather than *"arcuatus"*. BALSS' hermit crab specimens from *"Valdivia"*, stn 246 are of *Sympagurus trispinosus* (Balss, 1911), a species distributed in the Indo-Pacific (LEMAITRE, 1994, 1996).

Parapagurus benedicti can be separated from all other species of the genus known to occur in the eastern Pacific, by the spines present on the ventral margins of the meri of the first and second ambulatory legs (Fig. 14a-d); and the dorsolateral distal angle of the second antennal segment (Fig. 13a), which is distinctly more strongly developed than in other species of the genus, and terminates in a multifid spine with a slightly concave

dorsal face. The bifid or less frequently multifid condition of the ocular acicles of *P. benedicti* also is a useful diagnostic character. However, as mentioned under "Variations and Abnormalities", the ocular acicles are variable and can terminate in a simple spine in a significant number of specimens.

Parapagurus holthuisi Lemaitre, 1989

Figs 16-18, 47, 49-50

Parapagurus abyssorum Henderson, 1888: 87 (in part), pl. 9, fig. 2. — MURRAY, 1895: 1129 (in part); 1896: 388 (in part). — GORDAN, 1956: 337 (lit.). [Not *Parapagurus abyssorum* (Filhol, 1885a); see Remarks].

?*Parapagurus pilosimanus* - HAIG, 1955: 17. — PORTER, 1906: 129. [See Remarks under *Parapagurus abyssorum* (Filhol, 1885a)].

Parapagurus pilosimanus abyssorum - DE SAINT LAURENT, 1972: 103 (in part), ?not pl. 1, fig. 7 (see Remarks).

Parapagurus holthuisi Lemaitre, 1989: 34. [Replacement name for *Parapagurus abyssorum* Henderson, 1888, junior homonym of *Parapagurus abyssorum* (Filhol, 1885a)].

MATERIAL EXAMINED. — **Eastern Pacific**. *"Challenger"*, stn 300, W of Valparaiso, Chile, 33°42'S, 78°18'W, 2515 m, 17.12.1875: ♂ 14.9 mm , holotype (NHM 1888:33), 5 ♂ 11.8-13.3 mm, 1 ♀ 7.8 mm, 2 ov. ♀ 8.1, 11.4 mm , paratypes (NHM 1888:33). — Stn 3374, Galápagos Islands, 2°35'N, 83°53'W, 3334 m, 3.03.1891: 1 ov. ♀ 6.3 mm (USNM 42625). — Stn 4647, off Perú, 4°33'S, 87°42'30"W, 3667 m, 9.11.1904: 10 ♂ 5.9-10.0 mm, 6 ♀ 5.1-7.0 mm (USNM 276114); 2 ♂ 8.8, 9.4 mm, 2 ov. ♀ 5.7, 6.0 mm (MNHN-Pg 5649).

"Challenger". Chile. Juan Fernández Island, [no stn number], 2115 m: 1 ♂ 13.3 mm, 3 ov. ♀ 10.0-10.4 mm (USNM 15298). — Off Juan Fernández Island, [no stn number], 2115 m: 3 ♂ 8.5-12.8 mm (ZMK). — Off Valparaiso, [no stn number or other data]: 1 ♀ 11.2 mm, 1 ov. ♀ 10.7 mm (USNM 156411).

Central Pacific. *Magellan Rise.* POSSE EXPEDITION, *"Alvin"*, dive 1816, 7°00'N, 177°00'W, 3150 m, 17.03.1987, coll. K. SMITH: 1 ♂ 12.2 mm (SIO C9941).

TYPES. — *Holotype* : ♂ 14.9 mm (Holotype of *Parapagurus abyssorum* Henderson, 1888), *"Challenger"*, stn 300, W of Valparaiso, Chile, 33°42'S, 78°18'W, 2515 m, 17.12.1875 (NHM 1888:33). *Paratypes*: 5 ♂ 11.8-13.3 mm, 1 ♀ 7.8 mm, 2 ov. ♀ 8.1, 11.4 mm, same data as holotype (NHM 1888:33).

REDESCRIPTION. — Shield (Fig. 16a) about as long as broad; dorsal surface usually well calcified, with scattered short setae; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margin sloping. Rostrum broadly subtriangular, rounded distally, overreaching lateral projections; often with inconspicuous low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 16b) unarmed, setose.

Ocular peduncles (including corneae) distinctly less than half length of shield, each with rows of setae dorsally; peduncles inflated basally, slightly constricted medially. Ocular acicles subtriangular, terminating in strong simple spine; separated basally by slightly less than basal width of one acicle.

Antennular peduncles slender, long, exceeding distal margins of corneae by 0.8 or more length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 1-3 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 16b) exceeding distal margins of cornea by about 0.8 or more length of fifth segments. Fifth segment with scattered setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong multifid spine; mesial margin with spine on dorsodistal angle. First segment unarmed on lateral face; ventromesial angle produced, with row of small spines. Antennal acicles weakly curved in dorsal view, setose; exceeding distal margin of cornea by about half or less length of acicle; mesial margin armed usually with 4 to 8 (range 1 to 10) small spines. Flagellum distinctly overreaching extended right cheliped, with sparse short setae less than 1 flagellar articles in length.

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule (Fig. 16c-d) with external lobe of endopod weakly developed, internal lobe with long terminal seta and 4 subterminal setae. Third maxilliped with crista dentata consisting of about 19 corneous-tipped teeth. Sternite of third maxilliped with spine on each side of midline. Epistomial spine usually present.

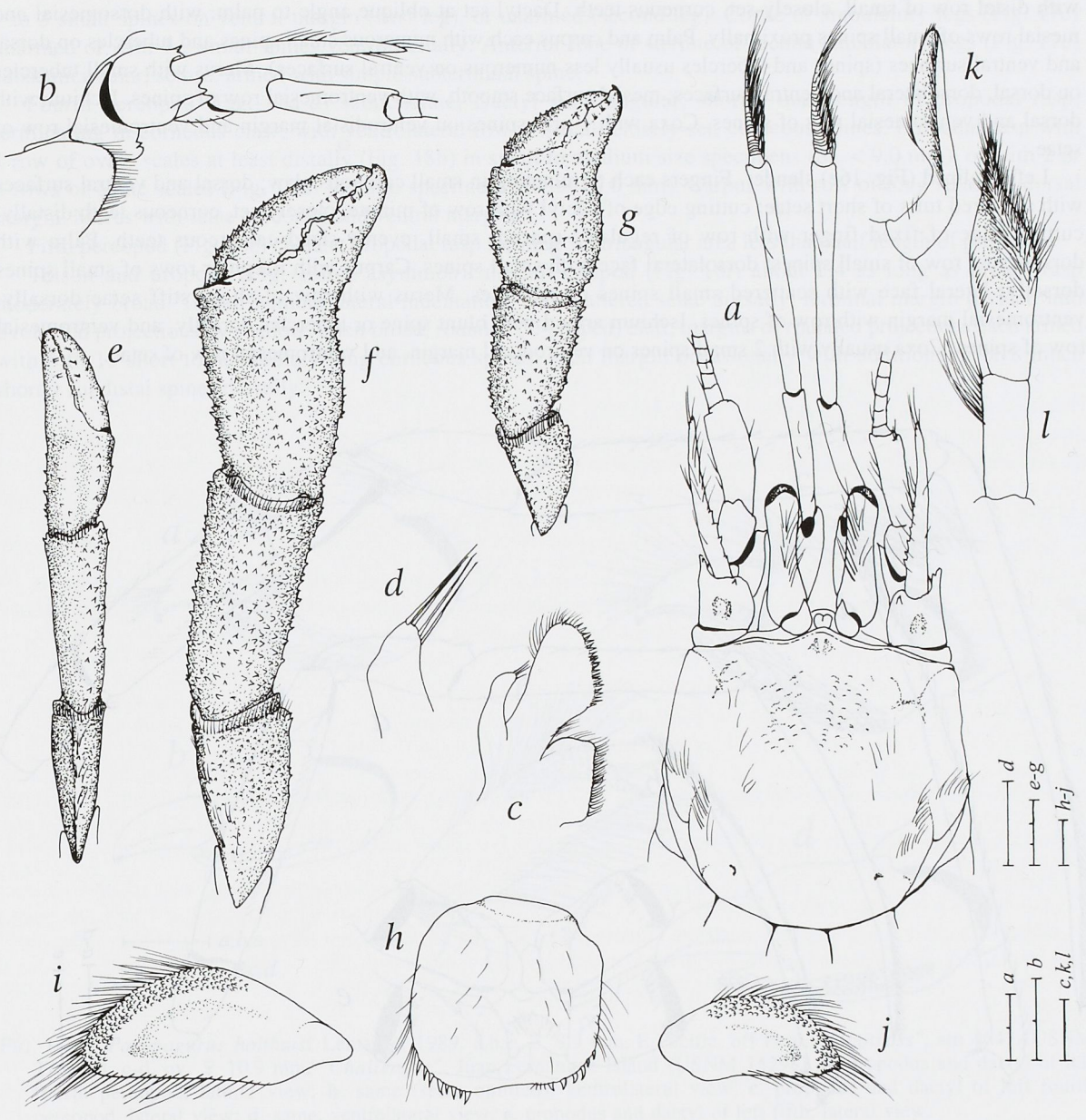


FIG. 16. — *Parapagurus holthuisi* Lemaitre, 1989, NE Pacific, off Perú, *"Albatross"*, stn 4647 (USNM 276114): a-b,e-f, h-j, ♂ 8.9 mm; c,d,k,l, ♂ 9.6 mm; g, ov. ♀ 7.0 mm. **a**, shield and cephalic appendages; **b**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **c**, left maxillule, internal view; **d**, distal end of endopod of same; **e**, left cheliped (setae omitted); **f**, right cheliped (setae omitted); **g**, right cheliped (setae omitted); **h**, telson, dorsal view; **i-j**, left (i) and right exopod of uropods, dorsal view; **k**, male left first pleopod, mesial view; **l**, male second pleopod, anterior view.

Scales equal 2 mm (a-b), 1 mm (c-d,k-l), 3 mm (e-g), and 0.5 mm (h-j).

Chelipeds markedly dissimilar, each with dorsal surfaces of carpus and chela covered with moderately dense setation; proportions of carpus and chela influenced by size and sexual dimorphism (see Variations). Right cheliped (Fig. 16f-g) with fingers bent inwards at tips, each terminating in small corneous claw; with tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also

with distal row of small, closely-set, corneous teeth. Dactyl set at oblique angle to palm, with dorsomesial and mesial rows of small spines proximally. Palm and carpus each with numerous small spines and tubercles on dorsal and ventral surfaces (spines and tubercles usually less numerous on ventral surfaces). Merus with small tubercles on dorsal, dorsolateral and ventral surfaces; mesial surface smooth, with ventromesial row of spines. Ischium with dorsal and ventromesial row of spines. Coxa with 1 or 2 spines on ventrodistal margin and ventromesial row of setae.

Left cheliped (Fig. 16e) slender. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute, closely-set, corneous teeth distally; cutting edge of fixed finger with row of regularly-spaced, small, evenly-sized calcareous teeth. Palm with dorsomesial row of small spines; dorsolateral face with small spines. Carpus with irregular rows of small spines dorsally; lateral face with scattered small spines or tubercles. Merus with row of short, stiff setae dorsally; ventromesial margin with row of spines. Ischium armed with blunt spine or tubercles dorsally, and ventromesial row of spines. Coxa usually with 2 small spines on ventrodistal margin, and ventromesial row of setae.

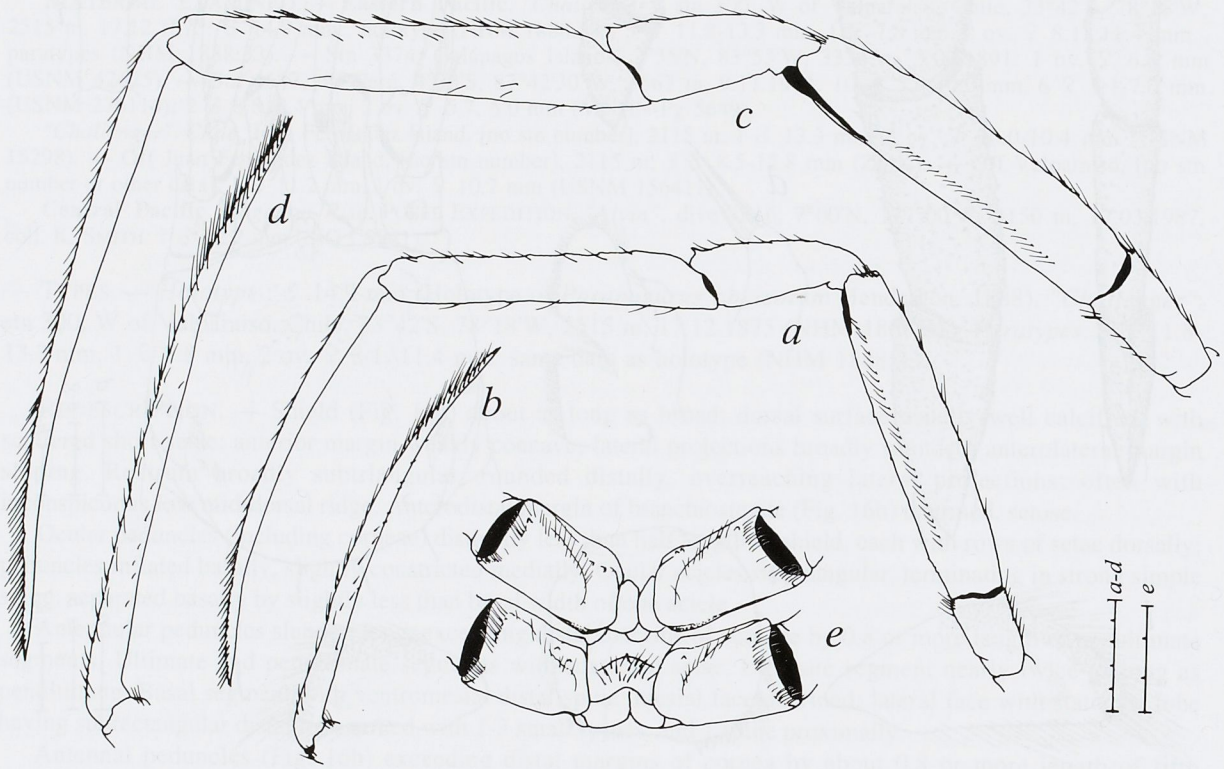


FIG. 17. — *Parapagurus holthuisi* Lemaitre, 1989, ♂ 8.9 mm, E Pacific, off Perú, *"Albatross"*, stn 4647 (USNM 276114): **a**, first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, coxae and sternites of ambulatory legs, ventral view.
Scales equal 5 mm (a-d), and 3 mm (e).

Ambulatory legs (Fig. 17a-d) similar from right to left (except slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl 1.3 to 1.5 times as long as propodus; with dorsal and ventromesial distal row of setae; ventromesial margin with row of about 8 or more minute corneous spinules. Merus, carpus, and propodus each with short stiff setae on dorsal margin (setae on propodus usually arranged in short transverse rows). Propodus 6 or more times as long as high. Carpus with dorsodistal spine. Merus of first ambulatory leg about 4.5 times as long as high; with longitudinal row of short setae on lateral face. Ischium with

1 to 3 small spines on ventral margin (first leg), or unarmed (second leg). Coxae of ambulatory legs (Fig. 17e) unarmed or with 1-3 small spines ventromesially. Anterior lobe of sternite of second ambulatory legs (Fig. 17e) subsemicircular, setose, armed with simple subterminal spine.

Fourth pereopod (Fig. 18a-d) semichelate. Dactyl subtriangular; shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp with 1 row of ovate scales at least distally (Fig. 18b) in small to medium size specimens (SL < 9.0 mm), or with 2 or 3 rows of ovate scales (Fig. 18d) in large specimens (SL > 10.0 mm). Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 18e) chelate; propodal rasp forming subtriangular area less than half length of propodus.

Telson and uropods (Fig. 16h-j) asymmetrical. Left exopod (Fig. 16i) about 2.4 as long as broad; rasp moderately broad. Telson without lateral indentation, and scattered setae dorsally; terminal margin divided into 2 rounded projections by shallow, often broad, rounded (U-shaped) cleft; margins of rounded projections each armed with 6 to 15 short to moderately long corneous spines, each margin occasionally with additional 7 or 8 much shorter subdistal spines dorsally.

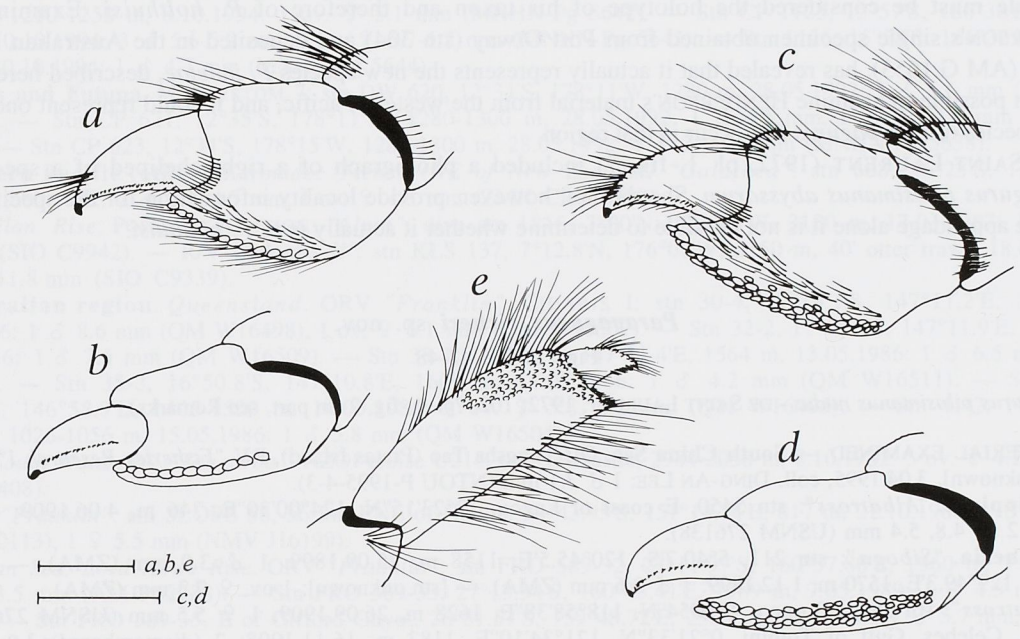


FIG. 18. — *Parapagurus holthuisi* Lemaitre, 1989. a,b,e, ♂ 8.9 mm, E Pacific, off Perú, *"Albatross"*, stn 4647 (USNM 276114); c-d, ov. ♀ 10.9 mm, *"Challenger"*, Juan Fernández Island (USNM 15298). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fourth pereopod, lateral view; **d**, same, ventrolateral view; **e**, propodus and dactyl of left fifth, lateral view.
Scales equal 1 mm.

SIZE RANGE. — Males, SL 5.9 to 14.9 mm. Females 5.1 to 11.2 mm. Ovigerous females 8.1 to 11.4 mm.

VARIATIONS. — Males with palm and carpus of right cheliped (Fig. 16f) longer than broad: palm as much as 1.3 times as long as broad, carpus as much as 2.2 times as long as broad. Females with palm (Fig. 16g) about as long as broad, carpus about 1.5 times as long as broad.

HABITAT. — Has been found living in anthozoans (actinians).

DISTRIBUTION (Figs 47, 49, 50). — Central Pacific: Magellan Rise. Eastern Pacific: Galápagos Islands; off Perú; and off Chile, including Juan Fernández Island. Depth: 2115 to 3667 m.

AFFINITIES. — This species is similar to *P. saintlaurentae* sp. nov.; however, the two differ in several characters. The scales of the propodal rasp of the fourth pereopod are ovate in *P. hothuisi*, whereas the scales are lanceolate or conical in *P. saintlaurentae* sp. nov. The terminal margin of the telson is divided into two rounded projections by a shallow cleft in *P. holthuisi* (Fig. 16h); the telson is divided by a deep cleft in *P. saintlaurentae* sp. nov. (Fig. 31f,i). The antennal scales are usually armed with four or more strong spines, and exceed the distal margin of the cornea by half or less than half the length of the acicles in *P. holthuisi* (Fig. 16a); the acicles are usually unarmed or with one or two weak spines, and exceed the distal margin of the corneae by more than half the length of the acicles in *P. saintlaurentae* sp. nov. (Fig. 28a-b).

REMARKS. — As previously mentioned, *Parapagurus holthuisi* Lemaitre, 1989, is a replacement name proposed by LEMAITRE (1989) for *P. abyssorum* Henderson, 1888, a junior homonym of *P. abyssorum* (Filhol, 1885a). The *"Challenger"* material used by HENDERSON (1888) to describe his *P. abyssorum* included specimens from the Atlantic (Bermuda; Sierra Leone; Tristan da Cunha), western Pacific (Banda, Indonesia; Philippines; north of Papua New Guinea; Yokohama, Japan), and eastern Pacific (west of Valparaiso, and Port Otway, Chile). HENDERSON indicated that his description was based on a male specimen from west of Valparaiso (stn 300); thus, that male must be considered the holotype of his taxon and therefore of *P. holthuisi*. Examination of HENDERSON's single specimen obtained from Port Otway (stn 304) and deposited in the Australian Museum, Sydney (AM G.1653), has revealed that it actually represents the new species *P. janetae*, described herein. It has not been possible to examine HENDERSON's material from the western Pacific, and it could represent one or more of the species of *Parapagurus* that occur in that region.

DE SAINT LAURENT (1972, pl. 1, fig. 7) included a photograph of a right cheliped of a specimen of *Parapagurus pilosimanus abyssorum*. She did not, however, provide locality information for the specimen, and from the appendage alone it is not possible to determine whether it actually is of *P. holthuisi*.

Parapagurus richeri sp. nov.

Figs 19-23, 47-48

Parapagurus pilosimanus nudus - DE SAINT LAURENT, 1972: 102, ?pl. 1, fig. 2 (in part, see Remarks).

MATERIAL EXAMINED. — **South China Sea**. Off Tungsha Tao (Pratas Island), RV *"Fisheries Research I"*, trawled, [depth unknown], 3.04.1995, coll. DING-AN LEE: 1 ♂ 7.1 mm (NTOU P-1995-4-3).

Philippines. *"Albatross"*: stn 5450, E coast of Luzon, 13°23'15"N, 124°00'30"E, 746 m, 4.06.1909: 4 ♂ 4.8-5.4 mm, 2 ♀ 4.8, 5.4 mm (USNM 276138).

Indonesia. *"Siboga"*: stn 211, 5°40.7'S, 120°45.5'E, 1158 m, 25.09.1899: 1 ♂ 3.9 mm (ZMA). — Stn 241, 4°24.3'S, 129°49.3'E, 1570 m, 1.12.1899: 1 ♂ 3.6 mm (ZMA). — [stn unknown]: 1 ov. ♀ 7.3 mm (ZMA).

"Albatross": stn 5582, Borneo, 4°19'54"N, 118°58'38"E, 1628 m, 26.09.1909: 1 ♀ 5.5 mm (USNM 276144). — Stn 5605, Celebes, Gulf of Tomini, 0°21'33"N, 121°34'10"E, 1183 m, 16.11.1908: 2 (dismembered) 3.9, 6.0 mm (USNM 276132). — Stn 5606, 0°16'28"N, 121°33'30"E, 1525 m, 17.11.1909: 1 ♂ 4.6 mm, 1 ov. ♀ 4.5 mm (USNM 276133). — Stn 5613, Celebes, Gulf of Tomini, 0°42'00"S, 121°44'00"E, 1375 m, 20.11.1909: 1 ♀ 4.2 mm (USNM 276134). — Stn 5648, Buton Strait, 5°35'00"S, 122°20'00"E, 1022 m, 16.11.1909: 2 ♀ 4.2, 5.8 mm (USNM 276135). — Stn 5651, Celebes, Gulf of Bone, 4°43'50"N, 121°23'24"E, 1280 m, 17.12.1909: 1 ♀ 5.5 mm (USNM 276136). — Stn 5660, Flores Sea, 5°36'30"S, 120°49'00"E, 1266 m, 20.12.1909: 2 ♂ 3.7, 5.7 mm (USNM 276137).

New Caledonia. BIOCAL: stn CP 05, 21°16'S, 166°44'E, 2340 m, 11.08.1985: 4 ♂ 3.7-5.1 mm (USNM 276139). — Stn CP 17, 20°35'S, 167°25'E, 3680 m, 14.08.1985: 4 ♂ 2.2-5.4 mm, 1 ♀ 2.8 mm, 1 ov. ♀ 3.9 mm (MNHN-Pg 5615). — Stn CP 23, 22°46'S, 166°20'E, 2040 m, 28.08.1985: 8 ♂ 2.1-4.3 mm, 1 ♀ 2.8 mm, 1 ov. ♀ 3.1 mm (MNHN-Pg 5616). — Stn CP 26, 22°39.45'S, 166°27.41'E, 1618-1640 m, 28.08.1985: 5 ♂ 3.4-6.1 mm, 1 ♀ 3.4 mm, 3 ov. ♀ 3.1-4.2 mm (MNHN-Pg 5617). — Stn CP 27, 22°05.52'S, 166°25.90'E, 1850-1900, 28.08.1985: 3 ♂ 2.2-3.7 mm, 1 ♀ 5.4 mm, 1 ov. ♀ 4.1 mm (MNHN-Pg 5618). — Stn CP 57, 23°43.26'S, 166°58.06'E, 1490-1620 m, 1.09.1985: 4 ♂ 3.3-3.7 mm, 2 ♀ 3.0, 3.4 mm, 1 ov. ♀ 3.7 mm (MNHN-Pg 5619). — Stn CP 60, 24°01.45'S, 167°08.43'E, 1480-1530 m, 2.09.1985: 2 ♂ 1.5, 5.1 mm (MNHN-Pg 5620). — Stn CP 62, 24°19.06'S, 167°48.65'E, 1395-1410 m, 2.09.1985: 1 ♀ 3.4 mm (MNHN-Pg 5621). — Stn CP 63, 24°28.69'S, 168°07.72'E, 2160 m, 2.09.1985: 1 ♂ 3.2 mm, 1 ♀ 3.3 mm (MNHN-Pg 5622). — Stn CP 72, 22°09.02'S, 167°33.18'E, 2100-2110 m, 4.09.1985: 1 ♀ 4.3 mm (MNHN-Pg 5623).

BIOGEOCAL: stn CP 214, 22°43.09'S, 166°27.19'E, 1665-1590 m, 9.04.1987: 9 ♂ 3.1-5.4 mm, 2 ♀ 2.5, 3.3 mm, 1 ov. ♀ 3.3 mm (USNM 276140). — Stn CP 216, 22°50.67'S, 166°22.75'E, 2175-2250 m, 10.04.1987: 1 ov. ♀

3.8 mm (NMNH-Pg 5624). — Stn CP 250, 21°24.63'S, 166°28.21'E, 2350 m, 15.04.1987: 1 ♂ 4.6 mm (MNHN-Pg 5625). — Stn CP 260, 21°00.00'S, 167°58.34'E, 1820-1980 m, 17.04.1987: 5 ♂ 2.8-4.3 mm, 4 ♀ 3.0-4.0, 7 ov. ♀ 3.0-4.0 mm (MNHN-Pg 5626). — Stn CP 265, 21°04.09'S, 167°00.40'E, 1760-1870 m, 18.04.1987: 1 ♂ 4.0 mm, 1 ov. ♀ 3.9 mm (MNHN-Pg 5627). — Stn CP 266, 21°04.85'S, 167°57.14'E, 2100-1990 m, 18.04.1987: 3 ♂ 2.7-3.3 mm, 2 ov. ♀ 3.6, 4.3 mm (MNHN-Pg 5628). — Stn 272, 21°00.04'S, 166°56.94'E, 1615-1710 m, 20.04.1987: 10 ♂ 3.0-6.1 mm, 2 ♀ 3.3, 3.7 mm, 5 ov. ♀ 3.4-4.0 mm, 1 immat. 1.7 mm (MNHN-Pg 5629). — Stn 272, 21°00.04'S, 166°56.94'E, 1615-1710 m, 20.04.1987: 1 ♂ 4.9 mm (MNHN-Pg 5614). — Stn 273, 21°01.53'S, 166°57.41'E, 1920-2040 m, 20.04.1987: 6 ♂ 2.7-4.6 mm, 2 ♀ 4.5, 4.6 mm, 4 ov. ♀ 3.1-4.8 mm (MNHN-Pg 5630); 2 ♂ 3.7, 5.2 mm (USNM 276141). — Stn 317, 20°48.12'S, 166°53.16'E, 1630-1620 m, 2.05.1987: 2 ♂ 2.4, 3.7 mm, 3 ♀ 2.5-4.0 mm, 3 ov. ♀ 3.3-5.0 mm (MNHN-Pg 5631). — Stn CP 321, 21°12.00'S, 166°59.85'E, 2190-2205 m, 3.05.1987: 3 ♂ 2.7-4.4 mm, 2 ♀ 3.3, 4.1 mm, 2 ov. ♀ 4.2,4.5 mm (MNHN-Pg 5632). — Stn CP 329, 21°09.05'S, 166°40.08'E, 2315-2310 m, 4.05.1987: 1 ♂ 3.2 mm (MNHN-Pg 5633). — Stn 341, 21°29.73'S, 166°47.37'E, 2334 m, 6.05.1987: 1 ♂ 3.7 mm, 1 ♀ 4.0 mm, 2 ov. ♀ 3.3, 4.5 mm (MNHN-Pg 5634).

BATHUS 3: stn CP 844, 23°06'S, 166°45'E, 908 m, 1.12.1993: 1 ♂ 4.5 mm (MNHN-Pg 5635).

HALIPRO 1: stn CC 856, 21°44'S, 166°37'E, 311-365 m, 20.03.1994: 1 ov. ♀ 4.1 mm (MNHN-Pg 5636).

Vanuatu. MUSORSTOM 8: stn CP 956, 20°33'S, 169°35'E, 1175-1210 m, 20.09.1994: 1 ♂ 3.9 mm (MNHN-Pg 5639). — Stn 1109, 14°52'S, 167°18'E, 1550-1620 m, 8.10.1994: 1 ♀ 3.7 mm, 1 ov. ♀ 5.1 mm (MNHN-Pg 5640). — Stn CP 1110, 14°49'S, 167°15'E, 1360 m, 8.10.1994: 1 ov. ♀ 4.0 mm (MNHN-Pg 5641). — Stn CP 1111, 14°51'S, 167°14'E, 1210-1250 m, 8.10.1994: 1 ov. ♀ 5.1 mm (MNHN-Pg 5642). — Stn CP 1125, 15°57'S, 166°38'E, 1160-1220 m, 10.10.1994: 3 ♂ 5.6-5.9 mm, 2 ov. ♀ 5.7-6.2 mm (MNHN-Pg 5643). — Stn 1126, 15°58'S, 166°39'E, 1210-1260 m, 10.10.1994: 1 ♂ 4.7 mm (MNHN-Pg 5644).

Wallis and Futuna. MUSORSTOM 7: stn DW 620, 12°34'S, 178°11'W, 1280 m, 28.05.1992: 1 ♂ 6.6 mm (MNHN-Pg 5637). — Stn CP 621, 12°35'S, 178°11'W, 1280-1300 m, 28.05.1992: 1 ♂ 4.5 mm, 1 ov. ♀ 4.6 mm (USNM 276142). — Stn CP 623, 12°34'S, 178°15'W, 1280-1300 m, 28.05.1992: 4 ♂ 2.1-2.6 mm (MNHN-Pg 5638).

Western Pacific (other). *Kermadec Trench (NE of New Zealand)*. *"Galathea"*: stn 668, 36°23'S, 177°41'E, 2640 m, 29.02.1952: 2 ♂ 3.1, 4.3 mm, 1 ov. ♀ 4.3 mm (ZMK CRU-3389).

Magellan Rise. POSSE EXPEDITION: *"Alvin"*, dive stn 1816, 7°00'N, 177°00'W, 3150 m, 17.03.1987: 1 ov. ♀ 11.0 mm (SIO C9942). — R/V *"Atlantis II"*, stn KLS 137, 7°12.8'N, 176°07'W, 3150 m, 40' otter trawl, 18.03.1987: 3 ♂ 6.6-11.8 mm (SIO C9339).

Australian region. *Queensland*. ORV *"Franklin"*. CIDARIS I: stn 30-4, 17°19.1'S, 147°11.2'E, 1403 m, 12.05.1986: 1 ♂ 8.6 mm (QM W16498), 1 ov. ♀ 6.1 mm (QM W16507). — Stn 32-2, 17°05.9'S, 147°11.9'E, 1517 m, 13.05.1986: 1 ♂ 7.5 mm (QM W16509). — Stn 33-1, 16°58.7'S, 147°11.4'E, 1564 m, 13.05.1986: 1 ♂ 6.5 mm (QM W16510). — Stn 35-3, 16°50.8'S, 147°10.8'E, 1609 m, 14.05.1986: 1 ♂ 4.2 mm (QM W16511). — Stn 37-1, 17°01.7'S, 146°58.9'E, 1405-1500 m, 14.05.1986: 2 ov. ♀ 5.8, 6.2 mm (QM W16495). — Stn 41-2, 17°33.3'S, 146°60'E, 1026-1056 m, 15.05.1986: 1 ♂ 5.8 mm (QM W16504).

New South Wales. RV *"Tangaroa"*. NZOI cruise U214, off Newcastle, 2984-3058 m, 8.10.1982: 3 ov. ♀ 4.2-5.1 mm (AM P40408).

ORV *"Franklin"*: stn SLOPE 58, 56 km ENE of Nowra, 34°43.95'S, 151°14.74'E, 817 m, 22.10.1988: 1 ♂ 8.2 mm (NMV J40113), 1 ♀ 5.5 mm (NMV J16199).

Tasman Sea, Lord Howe Rise. ORV *"Franklin"*: stn FRO 589-32, 27°11.97'S, 160°37.80'E, 1960 m, 7.05.1989: 1 ov. ♀ 3.5 mm (AM P52738). — Stn FRO 589-33, 27°13.34'S, 160°43.41'E, 1989 m, 7.05.1989: 1 ♂ 4.5 mm (AM P39445). — Stn FRO 589-35, E of Gifford Guyot, 26°51.57'S, 159°48.72'E, 2500 m, 8.05.1989: 1 ♂ 5.7 mm, 1 ov. ♀ 6.1 mm (AM P52739).

Western Indian Ocean. *Cape Town to Durban*. *"Galathea"*: stn 178, 35°07'S, 30°35'E, 4470 m, 23.01.1951: 2 ♂ 4.8, 7.2 mm, 2 ov. ♀ 4.9, 5.2 mm (ZMK CRU-3386). — Stn 190, 29°42'S, 33°19'E, 2790 m, 3.02.1951: 1 ♂ 3.2 mm (ZMK CRU-3387). — Stn 198, 30°22'S, 34°27'E, 2765 m, 15.02.1951: 1 ♂ 3.5 mm (ZMK CRU-3388).

TYPES. — *Holotype*: ♂ 4.9 mm, New Caledonia. BIOGEOCAL, stn 272, 21°00.04'S, 166°56.94'E, 1615-1710 m, 20.04.1987 (MNHN-Pg 5614). *Paratypes*: All the others specimens mentioned above.

DESCRIPTION. — Shield (Fig. 19a) about as long as broad; dorsal surface usually well calcified, with rows of short setae posteriorly on each side of midline; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margin sloping. Rostrum broadly subtriangular, rounded distally, slightly overreaching lateral projections; with low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 19d) rounded, unarmed, setose.

Ocular peduncles (including corneae) about half length of shield, each with dorsal longitudinal row of setae; peduncles inflated basally. Ocular acicles subtriangular, terminating in strong spine (rarely bifid); separated basally by slightly less than basal width of one acicle.

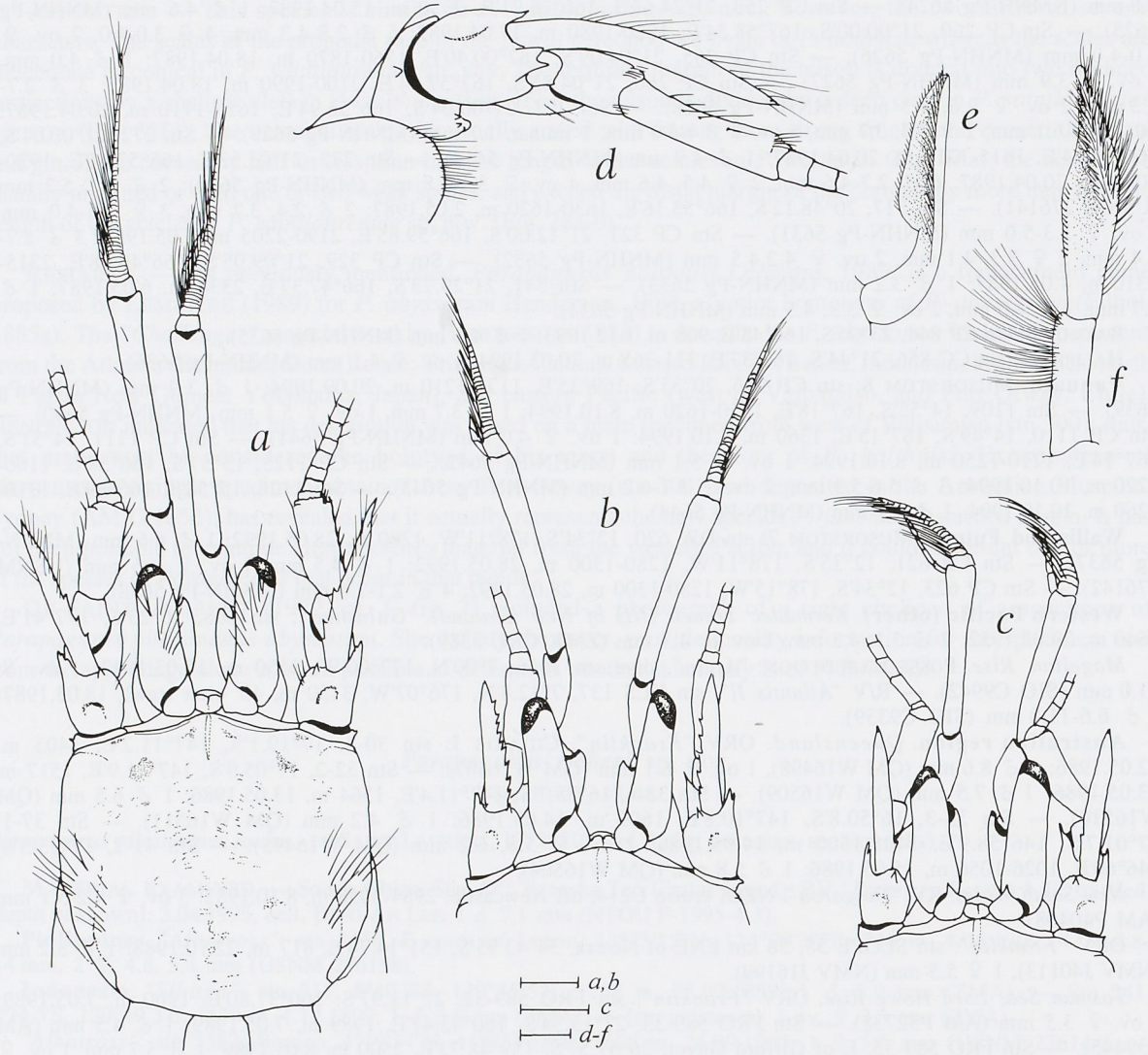


FIG. 19. — *Parapagurus richeri* sp. nov., New Caledonia. a,d, BIOGEOCAL stn 272, holotype ♂ 4.9 mm (MNHN-Pg 5614); b, BIOGEOCAL stn CP 266, paratype ♂ 4.6 mm (MNHN-Pg 5628); c, BIOCAL stn CP 17, paratype ♂ 3.6 mm (MNHN-Pg 5615); **e-f**, BIOGEOCAL stn 272, ♂ 5.4 mm (MNHN-Pg 5629). **a**, shield and cephalic appendages; **b-c**, anterior portion of shield and cephalic appendages (setae omitted); **d**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **e**, male first pleopod, mesial view; **f**, male second pleopod, anterior view.
Scales equal 1 mm (a-c), and 0.5 mm (d-f).

Antennular peduncles slender, long, exceeding distal margins of corneae by at least 0.25 length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 2 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 19d) exceeding distal margins of corneae by about half length of fifth segments. Fifth segment with setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong multifid spine; mesial margin with spine on dorsodistal angle. First segment with small spine on lateral face; ventromesial angle produced, with row of small spines. Antennal acicles (Fig. 19a-c) nearly straight in dorsal view, setose;

exceeding distal margin of cornea by 0.2 or more length of acicle; mesial margin usually armed on proximal half with 1-3 spines, occasionally with up to 8 spines (Fig. 19b). Flagellum distinctly overreaching extended right cheliped; articles with setae less than 1 to 2 flagellar articles in length.

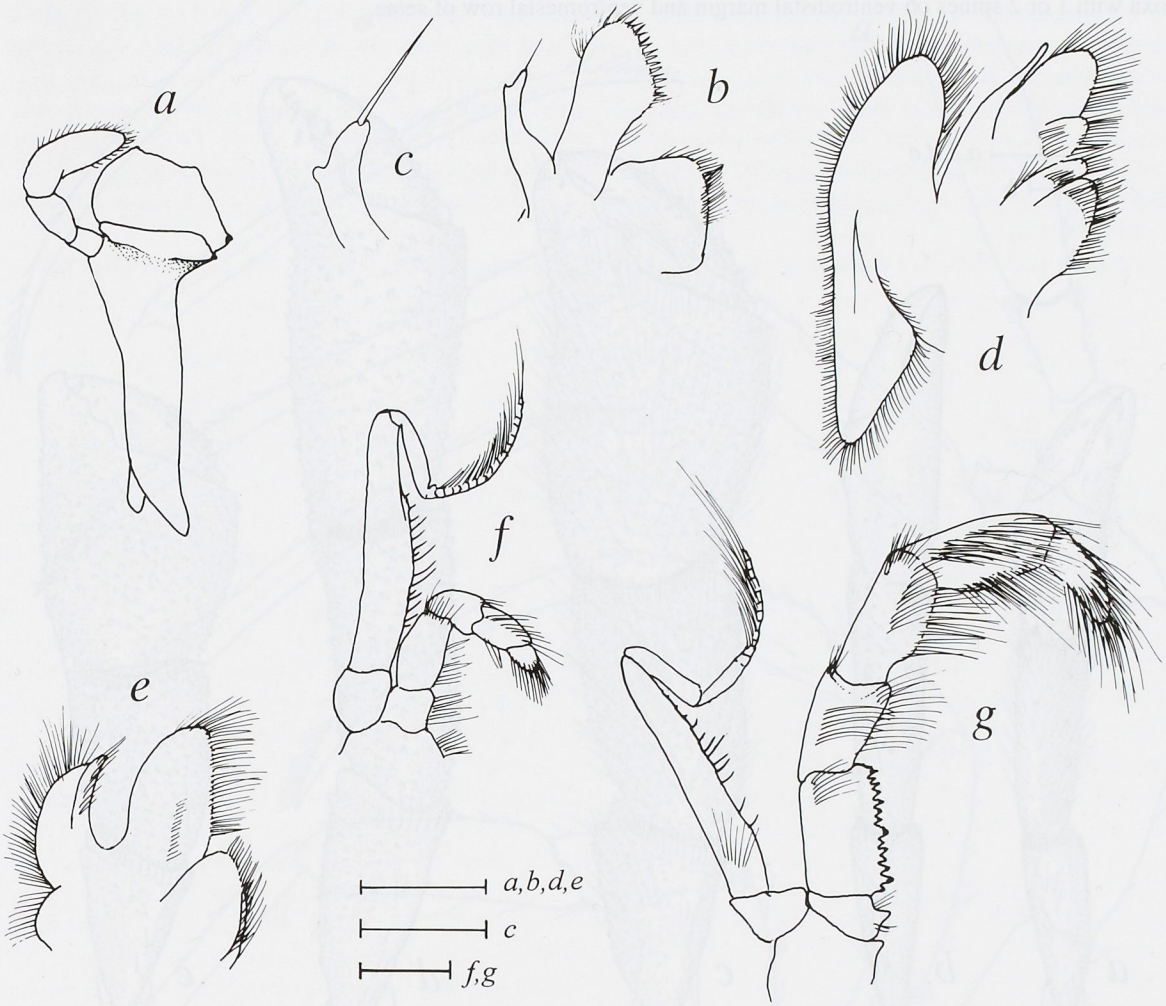


FIG. 20. — *Parapagurus richeri* sp. nov., New Caledonia, BIOGEOCAL stn 272, paratype ♂ 5.4 mm (MNHN-Pg 5629). Left mouthparts, internal view: **a**, mandible; **b**, maxillule; **c**, distal end of endopod of same; **d**, maxilla; **e**, first maxilliped; **f**, second maxilliped; **g**, third maxilliped. Scales equal 1 mm (a,b,d,e-g), and 0.5 mm (c).

Mandible (Fig. 20a) as figured. Maxillule (Fig. 20b-c) with external lobe of endopod weakly developed, internal lobe with long seta. Maxilla (Fig. 20d) with endopod exceeding distal margin of scaphognathite. First maxilliped (Fig. 20e) with endopod exceeding exopod in distal extension. Second maxilliped (Fig. 20f) without distinguishing characters. Third maxilliped (Fig. 20g) with crista dentata consisting of about 14 small corneous teeth; basis with 1 tooth mesially. Sternite of third maxilliped with spine on each side of midline. Epistomial spine usually present.

Chelipeds markedly dissimilar, each with dorsal surfaces of carpus and chela covered with moderately dense setation. Right cheliped (Fig. 21c-e) with proportions of carpus and chela influenced by size and sexual dimorphism (see Variations). Fingers bent inwards at tips, each terminating in small corneous claw; with few tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also with distal row of small, closely-set, corneous teeth. Dactyl set at slightly oblique angle to palm, with

dorsomesial and mesial row of small spines proximally. Palm and carpus each with numerous small, closely-set, spines and tubercles on dorsal surface; ventral surfaces of palm and carpus also with spines and tubercles but less numerous or sometimes few and scattered. Merus with small tubercles on dorsal, dorsolateral and ventral surfaces; mesial surface smooth, with ventromesial row of spines. Ischium with dorsal and ventromesial row of spines. Coxa with 1 or 2 spines on ventrodistal margin and ventromesial row of setae.

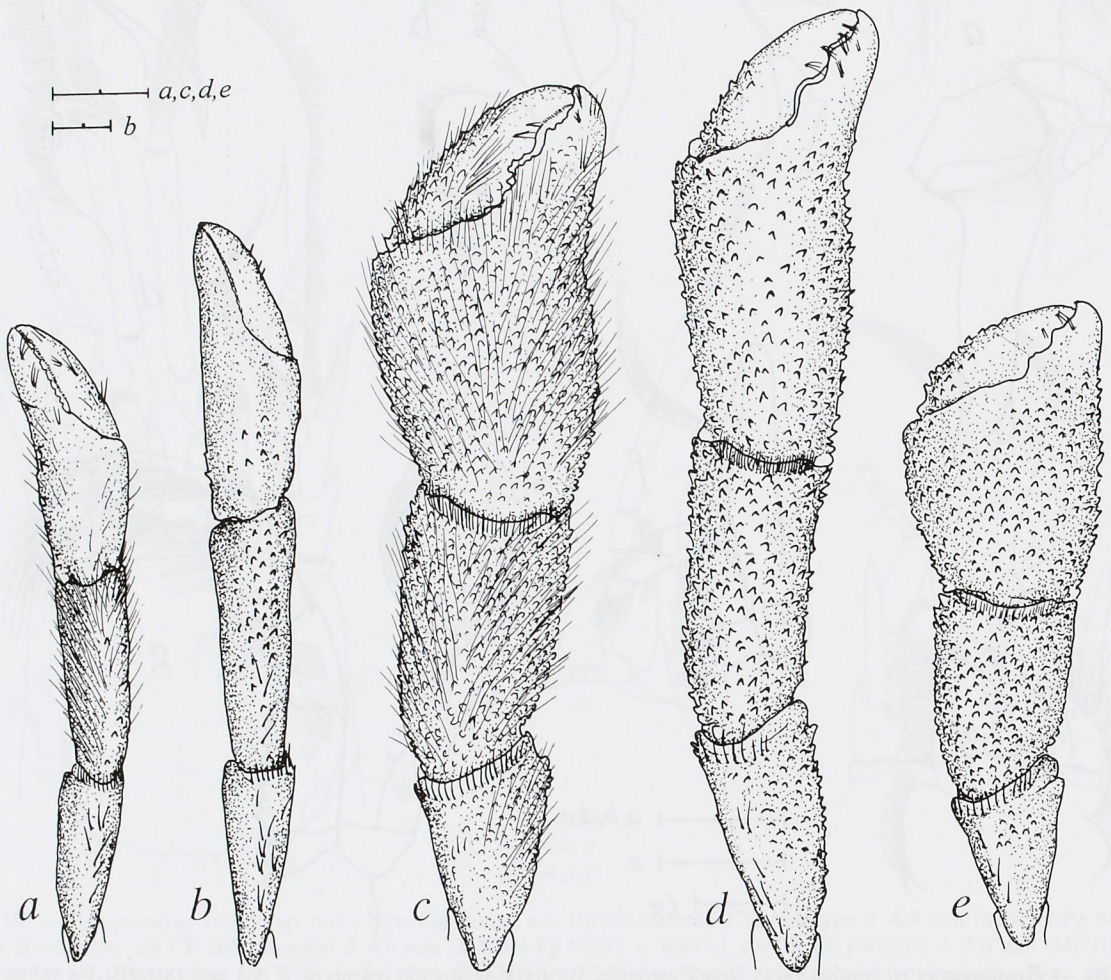


FIG. 21. — *Parapagurus richeri* sp. nov. a,c, New Caledonia, BIOGEOCAL stn 272, holotype ♂ 4.9 mm (MNHN-Pg 5614); b, ORV *"Franklin"*, stn 30-4, ♂ 8.6 mm (QM W16498); d, New Caledonia, BIOCAL stn CP 17, ♂ 5.2 mm (MNHN-Pg 5615); e, New Caledonia, BIOCAL stn CP 26, ov. ♀ 3.1 mm (MNHN-Pg 5617). **a-b**, left chelipeds (setae omitted in b); **c-e**, right chelipeds (setae omitted in d,e).
Scales equal 2 mm.

Left cheliped (Fig. 21a-b) slender. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute, closely-set, corneous teeth distally; cutting edge of fixed finger with row of regularly-spaced, small, evenly-sized calcareous teeth. Palm unarmed except for few small dorsomesial tubercles. Carpus armed with an irregular row or several rows of small spines or tubercles dorsally. Merus unarmed except for row of bristles on dorsal margin. Ischium with small, blunt setose tubercles on dorsal margin; usually with small spine on ventromesial margin proximally. Coxa usually with 2 small spines on ventrodistal margin, and ventromesial row of setae.

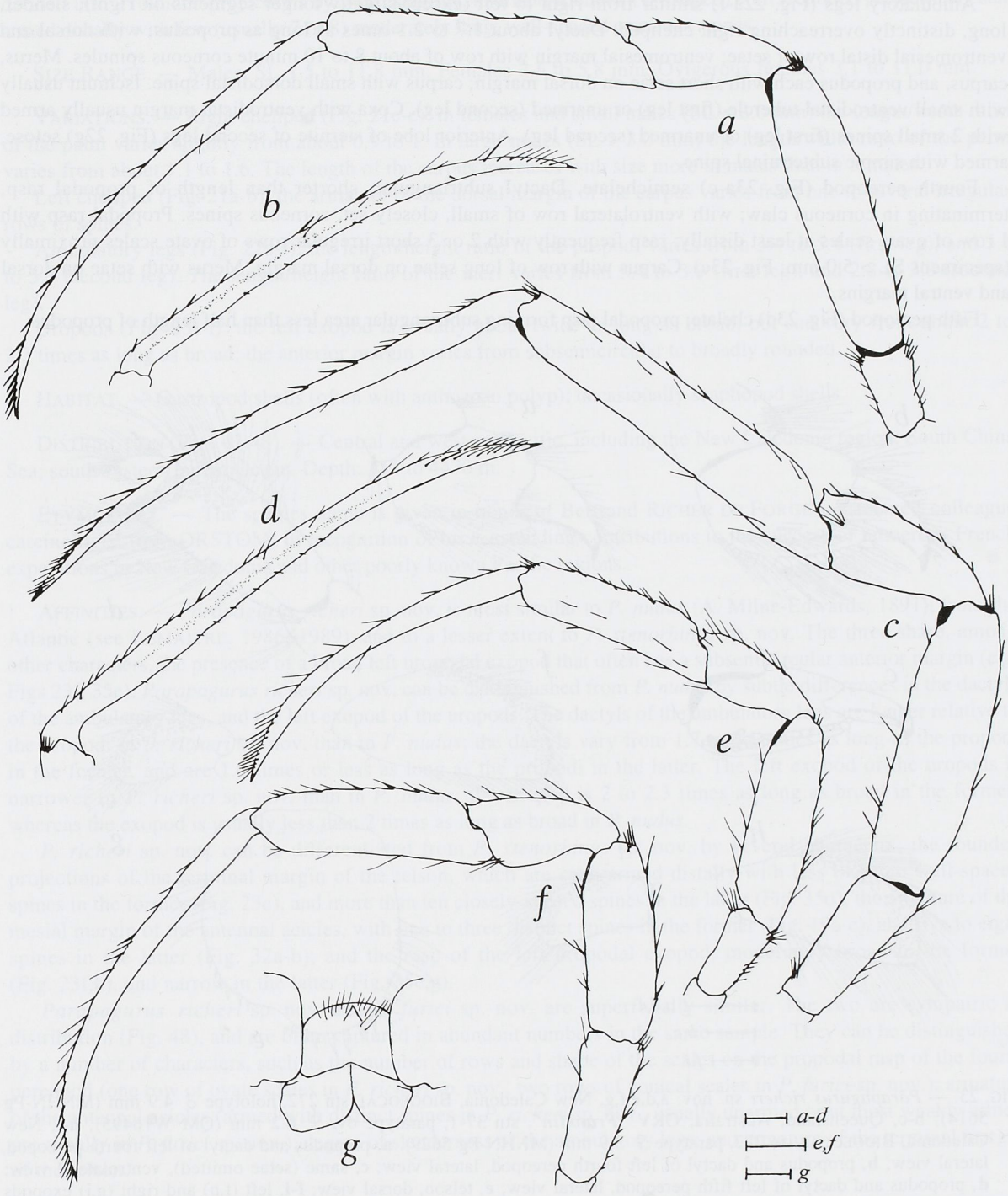


FIG. 22. — *Parapagurus richeri* sp. nov., New Caledonia: a-d,e, BIOGEOCAL stn 272, holotype ♂ 4.9 mm (MNHN-Pg 5614); e,f, BIOCAL stn CP 17, paratype ♂ 3.6 mm (MNHN-Pg 5615). **a**, first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, first ambulatory leg, lateral view; **f**, second ambulatory leg, lateral view; **g**, sternite of second ambulatory legs, ventral view.
Scales equal 1 mm (a-f), and 0.5 mm (g).

Ambulatory legs (Fig. 22a-f) similar from right to left (except slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl about 1.7 to 2.1 times as long as propodus; with dorsal and ventromesial distal row of setae; ventromesial margin with row of about 8 to 10 minute corneous spinules. Merus, carpus, and propodus each with short setae on dorsal margin; carpus with small dorsodistal spine. Ischium usually with small ventrodistal tubercle (first leg) or unarmed (second leg). Coxa with ventrodistal margin usually armed with 2 small spines (first leg) or unarmed (second leg). Anterior lobe of sternite of second legs (Fig. 22g) setose, armed with simple subterminal spine.

Fourth pereopod (Fig. 23a-c) semichelate. Dactyl subtriangular, shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp with 1 row of ovate scales at least distally; rasp frequently with 2 or 3 short irregular rows of ovate scales proximally (specimens SL > 5.0 mm; Fig. 23c). Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 23d) chelate; propodal rasp forming subtriangular area less than half length of propodus.

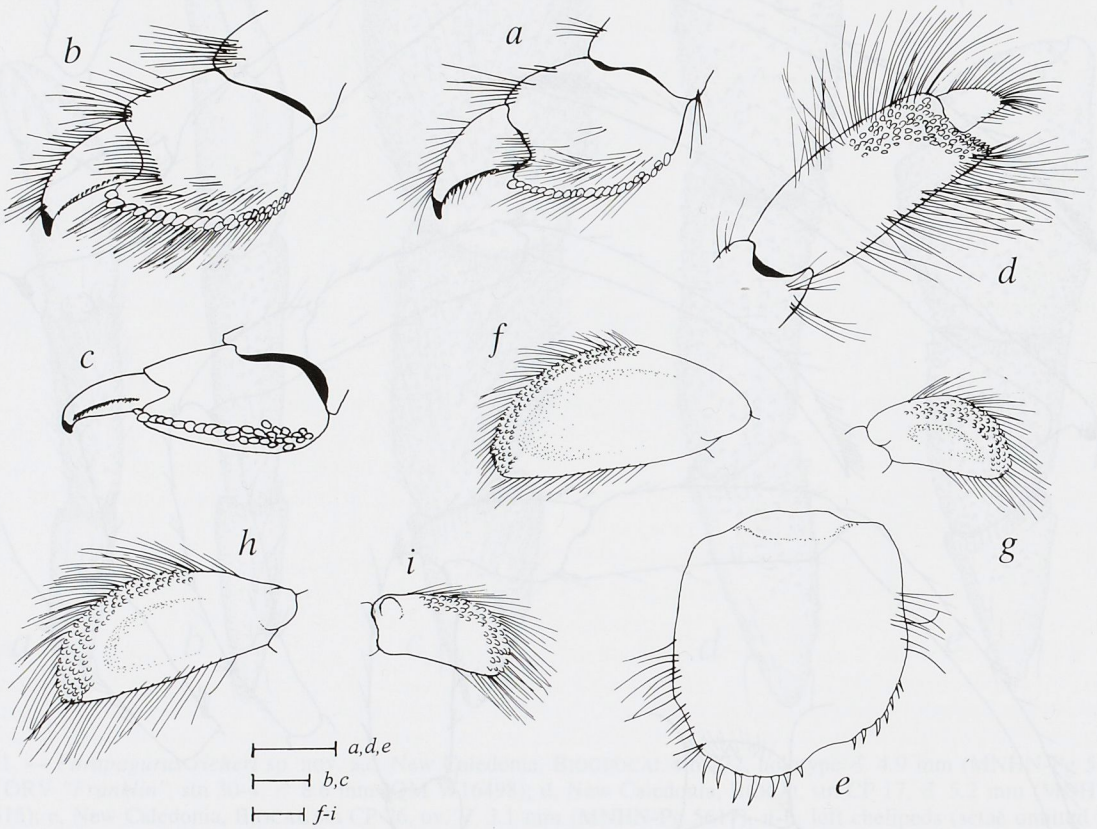


FIG. 23. — *Parapagurus richeri* sp. nov. a,d,e,f,g, New Caledonia, BIOGEOCAL stn 272, holotype ♂ 4.9 mm (MNHN-Pg 5614); b-c, Queensland, Australia, ORV *"Franklin"*, stn 37-1, paratype ov. ♀ 6.2 mm (QM W16495); h-i, New Caledonia, BIOGEOCAL stn 272, paratype ♀ 3.9 mm (MNHN-Pg 5629). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, propodus and dactyl of left fourth pereopod, lateral view; **c**, same (setae omitted), ventrolateral view; **d**, propodus and dactyl of left fifth pereopod, lateral view; **e**, telson, dorsal view; **f-i**, left (f,h) and right (g,i) exopods of uropods, dorsal view. Scales equal 0.5 mm.

Telson and uropods (Fig. 23e-i) asymmetrical (weakly asymmetrical in specimens living in scaphopod shells). Left exopod (Fig. 23f,h) relatively short, broad, often paddle-shaped, with moderately broad rasp (see Variations). Telson without lateral indentations; with scattered setae dorsally, and rows of long setae laterally; terminal margin

divided into 2 rounded projections by wide, shallow, unarmed rounded (U-shaped) cleft; rounded projections each armed distally with few (usually 7 or 8) moderately long, well-spaced corneous spines.

SIZE RANGE. — Males, SL 1.5 to 11.8 mm. Females 2.5 to 5.8 mm. Ovigerous females 3.1 to 11.0 mm.

VARIATIONS. — Right cheliped (Fig. 21c-e): in females and small males (SL < 3.0 mm) the length/width ratio of the palm varies slightly from about 0.9 to 1. In large males (SL > 3.0 mm) the length/width ratio of the palm varies from about 1.1 to 1.6. The length of the carpus increases with size more in males than in females.

Left cheliped (Fig. 21a-b): the armature of the dorsal margin of the carpus varies from one to several irregular rows of spines.

Ambulatory legs (Fig. 22a-f): the length/height ratio of the propodi varies from 3.4 to 5.4 (first leg), and 3.1 to 5.3 (second leg). The length/height ratio of the meri varies from 3.4 to 3.9 (first leg), and 2.8 to 3.3 (second leg).

Uropods (Fig. 23f-i): the left exopod is usually about twice as long as broad, but can vary from about 2 to 2.3 times as long as broad; the anterior margin varies from subsemicircular to broadly rounded.

HABITAT. — Gastropod shells (often with anthozoan polyp); occasionally scaphopod shells.

DISTRIBUTION (Figs 47-48). — Central and western Pacific, including the New Caledonia region; South China Sea; southwestern Indian Ocean. Depth: 311 to 4470 m.

ETYMOLOGY. — The species name is given in honor of Bertrand RICHER DE FORGES, esteemed colleague carcinologist from ORSTOM, in recognition of his outstanding contributions to the success of numerous French expeditions in New Caledonia and other poorly known Pacific regions.

AFFINITIES. — *Parapagurus richeri* sp. nov. is most similar to *P. nudus* (A. Milne-Edwards, 1891), from the Atlantic (see LEMAITRE, 1986, 1989), and to a lesser extent to *P. stenorhinus* sp. nov. The three share, among other characters, the presence of a broad left uropodal exopod that often has a subsemicircular anterior margin (e.g. Figs 23f, 35e). *Parapagurus richeri* sp. nov. can be distinguished from *P. nudus* by subtle differences in the dactyls of the ambulatory legs, and the left exopod of the uropods. The dactyls of the ambulatory legs are longer relative to the propodi in *P. richeri* sp. nov. than in *P. nudus*; the dactyls vary from 1.7 to 2.1 times as long as the propodi in the former, and are 1.6 times or less as long as the propodi in the latter. The left exopod of the uropods is narrower in *P. richeri* sp. nov. than in *P. nudus*; the exopod is 2 to 2.3 times as long as broad in the former, whereas the exopod is usually less than 2 times as long as broad in *P. nudus*.

P. richeri sp. nov. can be differentiated from *P. stenorhinus* sp. nov. by several characters: the rounded projections of the terminal margin of the telson, which are each armed distally with less than ten well-spaced spines in the former (Fig. 23e), and more than ten closely-spaced spines in the latter (Fig. 35d); the armature of the mesial margin of the antennal acicles, with one to three distinct spines in the former (Fig. 19a-c), and five to eight spines in the latter (Fig. 32a-b); and the rasp of the left uropodal exopod, moderately broad in the former (Fig. 23f,h), and narrow in the latter (Fig. 35e,g).

Parapagurus richeri sp. nov. and *P. furici* sp. nov. are superficially similar. The two are sympatric in distribution (Fig. 48), and are often captured in abundant numbers in the same sample. They can be distinguished by a number of characters, such as the number of rows and shape of the scales on the propodal rasp of the fourth pereopod (one row of ovate scales in *P. richeri* sp. nov., two rows of conical scales in *P. furici* sp. nov.); armature of the antennal acicles (armed with distinct spines in *P. richeri* sp. nov., usually unarmed or at most weakly armed proximally in *P. furici* sp. nov.); degree of slenderness of the ambulatory legs; and armature of the terminal margin of the telson.

REMARKS. — DE SAINT LAURENT (1972) considered that the distribution of *Parapagurus pilosimanus nudus* included the Indo-Pacific and the Atlantic. However, when LEMAITRE (1989) elevated *P. p. nudus* to specific rank he determined that this taxon occurred only in the Atlantic. Examination of the Indo-Pacific specimens used by DE SAINT LAURENT (1972) in her report of *P. p. nudus* has shown that she confounded that subspecies with the two new species *P. richeri* and *P. stenorhinus*.

Parapagurus furici sp. nov.

Figs 24-27, 47-48

Parapagurus pilosimanus - ALCOCK, 1901: 218; 1902: 133, 273, fig. 67 (See Remarks).

MATERIAL EXAMINED. — **Japan**. *"Albatross"*: stn 4975, 33°21'30"N, 135°38'50"E, 1302-997 m, 31.08.1906: 1 ♂ 8.3 mm (USNM 276130). — Stn 4980, Kobe to Yokohama, 34°09'N, 137°55'E, 927 m, 1.09.1906: 2 ♂ 7.0, 9.5 mm (USNM 276131). — Stn 5082, 34°05'N, 137°59'E, 1210 m, 20.10.1906: 3 ♀ 8.7-11.5 mm (USNM 276129).

RV *"Tansei-Maru"*: off Taito-saki, Boso Peninsula, 35°07'N, 140°55'E, 1351-1454 m, 24.04.1995, coll. T. KOMAI: 1 ♂ 7.2 mm (USNM 276118).

South China Sea. *Taiwan*. RV *"Fisheries Research I"*, off Tungsha Tao (Pratas Island), trawled, 1520 m, 25.04.1996, coll. DING-AN LEE: 1 ♂ 7.0 mm (NTOU 1996-4-25).

Philippines. RV*"Fishery Researcher I"*, stn 5-95, Lagonoy Gulf, 13°21.32'N, 124°12.26'E, 1037-1100 m, 24.09.1995: 1 ♂ 8.3 mm (ZRC 1998.54), 1 ♀ 6.3 mm (ZRC 1998.5).

Indonesia. *Celebes Sea*. *"Siboga"*: stn 208, 5°39'S, 122°12'E, 1866 m, 22.09.1899: 1 ♂ 7.0 mm (ZMA). — Stn 210a, 5°26'S, 121°18'E, 1944 m, 24.09.1899: 1 ♂ 7.2 mm (ZMA).

New Caledonia. BIOCAL: stn CP 05, 21°16.49'S, 166°43.56'E, 2340 m, 11.08.1985: 1 ov. ♀ 5.7 mm (MNHN-Pg 5581). — Stn CP 23, 22°45.84'S, 166°20.33'E, 2040 m, 28.08.1985: 1 ♂ 5.5 mm, 3 ov. ♀ 4.2-6.1 mm (MNHN-Pg 5582). — Stn CP 26, 22°39.66'S, 166°27.41'E, 1618-1640 m, 28.08.1985: 3 ♂ 4.2-5.7 mm, 1 ♀ 3.7 mm, 1 ov. ♀ 4.9 mm (USNM 276128). — Stn CP 27, 22°05.52'S, 166°26.41'E, 1850-1900 m, 28.08.1985: 2 ♂ 4.3, 5.2 mm, 4 ♀ 3.4-4.3 mm, 1 ov. ♀ 3.7 mm (MNHN-Pg 5583). — Stn CP 30, 23°08.44'S, 166°40.83'E, 1140 m, 29.08.1985: 1 ov. ♀ 4.2 mm (MNHN-Pg 5584). — Stn CP 57, 23°43.26'S, 166°58.06'E, 1490-1620 m, 1.09.1985: 3 ♂ 3.3-5.2 mm, 2 ♀ 3.9, 4.8 mm, 3 ov. ♀ 3.6, 4.6 mm (MNHN-Pg 5585). — Stn CP 62, 24°19.06'S, 167°48.65'E, 1395-1410 m, 2.09.1985: 2 ♂ 4.0, 4.5 mm, 1 ov. ♀ 6.9 mm (USNM 276127). — Stn CP 63, 24°28.69'S, 168°07.72'S, 2160 m, 2.09.1985: 3 ♂ 3.2-4.9 mm (MNHN-Pg 5586). — Stn CP 72, 22°09.02'S, 167°33.18'E, 2100-2110 m, 4.09.1985: 2 ♂ 4.09, 6.7 mm, 2 ♀ 4.0, 4.5 mm, 4 ov. ♀ 4.8-6.0 mm (USNM 276143).

BIOGEOCAL: stn CP 214, 22°43.09'S, 166°27.19'E, 1665-1590 m, 9.04.1987: 1 ♂ 3.2 mm, 1 ov. ♀ 4.6 mm (MNHN-Pg 5587). — Stn CP 243, 21°27.35'S, 166°25.76'E, 1820 m, 15.04.1987: 1 ♂ 5.8 mm, 1 ov. ♀ 5.2 mm (MNHN-Pg 5588). — Stn CP 250, 21°24.63'S, 166°28.21'E, 2350 m, 15.04.1987: 2 ov. ♀ 5.4, 5.5 mm (MNHN-Pg 5589). — Stn CP 260, 21°00.00'S, 167°58.34'E, 1820-1980 m, 17.04.1987: 2 ♂ 4.6, 6.7 mm, 2 ♀ 5.5, 6.1 mm, 4 ov. ♀ 5.2-6.0 mm (MNHN-Pg 5590). — Stn CP 265, 21°04.09'S, 167°00.40'E, 1760-1870 m, 18.04.1987: 3 ♂ 3.0-7.0 mm, 3 ov. ♀ 4.9-5.7 mm (MNHN-Pg 5591). — Stn CP 266, 21°04.85'S, 167°57.14'E, 2100-1990 m, 18.04.1987: 2 ♂ 6.0, 6.1 mm, 1 ♀ 5.1 mm, 1 ov. ♀ 4.5 mm (MNHN-Pg 5592). — Stn 272, 21°00.04'S, 166°56.94'E, 1615-1710 m, 20.04.1987: 2 ♀ 3.7, 5.7 mm (MNHN-Pg 5593). — Stn 273, 21°01.53'S, 166°57.41'E, 1920-2040 m, 20.04.1987: 7 ♂ 3.0-7.1 mm, 4 ♀ 4.0-4.6 mm, 4 ov. ♀ 4.2-4.8 mm (MNHN-Pg 5594). — Stn CP 283, 21°22.25'S, 166°31.07'E, 2375-2370 m, 26.04.1987: 3 ♂ 5.8-6.6 mm, 1 ov. ♀ 4.3 mm (MNHN-Pg 5595). — Stn DW 296, 20°38.35'S, 167°10.32'E, 1230-1270 m, 28.04.1987: 1 ♀ 3.0 mm (MNHN-Pg 5596). — Stn CP 317, 20°48.12'S, 166°53.16'E, 1630-1620 m, 2.05.1987: 1 ♂ 5.5 mm, 4 ov. ♀ 5.1-6.3 mm (USNM 276127). — Stn CP 321, 21°12.00'S, 166°59.85'E, 2190-2205 m, 3.05.1987: 1 ♂ 5.5 mm (MNHN-Pg 5597). — Stn CP 329, 21°09.05'S, 166°40.08'E, 2315-2310 m, 4.05.1987: 1 ♂ 6.7 mm (MNHN-Pg 5580); 1 ♂ 5.4 mm (MNHN-Pg 5598). — Stn CP 336, 21°12.22'S, 166°22.51'E, 2370-2380 m, 5.05.1987: 1 ♂ 5.1 mm (MNHN-Pg 5599). — Stn CP 341, 21°29.73'S, 166°47.37'E, 2334 m, 6.05.1987: 2 ♂ 4.7, 6.6 mm, 1 ov. ♀ 5.1 mm (MNHN-Pg 5600).

BATHUS 1: stn CP 651, 21°41'S, 166°40'E, 1080-1180 m, 11.03.1993: 4 ♂ 4.6-5.2 mm, 2 ♀ 5.9, 6.1 mm (MNHN-Pg 5601). — Stn CP 660, 21°10'S, 165°53'E, 786-800 m, 13.03.1993: 1 ov. ♀ 6.0 mm (MNHN-Pg 5602).

BATHUS 3: stn CP 822, 23°19'S, 167°57'E, 950-980 m, 29.11.1993: 1 ov. ♀ 5.6 mm (MNHN-Pg 5603). — Stn CP 844, 23°06'S, 166°45'E, 908 m, 1.12.1993: 10 ♂ 6.4-6.6 mm, 8 ov. ♀ 3.7-5.6 mm (MNHN-Pg 5604).

HALIPRO 1: stn CC 856, 21°44'S, 166°37'E, 311-365 m, 20.03.1994: 1 ♂ 6.1 mm (MNHN-Pg 5605). — Stn CH 876, 23°10'S, 166°49'E, 870-1000 m, 31.03.1994: 2 ♂ 5.6, 6.5 mm, 3 ov. ♀ 4.6, 5.4 mm (MNHN-Pg 5606).

Vanuatu. MUSORSTOM 8: stn CP 956, 20°33'S, 169°35'E, 1175-1210 m, 20.09.1994: 3 ♂ 3.9-6.0 mm, 2 ♀ 2.9-5.2 mm, 1 ov. ♀ 3.7 mm (MNHN-Pg 5608). — Stn DW 987, 19°23'S, 169°35'E, 1050-1040 m, 23.09.1994: 1 ov. ♀ 5.3 mm (MNHN-Pg 5609). — Stn CP 1037, 18°03'S, 168°54'E, 1058-1086 m, 29.09.1994: 1 ♀ 7.5 mm (MNHN-Pg 5610). — Stn CP 1076, 15°53'S, 167°30'E, 1100-1191 m, 4.10.1994: 1 ♂ 10.5 mm (MNHN-Pg 5611). — Stn CP 1125, 15°57'S, 166°38'E, 1160-1220 m, 10.10.1994: 4 ♂ 6.4-10.1 mm (MNHN-Pg 5612). — Stn CP 1126, 15°58'S, 166°39'E, 1210-1260 m, 10.10.1994: 5 ♂ 3.5-6.5 mm, 6 ov. ♀ 5.2-7.5 mm (MNHN-Pg 5613).

Wallis and Futuna. MUSORSTOM 7: stn CP 623, 12°34'S, 178°15'W, 1280-1300 m, 28.05.1992: 1 ♀ 4.0 mm (MNHN-Pg 5607).

Tasman Sea. ORV *"Franklin"* (coll. J.K. LOWRY): stn FRO 589-17, 29°42.06'S, 159°48.31'E, 2450 m, 3.05.1989: 1 ♂ 8.8 mm, 1 ov. ♀ 9.6 mm (AM P39450). — Stn FRO 589-32, 27°11.97'S, 160°37.80'E, 1960 m, 7.05.1989: 2 ♂

7.8, 9.5 mm, 1 ♂ 5.5 mm, 2 ov. ♀ 7.0, 7.1 mm (AM P39448). — Stn FRO 589-35, 26°51.57'S, 159°48.72'E, 2500 m, 8.05.1989: 2 ♂ 5.8, 9.2 mm, 5 ♂ 4.6-6.3 mm, 5 ov. ♀ 4.9-6.7 mm (AM P39449).

Arabian Sea. *"Investigator"*, [stn unknown], 1289-2195 m, [date unknown]: 1 ♂ 7.9 mm (AM P2623).

TYPES. — *Holotype*: ♂ 6.7 mm, BIOGEOCAL, stn CP 329, 21°09.05'S, 166°40.08'E, 2315-2310 m, 4.05. 1987 (MNHN-Pg 5580). *Paratypes*: All the others specimens mentioned above.

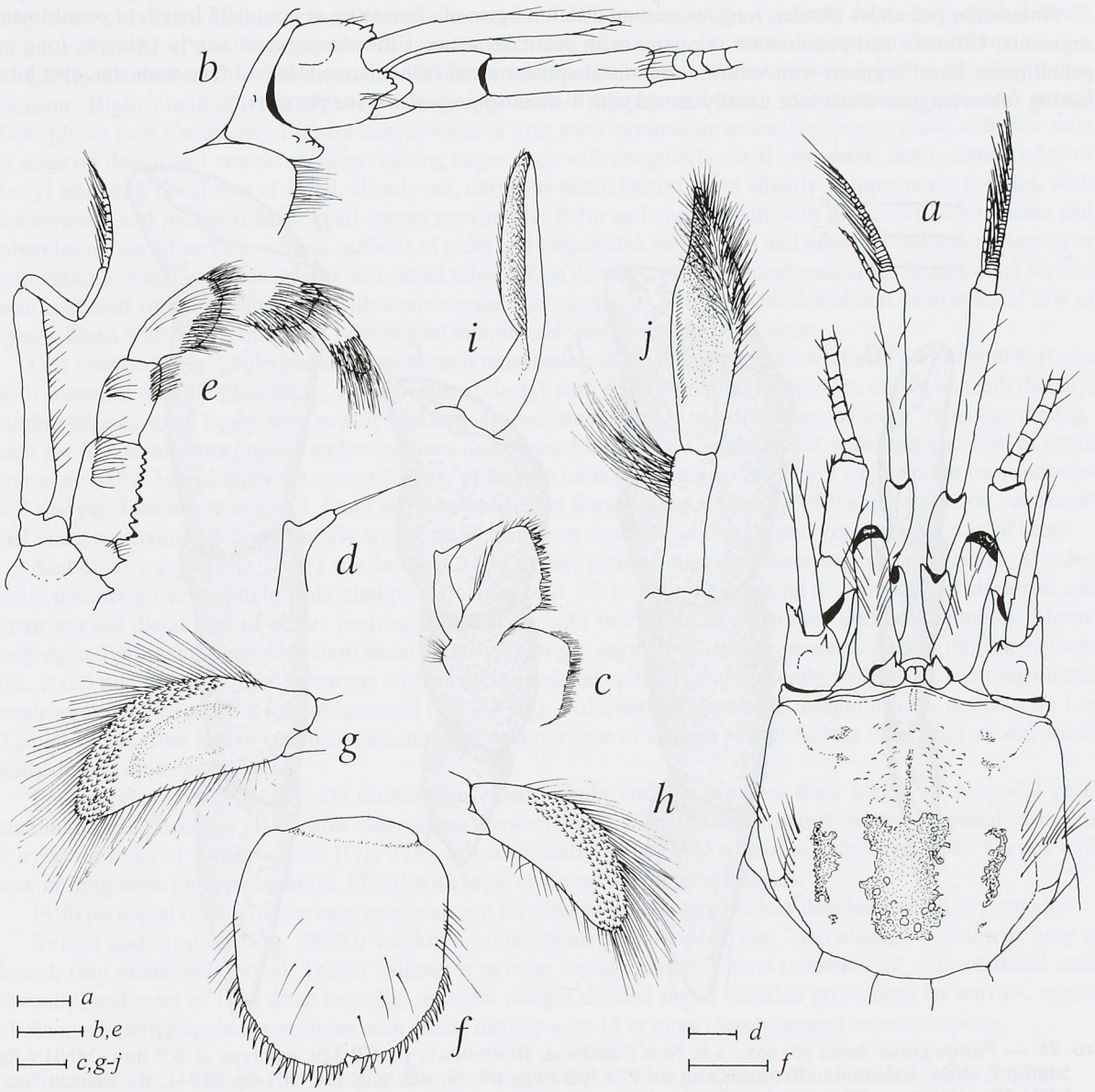


FIG. 24. — *Parapagurus furici* sp. nov., New Caledonia, BIOGEOCAL stn CP 329: a,b,f-h, holotype ♂ 6.7 mm (MNHN-Pg 5580); c-e,i,j, paratype ♂ 5.4 mm (MNHN-Pg 5598). **a**, shield and cephalic appendages; **b**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **c**, left maxillule, internal view; **d**, distal end of endopod of same; **e**, left third maxilliped, internal view; **f**, telson, dorsal view; **g-h**, left (g) and right (h) exopods of uropods, dorsal view; **i**, male first pleopod, mesial view; **j**, male second pleopod, anterior view.

Scales equal 1 mm (a,b,e), 0.5 mm (c,g-j,f), and 0.25 mm (d).

DESCRIPTION. — Shield (Fig. 24a) about as long as broad; dorsal surface usually well calcified, with rows of short setae posteriorly on each side of midline; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margin sloping. Rostrum broadly triangular, rounded distally, slightly overreaching lateral projections; with low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 24b) rounded, unarmed, setose.

Ocular peduncles (including corneae) about half length of shield, each with dorsal longitudinal row of setae; peduncles inflated basally. Ocular acicles subtriangular, terminating in strong spine; separated basally by slightly less than basal width of 1 acicle.

Antennular peduncles slender, long, exceeding distal margins of corneae by at least 0.25 length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe usually armed with 1 small spine, and 1 spine proximally.

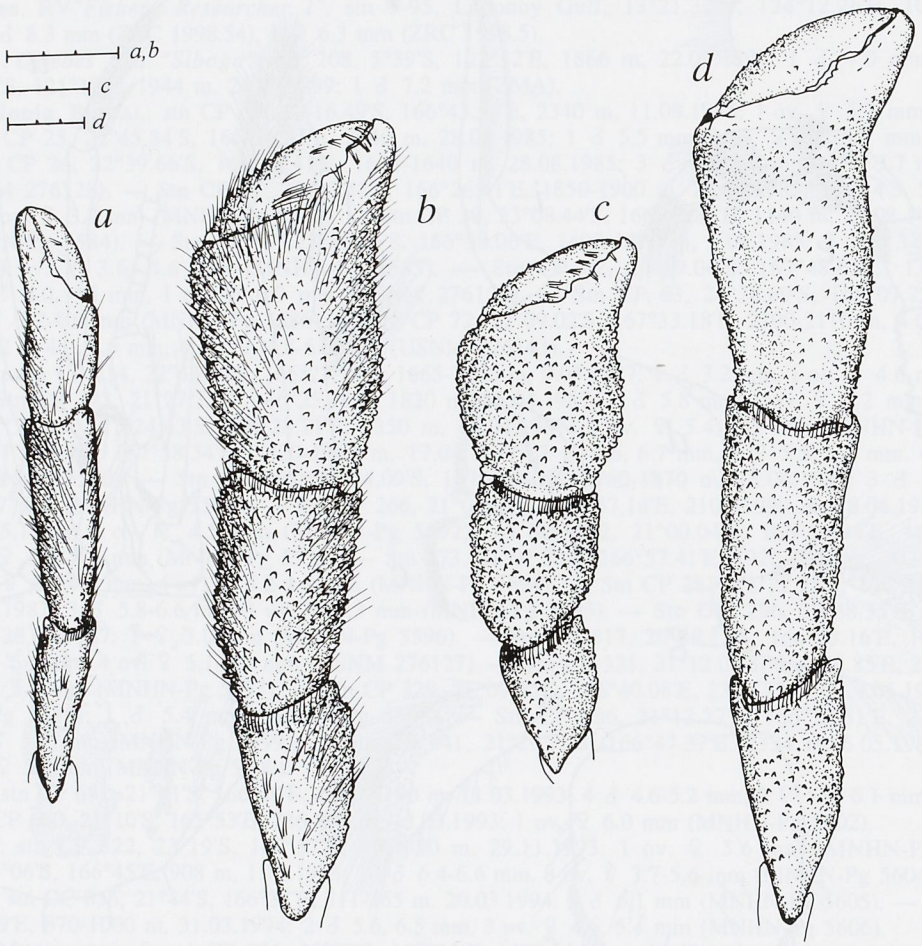


FIG. 25. — *Parapagurus furici* sp. nov.: a-b, New Caledonia, BIOGEOCAL, stn CP 329, holotype ♂ 6.7 mm (MNHN-Pg 5580); c, New Caledonia, BIOGEOCAL, stn 273, paratype ov. ♀ 4.8 mm (MNHN-Pg 5594); d, Tasman Sea, ORV *"Franklin"*, stn FRO 589-35, ♂ 9.2 mm (AM P39449). **a**, left cheliped; **b-d**, right chelipeds (setae omitted in c-d). Scales equal 3 mm (a, b, d), and 2 mm (c).

Antennal peduncles (Fig. 24b) exceeding distal margins of corneae by about half length of fifth segments. Fifth segment with setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong multifid

spine; mesial margin with spine on dorsodistal angle. First segment with or without small blunt spine on lateral face; ventromesial angle produced, with row of small spines. Antennal acicles nearly straight in dorsal view, setose; exceeding distal margin of cornea by 0.3 or more length of acicle; mesial margin usually unarmed, or at most with 1-3 small spines on proximal half. Flagellum distinctly overreaching extended right cheliped; articles with setae less than 1 to 2 flagellar articles in length.

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule (Fig. 24c-d) with external lobe of endopod weakly developed, internal lobe with long seta. Third maxilliped (Fig. 24e) with crista dentata consisting of about 10 small corneous teeth; coxa and basis each with 1 tooth mesially. Sternite of third maxilliped with spine on each side of midline. Epistomial spine usually absent.

Chelipeds markedly dissimilar, each with dorsal surfaces of carpus and chela covered with moderately dense setation. Right cheliped (Fig. 25b-d) with proportions of carpus and chela influenced by size and sexual dimorphism (see Variations). Fingers bent inwards at tips; each terminating in small corneous claw; with few tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also with distal row of small, closely-set, corneous teeth. Dactyl set at slightly oblique angle to palm, with dorsomesial and mesial row of small spines proximally. Palm and carpus each with numerous small spines and tubercles on dorsal surface; ventral surfaces of palm and carpus also with spines and tubercles but less numerous or sometimes few and scattered. Merus with small tubercles on dorsal, dorsolateral and ventral surfaces; mesial surface with scattered spines or tubercles, with ventromesial row of spines. Ischium with dorsal and ventromesial row of spines. Coxa with 1 or 2 spines on ventrodistal margin and ventromesial row of setae.

Left cheliped (Fig. 25a) slender. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute, closely-set, corneous teeth distally; cutting edge of fixed finger with row of regularly-spaced, small, evenly-sized, calcareous teeth. Palm unarmed except for few small dorsomesial and sometimes dorsolateral tubercles. Carpus armed with irregular row of small spines dorsally. Merus unarmed except for row of bristles on dorsal margin, and 1 or 2 small spines on ventromesial margin. Ischium with small, blunt setose tubercles on dorsal margin; usually with small spine on ventromesial margin proximally. Coxa usually with 2 small spines on ventrodistal margin and ventromesial row of setae.

Ambulatory legs (Fig. 26a-f) similar from right to left (except slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl about 1.7 to 1.9 times as long as propodus; with dorsal and ventromesial distal row of setae; ventromesial margin with row of up to 12 minute corneous spinules. Merus, carpus, and propodus each with short setae on dorsal margin; segments distinctly more slender in large specimens (SL ≥ 6.0 mm, e.g. Fig. 26a-f); carpus with small dorsodistal spine. Ischium usually with small ventrodistal and ventroproximal spine (first leg) or unarmed (second leg). Coxa with ventromesial margin usually armed with 1 or 2 small spines (first leg) or unarmed (second leg). Anterior lobe of sternite of second legs (Fig. 26g) setose, armed with simple subterminal spine.

Fourth pereopod (Fig. 27a-d)) semichelate. Dactyl subtriangular, shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp with 2 irregular rows of conical scales (Fig. 27b), or occasionally with 1 row at least distally (Fig. 27d). Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 27e) chelate; propodal rasp forming subtriangular area less than half length of propodus.

Telson and uropods (Fig. 24f-h)) weakly asymmetrical. Left exopod (Fig. 24g) about 2.6 times as long as broad; rasp moderately broad. Telson without or at most weakly marked lateral indentations; with scattered setae dorsally, and rows of long setae laterally; terminal margin divided into 2 rounded projections by narrow, angled (V-shaped) cleft; rounded projections each armed distally with 15 or more closely-spaced corneous spines.

SIZE RANGE. — Males, SL 3.0 to 10.5 mm. Females 2.9 to 11.5 mm. Ovigerous females 3.6 to 9.6 mm.

VARIATIONS. — Right cheliped: in males the length/width ratio of the palm varies from about 1.2 to 1.7 (Fig. 25b,d); in females the palm is usually about as long as wide or slightly wider than long (Fig. 25c). The length of the carpus increases with size more in males than in females. Ambulatory legs (Fig. 26a-f): the length/height ratio of the propodi varies from 5.2 to 7.9 (first leg), and 5.0 to 7.0 (second leg). The length/height ratio of the meri varies from 4.0 to 5.1 (first leg), and 3.4 to 4.4 (second leg).

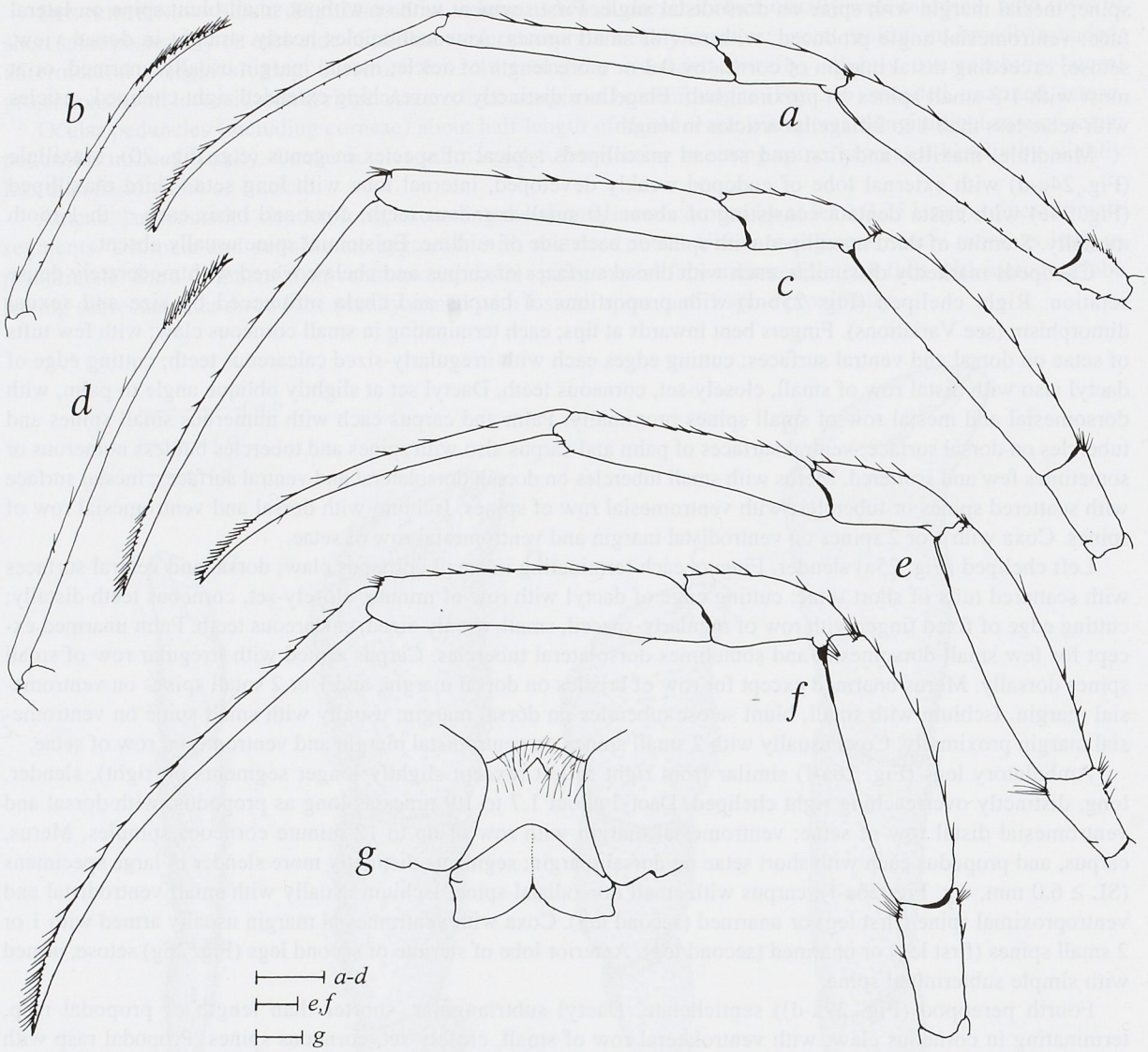


FIG. 26. — *Parapagurus furici* sp. nov., New Caledonia: a-d,g, BIOGEOCAL stn CP 329, holotype ♂ 6.7 mm (MNHN-Pg 5580); e-f, BIOGEOCAL stn 273, paratype ov. ♀ 4.8 mm (MNHN-Pg 5594). **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, left second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, left first ambulatory leg, lateral view; **f**, left second ambulatory leg, lateral view; **g**, sternite of second ambulatory legs, ventral view.

Scales equal 3 mm (a-d), 1 mm (e,f), and 0.5 mm (g).

HABITAT. — Usually found living in shelters formed by zoanthids.

DISTRIBUTION (Figs 47-48). — Western Pacific, including the New Caledonia region; Arabian Sea. Depth: 311 to 2500 m.

ETYMOLOGY. — The species is dedicated to Pierre FURIC, captain of the French research vessels N.O. *"Vauban"* and N.O. *"Alis"* during many MUSORSTOM deep-sea expeditions. The success of these expeditions was largely due to his expertise.

AFFINITIES. — As previously mentioned, *P. furici* sp. nov. and *P. richeri* sp. nov. are superficially similar but can be distinguished by differences in the armature of antennal acicles, slenderness of ambulatory legs, number of rows and shape of scales of the propodal rasp of the fourth pereopod, and armature of the terminal margin of the telson (see Affinities under *P. richeri* sp. nov.).

Compared to other *Parapagurus* species, the degree of slenderness of the ambulatory legs exhibited in specimens of *P. furici* sp. nov. is often quite striking. The length/width ratios of the meri and propodi of these appendages in this new species frequently serve as useful characters for identification of specimens.

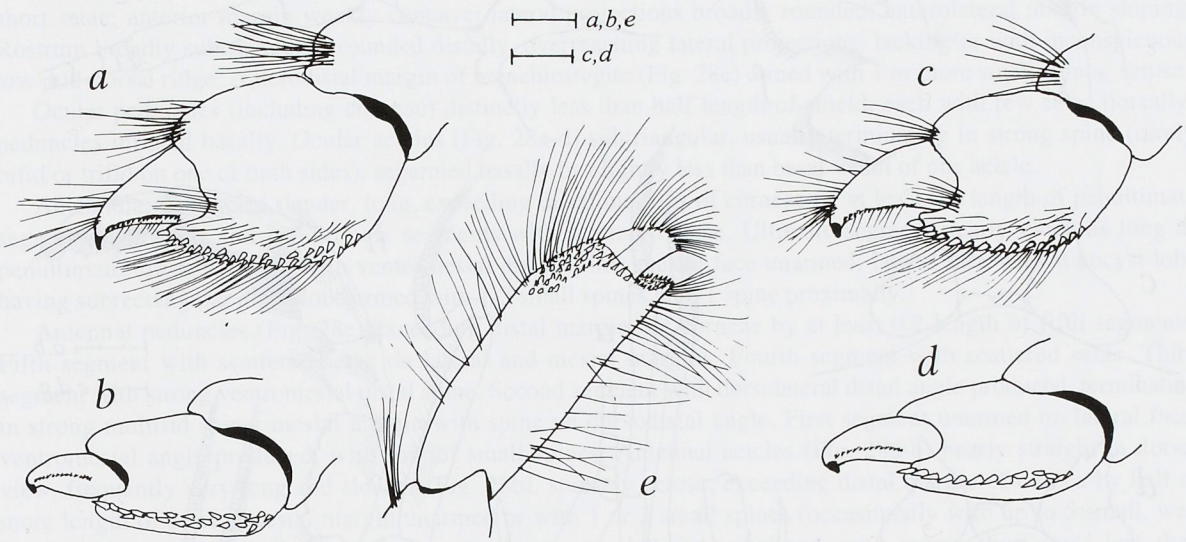


FIG. 27. — *Parapagurus furici* sp. nov., New Caledonia: a-b,e, BIOGEOCAL stn CP 329, holotype ♂ 6.7 mm (MNHN-Pg 5580); c-d, BIOGEOCAL stn CP 260, paratype ♂ 4.6 mm (MNHN-Pg 5590). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fourth pereopod, lateral view; **d**, same (setae omitted), ventrolateral view; **e**, propodus and dactyl of left fifth pereopod, lateral view. Scales equal 0.5 mm (a,b,e), and 0.25 mm (c,d).

REMARKS. — ALCOCK (1901) reported many specimens collected on the *"Investigator"* as *Parapagurus pilosimanus*. ALCOCK (1902) mentioned and depicted the same taxon in a general account of the deep sea fauna from Indian Seas based on samples obtained during the cruises of the *"Investigator"*. One of ALCOCK's specimens, a male collected in the Arabian Sea and deposited in the Australian Museum (AM P2623), has been examined; it represents the new species *P. furici*. The remaining specimens need to be located and studied in order to determine whether they also represent this or possibly other species.

Parapagurus saintlaurentae sp. nov.

Figs 28-31, 47, 49

Parapagurus pilosimanus pilosimanus - DE SAINT LAURENT, 1972: 102 (in part, see Remarks).
Parapagurus pilosimanus scaber - DE SAINT LAURENT, 1972: 102 (in part, see Remarks).

MATERIAL EXAMINED. — **Indian Ocean**.

Mozambique Channel. *"Galathea"*: stn 217, 14°20'S, 45°09'E, 3390 m, 27.02.1951: 2 ♂ 12.7, 15.5 mm (ZMK CRU-3390, 3391).

N of Madagascar. *"Galathea"*: stn 231, 8°52'S, 49°25'E, 5020 m, 7.03.1951: 1 ov. ♀ 11.9 mm (ZMK CRU-3392). — Stn 232, 9°03'S, 49°22'E, 4930 m, 8.03.1951: 1 ♂ 9.5 mm, 1 ov. ♀ 10.0 mm (ZMK CRU-3393, 3394). — Stn 233, 7°24'S, 48°24'E, 4730 m, 9.03.1951: 2 ♂ 11.6, 12.1 mm, 2 ♀ 7.5, 10.1 mm, 2 ov. ♀ 9.8, 10.1 mm (ZMK CRU-3395).

— Stn 234, 5°25'S, 47°09'E, 4820 m, 10.03.1951: 6 ♂ 5.4-14.7 mm, 4 ♀ 8.3-9.7 mm, 5 ov. ♀ 10.4-12.1 mm (ZMK CRU-3396). — Stn 235, 4°47'S, 46°19'E, 4810 m, 11.03.1951: ♂ 13.0 mm (ZMK CRU-3397); 24 ♂ 9.1-13.7 mm, 10 ♀ 9.1-11.6 mm, 32 ov. ♀ 8.8-10.7 mm (ZMK CRU-3398, 3399, 3400), 4 ♂ 12.5-13.4 mm, 1 ♀ 11.2 mm, 3 ov. ♀ 10.0-10.7 mm (USNM 276123).

SE Îles Glorieuses. BENTHEDI: stn BENT 90-CH, 11°44'S, 47°30'E, 3700 m, 4.04.1977: 1 ♀ 7.8 mm (MNHN-Pg 5645).

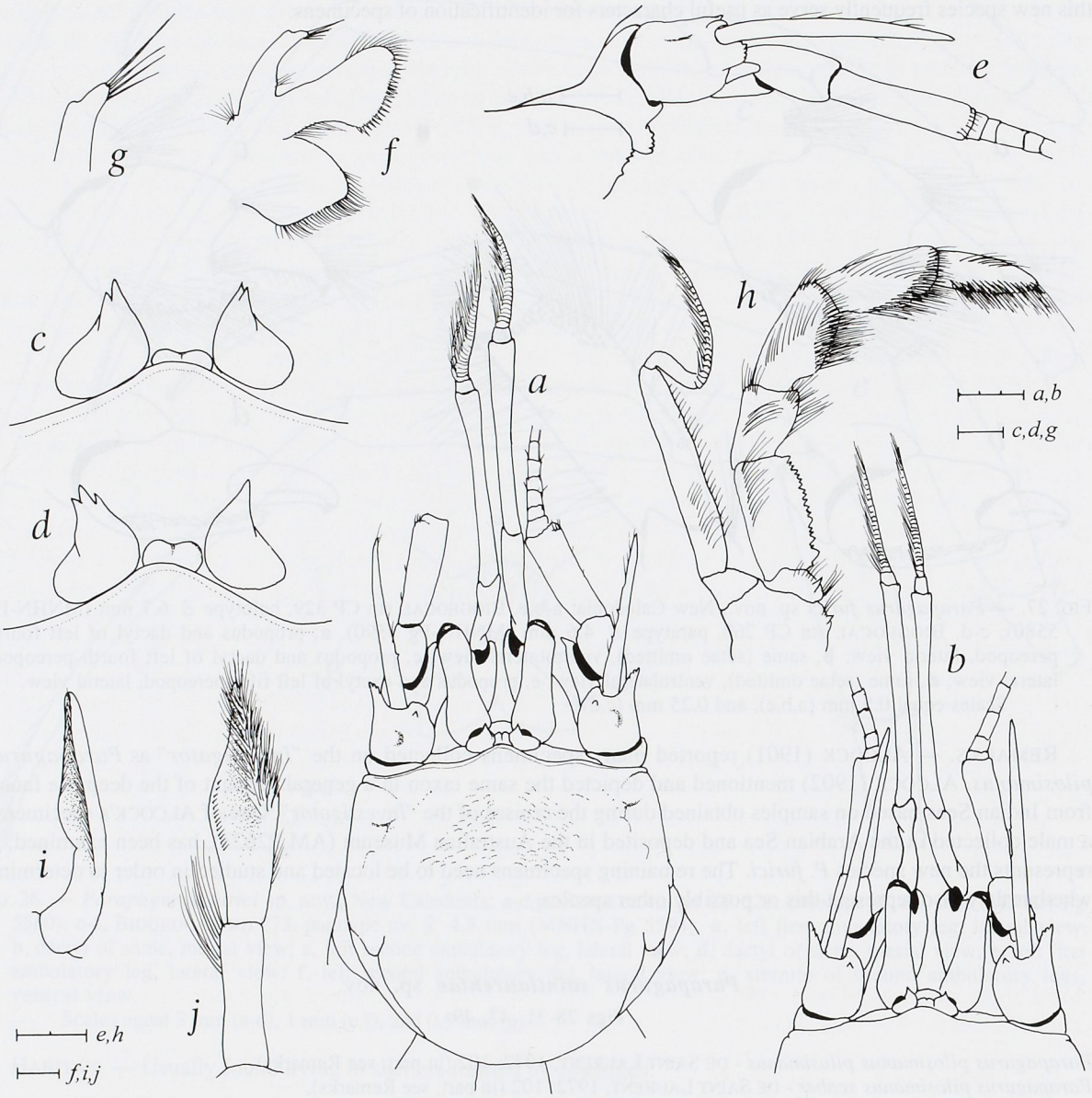


FIG. 28. — *Parapagurus saintlaurentae* sp. nov., Indian Ocean, *"Galathea"*, stn 235: a,e, holotype ♂ 13.0 mm (ZMK CRU-3397); b, paratype ♂ 12.4 mm (ZMK CRU-3398); c, paratype ♀ 11.1 mm (ZMK CRU-3398); d, paratype ♀ 11.0 mm (ZMK CRU-3398); f-j, paratype ♂ 12.2 mm (ZMK CRU-3398). **a**, shield and cephalic appendage; **b**, anterior portion of shield and cephalic appendages; **c-d**, ocular acicles, dorsal view; **e**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **f**, left maxillule, internal view; **g**, distal end of endopod of same; **h**, left third maxilliped, internal view; **i**, male left first pleopod, mesial view; **j**, male left second pleopod, anterior view.

Scales equal 3 mm (a,b), 0.5 mm (c,d,g), 2 mm (e,h), and 1 mm (f,i,j).

Kenya. *"Galathea"*: stn 238, 3°23'S, 44°04'E, 3960 m, 13.03.1951: 5 ♂ 6.3-9.2 mm, 4 ♀ 5.7-7.9 mm, 3 ov. ♀ 7.2-8.0 mm (ZMK CRU-3401).

SW of Sri Lanka (Ceylon).*"Galathea"*: stn 279, 1°00'N, 76°17'E, 4320 m, 8.04.1951: 4 ♂ 6.0-12.0 mm, 1 ov. ♀ 9.2 mm (ZMK CRU-3402). — Stn 282, 5°32'N, 78°41'E, 4040 m, 11.04.1951: 1 ♂ 8.5 mm, 1 ♀ 12.1 mm (ZMK CRU-3403).

TYPES. — *Holotype*: ♂ 13.0 mm,*"Galathea"*, stn 235, N of Madagascar, 4°47'S, 46°19'E, 4810 m, 11.03.1951 (ZMK CRU-3397). *Paratypes*: All the others specimens mentioned above.

DESCRIPTION. — Shield (Fig. 28a) about as long as broad; dorsal surface usually well calcified, with scattered short setae; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margin sloping. Rostrum broadly subtriangular, rounded distally, overreaching lateral projections; lacking or with inconspicuous low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 28e) armed with 1 or more small spines, setose.

Ocular peduncles (including corneae) distinctly less than half length of shield, each with few setae dorsally; peduncles inflated basally. Ocular acicles (Fig. 28a-d) subtriangular, usually terminating in strong spine (rarely bifid or trifid on one or both sides); separated basally by slightly less than basal width of one acicle.

Antennular peduncles slender, long, exceeding distal margins of corneae by at least 0.8 length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 1-3 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 28e) exceeding distal margins of corneae by at least 0.2 length of fifth segments. Fifth segment with scattered setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong multifid spine; mesial margin with spine on dorsodistal angle. First segment unarmed on lateral face; ventromesial angle produced, with row of small spines. Antennal acicles (Fig. 28a-b) nearly straight in dorsal view, frequently very long and slender (Fig. 28b), sparsely setose; exceeding distal margin of cornea by half or more length of acicle; mesial margin unarmed or with 1 or 2 small spines (occasionally with up to 5 small, well spaced spines). Flagellum distinctly overreaching extended right cheliped, with sparse short setae less than 1 flagellar articles in length.

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule (Fig. 28f-g) with external lobe of endopod weakly developed, internal lobe with long terminal seta and 4 subterminal setae. Third maxilliped (Fig. 28h) with crista dentata consisting of about 20 small corneous teeth; coxa and basis each with 1 tooth mesially. Sternite of third maxilliped with spine on each side of midline. Epistomial spine usually absent.

Chelipeds markedly dissimilar, each with dorsal surfaces of carpus and chela covered with moderately dense setation; proportions of carpus and chela influenced by size and sexual dimorphism (see Variations). Right cheliped (Fig. 29c-e) with fingers bent inwards at tips, each terminating in small corneous claw; with tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also with distal row of small, closely-set, corneous teeth. Dactyl set at oblique angle to palm, with dorsomesial and mesial row of small spines proximally. Palm and carpus each with numerous small spines and tubercles on dorsal and ventral surfaces (spines and tubercles usually less numerous on ventral surfaces). Merus with small tubercles on dorsal, dorsolateral and ventral surfaces; mesial surface smooth; with ventromesial row of spines. Ischium with dorsal and ventromesial row of spines. Coxa with 1 or 2 spines on ventrodistal margin and ventromesial row of setae.

Left cheliped (Fig. 29a-b) slender, more so in males than in females. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute, closely-set, corneous teeth distally; cutting edge of fixed finger with row of small regularly-spaced and evenly-sized calcareous teeth. Palm with dorsomesial row of small spines; dorsolateral face with small spines. Carpus with irregular row of small spines dorsally; lateral face with scattered small spines or tubercles. Merus with row of setae dorsally; ventromesial margin with row of spines. Ischium armed with blunt spines or tubercles dorsally, and ventromesial row of spines. Coxa usually with 2 small spines on ventrodistal margin and ventromesial row of setae.

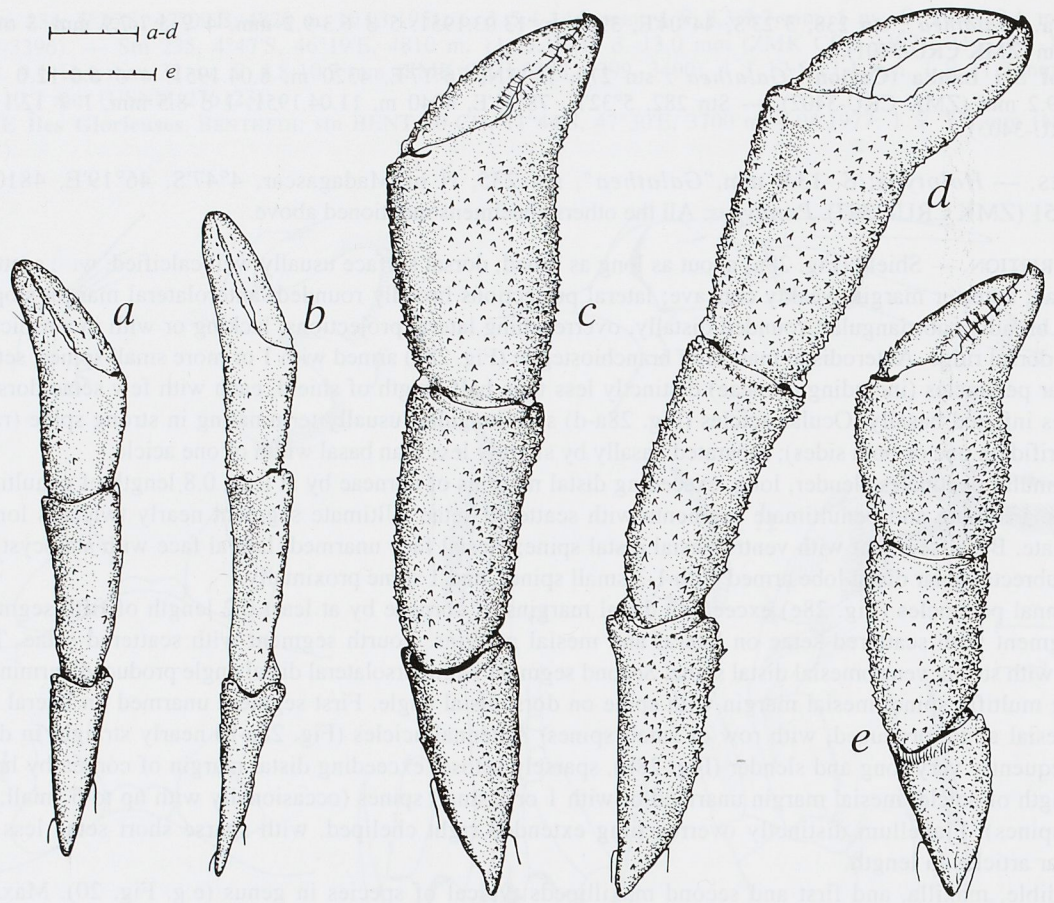


FIG. 29. — *Parapagurus saintlaurentae* sp. nov., Indian Ocean, *"Galathea"*, stn 235: a,c, holotype ♂ 13.0 mm (ZMK CRU-3397); b,d, paratype ♂ 13.5 mm (ZMK CRU-3398); e, paratype ♀ 10.7 mm (ZMK CRU-3398). **a-b**, left chelipeds (setae omitted); **c-e**, right chelipeds (setae omitted). Scales equal 5 mm.

Ambulatory legs (Fig. 30a-f) similar from right to left (except slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl about 1.5 times as long as propodus; with dorsal and ventromesial distal row of setae (missing in holotype, Fig. 30a-b,e-f); ventromesial margin with row of about 7 to 15 minute corneous spinules. Meri, carpi, and propodi each with small low tubercles bearing short stiff setae on dorsal margin. Meri and carpi each usually with dorsal margin ridge-like (e.g., Fig. 30c-d); merus 4.7 (first leg) or 3.9 (second leg) times as long as high. Carpus with rounded or often somewhat subglobular dorsodistal region marked by shallow oblique depression and with 1-3 small spines (Fig. 30c-d). Ischium with ventrodistal row of small spines (first leg), or small setose distal tubercle (second leg). Coxae of legs (Fig. 30g-h) each with ventromesial margin forming a lobe proximally, lobe often strongly produced and armed with 1 or more small spines. Anterior lobe of sternite of second legs (Fig. 30g-h) setose, armed with simple subterminal spine.

Fourth pereopod (Fig. 31a-d) semichelate. Dactyl subtriangular; shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp usually with 2 (Fig. 31b) or occasionally 3 (Fig. 31a) irregular rows of lanceolate or conical scales. Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 31e) chelate; propodal rasp forming subtriangular area less than half length of propodus.

Telson and uropods (Fig. 31f-i) weakly asymmetrical. Left exopod (Fig. 31g) elongate, about 2.6 times as long as broad; rasp moderately broad. Telson without or at most with weak lateral indentations, and scattered setae

dorsally; terminal margin divided into 2 rounded projections by wide, often deep rounded (U-shaped cleft); rounded projections each armed distally with moderately long corneous spines (about 15 left, 12 right).

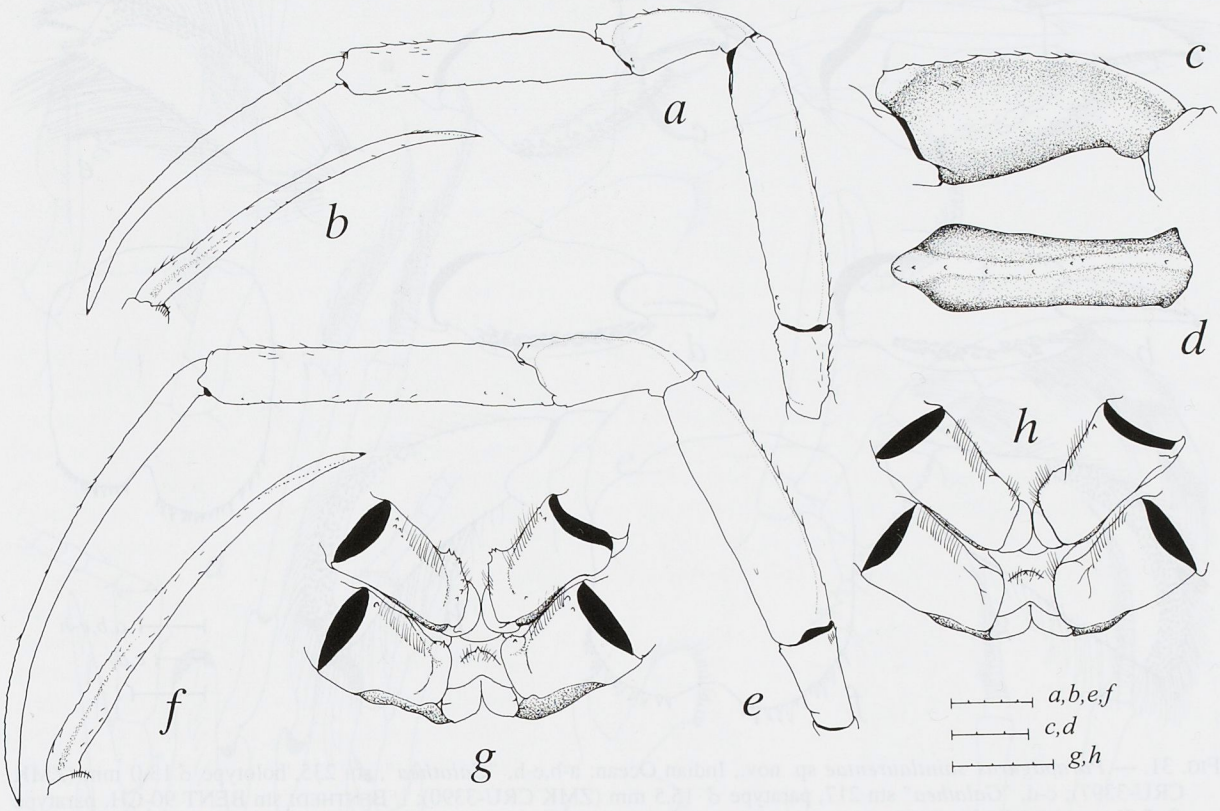


FIG. 30. — *Parapagurus saintlaurentae* sp. nov., Indian Ocean, *"Galathea"*, stn 235: a-g, holotype ♂ 13.0 mm (ZMK CRU-3397); h, paratype ♂ 13.6 mm (ZMK CRU-3398). **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, carpus of same, lateral view; **d**, same, dorsal view; **e**, left second ambulatory leg, lateral view; **f**, dactyl of same, mesial view; **g-h**, coxae and sternites of ambulatory legs, ventral view.
Scales equal 5 mm (a,b,e,f-h), and 3 mm (c,d).

SIZE RANGE. — Males, SL 5.4 to 15.5 mm. Females 5.7 to 12.1 mm. Ovigerous females 7.2 to 12.1 mm.

VARIATIONS. — The fingers of the right cheliped in large specimens (SL >13.0 mm) often leave a wide hiatus when closed (Fig. 29d). In males (Fig. 29c-d), the length/width ratio of the palm varies from 1.4 to 1.7; in females (Fig. 29e), the palm is usually about as long as wide. The length of the carpus increases with size more in males than in females.

HABITAT. — Found living in zoanthids, or actinians that secrete a chitinous carcinoecia.

DISTRIBUTION (Figs 47, 49). — Known so far only from the Indian Ocean, north of Madagascar, and southwest of Sri Lanka (Ceylon). Depth: 3390 to 5020 m.

ETYMOLOGY. — The specific name is given in honor of the eminent French carcinologist, Mme Michèle DE SAINT LAURENT, in recognition of her many important contributions to our knowledge of decapod crustaceans in general, and of parapagurids in particular.

AFFINITIES. — See *P. holthuisi*.

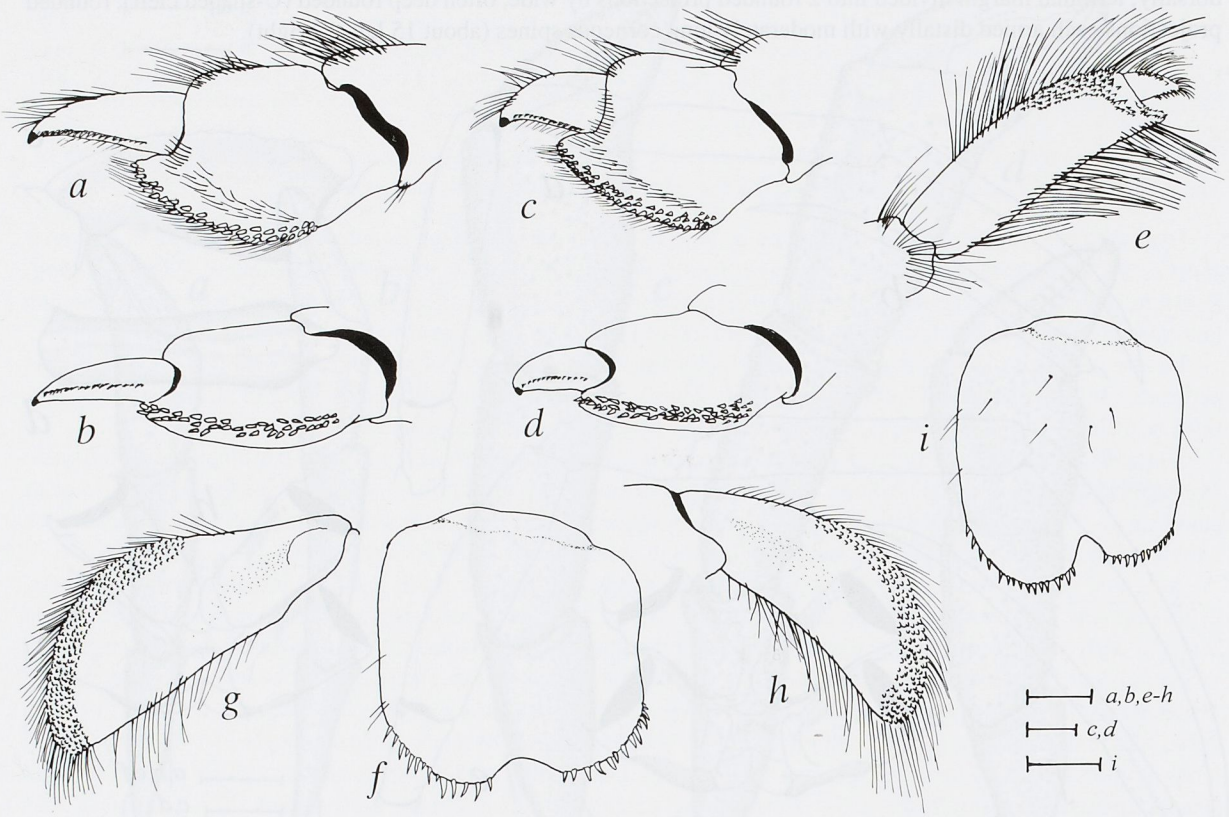


FIG. 31. — *Parapagurus saintlaurentae* sp. nov., Indian Ocean: a-b,e-h, *"Galathea"*, stn 235, holotype ♂ 13.0 mm (ZMK CRU-3397); c-d, *"Galathea"* stn 217, paratype ♂ 15.5 mm (ZMK CRU-3390); i, BENTHEDI stn BENT 90-CH, paratype ♀ 7.8 mm (MNHN-Pg 5645). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fourth pereopod, lateral view; **d**, same (setae omitted), ventrolateral view; **e**, propodus and dactyl of left fifth pereopod, lateral view; **f**, telson, dorsal view; **g-h**, left (g) and right (h) exopod of uropods, dorsal view; **i**, telson, dorsal view. Scales equal 1 mm.

REMARKS. — Examination of the Indo-Pacific material used by DE SAINT LAURENT (1972) in her report of *P. p. pilosimanus* and *P. p. scaber*, has shown that she confounded it with three species. DE SAINT LAURENT's Indo-Pacific material of *P. p. pilosimanus* actually contains specimens of *P. saintlaurentae* sp. nov. and, as previously mentioned, specimens of *P. latimanus*. DE SAINT LAURENT's Indo-Pacific material of *P. p. scaber* contains specimens of the new species *P. saintlaurentae* and *P. stenorhinus*.

Parapagurus stenorhinus sp. nov.

Figs 32-35, 47, 49

Parapagurus pilosimanus scaber - DE SAINT LAURENT, 1972: 102 (in part, see Remarks).
Parapagurus pilosimanus nudus - DE SAINT LAURENT, 1972: 102 (in part, see Remarks under *Parapagurus richeri* sp. nov.).

MATERIAL EXAMINED. — **Indian Ocean**.
South Africa. *"Galathea"*: stn 192, off Durban., 32°00'S, 32°41'E, 3530 m, 5.02.1951: 1 ♂ 6.4 mm (ZMK CRU-3405).
N of Madagascar. *"Galathea"*: stn 232, 9°03'S, 49°22'E, 4930 m, 8.03.1951: 1 ov. ♀ 5.5 mm (ZMK CRU-3404).
Kenya. *"Galathea"*: stn 238, 3°23'S, 44°04'E, 3960 m, 13.03.1951: 9 ♂ 3.6-7.5 mm, 8 ♀ 3.3-6.0 mm, 2 ov. ♀ 3.7, 5.8 mm (ZMK CRU-3406, 3407).

SW of Sri Lanka (Ceylon). *"Galathea"*: stn 280, 1°56'N, 77°05'E, 4465-4530 m, 9.04.1951: 1 ♀ 5.6 mm (ZMK CRU-3408).

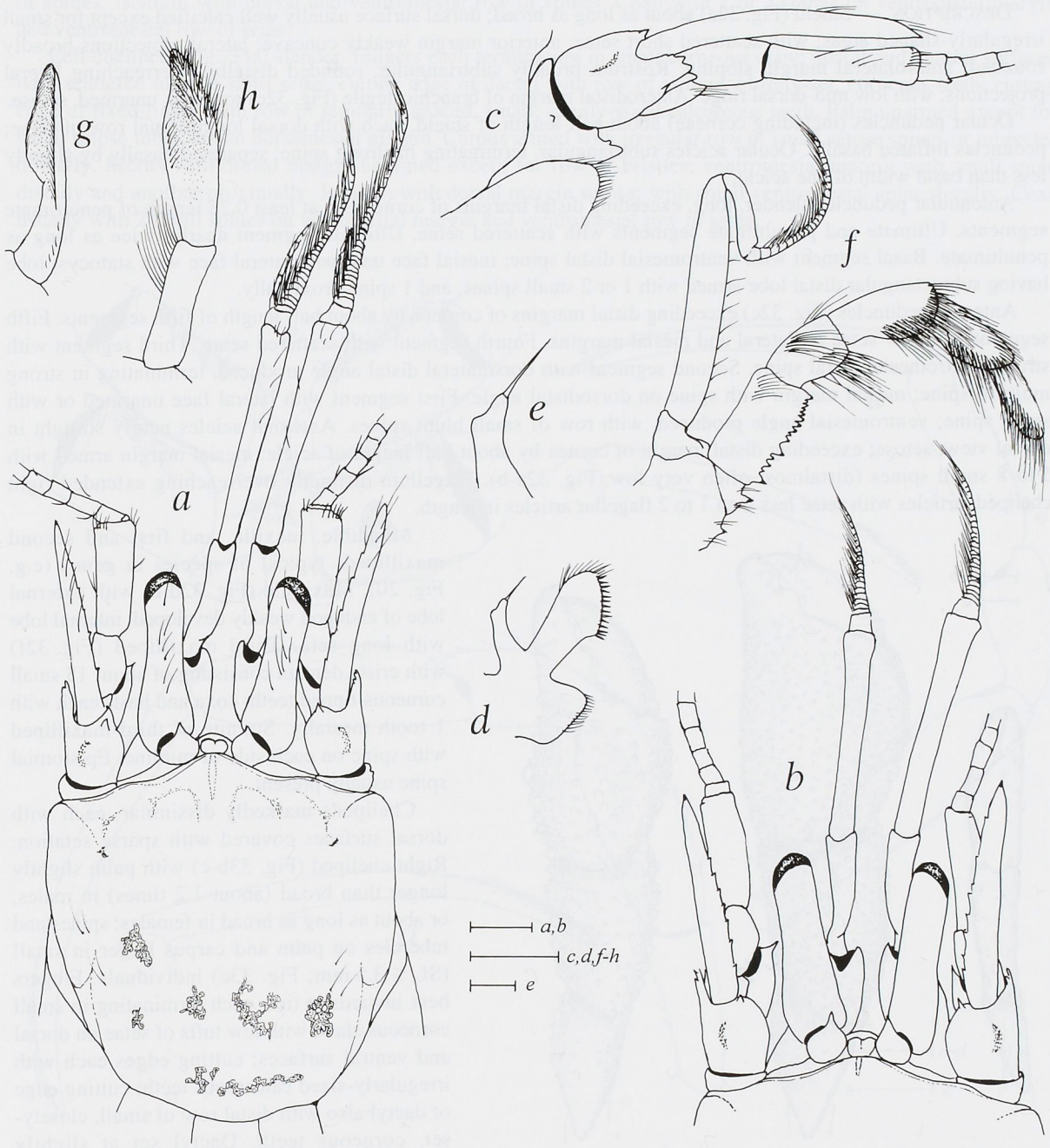


FIG. 32. — *Parapagurus stenorhinus* sp. nov., Indian Ocean, *"Galathea"*: a,c stn 232, holotype ov. ♀ 5.5 mm (ZMK CRU-3404); b, stn 192, paratype ♂ 6.4 mm (ZMK CRU-3405); d-h, stn 238, paratype ♂ 4.9 mm (ZMK CRU-3405). **a**, shield and cephalic appendages; **b**, anterior portion of shield and cephalic appendages (setae omitted); **c**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **d**, maxillule, internal view; **e**, distal portion of endopod of same; **f**, left third maxilliped, internal view; **g**, male left first pleopod, mesial view; **h**, male left second pleopod, anterior view.

Scales equal 1 mm (a-d,f-h), and 0.25 mm (e).

TYPES. — *Holotype*: ov. ♀ 5.5 mm, *"Galathea"*, stn 232, N of Madagascar, 9°03'S, 49°22'E, 4930 m, 8.03.1951 (ZMK CRU-3404). *Paratypes*: All the others specimens mentioned above.

DESCRIPTION. — Shield (Fig. 32a) about as long as broad; dorsal surface usually well calcified except for small irregularly-shaped areas; with scattered short setae; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margin sloping. Rostrum broadly subtriangular, rounded distally, overreaching lateral projections; with low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 32c) rounded, unarmed, setose.

Ocular peduncles (including corneae) about half length of shield, each with dorsal longitudinal row of setae; peduncles inflated basally. Ocular acicles subtriangular, terminating in strong spine; separated basally by slightly less than basal width of one acicle.

Antennular peduncles slender, long, exceeding distal margins of corneae by at least 0.25 length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 1 or 2 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 32c) exceeding distal margins of corneae by about half length of fifth segments. Fifth segment with few setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong multifid spine; mesial margin with spine on dorsodistal angle. First segment with lateral face unarmed or with small spine; ventromesial angle produced, with row of small blunt spines. Antennal acicles nearly straight in dorsal view, setose; exceeding distal margin of cornea by about half length of acicle; mesial margin armed with 5 to 8 small spines (distalmost often very low, Fig. 32a-b). Flagellum distinctly overreaching extended right cheliped; articles with setae less than 1 to 2 flagellar articles in length.

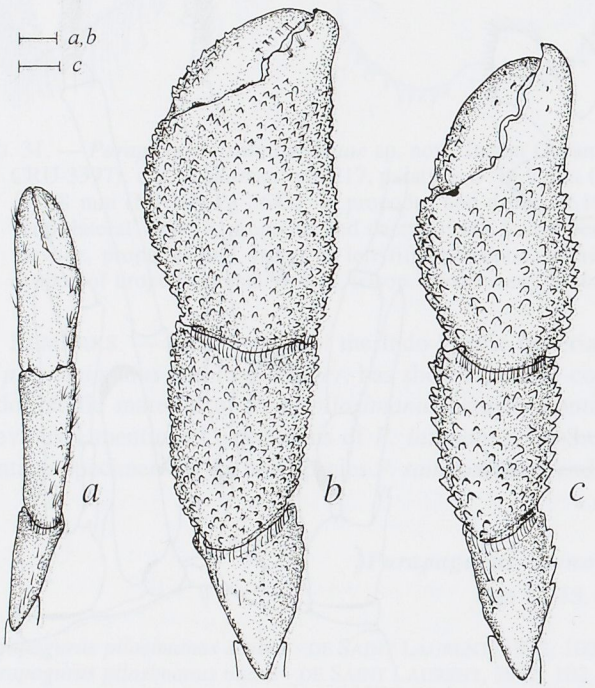


FIG. 33. — *Parapagurus stenorhinus* sp. nov., Indian Ocean, *"Galathea"*: a-b, stn 232, holotype ov. ♀ 5.5 mm (ZMKCRU-3404); c, stn 238, paratype ♀ 3.3 mm (ZMK CRU-3407). **a**, left cheliped; **b-c**, right chelipeds (setae omitted).
Scales equal 1 mm (a-b), and 0.5 mm (c).

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule (Fig. 32d-e) with external lobe of endopod weakly developed, internal lobe with long seta. Third maxilliped (Fig. 32f) with crista dentata consisting of about 15 small corneous-tipped teeth; coxa and basis each with 1 tooth mesially. Sternite of third maxilliped with spine on each side of midline. Epistomial spine usually present.

Chelipeds markedly dissimilar, each with dorsal surfaces covered with sparse setation. Right cheliped (Fig. 33b-c) with palm slightly longer than broad (about 1.2 times) in males, or about as long as broad in females; spines and tubercles on palm and carpus larger in small (SL ≤ 3.5 mm; Fig. 33c) individuals. Fingers bent inwards at tips, each terminating in small corneous claw; with few tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also with distal row of small, closely-set, corneous teeth. Dactyl set at slightly oblique angle to palm, with dorsomesial and mesial row of small spines proximally. Palm and carpus each with numerous small spines and tubercles on dorsal surface; ventral surfaces of palm and carpus also with spines and

tubercles but less numerous, tubercles on palm scattered (some often arranged in 2 median rows). Merus with scattered small tubercles on dorsal, dorsolateral and ventral surfaces; mesial surface smooth; with ventromesial row of spines. Ischium with dorsal and ventromesial row of spines. Coxa with 1 or 2 spines on ventrodistal margin and ventromesial row of setae.

Left cheliped (Fig. 33a) slender. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute, closely-set, corneous teeth; cutting edge of fixed finger with row of regularly-spaced, small, evenly-sized calcareous teeth. Palm unarmed except for small setose tubercles on dorsomesial margin. Carpus armed with irregular row of small setose spines or tubercles dorsally. Merus with dorsal margin unarmed except for row of bristles; ventromesial margin with small spine distally and another proximally. Ischium with dorsal margin setose; with small ventromesial spine distally. Coxa usually with 2 small spines on ventrodistal margin and ventromesial row of setae.

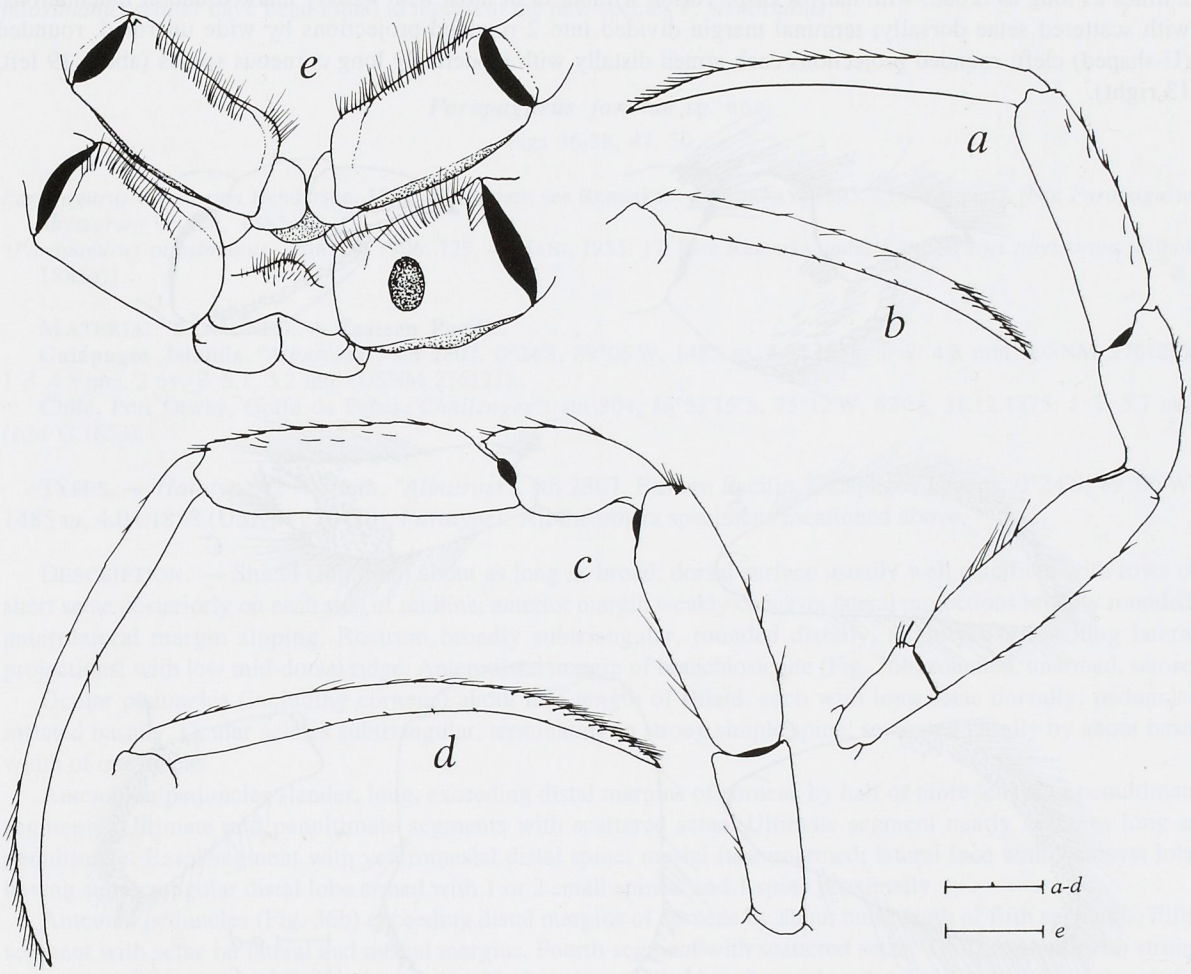


FIG. 34. — *Parapagurus stenorhinus* sp. nov., Indian Ocean, *"Galathea"*, stn 232, holotype ov. ♀ 5.5 mm (ZMK CRU-3404): **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, left second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, coxae and sternites of ambulatory legs. Scales equal 2 mm (a-d), and 1 mm (e).

Ambulatory legs (Fig. 34a-d) similar from right to left (except for slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl about 1.8 times as long as propodus; with dorsal and

ventromesial distal row of setae; ventromesial margin with row of about 8 to 10 minute corneous spinules. Merus, carpus, and propodus each with short bristles on dorsal margin; carpus with small dorsodistal spine; merus about 3.6 (first leg) or 2.9 (second leg) times as long as high. Ischium usually with small ventrodistal tubercle (first leg) or unarmed (second leg). Coxa (Fig. 34e) with ventrodistal margin usually armed with 1 or 2 small spines (first leg) or unarmed (second leg). Anterior lobe of sternite of second leg (Fig. 34e) setose, unarmed or with simple subterminal spine.

Fourth pereopod (Fig. 35a-b) semichelate. Dactyl subtriangular, shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp with 1 row of ovate scales at least distally; rasp sometimes with 2 short irregular rows of rounded scales proximally. Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 35c) chelate; propodal rasp forming subtriangular area less than half length of propodus.

Telson and uropods (Fig. 35d-f) asymmetrical. Left exopod (Fig. 35e) usually broad, paddle-shaped, about 2 times as long as broad; with narrow rasp. Telson without or at most with weakly marked lateral indentations; with scattered setae dorsally; terminal margin divided into 2 rounded projections by wide unarmed, rounded (U-shaped) cleft; rounded projections each armed distally with moderately long corneous spines (about 19 left, 13 right).

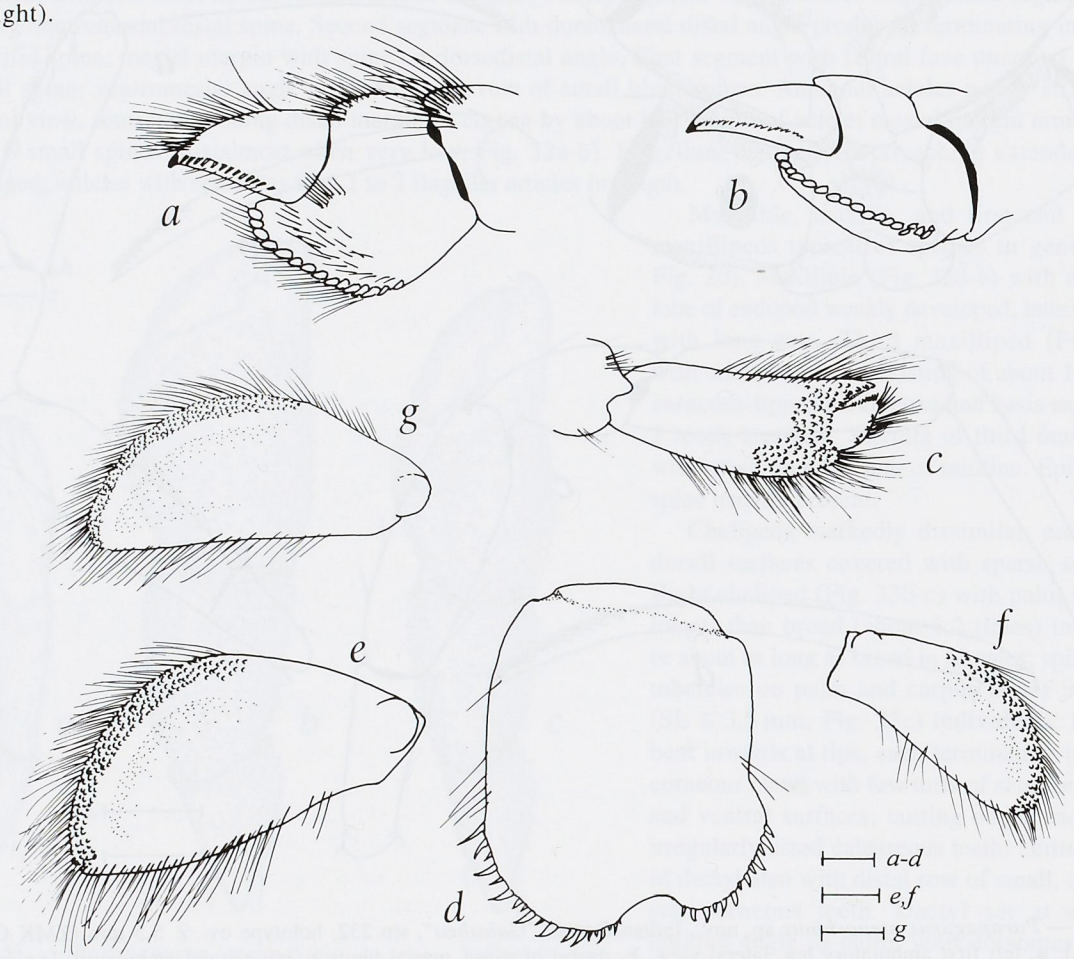


FIG. 35. — *Parapagurus stenorhinus* sp. nov., Indian Ocean, *"Galathea"*: a-f, stn 232, holotype ov. ♀ 5.5 mm (ZMK CRU-3404); g, stn 238, paratype ♂ 7.4 mm (ZMK CRU-3406). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fifth pereopod, lateral view; **d**, telson, dorsal view; **e-g**, left (e,g) and right (f) exopod of uropods, dorsal view.

Scales equal 0.25 mm (a-d,g), and 0.5 mm (e-f).

SIZE RANGE. — Males, SL 3.1 to 7.5 mm. Females 3.3 to 6.0 mm. Ovigerous females 3.7 to 5.8 mm.

HABITAT. — One of the specimens examined was lodged in gastropod shell, another in a scaphopod shell. The remaining specimens examined were without housing.

DISTRIBUTION (Figs 47, 49). — Indian Ocean, from off eastern Africa to southwest of Shri Lanka (Ceylon). Depth: 2400 to 4930 m.

ETYMOLOGY. — The specific name is a compound used as an adjective, derived from the Greek *stenos*, narrow, and *rhine*, rasp, and refers to the narrow rasp of the left uropodal exopod found in this species.

AFFINITIES. — See *P. richeri* sp. nov..

REMARKS. — Several Indo-Pacific specimens identified by DE SAINT LAURENT (1972) as *Parapagurus pilosimanus scaber* have been found to represent the new species *P. stenorhinus*.

Parapagurus janetae sp. nov.

Figs 36-38, 47, 50

Parapagurus abyssorum Henderson, 1888: 87 (in part, see Remarks). — MURRAY, 1895: 1140 (in part). [Not *Parapagurus abyssorum* (Filhol, 1885a)].

?*Parapagurus pilosimanus* - PORTER, 1906: 129. — HAIG, 1955: 17. [See Remarks under *Parapagurus abyssorum* (Filhol, 1885a)].

MATERIAL EXAMINED. — **Eastern Pacific**.

Galápagos Islands. *"Albatross"*: stn 2807, 0°24'S, 89°06'W, 1485 m, 4.04.1888: 1 ♀ 4.8 mm (USNM 276120); 1 ♂ 4.5 mm, 2 ov. ♀ 5.1, 5.2 mm (USNM 276121).

Chile. Port Otway, Golfo de Peñas,*"Challenger"*: stn 304, 46°53'15"S, 75°12'W, 82 m, 31.12.1875: 1 ♀ 5.7 mm (AM G.1653).

TYPES. — *Holotype*: ♀ 4.8 mm, *"Albatross"*, stn 2807, Eastern Pacific. Galápagos Islands, 0°24'S, 89°06'W, 1485 m, 4.04.1888 (USNM 276120). *Paratypes*: All the others specimens mentioned above.

DESCRIPTION. — Shield (Fig. 36a) about as long as broad; dorsal surface usually well calcified, with rows of short setae posteriorly on each side of midline; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margin sloping. Rostrum broadly subtriangular, rounded distally, slightly overreaching lateral projections; with low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 36b) rounded, unarmed, setose.

Ocular peduncles (including corneae) about half length of shield, each with long setae dorsally; peduncles inflated basally. Ocular acicles subtriangular, terminating in strong simple spine; separated basally by about basal width of one acicle.

Antennular peduncles slender, long, exceeding distal margins of corneae by half or more length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 1 or 2 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 36b) exceeding distal margins of corneae by about half length of fifth segments. Fifth segment with setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong multifid spine; mesial margin with spine on dorsodistal angle. First segment with lateral face unarmed; ventromesial angle produced, with row of small spines. Antennal acicles weakly curved in dorsal view, setose; exceeding distal margin of cornea by 0.2 or more length of acicle; mesial margin armed on proximal half with 2-5 small spines. Flagellum distinctly overreaching extended right cheliped; articles with setae less than 1 to 2 flagellar articles in length.

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule (Fig. 36c) with external lobe of endopod weakly developed, internal lobe with long seta. Third maxilliped

(Fig. 36d) with crista dentata consisting of about 13 small distal corneous teeth and 2 large partially fused corneous teeth proximally; coxa and basis each with 1 tooth mesially. Sternite of third maxilliped with spine on each side of midline. Epistomial spine present.

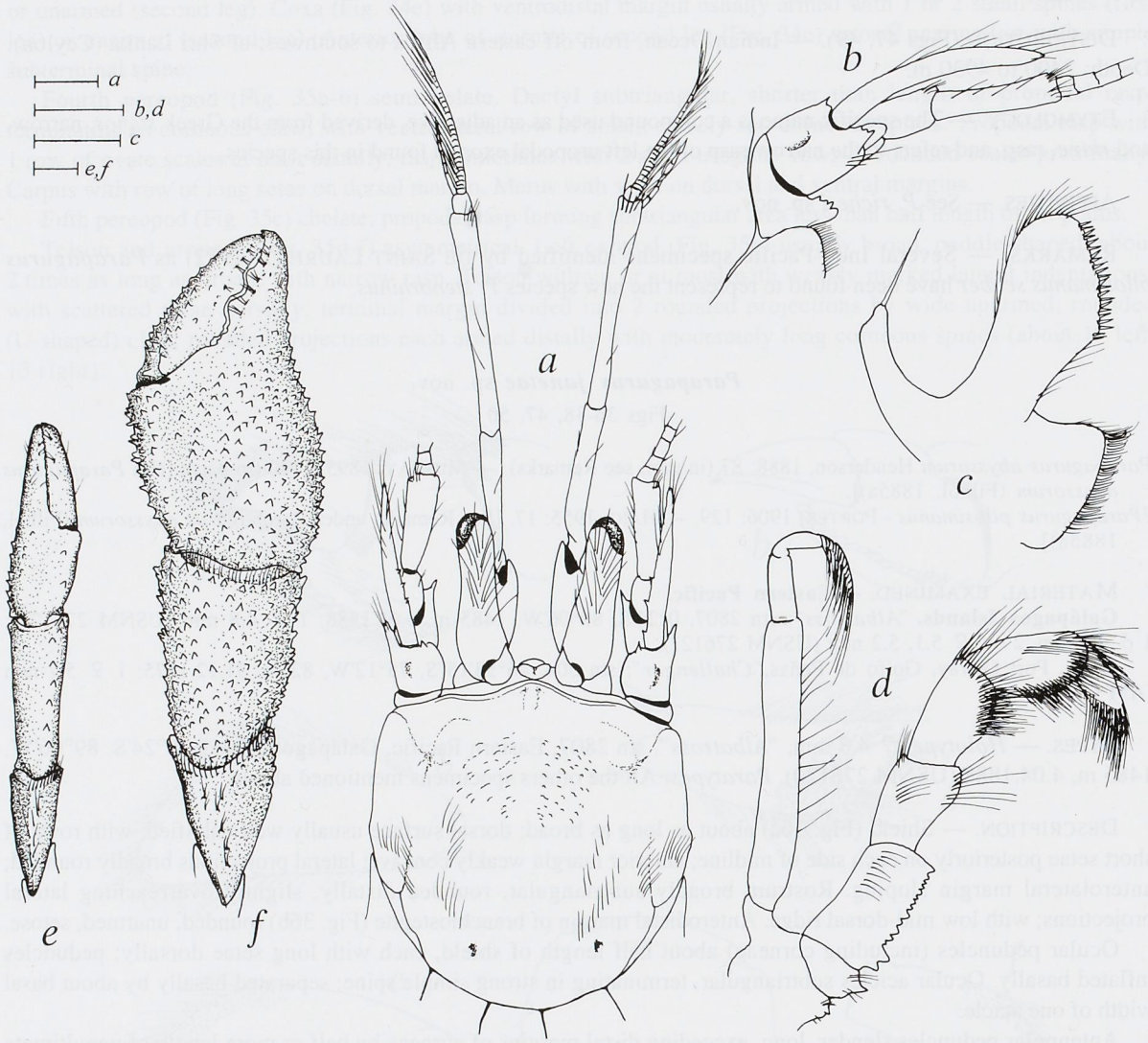


FIG. 36. — *Parapagurus janetae* sp. nov., eastern Pacific, *"Albatross"*, stn 2807: a-b,e-f, holotype ♀ 4.8 mm (USNM 276120); c-d, paratype ov. ♀ 5.2 mm (USNM 276121). **a**, shield and cephalic appendages; **b**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **c**, left maxilliped, internal view; **d**, left third maxilliped, internal view; **e**, left cheliped (most setae omitted); **f**, right cheliped (most setae omitted).
Scales equal 1 mm (a-b,d-f), and 0.5 mm (c).

Chelipeds markedly dissimilar, each with dorsal surfaces of carpus and chela covered with moderately dense setation. Right cheliped (Fig. 36f) with proportions of carpus and chela not markedly different in male and female specimens examined. Fingers bent inwards at tips, each terminating in small corneous claw; with tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also with distal row of small, closely-set, corneous teeth. Dactyl set at slightly oblique angle to palm, with dorsomesial and mesial rows of small spines proximally. Palm and carpus each with numerous small spines and

tubercles on dorsal surface; ventral surfaces of palm and carpus also with spines and tubercles but less numerous than on dorsal surfaces. Merus with small setose tubercles dorsally, and scattered small spines or tubercles dorsolaterally and on ventral surface; mesial surface smooth; with ventromesial row of spines. Ischium with blunt spines dorsally, and ventromesial row of spines. Coxa usually with 1 or 2 small spines on ventrodistal margin and ventromesial row of setae.

Left cheliped (Fig. 36e) slender. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute corneous teeth fused distally; cutting edge of fixed finger with row of regularly-spaced, small, evenly-sized calcareous teeth. Palm with 1-3 small spines or tubercles dorsomesially, and small spines dorsolaterally and laterally. Carpus armed with row of small spines

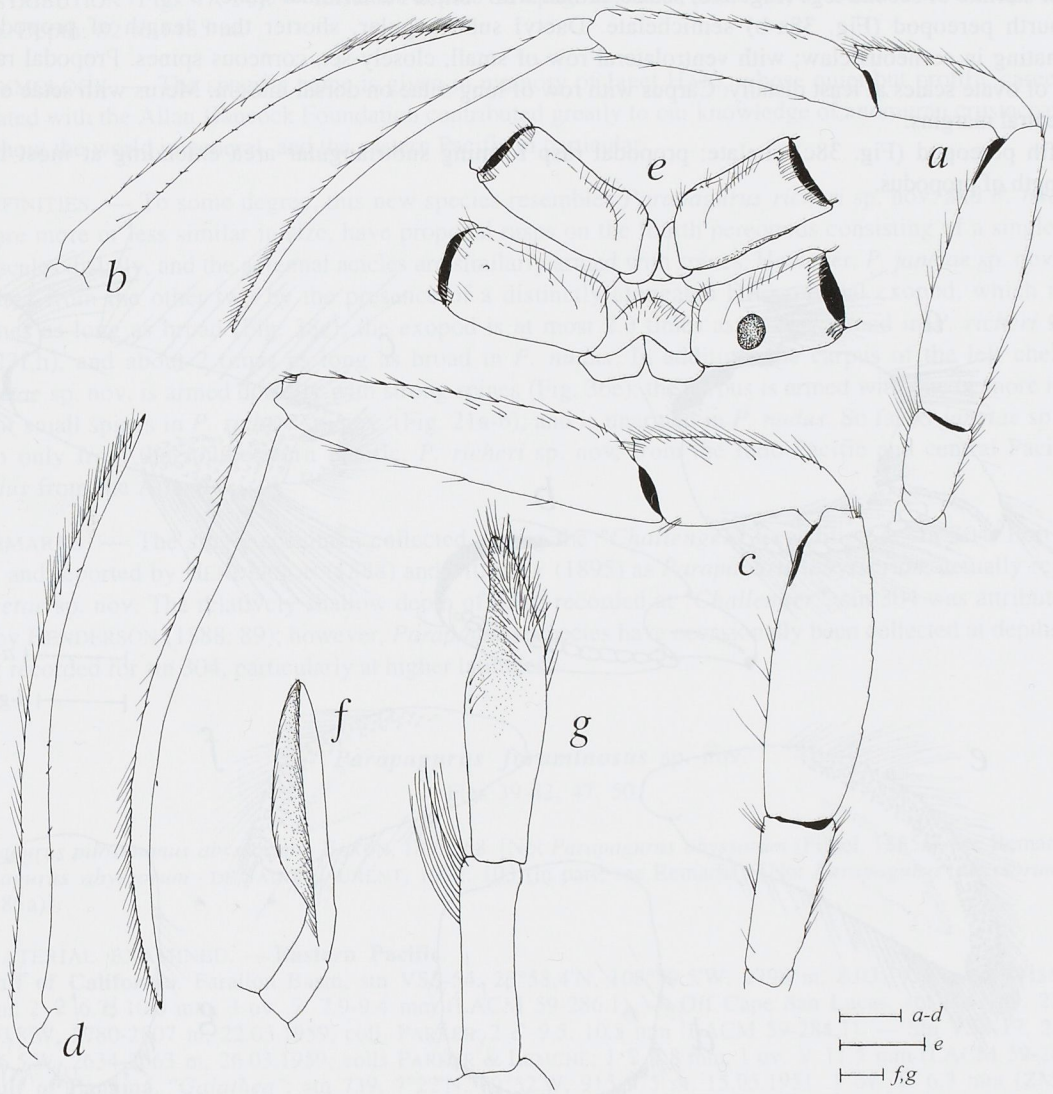


FIG. 37. — *Parapagurus janetae* sp. nov., eastern Pacific, *"Albatross"*, stn 2807: a-e, holotype ♀ 4.8 mm (USNM 276120); f-g, paratype ♂ 4.5 mm (USNM 276121). **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, left second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, coxae and sternites of ambulatory legs, ventral view; **f**, male left first pleopod, mesial view; **g**, male left second pleopod, anterior view.
Scales equal 1 mm (a-e), and 0.5 mm (f,g).

dorsally. Merus unarmed except for row of bristles on dorsal margin; with ventromesial row of spines. Ischium with small, low setose tubercles on dorsal margin; with 2 small spines on ventromesial margin (one distally, one proximally). Coxa usually with 2 small spines on ventrodistal margin and ventromesial row of setae.

Ambulatory legs (Fig. 37a-d) similar from right to left (except for slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl about 1.7 times as long as propodus; with dorsal and ventromesial distal row of setae; ventromesial margin with row of about 5 to 9 minute corneous spinules. Meri, carpi, and propodi each with short setae on dorsal margin, and smooth lateral and mesial faces; propodi about 3.8 to 4.0 (first leg) or 3.8 to 4.3 (second leg) times as long as high; carpi each with small dorsodistal spine; meri about 3.3 to 3.5 (first leg) or 2.4 to 3.0 (second leg) times as long as high. Ischia unarmed except for setae distally. Coxae (Fig. 37e) with ventromesial margin unarmed or at most with minute spine proximally. Anterior lobe of sternite of second legs (Fig. 37e) setose, armed with simple subterminal spine.

Fourth pereopod (Fig. 38a-b) semichelate. Dactyl subtriangular, shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp with 1 row of ovate scales at least distally. Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 38c) chelate; propodal rasp forming subtriangular area extending at most to about midlength of propodus.

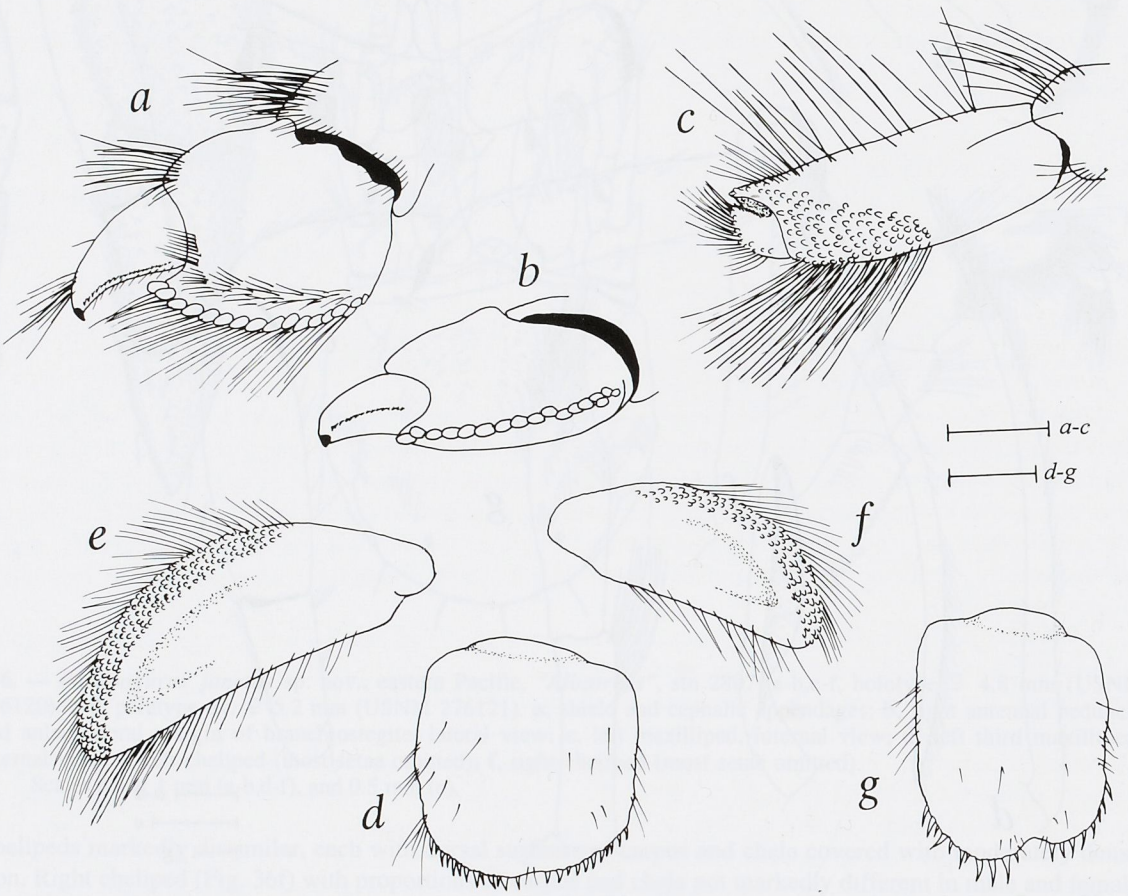


FIG. 38. — *Parapagurus janetae* sp. nov., eastern Pacific, *"Albatross"*, stn 2807: a-f, holotype ♀ 4.8 mm (USNM 276120); g, paratype ♂ 4.5 mm (USNM 276121). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fifth pereopod, lateral view; **d**, telson, dorsal view; **e-f**, left (e) and right (f) exopod of uropods, dorsal view; **g**, telson, dorsal view. Scales equal 0.5 mm.

Telson and uropods (Fig. 38d-g) weakly asymmetrical. Left exopod (Fig. 38e) elongate, about 2.9 times as long as broad; with moderately broad rasp. Telson without or at most with weakly marked lateral indentations; with scattered setae dorsally, and few long setae laterally; terminal margin divided into 2 rounded projections by unarmed, rounded (U-shaped) cleft (very shallow in females, deep in only known male; Fig. 38g); rounded projections each armed distally with 8 to 14 short to moderately long corneous spines.

SIZE RANGE. — Only known male, SL 4.5 mm. Females 4.8, 5.7 mm. Ovigerous females 5.1, 5.2 mm.

HABITAT. — According to HENDERSON (1888: 89), the specimen obtained during the *"Challenger"* expedition from Port Otway, was found living in a gastropod shell (*Trochus* sp.).

DISTRIBUTION (Figs 47, 50). — Eastern Pacific: Galápagos Islands, and coast of Chile (Port Otway, Golfo de Peñas). Depth: 82 to 1485 m.

ETYMOLOGY. — The specific name is given in memory of Janet HAIG, whose quiet but prolific career while associated with the Allan Hancock Foundation contributed greatly to our knowledge of anomuran crustaceans from throughout the world in general, and the eastern Pacific in particular.

AFFINITIES. — To some degree, this new species resembles *Parapagurus richeri* sp. nov. and *P. nudus*. All three are more or less similar in size, have propodal rasps on the fourth pereopods consisting of a single row of ovate scales distally, and the antennal acicles are similarly armed with spines. However, *P. janetae* sp. nov. can be separated from the other two by the presence of a distinctly elongated left uropodal exopod, which is about 2.9 times as long as broad (Fig. 38e); the exopod is at most 2.3 times as long as broad in *P. richeri* sp. nov. (Fig. 23f,h), and about 2 times as long as broad in *P. nudus*. In addition, the carpus of the left cheliped in *P. janetae* sp. nov. is armed dorsally with strong spines (Fig. 36e); the carpus is armed with one or more irregular rows of small spines in *P. richeri* sp. nov. (Fig. 21a-b), and is unarmed in *P. nudus*. So far *P. janetae* sp. nov. is known only from the southeastern Pacific, *P. richeri* sp. nov. from the Indo-Pacific and central Pacific, and *P. nudus* from the Atlantic.

REMARKS. — The single specimen collected during the *"Challenger"* Expedition at stn 304, Port Otway, Chile, and reported by HENDERSON (1888) and MURRAY (1895) as *Parapagurus abyssorum*, actually represents *P. janetae* sp. nov. The relatively shallow depth of 82 m recorded at *"Challenger"*, stn 304 was attributed to an error by HENDERSON (1888: 89); however, *Parapagurus* species have occasionally been collected at depths similar to that recorded for stn 304, particularly at higher latitudes.

Parapagurus foraminosus sp. nov.

Figs 39-42, 47, 50

Parapagurus pilosimanus abyssorum - FAXON, 1895: 68. [Not *Parapagurus abyssorum* (Filhol, 1885a); see Remarks].
Parapagurus abyssorum - DE SAINT LAURENT, 1972: 103 (in part; see Remarks). [Not *Parapagurus abyssorum* (Filhol, 1885a)].

MATERIAL EXAMINED. — **Eastern Pacific**.

Gulf of California. Farallon Basin, stn VSS-54, 23°58.4'N, 108°59.5'W, 2798 m, 8.03.1959, coll. WISNER: 1 ♂ 7.0 mm, 2 ♀ 6.7, 10.0 mm, 3 ov. ♀ 7.9-9.4 mm (LACM 59-286.1). — Off Cape San Lucas, stn P-41-59, 22°32.5'N, 109°40.8'W, 2780-2807 m, 22.03.1959, coll. PARKER: 2 ♂ 9.5, 10.3 mm (LACM 59-284.1). — Stn VSS-17, 22°35.6'N, 110°06.5'W, 2634-2663 m, 26.03.1959, colls PARKER & LEMCHE: 1 ♀ 7.8 mm, 1 ov. ♀ 11.5 mm (LACM 59-285.1).

Gulf of Panamá. *"Galathea"*: stn 739, 7°22'N, 79°32'W, 915-975 m, 15.05.1951: 1 ov. ♀ 6.3 mm (ZMK CRU-3409).

Baja California to Ecuador. *"Albatross"*: stn 2793, off Ecuador, Galera Point, 1°03'N, 80°15'W, 1306 m, 3.03.1888: 9 ♂ 4.0-8.9 mm, 3 ♀ 6.4-8.2 mm, 8 ov. ♀ 6.0-9.6 mm (USNM 18999). — Stn 2807, Galápagos Islands, San Cristobal Island, 0°24'S, 89°06'W, 1485 m, 4.04.1888: 1 ♂ 8.2 mm (USNM 276122); 6 ♂ 6.3-8.4 mm, 5 ♀ 5.8-8.8 mm (USNM 19000). — Stn 2986, Mexico, off Baja California, 28°57'N, 118°14'30"W, 1251 m, 28.02.1889: 1 ♂ 7.9 mm (USNM 276109). — Stn 3362, Cocos Island, 5°56'N, 85°10'30"W, 2149 m, 26.02.1891: 1 ♂ 6.2 mm (USNM

21667). — Stn 3363, Cocos Island, 5°43'N, 85°50'W, 1789 m, 26.02.1891: 7 ♂ 5.1-9.1 mm, 2 ♀ 5.6, 9.0 mm, 3 ov. ♀ 7.9-9.6 mm (USNM 21668). — Stn 3364, Cocos Island, 5°30'N, 86°08'30"W, 1650 m, 27.02.1891: 1 ♂ (damaged) (USNM 42623). — Stn 3366, Cocos Island, 5°30'N, 86°45'W, 1951 m, 27.02.1891: 2 ♂ 8.6, 9.5 mm, 2 ♂ 4.5, 7.8 mm (USNM 21669).— Stn 3371, off Colombia and Panamá, 5°26'20"N, 86°55'W, 1408 m, 1.03.1891: 6 ♂ 7.6-9.9 mm, 5 ♀ 6.7-9.0 mm, ov. ♀ 7.0-9.6 mm (MCZ 4524). — Stn 3375, off Colombia, Malpelo Island, 2°34'N, 82°29'W, 2197 m, 4.03.1891: 1 ♂ 8.8 mm (USNM 21670). — Stn 3376, off Colombia, Malpelo Island, 3°09'N, 82°08'W, 2070 m, 4.03.1891: 1 ♂ 5.2 mm, 1 ♀ 6.1 mm (USNM 42626); 1 ♂ 4.6 mm, 1 ♀ 3.0 mm (USNM 42627). — Stn 3380, off Colombia, Malpelo Island, 4°03'N, 81°31'W, 1644 m, 5.03.1891: 1 ♂ 6.4 mm (USNM 21671). — Stn 3392, Gulf of Panamá, SE of Azuero Peninsula, 7°05'30"N, 79°40'W, 2323 m, 10.03.1891: 1 ♂ 6.0 mm, 1 ♀ 3.7 mm (USNM 21672). — Stn 3393, Gulf of Panamá, SE of Azuero Peninsula, 7°15'00"S, 79°36'00"W, 1866 m, 10.03.1891: 2 ♂ 8.2, 10.0 mm, 2 ♀ 7.9, 8.9 mm (USNM 21673). — Stn 3400, E off Galápagos Islands, 0°36'S, 86°46'W, 2418 m, 27.03.1891: 1 ♂ 8.6 mm, 1 ov. ♀ 8.7 mm (USNM 21674); 3 ♂ 6.0-10.3 mm, 2 ♀ 7.3, 9.2 mm (MCZ 20,020). — Stn 3407, N of Galápagos Islands, San Salvador Island, 0°04'S, 90°24'30"W, 1619 m, 3.04.1891: fragments of specimen (USNM 21675). — Stn 3413, Galápagos Islands, Culpepper Island, 2°34', 92°06'W, 2487 m, 5.04.1891: 1 ♂ 10.4 mm (USNM 21676); 1 ♂ 9.2 mm, 2 ♀ 10.4, 12.5 mm, 1 ov. ♀ 11.5 mm (MCZ 4526). — Stn 3429, off Mexico, Mazatlán,

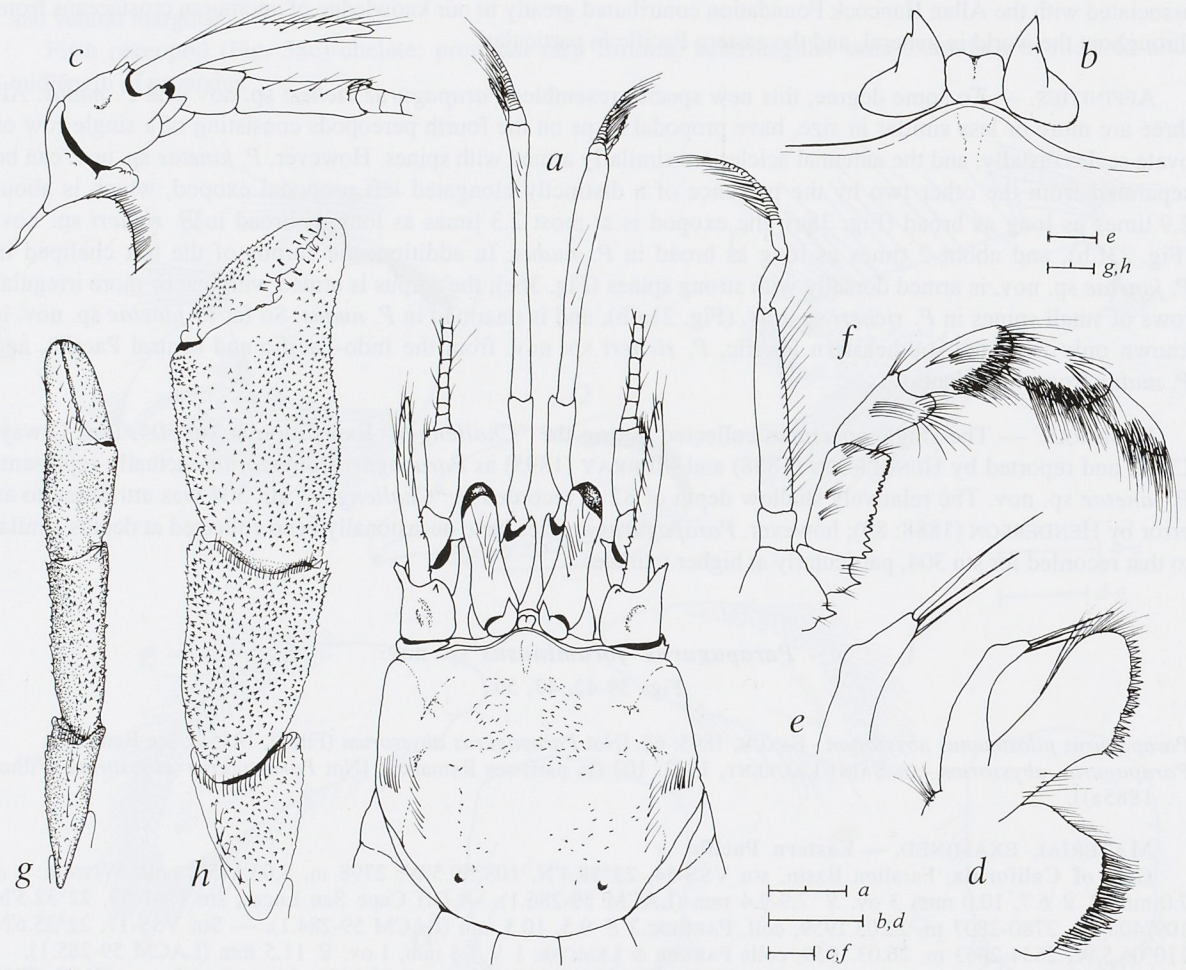


FIG. 39. — *Parapagurus foraminosus* sp. nov., eastern Pacific, *"Albatross"* : a,c,g,h, stn 2807, holotype ♂ 8.2 mm (USNM 276122); b, stn 2807, paratype ♂ 7.9 mm (USNM 19000); d-f, stn 5685, paratype ♂ 8.5 mm (USNM 276112). **a**, shield and cephalic appendages; **b**, ocular acicles and rostrum, dorsal view; **c**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **d**, left maxillule, internal view; **e**, distal end of endopod of same; **f**, left third maxilliped, internal view; **g**, left cheliped (setae omitted); **h**, right cheliped (setae omitted).
Scales equal 2 mm (a), 1 mm (b-d,f), 0.25 mm (e), and 2 mm (g,h).

22°30'30"N, 107°01'W, 1681 m, 19.04.1891: 2 ♂ 6.4 mm (parasitized), 9.2 mm (USNM 21677). — Stn 3431, 23°59'N, 108°40'W, 1820 m, 20.04.1891: 1 ♂ 11.0 mm, 1 ♀ 10.4 mm (USNM 21678). — Stn 3432, E of Baja California, Cerralvo Island, 24°22'30"N, 109°03'20"W, 2599 m, 20.04.1891: 1 ov. ♀ 7.8 mm (USNM 21679). — Stn 5676, Baja California, 25°31'15"N, 113°29'30"W, 1180 m, 17.03.1911: 7 ♂ 6.7-9.4 mm, 4 ♀ 7.8-9.9 mm, 11 ov. ♀ 7.9-9.7 mm (USNM 276113). — Stn 5685, Baja California, S of Abreojos Point, 25°42'45"N, 113°38'30"W, 1180 m, 22.04.1911: 5 ♂ 7.0-8.7 mm, 5 ♀ 7.8-9.3 mm, 4 ov. ♀ 6.7-9.6 mm (USNM 276112); 3 ♂ 7.8-8.7 mm, 1 ♀ 8.7 mm, 2 ov. ♀ 8.0, 9.2 mm (MNHN-Pg 5647). — Stn 5686, Mexico, SW of Abreojos Point, 26°14'N, 114°00'W, 1701 m, 22.04.1911: 1 ♂ 8.9 mm (USNM 276111). — Stn 5690, Mexico, E of Guadalupe Island, 29°29'N, 116°18'W, 2014 m, 24.04.1911: 1 ♂ 8.1 mm (USNM 276110).

TYPES. — *Holotype*: ♂ 8.2 mm, *"Albatross"*, stn 2807, Eastern Pacific. Galápagos Islands, San Cristobal Island, 0°24'S, 89°06'W, 1485 m, 4.04.1888 (USNM 276122). *Paratypes*: All the others specimens mentioned above.

DESCRIPTION. — Shield (Fig. 39a) about as broad as long or at most slightly broader than long; dorsal surface usually well calcified, with rows of short setae posteriorly on each side; anterior margin weakly concave; lateral projections broadly rounded; anterolateral margins sloping. Rostrum broadly subtriangular, rounded distally, overreaching lateral projections; with low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 39c) rounded, unarmed, setose.

Ocular peduncles (including corneae) less than half length of shield, each with dorsal row of setae; peduncles inflated basally; width of cornea about same as distal width of ocular peduncle. Ocular acicles subtriangular, terminating in strong simple or bifid spine (Fig. 39a-b); separated basally by slightly less than basal width of one acicle.

Antennular peduncles slender, exceeding distal margins of corneae by half or more length of penultimate segments. Ultimate and penultimate segments with scattered setae; ultimate segment nearly twice as long as penultimate. Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 1 or 2 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 39c) exceeding distal margins of corneae by about 0.6 length of fifth antennal segments. Fifth segment with setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced into strong, usually bifid spine; mesial margin with spine on dorsodistal angle. First segment with lateral face unarmed or with 1-3 small blunt spines; ventromesial angle produced, with row of small spines. Acicles weakly curved in dorsal view, exceeding distal margin of corneae by 0.3 to half length of acicle; mesial margin armed with 3 to 8 small spines on proximal half. Flagellum overreaching extended right cheliped; with setae about 1 to 2 flagellar articles in length.

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule (Fig. 39d-e) with external lobe weakly developed, internal lobe with 1 long terminal and 2 subterminal setae. Third maxilliped (Fig. 39f) with crista dentata consisting of about 17 small corneous teeth; coxa and basis each with strong sharp mesial tooth. Epistomial spine usually present. Sternite of third maxillipeds with strong spine on each side of midline.

Chelipeds markedly dissimilar. Right cheliped (Fig. 39h) with dorsal surfaces of carpus and chela covered with dense setation. Fingers bent inwards at tips, each terminating in small corneous claw; with tufts of setae dorsally and ventrally; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl with distal row of small, closely-set, corneous teeth. Dactyl about as long as mesial margin of palm; set at slightly oblique angle to palm; with numerous small spines on dorsomesial and mesial margins. Fixed finger with few small spines on dorsal face proximally, lacking spines distally. Palm and carpus each densely covered with small (often minute) spines on dorsal surfaces; with scattered small spines on ventral surfaces. Merus with dorsal row of short bristle-like setae; with small spines or tubercles on lateral and ventral surfaces, and ventromesial row of spines. Ischium with dorsal and ventromesial row of spines. Coxa with row of spines on ventrodistal margin and ventromesial row of setae.

Left cheliped (Fig. 39g) well calcified, with dense setation on carpus and chela. Fingers each terminating in short corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row

of minute, closely-set, corneous teeth; cutting edge of fixed finger with row of small, evenly-spaced, calcareous teeth interspersed with small corneous teeth. Palm with irregular rows of small spines on dorsolateral and dorsomesial faces. Carpus with irregular rows of small spines dorsally; ventral face unarmed. Merus with row of short bristle-like setae on dorsal margin; with few small spines on lateral and ventral faces. Ischium with small setose tubercles dorsally; ventromesial margin with small spine proximally and another distally. Coxa with row of spines on ventrodistal margin and ventromesial row of setae.

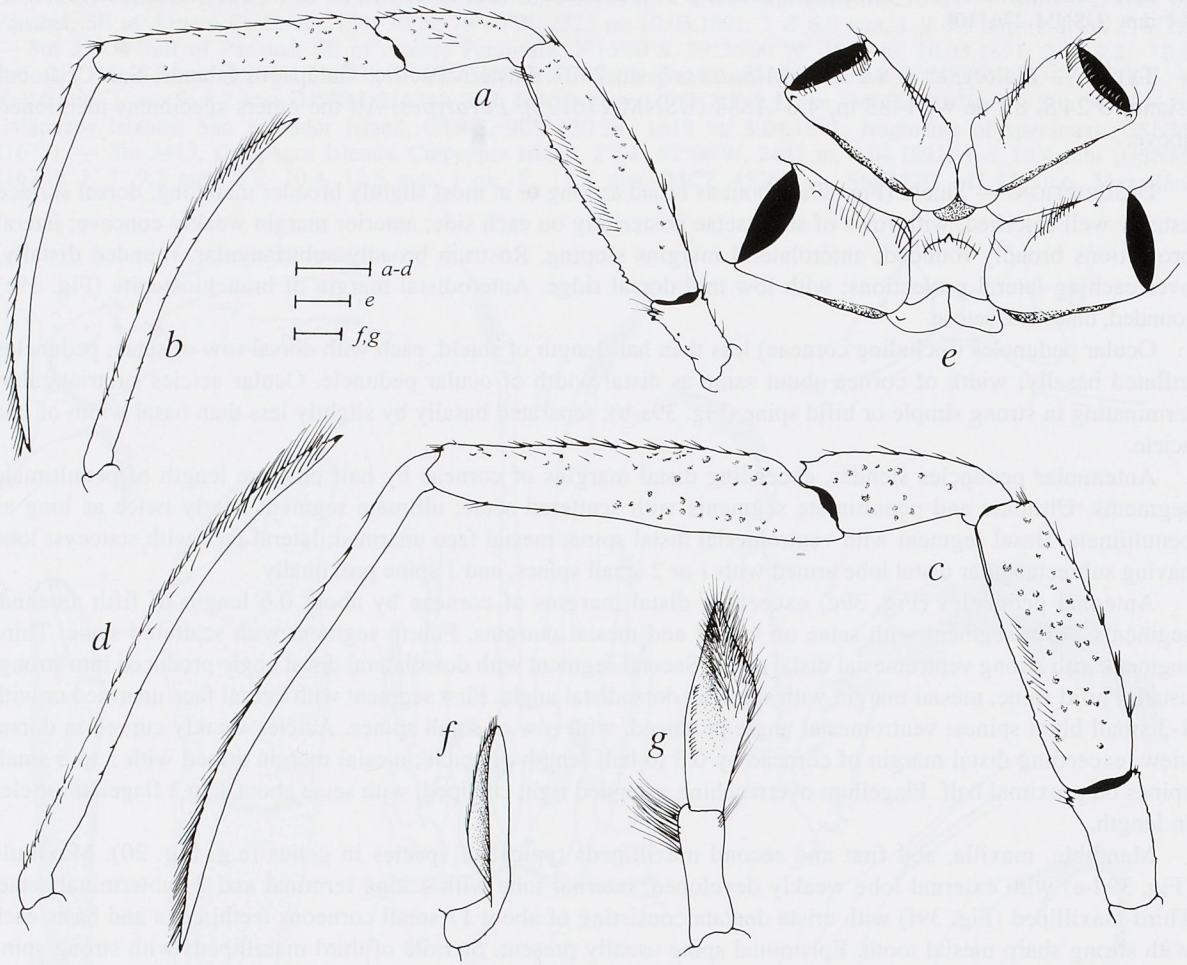


FIG. 40. — *Parapagurus foraminosus* sp. nov., eastern Pacific, *"Albatross"*, stn 2807, holotype ♂ 8.2 mm (USNM 276122): **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, left second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, coxae and sternite of ambulatory legs, ventral view; **f**, male left first pleopod, mesial view; **g**, male left second pleopod, anterior view.
Scales equal 3 mm (a-d), and 1 mm (e-g).

Ambulatory legs (Fig. 40a-d) similar from right to left (except slightly longer segments on right). Dactyl about 1.6 times as long as propodus; with ventromesial row of 2 to 8 minute spinules, and dorsal and dorsomesial distal rows of setae. Meri, carpi, and propodi each with lateral faces with shallow pits more numerous on second leg (Figs 40a,c, 41). Propodi about 5 times (first leg) or 4.5 times (second leg) as long as high; with short transverse rows of bristle-like setae on dorsolateral and dorsomesial faces. Carpi each with small dorsodistal spine; dorsal margins with short, bristle-like setae often set at bases of small spines or tubercles. Meri each about 3.7 (first leg) or 3 (second leg) times as long as high; dorsal margins with short, bristle-like setae; with longitudinal

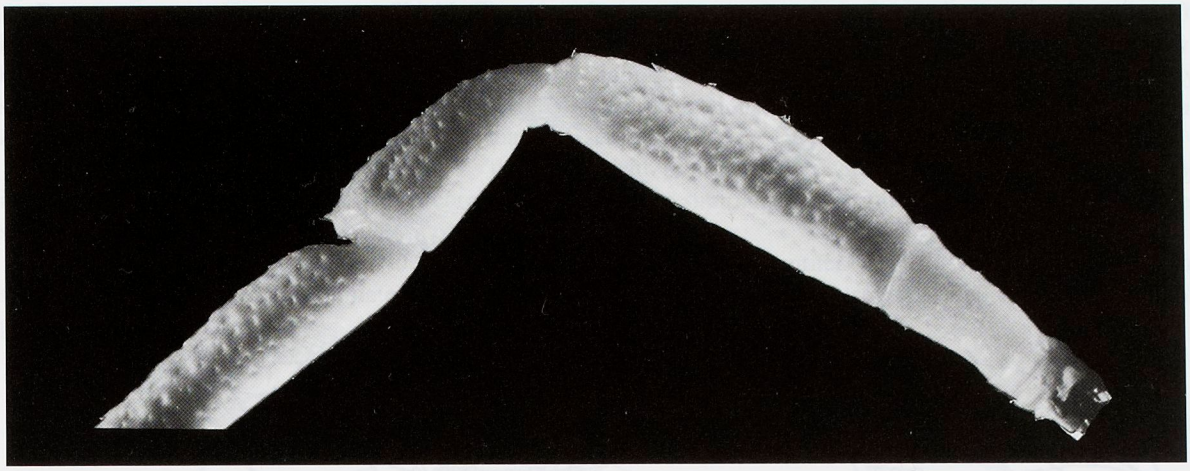


FIG. 41. — *Parapagurus foraminosus* sp. nov., eastern Pacific, Cocos Island, *"Albatross"*, stn 3363, paratype ♂ 9.4 mm (USNM 21668): ischium, merus, carpus, and portion of propodus, of left second ambulatory leg, showing pits, lateral view (x 4.2).

row of setae on ventral half of lateral face. Merus and ischium of first leg each with row of small spines on ventral margins; merus and ischium of second leg unarmed or with few small blunt spines. Coxa with ventrodistal margin unarmed or with small spines. Anterior lobe of sternite of second legs (Fig. 40e) subsemicircular, setose, with short subterminal spine.

Fourth pereopod (Fig. 42a-d) semichelate. Dactyl subtriangular, shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small corneous spines. Propodal rasp consisting of 1 or 2 rows of ovate scales. Carpus with long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 42e) chelate; propodal rasp occupying subtriangular area less than half length of propodus.

Telson and uropods (Fig. 42f-h) asymmetrical. Left exopod (Fig. 42g) of uropod about 2.3 times as long as broad, with broad rasp. Telson lacking or at most with weakly marked lateral indentations; with scattered setae dorsally, and long setae laterally; terminal margin divided into 2 rounded projections by rounded (U-shaped) cleft; rounded projections each armed distally with long, often curved, corneous spines (usually about 10 to 15, occasionally up to 26 on left).

SIZE RANGE. — Males, SL 4.0 to 11.0 mm. Females 3.0 to 10.4 mm. Ovigerous females 5.8 to 11.5 mm.

VARIATIONS. — Small individuals (SL < 5.0 mm) usually exhibit less numerous pits on the lateral faces of meri, carpi and propodi of the ambulatory legs, pits which are often more clearly visible by tilting the appendage to a ventrolateral view.

HABITAT. — Found in gastropod shells often completely covered by an actinian.

DISTRIBUTION (Figs 47, 50). — Eastern Pacific: Baja California to Ecuador, including Cocos Island and Galápagos Islands. Depth: 915 to 2807 m.

AFFINITIES. — This new species shares only general similarities with other *Parapagurus* species having ovate scales on the propodal rasp of the fourth pereopod. The dense spination on the dorsal surfaces of the merus, carpus and chela of the right cheliped resembles that of *P. microps*. In both species the dorsal surfaces are covered with dense, small (often minute) spines. However, *P. foraminosus* sp. nov. differs from *P. microps* and all other congeners, in having many shallow pits on the lateral faces of the meri, carpi, and propodi of the ambulatory legs (Fig. 41).

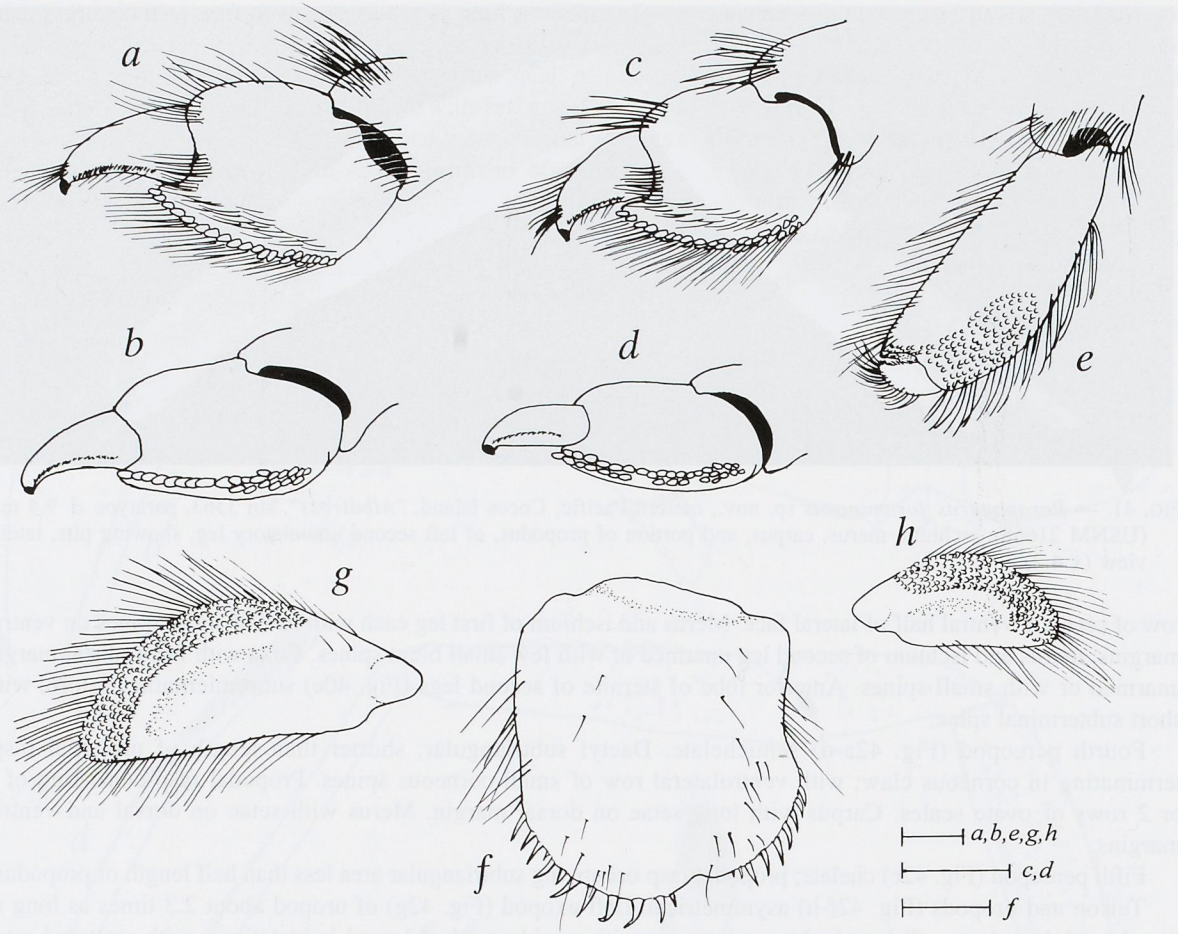


FIG. 42. — *Parapagurus foraminosus* sp. nov., eastern Pacific, *"Albatross"*: a-b,e-h, stn 2807, holotype ♂ 8.2 mm (USNM 276122); c,d, stn 2807, paratype ♂ 7.2 mm (USNM 19000). **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, same (setae omitted), ventrolateral view; **c**, propodus and dactyl of left fourth pereopod, lateral view; **d**, same (setae omitted), ventrolateral view; **e**, propodus and dactyl of left fifth pereopod, lateral view; **f**, telson, dorsal view; **g-h**, left (g) and right (h) exopod of uropods, dorsal view.
Scales equal 0.5 mm (a-b,e-h,), and 1 mm (c-d).

REMARKS. — The eastern Pacific material used by DE SAINT LAURENT (1972) in her report of *Parapagurus pilosimanus abyssorum* actually represents this new species.

Examination of the material reported by FAXON (1895) as *Parapagurus pilosimanus abyssorum* has shown that it represents *P. foraminosus* sp. nov.

Parapagurus wolffi sp. nov.

Figs 43-47, 50

Parapagurus abyssorum - GARTH & HAIG, 1971: 5. (See Remarks). [Not *Parapagurus abyssorum* (Filhol, 1885a)].

MATERIAL EXAMINED. — **Perú**. *"Anton Bruun"*, cruise 11, stn 169, 8°46'S, 80°44'W, 3909-3970 m, 2.11.1965: 1 ov. ♀ 4.6 mm (LACM 65-335.1).

TYPES. — The sole specimen known of this species is the one above which is the holotype.

DESCRIPTION OF HOLOTYPE. — Shield (Fig. 43a) about as long as broad; dorsal surface well calcified, with longitudinal rows of short setae on each side of midline, and small setose tubercle on each lateral margin medially; lateral projections broadly rounded; anterolateral margin sloping; anterior margin weakly concave. Rostrum broadly subtriangular, rounded distally, slightly overreaching lateral projections; with low mid-dorsal ridge. Anterodistal margin of branchiostegite (Fig. 43b) rounded, unarmed, setose.

Ocular peduncles (including corneae) less than half length of shield, each with long setae dorsally; peduncles inflated basally, constricted distally near corneae. Ocular acicles subtriangular, terminating in strong simple spine; separated basally by about basal width of one acicle.

Antennular peduncles slender, long, exceeding distal margins of corneae by full length of penultimate segments. Ultimate and penultimate segments with scattered setae. Ultimate segment about twice as long as penultimate.

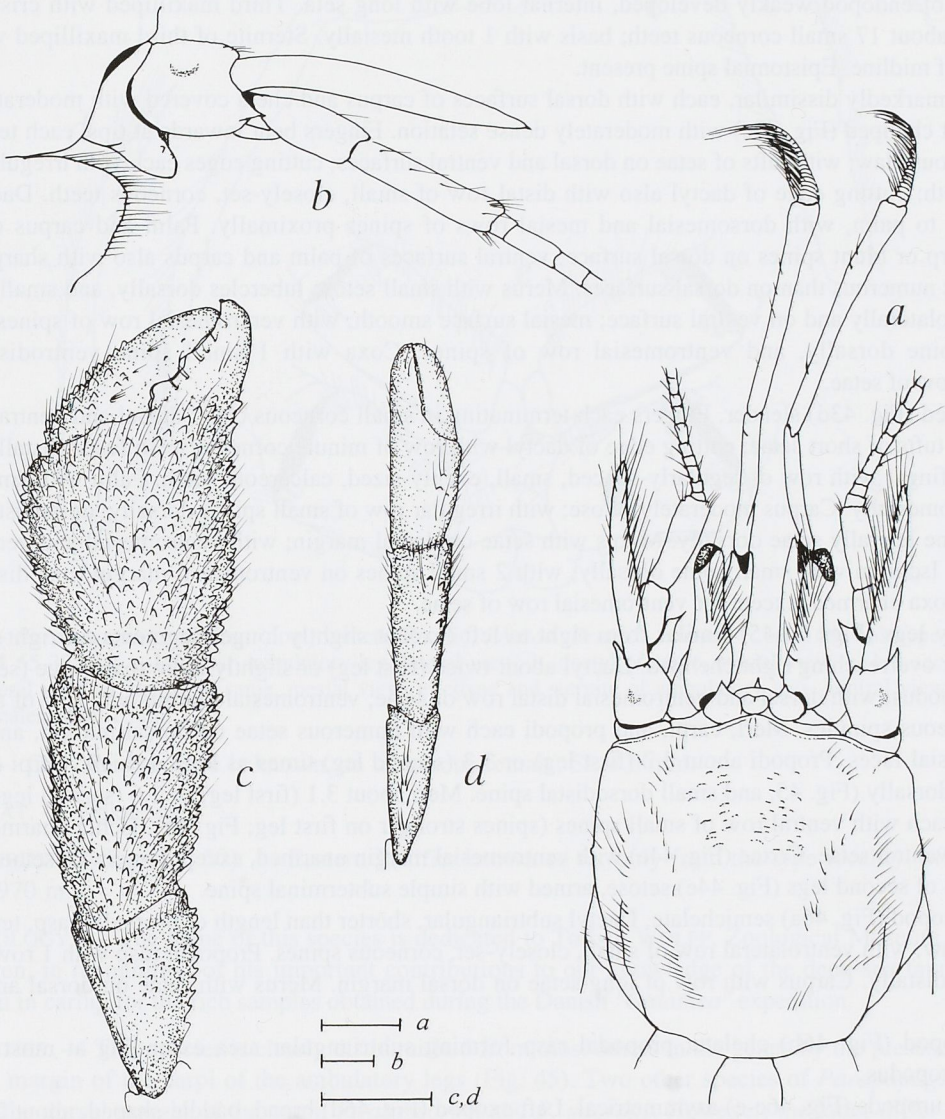


FIG. 43. — *Parapagurus wolffi* sp. nov., eastern Pacific, *"Anton Bruun"*, cruise 11, stn 169, holotype ov. ♀ 4.6 mm (LACM 65-335.1): **a**, shield and cephalic appendages; **b**, right antennal peduncle and anterolateral margin of branchiostegite, lateral view; **c**, right cheliped, dorsal view; **d**, left cheliped, dorsal view. Scales equal 1 mm.

Basal segment with ventromesial distal spine; mesial face unarmed; lateral face with statocyst lobe having subrectangular distal lobe armed with 1 small spines, and 1 spine proximally.

Antennal peduncles (Fig. 43b) exceeding distal margins of corneae by about half length of fifth segments. Fifth segment with scattered setae on lateral and mesial margins. Fourth segment with scattered setae. Third segment with strong ventromesial distal spine. Second segment with dorsolateral distal angle produced, terminating in strong spine; mesial margin unarmed (right) or with small blunt spine (left) on dorsodistal angle. First segment with lateral face unarmed; ventromesial angle produced, with row of small spines. Antennal acicles weakly curved in dorsal view, densely setose mesially; exceeding distal margin of cornea by about half length of acicle; mesial margin unarmed. Flagellum distinctly overreaching extended right cheliped, very setose; articles with setae 1 to 4 flagellar articles in length.

Mandible, maxilla, and first and second maxillipeds typical of species in genus (e.g. Fig. 20). Maxillule with external lobe of endopod weakly developed, internal lobe with long seta. Third maxilliped with crista dentata consisting of about 17 small corneous teeth; basis with 1 tooth mesially. Sternite of third maxilliped with spine on each side of midline. Epistomial spine present.

Chelipeds markedly dissimilar, each with dorsal surfaces of carpus and chela covered with moderately dense setation. Right cheliped (Fig. 43c) with moderately dense setation. Fingers bent inwards at tips, each terminating in small corneous claw; with tufts of setae on dorsal and ventral surfaces; cutting edges each with irregularly-sized calcareous teeth; cutting edge of dactyl also with distal row of small, closely-set, corneous teeth. Dactyl set at oblique angle to palm, with dorsomesial and mesial rows of spines proximally. Palm and carpus each with numerous sharp or blunt spines on dorsal surface; ventral surfaces of palm and carpus also with sharp or blunt spines but less numerous than on dorsal surfaces. Merus with small setose tubercles dorsally, and small spines or tubercles dorsolaterally and on ventral surface; mesial surface smooth; with ventromesial row of spines. Ischium with small spine dorsally, and ventromesial row of spines. Coxa with 1 small spine ventrodistally and ventromesial row of setae.

Left cheliped (Fig. 43d) slender. Fingers each terminating in small corneous claw; dorsal and ventral surfaces with scattered tufts of short setae; cutting edge of dactyl with row of minute corneous teeth fused distally; cutting edge of fixed finger with row of regularly-spaced, small, evenly-sized, calcareous teeth. Palm with small setose tubercles dorsomesially. Carpus moderately setose; with irregular row of small spines dorsally; dorsodistal margin with small spine laterally setae dorsally. Merus with setae on dorsal margin; with ventromesial and ventrolateral row of spines. Ischium with small spine dorsally; with 2 small spines on ventromesial margin (one distally, one proximally). Coxa unarmed, except for ventromesial row of setae.

Ambulatory legs (Figs 44-45) similar from right to left (except slightly longer segments on right), slender, long, distinctly overreaching right cheliped. Dactyl about twice (first leg) or slightly more than twice (second leg) as long as propodus; with dorsal and ventromesial distal row of setae; ventromesial margin with row of about 3 or 4 minute corneous spinules. Meri, carpi, and propodi each with numerous setae on dorsal margin, and smooth lateral and mesial faces. Propodi about 3.2 (first leg) or 3.3 (second leg) times as long as high. Carpi each with row of spines dorsally (Fig. 45, and small dorsodistal spine. Meri about 3.1 (first leg) or 2.6 (second leg) times as long as high; each with ventral row of small spines (spines stronger on first leg; Fig. 45). Ischia unarmed except for dorsal and ventral setae. Coxae (Fig. 44e) with ventromesial margin unarmed, except for row of setae. Anterior lobe of sternite of second legs (Fig. 44e) setose, armed with simple subterminal spine.

Fourth pereopod (Fig. 46a) semichelate. Dactyl subtriangular, shorter than length of propodal rasp, terminating in corneous claw; with ventrolateral row of small, closely-set, corneous spines. Propodal rasp with 1 row of ovate scales at least distally. Carpus with row of long setae on dorsal margin. Merus with setae on dorsal and ventral margins.

Fifth pereopod (Fig. 46b) chelate; propodal rasp forming subtriangular area extending at most to about midlength of propodus.

Telson and uropods (Fig. 46c-e) asymmetrical. Left exopod (Fig. 46d) broad, paddle-shaped, about 2 times as long as broad; with narrow rasp. Telson with weakly marked lateral indentations, and scattered setae dorsally; terminal margin divided into 2 rounded projections by unarmed, shallow, rounded (U-shaped) cleft; rounded projections each armed distally with 18 (left) and 10 (right) corneous spines.

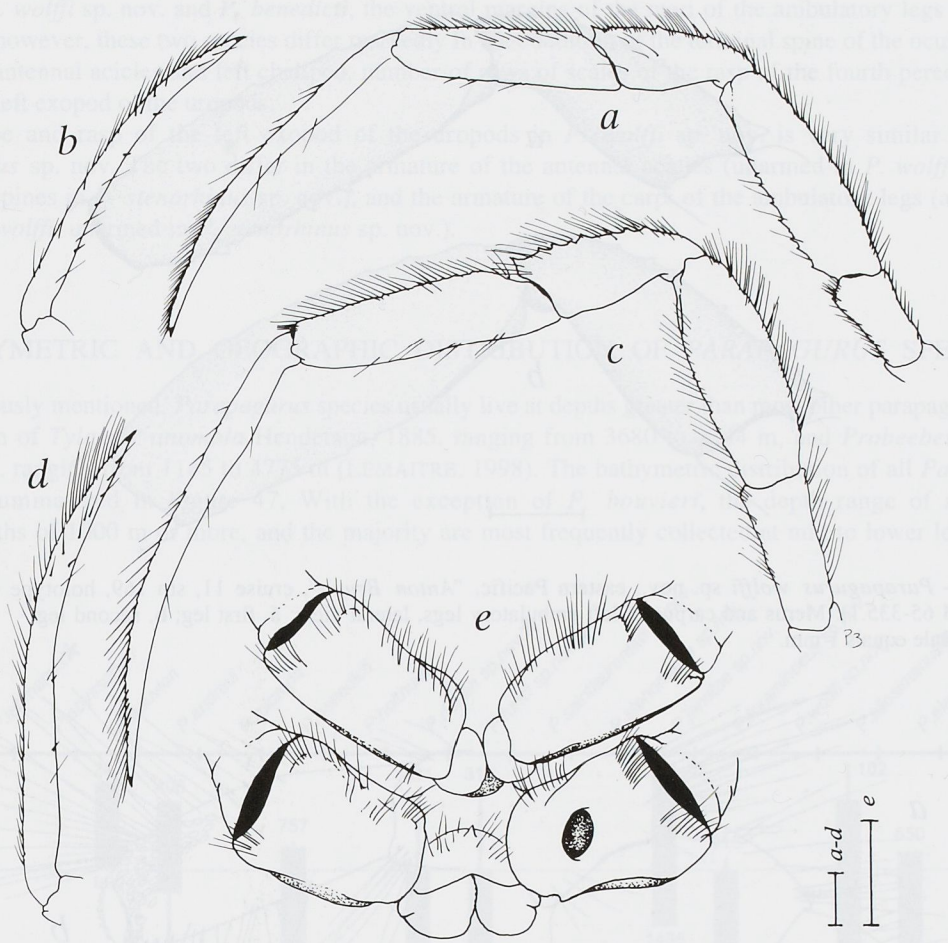


FIG. 44. — *Parapagurus wolffi* sp. nov., eastern Pacific, *"Anton Bruun"*, cruise 11, stn 169, holotype ov. ♀ 4.6 mm (LACM 65-335.1): **a**, left first ambulatory leg, lateral view; **b**, dactyl of same, mesial view; **c**, left second ambulatory leg, lateral view; **d**, dactyl of same, mesial view; **e**, coxae and sternite of ambulatory legs, ventral view.
Scales equal 1 mm.

SIZE. — Only the holotype is known, an ovigerous female, SL 4.6 mm.

HABITAT. — Unknown.

DISTRIBUTION (Figs 47, 50). — Eastern Pacific: known so far only from the type locality, off Perú. Depth: 3909 to 3970 m.

ETYMOLOGY. — The name of this species is dedicated to Torben WOLFF, Zoological Museum, University of Copenhagen, in recognition of his important contributions to our knowledge of the deep-sea fauna, and for his enthusiasm in caring for the rich samples obtained during the Danish *"Galathea"* expedition.

AFFINITIES. — This species is clearly distinguished from most others in the genus by the presence of spines on the dorsal margin of the carpi of the ambulatory legs (Fig. 45). Two other species of *Parapapagurus* also have spines on the dorsal margin of the carpi, *P. abyssorum* and *P. microps*. However, the latter differ from *P. wolffi* sp. nov. in several other characters, the most visible being the armature of the lateral faces of the meri, carpi, and propodi of the ambulatory legs; the lateral faces are unarmed in *P. wolffi* sp. nov., whereas they are armed with numerous spines in *P. abyssorum* and *P. microps*.

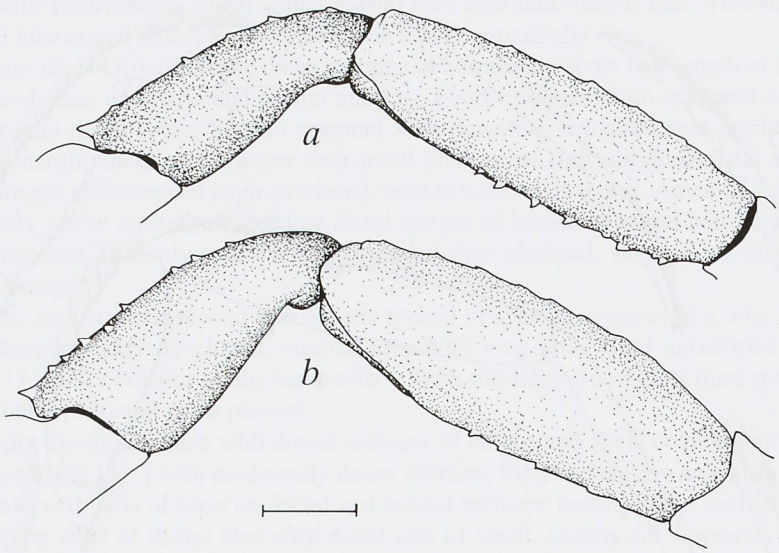


FIG. 45. — *Parapagurus wolffi* sp. nov., eastern Pacific, *"Anton Bruun"*, cruise 11, stn 169, holotype ov. ♀ 4.6 mm (LACM 65-335.1): Merus and carpus of left ambulatory legs, lateral view: **a**, first leg; **b**, second leg.
Scale equals 1 mm.

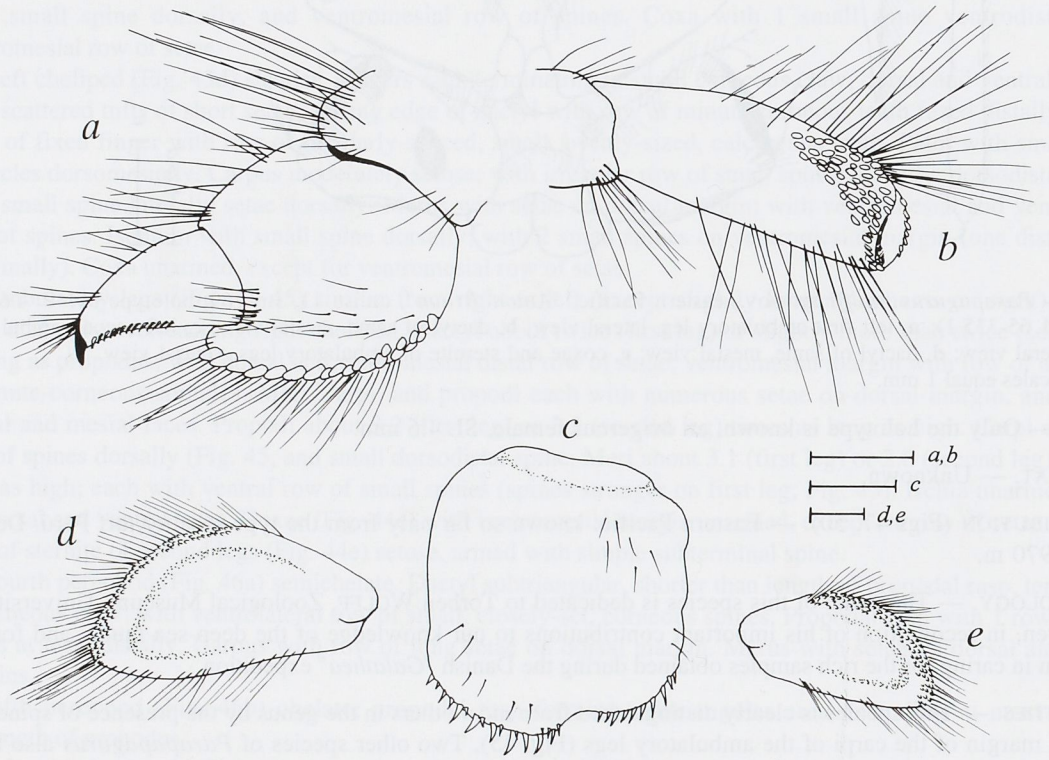


FIG. 46. — *Parapagurus wolffi* sp. nov., eastern Pacific, *"Anton Bruun"*, cruise 11, stn 169, holotype ov. ♀ 4.6 mm (LACM 65-335.1): **a**, propodus and dactyl of left fourth pereopod, lateral view; **b**, propodus and dactyl of left fifth pereopod, lateral view; **c**, telson, dorsal view; **d-e**, left (d) and right (e) exopods of uropods, dorsal view.
Scales equal 0.5 mm.

In both *P. wolffi* sp. nov. and *P. benedicti*, the ventral margins of the meri of the ambulatory legs are armed with spines; however, these two species differ markedly in the condition of the terminal spine of the ocular acicles, armature of antennal acicles and left cheliped, number of rows of scales of the rasp of the fourth pereopods, and shape of the left exopod of the uropods.

The shape and rasp of the left exopod of the uropods in *P. wolffi* sp. nov. is very similar to that of *P. stenorhinus* sp. nov. The two differ in the armature of the antennal acicles (unarmed in *P. wolffi* sp. nov., armed with spines in *P. stenorhinus* sp. nov.), and the armature of the carpi of the ambulatory legs (armed with spines in *P. wolffi*, unarmed in *P. stenorhinus* sp. nov.).

BATHYMETRIC AND GEOGRAPHIC DISTRIBUTION OF *PARAPAGURUS* SPECIES

As previously mentioned, *Parapagurus* species usually live at depths greater than most other parapagurids, with the exception of *Tylaspis anomala* Henderson, 1885, ranging from 3680 to 4344 m, and *Probeebei mirabilis* Boone, 1926, ranging from 1145 to 4775 m (LEMAITRE, 1998). The bathymetric distribution of all *Parapagurus* species is summarized in Figure 47. With the exception of *P. bouvieri*, the depth range of all species includes depths of 1000 m or more, and the majority are most frequently collected at mid to lower level depths

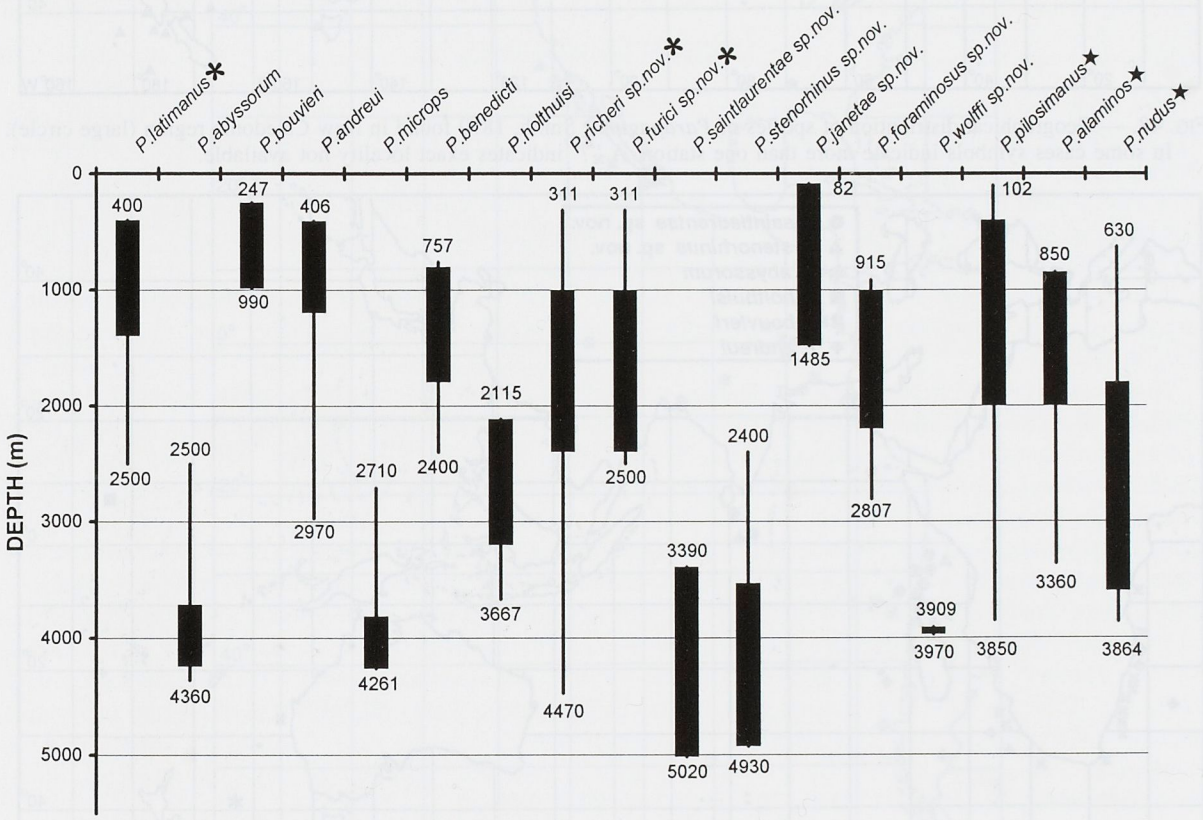


FIG. 47. — Bathymetric distribution of species of *Parapagurus* Smith, 1879 from the world, showing overall range (thin line) and most frequent range (black bar) for each species. The most frequent range was calculated from a station depth frequency histogram, and selecting a range that included 80% of station depths symmetrically around the mode. Depth data includes that used in this study as well as from published sources (e.g. DE SAINT LAURENT, 1972; MACPHERSON, 1983, 1984; LEMAITRE, 1986, 1989, 1990, 1997; LEMAITRE & MCLAUGHLIN, 1992). Asterisk: species found in New Caledonia; star: species known exclusively from the Atlantic Ocean.

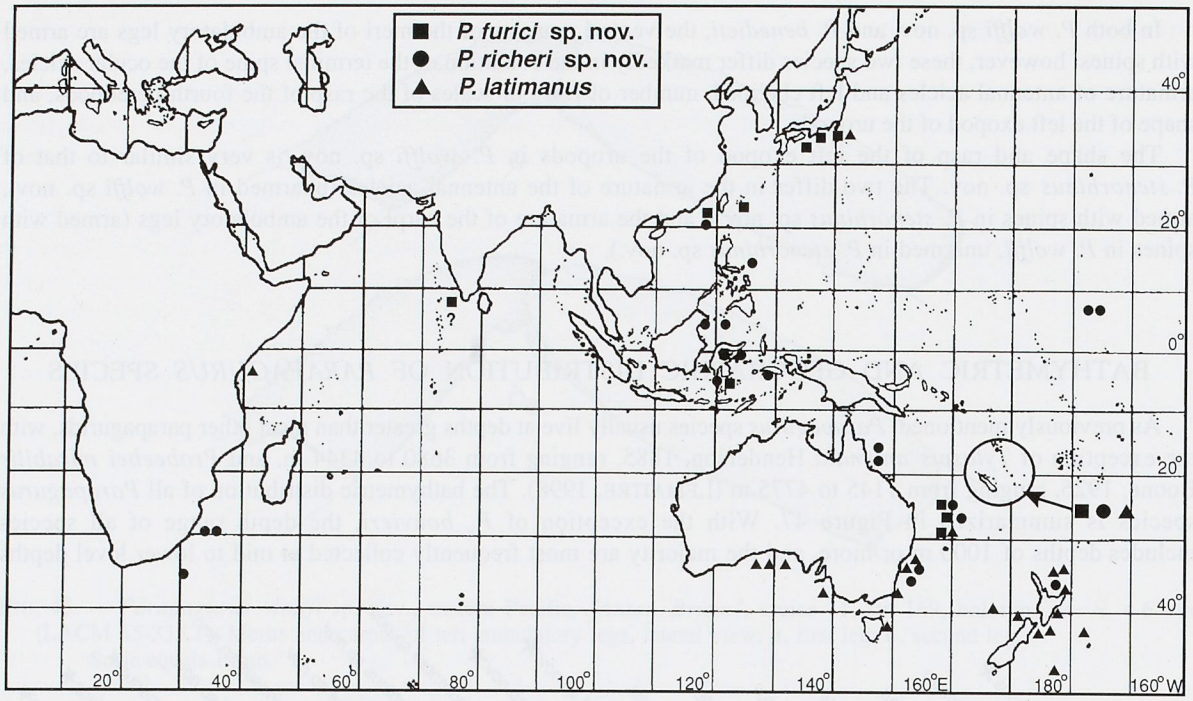


FIG. 48. — Geographical distribution of species of *Parapagurus* Smith, 1879 found in New Caledonia region (large circle). In some cases symbols indicate more than one station. A "?" indicates exact locality not available.

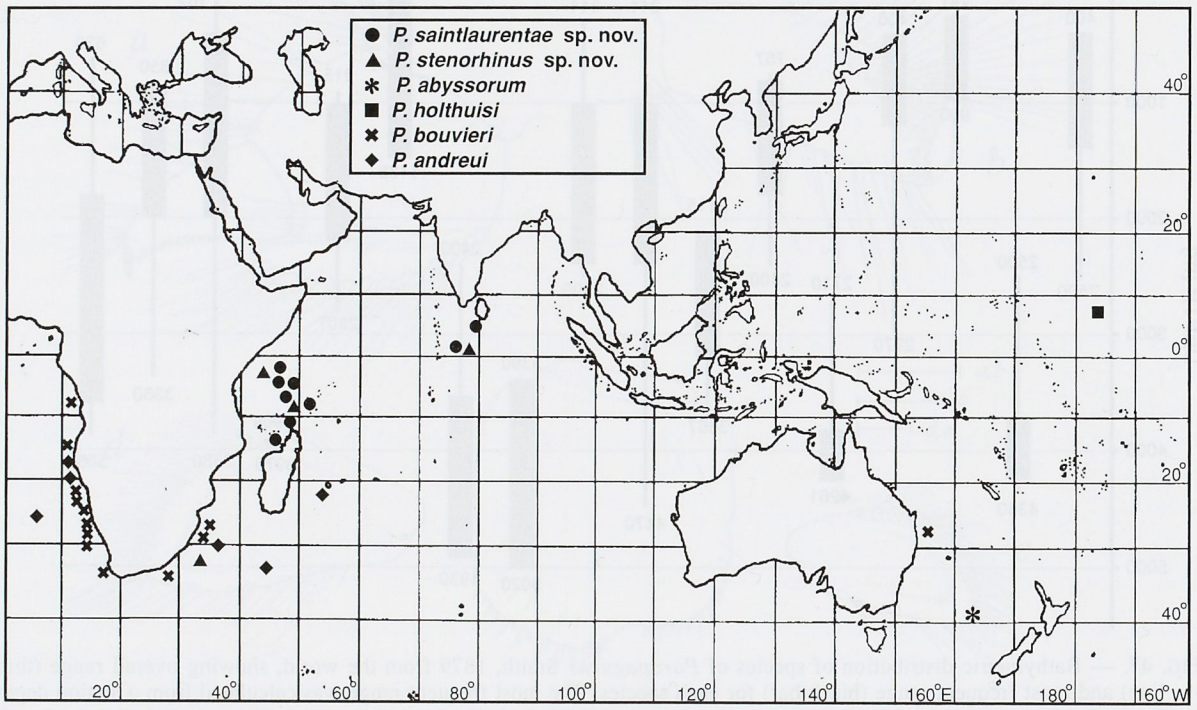


FIG. 49. — Geographical distribution of Indo-Pacific species of *Parapagurus* Smith, 1879 not found in New Caledonia region. For additional localities of *P. holthuisi* and *P. abyssorum* see FIG. 50, and LEMAITRE (1989: 29, fig. 12). In some cases symbols indicate more than one station.

(1000 to 3000 m) of the continental slope. Six species, *P. abyssorum*, *P. microps*, P. *holthuisi*, *P. saintlaurentae* sp. nov., *P. stenorhinus* sp. nov., and *P. wolffi* sp. nov., are so far known to occur exclusively below 2000 m; of these, *P. saintlaurentae* sp. nov., is found at 5020 m, which is the greatest depth recorded among all parapagurids. Only two species, *P. pilosimanus* and *P. janetae* sp. nov., have been collected in continental shelf depths (≤ 200 m), the former at 102 m off the northeastern coast of the United States (LEMAITRE, 1989), the latter at

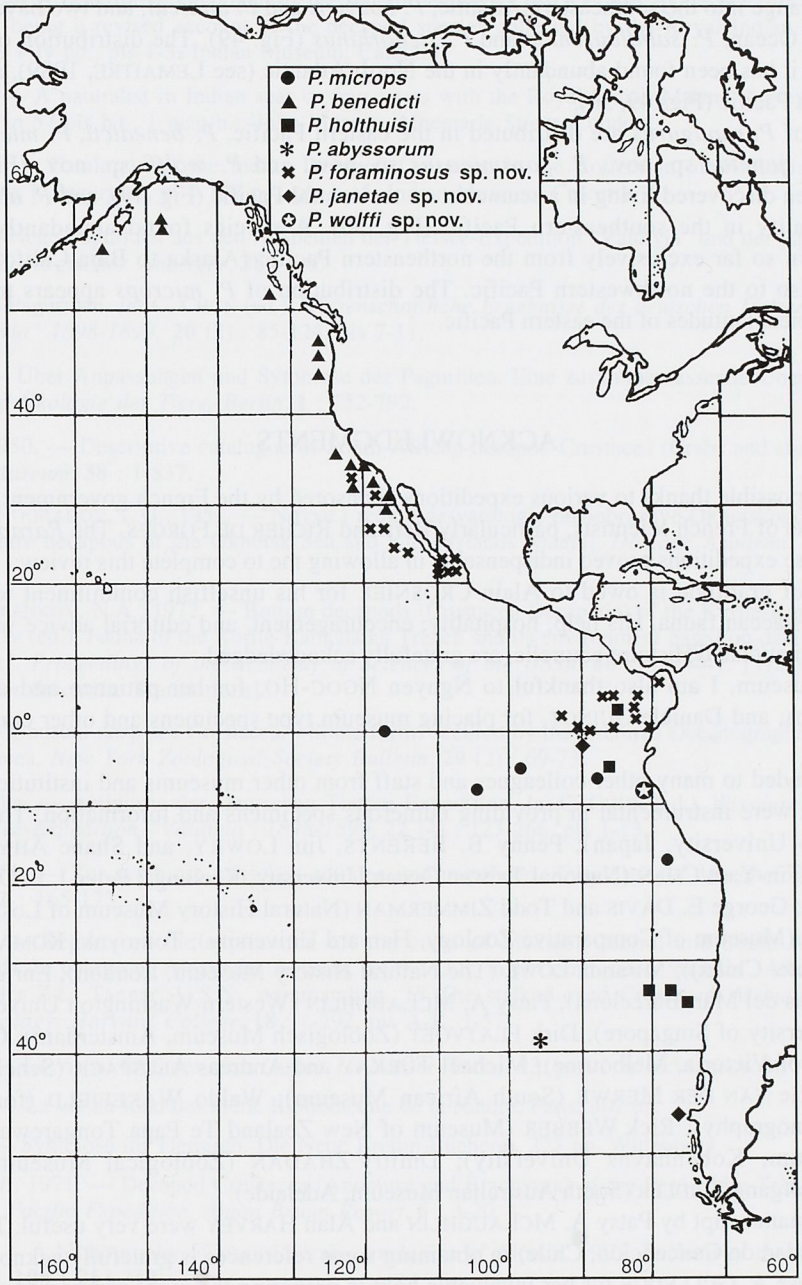


FIG. 50. — Geographical distribution of eastern Pacific species of *Parapagurus* Smith, 1879. For additional localities of *P. holthuisi* and *P. abyssorum* see FIG. 49, and LEMAITRE (1989: 29, fig. 12). In some cases symbols indicate more than one station.

82 m in the Gulf of Peñas, southern Chile. These exceptionally shallow collections (both at high latitudes) are rare, and may be attributable to the upward motion of deep cold water masses that would allow movement of individuals to much less deep water habitats.

In general, most species of *Parapagurus* are broadly distributed in one or two ocean basins (Figs 48-50). Of the 14 species that occur in the Pacific and Indian Oceans, three have been found in the New Caledonia region, *P. latimanus*, *P. richeri* sp. nov., and *P. furici* sp. nov. (Fig. 48); two are primarily distributed in the western Indian Ocean and range into the southeastern Atlantic, *P. bouvieri* and *P. andreui*, and two have so far been found only in the Indian Ocean, *P. saintlaurentae* and *P. stenorhinus* (Fig. 49). The distribution of *P. abyssorum* is particularly broad; it has been found abundantly in the North Atlantic (see LEMAITRE, 1989), and sparsely in the western and eastern Pacific (Figs 49, 50).

Seven species of *Parapagurus* are distributed in the eastern Pacific, *P. benedicti*, *P. microps*, *P. holthuisi*, *P. abyssorum*, *P. janetae* sp. nov., *P. foraminosus* sp. nov., and *P. wolffi* sp. nov. (Fig. 50). Of these, *P. holthuisi* has been discovered living in a seamount on the central Pacific (Fig. 49), and *P. abyssorum* is known from a single locality in the southeastern Pacific (Fig. 50). A species found abundantly in the region is *P. benedicti*, known so far exclusively from the northeastern Pacific (Alaska to Baja California, Mexico), but probably ranges also to the northwestern Pacific. The distribution of *P. microps* appears to include only the tropical and subtropical latitudes of the eastern Pacific.

ACKNOWLEDGMENTS

This study was possible thanks to various expeditions sponsored by the French government, and the outstanding collecting efforts of French scientists, particularly Bertrand RICHER DE FORGES. The *Parapagurus* specimens obtained during these expeditions proved indispensable in allowing me to complete this review.

A special debt of gratitude is owed to Alain CROSNIER for his unselfish commitment to the study of the New Caledonia crustacean fauna. His help, hospitality, encouragement, and editorial advice while working with him at the Muséum national d'Histoire naturelle, are gratefully acknowledged.

At the Paris museum, I am also thankful to Nguyen NGOC-HO, for her patience and care in processing numerous specimens; and Danièle GUINOT, for placing museum type specimens and other comparative material at my disposal.

Thanks are extended to many other colleagues and staff from other museums and institutions throughout the world, all of which were instrumental in providing numerous specimens and information. These include: Keiji BABA (Kumamoto University, Japan); Penny B. BERENTS, Jim LOWRY, and Shane AHYONG (Australian Museum, Sydney); Tin-Yam CHAN (National Taiwan Ocean University, Keelung); Peter J. F. DAVIE (Queensland Museum, Brisbane); George E. DAVIS and Todd ZIMMERMAN (Natural History Museum of Los Angeles County); Ardis B. JOHNSTON (Museum of Comparative Zoology, Harvard University); Tomoyuki KOMAI (Natural History Museum and Institute, Chiba)); Miranda LOWE (The Natural History Museum, London); Enrique MACPHERSON (Instituto de Ciencias del Mar, Barcelona); Patsy A. MCLAUGHLIN (Western Washington University); Peter K. L. NG (National University of Singapore); Dirk PLATVOET (Zoölogisch Museum, Amsterdam); Gary C. B. POORE (National Museum of Victoria, Melbourne); Michael TÜRKAY and Andreas ALLSPACH (Senckenberg Museum, Frankfürt); Michelle VAN DER MERWE (South African Museum); Waldo WAKEFIELD (formerly at Scripps Institution of Oceanography); Rick WEBBER (Museum of New Zealand Te Papa Tongarewa); Torben WOLFF (Zoological Museum, Kobenhavns University); Dmitry ZHADAN (Zoological Museum, Moscow State University); and Wolfgang ZEIDLER (South Australian Museum, Adelaide).

Reviews of the manuscript by Patsy A. MCLAUGHLIN and Alan HARVEY were very useful. The help of Marco RETAMAL (Universidad de Concepción, Chile) in obtaining some references is gratefully acknowledged. Last but not least, I thank Rose A. GULLEDGE for her invaluable help in preparing the maps and graphs.

REFERENCES

ALCOCK, A., 1894. — On the results of deep-sea dredging during the season 1890-91 (continued). Natural History notes from H.M. Indian Survey Steamer 'Investigator', Commander R.F. Hoskyn, R.N., commanding. Ser. 2, No. 1. *Annals and Magazine of Natural History*, (6) **13** : 225-245.

ALCOCK, A., 1901. — A descriptive catalogue of the Indian deep-sea Crustacea Decapoda Macrura and Anomala in the Indian Museum, being a revised account of the decapod species collected by the Royal Indian Marine Survey Ship Investigator, 286 + iv pp., pls 1-3. Indian Museum, Calcutta.

ALCOCK, A., 1902. — A naturalist in Indian seas or four years with the Royal Indian Marine Survey ship "Investigator", 328 pp., 98 figs in 57 pls h.t., 1 map h.t. John Murray, Albemarle Street, London

ALCOCK, A., 1905. — Catalogue of the Indian Decapod Crustacea in the Collection of the Indian Museum. Part II. Anomura. Fascicle I, Pagurides, xi + 197 pp., pls 1-15. Indian Museum, Calcutta.

BALSS, H., 1911. — Neue Paguriden aus den Ausbeuten der Tiefsee-Expedition "Valdivia" und der japanischen Expedition Prof. Dofleins. *Zoologischer Anzeiger*, **38** : 1-9.

BALSS, H., 1912. — Paguriden. *In*: C. CHUN (ed.), *Wissenschaftliche Ergebnisse der deutschen Tiefsee-Expedition auf dem Dampfer "Valdivia" 1898-1899,* **20** (2) : 85-124, pls 7-11.

BALSS, H., 1924. — Über Anpassungen und Symbiose der Paguriden. Eine zusammenfassende Übersicht. *Zeitschrift für Morphologie und Ökologie der Tiere, Berlin*, **1** : 752-792.

BARNARD, K. H., 1950. — Descriptive catalogue of South African decapod Crustacea (Crabs and shrimps). *Annals of the South African Museum*, **38** : 1-837.

BIRSHTEIN, Y. & VINOGRADOV, L.G., 1951. — Novye i redkie desyatinogie rakoobraznye Okhotskogo Morya i Kuril'shikh vod. [New and rare decapods of the Okhotsk Sea and Kuril Islands waters]. *Doklade Akademii Nauk SSSR*, **79** (2) : 357-360.

BIRSHTEIN, Y. & ZARENKOV, N.A., 1972. — Bottom decapods (Crustacea Decapoda) of the Kurile-Kamchatka Trench area. *In*: V.G. BOGOROV (ed.), Fauna of the Kurile-Kamchatka Trench and its environment based on data of the 39th Cruise of the R/V "Vityaz". *Proceedings of the Academy of Sciences of the USSR*, **86** : 439-447. [Translated from Russian, Israel Program for Scientific Translations].

BOONE, L., 1926. — Unusual deep-sea Crustacea. - Some forms secured by the Arcturus Oceanographic Expedition. A New family of Crustacea. *New York Zoological Society Bulletin*, **29** (2) : 69-73.

CARLGREN, O., 1928a. — Actiniaria der Deutschen Tiefsee-Expedition. *In*: C. CHUN (ed.), *Wissenschaftliche Ergebnisse Deutschen Tiefsee-Expedition "Valdivia" 1898-1899*, **22** (4) : 123-266, pls 1-13.

CARLGREN, O., 1928b. — Zur symbiose zwischen actinien und paguriden. *Zeitschrift für Morphologie und Ökologie der Tiere, Berlin,* **12** : 165-173.

FAXON, W., 1895. — Reports on the exploration off the coast of Mexico, Central and South America, and off the Galápagos Islands, in charge of Alexander Agassiz, by the U.S. Fish Commission Steamer "Albatross", during 1891, Lieut.-Commander Z.L. Tanner, U.S.N., commanding. 15 The stalked-eyed Crustacea. *Memoirs of the Museum of Comparative Zoology, Harvard College,* **18** : 1-292, pls A-K, 1-57.

FILHOL, H., 1885a. — La vie au fond des mers (suite). *La Nature* (Paris), **13**, part 2, n°635 (1er Août) : 152-154.

FILHOL, H., 1885b. — La vie au fond des mers. Bibliothèque de la Nature, Paris, 301 pp.

FÜLLER, H., 1958. — Symbiose im Tierreich. Die Neue Brehm-Bücherei, 227 pp. Wittenberg.

GARTH, J. & HAIG, J., 1971. — Decapod Crustacea (Anomura and Brachyura) of the Perú-Chile Trench. *Scientific Results of the Southeast Pacific Expedition, Anton Bruun Report*, **6** : 3-20.

GORDAN, J., 1956. — A bibliography of pagurid crabs, exclusive of Alcock, 1905. *Bulletin of the American Museum of Natural History,* **108** : 253-352.

HAIG, J., 1955. — The Crustacea Anomura of Chile. Reports of the Lund University Chile Expedition 1948-49. 20. *Lunds Universitets Årsskrift*, new series 2, **51** (12) : 1-68.

HART, J.F.L., 1982. — Crabs and their relatives of British Columbia. *British Columbia Provincial Museum Handbook*, (40), 267 pp.

HENDERSON, J.R., 1888. — Report on the Anomura collected by H.M.S. Challenger during the years 1873-76. *Report on the Scientific Results of the Voyage of H. M. S. Challenger during the years 1873-76*, (Zoology), **27** : xi + 221 pp, pls 1-21.

INGLE, R., 1993. — Hermit crabs of the northeastern Atlantic Ocean and Mediterranean Sea. An illustrated key. Identification Guide, (4), v + 495 pp. Chapman & Hall, London.

KENSLEY, B., 1969. — Decapod Crustacea from the south-west Indian Ocean. *Annals of the South African Museum*, **52** (7) : 149-181.

KENSLEY, B., 1974. — Type specimens of Decapoda (Crustacea) in the collections of the South African Museum. *Annals of the South African Museum*, **66** (4) : 55-80.

KENSLEY, B., 1977. — The South African Museum's Meiring Naude cruises, 2: Crustacea, Decapoda, Anomura and Brachyura. *Annals of the South African Museum*, **72** (9) : 161-188.

KENSLEY, B., 1981. — On the zoogeography of Southern African decapod Crustacea, with a distributional checklist of species. *Smithsonian Contributions to Zoology*, (338) : 1-64.

KOBJAKOVA, S.I., 1958. — Desyatinogive raki (Decapoda) rayona yuzhykl Kurils-kikh Ostrovov. [Systematic review of the Decapoda of the southern Kuril Islands]. *Issledovaniya Dal'nevostochnykh Morei SSSR*, **5** : 220-248.

LEMAITRE, R., 1986. — Western Atlantic species of the *Parapagurus pilosimanus* complex (Anomura: Paguroidea: Parapaguridae): description of a new species and morphological variations. *Journal of Crustacean Biology*, **6** (3) : 525-542.

LEMAITRE, R., 1989. — Revision of the genus *Parapagurus* (Anomura: Paguroidea: Parapaguridae), including redescriptions of the western Atlantic species. *Zoologische Verhandelingen*, (253) : 1-106.

LEMAITRE, R., 1990. — A review of eastern Atlantic species of the family Parapaguridae (Decapoda, Anomura, Paguroidea). *Journal of Natural History*, **24** : 219-240.

LEMAITRE, R., 1994. — Crustacea Decapoda: deep-water hermit crabs (Parapaguridae) from French Polynesia with descriptions of four new species. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 12. *Mémoires du Muséum national d'Histoire naturelle*, **161** : 375-419.

LEMAITRE, R., 1996. — Hermit crabs of the family Parapaguridae (Crustacea: Decapoda: Anomura) from Australia: species of *Strobopagurus* Lemaitre, 1989, *Sympagurus* Smith, 1883, and two new genera. *Records of the Australian Museum*, **48** (2) : 163-221.

LEMAITRE, R., 1997. — Crustacea Decapoda: Parapaguridae from the KARUBAR Cruise in Indonesia, with descriptions of two new species. *In*: A. CROSNIER & P. BOUCHET (eds), Résultats des Campagnes MUSORSTOM, Volume 16. *Mémoires du Muséum national d'Histoire naturelle*, **172** : 573-596.

LEMAITRE, R., 1998. — Revisiting *Tylaspis anomala* Henderson, 1885 (Parapaguridae), with comments on its relationships and evolution. *Zoosystema*, **20**(2): 289-305.

LEMAITRE, R. & MCLAUGHLIN, P.A., 1992. — Descriptions of megalopa and juveniles of *Sympagurus dimorphus* (Studer, 1883), with an account of the Parapaguridae (Crustacea: Anomura: Paguroidea) from Antarctic and Subantarctic waters. *Journal of Natural History*, **26** : 745-768.

LEMAITRE, R., MCLAUGHLIN, P.A. & GARCÍA-GÓMEZ, J., 1982. — The *Provenzanoi* group of hermit crabs (Crustacea, Decapoda, Paguridae) in the western Atlantic. Part IV. A review of the group, with notes on variations and abnormalities. *Bulletin of Marine Science*, **32** (3) : 670-701.

MACPHERSON, E., 1983a. — Crustáceos decápodos capturados en las costas de Namibia. *Resultados Expediciones Científicas. Investigaciones Pesqueras*, Supl. 11 : 3-79.

MACPHERSON, E., 1983b. — *Parapagurus hobbiti*, new species (Decapoda, Anomura, Parapaguridae), a hermit crab from the Valdivia Bank, southeast Atlantic. *Journal of Crustacean Biology*, **3** (3) : 472-476.

MACPHERSON, E., 1984. — Crustáceos decápodos del Banco Valdivia (Atlántico sudoriental). *Resultados Expediciones Científicas. Investigaciones Pesqueras*, Suppl. 12 : 39-105.

MAKAROV, V.V., 1938. — Rakoobraznyey, volume 10, no. 3, Anomura. [Crustacés Décapodes Anomures]. *Fauna SSSR*, n. ser., **16** : i-x + 1-324, pls 1-5. Akademii Nauk SSSR, Moscow and Leningrad.

MAKAROV, V.V., 1941. — The Decapoda Beringova i Chukotskogo Morei. *Issledovaniya Dal'nevostochniykh Morei SSSR-1*, **1** : 111-163. Akademii Nauk Soyuza SSR. [Explorations des mers de l'extrême-orient de l'URSS].

MAKAROV, V.V., 1962. — Crustacea, volume 10, no. 3, Anomura [English translation of MAKAROV, 1938]. *Fauna of USSR*, n. ser., **16** : 1-4 + 1-283, pls 1-5. Israel Program for Scientific Translation, Jerusalem. [Published for the National Science Foundation and Smithsonian Institution, Washington, D.C.].

MARSHALL, N.B., 1979. — Developments in deep-sea biology. Garland STPM Press, New York, 566 pp.

MCLAUGHLIN, P.A., 1974. — The hermit crabs (Crustacea Decapoda, Paguridae) of northwestern North America. *Zoologische Verhandelingen*, (130) : 1-396.

MCLAUGHLIN, P.A., 1982. — The *Provenzanoi* group of hermit crabs (Crustacea, Decapoda, Paguridae) in the western Atlantic. Part 3. *Pagurus protuberocarpus*, a new species from the southern Caribbean. *Bulletin of Marine Science*, **32** (3) : 664-669.

MCLAUGHLIN, P.A., 1997. — Crustacea Decapoda: hermit crabs of the family Paguridae from the KARUBAR Expedition in Indonesia. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 16. *Mémoires du Muséum national d'Histoire naturelle*, **172** : 433-572.

MCLAUGHLIN, P.A. & DE SAINT LAURENT, M., 1998. — A new genus for four species of hermit crabs formerly assigned to the genus *Pagurus* Fabricius (Decapoda: Anomura: Paguridae). *Proceedings of the Biological Society of Washington*, **111** (1) : 158-187.

MENZIES, R.J., GEORGE, R.Y. & ROWE, G.T., 1973. — Abyssal environment and ecology of the world oceans, 488 pp. John Wiley & Sons, New York.

MILNE-EDWARDS, A., 1891. — Pagurides nouveaux des Açores. Campagnes scientifiques de S.A. Le Prince de Monaco sur le yacht l'Hirondelle. *Bulletin de la Société Zoologique de France*, **16** (5) : 131-134.

MILNE-EDWARDS, A. & BOUVIER, E.-L., 1892a. — Note sur un Pagure des grandes profondeurs de la mer (*Parapagurus pilosimanus*). Congrès International de Zoologie, 2ème session, 1ère partie, Moscou 1892 : 1-15.

MILNE-EDWARDS, A. & BOUVIER, E.-L., 1892b. — Observations préliminaires sur les Paguriens recueillis par les expéditions françaises du "Travailleur" et du "Talisman". *Annales des Sciences Naturelles* (Zoologie et Paléontologie), (7)**13** : 185-226.

MILNE-EDWARDS, A. & BOUVIER, E.-L., 1899. — Crustacés décapodes provenant des campagnes de l'HIRONDELLE (Supplément) et de la PRINCESSE-ALICE (1891-1897). Brachyures et Anomoures. *Résultats des Campagnes scientifiques accomplies sur son yacht par Albert Ier Prince Souverain de Monaco*, **13** : 1-106.

MILNE-EDWARDS, A. & BOUVIER, E.-L., 1900. — Crustacés décapodes. 1. Brachyures et Anomoures. *Expéditions scientifiques du "Travailleur" et du "Talisman" pendant les années 1880, 1881, 1882, 1883*, **5** : 1-396.

MIYAKE, S., 1978. — The crustacean Anomura of Sagami Bay, 161 pp. Biological Laboratory, Imperial Household.

MIYAKE, S., 1982. — Japanese crustacean decapods and stomatopods in color. Vol. 1, Macrura, Anomura, and Stomatopoda, 261 pp. Hoikusha Publishing Co., Ltd., Osaka.

MURRAY, J., 1895. — Report on the scientific results of the voyage of H.M.S. Challenger during the years 1873-76. A summary of the scientific results. *Report on the scientific results of the voyage of H. M. S. Challenger, during the years 1873-76*, (Zoology), (1, 2) : 1-1608.

MURRAY, J., 1896. — On the deep and shallow water marine fauna of the Kerguelen region of the Great Southern Ocean. *Transactions of the Royal Society of Edinburgh*, **38**, part 2, n°10 : 343-500, 1 map.

NOBRE, A., 1931. — Crustáceos decápodos e stomatópodos marinhos de Portugal, iv + 307 pp., 2 pls. Instituto de Zoologia Universidade do Pôrto, Pôrto-Impresa Portuguesa.

NOBRE, A., 1936. — Crustáceos decápodos e stomatópodos marinhos de Portugal. Fauna Marinha de Portugal (2nd ed.), **4** : viii + 213 pp, 61 pls. Pôrto.

PORTER, C.E., 1906. — Materiales para la fauna carcinolójica de Chile. 5. Sobre algunos Crustáceos de Los Vilos. *Revista Chilena de Historia Natural*, **10** : 128-138.

RATHBUN, M.J., 1904. — Decapod crustaceans of the northwest coast of North America. *Harriman Alaska Expedition Series*, **10** : 1-190, pls 1-10.

RATHBUN, M. J., 1910. — [Reprint of RATHBUN, 1904; Smithsonian Institution, Washington, same pagination].

REINHARD, E.G., 1944. — Rhizocephalan parasites of hermit crabs from the Northwest Pacific. *Journal of the Washington Academy of Sciences*, **34** (2) : 49-58.

REISCHMAN, P.G., 1959. — Rhizocephala of the genus *Peltogasterella* from the coast of the state of Washington to the Bering Sea. *Proceedings of the Koninklijke Nederlandse Akademie van Wetenschappen*, ser. C, **62** (4) : 409-435.

ROSS, D. M., 1967. — Behavioural and ecological relationships between sea anemones and other invertebrates. *Oceanography and Marine Biology Annual Review*, **5** : 291-316.

SAINT LAURENT, M. DE, 1972. — Sur la famille des Parapaguridae Smith, 1882. Description de *Typhlopagurus foresti* gen. nov., et de quinze espèces ou sous-espèces nouvelles de *Parapagurus* Smith (Crustacea, Decapoda). *Bijdragen tot de Dierkunde*, **42** (2) : 97-123.

SAINT LAURENT, M. DE, 1985. — 40. Remarques sur la distribution des crustacés décapodes. Pp. 469-478. *In*: L. LAUBIER & C. MONNIOT (eds), Peuplements profonds du Golfe de Gascogne. Campagnes Biogas, viii + 629 pp. Institut Français de Recherche pour l'Exploitation de la Mer (IFREMER).

SMITH, S.I., 1879. — The stalked-eyed crustaceans of the Atlantic coast of North America north of Cape Cod. *Transactions of the Connecticut Academy of Arts and Sciences*, **5** (1) : 27-136.

SMITH, S.I., 1884. — XV. Report on the decapod Crustacea of the "Albatross" dredgings off the east coast of the United States in 1883. *Report of the Commissioner for 1882, United States Commission of Fish and Fisheries*, **10** : 345-426, pls 1-10.

SMITH, S.I., 1882. — XVII. Report on the Crustacea. Part I. Decapoda. Reports on the dredging, under the supervision of Alexander Agassiz, on the east coast of the United States, during the summer of 1880, by the U.S. Coast Survey Steamer "Blake", commander J.R. Bartlett U.S.N., commanding. *Bulletin of the Museum of Comparative Zoology, Harvard College*, **10** (1) : 1-108.

SMITH, S.I., 1886. — XXI. Report on the decapod Crustacea of the "Albatross" dredgings off the east coast of the United States during the summer and autumn of 1884. *Report of the Commissioner for 1885, United States Commission of Fish and Fisheries*, **13** : 605-705, pls 1-22.

STEBBING, T. R. R., 1910. — General catalogue of South African Crustacea (Part V of S.A. Crustacea, for the Marine Investigations in South Africa). *Annals of the South African Museum*, **6** (4) : 281-599.

TAKEDA, M., 1982. — Keys to the Japanese and foreign Crustaceans fully illustrated in colors, vi+58+285 pp. Hokuryukan, Tokyo.

VINOGRADOV, L.G., 1950. — Opredelitel'krevetok, rakov i krabov Dal'nego Vostoka. [A key to the shrimps, lobsters and crabs of the Far East]. *Izvestiya Tikhookeanskogo Nauchno-Issledovatel'skogo Instituta Rbnogo Khozyaistva i Okeanografii*, **33** : 179-358, pls 1-53.

WOOD-MASON, J., & ALCOCK, A., 1891. — Natural history notes from H.M. Indian marine Survey Steamer 'Investigator', Commander R. F. Hoskyn, R. N., commanding. 21. Note on the results of the last season's deep-sea dredging. The *Annals and Magazine of Natural History*, (6) **7** (38) : 186-202; (39) : 258-276.

7

Crustacea Decapoda: Albuneidae and Hippidae of the tropical Indo-West Pacific region

Christopher B. BOYKO

Department of Invertebrates
American Museum of Natural History
Central Park West at 79th St.
New York, NY 10024, USA

and

Department of Biological Sciences
University of Rhode Island
Kingston, RI 02881, USA

&

Alan W. HARVEY

Department of Invertebrates
American Museum of Natural History
Central Park West at 79th St.
New York, NY 10024, USA

(Current address: Department of Biology
Georgia Southern University
Statesboro, GA, 30460, USA)

ABSTRACT

Based primarily on samples collected during French expeditions to New Caledonia and nearby regions, two new species of the sand crab family Albuneidae Stimpson, 1858 are described from the tropical Indo-West Pacific Ocean: *Albunea holthuisi*, from Tanzania, Madagascar, and Indonesia, and *Austrolepidopa caledonia*, from New Caledonia. Two closely related, and often synonymized, species of *Albunea*: *A. microps* Miers, 1878 and *A. elioti* Benedict, 1904 are found to be distinct. Several important diagnostic morphological features, not previously described in the Albuneidae, are discussed. In addition, we provide diagnoses for three Indo-West Pacific species of mole crabs in the family Hippidae Latreille, 1825, including the very similar *Hippa pacifica* Dana, 1852 and *H. celaeno* (de Man, 1896). An annotated list of the 37 species of Hippoidea reported from the Indo-West Pacific region is provided, along with a diagnostic key to these species.

RÉSUMÉ

Crustacea Decapoda: Albuneidae et Hippidae de l'Indo-Ouest Pacifique tropical.

En se basant, au départ, sur les récoltes faites durant diverses expéditions françaises au large de la Nouvelle-Calédonie et dans des régions voisines, deux nouvelles espèces appartenant à la famille des Albuneidae Stimpson, 1858 sont

BOYKO, C. B. & HARVEY, A. W., 1999. — Crustacea Decapoda: Albuneidae and Hippidae of the tropical Indo-West Pacific region. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*, **180**: 379-406. Paris ISBN 2-85653-520-8.

décrites de l'Indo-Ouest Pacifique: *Albunea holthuisi* sp. nov., connue de la Tanzanie, de Madagascar et de l'Indonésie et *Austrolepidopa caledonia* sp. nov., connue de la Nouvelle-Calédonie. Le réexamen de deux espèces d'*Albunea*, proches et souvent mises en synonymie, *A. microps* Miers, 1878 et *A. elioti* Benedict, 1904 a montré qu'elles sont distinctes. Plusieurs caractères morphologiques distinctifs, qui n'avaient pas encore été décrits chez les Albuneidae, sont discutés. Des diagnoses pour trois espèces de la famille des Hippidae Latreille, 1825, comprenant les espèces *Hippa pacifica* Dana, 1852 et *H. celaeno* (de Man, 1896), très proches l'une de l'autre, sont publiées. Enfin, une liste commentée des 37 espèces d'Hippoidea signalées de l'Indo-Ouest Pacifique est proposée, accompagnée d'une clé d'identification de ces espèces.

INTRODUCTION

Crustaceans in the anomuran superfamily Hippoidea Latreille, 1825 are specialized burrowing crabs that live in sandy habitats in shallow waters, predominantly in the tropics. Historically, there has been little systematic work in either hippoid family (i.e., the Albuneidae and the Hippidae) on a regional or worldwide basis. In the Albuneidae, there has been no comprehensive study of any genus outside of SCHMITT's (1942) review of *Blepharipoda* Randall, 1839 and EFFORD's (1971) revision of *Lepidopa* Stimpson, 1858. SERÈNE's (1979) review of *Paralbunea* Serène, 1979 was by his own admission incomplete, as he did not examine specimens of all the taxa during the study. For *Hippa* Fabricius, 1787, the largest genus in the Hippidae, there have been regional reviews (EFFORD, 1972; HAIG, 1974b). A list of *Hippa* species has been prepared (HAIG *et al.*, 1986), but the genus has not been reviewed comprehensively since the work of DE MAN (1896; 1898). EFFORD (1976) summarized worldwide distributional data for the genus *Emerita* Scopoli, 1777. None of the other seven genera in these families have been well studied systematically.

Even less is known about the phylogenetic relationships among the species and genera in the Hippoidea. EFFORD (1969) proposed a phylogeny for the albuneid genera and later (1971) presented a preliminary tree for the genus *Lepidopa*, but these were based on relatively few morphological characters. TAM *et al.* (1996) presented a molecular phylogeny for American species of *Emerita*. We plan to generate a comprehensive phylogeny for the Hippoidea, but this first requires better understanding of the taxonomy for the species involved.

The Hippoidea is represented in the tropical Indo-West Pacific region by 37 described species. In the present paper we summarize the current state of taxonomic knowledge regarding the tropical Indo-West Pacific species of Hippoidea, describe two new species of albuneids, present new information on species ranges and biology, and discuss the morphological differences that allow the separation of two closely related species of *Hippa*. In addition, we provide a dichotomous key to facilitate the identification of Indo-West Pacific hippoids.

MATERIALS AND METHODS

Since 1976, ORSTOM (Institut français de Recherche scientifique pour le Développement en Coopération) and the Muséum national d'Histoire naturelle, Paris, have participated in a joint study of the bathyal fauna of the southwest Indo-Pacific. Several cruises have been undertaken but they have been mostly interested in the deep-water environment and few have collected Hippoidea which live in shallow water, rarely down to 225 m.

The cruises that have collected Hippoidea are:

- CORINDON 2 in the Makassar Strait, Indonesia, from 29 October to 12 November 1980 (see MOOSA, 1984).
- SMIB 6, which from 28 February to 12 March 1990 explored the "grand passage" north of New Caledonia (see RICHER DE FORGES, 1993).

In addition, collections were made by the MONTROUZIER EXPEDITION, which from 23 August to 5 November 1993 explored the lagoon and reef environments of two sites on North Caledonia: Touho on the east coast and Koumac on the west coast (see BOUCHET, 1994).

Other collections made by ORSTOM scientists in New Caledonia and Madagascar were also examined.

All this material is deposited at the Muséum national d'Histoire naturelle (MNHN).

Additionally, we examined material from the following institutions: the Academy of Natural Sciences of Philadelphia, Pennsylvania, USA (ANSP), the American Museum of Natural History, New York, USA (AMNH), the British Museum (Natural History) (now The Natural History Museum), London, England (BMNH), the Museum of Comparative Zoology, Massachusetts, USA (MCZ), the Musée Royal de l'Afrique Centrale, Tervuren, Belgium (MRAC), the Nationaal Natuurhistorisch Museum (formerly Rijksmuseum van Natuurlijke Historie), Leiden, The Netherlands (RMNH), the University Museum of Zoology, Cambridge, England (UMZC), the National Museum of Natural History, Washington, D.C., USA (USNM), the Western Australian Museum, Perth, Australia (WAM), and the Zoological Museum, University of Copenhagen, Denmark (ZMUC). The type specimens are deposited as specified in the species entries.

In the lists of material examined, measurements are given for carapace length (CL), as measured from the midline of the anterior margin (including rostrum, if any) to the midline of the posterior concavity. The names of cruises are in all capital letters, whereas the names of vessels are in both italics and quotation marks. In the lists of synonyms, asterisks indicate those publications that refer to materials re-examined by us during the present study.

For illustrations, we first captured specimen images on a Macintosh™ computer with a digital camera connected to a Wild M8 dissecting microscope. These images were then prepared for publication using the programs Adobe Photoshop™ and Adobe Illustrator™. We attempted to accurately record the position and size of setae in these drawings but, for clarity of presentation, excluded plumules of plumose setae.

SYSTEMATIC ACCOUNT

HIPPOIDEA Latreille, 1825

ALBUNEIDAE Stimpson, 1858

REMARKS. — During the course of this study, we encountered several diagnostic morphological features that have not been described previously for albuneids. For example, the carapace (Fig. 1) bears a broad mat of very short, dense, simple setae just behind the front. This mat, hereafter called the setal field, varies in shape and extent across genera and species, but appears to be relatively invariant within species.

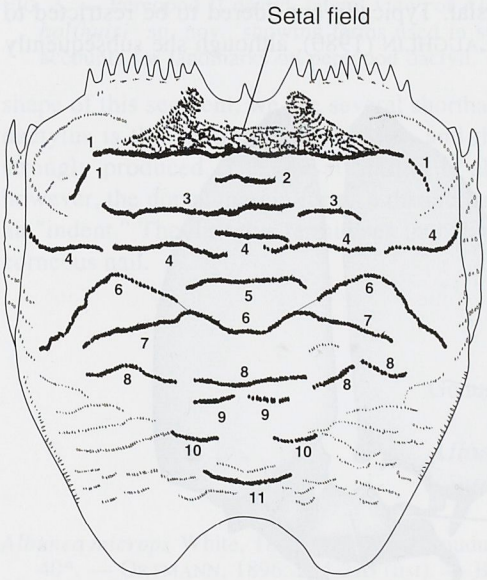


FIG. 1. — Diagrammatic albuneid carapace, based on *Albunea microps*, showing setal field behind front, and 11 setose carapace grooves discussed in species accounts.

The carapace of albuneids typically possesses numerous transverse, setose grooves. Although carapace grooves (CG) have been scarcely mentioned by previous authors, we have identified at least eleven major grooves (numbered 1–11 in Fig. 1) the homology of which can be recognized across albuneid genera. Variability in the presence and the degree of fragmentation of specific grooves, in the anterior-posterior displacement of individual fragments, and in the texture of the grooves (e.g., smooth, crenulate) tends to be conserved within species, and thus carapace grooves are useful in recognizing species.

The median element of CG1 forms the posterior margin of the setal field and also of the front. In some genera, the curved lateral elements of CG1 are often displaced posteriorly (as in Fig. 1). The metagastric region contains the short, anterior CG2 and the longer, posterior CG3. CG4 spans the width of the carapace and marks the border of the metagastric and mesogastric regions. CG5 is a fairly short groove that occurs medially in the mesogastric region. CG6 corresponds to the cervical groove in other

Anomura. CG7 is usually divided into 2 well-separated lateral fragments, but in some genera (e.g., *Austrolepidopa* Efford & Haig, 1968 and *Lepidopa*), CG7 merges medially with CG6. CG8–11 are relatively short medial grooves arranged anteriorly to posteriorly in the cardiac region.

In several genera of albuneids, nearly transparent and presumably decalcified "windows" can be found on various locations on the crab, including lateral and mesial surfaces of the second through fourth pereopods and on the dorsal surface of the first and second abdominal somites. Such decalcified windows have not been reported previously for any albuneid. Similar "windows" occur on the mesial surface of the merus in several genera in the anomuran family Porcellanidae Haworth, 1825, and on the mesial surface of the coxa of the first pereopods in the hippid genus *Emerita*, but are lacking in *Hippa* and *Mastigochirus* Stimpson, 1858 (HARVEY, in press).

As is typical in decapod crustaceans, albuneid females have gonopores on the coxae of the third pereopods, whereas males have gonopores on the coxae of the fifth pereopods. However, in some albuneid genera (e.g., *Austrolepidopa* and *Lepidopa*), males also have a small pore on the coxa of the third pereopod (hereafter referred to as the "male pore"), in a position analogous to that of the female gonopore. The precise nature and function of this male pore is unknown.

In albuneids, females have well developed uniramous pleopods on abdominal somites II-V, whereas pleopods are thought to be completely lacking in males (e.g., MARTIN & ABELE, 1986). However, we have found, in specimens with well developed pores on the fifth pereopods, rudimentary to small pleopods on abdominal somites II-V in several albuneid genera (e.g., *Austrolepidopa* and *Lepidopa*). The existence of the "male pore" and of small pleopods in males were not previously recognized in albuneids, which we suspect has led to the incorrect sexing of crabs and contributed to a probably erroneous impression that males are exceedingly rare or even absent in many species of albuneids. For example, the holotype of *Austrolepidopa trigonops* Efford & Haig, 1968 was described as an immature female with incompletely developed pleopods and gonopores, but we have examined this specimen and determined that it is in fact a male. In those species in which the male pore occurs, it is always smaller than gonopores of same-sized females; likewise, the pleopods of females are always much more developed than those of males. Males are most reliably recognized by the presence of a gonopore on the fifth pereopod and the rudimentary degree of development of the pleopods. In small specimens, however, the presence or absence of the male gonopore is a more reliable indicator of sex than is pleopod development because both males and females have small pleopod buds as juveniles.

The presence in albuneids of ocular acicles has been controversial. Typically considered to be restricted to hermit crabs, ocular acicles were first reported in albuneids by MCLAUGHLIN (1980), although she subsequently

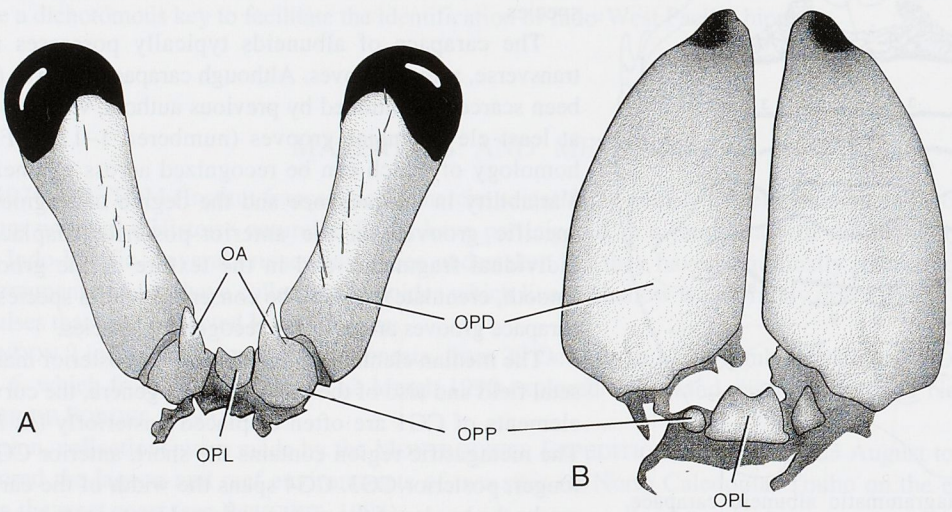


FIG. 2. — Diagrammatic anomuran eyes, showing relationship between proximal ocular peduncle segments (PS), distal ocular peduncle segments (DS), ocular acicles (AC) and ocular plates (OP): **A**, *Sympagurus dimorphus* (Studer, 1883), a typical hermit crab; **B**, *Albunea* sp. undescribed, a typical albuneid.

concluded that the structures on albuneids were "not acicles, but rather, calcified portions of the hippoid ocular plate" (McLAUGHLIN, 1983: 615). Nonetheless, MARTIN and ABELE (1986: 578) scored the Albuneidae as having ocular acicles, remarking that they were "unsure about the differences between small ocular acicles and pieces of the ocular plate". The distinction is straightforward. In decapod crustaceans, the ocular peduncle typically consists of a proximal segment and a distal segment; in rare cases, one or both of these segments may be secondarily subdivided (POWAR, 1969). The ocular plate is the medial calcified acron to which the ocular peduncles are attached. Based on muscle site attachments, POWAR (1969) clearly established the homology of the proximal and distal ocular segments, as well as the ocular plate, across the Decapoda. True ocular acicles are not part of the ocular plate, but rather are spinous or platelike anterodorsal extensions of the proximal segment of the ocular peduncle (Fig. 2).

In some taxa (e.g., the diogenid hermit crab genus *Dardanus* Paulson, 1875, and many albuneids), the ocular plate is exposed, that is, not covered by the anterior carapace. In some albuneids, this exposed ocular plate is also deeply indented medially, perhaps consistent with the hypothesis that the ocular plate represents the fusion of primitively paired basal eyestalk segments (POWAR, 1969). This deeply indented ocular plate gives an impression superficially similar, but clearly not homologous, to the ocular acicles on the proximal ocular segment of hermit crabs, which we presume to be the source of confusion among earlier workers.

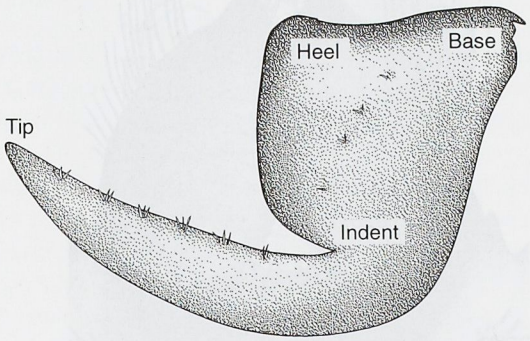


FIG. 3. — Pereopod II dactyl, lateral view, of *Albunea holthuisi* sp. nov., showing terms used in species accounts for landmarks on pereopod dactyli.

As observed by previous workers, the third maxilliped contains a number of morphological characters for distinguishing among albuneid genera and species. In most anomurans, the basis bears a medial row of teeth, termed the crista dentata. Among the albuneids, only two aberrant genera, *Blepharipoda* and *Lophomastix* Benedict, 1904, are thought to possess a crista dentata (MARTIN & ABELE, 1986; McLAUGHLIN & LEMAITRE, 1997). However, we have observed a very reduced crista dentata on several species of *Albunea*. Other than the third maxilliped, the mouthparts of albuneids tend to lack distinguishing features and so are not described herein.

The shape of the dactylus of the pereopods, particularly the third pereopod, has been used widely to distinguish among species of albuneids. To describe the complex shape of this segment, we use several shorthand terms to refer to important landmarks (Fig. 3). The "base" of the dactylus is the ventroproximal angle, and the "heel" corresponds to the dorsoproximal angle, which is often strongly produced. The dorsal margin is almost always concave, sometimes smoothly so; in most species, however, the dorsal margin forms a distinct angular incision proximally, the apex of which is herein referred to as an "indent." The dactylus terminates in a "tip," which in hippoids is at least somewhat rounded and lacking in a corneous nail.

Genus ***ALBUNEA*** Weber, 1795

Albunea microps Miers, 1878

Figs 1, 4

Albunea microps White, 1847: 129 (nomen nudum)*. — MIERS, 1878: 328-329, pl. 5, figs 12-13*. — HENDERSON, 1888: 40*. — ORTMANN, 1896: 224-225 (list). — BORRADAILE, 1904: 751*. — GORDON, 1938: 187, fig. 3c*. — SERÈNE & UMALI, 1965: 95-97, pl. 6, figs 1-6, text fig. 12c. — THOMASSIN, 1969: 140-143 (part), text figs 2, 3b. — MIYAKE, 1978: 154-155, fig. 60b.

Albunea [sp.] Gordon, 1938: 189-190, fig. 1d*.

Not *Albunea microps* - THOMASSIN, 1969: 140-143 (part), pl. 2, figs 1-9 (= *Albunea elioti* Benedict, 1904).

MATERIAL EXAMINED. — **Philippines**. *Sulu Archipelago*. "Sooloo Islands" [= Sulu Archipelago], coll. unknown: 1 ♂ 11.3 mm (BMNH 1937.6.7.3).

"Challenger": stn 212, 06°54'N, 122°18'E, 3-6 m, 30.01.1875 : 1 ♂ 9.5 mm (ZMUC 2715).

Indonesia. *"Gloria Maris"*: stn 549, east coast of Rouw Island, Aoeri Group, west "Geelvinck" (= Cenderawasih) Bay, "New Guinea" (= Irian Jaya), coll. A. J. OSTHEIMER, 23.02.1956: 1 ♂ 11.2 mm (RMNH 23641).

CORINDON 2: stn DR 293, 02°37.7'S, 117°49.4'E, Sulawesi, Makassar Strait, 45 m, 11.11.1980: 1 ov. ♀ 12.1 mm (MNHN-Hi 201).

Andaman Islands. Port Blair, coll. unknown: 2 ♂ 6.2-6.7 mm (BMNH 1956.1.14.20).

Maldive Islands. Mahlosmadulu Atoll, 37 m, coll. J. S. GARDINER: 2 juv. ♀ 4.6-4.7 mm (UMZC).

Oman. Muscat, 12-27 m, coll. unknown: 1 ♂ 7.8 mm (BMNH 1901.4.20.10).

Seychelles. Mahé, coll. Mission Zoologique MRAC-ULB, July-Aug. 1972: 2 ♀ 6.0-10.2 mm (MRAC 53.604).

Tanzania. Stn 650, dredged in shell and sponge, about 1.5 mi (= 2.5 km) east of Puopu Island, northwest Zanzibar, 13-16 m, coll. A. J. OSTHEIMER III, 20.02.1957: 1 ♀ 12.8 mm (ANSP CA4647). — Dredged in muddy sand, around Bawi and Change Islands, off Zanzibar City, Zanzibar, 11-29 m, coll. A. J. OSTHEIMER III, 27.02.1957: 1 ♀ 10.9 mm (ANSP CA4646).

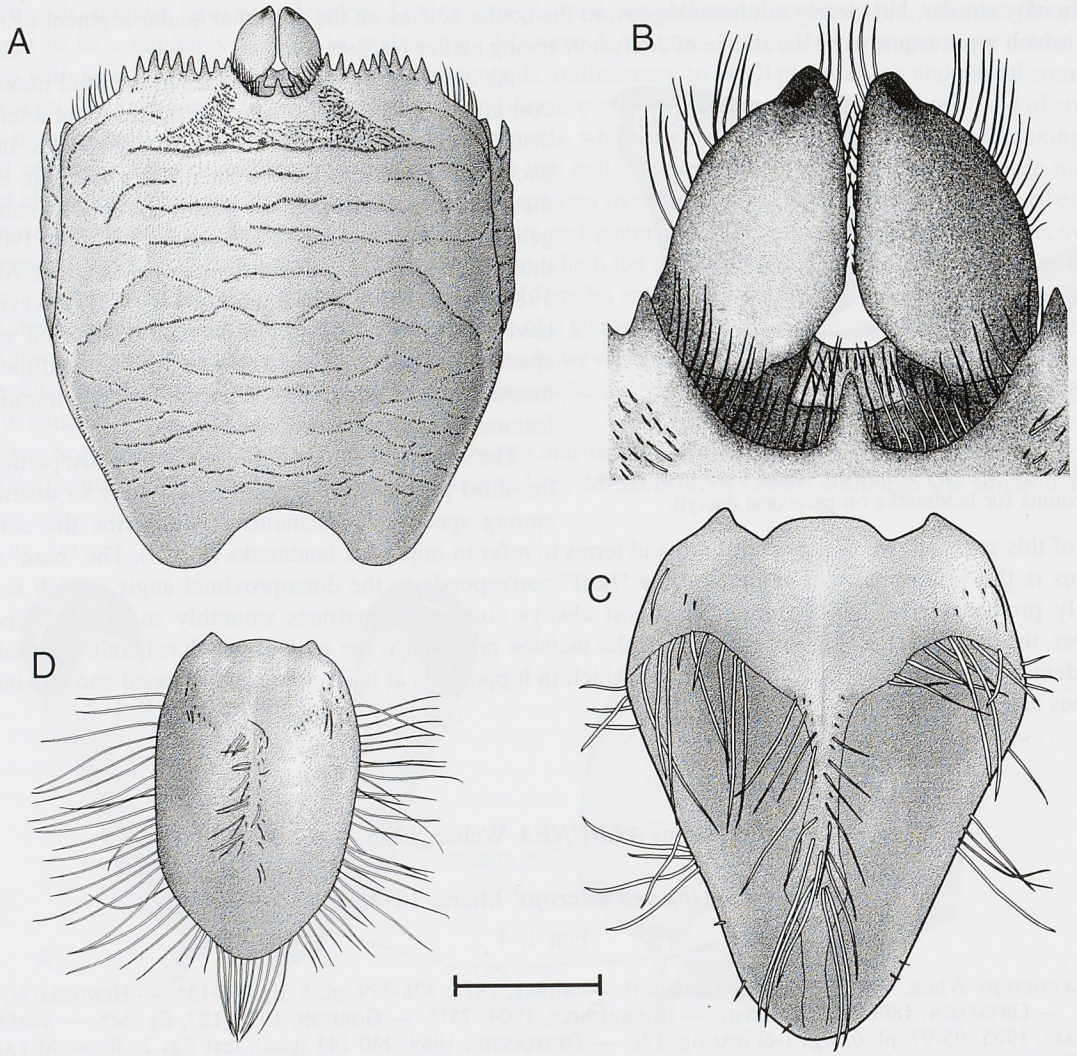


FIG. 4. — *Albunea microps* Miers, 1878, ov. ♀ 12.1 mm (MNHN-Hi 201) (A, B, D); ♂, holotype, 11.3 mm (BMNH 1937.6.7.3) (C). **A**, carapace, dorsal view; **B**, eyes, dorsal view; **C**, telson of male, dorsal view; **D**, telson of female, dorsal view. Scale = 0.75 mm (B), 1.0 mm (C), 2.0 mm (D), and 4.0 mm (A).

TYPE. — *Holotype*: ♂ 11.3 mm, "Sooloo Islands" [= Sulu Archipelago, Philippines] (BMNH 1937.6.7.3).

DIAGNOSIS. — Carapace (Fig. 4A) slightly longer than wide, covered with strongly setose grooves. Anterior margin with about 9 teeth on either side of ocular sinus. Setal field with thick anterolateral projections and truncate anteromedial margin. CG1 with lateral elements separated, displaced posteriorly from median element; CG4 fragmented, median element displaced anteriorly; CG5 entire; CG6 and CG7 united; CG 11 present. Rostrum present, exceeding posterior margin of ocular plate by about half length of ocular plate. Ocular plate subquadrate (Fig. 4B). Ocular peduncles (Fig. 4B) dorsoventrally flattened and oblong in shape, rounded at tip, approximated along distal 2/3 of mesial margin; lateral margin convex except at concave tip; mesial margin convex. Cornea on lateral margin at tip. Dactyli of pereopods II and III with heels smoothly rounded. Dactylus of pereopod IV sinuous from base to tip; indent slight. Telson of male (Fig. 4C) broadly triangular, inflated dorsally, broadly rounded at tip, strongly calcified proximally; large decalcified windows on either side of thin medial calcified strip; long thin setae medially and along anterior margin of windows. Telson of female (Fig. 4D) flattened, ovate, longitudinal row of short, thin setae medially.

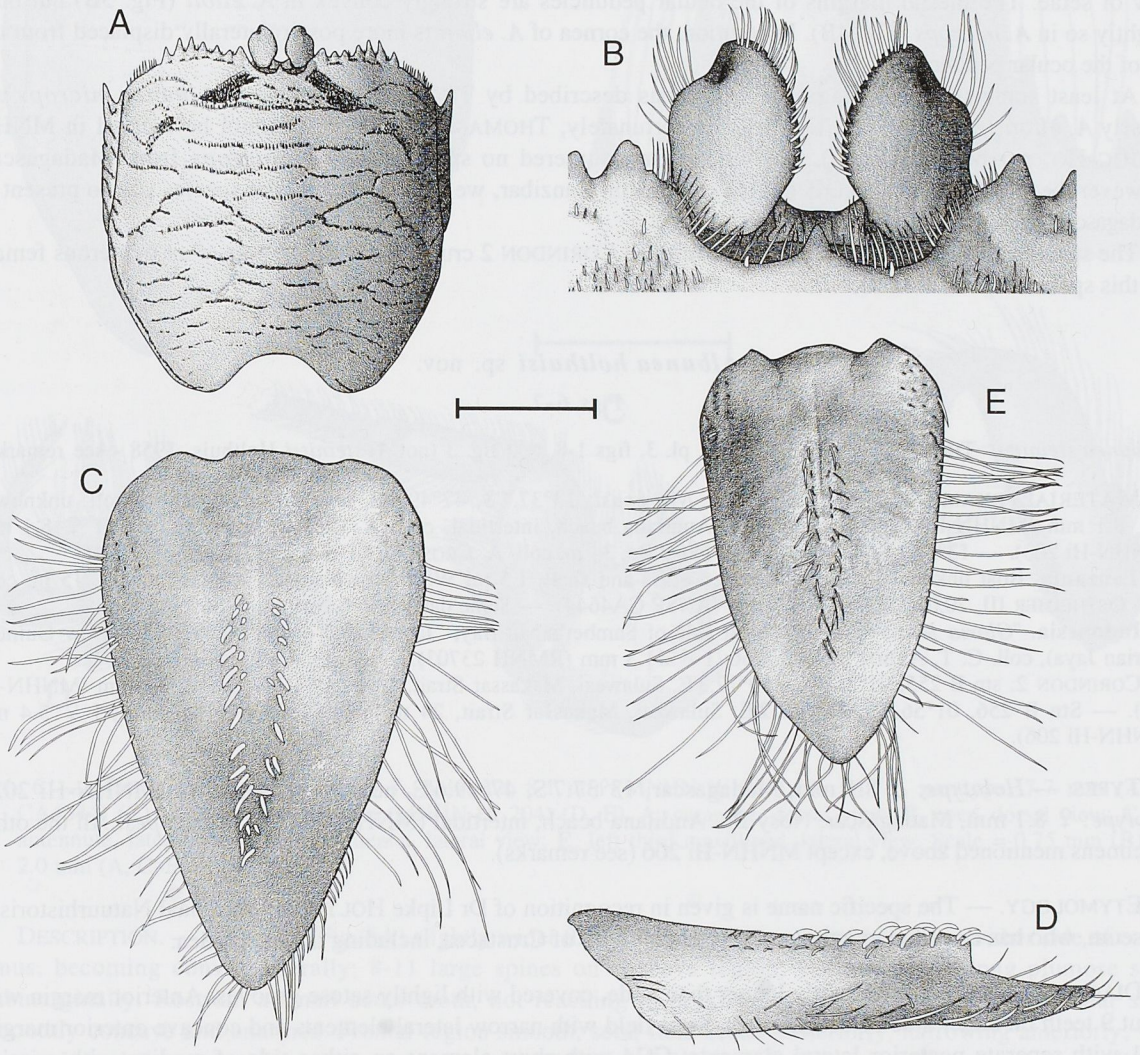


FIG. 5. — *Albunea elioti* Benedict, 1904, ♀, holotype, 16.2 mm (USNM 26169) (A, B, E); ♂, 16.5 mm (USNM 281472) (C, D). **A**, carapace, dorsal view; **B**, eyes, dorsal view; **C**, telson of male, dorsal view; **D**, telson of male, lateral view; **E**, telson of female, dorsal view. Scale = 0.75 mm (B), 2.0 mm (E), 3.0 mm (C, D), and 4.0 mm (A).

DISTRIBUTION. — Widely distributed in the Indo-West Pacific from the east coast of Africa to Indonesia and the Philippines and north to southern Japan; 3-45 m depth.

REMARKS. — *Albunea microps* has been confused with *A. elioti* Benedict, 1904, previously known only from the holotype female, from Samoa (USNM 26169, 16.2 mm ; Fig. 5A, B, E). GORDON (1938) first suggested that *A. elioti* was perhaps the same as *A. microps*, and other authors (SERÈNE & UMALI, 1965; THOMASSIN, 1969; MIYAKE, 1978) have treated her suggestion as definitive. From our examinations of the holotype of *A. elioti* and two additional male specimens we discovered from Tonga (USNM 281472, 16.5 mm ; Fig. 5C, D) and Madagascar (MNHN-Hi-88, 10.4 mm), we have determined that this species is distinct from *A. microps*. The shape of both the telson of the male and the eyes can be used to tell the two species apart. The telson of the male of *A. microps* (Fig. 4C) is heavily calcified and somewhat inflated proximally, but partially decalcified distally and narrowing to a produced tip. An oblique row of long setae is present just proximal to the demarcation line between the calcified and decalcified regions on each side of the median line. In *A. elioti*, the telson of the male is narrowly triangular (Fig. 5C), fully calcified, with short thick setae on a strong medial ridge (Fig. 5D), and lacks the oblique row of setae. The mesial margins of the ocular peduncles are strongly convex in *A. elioti* (Fig. 5B) but only slightly so in *A. microps* (Fig. 4B). In addition, the cornea of *A. elioti* is more posterolaterally displaced from the tip of the ocular peduncle.

At least some of the Madagascar specimens described by THOMASSIN (1969) as *Albunea microps* are clearly *A. elioti* (e.g., his pl. 2, figs 1-9). Unfortunately, THOMASSIN's material cannot be located in MNHN (NGOC-HO, personal commun.), and we have encountered no specimens of *A. microps* from Madagascar. However, because we have recorded *A. microps* from Zanzibar, we do suspect that the species is also present in Madagascar.

The specimen of *A. microps* collected during the CORINDON 2 cruise is the first report of an ovigerous female for this species.

Albunea holthuisi sp. nov.

Figs 6–7

?*Albunea steinitzi* - THOMASSIN, 1969: 143-146, pl. 3, figs 1-8, text fig. 3 (not *A. steinitzi* Holthuis, 1958 - see remarks).

MATERIAL EXAMINED. — **Madagascar**. *NW coast*: 13°37.7'S, 47°49.6'E, near Nosy Be, 25 m, coll. unknown: 1 ♂ 8.1 mm (MNHN-Hi 202). — Nosy Be, Andilana beach, intertidal, coll. A. CROSNIER, Sept. 1959: 1 ♀ 8.1 mm (MNHN-Hi 203). — 13°38.3'S, 42°49.6'E, near Nosy Be, 34 m, coll. A. CROSNIER : 1 ♂ 8 mm (MNHN-Hi 204).

Tanzania. Boat unknown: stn 651, dredged grass and shell, 1.5 mi WSW Ros Nungwa, north Zanzibar, 15 m, coll. A. J. OSTHEIMER III, 20.02.1957: 1 ♂ 7.7 mm (ANSP CA4644). — Same data: 1 ♀ 6.7 mm (ANSP CA4645).

Indonesia. *"Gloria Maris"*: stn 522, west side of Samberbaban Bay, "Japen" (= Yapen) Island, "West New Guinea" (= Irian Jaya), coll. C. T. ABBOT , 14.02.1956: 1 ♂ 11.3 mm (RMNH 23703).

CORINDON 2: stn B 255, 01°56.5'S, 119°17.3'E, Sulawesi, Makassar Strait, 13 m, 6.11.1980: 1 ♀ 7.1 mm (MNHN-Hi 205). — Stn B 256, 01°56.5'S, 119°17.2'E, Sulawesi, Makassar Strait, 24 m, 6.11.1980: 1 ♂ 4.9 mm ; 1 ♀ 5.4 mm (MNHN-Hi 206).

TYPES. — *Holotype*: ♂ 8.1 mm, Madagascar, 13°37.7'S, 47°49.6'E, near Nosy Be, 25 m (MNHN-Hi 202). *Allotype*: ♀ 8.1 mm, Madagascar, Nosy Be, Andilana beach, intertidal (MNHN-Hi 203). *Paratypes*: All the other specimens mentioned above, except MNHN-Hi 206 (see remarks).

ETYMOLOGY. — The specific name is given in recognition of Dr Lipke HOLTHUIS, Nationaal Natuurhistorisch Museum, who has contributed immeasurably to the study of Crustacea, including the Hippoidea.

DIAGNOSIS. — Carapace slightly longer than wide, covered with lightly setose grooves. Anterior margin with about 9 teeth on either side of ocular sinus. Setal field with narrow lateral elements and concave anterior margin. CG1 with separate posterior lateral elements; CG4 with short element on either side of median with missing elements at midline and between median and laterals; CG5 present only as short lateral elements; CG6 and CG7 separate; CG8 complete; CG11 present. Rostrum present, not reaching posterior margin of ocular plate. Ocular

plate triangular. Ocular peduncles dorsoventrally flattened and oblong in shape, tapering at tip, approximated along distal 2/3 of mesial margin; lateral margin convex except slightly concave at tip; mesial margin convex. Cornea at tip. Dactylus of pereopod II with heel slightly produced, low and rounded. Dactylus of pereopod III with heel slightly projecting, acute. Dactylus of pereopod IV sinuous from base to tip, with slight indent. Telson of male spatulate; tip broadly truncate; dorsal surface with elevated median longitudinal ridge bearing short thick setae proximally and long thick setae distally. Telson of female flattened and spatulate, longitudinal row of short, thin setae medially.

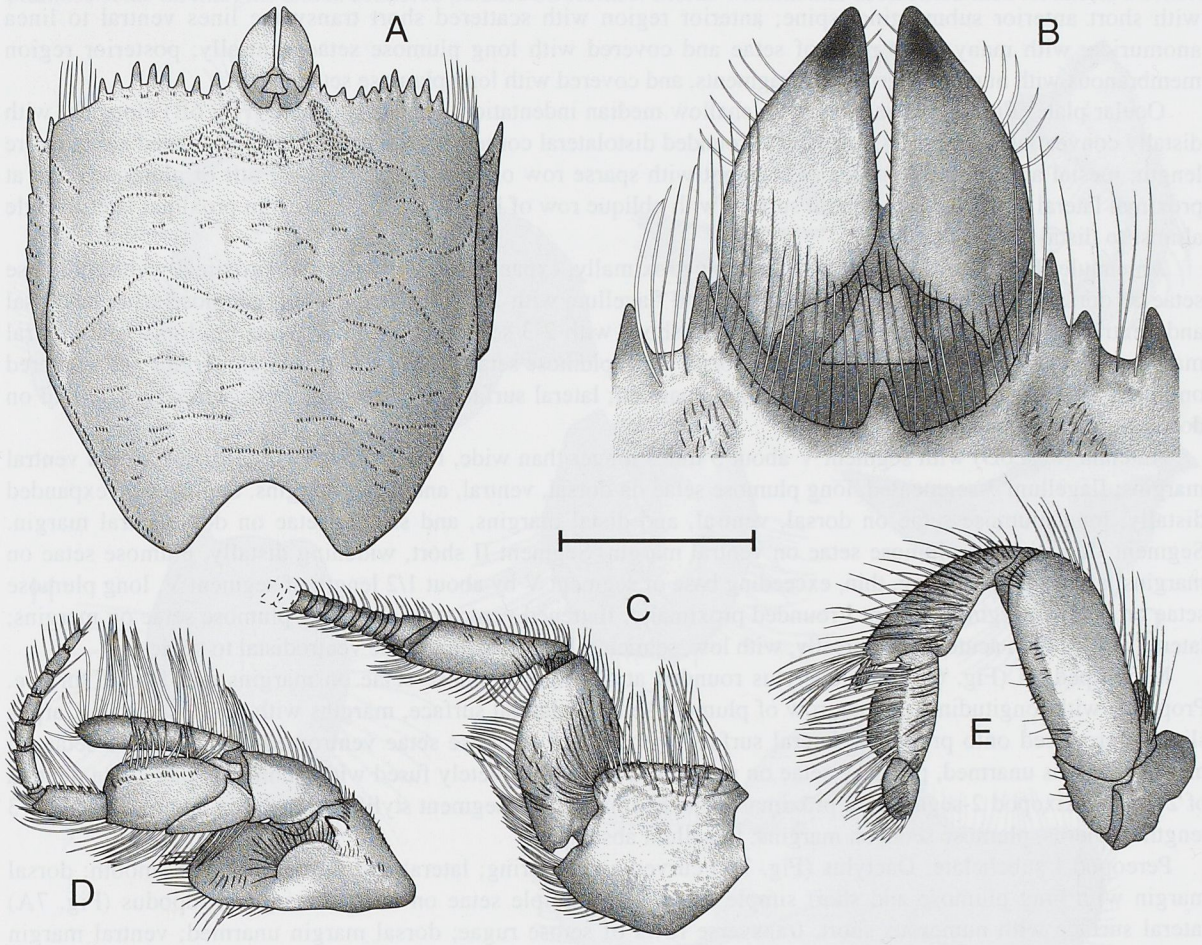


FIG. 6. — *Albunea holthuisi* sp. nov., ♂, holotype, 8.1 mm (MNHN-Hi 202) (A, B); ♂, paratype, 7.7 mm (ANSP CA4644) (C); ♂, paratype, 8.0 mm (MNHN-Hi 204) (D, E). **A**, carapace, dorsal view; **B**, eyes, dorsal view; **C**, left antennule, lateral view; **D**, left antenna, lateral view; **E**, left third maxilliped, lateral view. Scale = 0.75 mm (B) and 2.0 mm (A, C–E).

DESCRIPTION. — Carapace (Fig. 6A) slightly wider than long. Anterior margin concave on either side of ocular sinus, becoming convex laterally; 8-11 large spines on concave region; ventral row of long plumose setae submarginally. Rostrum a small acute tooth, not reaching to proximal margin of ocular plate. Ocular sinus smoothly concave and unarmed. Frontal region smooth; setal field broad posteriorly, narrowing anteriorly, with narrow lateral elements and concave anterior margin. CG1 parallel to anterior margin of carapace, sinuous, slightly crenulate, divided into medial fragment and curved lateral elements that are displaced posteriorly. Mesogastric region smooth; CG2 short; CG3 broken into 6 short elements approximately equally spaced between posterior

elements of CG1; CG4 fragmented into four elements with gap at midline and between median and lateral elements. Hepatic region smooth, with short setose groove at median of lateral margin. Epibranchial region roughly triangular, smooth; posterolateral margin with short row of setae. Metagastric region smooth; CG5 present only as short lateral elements directly posterior to median elements of CG4; CG6 slightly crenulate, strongly concave medially and sloping out to convex lateral thirds; CG7 transverse and separate from CG6. Cardiac region smooth; CG8 uninterrupted; CG9 present only as lateral short lines; CG10 present in two fragments, separated by length of single fragment; CG11 present. Branchial region with numerous short, transverse rows of setae. Posterior margin deeply and evenly convex, with submarginal groove interrupted medially. Branchiostegite with short anterior submarginal spine; anterior region with scattered short transverse lines ventral to linea anomurica, with many short rows of setae and covered with long plumose setae ventrally; posterior region membranous with numerous, irregular fragments, and covered with long plumose setae.

Ocular plate (Fig. 6B) triangular, with shallow median indentation. Ocular peduncle (Fig. 6B) elongate, with distally convex lateral margins, tapering to rounded distolateral cornea; mesial margins approximated along entire length; mesial and ventral margins of segment with sparse row of long plumose setae; tuft of plumose setae at proximal lateral ventral angle; ventral surface with oblique row of long plumose setae from proximal lateral angle almost to distal mesial margin.

Antennule (Fig. 6C) with segment III narrow proximally, expanding distally to twice proximal width; plumose setae on dorsal and ventral margins; dorsal exopod flagellum with 76-104 segments, long plumose setae on dorsal and ventral margins; ventral endopod flagellum short, with 2-3 segments, plumose setae on dorsal and ventral margins. Segment II medially inflated from dorsal view, plumose setae on dorsal and ventral margins and scattered on lateral surface. Segment I wider than long, unarmed; lateral surface with long plumose setae dorsally and on dorsal and ventral margins.

Antenna (Fig. 6D) with segment V about 3 times longer than wide, long plumose setae on dorsal and ventral margins; flagellum 7-segmented, long plumose setae on dorsal, ventral, and distal margins. Segment IV expanded distally, long plumose setae on dorsal, ventral, and distal margins, and simple setae on dorsolateral margin. Segment III with long plumose setae on ventral margin. Segment II short, widening distally, plumose setae on margins; antennal acicle long, thin, exceeding base of segment V by about 1/2 length of segment V, long plumose setae on dorsal margin. Segment I rounded proximally, flattened ventromesially, long plumose setae on margins; lateral surface with acute spine dorsally, with low, semicircular dorsolateral lobe ventrodistal to spine.

Maxilliped III (Fig. 6E) with dactylus rounded at tip, long plumose setae on margins and lateral surface. Propodus with longitudinal median row of plumose setae on lateral surface, margins with plumose setae. Carpus slightly produced onto propodus, lateral surface with row of plumose setae ventromedially; plumose setae on margins. Merus unarmed, plumose setae on margins. Basis incompletely fused with ischium; weak crista dentata of 2-3 teeth. Exopod 2-segmented, proximal segment small, distal segment styliform, tapering, approximately 1/3 length of merus, plumose setae on margins; flagellum absent.

Pereopod I subchelate. Dactylus (Fig. 7A) curved and tapering; lateral and mesial surfaces smooth; dorsal margin with long plumose and short simple setae, short simple setae on ventral margin. Propodus (Fig. 7A) lateral surface with numerous short, transverse rows of setose rugae; dorsal margin unarmed; ventral margin distally produced into acute spine; cutting edge lacking teeth, lined with long plumose setae; lateral, mesial and ventral margins with long setae. Carpus (Fig. 7A) with dorsodistal angle produced into small corneous spine; dorsal and distal margins with long plumose setae; lateral surface with distal rugose area, few transverse setose ridges on distal 2/3 of surface; mesial surface smooth with scattered rows of long plumose setae, margins with long plumose setae. Merus unarmed; lateral surface with scattered transverse rows of long plumose setae, margins with long plumose setae; mesial surface with few short rows of setae. Basi-ischium incompletely fused, unarmed. Coxa unarmed.

Pereopods II-IV with dactyli laterally compressed and dorsoventrally expanded.

Pereopod II dactylus (Fig. 7B) smooth; base to heel concave, heel with smoothly rounded low spur, heel to tip acutely indented and narrow, tip acute, tip to base broadly convex; lateral surface smooth, several small tufts of short setae in roughly straight line across medioproximal surface, several widely spaced submarginal tufts of short setae dorsodistally; mesial surface smooth, ventral margin with long plumose setae, dorsal margin with short

plumose setae, patch of long plumose setae at base (not illustrated). Propodus dorsal surface smooth, ventral margin inflated and rounded; oblique row of long plumose setae on distal margin of lateral surface; distal and ventral margins with long plumose setae; dorsolateral surface a narrow, oblique, flattened shelf, short setae on dorsal margin and long plumose setae on ventral margin; mesial surface with elevated, curved, setose ridge from ventral junction with dactylus almost to ventral proximal junction with carpus. Carpus slightly produced, gently rounded; lateral surface nearly smooth, with irregular, broken row of rugae and submarginal elevated ridge ventrally, rugae and ridge with long plumose setae, margins with long plumose setae; mesial surface smooth, long plumose setae on margins and in scattered patches on surface. Merus with medial decalcified area on lateral surface,

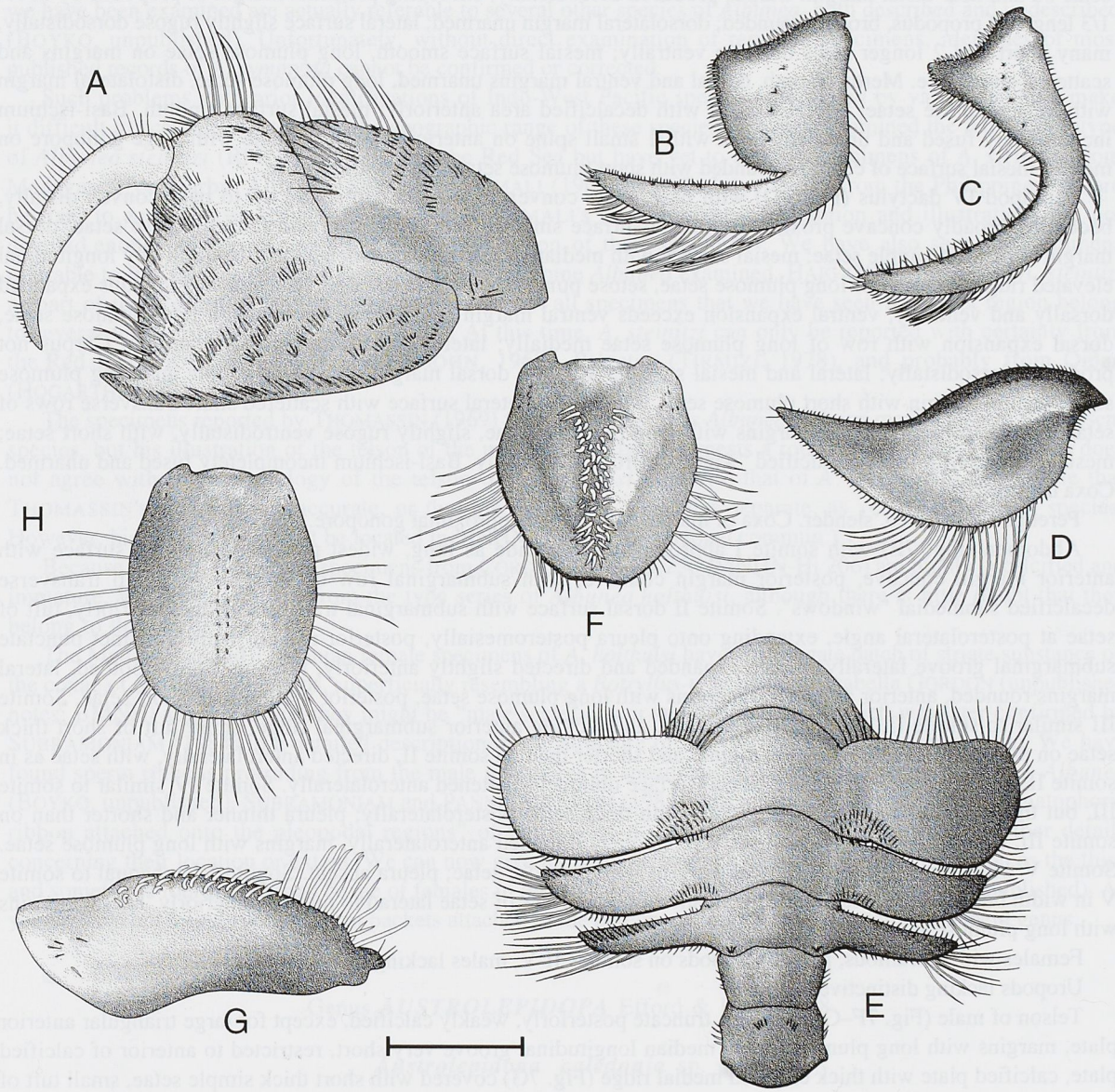


FIG. 7. — *Albunea holthuisi* sp. nov., ♂, holotype, 8.1 mm (MNHN-Hi 201) (A–G); ♀, allotype, 8.1 mm, MNHN-Hi 203 (H). **A**, left chela, lateral view; **B**, left pereopod II dactyl, lateral view; **C**, left pereopod III dactyl, lateral view; **D**, left pereopod IV dactyl, lateral view; **E**, abdomen, dorsal view; **F**, telson of male, dorsal view; **G**, telson of male, lateral view; **H**, telson of female, dorsal view. Scale = 1.0 mm (**H**), 1.5 mm (F, G), and 2.0 mm (A–E).

long plumose setae on lateral margins; mesial surface nearly smooth, with few setae. Basi-ischium incompletely fused and unarmed. Coxa with 1 small spine on anterior margin.

Pereopod III dactylus (Fig. 7C) with base to heel concave, heel produced in short, acute spur, heel to indent nearly straight, indent broadly concave, tip acute, tip to base smoothly convex to straight; lateral surface smooth, dorsodistal margin with tufts of short setae, ventromesial margin with long plumose setae, dorsal margin with short simple and plumose setae; mesial surface smooth, plumose setae proximally at junction with propodus. Propodus weakly inflated; lateral surface smooth, long plumose setae distally, simple setae on margins, long plumose setae on ventral margin, dorsolateral surface narrow, oblique, flattened; mesial surface with scattered long setae on and near distal margin. Carpus produced dorsodistally, exceeding proximal margin of propodus by about 1/3 length of propodus, broadly rounded; dorsolateral margin unarmed; lateral surface slightly rugose dorsodistally, many short and 2 longer rows of setae ventrally; mesial surface smooth, long plumose setae on margins and scattered on surface. Merus smooth, dorsal and ventral margins unarmed, long plumose setae, distolateral margin with long plumose setae; lateral surface with decalcified area anteriorly; mesial surface smooth. Basi-ischium incompletely fused and unarmed. Coxa with 1 small spine on anterior margin. Female with large gonopore on median mesial surface of coxa, surrounded with short plumose setae; male without pore.

Pereopod IV dactylus (Fig. 7D) with base to tip convex to straight, tip acute, tip to base convex distally, becoming broadly concave proximally; lateral surface smooth, ventral margin with long plumose setae, dorsal margin with short simple setae; mesial surface with median decalcified area, demarcated ventrally by longitudinal elevated ridge with row of long plumose setae, setose punctae ventral to decalcified window. Propodus expanded dorsally and ventrally, ventral expansion exceeds ventral margin of dactylus, margin with long plumose setae, dorsal expansion with row of long plumose setae medially; lateral and mesial surfaces smooth. Carpus not produced dorsodistally; lateral and mesial surfaces smooth, dorsal margin with short simple and long plumose setae, ventral margin with short plumose setae. Merus with lateral surface with scattered short transverse rows of setae, dorsal and ventrodistal margins with long plumose setae, slightly rugose ventrodistally, with short setae; mesial surface with large decalcified "window" proximoventrally. Basi-ischium incompletely fused and unarmed. Coxa unarmed.

Pereopod V reduced, slender. Coxa of male with large mesioproximal gonopore.

Abdomen (Fig. 7E) with somite I approximately as wide as long, widest posteriorly; dorsal surface with anterior margin concave, posterior margin concave, with submarginal row of short setae, small transverse decalcified submedial "windows". Somite II dorsal surface with submarginal transverse ridge anteriorly, tuft of setae at posterolateral angle, extending onto pleura posteromesially, posterior margin with indistinct punctate submarginal groove laterally; pleura expanded and directed slightly anteriorly, margins finely toothed, lateral margins rounded, anterior and lateral margins with long plumose setae, posterior margin with short setae. Somite III similar to somite II, but narrower, shorter, and lacking anterior submarginal ridge, small tuft of short thick setae on posterolateral angle; pleura thinner and shorter than on somite II, directed anterolaterally, with setae as in somite II, anterolateral angle acute, dorsal surface obliquely flattened anterolaterally. Somite IV similar to somite III, but thinner and shorter; dorsal surface with thick setae posterolaterally; pleura thinner and shorter than on somite III, directed laterally, dorsal surface obliquely flattened anterolaterally, margins with long plumose setae. Somite V wider than somite IV, lateral margins with plumose setae; pleura absent. Somite VI subequal to somite V in width but longer, dorsal surface with short oblique rows of setae laterad to midline anteriorly, lateral margins with long plumose setae; pleura absent.

Females with uniramous, paired pleopods on somites II-V, males lacking pleopods.

Uropods lacking distinctive features.

Telson of male (Fig. 7F–G) spatulate, truncate posteriorly, weakly calcified, except for large triangular anterior plate, margins with long plumose setae; median longitudinal groove very short, restricted to anterior of calcified plate, calcified plate with thick elevated medial ridge (Fig. 7G) covered with short thick simple setae, small tuft of setae at anterolateral margin. Telson of female (Fig. 7H) ovate, longer than wide, slightly truncate posteriorly, dorsal surface smooth, with median longitudinal groove anteriorly, row of setose punctae lateral to midline from median of longitudinal groove almost to posterior margin; margins with long plumose setae.

DISTRIBUTION. — Known from Madagascar, Tanzania, and Irian Jaya and Makassar, Indonesia; 0-34 m depth.

REMARKS. — *Albunea holthuisi* is most similar to *A. steinitzi* Holthuis, 1958. *Albunea holthuisi* differs from *A. steinitzi* in that CG8 is entire, and CG11 is present; additionally, the telson of the male has a pronounced ridge, and has shorter medial setae. *Albunea symmysta* (Linnaeus, 1758) *sensu stricto* differs from both of these species by having laterally inflated ocular peduncles, a strongly spurred heel on the dactylus of the third pereopod, and a distinctively flat and broadly triangular male telson with only a few short setae on either side of the midline.

No records in the literature can be ascribed definitively to *A. holthuisi*. However, given the excessively wide range of variability that has been incorrectly attributed to *A. symmysta*, it is possible that some published records assigned to *"A. symmysta"* may in fact be *A. holthuisi*. Many of the specimens published as "*A. symmysta*" that we have been examined are actually referable to several other species of *Albunea*, both described and undescribed (BOYKO, unpublished). Unfortunately, without direct examination of reported specimens, identities of most published records of *A. symmysta* cannot be confirmed or corrected.

Such problems with prior identifications of Indo-West Pacific species of *Albunea* by various authors make it difficult to accurately determine the geographic range of these species. We have examined the female holotype of *Albunea steinitzi* (RMNH 11847) from the Red Sea but have yet to see any specimens of *A. steintizi* from Madagascar or nearby. Although SERÈNE and UMALI (1965) identified *A. steinitzi* from the Philippines, we are hesitant to accept those records as SERÈNE and UMALI's (1965) written description and illustrations are not detailed enough to permit unambiguous identification of their specimens. We have also seen no specimens referable to this species among a large series of Philippine *Albunea* examined. HAIG (1974a) included *A. steintizi* as part of the Western Australia anomuran fauna, but all specimens that we have seen from that region belong to several undescribed species in this genus. At this time, *A. steinitzi* can only be reported with certainty from the Red Sea (HOLTHUIS, 1958; LEWINSOHN, 1969), Pakistan (TIRMIZI, 1978), and probably from Oman (HOGARTH, 1988).

The specimens reported by THOMASSIN (1969) from Madagascar as *Albunea steinitzi* may belong to the present species, but his illustration of the telson of the male in text fig. 4 suggests a rounded, produced tip, which does not agree with the morphology of the telson of *A. holthuisi*, nor with that of *A. steinitzi*. It is possible that THOMASSIN's figures are inaccurate, or that his specimens were of a separate, as yet unrecognized, species. However, his specimens cannot be located in MNHN (NGOC HO, personal commun.).

Because the two Indonesian specimens from CORINDON 2 stn B 256 (MNHN-Hi 206) are highly decalcified and immature, we excluded them from the type series of *Albunea holthuisi*, although there is little doubt that they belong to this taxon.

The Madagascar and Tanzanian female specimens of *A. holthuisi* have an elongate patch of striate substance on the coxae of the third pereopods, superficially resembling a *Botryllus*-type tunicate. Isabella GORDON (unpublished notes; BMNH) suggested that they might be "male secretions or spermatophores," which was later confirmed by SUBRAMONIAM (1984) in a detailed description of the structure of the spermatophore in *A. symmysta*. We have found sperm ribbons protruding from the male gonopores in specimens of several species in the genus *Albunea* (BOYKO, unpublished). SUBRAMONIAM and PANNEERSELVAM (1985) subsequently alluded to the "spermatophoric ribbon attached onto the pleopodal regions" of females of *A. symmysta*, but did not provide further details concerning their location or extent. We can now give the specific location of sperm ribbon deposition as the third and sometimes fourth pereopod coxae of females in this species and others in the genus (BOYKO, unpublished). As yet we have not found similar sperm packets attached to the pereopods of females in any other albuneid genus.

Genus ***AUSTROLEPIDOPA*** Efford & Haig, 1968

Austrolepidopa caledonia sp. nov.

Fig. 8-9

MATERIAL EXAMINED. — **New Caledonia**. SMIB 6: stn DW 107, 19°07.6'S, 163°30.2'E, Grand Passage, 205 m, 2.03.1990: 1 ♂ 9.2 mm (MNHN-Hi 207); 1 ♀ 11.5 mm (MNHN-Hi 208). — Stn DW 109, 19°05.7'S, 163°29.7'E, 225 m, 2.03.1990: 1 ♀ 8 mm (MNHN-Hi 209).

TYPES. — *Holotype*: ♂ 9.2 mm, New Caledonia, SMIB 6, stn DW 107, 19°07.6'S, 163°30.2'E, Grand Passage, 205 m (MNHN-Hi 207). *Allotype*: ♀ 11.5 mm, same data as the holotype (MNHN-Hi 208). *Paratype*: ♀ 8 mm, New Caledonia, SMIB 6, stn 109, 19°05.7'S, 163°29.7'E, 225 m (MNHN-Hi 209).

ETYMOLOGY. — The specific name is given after the type locality, New Caledonia, and is treated as a noun in apposition.

DIAGNOSIS. — Carapace longer than wide, covered with strongly setose grooves. Setal field with straight anterior margin and narrow lateral elements directed posteriorly. CG1 with contiguous posterior lateral elements; CG4 nearly entire, with median section slightly displaced anteriorly; CG5 absent; CG6 merged with CG4 laterally and with CG7 medially to form two separate hybrid grooves; CG8 complete; CG11 absent. Anterior margin of carapace with finely toothed lobe lateral to ocular sinus. Rostrum absent, rostral region truncate anteriorly, finely toothed. Ocular plate completely concealed dorsally by rostral region. Ocular peduncles dorsoventrally flattened and triangular in shape, separated by slightly more than length of ocular peduncle, lateral margin slightly convex, mesial margin slightly concave. Cornea not visible. Dactylus of pereopod II with heel slightly produced, low and rounded. Dactylus of pereopod III with heel slightly projecting, rounded. Dactylus of pereopod IV deeply concave from base to tip, with smoothly rounded indent. Telson of male and female similar; flattened and ovate, medially with tufts of short, thin setae in paired longitudinal rows.

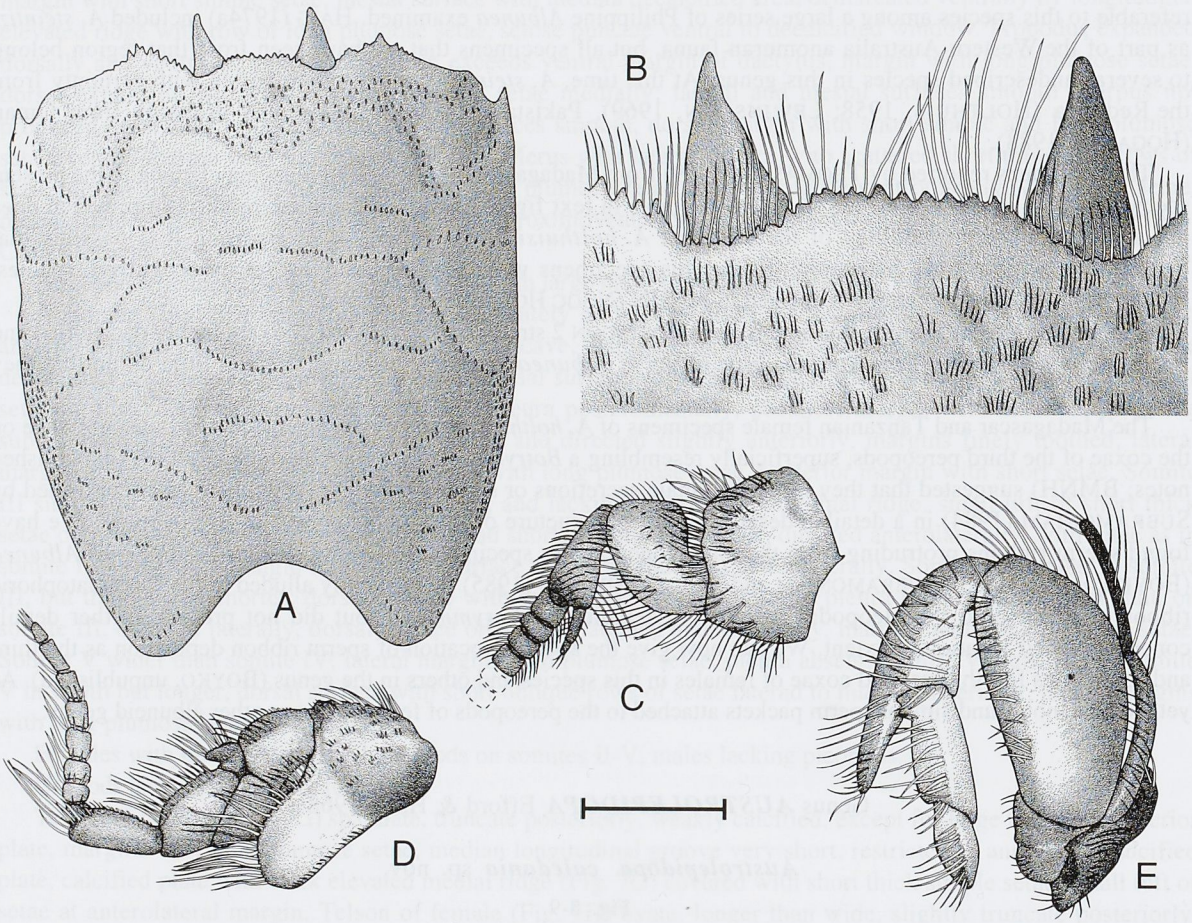


FIG. 8. — *Austrolepidopa caledonia*, sp. nov., ♀, allotype, 11.5 mm (MNHN-Hi 208) (A, B); ♀, paratype, 8.0 mm (MNHN-HI 209) (C–E). **A**, carapace, dorsal view; **B**, eyes, dorsal view; **C**, left antennule, lateral view; **D**, left antenna, lateral view; **E**, left third maxilliped, lateral view. Scale = 1.0 mm (B), 1.5 mm (C–E), and 4.0 mm (A).

DESCRIPTION. — Carapace (Fig. 8A) about as wide as long. Anterior margin dentate between ocular peduncles, submarginal ventral row of long plumose setae. Rostrum absent, rostral area truncate, overreaching base of ocular peduncles and exceeded by anterolateral lobes. Ocular sinus concave, dentate. Anterolateral lobe broadly triangular, dentate on margin, with mesial margin convex and lateral margin concave. Frontal region smooth, setal field with anterior and posterior margins subequal in length, narrow lateral elements directed posteriorly, straight anterior margin. CG1 sinuous, slightly crenulate, bearing short setae, connected to posterior lateral elements. Mesogastric region smooth, CG2 absent; CG3 present only as short lateral grooves; CG4 nearly entire, median element slightly displaced anteriorly. Hepatic region rugose anteriorly and anteromesially, otherwise smooth, with short rugose and setose lateral spine present on anterolateral margin. Epibranchial region roughly triangular, smooth, posterior lateral margin with short row of setae. Metagastric region smooth; CG5 absent; CG6 slightly crenulate, median concave element merging with CG7 to form hybrid groove, lateral fragments of CG6 connecting with CG4; CG7 transverse, merging with median third of CG6. Cardiac region smooth; CG8 uninterrupted; CG9 absent; CG10 present as oblique grooves almost meeting in median; CG11 absent. Branchial region with 8-9 short, transverse rows of setae. Posterior margin deeply and evenly convex, with short lateral submarginal groove. Branchiostegite unarmed, covered with long golden plumose setae, anterior region with many short rows of setae, posterior region well calcified dorsally, membranous ventrally, with numerous irregular fragments.

Ocular plate completely concealed by front of carapace (Fig. 8B). Ocular peduncle (Fig. 8B) triangular (almost ovate in smallest specimen), broadly separated, margins without setae, cornea not apparent but ocular pigment visible in mesiodistal area.

Antennule (Fig. 8C) with segment III narrow proximally, expanding distally to twice proximal width, produced distoventrally, simple setae on dorsal margin and few long plumose setae on distoventral margin; dorsal exopod flagellum with 67 segments (only 1 specimen with intact flagella), long plumose setae on dorsal and ventral margins; ventral endopod flagellum short, usually of 3 segments (proximal pair sometimes fused), plumose setae on dorsal and ventral margins. Segment II with plumose setae on dorsal and ventral margins, and scattered on lateral surface. Segment I wider than long, small tubercle on proximoventral margin, lateral surface with long plumose setae dorsally and ventrally, and on dorsal, ventral and distal margins.

Antenna (Fig. 8D) with segment V about twice longer than wide, long plumose setae on dorsomesial margin, and long simple setae on dorsolateral margin; flagellum with 7–8 segments, long simple setae on dorsal, ventral, lateral and distal margins. Segment IV with long plumose setae on dorsomesial margin, and long simple setae on dorsolateral margin. Segment III with long plumose setae on ventral margin, and scattered long simple setae on proximodorsal margin. Segment II short, widening distally, with long simple setae on dorsolateral margin; antennal acicle short, rounded, exceeding base of segment IV by about 1/4 length of segment IV, long plumose setae on dorsal margin and long simple setae on lateral margin. Segment I rounded dorsally, flattened ventrally, long plumose setae on margins, lateral surface rugose and with long setae dorsally, produced ventrally into oblong flattened plate.

Maxilliped III (Fig. 8E) with dactylus with rounded tip, long simple setae on margins and lateral surface. Propodus with longitudinal median row of simple setae, margins with simple setae. Carpus produced nearly to distal end of propodus; lateral surface and margins with plumose setae. Merus inflated, unarmed, with plumose setae on margins. Basis incompletely fused with ischium, without crista dentata. Exopod 2-segmented, proximal segment small, distal segment styliform, tapering, approximately 1/2 length of merus, plumose setae on margins; flagellum 1-segmented, almost reaching distal end of merus.

Pereopod I subchelate. Dactylus (Fig. 9A) curved and tapering; lateral and mesial surfaces smooth, dorsal margin with long plumose and short simple setae, ventral margin with short simple setae. Propodus (Fig. 9A) lateral surface with numerous short, transverse rows of setose rugae, dorsal margin unarmed, ventral margin distally produced into acute spine, cutting edge lacking teeth, lined with long plumose setae; lateral, mesial and ventral margins with long setae. Carpus unarmed, dorsal and distal margins with long plumose setae; lateral surface with few transverse rows of setae; mesial surface smooth, with scattered rows of long plumose setae, margins with long plumose setae. Merus unarmed; lateral surface with scattered transverse rows of long plumose setae, margins with long plumose setae; mesial side with few short rows of setae. Basi-ischium incompletely fused, unarmed. Coxa unarmed.

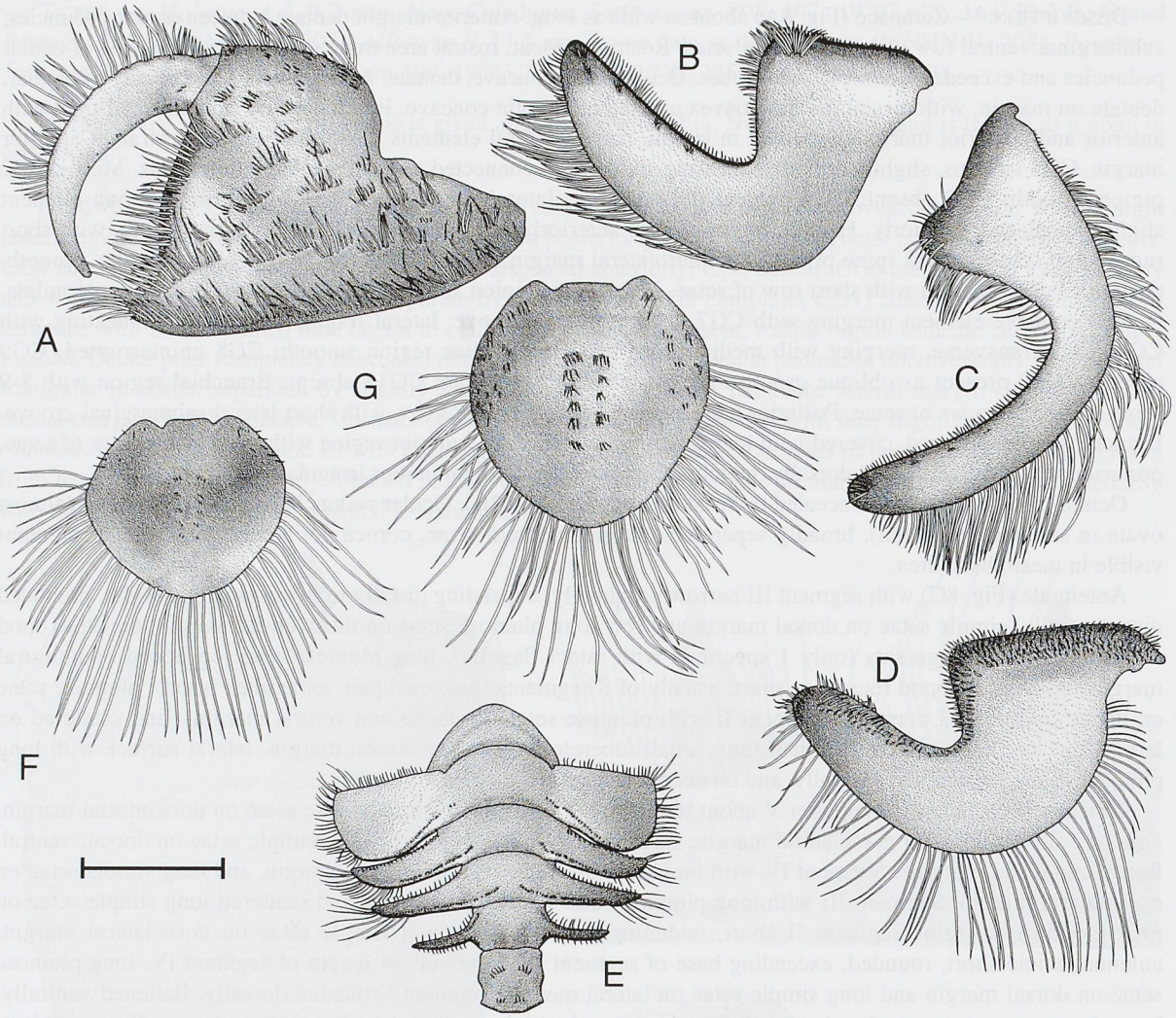


FIG. 9. — *Austrolepidopa caledonia* sp. nov., ♀, allotype, 11.5 mm (MNHN-Hi 208) (A–E, G); ♂, holotype, 9.2 mm (MNHN-Hi 207) (F). **A**, left chela, lateral view; **B**, left pereopod II dactyl, lateral view; **C**, left pereopod III dactyl, lateral view; **D**, left pereopod IV dactyl, lateral view; **E**, abdomen, dorsal view; **F**, telson of male, dorsal view; **G**, telson of female, dorsal view. Scale = 2.0 mm (A–D, F, G), and 4.0 mm (E).

Pereopods II-IV with dactyli laterally compressed and dorsoventrally expanded.

Pereopod II dactylus (Fig. 9B) smooth, base to heel slightly concave, heel with smoothly rounded low spur, heel to tip broadly indented and wide, tip rounded, tip to base broadly convex; lateral surface smooth, few setae along dorsal margin between heel and tip; mesial surface smooth, ventral margin with long plumose setae, dorsal margin with short plumose setae and a patch of long plumose setae between heel and base (not illustrated). Propodus dorsal surface smooth, ventral margin inflated and rounded, oblique open row of long plumose setae on lateral surface, distal and ventral margins with long plumose setae; dorsolateral surface a narrow, oblique, flattened shelf, short setae on dorsal margin and long plumose setae on ventral margin; mesial surface with curved row of simple setae from ventral junction with dactylus almost to ventral proximal junction with carpus. Carpus slightly inflated and produced, gently rounded; lateral surface nearly smooth, with irregular, broken row of rugae and submarginal elevated ridge ventrally, rugae and ridge with long plumose setae, margins with long plumose setae; mesial surface smooth, submarginal and marginal rows of long plumose setae dorsally. Merus lateral surface fully

calcified, long plumose setae on margins; mesial surface with row of long plumose setae below dorsal margin and row of setal patches 1/3 from ventral margin. Basi-ischium incompletely fused and unarmed. Coxa unarmed.

Pereopod III dactylus (Fig. 9C) with base to heel slightly concave, heel low and rounded, heel to tip broadly concave, tip rounded, tip to base smoothly convex; lateral surface smooth, dorsal margin with few tufts of setae; mesial surface smooth, with plumose setae proximally between heel and junction with propodus, ventral margin with long plumose setae, dorsal margin with short simple and plumose setae. Propodus not much inflated; lateral surface smooth, dorsolateral surface a narrow, oblique, flattened shelf, long plumose setae distally, simple setae on margins, long plumose setae on ventral margin; mesial surface with scattered long setae on and near distal margin. Carpus produced, nearly reaching distal margin of propodus, broadly rounded and inflated distally, dorsolateral margin unarmed; lateral surface covered with numerous rows of short, simple setae forming a setal mat, increasingly prominent distally; mesial surface smooth, long plumose setae on margins. Merus smooth, ovate, dorsal and ventral margins unarmed, with long plumose setae, laterodistal margin with long plumose setae; lateral surface fully calcified; mesial surface smooth. Basi-ischium incompletely fused and unarmed. Coxa unarmed. Female with large gonopore on ventral surface of coxa, lacking setae, male with similar but smaller pore.

Pereopod IV dactylus (Fig. 9D) with base to heel straight, heel to tip broadly concave, tip rounded, tip to base evenly convex, heel and blade of dactylus subequal in length; lateral surface smooth, ventral margin with long plumose setae, dorsal margin with short simple setae; mesial surface smooth, plumose setae proximally. Propodus expanded dorsally and ventrally; ventral expansion equals ventral dactylus margin, numerous short simple setae at margins; dorsal expansion with row of long plumose setae; lateral and mesial surfaces smooth. Carpus not produced dorsodistally; lateral and mesial surfaces smooth, dorsal margin with short simple and long plumose setae, ventral margin with short plumose setae. Merus with scattered short transverse rows of setae on lateral surface, dorsal and ventrodistal margins with long plumose setae, ventrodistal angle slightly expanded, ventral surface fully calcified, smooth. Basi-ischium incompletely fused and unarmed. Coxa unarmed.

Pereopod V reduced, slender. Coxa of male with large mesiodistal gonopore.

Abdomen (Fig. 9E) with somite I approximately as wide as long, widest posteriorly, dorsal surface with anterior margin straight, small submarginal decalcified spots anteriorly, posterior margin slightly concave, submarginal row of short setae on elevated ridge, open row of setae anterior to ridge. Somite II anterior margin straight, with tuft of setae at posterolateral angle; pleura expanded and directed slightly anteriorly, lateral margins angled anteriorly and rounded posteriorly, anterior and lateral margins with long plumose setae, posterior margin with row of short setae, becoming submarginal posteromesially. Somite III similar to somite II, but shorter; pleura thinner and shorter than those of somite II, directed anteriorly, with setae as in somite II, anterolateral angle acute, dorsal surface obliquely flattened anterolaterally. Somite IV similar to somite III, but thinner and shorter; with posterior row of setae interrupted in median of posterior margin; pleura thinner and shorter than on somite III, directed laterally and slightly anteriorly, dorsal surface obliquely flattened anterolaterally, margins with long plumose setae. Somite V narrower than somite IV; pleura about 2/3 as long as on somite IV, directed posteriorly and laterally, with setae as in somite IV, except with posterior row setae terminating at posterolateral angle of somite. Somite VI subequal to somite V in width but longer, dorsal surface with short oblique rows of setae laterad to midline posteriorly and medially, anterolateral margins with scattered plumose setae; pleura absent.

Females with uniramous, paired pleopods on somites II-V, males with small pleopod buds on somites II-V.

Uropods lacking distinctive features.

Telson of male (Fig. 9F) ovate, slightly wider than long, smoothly rounded posteriorly, dorsal surface with 6 short transverse rows of setae laterad to midline in median 1/3 of segment, rugose near anterolateral angle, with short setae, margins with long plumose setae. Telson of female (Fig. 9G) similar to that of male, with larger rugose areas anterolaterally.

DISTRIBUTION. — Known from only New Caledonia; 205-225 m depth.

REMARKS. — *Austrolepidopa caledonia* is most closely related to the west Australian *A. trigonops* Efford & Haig, 1968, of which we have examined the holotype (WAM 62-62) and one of the paratypes (WAM 72-62). Besides the considerable differences in geographic location and bathymetric distribution (*A. trigonops* ranges from 11 to 36 m), *A. trigonops* differs from *A. caledonia* in having larger anterolateral spines, deeper ocular sinuses and

less anteriorly projected setal field. The carapace grooves also differ between the two species; for example, in *A. trigonops*, the median section of CG4 in the metagastric region is broken into four short elements, and CG8 is interrupted medially and less produced laterally.

As mentioned earlier, there has been some confusion regarding sexual characteristics in this genus. For example, the holotype of *A. trigonops* is not a female, as identified by EFFORD and HAIG (1968), but rather a male. In this genus, males not only possess gonopores on the coxae of the fifth pereopods, but also have small but distinct pores on the coxae of the third pereopods, as well as small pleopod buds on abdominal somites 2-5. Females have gonopores on only the third pereopod coxae and long, well developed pleopods on abdominal somites 2-5.

The present record from 225 m is the greatest depth reported for any species in the Albuneidae, considerably exceeding the previous record, 151 m for a specimen of *Albunea symmysta* (Linnaeus, 1758) from the Philippines (USNM 68613; previously unpublished). *Austrolepidopa caledonia* appears to live in a habitat at least partially composed of pteropod ooze, as evidenced by the small *Limacina*-type pteropods (Mollusca) found adhered to the holotype (P. MIKKELSEN, personal commun.).

Family HIPPIDAE Latreille, 1825

Genus *HIPPA* Fabricius, 1787

REMARKS. — Systematic literature on the genus *Hippa* is extensive but confusing, and in many cases it is impossible to determine which species are referred to without direct examination of specimens. As it is beyond the scope of this study to resolve these problems, we give only select references in the lists of synonyms for species in this genus.

Hippa pacifica (Dana, 1852)

Fig. 10

Remipes pacificus Dana, 1852: 407-408; 1855: pl. 25, figs 7a-g. — DE MAN, 1896: 462, 476-478; 1898: 705, pl. 33, figs 53, 53a-c; 1902: 690.

Remipes testudinarius - MIERS, 1878: 316-318 (in part), probably pl. 5, fig. 1 (not *R. testudinarius* Latreille, 1806 = *Hippa adactyla* Fabricius, 1787).

Hippa pacificus - THOMASSIN, 1969: 157-160, pl. 7, text figs 7c, 8c, 10.

Hippa pacifica - EFFORD, 1972: 119-121. — HAIG, 1974b: 181-183, fig. 3 (and references therein). — BAUCHAU, 1985: 313-314, pl. 4, pl. 5b-c.

Hippa pacific [sic] - SUN & WANG, 1996: 28-29, fig. 2.

MATERIAL EXAMINED. — **New Caledonia**. Islets Sainte-Marie, southwest lagoon, intertidal, coll. BARGIBANT, 14.02.1988: 1 ov. ♀ 16.4 mm (MNHN-Hi 211). — Poé beach, intertidal, coll. DANIGO: 2 ♀ 10.7-12.5 mm ; 2 ov. ♀ 16.5-17.9 mm (MNHN-Hi 215). — Vata cove, intertidal, coll. Rudo VON COSEL, 3.11.1993: 1 ♂ 14.6 mm ; 2 ov. ♀ 18.5-20.1 mm (MNHN-HI 216).

MONTROUZIER EXPEDITION. *Touho Bay*: intertidal, 8.09.1993: 2 ov. ♀ 13.4-16.4 mm (MNHN-Hi 212). — Intertidal, 9.09.1993: 14 ♂ 5.5-11.8 mm ; 3 ♀ 12.9-16.5 mm ; 2 ov. ♀ 15.4-16.1 mm (MNHN-Hi 213). — Intertidal, 9.09.1993: 1 ♀ 12.0 mm ; 1 ov. ♀ 18.9 mm (MNHN-Hi 214).

Loyalty Islands. Niri Bay, intertidal, June 1986: 17 ♂ 5.0-11.6 mm ; 20 ♀ 6.1-18.7 mm ; 13 ov. ♀ 12.2-20.2 mm (MNHN-Hi 210).

Hawaii. Flag Poles, Kailua Beach, intertidal, coll. F. MAK, K. BUNNEY, Y. KIM, 27.05.1996: 6 ♂ 7.3-12.3 mm ; 6 ♀ 11.0-15.3 mm ; 1 ov. ♀ 13.7 mm (A. HARVEY personal coll.).

TYPES. — *Syntypes*: Hawaii and Fiji Islands. 1 specimen, Sandwich [= Hawaiian] Islands (MCZ 1406; not examined for this study). Whereabouts of syntypes from Fiji Islands unknown.

DIAGNOSIS. — Carapace (Fig. 10A) covered with wavy, transverse grooves. Frontal margin (Fig. 10B) with four rounded lobes, mesial pair slightly less projecting than lateral pair, separated by a shallow concavity, rarely

with a minute median denticle. Lateral margin of carapace (Fig. 10C) with submarginal row of 30–40 slightly elongate, setose pits. Antenna (Fig. 10D) normally with two-segmented flagellum. Dactylus of second and third pereopods with concave dorsal margin, indent obtuse. Telson (Fig. 10E) with lateral margins slightly convex, smoothly converging distally (modified from HAIG, 1974b).

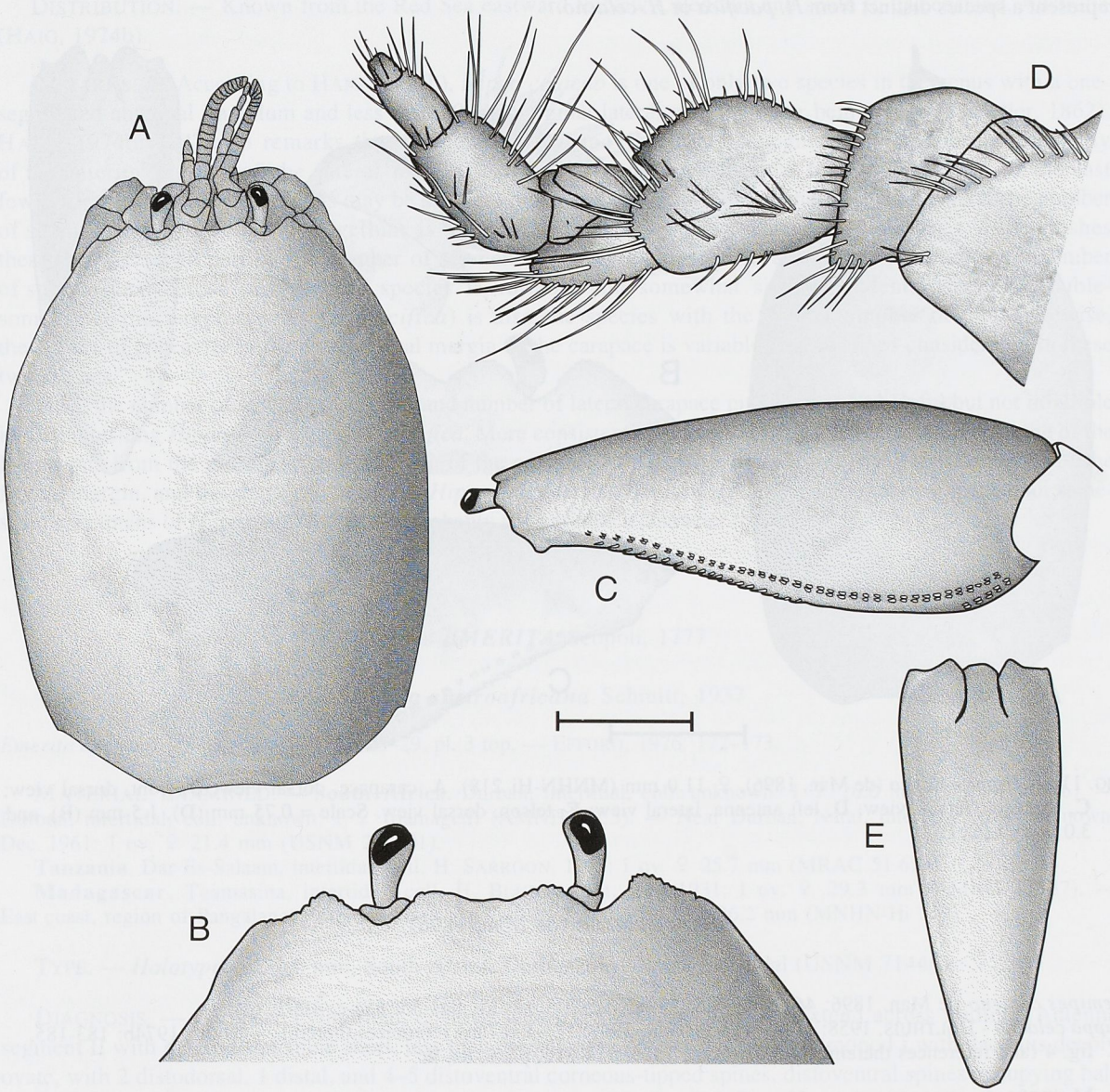


FIG. 10. — *Hippa pacifica* (Dana, 1852), ♀ 12.1 mm (MNHN-Hi 210). **A**, carapace, dorsal view; **B**, front, dorsal view; **C**, carapace, lateral view; **D**, left antenna, lateral view; **E**, telson, dorsal view. Scale = 0.75 mm (D), 1.5 mm (B), and 3.0 mm (A, C, E).

DISTRIBUTION. — One of the most widely ranging anomurans; known from Tanzania eastward to Australia, north to China and across to the Hawaiian Islands (HAIG, 1974b; SUN & WANG, 1996). It is also found in the east Pacific from the upper Gulf of California south to Panama as well as Socorro, Clipperton, Cocos, and the Galápagos Islands (EFFORD, 1972).

REMARKS. — One of the key diagnostic features of *Hippa pacifica* is the two-segmented antennal flagellum. Interestingly, in several of the New Caledonian specimens one of the antennal flagella has the normal two segments and the other has only one segment. In a more problematic specimen from Niri Bay (MNHN-Hi 210), both antennae are 3-segmented, and the frontal margin closely resembles that of *H. celaeno*, but in most other respects this specimen is characteristic of *H. pacifica*. Additional material may eventually show this specimen to represent a species distinct from *H. pacifica* or *H. celaeno*.

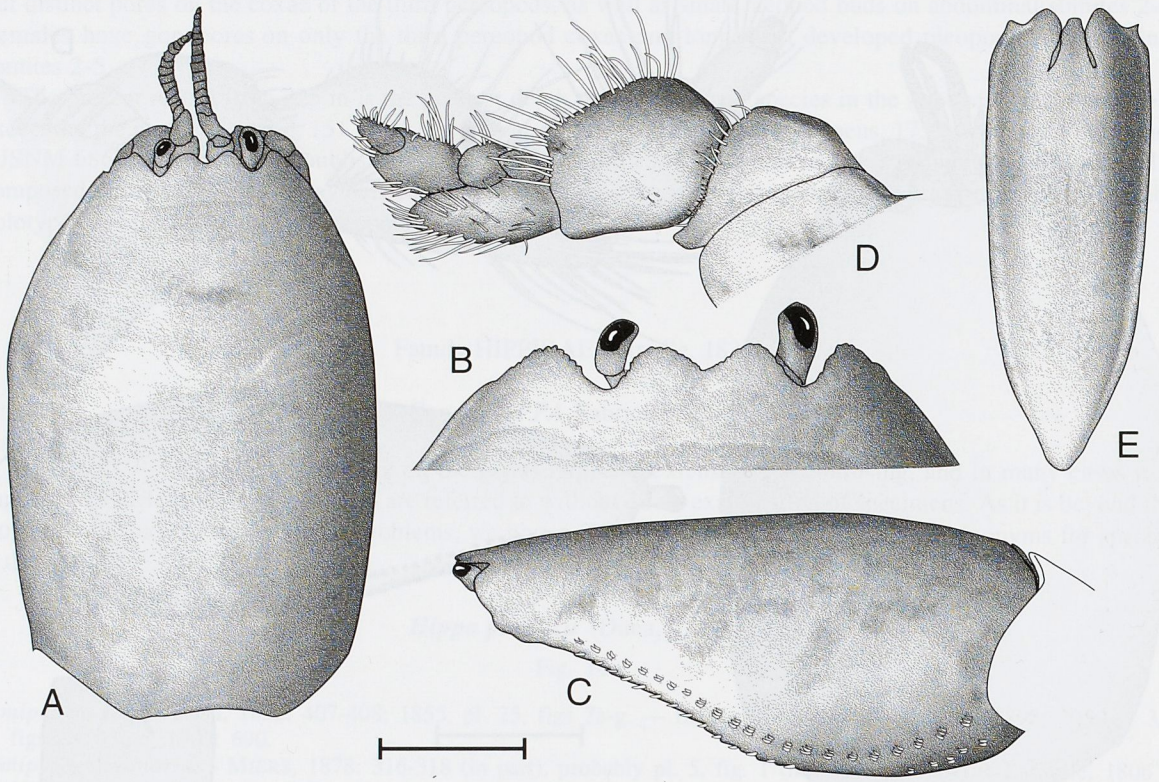


FIG. 11. — *Hippa celaeno* (de Man, 1896), ♀ 11.0 mm (MNHN-Hi 218). **A**, carapace, dorsal view; **B**, front, dorsal view; **C**, carapace, lateral view; **D**, left antenna, lateral view; **E**, telson, dorsal view. Scale = 0.75 mm (D), 1.5 mm (B), and 3.0 mm (A, C, E).

Hippa celaeno (de Man, 1896)

Fig. 11

Remipes celaeno de Man, 1896: 462, 483-488; 1898: 705-706, pl. 33, figs 55, 55a-e; 1902: 690.
Hippa celaeno - HOLTHUIS, 1958: 42. — LEWINSOHN, 1969: 173-174 (and references therein). — HAIG, 1974b: 183-185, fig. 4 (and references therein). — BAUCHAU, 1985: 314-315, pls 6, 8a, 9c.

MATERIAL EXAMINED. — **New Caledonia**. MONTROUZIER EXPEDITION. *Touho Bay*: intertidal, 8.09.1993: 1 ov. ♀ 9.9 mm. (MNHN-Hi 217). — Intertidal, 9.09.1993: 1 ♂ 5.9 mm ; 8 ov. ♀ 10.9-12.32 mm.(MNHN-Hi 218).

TYPES. — Indonesia: Makassar and Amboina. 3 syntypic lots are in the RMNH (D1641, D1751, D2618, see FRANSEN *et all.*, 1997) but they were not examined.

DIAGNOSIS. — Carapace (Fig. 11A) covered with wavy, transverse grooves. Frontal margin (Fig. 11B) with four dentate, rounded lobes, mesial pair as projecting as lateral pair, separated by a deep concavity. Lateral margin

of carapace (Fig. 11C) with submarginal row of 20–30 slightly elongate, setose pits, row sharply diverging from margin posteriorly. Antenna (Fig. 11D) with one-segmented flagellum. Dactylus of second and third pereopods with concave dorsal margin, obtuse indent. Telson (Fig. 11E) with lateral margins parallel proximally, slightly concave and with a noticeably constricted tip (modified from HAIG, 1974b).

DISTRIBUTION. — Known from the Red Sea eastward to New Caledonia and south to Queensland, Australia (HAIG, 1974b).

REMARKS. — According to HAIG (1974b), *Hippa celaeno* is one of only two species in the genus with a one-segmented antennal flagellum and less than 30 submarginal lateral pits, the other being *H. picta* (Heller, 1862). HAIG (1974b: 184) also remarks that "*Hippa celaeno* may be easily recognized by the abrupt concavity of the anterior portion of the lateral margin, and by the strong divergence from that margin of the last few setiferous pits". However, this may be an oversimplification. As mentioned under *Hippa pacifica*, the number of segments in the antennal flagellum is somewhat variable; indeed, HAIG's (1974b) key distinguishes these two species in part by the number of segments "normally" present. In addition, we find that the number of submarginal setose pits in both species is variable and somewhat size dependent, which is troublesome since the larger species (*H. pacifica*) is also the species with the greater number of pits. Likewise, the degree of concavity in the anterolateral margin of the carapace is variable, and overlaps considerably in these two species.

Thus, the number of antennal segments and number of lateral carapace pits seem to be helpful but not infallible in distinguishing *Hippa celaeno* and *H. pacifica*. More consistent characters include the degree of divergence of the lateral pits from the posterior lateral margin of the carapace, the relative depth of the median indentation of the frontal margin, and the shape of the telson. *Hippa celaeno* also has a relatively more slender carapace than same-sized specimens of *H. pacifica*, but this is probably too variable a character to be reliable.

Genus ***EMERITA*** Scopoli, 1777

Emerita austroafricana Schmitt, 1937

Emerita austroafricana Schmitt, 1937: 25–29, pl. 3 top. — EFFORD, 1976: 172–173.

MATERIAL EXAMINED. — **South Africa**. Durban, intertidal, coll. unknown: 1 ♀ 26.0 mm (USNM 71446). — Durban, intertidal, coll. unknown: 1 ♀ (damaged) (AMNH 1155). — Near Durban, Natal, intertidal, coll. unknown, Dec. 1961: 1 ov. ♀ 21.4 mm (USNM 267801).

Tanzania. Dar Es-Salaam, intertidal, coll. H. SARROON, 1965: 1 ov. ♀ 25.7 mm (MRAC 51.623).

Madagascar. Toamasina, intertidal, coll. H. BLUNTSCHLI, June 1931: 1 ov. ♀ 29.3 mm (AMNH 17537). — East coast, region of Pangalanes, intertidal, coll. A. KIENER, Sept. 1970: 1 ♀ 26.2 mm (MNHN-Hi 219).

TYPE. — *Holotype*: ♀ 26.0 mm, South Africa, Durban Bay, Natal, intertidal (USNM 71446).

DIAGNOSIS. — Carapace cylindrical, covered with transverse grooves that extend across midline. Antenna segment II with mediodistal spine short, less than twice length dorsodistal spine. Pereopod I with dactylus deeply ovate, with 2 distodorsal, 1 distal, and 4–5 distoventral corneous-tipped spines, distoventral spines occupying half to 2/3 ventral margin; carpus with pronounced anteromesial spine.

DISTRIBUTION. — Known from Madagascar and Mozambique south to Durban and Natal, South Africa (EFFORD, 1976). The above record from Dar-Es-Salaam represents an approximately 1000 km northward range extension.

REMARKS. — Scarcely more is known about this species since EFFORD (1976) summarized its distribution and commented that it is one of the least known members of the genus.

Annotated list of the tropical Indo-West Pacific species of the superfamily Hippoidea

(Taxa listed in bold-faced text are discussed in the main body of the paper).

ALBUNEIDAE

Albunea elioti Benedict, 1904 (see under *A. microps* in text).

Albunea holthuisi sp. nov.

Albunea madagascariensis Thomassin, 1973, known only from Madagascar.

Albunea microps Miers, 1878.

Albunea speciosa Dana, 1852, known with certainty only from Hawaii (SERÈNE, 1973). The identification of a specimen from the Maldives by BORRADAILE (1904) is questionable and needs reexamination.

Albunea steinitzi Holthuis, 1958 (see under *A. holthuisi* sp. nov. in text).

Albunea symmysta (Linnaeus, 1758), known from the west coast of Africa north into the Red Sea and east to the Philippines and Japan (THOMASSIN, 1969). However, many of these records are not *A. symmysta sensu stricto* (BOYKO, unpublished) and the true range of this species is not completely known.

Albunea thurstoni Henderson, 1893, known from India and the Red Sea (LEWINSOHN, 1969). THOMASSIN's (1969) specimens from Madagascar are referable to *A. madagascariensis* (see THOMASSIN, 1973).

Austrolepidopa caledonia sp. nov.

Austrolepidopa schmitti Efford & Haig, 1968, known from Queensland, Australia.

Austrolepidopa trigonops Efford & Haig, 1968, known from Western Australia (see under *A. caledonia* in text).

Leucolepidopa sunda Efford, 1969, known only from the holotype collected in the Sunda Strait between Sumatra and Java.

Paralbunea dayriti (Serène & Umali, 1965), known from the Philippines and China (SUN & WANG, 1996). HAIG (1974a) cited this species in a list of Western Australia anomurans, but we have seen no specimens from that region.

Paralbunea manihinei Serène, 1979, known only from the Seychelles.

Paralbunea mariellae (Serène, 1973), known from Indonesia. HAIG (1974a) cited this species in a list of Western Australia anomurans (as *Albunea* undescribed sp.), but we have seen no specimens from that region.

Paralbunea paradoxa (Gordon, 1938), known from Singapore and the Philippines (see SERÈNE & UMALI, 1965).

Stemonopa insignis Efford & Haig, 1968, known only from the holotype collected in Western Australia.

Zygopa nortoni Serène & Umali, 1965, known only from the Philippines.

HIPPIDAE

Emerita austroafricana Schmitt, 1937.

Emerita emeritus (Linnaeus, 1767), known from the west coast of India eastward to Vietnam and southward to Sumatra and Java, Indonesia (EFFORD, 1976).

Emerita holthuisi Sankolli, 1965, known from the southern Red Sea along the coast to the southern west coast of India (EFFORD, 1976).

Emerita karachiensis Niazi & Haque, 1974, known only from Karachi, Pakistan. A probable synonym of *E. holthuisi* (unpublished data).

Hippa adactyla Fabricius, 1787, known from the west coast of Madagascar to Australia, eastward to the Marquesas Islands, and northward to Japan (HAIG, 1974b).

Hippa admirabilis (Thallwitz, 1892), known from New Guinea and Indonesia (DE MAN, 1896).

Hippa alcimede (de Man, 1902), known only from Java, Indonesia. A possible synonym of *H. hirtipes*; the allometric features DE MAN used to distinguish the smaller *H. alcimede* from *H. hirtipes* are consistent with size-related allometric changes within other hippid species (unpublished data).

Hippa australis Hale, 1927, known from South and Western Australia (HAIG, 1974b).

Hippa celaeno (de Man, 1896).

Hippa granulatus (Borradaile, 1904) (not in key), known from the Maldives. This species is a possible synonym of *H. alcimede* (see HAIG *et al.*, 1986).

Hippa hirtipes (Dana, 1852), known from a few records in Indonesia and Papua New Guinea (BAUCHAU, 1985).

Hippa indica Haig, Murugan & Balakrishnan Nair, 1986, known only from the southwest coast of India.

Hippa marmoratus (Jacquinot, 1846) (not in key), known only from Raffles Bay, Australia (HAIG 1974b), is a possible synonym of *H. pacifica* (see HAIG *et al.*, 1986). For date see CLARK & CROSNIER (in press).

Hippa ovalis (A. Milne Edwards, 1862), known from the east coast of Africa eastward to Papua New Guinea (BAUCHAU, 1985).

Hippa pacifica (Dana, 1852).

Hippa picta (Heller, 1862), known from the Red Sea (HOLTHUIS, 1958).

Hippa truncatifrons (Miers, 1878), known from Japan and China (HAIG *et al.*, 1986).

Mastigochirus gracilis (Stimpson, 1858), known only from China (SUN & WANG, 1996).

Mastigochirus quadrilobatus Miers, 1878, known from India, the Philippines, Western Australia and Queensland, Australia (HAIG, 1974b).

Key to the tropical Indo-West Pacific species of the superfamily Hippoidea

1. Pereopod I dactylus subchelate ..... Albuneidae ... **2**
— Pereopod I dactylus simple ..... Hippidae ... **19**

2. Abdominal somite V with pleura **3**
— Abdominal somite V without pleura **6**

3. Antenna with 3 flagellar articles ..... *Leucolepidopa sunda* Efford, 1969
— Antenna with more than 3 flagellar articles ..... *Austrolepidopa* Efford & Haig, 1968 ... **4**

4. Ocular peduncles triangular in shape, rostral area margin dentate **5**
— Ocular peduncles ovate, rostral area margin smooth ..... *A. schmitti* Efford & Haig, 1968

5. Setal field projecting almost to base of ocular sinus, CG8 entire .....
..... ***A. caledonia*** sp. nov.
— Setal field projecting anteriorly on level with base of lateral carapace spine, CG8 broken
..... ***A. trigonops*** Efford & Haig, 1968 (see under *A. caledonia* sp. nov. in text)

6. Antennal segment I with spine ..... *Albunea* Weber, 1795 ... **7**
— Antennal segment I without spine **14**

7. Pereopod III dactylus heel acute **8**
— Pereopod III dactylus heel rounded **10**

8. CG 11 present ..... ***A. holthuisi*** sp. nov.
— CG 11 absent **9**

9. Telson of male spatulate, dorsoventrally compressed ..... *A. symmysta* (Linnaeus, 1758)
— Telson of male ovate with median setose ridge .....
.....***A. steinitzi*** Holthuis, 1958 (see under *A. holthuisi* sp. nov. in text)

10. Ocular peduncle mesial margin straight **11**
— Ocular peduncle mesial margin convex **13**

11. Ocular peduncle lateral margin convex ..... *A. thurstoni* Henderson, 1893
— Ocular peduncle lateral margin concave **12**

12. Rostrum not exceeding distal margin of ocular plate ..... *A. speciosa* Dana, 1852
— Rostrum exceeding distal margin of ocular plate .. *A. madagascariensis* Thomassin, 1973

13. Lateral indentation of cornea approximately 1/6 length of ocular peduncle ..... ***A. microps*** Miers, 1878
— Lateral indentation of cornea approximately 1/2 length of ocular peduncle ..... ***A. elioti*** Benedict, 1904 (see under *A. microps* in text)

14. Ocular peduncles fused ..... *Zygopa nortoni* Serène & Umali, 1965
— Ocular peduncles separate **15**

15. Ocular peduncles equal to or greater than carapace length ..... *Stemonopa insignis* Efford & Haig, 1968
— Ocular peduncles less than carapace length ..... *Paralbunea* Serène, 1979 ... **16**

16. Pereopod III dactylus heel acute **17**
— Pereopod III dactylus heel rounded **18**

17. Pereopod IV dactylus heel acute ..... *P. paradoxa* (Gordon, 1938)
— Pereopod IV dactylus heel rounded ..... *P. dayriti* (Serène & Umali, 1965)

18. Carapace nearly smooth ..... *P. manihinei* Serène, 1979
— Carapace coarsely granular ..... *P. mariellae* (Serène, 1973)

19. Antennal flagellum at least as long as carapace, densely covered ventrally with long plumose setae ..... *Emerita* Scopoli, 1777 ... **20**
— Antennal flagellum considerably shorter than carapace **22**

20. Pereopod I dactylus more than twice as long as wide, dorsal margin lacking spines ..... *E. holthuisi* Sankolli, 1965
— Pereopod I dactylus less than twice as long as wide, dorsal margin armed with spines. **21**

21. Pereopod I dactylus with spines along distal two-thirds or more of ventral margin ..... ***E. austroafricana*** Schmitt, 1937
— Pereopod I dactylus with spines along distal half of ventral margin ..... *E. emeritus* (Linnaeus, 1767)

22. Pereopod I dactylus nearly as long as carapace, multiarticulate ..... *Mastigochirus* Miers, 1878 ... **23**
— Pereopod I dactylus less than one-fourth length of carapace, nonarticulated ..... *Hippa* Fabricius, 1787... **24**

23. Frontal margin of carapace with 4 teeth; lateral margins of carapace unarmed ..... *M. quadrilobatus* Miers, 1878
— Frontal margin of carapace with 3 teeth; lateral margins of carapace with several spines ..... *M. gracilis* (Stimpson, 1858)

24. Frontal margin of carapace straight or slightly concave; lateral surface of carapace finely punctate; dactylus of pereopods II and III with anterior margin nearly straight ..... *H. indica* Haig, Murugan & Nair, 1986
— Frontal margin of carapace with 1–3 median lobes; lateral surface of carapace with submarginal row of pits or striations; dactylus of pereopods II and III with anterior margin concave **25**

25. Frontal margin of carapace with 2 or 3 median lobes, lateral frontal lobes well developed; lateral surface of carapace with submarginal row of setose pits **26**
— Frontal margin of carapace with 1 broad median lobe, lateral frontal lobes weakly developed; lateral margin of carapace with series of oblique striations or rows of pits **33**

26. Carapace lacking fine transverse grooves, finely punctate **27**
— Carapace covered with fine tranverse grooves **28**

27. Carapace with posterolateral margins oblique ..... *H. hirtipes* (Dana, 1852)
— Carapace with posterolateral margins nearly parallel ..... *H. alcimede* (de Man, 1902)

28. Lateral lobes of carapace front greatly exceed median lobes **29**
— All frontal lobes about equally projecting **30**

29. Dactylus of pereopods II and III with anterior margin cut into right angles; antennal flagellum with 3–6 articles ..... *H. adactyla* Fabricius, 1787
— Dactylus of pereopods II and III with anterior margin obtuse; antennal flagellum with 1–2 articles ..... *H. admirabilis* (Thallwitz, 1892)

30. Antennal flagellum with 1 article; lateral margin of carapace with less than 30 pits in submarginal row **31**
— Antennal flagellum with 2–3 articles; lateral margin of carapace with 30 or more pits in submarginal row **32**

31. Submarginal row of pits diverges from lateral margin of carapace posteriorly; frontal lobes broadly rounded, sinuses between lobes subequal in depth .....
..... ***H. celaeno*** (de Man, 1896)
— Submarginal row of pits does not diverge from lateral margin of carapace posteriorly; frontal lobes triangular, median sinus shallower than lateral sinuses .....
..... *H. picta* (Heller, 1862)

32. Lateral margin of carapace with 30–40 pits; antennal flagellum usually with 2 articles; median frontal lobes separated by shallow sinus, rarely with minute median denticle .....
..... ***H. pacifica*** (Dana, 1852)
— Lateral margin of carapace with 45–55 pits; antennal flagellum with 3 articles; median frontal lobes separated by pronounced, broadly rounded lobe .....
..... *H. ovalis* (A. Milne Edwards, 1862)

33. Dorsal antennular flagellum with 19–26 articles, gradually tapering from base to tip .....
..... *H. truncatifrons* (Miers, 1878)
— Dorsal antennular flagellum with 32–40 articles, tapering only near tip .....
..... *H. australis* Hale, 1927

ACKNOWLEDGMENTS

We would like to thank the following for loans of specimens: NGUYEN Ngoc-Ho, Muséum national d'Histoire naturelle, Paris; Gary ROSENBERG, Academy of Natural Science of Philadelphia; Charles H.J.M. FRANSEN, Nationaal Natuurhistorisch Museum, Leiden; Niel BRUCE, Zoological Museum, University of Copenhagen; Rudy JOCQUÉ, Musée royal de l'Afrique Centrale, Tervuren; Rafael LEMAITRE, National Museum of Natural History, Washington; Miranda LOWE , The Natural History Museum, London; Jane GRIFFITH, Western Australian Museum, Perth; and Ray J. SYMONDS, University Museum of Zoology, Cambridge.

The manuscript benefitted greatly from the thoughtful comments and suggestions of Darryl FELDER and Ray MANNING. Special thanks are extended to Alain CROSNIER and Bertrand RICHER DE FORGES, both from ORSTOM, for providing the MUSORSTOM materials.

REFERENCES

BAUCHAU, A. G., 1985. — Les espèces du genre *Hippa* recueillies sur les plages septentrionales de la Papouasie-Nouvelle Guinée (Crustacea, Decapoda, Anomura). *Indo-Malayan Zoology*, **2** (2): 309-318, 9 pls.

BENEDICT, J. E., 1904. — A new genus and two new species of crustaceans of the family Albuneidae from the Pacific Ocean; with remarks on the probable use of the antennule in *Albunea* and *Lepidopa*. *Proceedings of the United States National Museum*, **27**: 621-625.

BORRADAILE, L. A., 1904. — Marine crustaceans. XIII. The Hippidea, Thalassinidea and Scyllaridea. *In*: J. S. GARDINER (ed.), *The fauna and geography of the Maldive and Laccadive Archipelagoes*, **2**: 750-754, pl. 58.

BOUCHET, P., 1994. — Atelier Biodiversité récifale. Expédition Montrouzier. Touho-Koumac, Nouvelle Calédonie, 23 août-5 novembre 1993. *Rapports de Missions. Sciences de la Mer. Biologie marine. Centre ORSTOM de Nouméa*, (24), 63 pp.

CLARK, P.F. & CROSNIER, A., in press. — The Zoology of the Voyage au pole sud et dans l'Océanie sur les corvettes l'Astrolabe et la Zélée exécuté par ordre du roi pendant les années 1837-1838-1839-1840 sous le commandement de M. Dumont-D'Urville, 1842-1854: titles, volumes, plates, text, contents, proposed dates and anecdotal history of the publication. *Archives of Natural History*.

DANA, J. D., 1852. — Crustacea. U.S. Exploring Expedition during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N., **13** (1): 1–685. C. Sherman, Philadelphia.

DANA, J. D., 1855. — Crustacea. United States Exploring Expedition, during the years 1838, 1839, 1840, 1841, 1842, under the command of Charles Wilkes, U.S.N. Atlas. 27 pp., 96 pls. C. Sherman, Philadelphia.

EFFORD, I. E., 1969. — *Leucolepidopa sunda* gen. nov., sp. nov. (Decapoda: Albuneidae), a new Indo-West Pacific sand crab. *Breviora*, (318), 9 pp.

EFFORD, I.E., 1971. — The species of sand crabs in the genus *Lepidopa* (Decapoda: Albuneidae). *Zoologische Anzeiger, Leipzig*, **186** (1/2): 59-102.

EFFORD, I. E., 1972. — The distribution of the sand crabs, *Hippa strigillata* (Stimpson) and *Hippa pacifica* (Dana) in the eastern Pacific Ocean (Decapoda, Anomura). *Crustaceana*, **23** (2): 119-122.

EFFORD, I. E., 1976. — Distribution of the sand crabs in the genus *Emerita* (Decapoda, Hippidae). *Crustaceana*, **30** (2): 169-183.

EFFORD, I. E. & HAIG, J., 1968. — Two new genera and three new species of crabs (Decapoda: Anomura: Albuneidae) from Australia. *Australian Journal of Zoology*, **16** (6): 897-914.

FABRICIUS, J. C., 1787. — Mantissa insectorum sistens eorum species nuper detectas adjectis characteribus genericis differentiis specificis, emendationibus, observationibus. **1**: xx + 348 pp. Hafniae.

FRANSEN, C. H. J. M., HOLTHUIS, L. B. & ADEMA, J. P. H. M., 1997. — Type-catalog of the decapod Crustacea in the collections of the Nationaal Natuurhistorisch Museum, with appendices of pre-1900 collectors and material. *Zoologische Verhandelingen Leiden*, **311**: 1-344.

GORDON, I., 1938. — A comparison of the two genera *Albunea* and *Lepidopa* (Crustacea, Anomura), with description of a new species from Singapore. *Bulletin of the Raffles Museum*, **14**: 186-197.

HAIG, J., 1974a [1972]. — The anomuran crabs of Western Australia: their distribution in the Indian Ocean and adjacent seas. *Journal of the Marine Biological Association of India*, **14** (2): 443-451.

HAIG, J., 1974b. — A review of the Australian crabs of the family Hippidae (Crustacea, Decapoda, Anomura). *Memoirs of the Queensland Museum*, **71** (1): 175-189.

HAIG, J., MURUGAN, T. & BALAKRISHNAN NAIR, N., 1986. — *Hippa indica*, a new species of mole crab (Decapoda, Anomura, Hippidae) from the south west coast of India. *Crustaceana*, **51** (3): 286-292.

HALE, H. M., 1927. — The crustaceans of South Australia. Part 1: 1-201. Government printing, Adelaide.

HELLER, C., 1862. — Beiträge zur Crustaceen-Fauna des rothen Meeres. Zweiter Theil. *Sitzungsberichte der Akademie der Wissenschaften. Mathematisch-Naturwissenschaftliche Classe. Wien*, **44** (1): 241-295, pl. 1-3.

HENDERSON, J. R., 1888. — Report on the Anomura collected by H. M. S. Challenger during the years 1873-76. *Report on the Scientific Results of the Voyage of H. M. S. Challenger during the years 1873-76 under the command of Captain George S. Nares, R. N., F. R. S. and the late Captain Frank Tourlé Thomson, R. N.*, Zoology, **27** (1): 228 pp., 21 pls.

HOGARTH, P. J., 1988. — Anomuran Crustacea (Paguridea, Porcellanidae, and Hippidea) from Oman, principally from Dhofar province, southern Oman. *Journal of Natural History*, **22** (4): 1095-1110.

HOLTHUIS, L. B., 1958. — Crustacea Decapoda from the northern Red Sea (Gulf of Aqaba and Sinai Peninsula) II. Hippidea and Brachyura (Dromiacea, Oxystomata, and Grapsoidea). *Israel Sea Fisheries Research Station Bulletin*, **17** (9): 41-54.

JACQUINOT, H., 1846. — Crustacés: pl. 8. *In*: J. B. HOMBRON & H. JACQUINOT (eds). Voyage au pole sud et dand l'Océanie sur les corvettes l'Astrolabe et la Zélée pendant les années 1837-1838-1839-1840 sous le commandement de M. Dumont-d'Urville capitaine de vaisseau, publié par ordre du gouvernement et sous la direction supérieure de M. Jacquinot, capitaine de vaisseau, commandant de la Zélée. Zoologie. Atlas. Gide, Paris.

LEWINSOHN, C., 1969. — The Second Israel South Red Sea Expedition, 1965. Die anomuren des Roten Meeres (Crustacea Decapoda: Paguridea, Galatheidea, Hippidea). *Zoologische Verhandelingen, Leiden*, (104): 213 pp., 2 pls.

LINNAEUS, C., 1758. — Systema naturae per regna tria naturae, secundum classes, ordines, genera, species, cum charcteribus, differentis, synonymis, locis. 10th edition. Vol I: 824 pp. Holmiae: Laurentii Salvii.

LINNAEUS, C., 1767. — Systema naturae (12th edition). Vol. I, part II: 533-1327. Holmiae: Laurentii Salvii.

MAN, J. G. DE, 1896. — Bericht über die von Herrn Schiffscapitän Storm zu Atjeh, an den westlichen Küsten von Malakka, Borneo und Celebes sowie in der Java-See gesammelten Decapoden und Stomatopoden. Vierter Theil. *Zoologische Jahrbücher. Abteilung für Systematik und Geographie der Biologischen Thiere*, **9**: 459-514.

MAN, J. G. DE, 1898. — *Ibid.* Sechter (Schluss-) Theil. *Zoologische Jarhbücher. Abteilung für Systematik und Geographie der Biologischen Thiere*, **10**: 677-708, pls 28-38.

MAN, J. G. DE, 1902. — Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten Dekapoden und Stomatopoden. *Abhandlungen der Senckenbergischen Naturforschenden Gesellschaft*, **25** (3): 465-929, pls 19-27.

MARTIN, J. W. & ABELE, L. G., 1986. — Phylogenetic relationships of the genus *Aegla* (Decapoda: Anomura: Aeglidae), with comments on anomuran phylogeny. *Journal of Crustacean Biology*, **6** (3): 576-616.

MCLAUGHLIN, P. A., 1980. — Comparative morphology of Recent Crustacea. 177 pp. Freeman Press, San Francisco.

MCLAUGHLIN, P. A., 1983. — Hermit crabs - are they really polyphyletic? *Journal of Crustacean Biology*, **3** (4): 608–621.

MCLAUGHLIN, P. A., & LEMAITRE, R., 1997. — Carcinization in the Anomura - fact or fiction? I. Evidence from adult morphology. *Contributions to Zoology (Bijdragen tot de Dierkunde)*, **67** (2): 79–123.

MIERS, E. J., 1878. — Revision of the Hippidea. *Journal of the Linnean Society*, Zoology, **14** (76): 312-336, pl. 5.

MILNE EDWARDS, A., 1862. — Annexe F, Faune carcinologique de l'île de la Réunion. 16 pp., pls 17-19. *In*: L. MAILLARD, Notes sur l'ile de la Réunion. Palais-Royal, Paris.

MIYAKE, S., 1978. — The crustacean Anomura of Sagami Bay. 200 pp., 4 pls. Biology Laboratory, Imperial Household, Tokyo.

MOOSA, K., 1984. — Report on the CORINDON cruises. *Marine Research in Indonesia*, (24): 1-6.

NIAZI, M. S. & HAQUE, M. M., 1974. — On a new species of mole-crab (*Emerita karachiensis* sp. nov.) with a key to common Indo-Pacific species. *Records (Zoological Survey of Pakistan)*, **5**: 1–6.

ORTMANN, A. E., 1896. — Die geographische Verbreitung der Decapodengruppe der Hippidea. *Zoologische Jahrbücher. Abteilung für Systematik und Geographie der Biologischen Thiere*, **9** (2): 219-243.

POWAR, C. B., 1969. — Musculature of the eyestalk in Crustacea. *Acta Zoologica*, **50**: 127–141.

RICHER DE FORGES, B., 1993. — Campagnes d'exploration de la faune bathyale faite depuis mai 1989 dans la zone économique de la Nouvelle-Calédonie. Liste des stations. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 10. *Mémoires du Muséum national d'Histoire naturelle*, **156**: 27-32.

SANKOLLI, K. N., 1965. — On a new species of *Emerita* (Decapoda, Anomura) from India, with a note on *Emerita emeritus* (L.). *Crustaceana*, **8**: 48–54.

SCHMITT, W. L., 1937. — A new species of *Emerita* (Crustacea) from South Africa. *Annals of the South African Museum*, **32** (2): 25–29, pl. 3.

SCHMITT, W. L., 1942. — A new species of sand bug, *Blepharipoda doelloi*, from Argentina. *Smithsonian Miscellaneous Collections*, **101** (18): 10 pp., 1 pl.

SERÈNE, R., 1973. — A new species of Decapoda Hippidea: *Albunea mariellae* nov. sp. from the Banda Sea. *Crustaceana*, **24** (3): 261-264, 2 pls.

SERÈNE, R., 1979. — Description of *Paralbunea manihinei* gen. and spec. nov. (Decapoda, Hippidea, Albuneidae). *Crustaceana*, suppl. 5: 95-99, 1 pl.

SERÈNE, R. & UMALI, A. F., 1965. — A review of Philippine Albuneidae, with descriptions of two new species. *Philippine Journal of Science*, **94** (1): 87-116, 6 pls.

STIMPSON, W., 1858. — Prodromus descriptionis animalium evertebratum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgold et Johanne Rodgers ducibus, observavit et descripsit. Pars VII. Crustacea Anomura. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **10**: 225-252.

SUBRAMONIAM, T., 1984. — Spermatophore formation in two intertidal crabs *Albunea symnista* and *Emerita asiatica* (Decapoda: Anomura). *Biological Bulletin (Woods Hole)*, **166** (1): 78-95.

SUBRAMONIAM, T. & PANNEERSELVAM, M., 1985. — Semi-annual breeding pattern in the burrowing sand crab *Albunea symmista* (L.) (= *symnista*) of Madras coast. *Indian Journal of Marine Science*, **14** (4): 226- 227.

SUN, X. & WANG, J., 1996. — Notes on the Hippoidea in the Beijing Natural History Museum. *Memoirs of Beijing Natural History Museum*, **55**: 25-37.

TAM, Y. K., KORNFIELD, I. & OJEDA, F. P., 1996. — Divergence and zoogeography of mole crabs, *Emerita* spp. (Decapoda: Hippidae), in the Americas. *Marine Biology*, **125**: 489-497.

THALLWITZ, J., 1892. — Decapoden-Studien, insbesondere basiert auf A. B. Meyer's Sammlungen im Ost-indischen Archipel, nebst einer Aufzählung der Decapoden und Stomatopoden des Dresdener Museums. *Abhandlungen und Berichte des Museums zu Dresden*, 1890/91 (3): 1-55, 1 pl.

THOMASSIN, B., 1969. — Identification, variabilité et écologie des Hippidea (Crustacea, Anomura) de la région de Tuléar, S.W. de Madagascar. *Recueil des Travaux de la Station Marine d'Endoume*, supplément 9: 135-177.

THOMASSIN, B. A., 1973. — *Albunea madagascariensis* n. sp., nouvelle espèce d'Hippidea (Decapoda, Anomura) des sables coralliens de la région de Tuléar (S.W. de Madagascar). *Crustaceana*, **24** (3): 265-274, 1 pl.

TIRMIZI, N. M., 1978. — On the presence of *Albunea steinitzi* Holthuis in the northern Arabian Sea (Decapoda, Hippidea). *Crustaceana*, **35** (1): 94-95.

WEBER, F., 1795. — Nomenclator entomologicus secundum entomologiam systematicam ill. Fabricii, adjectis speciebus recens detectis et varietatibus, viii + 171 pp. Chilonii [Kiel] et Hamburgi.

WHITE, A., 1847. — List of the specimens of Crustacea in the collection of the British Museum, 143 pp. London.

8

Crustacea Decapoda: Species of the genera *Agononida* Baba & de Saint Laurent, 1996 and *Munida* Leach, 1820 (Galatheidae) collected during the MUSORSTOM 8 cruise in Vanuatu

Enrique MACPHERSON

Centro de Estudios Avanzados de Blanes (CSIC)
Camí de Santa Bárbara s/n
17300 Blanes (Girona), Spain

ABSTRACT

Galatheid crustaceans of the genera *Agononida* Baba & de Saint Laurent, 1996 and *Munida* Leach, 1820 collected in Vanuatu, during the MUSORSTOM 8 cruise (September-October, 1994) have been studied. The collection contains 8 species of the genus *Agononida* and 25 belonging to the genus *Munida*. Two species are described as new: *A. alisae* and *M. congesta*. *A. alisae*, close to *A. callirhoe* (Macpherson, 1994), can be distinguished easily by the spines of the carapace and the antennal peduncle. *M. congesta* is close to *M. miliaris* Henderson, 1855, but is distinguished by the shape and the spines of the chelipeds.

RÉSUMÉ

Crustacea Decapoda : Espèces des genres *Agononida* Baba & de Saint Laurent, 1996 et *Munida* Leach, 1820 (Galatheidae) récoltées durant la campagne MUSORSTOM 8 au Vanuatu.

Les espèces des genres *Agononida* Baba & de Saint Laurent, 1996, et *Munida* Leach, 1820, récoltées à Vanuatu (Campagne MUSORSTOM 8, septembre-octobre, 1994) sont au nombre de 8 et 25, respectivement. Deux espèces (*A. alisae* et *M. congesta*) sont nouvelles. *A. alisae*, proche de *A. callirrhoe* (Macpherson, 1994) se différencie facilement par l'armature de la carapace et du pédoncule antennaire. *M. congesta* est proche de *M. militaris* Henderson, 1885, mais se différencie par la forme et l'armature des chélipèdes.

MACPHERSON, E., 1999. — Crustacea Decapoda: Species of the genera *Agononida* Baba & de Saint Laurent, 1996 and *Munida* Leach, 1820 (Galatheidae) collected during the MUSORSTOM 8 cruise in Vanuatu. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*, **180**: 407-426. Paris ISBN 2-85653-520-8.

INTRODUCTION

During September-October of 1994 the cruise MUSORSTOM 8 was carried out in the Vanuatu waters (RICHER DE FORGES *et al.*, 1995) and numerous representatives of the genera *Agononida* Baba & de Saint Laurent, 1996 and *Munida* Leach, 1820 were collected. The study of these specimens revealed the presence of 8 species of the genus *Agononida* and 25 species belonging to the genus *Munida*. One species of each genus has been considered here as new.

The colour patterns of some species (*Agononida fortiantennata, A. squamosa, Munida masi, M. rhodonia, M. rubrodigitalis* and *M. congesta*) have been included in their remarks and descriptions. These patterns have been described from colour slides of material obtained during the cruise by J.L. MENOU. As it has been pointed out in other works (e.g. RICE & DE SAINT LAURENT, 1985; MACPHERSON & DE SAINT LAURENT, 1991; MACPHERSON, 1994) the colouration can be a great help in species identification, although some species can show some colour variability. The colour variations observed in some species (e.g. *M. rhodonia, M. rubrodigitalis*, see below) recommend to use colour pattern with caution, especially when the ground colours are the same. However, the existence of two colour forms in *Agononida squamosa* (one form uniformly red and a second form with yellow and purple spots, see below), without any additional and clear morphological difference, emphasizes the necesity of complementary studies, e.g. genetics, mating behaviour, to clarify the validity and importance of the colour pattern as a taxonomic character in this group (BRUCE, 1975; KNOWLTON, 1986).

The types of the new species and other material have been deposited in the collections of the Muséum national d'Histoire naturelle, Paris. Measurements given are of carapace length (CL), excluding rostrum, and the terminology used mainly follows previous papers (ZARIQUIEY-ALVAREZ, 1952; MACPHERSON & DE SAINT LAURENT, 1991; MACPHERSON, 1994; BABA & DE SAINT LAURENT, 1996).

LIST OF STATIONS

The abbreviations of the gears used are: DW = Waren dredge, CP = Beam trawl, CC = Otter trawl, CAS = trap.

Station DW 958. — 20.09.1994, 20°20'S, 169°47'E, 497-570 m: *A. laurentae.*
Station DW 959. — 20.09.1994, 20°20'S, 169°48'E, 436-475 m: *A. squamosa.*
Station CP 961. — 21.09.1994, 20°18'S, 169°49'E, 100-110 m: *M. clinata, M. gordoae.*
Station CP 962. — 21.09.1994, 20°19'S, 169°49'E, 370-400 m: *M. rogeri, M. tyche.*
Station CP 963. — 21.09.1994, 20°20'S, 169°49'E, 400-440 m: *A. alisae, A. squamosa, M. runcinata.*
Station DW 965. — 21.09.1994, 20°20'S, 169°51'E, 361-377 m: *M. notata.*
Station DW 966. — 21.09.1994, 20°19'S, 169°52'E, 128-150 m: *M. clinata, M. elegantissima.*
Station CP 971. — 21.09.1994, 20°19'S, 169°53'E, 250-315 m: *M. sao, M. semoni.*
Station DW 972. — 22.09.1994, 19°22'S, 169°28'E, 487-507 m: *A. ocyrhoe.*
Station CP 973. — 22.09.1994, 19°21'S, 169°27'E, 460-480 m: *A. squamosa.*
Station CP 974. — 22.09.1994, 19°21'S, 169°28'E, 492-520 m: *A. incerta, A. ocyrhoe, A. squamosa, M. rubrodigitalis, M. tuberculata.*
Station CP 975. — 22.09.1994, 19°23'S, 169°29'E, 536-566 m: *A. incerta, M. congesta, M. rhodonia.*
Station DW 978. — 22.09.1994, 19°23'S, 169°27'E, 408-413 m: *M. leptitis, M. runcinata.*
Station CP 980. — 22.09.1994, 19°21'S, 169°25'E, 433-450 m: *A. laurentae, A. squamosa, M. idyia.*
Station CP 982. — 23.09.1994, 19°22'S, 169°26'E, 408-410 m: *A. laurentae, A. squamosa, M. leagora.*
Station CP 983. — 23.09.1994, 19°22'S, 169°28'E, 475-480 m: *A. laurentae, M. leptitis, M. rubrodigitalis.*
Station CP 984. — 23.09.1994, 19°20'S, 169°26'E, 480-544 m: *A. incerta, A. ocyrhoe, A. squamosa, M. rubrodigitalis.*
Station CP 985. — 23.09.1994, 19°22'S, 169°26'E, 536-563 m: *M. rubrodigitalis, M. tuberculata.*
Station DW 986. — 23.09.1994, 19°21'S, 169°31'E, 602-648 m: *M. rhodonia.*

Station DW 988. — 23.09.1994, 19°16'S, 169°24'E, 372-466 m: *M. rufiantennulata, M. runcinata.*
Station DW 989. — 23.09.1994, 19°14'S, 169°20'E, 650-669 m: *A. incerta.*
Station CP 990. — 24.09.1994, 18°52'S, 168°51'E, 980-990 m: *A. eminens, M. microps.*
Station CP 991. — 24.09.1994, 18°51'S, 168°52'E, 910-936 m: *A. eminens, M. microps.*
Station CP 992. — 24.09.1994, 18°52'S, 168°55'E, 748-775 m: *M. microps, M. rosula.*
Station CP 993. — 24.09.1994, 18°48'S, 168°54'E, 780-783 m: *A. eminens, M. microps, M. rosula.*
Station CP 994. — 25.09.1994, 18°47'S, 168°56'E, 641-649 m: *A. incerta.*
Station CC 996. — 25.09.1994, 18°52'S, 168°56'E, 764-786 m: *A. eminens, M. rosula.*
Station CP 1001. — 26.09.1994, 18°49'S, 168°59'E, 764-786 m: *M. masi.*
Station CP 1007. — 26.09.1994, 18°52'S, 168°56'E, 720-830 m: *A. eminens, M. microps, M. rosula.*
Station CP 1008. — 26.09.1994, 18°53'S, 168°53'E, 919-1000 m: *A. eminens, M. microps.*
Station DW 1014. — 27.09.1994, 17°54'S, 168°19'E, 495-498 m: *M. microps.*
Station CP 1017. — 27.09.1994, 17°53'S, 168°26'E, 294-295 m: *M. notata.*
Station CP 1018. — 27.09.1994, 17°53'S, 168°25'E, 300-301 m: *M. notata.*
Station DW 1021. — 28.09.1994, 17°43'S, 168°37'E, 124-130 m: *M. clinata.*
Station CP 1024. — 28.09.1994, 17°48'S, 168°39'E, 335-370 m: *M. notata.*
Station CP 1025. — 28.09.1994, 17°49'S, 168°39'E, 385-410 m: *A. alisae, A. squamosa, M. runcinata.*
Station CP 1026. — 28.09.1994, 17°50'S, 168°39'E, 437-504 m: *A. squamosa, M. sao.*
Station CP 1027. — 28.09.1994, 17°53'S, 168°39'E, 550-571 m: *A. incerta, A. normani, M. rhodonia, M. tuberculata.*
Station CP 1028. — 28.09.1994, 17°54'S, 168°40'E, 624-668 m: *A. incerta, A. normani, M. congesta, M. leviantennata, M. rhodonia.*
Station DW 1029. — 28.09.1994, 17°53'S, 168°34'E, 324-360 m: *A. squamosa.*
Station CC 1033. — 29.09.1994, 17°54'S, 168°40'E, 650-691 m: *A. incerta.*
Station CC 1034. — 29.09.1994, 17°54'S, 168°42'E, 690-750 m: *A. eminens, M. militaris.*
Station CP 1035. — 29.09.1994, 17°56'S, 168°44'E, 765-780 m: *A. eminens, M. rosula, M. runcinata.*
Station CP 1036. — 29.09.1994, 18°01'S, 168°48'E, 920-950 m: *A. eminens, M. microps.*
Station CP 1037. — 29.09.1994, 18°03'S, 168°54'E, 1058-1086 m: *M. microps.*
Station DW 1042. — 30.09.1994, 16°52'S, 168°52'E, 200-260 m: *M. tyche.*
Station DW 1043. — 30.09.1994, 16°52'S, 168°25'E, 350-372 m: *M. runcinata.*
Station DW 1045. — 30.09.1994, 16°54'S, 168°20'E, 459-488 m: *A. incerta, M. rhodonia.*
Station CP 1047. — 30.09.1994, 16°53'S, 168°10'E, 486-494 m: *A. incerta, M. pagesi, M. rhodonia, M. rubrodigitalis, M. sacksi.*
Station CP 1049. — 1.10.1994, 16°39'S, 168°02'E, 469-525 m: *A. squamosa, M. idyia, M. rhodonia, M. rubrodigitalis.*
Station CP 1050. — 1.10.1994, 16°39'S, 168°01'E, 541-577 m: *A. incerta, M. rhodonia.*
Station CP 1051. — 1.10.1994, 16°36'S, 167°59'E, 555-558 m: *M. leviantennata, M. rhodonia.*
Station CP 1055. — 1.10.1994, 16°30'S, 167°55'E, 572-580 m: *M. rhodonia.*
Station CC 1056. — 1.10.1994, 16°33'S, 167°55'E, 602-620 m: *A. incerta, M. rosula.*
Station DW 1060. — 2.10.1994, 16°13'S, 167°20'E, 397-375 m: *A. squamosa, M. idyia, M. leagora.*
Station DW 1061. — 2.10.1994, 16°14'S, 167°20'E, 458-512 m: *M. sao.*
Station DW 1065. — 2.10.1994, 16°16'S, 167°21'E, 360-419 m: *M. notata, M. runcinata.*
Station DW 1067. — 2.10.1994, 16°16'S, 167°21'E, 344-366 m: *M. leagora.*
Station DW 1070. — 4.10.1994, 15°36'S, 167°16'E, 184-190 m: *M. sao.*
Station CP 1071. — 4.10.1994, 15°36'S, 167°16'E, 180-191 m: *M. semoni.*
Station CP 1073. — 4.10.1994, 15°45'S, 167°22'E, 630-650 m: *A. incerta, M. leviantennata, M. rhodonia, M. rosula.*
Station CP 1075. — 4.10.1994, 15°53'S, 167°27'E, 944-956 m: *M. microps.*
Station CP 1076. — 4.10.1994, 15°53'S, 167°30'E, 1100-1191 m: *A. fortiantennata, M. microps.*
Station CP 1077. — 5.10.1994, 16°04'S, 167°06'E, 180-210 m: *M. elegantissima, M. semoni.*

Station CP 1078. — 5.10.1994, 16°03'S, 167°26'E, 194-230 m: *M. semoni.*
Station CP 1080. — 5.10.1994, 15°57'S, 167°27'E, 799-850 m: *A. eminens, M. microps, M. rosula.*
Station CAS 1081. — 5.10.1994, 15°55'S, 167°27'E, 908 m: *M. microps.*
Station CP 1083. — 5.10.1994, 15°51'S, 167°19'E, 397-439 m: *A. squamosa, M. leagora.*
Station CP 1086. — 5.10.1994, 15°36'S, 167°16'E, 182-215 m: *M. sao.*
Station CP 1087. — 6.10.1994, 15°10'S, 167°14'E, 394-421 m: *A. alisae, A. squamosa, M. idyia, M. runcinata.*
Station CP 1088. — 6.10.1994, 15°09'S, 167°15'E, 425-455 m: *A. squamosa, M. idyia, M. leviantennata, M. rubrodigitalis, M. sao.*
Station CP 1089. — 6.10.1994, 15°08'S, 167°17'E, 494-516 m: *A. incerta, M. rhodonia, M. rubrodigitalis, M. sao.*
Station CP 1090. — 6.10.1994, 15°08'S, 167°17'E, 470-502 m: *A. incerta, M. rhodonia, M. rubrodigitalis.*
Station CP 1091. — 6.10.1994, 15°10'S, 167°13'E, 344-350 m: *A. incerta, M. notata.*
Station CP 1095. — 6.10.1994, 15°07'S, 167°11'E, 304-320 m: *M. sao.*
Station DW 1097. — 7.10.1994, 15°05'S, 167°10'E, 281-288 m: *A. incerta, M. notata.*
Station CP 1098. — 7.10.1994, 15°04'S, 167°10'E, 277-285 m: *M. sao.*
Station DW 1100. — 7.10.1994, 15°04'S, 167°09'E, 258-265 m: *M. leptitis.*
Station CP 1102. — 7.10.1994, 15°03'S, 167°08'E, 208-210 m: *M. semoni.*
Station CP 1107. — 7.10.1994, 15°05'S, 167°15'E, 397-402 m: *A. squamosa, M. sao.*
Station DW 1108. — 7.10.1994, 15°04'S, 167°15'E, 405-419 m: *A. squamosa.*
Station CP 1111. — 8.10.1994, 14°51'S, 167°14'E, 1210-1250 m: *M. leviantennata, M. typhle.*
Station CP 1114. — 8.10.1994, 15°52'S, 167°03'E, 647 m: *A. incerta, M. militaris.*
Station CP 1118. — 9.10.1994, 15°08'S, 166°53'E, 191-248 m: *M. semoni.*
Station CP 1119. — 9.10.1994, 15°08'S, 166°53'E, 254-300 m: *M. semoni.*
Station CP 1124. — 9.10.1994, 15°01'S, 166°56'E, 532-599 m: *A. incerta, M. rhodonia, M. sacksi.*
Station CP 1125. — 10.10.1994, 15°57'S, 166°38'E, 1160-1220 m: *M. microps.*
Station CP 1126. — 10.10.1994, 15°58'S, 166°39'E, 1210-1260 m: *M. microps.*
Station CP 1129. — 10.10.1994, 16°00'S, 166°39'E, 1014-1050 m: *A. fortiantennata, M. microps.*
Station CP 1131. — 11.10.1994, 15°38'S, 167°03'E, 140-175 m: *M. tyche.*
Station CP 1132. — 11.10.1994, 15°38'S, 167°02'E, 161-182 m: *M. tyche.*
Station CP 1133. — 11.10.1994, 15°38'S, 167°03'E, 174-210 m: *M. tyche.*
Station CP 1135. — 11.10.1994, 15°40'S, 167°02'E, 282-375 m: *M. masi, M. runcinata, M. sacksi.*
Station CP 1136. — 11.10.1994, 15°40'S, 167°01'E, 398-400 m: *A. squamosa, M. idyia, M. sao.*
Station CP 1137. — 11.10.1994, 15°41'S, 167°02'E, 360-371 m: *A. squamosa, M. idyia, M. leviantennata, M. runcinata, M. sao.*
Station CP 1138. — 11.10.1994, 15°44'S, 167°04'E, 462-492 m: *A. incerta, M. leagora.*
Station CP 1139. — 11.10.1994, 15°47'S, 167°08'E, 235-251 m: *M. masi.*

SYSTEMATIC ACCOUNT

Agononida alisae sp. nov.

Fig. 1

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 963, 400-440 m: 13 ♂ 10.2 to 15.3 mm; 24 ov. ♀ 10.2 to 14.5 mm; 3 ♀ 11.6 to 12.7 mm; 1 juv. 6.2 mm. — Stn 1025, 385-410 m: 1 ov. ♀ 10.4 mm; 2 ♀ 7.5 and 8.4 mm. — Stn 1087, 394-421 m: 1 ♂ 8.2 mm; 2 ov. ♀ 10.3 and 13.3 mm.

TYPES. — The male of 12.6 mm from the Stn 1076 has been selected as holotype, the other specimens are paratypes.

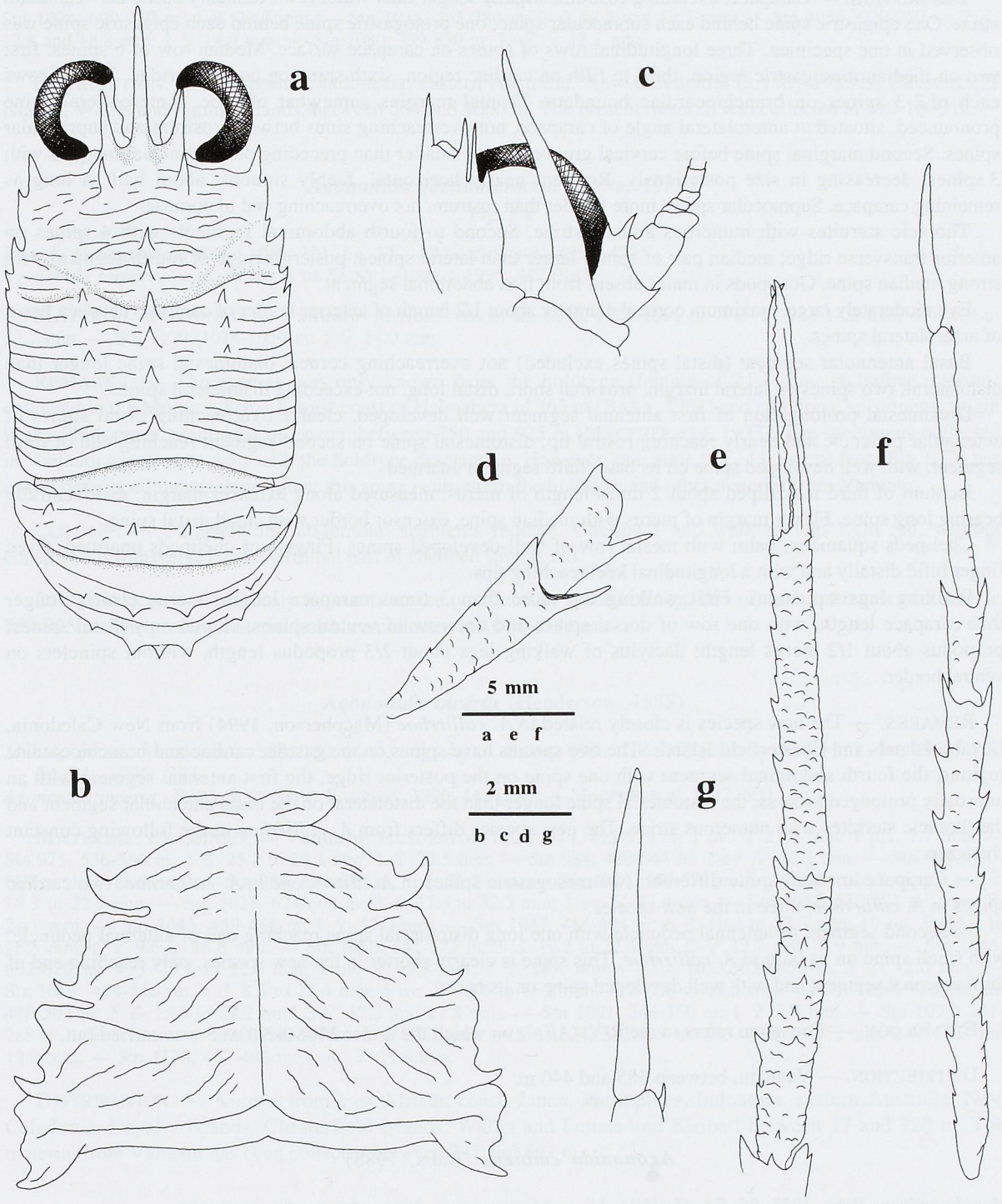


FIG. 1. — *Agononida alisae* sp. nov., ♂, 12.6 mm, holotype from stn 1076 : **a**, carapace, dorsal view; **b**, sternal plastron; **c**, ventral view of cephalic region, showing antennula and antennal peduncles; **d**, right third maxilliped, lateral view; **e**, right cheliped, dorsal view; **f**, right first walking leg, lateral view; **g**, dactylus of right first walking, lateral view.

DESCRIPTION. — Carapace, excluding rostrum, slightly longer than wide; few secondary striae between main striae. One epigastric spine behind each supraocular spine; one protogastric spine behind each epigastric spine was observed in one specimen. Three longitudinal rows of spines on carapace surface. Median row of 6 spines: first two on median mesogastric region, third to fifth on cardiac region, sixth spine on posterior ridge. Lateral rows each of 2-3 spines on branchiocardiac boundary. Frontal margins somewhat oblique. Anterolateral spine pronounced, situated at anterolateral angle of carapace, not overreaching sinus between rostrum and supraocular spines. Second marginal spine before cervical groove clearly smaller than preceding one. Branchial margins with 3 spines, decreasing in size posteriously. Rostrum nearly horizontal, feebly sinuous, about half as long as remaining carapace. Supraocular spines more slender than rostrum, not overreaching end of corneae.

Thoracic sternites with numerous arcuate striae. Second to fourth abdominal segments with 4 spines on anterior transverse ridge; median pair of spines larger than lateral spines; posterior ridge of fourth segment with strong median spine. Gonopods in males absent from first abdominal segment.

Eye moderately large, maximum corneal diameter about 1/2 length of anterior border of carapace between bases of anterolateral spines.

Basal antennular segment (distal spines excluded) not overreaching cornea; distomesial spine longer than distolateral; two spines on lateral margin, proximal short, distal long, not exceeding distolateral spine.

Distomesial prolongation of first antennal segment well developed, clearly overreaching distal spines of antennular peduncle and nearly reaching rostral tip; distomesial spine on second segment reaching end of third segment, with well developed spine on its base; third segment unarmed.

Ischium of third maxilliped about 2 times length of merus, measured along extensor margin, distoventrally bearing long spine. Flexor margin of merus with median spine, extensor border with small distal spine.

Chelipeds squamous; palm with mesial row of well-developed spines. Fingers of chelipeds unarmed, fixed finger bifid distally and with a longitudinal keel reaching tips.

Walking legs squamous. First walking leg more than 3 times carapace length; merus clearly longer than carapace length, with one row of dorsal spines and one row of ventral spines; carpus only distal spines; propodus about 1/2 merus length; dactylus of walking legs about 2/3 propodus length, without spinelets on ventral border.

REMARKS. — The new species is closely related to *A. callirrhoe* (Macpherson, 1994) from New Caledonia, Loyalty Islands and Chesterfield Islands. The two species have spines on the gastric, cardiac and branchiocardiac regions, the fourth abdominal segment with one spine on the posterior ridge, the first antennal segment with an unusually prolonged process, the distomesial spine longer than the distolateral on the basal antennular segment and the thoracic sternites with numerous striae. The new species differs from *A. callirrhoe* in the following constant characters:

— Carapace armature quite different: two mesogastric spines in *A. alisae*, one in *A. callirrhoe*; two cardiac spines in *A. callirrhoe*, three in the new species.

— Second segment of antennal peduncle with one long distomesial spine reaching end of antennal peduncle, with small spine on its base in *A. callirrhoe*. This spine is clearly shorter in the new species, only reaching end of third antennal segment and with well developed spine on its base.

ETYMOLOGY. — The name refers to the R/V *"Alis"*, on which the cruise MUSORSTOM 8 was carried out.

DISTRIBUTION. — Vanuatu, between 385 and 440 m.

Agononida eminens (Baba, 1988)

Munida eminens Baba, 1988: 95, fig. 35; 1994: 11. — MACPHERSON, 1994: 456, fig. 72; 1995: 392.
Agononida eminens - BABA & DE SAINT LAURENT, 1995: 442 (list). — MACPHERSON, 1997: 600.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 990, 980-990 m: 2 ♀ 12.4 and 13.6 mm. — Stn 991, 910-936 m: 2 ♂ 13.0 and 15.0 mm; 3 ♀ 9.8 to 14.6 mm. — Stn 993, 780-783 m: 1 ♀ 15.8 m. — Stn 996, 764-786 m: 1 ♀

15.4 mm. — Stn 1007, 720-830 m: 1 ♂ 16.7 mm; 1 ♀ 18.0 mm. — Stn 1008, 919-1000 m: 2 ♂ 13.4 and 14.2 mm. — Stn 1034, 690-750 m: 1 ♂ 20.0 mm. — Stn 1035, 765-780 m: 2 ♂ 18.2 and 19.7 mm. — Stn 1036, 920-950 m: 2 ♂ 12.8 and 18.8 mm; 1 ♀ 14.9 mm. — Stn 1080, 799-830 m: 1 ov. ♀ 18.1 mm.

DISTRIBUTION. — Philippines, Indonesia, eastern Australia, New Caledonia, Loyalty Islands, Chesterfield Islands, Wallis and Futuna Islands, between 564 and 1000 m. The present material was collected at 690-1000 m.

Agononida fortiantennata (Baba, 1988)

Fig. 3 a

Munida fortiantennata Baba, 1988: 101, fig. 37. — MACPHERSON, 1993: 428.
Agononida fortiantennata - BABA & DE SAINT LAURENT, 1996: 442 (list).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1076, 1100-1191 m: 4 ♂ 11.5 to 14.2 mm; 5 ♀ 8.3 to 13.7 mm. — Stn 1129, 1014-1050 m: 1 ♀ 14.0 mm.

REMARKS. — The species was only known from the holotype (female of 21.7 mm, including rostrum) collected in the Molucca Sea, off west coast of Halmahera in 763 m (BABA, 1988) and additional specimens caught in the Philippines, southwest of Luzon, between 750 and 925 m (MACPHERSON, 1993). The specimens collected in Vanuatu agree quite well with the holotype description. However, one male (CL, 11.5 mm) from Stn 1076 has a well developed mesogastric spine; this spine is absent in the holotype and other material from Vanuatu.

COLOUR. — Carapace and abdominal segments reddish. Chelipeds and walking legs light red, without conspicuous transverse bands; terminal part of cheliped fingers red.

DISTRIBUTION. — Previously known from the type locality (Molucca Sea, 763 m) and southwest of Luzon at 750-925 m. The present material has been collected at 1014-1191 m.

Agononida incerta (Henderson, 1888)

Munida incerta Henderson, 1888: 130, pl. 13, fig. 4a. — BABA, 1988: 106; 1994: 12. — MACPHERSON, 1994: 478, fig. 74; 1995: 394.
Agononida incerta - BABA & DE SAINT LAURENT, 1996: 442 (list). — MACPHERSON, 1997: 600.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 974, 492-520 m: 1 ov. ♀ 22.8 mm; 1 juv. 7.7 mm. — Stn 975, 536-566 m: 3 ♂ 25.2 to 29.1 mm; 1 ♀ 22.5 mm. — Stn 984, 480-544 m: 1 ov. ♀ 20.3 mm. — Stn 989, 650-669 m: 1 ♂ 12.6 mm. — Stn 994, 641-649 m: 1 ♂ 25.2 mm. — Stn 1027, 550-571 m: 5 ♂ 20.4 to 26.8 mm; 3 ov. ♀ 18.3 to 22.7 mm. — Stn 1028, 624-668 m: 3 ♂ 27.4 to 32.3 mm; 1 ov. ♀ 23.4 mm. — Stn 1033, 650-691 m: 1 ov. ♀ 21.1 mm. — Stn 1045, 459-488 m: 1 ♀ 17.0 mm. — Stn 1047, 486-494 m: 6 ♂ 10.3 to 22.3 mm; 10 ov. ♀ 15.3 to 18.8 mm; 6 ♀ 9.6 to 16.6 mm. — Stn 1050, 541-577 m: 3 ♂ 19.2 to 22.6 mm; 2 ♀ 12.7 and 17.9 mm. — Stn 1056, 602-620 m: 4 ♂ 17.6 to 22.0 mm; 1 ov. ♀ 17.8 mm; 1 ♀ 18.1 mm. — Stn 1073, 630-650 m: 1 ♂ 12.0 mm. — Stn 1089, 494-516 m: 8 ♂ 8.5 to 22.4 mm; 5 ov. ♀ 13.6 to 16.2 mm; 5 ♀ 7.0 to 19.3 mm. — Stn 1090, 470-502 m: 470-502 m: 5 ♂ 15.3 to 22.2 mm; 2 ♀ 17.3 and 17.8 mm. — Stn 1091, 344-350 m: 1 ♀ 7.0 mm. — Stn 1097, 281-288 m: 1 ♀ 8.7 mm. — Stn 1114, 647 m: 1 ♀ 23.3 mm. — Stn 1124, 532-599 m: 5 ♂ 11.0 to 18.2 mm; 2 ♀ 10.3 and 12.8 mm. — Stn 1138, 462-492 m: 1 ov. ♀ 19.8 mm.

DISTRIBUTION. — Known from east African coast, Japan, Philippines, Indonesia, eastern Australia, New Caledonia, Loyalty Islands, Chesterfield Islands, Wallis and Futuna and Kiribati between 17 and 720 m. The material from Vanuatu has been collected between 281 and 691 m.

Agononida laurentae (Macpherson, 1994)

Munida laurentae Macpherson, 1994: 483, figs 25, 92.
Agononida laurentae - BABA & DE SAINT LAURENT, 1995: 442 (list).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 980, 433-450 m: 2 ♂ 10.6 and 13.6 mm. — Stn 982, 408-410 m: 1 ov. ♀ 14.0 mm. — Stn 983, 475-480 m: 3 ♀ 6.4 to 11.4 mm.

DISTRIBUTION. — Known from New Caledonia, Loyalty Islands, Chesterfield Islands, Matthew and Hunter Islands, between 260 and 610 m. The material from Vanuatu has been collected at 408-480 m.

Agononida normani (Henderson, 1885)

Munida Normani Henderson, 1885: 408.
Munida normani - HENDERSON, 1888: 129, pl. 13, fig. 5. — BABA, 1988: 83 (key). — MACPHERSON, 1994: 500; 1995: 400, fig. 20.
Agononida normani - BABA & DE SAINT LAURENT, 1996: 442 (list).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1027, 550-571 m: 2 ♀ 11.2 and 12.0 mm. — Stn 1028, 624-668 m: 1 ♂ 8.2 mm.

REMARKS. — The specimens from Vanuatu agree with the types and additional material from New Caledonia, Wallis and Futuna. However, the cardiac spines are absent in the present material, whereas there are 0-5 spines in the types and other material previously collected.

DISTRIBUTION. — The species has previously been cited in Fiji, New Caledonia and Wallis and Futuna area between 320 and 600 m. The present material was caught at depths between 550 and 668 m.

Agononida ocyrhoe (Macpherson, 1994)

Munida ocyrhoe Macpherson, 1994: 503, figs 35, 79; 1995: 402, fig. 21.
Agononida ocyrhoe - BABA & DE SAINT LAURENT, 1996: 442 (list).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 972, 487-507 m: 1 juv. 5.5 mm. — Stn 974, 492-520 m: 2 ♂ 11.4 and 13.5 mm; 2 ov. ♀ 12.5 and 14.6 mm. — Stn 984, 480-544 m: 3 ♂ 8.5 to 21.2 mm.

DISTRIBUTION. — The species has previously been cited in New Caledonia, Chesterfield Islands and Wallis Islands between 420 and 650 m. The material from Vanuatu has been collected at 480-544 m.

Agononida squamosa (Henderson, 1885)

Figs 3 b-c

Munida squamosa Henderson, 1885: 409; 1888: 131, pl. 13, figs 1a-b. — BABA, 1988: 133 (in part); 1994: 12. — MACPHERSON, 1993: 425, fig. 1h-l; 1994: 537, fig. 96; 1995: 406.
Agononida squamosa - BABA & DE SAINT LAURENT, 1996: 442 (list). — MACPHERSON, 1997: 603.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 959, 436-475 m: 1 ♂ 15.2 mm. — Stn 963, 400-440 m: 1 ♂ 14.5 mm; 1 ♀ 7.6 mm. — Stn 973, 460-480 m: 1 ♂ 13.2 mm. — Stn 974, 492-520 m: 2 ♂ 14.4 and 16.5 mm. — Stn 980, 433-450 m: 14 ♂ 8.2 to 15.9 mm; 1 ov. ♀ 11.3 mm; 4 ♀ 8.0 to 14.8 mm; 3 juv. 6.5 to 6.6 mm. — Stn 982, 408-410 m: 1 ov. ♀ 11.6 mm. — Stn 984, 480-544 m: 2 ♂ 14.2 and 14.5 mm. — Stn 1025, 385-410 m: 1 ♂ 9.5 mm; 3 ov. ♀ 13.8 to 14.7 mm. — Stn 1026, 437-504 m: 2 ♂ 14.7 and 15.3 mm; 1 ov. ♀ 11.8 mm. — Stn 1029, 324-360 m: 1 ov. ♀ 12.6 mm. — Stn 1049, 469-525 m: 1 ♂ 11.4 mm; 3 ov. ♀ 15.4 to 18.5 mm. — Stn 1060, 375-397 m: 1 ♂ 15.0 mm; 1 ov. ♀ 10.2 mm. — Stn 1083, 397-439 m: 3 ♂ 11.4 to 14.2 mm; 1 ov. ♀ 11.9 mm. — Stn 1087, 394-421 m: 1 ♂ 6.3 mm; 1 ov. ♀ 8.7 mm. — Stn 1088, 425-455 m: 1 ♂ 15.0 mm; 3 ov. ♀ 11.8 to 14.2 mm. — Stn 1107, 397-402 m: 1 ♂ 11.3 mm; 2 ov. ♀ 12.0 and 12.8 mm. — Stn 1108, 405-419 m: 1 ♂ 12.9 mm. — Stn 1136, 398-400 m: 1 ov. ♀ 12.1 mm; 2 ♀ 10.0 and 12.2 mm. — Stn 1137, 360-371 m: 5 ♂ 11.6 to 16.2 mm; 6 ov. ♀ 9.8 to 14.2 mm; 3 juv. 6.4 to 6.8 mm.

REMARKS. — The colour pattern of the ovigerous female (CL, 12.6 mm) from Stn 1029 (Fig. 3c) agrees with the figure and description of the specimens from Loyalty Islands, having numerous yellow and purple spots on

the carapace, and red and whitish bands on the pereiopods (MACPHERSON, 1994). However, one male (CL, 13.2 mm) from Stn 973 (Fig. 3b) has the carapace, abdominal segments and pereiopods uniformly red, without bands and spots. This clear difference in the colour patterns suggests the existence of two forms or species. However, no other clear morphological differences have been observed and, as has been pointed out in the Introduction, a revision of the species using complementary techniques is strongly recommended.

DISTRIBUTION. — Japan, Indonesia, Admiralty Islands, northeastern Australia, New Caledonia, Loyalty Islands and Wallis Islands, between 176 and 752 m. The specimens from Vanuatu were collected at 324-525 m.

Genus ***MUNIDA*** Leach, 1820

Munida clinata Macpherson, 1994

Munida clinata Macpherson, 1994: 457, fig. 11; 1995: 391; 1997: 605.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 961, 100-110 m: 2 ov. ♀ 7.8 and 8.7 mm. — Stn 966, 128-150 m: 1 ♂ 5.5 mm; 1 ov. ♀ 8.8 mm. — Stn 1021, 124-130 m: 1 ov. ♀ 5.4 mm.

DISTRIBUTION. — Previously known from the Philippines, Indonesia, New Caledonia, Chesterfield Islands and Futuna Island, between 28 and 245 m. The specimens from Vanuatu were collected at 124-150 m.

Munida congesta sp. nov.

Figs 2, 3 d, 4 a

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 975, 536-566 m: 1 ♂ 7.6 mm; 1 ov. ♀ 10.2 mm . — Stn 1028, 624-668 m: 1 ♀ 12.6 mm.

TYPES. — The ovigerous female of 10.2 mm from the Stn 975 has been selected as holotype, the other specimens are paratypes.

ETYMOLOGY. — From the Latin, *congestus*, dense, thick, in reference to the massive chelipeds.

DESCRIPTION. — Carapace as long as wide. Main striae on posterior part of carapace interrupted in cardiac region. Few secondary striae present. Intestinal region without striae. Three-five pairs of epigastric spines; one branchial anterior spine on each side.

Frontal margins somewhat oblique. Lateral margins slightly convex. Anterolateral spine well developed, situated at anterolateral angle, reaching level of sinus between rostrum and supraocular spine. Second marginal spine before cervical groove clearly smaller than preceding one. Branchial margins with 5 spines.

Rostrum about half as long as carapace. Supraocular spines more slender than rostrum, reaching to its midlength, but not to end of corneae, slightly divergent.

Thoracic sternites without striae.

Second abdominal segment with one row of 7-8 spines on anterior border. Second to fourth segments with one transverse stria.

Eyes large, maximum corneal diameter about half the distance between bases of anterolateral spines.

Basal segment of antennule reaching end of cornea; distomesial spine shorter than distolateral; two spines on lateral margin, proximal short, located at midlength of segment, distal long, overreaching distal spine.

First segment of antennal peduncle with strong distomesial spine, not reaching end of second segment; second segment with two distal spines, mesial longer than lateral, not overreaching antennal peduncle.

Ischium of third maxilliped slightly longer than merus, measured along extensor border, distoventrally bearing spine. Merus bearing two well developed spines on flexor margin, proximal spine clearly longer than distal. Extensor margin unarmed.

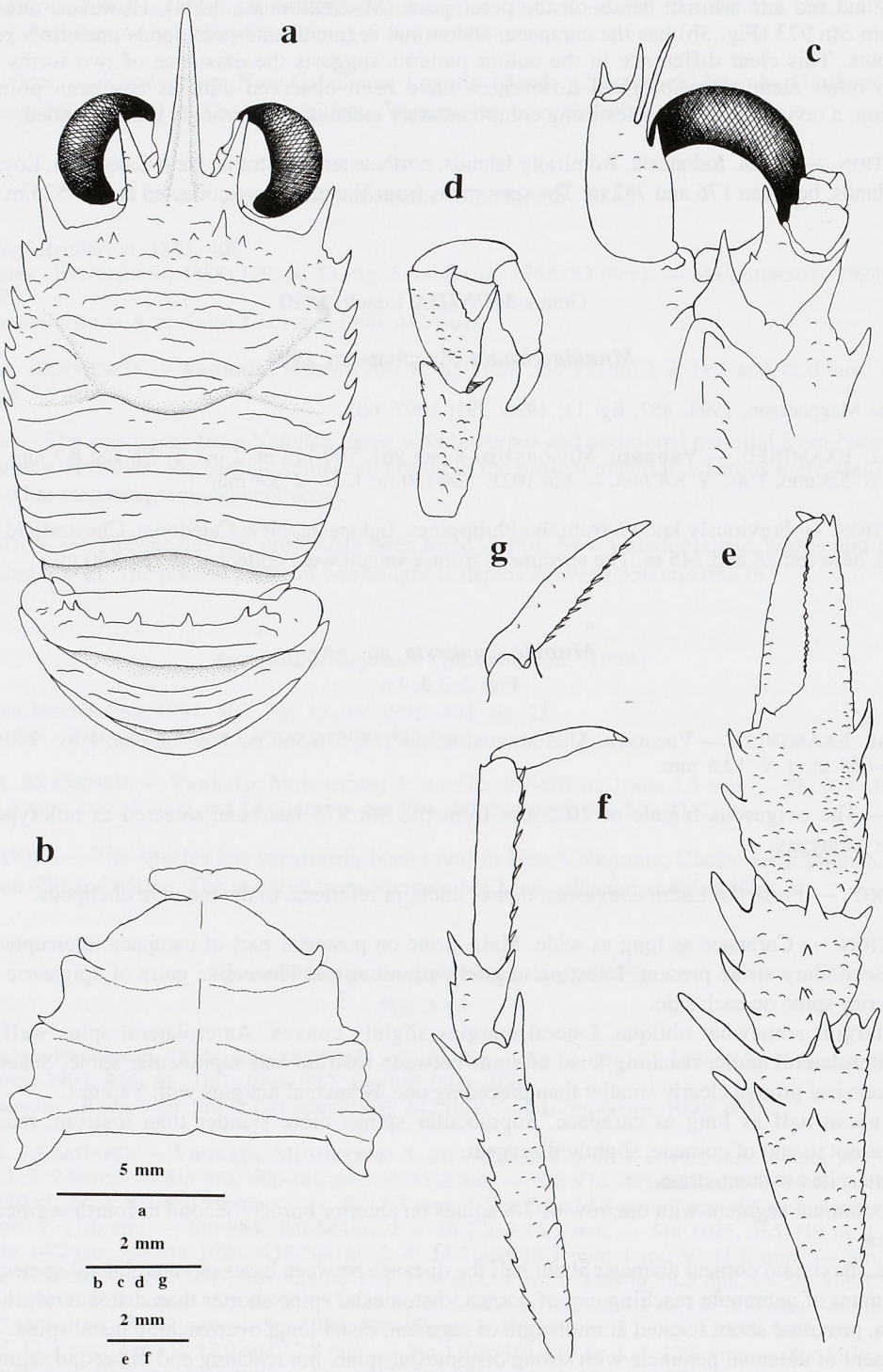


FIG. 2. — *Munida congesta* sp. nov., ovig. ♀, 10.2 mm, holotype from stn 975 : **a**, carapace, dorsal view; **b**, sternal plastron; **c**, ventral view of cephalic region, showing antennula and antennal peduncles; **d**, right third maxilliped, lateral view; **e**, right cheliped, dorsal view; **f**, right first walking leg, lateral view; **g**, dactylus of right first walking, lateral view.

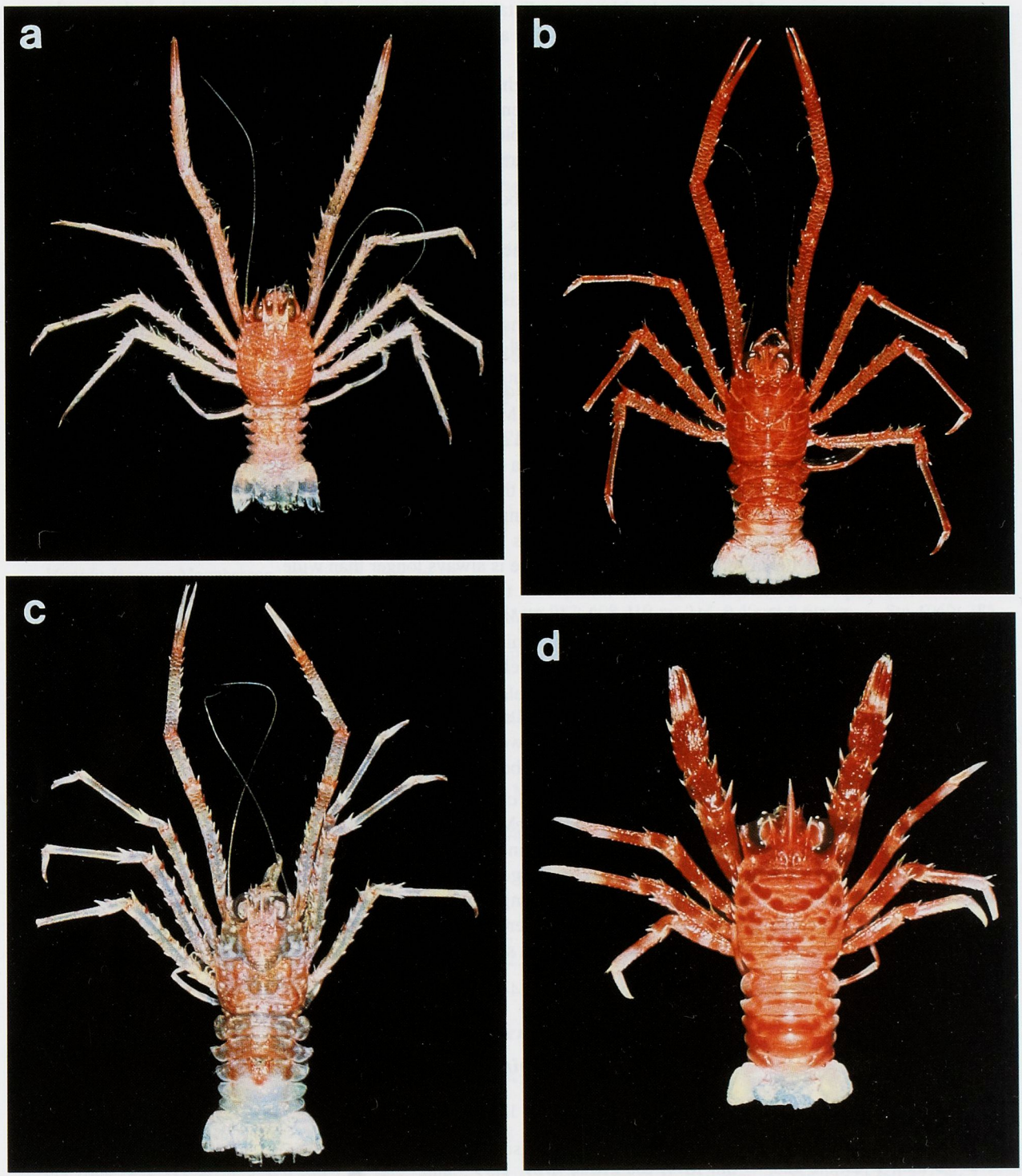


FIG. 3. — **a**, *Agononida fortiantennata* (Baba, 1986), male 11.9 mm, stn 1076; **b**, *Agononida squamosa* (Henderson, 1885), male 13.2 mm, stn 973; **c**, *Agononida squamosa* (Henderson, 1885), ovigerous female 12.6 mm, stn 1029; **d**, *Munida congesta* sp. nov., ovigerous female 10.2 mm, holotype, stn 975.

Chelipeds squamous. Merus armed with strong distal spines, distomesial spine strong, clearly longer than others. Carpus and palm with some spines on dorsal side and marginal borders. Fixed finger unarmed except small distal spine; movable finger with small proximal spine.

Second pereiopod twice carapace length; merus slightly shorter than carapace, about twice propodus length, with dorsal row of spines, increasing in size distally, ventral border with one long distal spine. Carpus with two well developed distal spines. Propodus with some movable spinules along ventral border. Dactylus slightly shorter than propodus, with row of movable spinules along ventral margin.

COLOUR. — *Holotype*: Ground colour of carapace, abdominal segments and pereiopods orange, with some red spots, more numerous on gastric and branchial regions of carapace and fourth and fifth abdominal segments. Telson and uropods white. Rostrum and supraocular spines reddish, tips white. Merus of chelipeds with transverse red bands; carpus and palm red, fingers with proximal and distal parts whitish, median part red. Walking legs with some transverse red bands, terminal half of dactylus whitish (Fig. 3d).

Paratype (male CL 7.6 mm, Stn 975) with less conspicous red spots on the carapace, distal part of merus, carpus and proximal part of palm of chelipeds whitish (Fig. 4a).

REMARKS. — The new species resembles *Munida militaris* Henderson, 1885 from Indonesia, Fiji, New Caledonia and Wallis and Futuna area (BABA & MACPHERSON, 1991; MACPHERSON, 1994; 1995). Both species have five spines on the branchial margin, second abdominal segment armed with spines along the anterior ridge, intestinal region without striae, one transverse stria on the second and third abdominal segments, eyes large, thoracic sternites without striae and distolateral spine of the basal antennular peduncle longer than the distomesial spine. However, they can be distinguished by the following characters:

— The carapace is more massive in the new species than in *M. militaris*. The carapace is always as long as wide in *M. congesta*, whereas in *M. militaris* the carapace is always longer than wide.

— The chelipeds are shorter and more massive in the new species than in *M. militaris*. The palm of the chelipeds is more than 2 times longer than high in *M. militaris*, being less than 2 times in *M. congesta*. This difference is quite clear comparing specimens of similar size and sex.

— The fixed finger of the cheliped has one well developed basal spine in *M. militaris*. This spine is absent in the new species.

— The colour patterns are different. The carapace and abdominal segments have numerous large red spots in the new species, these spots are absent in *M. militaris*. However, as it has been pointed out in the Introduction, the differences in the colour patterns between species should be considered with caution.

M. congesta is also close to a group of species (*M. curvirostris* Henderson, 1885; *M. masoae* Macpherson, 1995; *M. punctata* Macpherson, 1997; *M. rhodonia* Macpherson, 1994; *M. rosula* Macpherson, 1994 and *M. spissa* Macpherson, 1995) from the Western Pacific and the Indian ocean waters, which shares some characters (e.g. five spines on lateral branchial margins, eyes large, second abdominal segment with a row of spines on anterior ridge). However, it is easily distinguished, among other characters, by the size of the distal spines of the basal antennular peduncle. The distolateral spine is longer than the distomesial one in *M. congesta*, whereas in the above mentioned species the distal spines are subequal in size.

DISTRIBUTION. — Vanuatu, between 536-566 and 624-668 m.

Munida elegantissima de Man, 1902

Munida elegantissima - BABA, 1988: 94 (references); 1989: 131. — MACPHERSON, 1994: 465; 1995: 391.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 966, 128-150 m: 2 ♂ 7.6 and 8.5 mm; 1 ov. ♀ 10.3 mm; 1 ♀ 8.9 mm; 1 juv. 3.2 mm. — Stn 1077, 180-210 m: 1 ov. ♀. 9.3 mm.

DISTRIBUTION. — The species has previously been cited from the Eastern Indian Ocean, Malay Archipelago, Indonesia, Philippines, Japan, Western and Eastern Australia, New Caledonia, Bellona Island and Futuna Island, between 20 and 440 m. The specimens from Vanuatu were collected at 128-210 m.

Munida gordoae Macpherson, 1994

Munida gordoae Macpherson, 1994: 469, fig. 18.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 961, 100-110 m: 1 ov. ♀ 4.8 mm; 1 ♀ 4.7 mm.

DISTRIBUTION. — New Caledonia, Loyalty Islands, Matthew and Hunter Islands and Chesterfield Islands, between 80 and 283 m. The present material was collected at 100-110 m.

Munida idyia Macpherson, 1994

Munida idyia Macpherson, 1994: 477, fig. 23.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 980, 433-450 m: 1 ♂ 7.2 mm. — Stn 1049, 469-525 m: 1 ♀ 10.4 mm. — Stn 1060, 375-397 m: 1 ♂ 9.8 mm. — Stn 1087, 394-421 m: 1 ♂ 9.1 mm; 3 ov. ♀ 8.7 to 10.2 mm; 1 ♀ 11.2 mm. — Stn 1088, 425-455 m: 1 ov. ♀ 10.2 mm. — Stn 1136, 398-400 m: 1 ♂ 13.2 mm; 2 ov. ♀ 9.5 and 9.7 mm; 2 ♀ 7.6 and 11.3 mm. — Stn 1137, 360-371 m: 2 ♂ 7.8 and 9.5 mm; 1 ♀ 6.8 mm.

DISTRIBUTION. — Previously known from New Caledonia, in 485 m depth. The specimens from Vanuatu were caught between 360 and 525 m.

Munida leagora Macpherson, 1994

Munida leagora Macpherson, 1994: 485, figs 26, 76.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 982, 408-410 m: 2 ♂ 9.4 and 9.6 mm. — Stn 1060, 375-397 m: 1 ov. ♀ 12.6 mm. — Stn 1067, 344-366 m: 1 ov. ♀ 10.7 mm; 1 ♀ 6.3 mm. — Stn 1083, 397-439 m: 2 ♂ 6.3 and 12.9 mm; 5 ov. ♀ 8.3 to 14.2 mm; 2 ♀ 8.6 and 10.1 mm. — Stn 1138, 462-498 m: 1 ov. ♀ 12.2 mm.

DISTRIBUTION. — Previously known from New Caledonia, Loyalty Islands and Chesterfield Islands, between 265 and 580 m. The present material was collected at 344-498 m.

Munida leptitis Macpherson, 1994

Munida leptitis Macpherson, 1994: 487, fig. 27; 1995: 394, fig. 14; 1997: 607.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 978, 408-413 m: 1 ov. ♀ 4.4 mm. — Stn 983, 475-480 m: 3 ♂ 3.3 to 6.5 mm. — Stn 1100, 258-265 m: 1 ♀ 4.3 mm.

DISTRIBUTION. — New Caledonia, Loyalty Islands, Wallis and Futuna Islands and Indonesia between 21 and 440 m. The specimens from Vanuatu were collected at 258-480 m.

Munida leviantennata Baba, 1988

Munida leviantennata Baba, 1988: 111, figs 41, 42; 1994: 12, fig. 5. — MACPHERSON, 1994: 491; 1995: 395; 1997: 608.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 958, 497-570 m: 1 ♀ 9.6 mm. — Stn 1028, 624-668 m: 1 ♂ 13.2 mm. — Stn 1051, 555-558 m: 1 ov. ♀ 12.4 mm. — Stn 1073, 630-650 m: 4 ♂ 12.0 to 13.2 mm. — Stn 1088, 425-455 m: 2 ♂ 9.8 and 13.3 mm. — Stn 1111, 1210-1250 m: 1 ♀ 10.9 mm. — Stn 1137, 360-371 m: 1 ♂ 11.5 mm.

DISTRIBUTION. — Philippines, Indonesia, eastern Australia, New Caledonia, Chesterfield Islands and Wallis Islands, between 300 and 660 m. The present material was obtained between 360 and 1250 m.

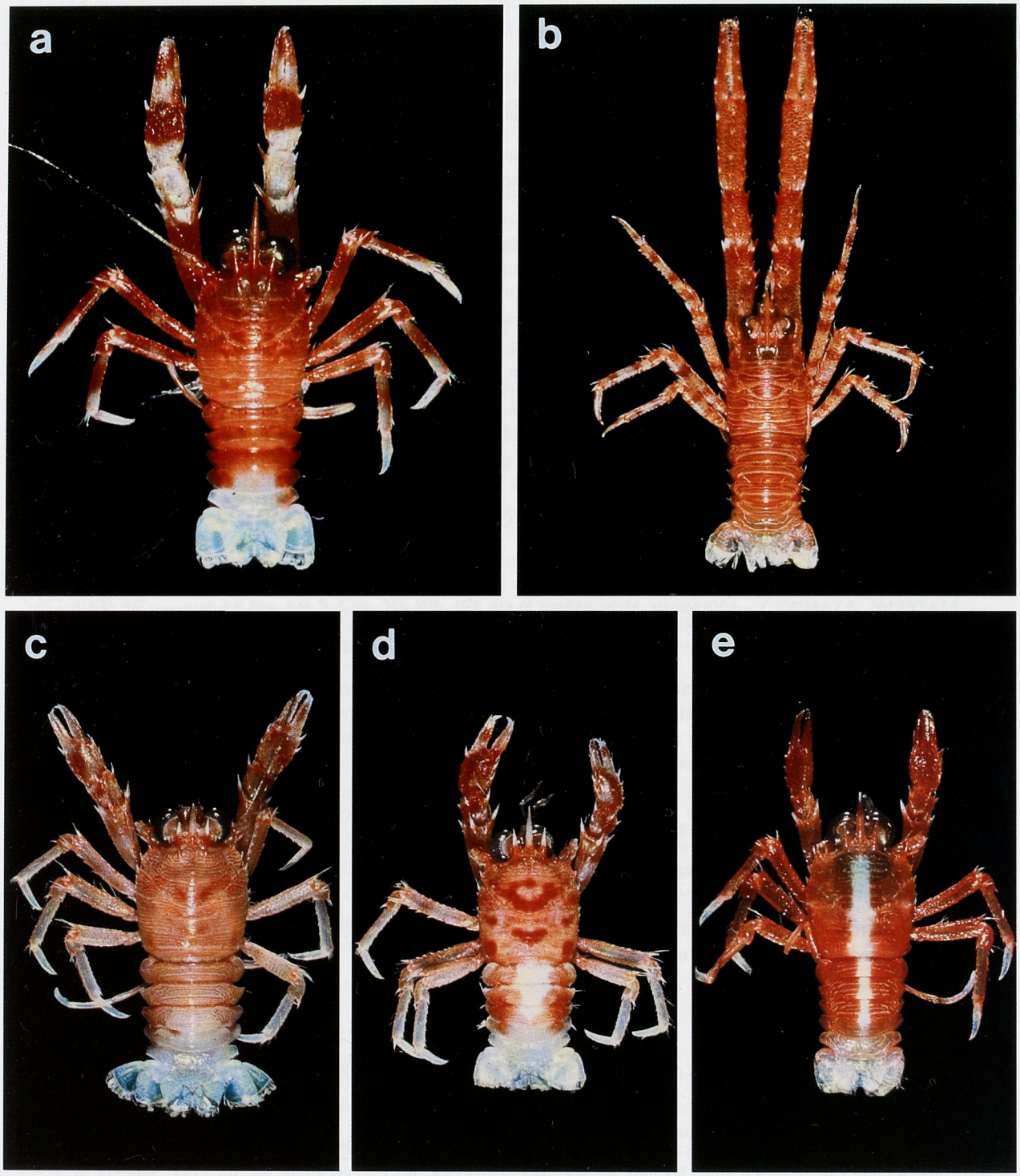


FIG. 4. — **a**, *Munida congesta* sp. nov., male 7.6 mm, paratype, stn 975; **b**, *Munida masi* Macpherson, 1994, male 8.8 mm, stn 1001; **c**, *Munida rhodonia* Macpherson, 1994, ovigerous female 10.3 mm, stn 1027; **d**, *Munida rhodonia* Macpherson, 1994, female 9.0 mm, stn 1027; **e**, *Munida rubrodigitalis* Baba, 1994, male 6.4 mm, stn 985.

Munida masi Macpherson, 1994

Fig. 4 b

Munida masi Macpherson, 1994: 495, fig. 31.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1001, 150-250 m: 1 ♂ 8.8 mm; 1 ♀ 5.8 mm. — Stn 1135, 282-375 m: 1 ♂ 9.4 mm; 1 ov. ♀ 7.9 mm. — Stn 1039, 464-472 m: 1 ♂ 7.1 mm.

REMARKS. — The species was only known from the holotype (male of CL, 10.6 mm) collected in New Caledonia, between 250-290 m. The specimens collected in Vanuatu fully agree with the holotype description.

COLOUR. — Ground colour of carapace and abdominal segments red. Rostrum and supraocular spines red. Chelipeds reddish, with some white spots along lateral margins of articles. Walking legs reddish, with some transverse deep red bands.

DISTRIBUTION. — Previously known from New Caledonia between 250-290 m. The specimens from Vanuatu were collected between 150-472 m.

Munida microps Alcock, 1894

Munida microps Alcock, 1894: 326. — BABA, 1988: 122 (references); 1994: 13. — MACPHERSON, 1994: 496, fig. 32; 1995: 397; 1997: 608.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 990, 980-990 m: 4 ♂ 10.4 to 11.3 mm; 2 ov. ♀ 10.7 and 13.6 mm; 1 ♀ 9.7 mm. — Stn 991, 910-936 m: 4 ♂ 6.0 to 16.8 mm; 3 ov. ♀ 11.5 to 13.7 mm; 1 ♀ 9.3 mm. — Stn 992, 748-775 m: 12 ♂ 6.5 to 18.8 mm; 2 ov. ♀ 11.0 and 16.4 mm; 4 ♀ 7.7 to 15.4 mm. — Stn 993, 780-783 m: 1 ♂ 11.0 mm. — Stn 1007, 720-830 m: 1 ♂ 10.2 mm; 1 ov. ♀ 14.4 mm. — Stn 1008, 919-1000 m: 6 ♂ 13.4 to 17.9 mm; 6 ov. ♀ 11.3 to 16.3 mm. — Stn 1014, 495-498 m: 1 ♀ 14.6 mm. — Stn 1036, 920-950 m: 4 ♂ 6.6 to 12. mm; 2 ov. ♀ 10.3 and 15.6 mm. — Stn 1037, 1058-1086 m: 8 ♂ 6.7 to 15.2 mm; 1 ov. ♀ 12.6 mm; 9 ♀ 8.5 to 12.3 mm. — Stn 1075, 944-956 m: 4 ♂ 9.7 to 19.4 mm; 6 ov. ♀ 13.5 to 15.8 mm; 1 ♀ 8.3 mm. — Stn 1076, 1100-1191 m: 26 ♂ 6.8 to 15.6 mm; 11 ov. ♀ 11.0 to 13.7 mm; 10 ♀ 9.0 to 14.1 mm. — Stn 1080, 799-850 m: 23 ♂ 14.2 to 20.2 mm; 2 ov. ♀ 9.8 and 10.3 mm; 7 ♀ 10.0 to 18.1 mm. — Stn 1081, 908 m: 2 ♂ 19.1 and 19.8 mm; 2 ov. ♀ 13.0 and 16.5 mm. — Stn 1125, 1160-1220 m: 2 ♂ 8.4 and 9.3 mm; 1 ♀ 6.5 mm. — Stn 1126, 1210-1260 m: 7 ♂ 8.6 to 11.0 mm; 1 ov. ♀ 11.6 mm; 1 ♀ 8.0 mm. — Stn 1129, 1014-1050 m: 1 ♀ 13.3 mm.

DISTRIBUTION. — The species has been previously cited in Arabian Sea, Maldives Islands, Philippines, Indonesia, southeastern Australia, New Caledonia, Chesterfield Islands, Wallis and Futuna Islands, between 686 and 1240 m. The specimens from Vanuatu were collected at 495-1260 m.

Munida militaris Henderson, 1885

Munida militaris - BABA & MACPHERSON, 1991: 539, fig. 1 (synonymies and references). — MACPHERSON, 1994: 496; 1995: 399, fig. 16.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1034, 690-750 m: 1 ♂ 20.8 mm. — Stn 1114, 647 m: 2 ov. ♀ 12.8 and 17.8 mm.

DISTRIBUTION. — The species is known from Indonesia, New Caledonia, Fiji and Wallis and Futuna area, between 183 and 1280 m. The present material was collected at depths between 647 and 750 m.

Munida notata Macpherson, 1994

Munida notata Macpherson, 1994: 500, figs 34,78; 1995: 402.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 965, 361-377 m: 1 ♂ 8.6 mm; 1 ov. ♀ 8.3 mm. — Stn 1017, 294-295 m: 1 ♂ 7.0 mm; 6 ov. ♀ 6.9 to 9.7 mm. — Stn 1018, 300-301 m: 1 ov. ♀ 7.8 mm; 2 ♀ 6.4 and 7.0 mm. — Stn 1024, 335-370 m: 2 ♂ 6.8 and 8.4 mm. — Stn 1058, 319 m: 1 ♂ 6.4 mm. — Stn 1065, 360-419 m: 1 ♀ 9.7 mm. — Stn 1091, 344-350 m: 1 ♀ 8.8 mm. — Stn 1097, 281-288 m: 2 ♂ 6.1 and 8.0 mm; 1 ov. ♀ 7.5 mm.

DISTRIBUTION. — Previously known from New Caledonia, Loyalty Islands, Chesterfield Islands, Wallis and Futuna Islands, between 59 and 850 m. The present material was caught at depths between 281 and 419 m.

Munida pagesi Macpherson, 1994

Munida pagesi Macpherson, 1994: 507, fig. 37.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1047, 486-494 m: 1 ♂ 16.8 mm; 1 ov. ♀ 14.8 mm.

DISTRIBUTION. — The species has previously been cited in New Caledonia and Loyalty Islands, between 250 and 600 m. The specimens from Vanuatu were obtained at 486-494 m.

Munida rhodonia Macpherson, 1994

Figs 4 c-d

Munida rhodonia Macpherson, 1994: 517, figs 13a, 43, 81.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 975, 536-566 m: 3 ♂ 8.0 to 10.6 mm; 3 ov. ♀ 8.7 to 12.1 mm; 1 ♀ 12.4 mm. — Stn 986, 602-648 m: 1 ♂ 10.8 mm. — Stn 1027, 550-571 m: 1 ♂ 6.8 mm; 2 ov. ♀ 10.3 and 12.3 mm; 5 ♀ 8.6 to 12.5 mm. — Stn 1028, 624-668 m: 1 ov. ♀ 11.2 mm. — Stn 1045, 459-488 m: 1 ♂ 6.7 mm. — Stn 1047, 486-494 m: 3 ♂ 7.5 to 9.2 mm; 1 ov. ♀ 12.1 mm; 1 ♀ 7.8 mm. — Stn 1049, 469-525 m: 1 ♂ 9.8 mm. — Stn 1050, 541-577 m: 1 ov. ♀ 14.3 mm; 1 ♀ 8.3 mm. — Stn 1051, 555-558 m: 1 ♂ 11.0 mm; 3 ♀ 7.9 to 13.5 mm. — Stn 1055, 572-580 m: 2 ov. ♀ 8.3 and 11.4 mm. — Stn 1073, 630-650 m: 1 ♂ 6.8 mm; 2 ov. ♀ 12.4 and 13.0 mm. — Stn 1089, 494-516 m: 4 ♀ 6.2 to 11.0 mm. — Stn 1090, 470-502 m: 1 ♂ 10.4 mm; 1 ov. ♀ 10.6 mm. — Stn 1124, 532-599 m: 5 ♂ 7.7 to 10.0 mm; 4 ov. ♀ 9.3 to 14.2 mm.

REMARKS. — The colour pattern of the specimens photographed in Vanuatu generally agrees with the type description. However, the female (CL, 9.0 mm) from Stn 1027, have some red spots on gastric, cardiac and branchial regions and a median white band on the second to fourth abdominal segments. These red spots and white band are less conspicuous in an ovigerous female (CL, 10.3 mm) from the same station. Both specimens have the distal part of the rostrum and supraocular spines white. These spots and bands are absent in the specimens from New Caledonia. No other morphological differences between New Caledonia and Vanuatu specimens were observed.

DISTRIBUTION. — Previously cited in New Caledonia, Loyalty Islands and Chesterfield Islands, between 475 and 705 m. The material examined here was collected at 459-668 m.

Munida rogeri Macpherson, 1994

Munida rogeri Macpherson, 1994: 518, fig. 44.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 962, 370-400 m: 1 ♂ 4.6 mm.

DISTRIBUTION. — Previously known from New Caledonia, Loyalty Islands and Chesterfield Islands, between 245 and 390 m. The material from Vanuatu was collected at 370-400 m.

Munida rosula Macpherson, 1994

Munida rosula Macpherson, 1994: 521, figs 45, 82; 1995: 404.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 992, 748-775 m: 4 ♂ 8.4 to 14.4 mm; 4 ov. ♀ 14.4 to 16.0 mm; 6 ♀ 7.3 to 12.3 mm. — Stn 993, 780-783 m: 1 ♂ 13.3 mm. — Stn 996, 764-786 m: 2 ♂ 10.0 and 14.8 mm; 3 ♀ 9.6 to 15.3 mm. — Stn 1007, 720-830 m: 1 ♀ 16.5 mm. — Stn 1035, 765-780 m: 1 ♂ 11.0 mm; 4 ov. ♀ 14.5 to 17.0 mm; 1 ♀ 10.6 mm. — Stn 1056, 602-620 m: 3 ♂ 12.2 to 15.4 mm. — Stn 1073, 630-650 m: 6 ♂ 8.0 to 14.4 mm; 1 ov. ♀ 15.7 mm; 1 ♀ 10.4 mm. — Stn 1080, 799-850 m: 3 ♂ 11.7 to 16.8 mm; 3 ov. ♀ 13.4 to 16.7 mm; 5 ♀ 8.1 to 17.7 mm.

DISTRIBUTION. — The species has previously been cited in New Caledonia, Loyalty Islands, Chesterfield Islands and Wallis and Futuna area, between 465 and 860 m. The specimens from Vanuatu were caught at 602-850 m.

Munida rubrodigitalis Baba, 1994

Fig. 4 e

Munida rubrodigitalis Baba, 1994: 13, fig. 6. — MACPHERSON, 1997: 610.
Munida sp. - MACPHERSON, 1994: 558, figs 13b, 90.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 974, 490-520 m: 3 ♂ 9.6 to 13.6 mm; 3 ov. ♀ 13.2 to 13.4 mm; 1 ♀ 9.3 mm. — Stn 983, 475-480 m: 2 ♂ 10.0 and 11.2 mm; 2 ov. ♀ 12.9 and 13.0 mm; 1 ♀ 5.9 mm. — Stn 984, 480-544 m: 3 ♂ 9.5 to 11.1 mm; 3 ov. ♀ 12.2 to 12.5 mm; 1 ♀ 11.6 mm. — Stn 985, 536-563 m: 1 ♂ 6.4 mm. — Stn 1047, 486-494 m: 1 ♂ 11.7 mm; 1 ov. ♀ 11.8 mm; 2 ♀ 10.2 and 12.0 mm. — Stn 1049, 469-525 m: 1 ov. ♀ 11.5 mm; 1 ♀ 8.8 mm. — Stn 1088, 425-455 m: 3 ♂ 7.8 to 10.2 mm. — Stn 1089, 494-516 m: 1 ov. ♀ 13.3 mm. — Stn 1090, 470-502 m: 1 ov. ♀ 14.3 mm.

REMARKS. — The specimens from Vanuatu generally agree with the type description and the specimens from New Caledonia and Indonesia. However, the specimen photografed (male, CL, 6.4 mm, Stn 985) has a longitudinal median white band from the epigastric region to the fourth abdominal segment. This band is absent in the New Caledonia material.

DISTRIBUTION. — The species has previously been cited in Eastern Australia, Indonesia, New Caledonia and Loyalty Islands, between 285 and 503 m. The specimens from Vanuatu were obtained at 425-563 m.

Munida rufiantennulata Baba, 1969

Munida rufiantennulata Baba, 1969: 23, fig. 7; 1988: 128; 1989: 131. — MACPHERSON, 1994: 523, figs 46, 83; 1997: 610.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 988, 372-466 m: 2 ♂ 4.2 and 8.3 mm.

DISTRIBUTION. — Previously known from Japan, Philippines, Indonesia, New Caledonia, Loyalty Islands, Chesterfield Islands, Matthew and Hunter Islands, between 205 and 610 m. The material examined here was collected at 372-466 m.

Munida runcinata Macpherson, 1994

Munida runcinata Macpherson, 1994: 525, fig. 47; 1995: 405, fig. 19.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 963, 400-440 m: 6 ♂ 6.5 to 8.7 mm; 6 ov. ♀ 7.4 to 9.7 mm. — Stn 978, 408-413 m: 2 ♂ 7.7 and 8.5 mm; 2 ov. ♀ 6.1 and 6.8 mm; 1 ♀ 6.6 mm. — Stn 988, 372-466 m: 1 ov. ♀ 7.8 mm. — Stn 1025, 385-410 m: 9 ♂ 6.7 to 9.5 mm; 3 ov. ♀ 7.6 to 9.3 mm; 2 ♀ 6.6 and 7.1 mm. — Stn 1035, 282-375 m: 1 ♂ 6.3 mm; 1 ov. ♀ 7.8 mm. — Stn 1043, 350-372 m: 1 ov. ♀ 8.1 mm. — Stn 1065, 360-419 m: 3 ♂ 7.2 to 8.3 mm; 3 ♀ 5.8 to 8.9 mm. — Stn 1087, 394-421 m: 1 ♂ 6.3 mm; 1 ov. ♀ 8.7 mm. — Stn 1135, 282-375 m: 1 ♂ 6.3 mm; 1 ov. ♀ 8.7 mm. — Stn 1137, 360-371 m: 1 ♂ 10.2 mm; 1 ov. ♀ 8.2 mm; 3 ♀ 6.6 to 7.7 mm.

DISTRIBUTION. — Previously cited in New Caledonia, Loyalty Islands, Wallis and Futuna Islands, between 245 and 500 m. The specimens from Vanuatu were collected between 282 and 466 m.

Munida sao Macpherson, 1994

Munida sao Macpherson, 1994: 529, fig. 49.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 971, 250-315 m: 1 ov. ♀ 7.5 mm. — Stn 1026, 437-504 m: 1 ♂ 6.3 mm; 3 ov. ♀ 11.4 to 16.0 mm; 1 ♀ 5.7 mm. — Stn 1061, 458-512 m: 2 ♂ 8.6 and 9.4 mm. — Stn 1070, 184-190 m: 3 ♂ 5.8 to 9.9 mm; 1 ♀ 7.4 mm. — Stn 1086, 182-215 m: 6 ♂ 6.0 to 7.4 mm; 3 ♀ 4.7 to 7.9 mm. — Stn 1088, 425-455 m: 1 ♂ 14.3 mm; 6 ov. ♀ 10.0 to 12.6 mm. — Stn 1089, 494-516 m: 1 ♂ 14.2 mm. — Stn 1095, 304-320 m: 1 ov. ♀ 7.8 mm. — Stn 1098, 277-285 m: 2 ♂ 5.8 and 9.0 mm; 1 ov. ♀ 6.3 mm; 1 ♀ 6.0 mm. — Stn 1107, 397-402 m: 2 ♂ 12.3 and 15.1 mm; 1 ov. ♀ 11.6 mm. — Stn 1136, 398-400 m: 9 ♂ 8.3 to 15.4 mm; 6 ov. ♀ 8.8 to 13.0 mm; 1 ♀ 10.4 mm. — Stn 1137, 360-371 m: 6 ♂ 9.3 to 12.1 mm; 2 ov. ♀ 10.4 and 10.5 mm; 1 ♀ 13.0 mm.

DISTRIBUTION. — Known from New Caledonia, between 165 and 260 m. The material from Vanuatu was obtained from 182-516 m.

Munida sacksi Macpherson, 1993

Munida sacksi Macpherson, 1993: 438, fig. 6; 1994 : 438 (key).

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1047, 486-494 m: 1 ov. ♀ 11.5 mm. — Stn 1124, 532-599 m: 1 ♀ 10.4 mm. — Stn 1135, 282-375 m: 1 ♀ 5.6 mm.

DISTRIBUTION. — Previously known from the Philippines and New Caledonia, between 300 and 550 m. The present material has been collected at 486-599 m.

Munida semoni Ortmann, 1894

Munida semoni - MACPHERSON & BABA, 1993: 411, fig. 17 (references). — MACPHERSON, 1994: 530; 1995: 405.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 971, 250-315 m: 1 ♀ 7.8 mm. — Stn 1071, 180-191 m: 1 ♂ 9.3 mm; 1 ♀ 7.6 mm. — Stn 1077, 180-210 m: 2 ♂ 7.4 and 8.9 mm; 1 ov. ♀ 9.5 mm; 1 ♀ 10.2 mm. — Stn 1078, 194-230 m: 1 ♂ 8.4 mm. — Stn 1102, 208-210 m: 2 ♂ 7.3 and 8.2 mm. — Stn 1118, 191-248 m: 1 ♀ 6.3 mm. — Stn 1119, 254-300 m: 16 ♂ 5.4 to 8.3 mm; 6 ov. ♀ 6.1 to 7.6 mm; 1 juv. 3.1 mm.

DISTRIBUTION. — The species has been cited in Indonesia, New Caledonia and Futuna Island, between 245 and 440 m. The specimens from Vanuatu were caught at 180-315 m.

Munida tuberculata Henderson, 1885

Munida tuberculata - MACPHERSON, 1994: 547, fig. 58 (references); 1995: 408.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 974, 492-520 m: 1 ♂ 3.8 mm. — Stn 985, 536-563 m: 1 ♀ 3.9 mm. — Stn 1027, 550-571 m: 2 ♂ 3.6 and 3.8 mm.

DISTRIBUTION. — The species has previously been cited in Fiji, New Caldonia, Matthew and Hunter Islands, Wallis and Futuna area, between 420 and 650 m. The material studied here was collected at 492-571 m.

Munida tyche Macpherson, 1994

Munida tyche Macpherson, 1994: 549, fig. 59; 1995: 408, fig. 22.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 962, 370-400 m: 1 ♂ 12.3 mm. — Stn 1042, 200-260 m: 3 ♂ 6.3 to 8.5 mm; 2 ov. ♀ 6.1 and 7.7 mm; 1 ♀ 6.0 mm. — Stn 1131, 140-175 m: 4 ♂ 4.4 to 7.1 mm; 1 ov. ♀

10.1 mm; 1 ♂ 5.7 mm; 2 juv. 3.2 and 3.4 mm. — Stn 1132, 161-182 m: 1 ♂ 6.0 mm. — Stn 1133, 174-210 m: 1 ♂ 9.2 mm; 1 ♀ 7.2 mm.

DISTRIBUTION. — Known from New Caledonia, Chesterfield Islands and Futuna Island, between 200 and 440 m. The material from Vanuatu was obtained from 140-400 m.

Munida typhle Macpherson, 1994

Munida typhle Macpherson, 1994: 549, fig. 60.

MATERIAL EXAMINED. — **Vanuatu**. MUSORSTOM 8: stn 1111, 1210-1250 m: 1 ov. ♀ 11.2 mm.

DISTRIBUTION. — Previously known from New Caledonia, between 1395 and 1470 m. The specimen from Vanuatu was collected at 1210-1250 m.

ACKNOWLEDGEMENTS

I am very grateful to A. CROSNIER and B. RICHER DE FORGES of ORSTOM for their support and help and for making this interesting material available to me. Thanks are also due to M.K. WICKSTEN (Texas A&M University) and K. BABA (Kumamoto University) for their improvements to the manuscript. The species have been illustrated by J. MACPHERSON and J.L. MENOU of ORSTOM took the colour photographs.

REFERENCES

ALCOCK, A., 1894. — Natural History notes from H.M. Indian Marine Survey Steamer "Investigator", commander R.F. Hoskyn, R.N., commanding. Series II, No. 1. On the results of deep-sea dredging during the season 1890-91 (continued). *Annals and Magazine of Natural History*, (6) **13**: 321-334.

BABA, K., 1969. — Four new genera with their representatives and six new species of the Galatheidae in the collection of the Zoological Laboratory, Kyushu University, with redefinition of the genus *Galathea*. *OHMU, Occasional Papers of the Zoological Laboratory of the Faculty of Agriculture, Kyushu University*, **2** (1): 1-32.

BABA, K., 1988. — Chirostylid and Galatheid Crustaceans (Decapoda: Anomura) of the "Albatross" Philippine Expedition, 1907-1910. *Researches on Crustacea*, Special Number **2**: v + 203 pp.

BABA, K., 1989. — Anomuran Crustaceans obtained by dredging from Oshima Strait, Amami-Oshima of the Ryukyu Islands. *Memoirs of the National Science Museum, Tokyo*, **22**: 127-134.

BABA, K., 1994. — Deep-sea Galatheid crustaceans (Anomura: Galatheidae) collected by the 'Cidaris I' expedition off central Queensland, Australia. *Memoirs of the Queensland Museum*, **35**: 1-21.

BABA, K., & MACPHERSON, E., 1991. — Reexamination of the type material of *Munida militaris* Henderson, 1885 (Crustacea: Decapoda: Galatheidae), with the selection of a lectotype. *Proceedings of the Biological Society of Washington*, **104**: 538-544.

BABA, K., & DE SAINT LAURENT, M., 1996. — Crustacea Decapoda : Revision of the genus *Bathymunida* Balss, 1914, with six new related genera (Galatheidae). *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Vol. 15. *Mémoires du Muséum national d'Histoire naturelle*, **168**: 433-502.

BRUCE, A.J., 1975. — Coral reef shrimps and their colour patterns. *Endeavor*, **34**: 23-27.

HENDERSON, J. R., 1885. — Diagnoses of the new species of Galatheidea collected during the "Challenger" Expedition. *Annals and Magazine of Natural History*, (5) **16**: 407-421.

HENDERSON, J. R., 1888. — Report on the Anomura Collected by H.M.S. Challenger During the Years 1873-76. *Report of Scientific Results of H.M.S. Challenger*, Zoology, **27**: vi + 221 pp., 21 pls.

KNOWLTON, N., 1986. — Cryptic and sibling species among the decapod Crustacea. *Journal of Crustacean Biology*, **6**: 356-363.

MACPHERSON, E., 1993. — Crustacea Decapoda : Species of the genus *Munida* Leach, 1820 (Galatheidae) collected during the MUSORSTOM and CORINDON cruises in the Philippines and Indonesia. *In*:: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Vol. 10. *Mémoires du Muséum national d'Histoire naturelle,* **156**: 421-442.

MACPHERSON, E., 1994. — Crustacea Decapoda : Studies on the genus *Munida* Leach, 1820 (Galatheidae) in New Caledonian and adjacents waters with descriptions of 56 new species. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Vol. 12. *Mémoires du Muséum national d'Histoire naturelle,* **161**: 421-569.

MACPHERSON, E., 1995. — Crustacea Decapoda : Species of the genera *Munida* Leach, 1820 and *Paramunida* Baba, 1988 (Galatheidae) from Wallis and Futuna. *In*:: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Vol. 15. *Mémoires du Muséum national d'Histoire naturelle,* **168**: 387-421.

MACPHERSON, E., 1997. Crustacea Decapoda: Species of the genera *Agononida* Baba & de Saint Laurent, 1996 and *Munida* Leach, 1820 (Galatheidae) from KARUBAR Cruise. *In*: A. CROSNIER & P. BOUCHET (eds.), Résultats des Campagnes MUSORSTOM, Volume 16. *Mémoires du Muséum national d'Histoire naturelle,* **172**: 597-612.

MACPHERSON, E., & BABA, K., 1993. — Crustacea Decapoda : *Munida japonica* Stimpson, 1858, and related species (Galatheidae). *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, vol. 10. *Mémoires du Muséum national d'Histoire naturelle,* **156**: 381-420.

MACPHERSON, E., & DE SAINT LAURENT, M., 1991. — Galatheid crustaceans of the genus *Munida* from French Polynesia. *Bulletin du Muséum national d'Histoire naturelle, Paris*, (4), sect. A, **13** (3-4): 373-422.

ORTMANN, A., 1894. — Crustaceen. *In* : SEMON, R., Zoologische Forschungsreisen in Australien und dem malayischen Archipel. *Denkschriften der Medizinisch-Naturwissenschaftlichen Gesellschaft zu Jena,* **8**: 3-80, pls. 1-3.

RICE, A. I., & DE SAINT LAURENT, M., 1986. — The nomenclature and diagnostic characters of four north-eastern Atlantic species of the genus *Munida* Leach : *M. rugosa* (Fabricius), *M. tenuimana* G.O. Sars, *M. intermedia* A. Milne Edwards and Bouvier, and *M. sarsi* Huus (Crustacea Decapoda Galatheidae). *Journal of Natural History*, **30**: 143-163.

RICHER DE FORGES, B., FALIEX, E., & MENOU, J.L., 1995. — La campagne MUSORSTOM 8 dans l'archipel de Vanuatu. Compte rendu et liste des stations. *In*:: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, vol. 15. *Mémoires du Muséum national d'Histoire naturelle,* **168**: 9-32.

ZARIQUIEY ALVAREZ, R., 1952. — Estudio de las especies europeas del gen. *Munida* Leach 1818. *Eos*, **28**: 143-231.

9

Crustacea Decapoda: Revision of the Family Dynomenidae

Colin L. McLAY

Department of Zoology
University of Canterbury
Christchurch, New Zealand

ABSTRACT

The Dynomenidae are a group of small, uncommon, primitive crabs, which are often associated with corals. They inhabit depths down to around 500 m, between latitudes 40°N and 40°S. All genera and species are revised and redescribed, and the genus *Dynomene* Desmarest, 1823 is divided into two additional genera. As a result, there are thirteen known species belonging to five genera: *Dynomene* Desmarest, 1823 [*D. hispida* Guérin-Méneville, 1832, *D. praedator* A. Milne Edwards, 1879, *D. pugnatrix* de Man, 1889, *D. filholi* Bouvier, 1894, and *D. pilumnoides* Alcock, 1900], *Hirsutodynomene* gen. nov. [*H. spinosa* (Rathbun, 1911), and *H. ursula* (Stimpson, 1860)], *Metadynomene* gen. nov. [*M. devaneyi* (Takeda, 1977), *M. tanensis* (Yokoya, 1933), and *M. crosnieri* sp. nov.], *Acanthodromia* A. Milne Edwards, 1880 [*A. erinacea* A. Milne Edwards, 1880, and *A. margarita* (Alcock, 1899)], and *Paradynomene* Sakai, 1963 [*P. tuberculata* Sakai, 1963]. A key is provided to identify these species. In addition nine fossil genera, dating from the Upper Jurassic, are known: *Stephanometopon* Bosquet, 1854, *Dromiopsis* Reuss, 1859, *Palaeodromites* A. Milne Edwards, 1865, *Cyamocarcinus* Bittner, 1883, *Graptocarcinus* Roemer, 1887, *Cyclothyreus* Remes, 1895, *Gemmellarocarcinus* Checchia-Rispoli, 1905, *Glyptodynomene* Van Straelen, 1944, *Trachynotocarcinus* Wright & Collins, 1972. Some extinct species have also been placed in the genus *Dynomene*. The definition of the family Dynomenidae given by ALCOCK (1901) is updated and expanded in order to allow fossil species to be more accurately determined. Because of overlap with the Dromiidae, there has been some uncertainty about true family affinities of some fossils. Although these genera are in need of revision, this is not undertaken in this paper.

The status of *Dynomene pilumnoides* is established as a valid species, *D. pugnatrix brevimana* Rathbun, 1911 is synonymized with *D. pugnatrix* de Man, 1889, *D. granulobata* Dai, Yang & Lan, 1981 is a synonym of *D. hispida,* while *D. sinensis* Chen, 1979, *D. tenuilobata* Dai, Yang & Lan, 1981, and *D. huangluensis* Dai, Cai & Yang, 1996 are all synonyms of *D. praedator*. Dynomenids are reported from Australia for the first time in *D. pilumnoides*, and *Hirsutodynomene spinosa*. The status of *Metadynomene tanensis* (Yokoya, 1933) is established as a widespread Pacific species and shown to be part of the fauna of Japan, where it has been confused with *D. praedator*. *Paradynomene tuberculata*, previously known from Japan and New Caledonia, is now recorded from the Gulf of Aden, Indian Ocean. *P. tuberculata* as well as *D. praedator* and *H. spinosa*, are reported from Guam. The Atlantic Ocean and the Indo-Pacific share genera of dynomenids but not species. The biogeographic history of dynomenids is interpreted

McLAY, C. L., 1999. — Crustacea Decapoda: Revision of the Family Dynomenidae. *In* : A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*, **180**: 427-569. Paris ISBN 2-85653-520-8.

in the light of their present distribution and in relation to plate tectonics. Ancestral dynomenids are assumed to have been tethyan crabs and *D. filholi* and *Acanthodromia erinacea*, two insular Atlantic species, are shown to be tethyan relicts. By contrast, *Hirsutodynomene ursula* from the eastern Pacific, seems to be a species of quite recent origin.

In redescribing the species particular attention is paid to some new characters: setae, gills, epipods and gill cleaning mechanisms, the subchelate structure of the last pereopods and the male pleopods. This work was undertaken using a scanning electron microscope. Differences in the gross appearance of setae can be used to separate species and there are substantial differences in setal structure at the microscopic level. The standard branchial formula for dynomenids is shown to be nineteen gills plus seven epipods. There is little variation in gill numbers but substantial variation in gill shape between species. Although dynomenid gills are often said to be "transitional" they are arranged as in phyllobranchs but with the epibranchial part divided into varying numbers of lobes which gives them a trichobranch-like appearance. *Acanthodromia* has gills which are almost identical to the phyllobranchs of the Dromiidae but which retain the "dynomenid notch" on each side which, in cross section, give each gill plate a violin shape. The gill cleaning mechanism in dynomenids is complex, being carried out by no less than eight appendages (long setae on the posterior margin of the scaphognathite and the seven epipods) as well as stiff setae on the posterior hypobranchial wall of the gill chamber. In eubrachyurans only three appendages (maxillipodal epipods) are used.

In dynomenids the last pereopod is very reduced (on average less than one-third the length of the fourth pereopod) and carried in a horizontal position alongside the posterolateral carapace margin above the base of the preceding pereopod. They are not, as it has been commonly described, carried subdorsally. Using a scanning electron microscope it was revealed that this limb is sexually dimorphic: in males the dactyl has the normal shape of a tiny claw, but in females the dactyl is a flattened plate, bearing five to sixteen spines which are opposable to an extension of the propodus. In both males and females the propodal extension is armed with spines but in *Hirsutodynomene*, *Metadynomene* and *Paradynomene*, females have a significantly larger number of spines, which are armed with tiny teeth. Males of three species have an additional small spine on the outer margin of the dactyl. This is a character, previously only known amongst the Dromiidae, which suggests that the last pereopod of dynomenids may have evolved from a camouflage-carrying limb. This limb appears to be vestigial and it is difficult to know what its function may have been amongst the dynomenid ancestors. However its most likely former role appears to be as a cleaning appendage, but certainly not for carrying pieces of camouflage as it is found amongst the dromiids and homolids.

All dynomenids, except *Acanthodromia*, lack an effective abdominal locking mechanism and both sexes have five pairs of pleopods. The female has vestigial, uniramous first pleopods followed by four pairs of normal biramous pleopods, while the male has the normal first two pairs of pleopods as well as three pairs of rudimentary pleopods on segments three to five. These rudimentary pleopods can be uniramous or bifid. In *Metadynomene tanensis* 17% of females were gynandromorphs with small male first pleopods but the remaining pleopods were normal.

The diet of dynomenids seems to consist of food obtained by sieving fine sediment or perhaps coral mucus. The bunches of stiff setae on the inner margins of the cheliped fingers and third maxillipeds are probably used to separate fine organic fragments. Most of their gut contents are unidentifiable soft organic material along with small amounts of chopped chitinous fragments perhaps coming from hydroids or other crustaceans. Dynomenids appear to be deposit feeders.

Dynomenids have a broadcast reproductive strategy, with indirect development, laying small eggs (mean diameter = 0.49 mm) which probably produce planktonic larvae. Dynomenid larvae have never been reported in plankton samples. Males are on average 19% larger than females which become sexually mature at 5-8 mm CW for small species, or 9-13 mm CW for large species. Egg numbers increase logarithmically with body size. Given the sister group relationship with homolodromiids (which have very abbreviated development) it is implied that dynomenids and dromiids evolved from ancestors which had large eggs and perhaps a brooding strategy. This conclusion is contrary to accepted wisdom, but it is the most parsimonious answer. Some dromiids have retained the brooding strategy but others have independently evolved a broadcast strategy. The evolution of such a strategy in both these families is probably related to their colonization of the shallow water habitat. Both dynomenids and dromiids are mostly crabs of the continental shelf whereas homolodromiids are crabs of the continental slope.

Using morphological characters the phylogenetic relationships of the Dynomenidae are examined. Both the Dynomenidae and the Dromiidae are monophyletic, sharing significant apomorphies. The resemblance of some dynomenids and dromiids is shown to be the result of convergent evolution within these families. The Homolodromiidae are also monophyletic but are defined almost exclusively by plesiomorphies. Monophyly of the Dromiacea de Haan, 1833 is supported by morphological characters with the Dynomenidae and Dromiidae together being the sister group of the Homolodromiidae. The ancestor of these three families was probably a camouflage carrying crab, using both of the last two pairs of pereopods. A controversial aspect of the sister group relationships of the dromiaceans is the need to assume that in dynomenids the fourth pereopod has reverted to a locomotory role and the fifth pereopod became a cleaning limb. Monophyly of the Podotremata Guinot, 1977 is also supported. This analysis suggests that camouflage-carrying behaviour has evolved independently in the Dromiidae (and probably in the Homolodromiidae) and the Homolidae. Dromiids carry pieces of sponges or ascidians as well as shells, using the last two pairs of pereopods, while homolids carry sponges or anemones, using only the last pair of pereopods. The ancestor of the Dromiacea and Archaeobrachyura was probably an inhabitant of deeper waters and not a camouflage carrying crab.

RÉSUMÉ

Crustacea Decapoda: Révision de la famille Dynomenidae.

Les Dynomenidae forment un groupe de petits crabes primitifs, peu communs, souvent associés au corail. Ils habitent des profondeurs n'excédant pas les 500 m, à des latitudes comprises entre 40°N et 40°S. Tous les genres et toutes les espèces sont révisés et redécrits. Le genre *Dynomene* Desmarest, 1823, est divisé et deux nouveaux genres sont créés. Finalement, les treize espèces connues sont réparties en cinq genres : *Dynomene* Desmarest, 1823 [*D. hispida* Guérin-Méneville, 1832; *D. praedator* A. Milne Edwards, 1879; *D. pugnatrix* de Man, 1889; *D. filholi* Bouvier, 1894; *D. pilumnoides* Alcock, 1900]; *Hirsutodynomene* gen. nov. [*H. spinosa* (Rathbun, 1911) et *H. ursula* (Stimpson, 1860)]; *Metadynomene* gen. nov. [*M. devaneyi* (Takeda, 1977); *M. tanensis* (Yokoya, 1933) et *M. crosnieri* sp. nov.]; *Acanthodromia* A. Milne Edwards, 1880 [*A. erinacea* A. Milne Edwards, 1880 et *A. margarita* (Alcock, 1899)] et *Paradynomene* Sakai, 1963 [*P. tuberculata* Sakai, 1963]. Une clef permet d'identifier les diverses espèces. Neuf genres fossiles attribués aux Dynomenidae sont connus du Jurassique supérieur : *Stephanometopon* Bosquet, 1854; *Dromiopsis* Reuss, 1859; *Palaeodromites* A. Milne Edwards, 1865; *Cyamocarcinus* Bittner, 1883; *Graptocarcinus* Roemer, 1887; *Cyclothyreus* Remes, 1895; *Gemmellarocarcinus* Checchia-Rispoli, 1905; *Glyptodynomene* Van Straelen, 1944; *Trachynotocarcinus* Wright & Collins, 1972. Enfin, quelques espèces éteintes ont été rapportées au genre *Dynomene*. La définition originale de la famille des Dynomenidae, donnée par ALCOCK (1901), est mise à jour et étendue afin de pouvoir y accueillir les espèces fossiles. Les véritables affinités de certains fossiles sont incertaines et difficiles à interpréter en raison de confusions possibles avec les Dromiidae. Bien qu'une révision de ces genres fossiles s'avère nécessaire, il n'a pas été possible de l'entreprendre dans le cadre du présent travail.

Dynomene pilumnoides est établie comme une espèce valide. *D. pugnatrix brevimana* Rathbun, 1911, est mise en synonymie avec *D. pugnatrix* de Man, 1889. *D. granulobata* Dai, Yang & Lan, 1981, est synonyme de *D. hispida,* tandis que *D. sinense* Chen, 1979, *D. tenuilobata* Dai, Yang & Lan, 1981, et *D. huangluensis* Dai, Cai & Yang, 1996, sont synonymes de *D. praedator*. Pour la première fois, des Dynomenidae sont signalés d'Australie, à savoir *D. pilumnoides* et *Hirsutodynomene spinosa*. Le statut de *Metadynomene tanensis* (Yokoya, 1933) est bien établi : il s'agit d'une espèce largement répandue dans le Pacifique et qui, au Japon, avait été confondue avec *D. praedator*. *Paradynomene tuberculata*, auparavant connue du Japon et de Nouvelle-Calédonie, est signalée du golfe d'Aden. *P. tuberculata* ainsi que *D. praedator* et *H. spinosa* sont signalées de Guam. L'Atlantique et l'Indo-Pacifique partagent des genres mais non des espèces de Dynomenidae. L'histoire biogéographique des Dynomenidae est tracée à la lumière de leur distribution actuelle et des phénomènes liés à la tectonique des plaques. Les représentants ancestraux des Dynomenides sont supposés avoir été des formes de la Téthys. *D. filholi* ainsi qu'*Acanthodromia erinacea*, deux espèces insulaires de l'Atlantique, apparaissent comme des reliques téthysiennes. En revanche, *Hirsutodynomene ursula*, du Pacifique oriental, serait une espèce d'origine très récente.

Lors de la description des espèces, nous avons considéré de nouveaux caractères (soies, branchies, épipodites, mécanisme de nettoyage des branchies, structure subchéliforme du dernier péréiopode, pléopodes mâles) et complété nos observations par leur étude en microscopie électronique à balayage. Visibles à l'œil nu et au binoculaire, les différences dans l'apparence des soies, qui peuvent être utilisées pour séparer les espèces, se révèlent à l'échelle microscopique comme représentant des structures très variées et bien distinctes. La formule branchiale standard pour les branchies est de 19 branchies plus sept épipodites. Il y a peu de variations dans leur nombre; mais de substantielles variations dans leur forme distinguent les espèces. Bien qu'elles soient souvent qualifiées comme étant d'un type intermédiaire, les branchies dynoméniennes sont disposées comme des phyllobranchies à la différence que la partie épibranchiale est divisée en un nombre varié de lobes, ce qui leur donne une apparence de trichobranchies. *Acanthodromia* a des branchies presque identiques aux phyllobranchies des Dromiidae mais conservant l'*encoche dynoménienne* de chaque côté, ce qui, en coupe, donne à chaque branchie la forme d'un violon. Chez les Dynomenidae le mécanisme de nettoyage des branchies est complexe, étant réalisé par non moins de huit appendices (longues soies sur le bord postérieur du scaphognathite et des sept épipodites) aussi bien que par des soies raides sur la paroi hypobranchiale postérieure de la chambre branchiale. Chez les Eubrachyura, seuls trois appendices (épipodites des maxillipèdes) sont utilisés.

Chez les Dynomenidae, la dernière paire de péréiopodes est très réduite (en moyenne inférieure au tiers de la longueur du quatrième péréiopode) et disposée horizontalement le long du bord postérolatéral de la carapace, au-dessus du péréiopode précédent. L'observation en microscopie électronique a révélé que cet appendice est sexuellement dimorphique : chez le mâle, le dactyle a la forme normale d'une petite pince tandis que, chez la femelle, le dactyle est une pièce aplatie qui porte de cinq à seize épines opposables à une expansion du propode. Dans les deux sexes, l'expansion du propode est armée d'épines; mais, dans les genres *Hirsutodynomene*, *Metadynomene* et *Paradynomene*, les femelles ont un nombre plus élevé d'épines, elles-mêmes armées de très petites dents. Le mâle de trois espèces a une épine supplémentaire sur le bord externe du dactyle, ce qui était jusqu'alors un caractère connu seulement chez les Dromiidae et suggère que le dernier péréiopode des Dynomenidae pourrait provenir de l'évolution d'un appendice destiné à porter des pièces de camouflage. Le dernier péréiopode se présente bien comme un appendice vestigial, et il est difficile de savoir quelle fonction il pouvait assumer chez les Dynomenidae ancestraux. Son rôle le plus probable serait celui d'un appendice nettoyeur, et certainement pas celui d'un appendice transportant un objet pour le camouflage, comme c'est le cas chez les Dromiidae et les Homolidae.

Tous les Dynomenidae, à l'exception des *Acanthodromia*, sont dépourvus d'un appareil de maintien de l'abdomen. Les deux sexes portent cinq paires de pléopodes. La femelle possède une première paire de pléopodes uniramés, vestigiaux, suivie de quatre paires de pléopodes normalement biramés, alors que le mâle a les deux paires normales de pléopodes sexuels ainsi que trois paires de pléopodes vestigiaux sur les segments 3 à 5. Ces pléopodes vestigiaux peuvent être uniramés ou bifides. Chez *Metadynomene tanensis* 17% des femalles sont gynandromorphes, avec de petits premiers pléopodes de type mâle tandis que les autres pléopodes sont normaux.

L'alimentation des Dynomenidae paraît consister en nourriture obtenue en filtrant les sédiments fins ou peut-être le mucus des coraux. Les touffes de soies raides sur le bord interne des doigts des chélipèdes et sur les troisièmes maxillipèdes sont probablement utilisées pour séparer les fragments organiques. L'estomac contient en majorité du matériel organique mou non identifiable en même temps que de petites quantités de fragments durs de chitine provenant probablement d'hydroïdes ou de crustacés. Les Dynomenidae se présentent comme des détritivores.

Les Dynomenidae ont une reproduction avec développement non abrégé, indirect, et avec de petits œufs (diamètre moyen = 0.49 mm) qui se développent certainement en larves planctoniques. De telles larves dynoméniennes n'ont jamais été trouvées dans le plancton. Les mâles sont en moyenne 19% plus grand que les femelles; ces dernières deviennent sexuellement matures entre 5-8 mm de largeur de carapace pour les espèces de taille peu élevée, entre 9-13 mm pour les plus grandes espèces. Le nombre des œufs augmente de façon logarithmique avec les dimensions du corps. Etant donné la relation de groupe-frère avec les Homolodromiidae, il est probable que l'ensemble que constituent les Dynomenidae et les Dromiidae a évolué à partir d'ancêtres ayant eu de gros œufs. Cette conclusion est contraire à ce qui est communément accepté, mais elle est la réponse la plus parcimonieuse. Cet ensemble (Dynomenidae et Dromiidae) a peut-être eu une stratégie de protection de la ponte. Certains Dromiidae ont conservé une stratégie de protection de la ponte, mais d'autres ont, indépendamment, développé une stratégie de dissémination. L'évolution d'une telle stratégie chez ces deux familles est probablement liée à leur colonisation d'un habitat dans des eaux peu profondes. Aussi bien les Dynomenidae que les Dromiidae sont essentiellement des crabes de la plate-forme continentale, tandis que les Homolodromiidae sont des crabes du talus continental.

Sur la base des caractères morphologiques, les relations phylogénétiques des Dynomenidae sont analysées. Dynomenidae et Dromiidae sont monophylétiques, partageant des apomorphies significatives. La ressemblance de certains Dynomenidae avec les Dromiidae serait le résultat d'une évolution convergente à l'intérieur de ces familles. Les Homolodromiidae sont également monophylétiques mais ils sont presque exclusivement définis par des plésiomorphies. La monophylie des Dromiacea de Haan, 1833, est supportée par des caractères morphologiques, les Dynomenidae et Dromiidae formant, ensemble, le groupe-frère des Homolodromiidae. L'ancêtre de ces trois familles était probablement un crabe qui se camouflait en utilisant ses deux dernières paires de pattes. Les relations de groupe-frère pour les familles de Dromiacea nécessitent d'admettre une réversion pour la quatrième paire de pattes des Dynomenidae puisqu'elle a retrouvé un rôle locomoteur, tandis que la cinquième paire devenait un appendice nettoyeur. La monophylie des Podotremata Guinot, 1977, est corroborée. Cette analyse suggère que le comportement de camouflage par maintien d'un objet au-dessus du corps a évolué indépendamment chez les Dromiidae (et probablement chez les Homolodromiidae) et chez les Homolidae. Les Dromiidae portent des éponges ou des ascidies ainsi que des coquilles, en se servant de leurs deux dernières paires de péréiopodes, tandis que les Homolidae transportent des éponges et des anémones, en se servant seulement de leur dernière paire de péréiopodes. L'ancêtre des Dromiacea et des Archaeobrachyoures était probablement un habitant des eaux profondes et n'était pas un crabe se camouflant grâce au transport d'un objet au-dessus du corps.

TABLE OF CONTENTS

INTRODUCTION 431
HISTORY OF THE DYNOMENIDAE 432
FOSSIL DYNOMENIDAE 434
MATERIAL EXAMINED 435
TERMINOLOGY AND PRESENTATION 435
MORPHOLOGY OF THE DYNOMENIDAE 439
Carapace 439
Setae 441
Antennules, Antennae and Orbits 431
Mouthparts 431
Gills and Epipods 443
Pereopods 449
Female sternal Sutures 454

Abdomen 455
Pleopods 456
Uropods 462
Phylogenetic Relationships 462
Family DYNOMENIDAE 467
Key to the species of the family Dynomenidae 469
Genus ***DYNOMENE*** Desmarest, 1823 471
Dynomene hispida Guérin-Méneville, 1832 473
Dynomene praedator A. Milne Edwards, 1879 481
Dynomene filholi Bouvier, 1894 488
Dynomene pilumnoides Alcock, 1900 494
Dynomene pugnatrix de Man, 1889 500
Genus ***HIRSUTODYNOMENE*** gen. nov. 504
Hirsutodynomene spinosa (Rathbun, 1911) 505
Hirsutodynomene ursula (Stimpson, 1860) 510
Genus ***METADYNOMENE*** gen. nov. 516
Metadynomene devaneyi (Takeda, 1977) 517
Metadynomene tanensis (Yokoya, 1933) 521
Metadynomene crosnieri sp. nov. 530
Genus ***ACANTHODROMIA*** A. Milne Edwards, 1880 534
Acanthodromia erinacea Milne Edwards, 1880 535
Acanthodromia margarita (Alcock, 1899) 539
Genus ***PARADYNOMENE*** Sakai, 1963 542
Paradynomene tuberculata Sakai, 1963 543
DISCUSSION 549
Habitat 549
Diet 549
Reproductive Strategy 550
Depth Distribution 550
Biogeography 552
ACKNOWLEDGEMENTS 556
REFERENCES 557
INDEX 567

INTRODUCTION

Dynomenids are a small group of uncommon primitive crabs living in tropical and warm parts of the Atlantic, Indian and Pacific Oceans. The shallow water species are often associated with reef-building corals, but other species live in deeper waters of the continental shelf. The maximum depth record for a dynomenid is 540 m (for *Acanthodromia erinacea* A. Milne Edwards, 1880). The first species to be described was *Dynomene hispida* Guérin-Méneville, 1832 which was based on a specimen collected from Mauritius, in the Indian Ocean. The family name, Dynomenidae Ortmann, 1892, was not erected until much later, but the type species for the family is *D. hispida*. Until now the family has included three genera: *Dynomene* Desmarest, 1823, *Acanthodromia* A. Milne Edwards, 1880, and *Paradynomene* Sakai, 1963. By far the majority of species have been assigned to the genus *Dynomene*.

In this paper I describe one new dynomenid species, redescribe all of the previously known species, and provide a key for their identification. This work is based on the examination of almost 600 specimens. It began with the collections from New Caledonia, Philippines, Indonesia and Madagascar, held by the Muséum national

d'Histoire naturelle, Paris, but also included specimens from most of the world's major museums. In the literature, dynomenids have been reported from coastal areas bordering all tropical seas except for Australia. In this paper I provide the first records of these crabs from Australian waters. Also many new records for the Pacific islands are included.

Besides the customary features used to describe these crabs, I also include some details of their structure that can only be determined using a scanning electron microscope. This has been particularly helpful in ascertaining the nature of the subchelate mechanism of the reduced fifth pereopods and has revealed that in dynomenids these limbs are sexually dimorphic. The scanning electron microscope has also been very helpful in elucidating the fine structure of setae, gills and male pleopods. Some information about the diet and reproductive strategy is also included.

Despite their occurrence in shallow tropical waters the larval stages of dynomenids have never been collected in the field. The only information comes from larvae dissected from advanced stage eggs of *Acanthodromia erinacea* (see RICE, 1981). The lack of information about larval development, which could be useful in aiding the determination of phylogenetic relationships, is a major gap in our knowledge of this family.

This work follows on from a study of the Dromiidae (McLAY, 1993) which are regarded as the sister group of the Dynomenidae. With the recent completion of a major review of the Homolodromiidae (GUINOT, 1995) the opportunity is taken to explore the phylogenetic relationships between all three families of the Dromiacea sensu DE HAAN.

HISTORY OF THE DYNOMENIDAE

The following is a chronological list of recent genera and species (where appropriate the valid name is shown in brackets):

Genus ***DYNOMENE*** Desmarest, 1823
- *D. hispida* Guérin-Méneville, 1832 (type species of the genus).
- *D. latreillii* Eydoux & Souleyet, 1842 [= *D. hispida* Guérin-Méneville, 1832].
- *D. ursula* Stimpson, 1860 [= *Hirsutodynomene ursula* (Stimpson, 1860)].
- *D. praedator* A. Milne Edwards, 1879.
- *D. pugnatrix* de Man, 1889.
- *D. filholi* Bouvier, 1894.
- *D. margarita* Alcock, 1899 [= *Acanthodromia margarita* (Alcock, 1899)].
- *D. pilumnoides* Alcock, 1900.
- *D. platyarthrodes* Stebbing, 1905 [= *Speodromia platyarthrodes* (Stebbing, 1905)].
- *D. pugnatrix brevimana* Rathbun, 1911 [= *D. pugnatrix* de Man, 1889].
- *D. spinosa* Rathbun, 1911 [= *Hirsutodynomene spinosa* (Rathbun, 1911)].
- *D. actaeiformis* (Stebbing, 1921) [= *D. pilumnoides* Alcock, 1900].
- *D. tanensis* Yokoya, 1933 [= *Metadynomene tanensis* (Yokoya, 1933)].
- *D. devaneyi* Takeda, 1977 [= *Metadynomene devaneyi* (Takeda, 1977)].
- *D. sinensis* Chen, 1979 [= *D. praedator* A. Milne Edwards, 1879].
- *D. granulobata* Dai & Yang, 1981 [= *D. hispida* Guérin-Méneville, 1832].
- *D. tenuilobata* Dai & Lan, 1981 [= *D. praedator* A. Milne Edwards, 1879].
- *D. huangluensis* Dai, Cai & Yang, 1996 [= *D. praedator* A. Milne Edwards, 1879].

Genus ***ACANTHODROMIA*** A. Milne Edwards, 1880
- *A. erinacea* A. Milne Edwards, 1880 (type species of the genus).
- *A. margarita* (Alcock, 1899).

Genus ***MAXILLOTHRIX*** Stebbing, 1921
- *Maxillothrix actaeiformis* Stebbing, 1921 (type and only species of the genus) [= *Dynomene pilumnoides* Alcock, 1900].

Genus ***PARADYNOMENE*** Sakai, 1963
P. tuberculata Sakai, 1963 (type and only species of the genus).

Genus ***HIRSUTODYNOMENE*** gen. nov.
H. spinosa (Rathbun, 1911) (type species of the genus).
H. ursula (Stimpson, 1860).

Genus ***METADYNOMENE*** gen. nov.
M. devaneyi (Takeda, 1977) (type species of the genus).
M. tanensis (Yokoya, 1933).
M. crosnieri sp. nov.

The following species have been described and at least initially assigned to the genus *Dynomene* Desmarest, 1823. The first dynomenid to be described was *Dynomene hispida* Guérin-Méneville, 1832 based on a specimen collected from Mauritius Id, east of Madagascar. The second species to be described was *D. latreillii* Eydoux & Souleyet, 1842 from a specimen collected from Hawaii during the voyage of the *"Bonite"*. A. MILNE EDWARDS (1879) and later PEYROT-CLAUSADE & SERÈNE (1976) showed that the preceding species was in fact a synonym of *D. hispida*. Some years later, the third species, *D. ursula* Stimpson, 1860, was collected from Cape San Lucas, Baja California, by John XANTUS. The fourth species, *D. praedator* A. Milne Edwards, 1879, was discovered at New Caledonia by M. BALANSA. The fifth species, *D. pugnatrix* de Man, 1889, also came from Mauritius. The only species of *Dynomene* known from the Atlantic, *D. filholi* Bouvier, 1894, was collected from the Cape Verde Ids during the voyages of the *"Talisman"* and *"Travailleur"*. The seventh species was *D. margarita* Alcock, 1899, collected from the Andaman Sea during deep-sea surveys by the *"Investigator"*. The eighth species, *D. pilumnoides* Alcock, 1900 was first collected from the Laccadive Archipelago, India. The next name added to *Dynomene* was the sub-species *D. pugnatrix brevimana* Rathbun, 1911, from Providence Id, followed by *D. spinosa* Rathbun, 1911 from Coetivy, Seychelles. Both of these specimens were collected during the Percy Sladen Trust Expedition to the Indian Ocean, 1905. *D. spinosa* is the last species of this genus whose type locality is in the Indian Ocean. Clearly collecting in the Indian Ocean area played an important role in the early development of knowledge about this family of crabs, contributing ten of the eleven known species.

The second phase in the development of our understanding of the dynomenids resulted from investigations in the greater Pacific Ocean. The remaining species have type localities in the Pacific Ocean: *Dynomene tanensis* Yokoya, 1933, came from Tanegasima Id, Japan, and *D. devaneyi* Takeda, 1977, was collected by the submersible, *"Star II"*, from Hawaii. The last four species have only recently been described from the coasts of China or Taiwan: *D. sinensis* Chen, 1979, *D. granulobata* Dai & Yang, 1981, *D. tenuilobata* Dai & Lan, 1981, and *D. huangluensis* Dai, Cai & Yang, 1996. Thus there have been 15 species or sub-species of dynomenid crabs assigned to the genus *Dynomene*. In addition two species of the Dromiidae have been erroneously placed in this genus: *Dynomene depressa* Brocchi, 1875 (= *Dromidia spongiosa* Stimpson, 1858), and *Dynomene platyarthrodes* Stebbing, 1905 [= *Speodromia platyarthrodes* (Stebbing, 1905)].

The second dynomenid genus to be erected was *Acanthodromia* A. Milne Edwards, 1880, for *A. erinacea* Milne Edwards, 1880, collected from Guadeloupe, Atlantic Ocean, by the United States coast survey steamer *"Blake"*. Probably through an oversight when creating the family name Dynomenidae, ORTMANN (1892) did not include this genus in his new family. A second species, *A. margarita* (Alcock, 1899), was collected from the Andaman Sea, Indian Ocean, by the *"Investigator"*, which was initially placed in the genus *Dynomene*.

The third genus *Maxillothrix* Stebbing, 1921, was initially placed in the family Xanthidae. But the only species to be assigned to this genus, *M. actaeiformis* Stebbing, 1921, based on a specimen from the Natal coast, was later found to be a synonym of *Dynomene pilumnoides* Alcock, 1900. Two authors, SERÈNE (1968) and TAKEDA (1977) used the name *Dynomene actaeiformis* (Stebbing, 1921) in faunal lists.

Finally, the monospecific *Paradynomene* Sakai, 1963 was created for *P. tuberculata* Sakai, 1963 from Sagami Bay, Japan.

Thus prior to the commencement of this work, the family Dynomenidae contained a total of 16 species belonging to 3 genera. Herein I synonymize all four of the recently described *Dynomene* species from China and

Taiwan, and create two new genera for some of the species of *Dynomene*: *Hirsutodynomene* gen. nov. for *D. spinosa* and *D. ursula*, and *Metadynomene* gen. nov. for *D. devaneyi*, *D. tanensis* and a new species, *M. crosnieri* sp. nov., from the Glorieuses Ids, north of Madagascar. In recent years new collections have extended the ranges of known species without adding greatly to the number of species. The net result of all these changes is that the family Dynomenidae now contains five genera and thirteen species.

FOSSIL DYNOMENIDAE

Dynomenids have an extensive fossil record, dating from the Upper Jurassic (GLAESSNER, 1980), and there has been much discussion about the placement of genera in this family or in other families. The fossil record does not provide a clear answer to the question about the relationships of these crabs. Some of the difficulties arise because, while it may be easy to define the essential features of extant species, which justify their inclusion in the family, it is not so easy when it comes to fossils. Here, we have only carapace shape, development of teeth, and a few grooves incised on the dorsal carapace surface. For fossils, the definition of the family has to be based on a different and very limited set of characters and it is likely that the range of fossil species included is much wider than for modern species. For the extant species most are relatively small crabs whereas many of the fossil specimens are quite large and probably do not belong in the Dynomenidae. There is no reason to think that there has been a decrease in crab size during their evolution. I have examined some of the fossils which have been assigned to this family and have attempted to include a set of carapace characters which both modern and fossil species share.

The following chronological list of fossil genera is based on BALSS (1957: 1606) and GLAESSNER (1969), but modified after WRIGHT & COLLINS (1972) and COLLINS *et al.* (1995):

DYNOMENE Desmarest, 1823 (type species *D. hispida* Guérin-Méneville, 1832, by subsequent monotypy of GUÉRIN-MÉNEVILLE, 1832).

STEPHANOMETOPON Bosquet, 1854 (type species *Stephanometopon granulatum* Bosquet, 1854 by monotypy).

DROMIOPSIS Reuss, 1859 (type species *Brachyurites rugosus* von Schlotheim, 1820, by subsequent designation of BEURLEN, 1928).

PALAEODROMITES A. Milne Edwards, 1865 (type species *P. octodentatus* A. Milne Edwards, 1865, by monotypy).

CYAMOCARCINUS Bittner, 1883 (type species *C. angustifrons* Bittner, 1883, by monotypy).

GRAPTOCARCINUS Roemer, 1887 (type species *G. texanus* Roemer, 1887, by monotypy).

CYCLOTHYREUS Remes, 1895 (type species *C. strambergensis* Remes, 1895, by subsequent designation of BEURLEN, 1928).

GEMMELLAROCARCINUS Checchia-Rispoli, 1905 (type species *G. loerentheyi* Checchia-Rispoli, 1905, by monotypy).

GLYPTODYNOMENE Van Straelen, 1944 (type species *G. alsasuensis* Van Straelen, 1944, by monotypy).

TRACHYNOTOCARCINUS Wright & Collins, 1972 (type species *Trachynotus sulcatus* Bell, 1863, by monotypy).

There are a total of nine extinct fossil genera. Only one extant genus, *Dynomene* has fossil representatives. With the revision of this genus, undertaken herein, it is likely that some of the fossil species assigned to *Dynomene* will be able to be placed in the new genera. It is beyond the scope of the present report to examine the validity of all the fossil species and until this is done the fossil record has only limited value in helping to reveal the phylogenetic relationships of the dynomenids.

MATERIAL EXAMINED

The following abbreviations are used for material examined at or borrowed from museum collections:

AMS - Australian Museum, Sydney.
ANSP - Philadelphia Academy of Natural Sciences.
BMNH - Natural History Museum, London.
BPBM - Bernice P. Bishop Museum, Honolulu.
LACM - Natural History Museum, Los Angeles County.
MCZ - Museum of Comparative Zoology, Harvard University.
MNHN - Muséum national d'Histoire naturelle, Paris.
MZUF - Museo Zoologico de "La Specola", Firenze, Italy.
NTOU - National Taiwan Ocean University, Keelung, Taiwan.
QM - Queensland Museum, Brisbane.
RMNH - Nationaal Natuurhistorisch Museum, Leiden (formerly Rijksmuseum van Natuurlijke Historie).
SMF - Natur-Museum und Forschung Institut Senckenberg, Frankfurt.
UGM - University of Guam.
USNM - United States National Museum, Smithsonian Institution, Washington.
WAM - Western Australian Museum, Perth.
ZMB - Museum für Naturkunde, Humboldt Universität, Berlin.
ZMUC - Zoologisk Museum, Copenhagen.
ZRC - Zoological Reference Collection, Department of Zoology, National University of Singapore.

When in the lists of material examined, no place of deposit is mentioned, this means that the material is at the MNHN.

TERMINOLOGY AND PRESENTATION

Measurements were made, using vernier calipers under a binocular microscope, to an accuracy of 0.1 mm. Measurements of chelipeds and abdomen used for determining relative growth in *Metadynomene tanensis* were made as follows: cheliped propodus length was measured along the inferior margin from the joint with the carpus to the tip of the fixed finger; cheliped propodus depth was measured from the superior to the inferior margin at the widest point; abdomen width was measured as the greatest width of the penultimate segment. To determine the relative sizes of the articles of the last two pairs of pereopods their lengths were measured along the superior margin of each limb. The length of each article was divided by the total length and converted to a percentage.

Carapace dimensions are given as carapace width (CW) x carapace length (CL) e.g. 1 ♂ 9.8 x 8.0 mm. Carapace width includes any anterolateral teeth and was measured across the widest point. Carapace length includes any rostral teeth and was measured to the posterior margin in the mid-line.

The description of each species follows the format: carapace shape and ornamentation, tomentum, anterolateral margin, frontal margin and orbital region including antennule and antenna, subhepatic area, third maxillipeds and female sternal sutures 7/8. This is followed by the gill formula and shape of the gill plates. The cheliped is dealt with separately, followed by the first three pairs of walking legs, and then the reduced last pair of legs. Finally, the abdomen size and shape, and the five pairs of male and female pleopods.

The tomentum is an important feature of these crabs and is described in terms of the length of the setae, their density, and their distribution, especially on the surface of the carapace. Setal size is expressed either as the length ratio of long setae/short setae, or as a ratio of CW. Setal density is expressed in terms of the degree to which the carapace surface is obscured in dorsal view. Setae were investigated using a scanning electron microscope and the results are dealt with in terms of setae shape and the distribution of setules along the shaft.

The major carapace grooves are named according to GLAESSNER (1969) and are treated as follows: frontal groove, cervical groove, cardiac groove, and pleural suture.

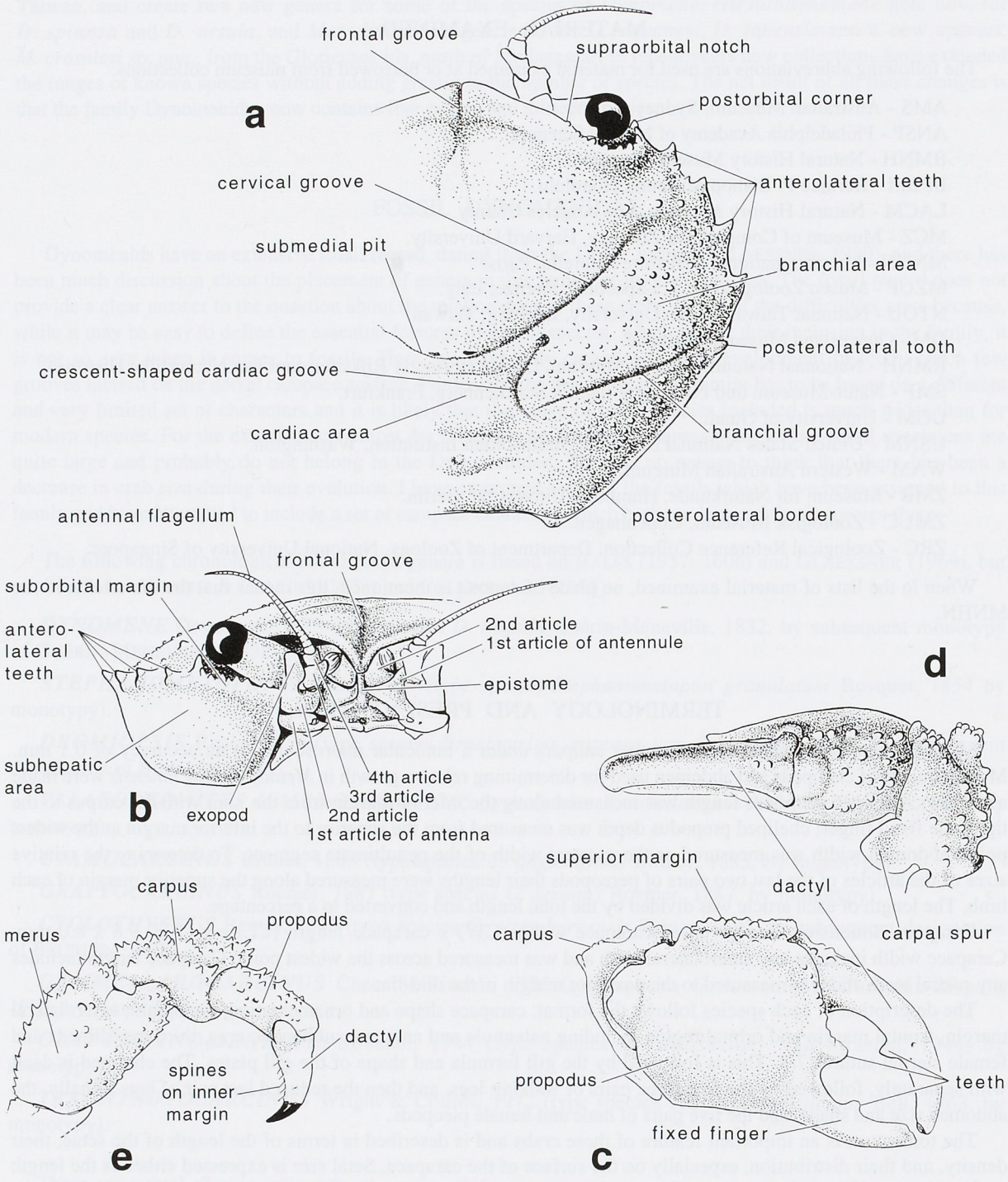


FIG. 1. — Selected figures illustrating the terminology used to describe crabs of the family Dynomenidae : a-b, e based on *Dynomene hispida*, c-d based on *D. praedator*: **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod.

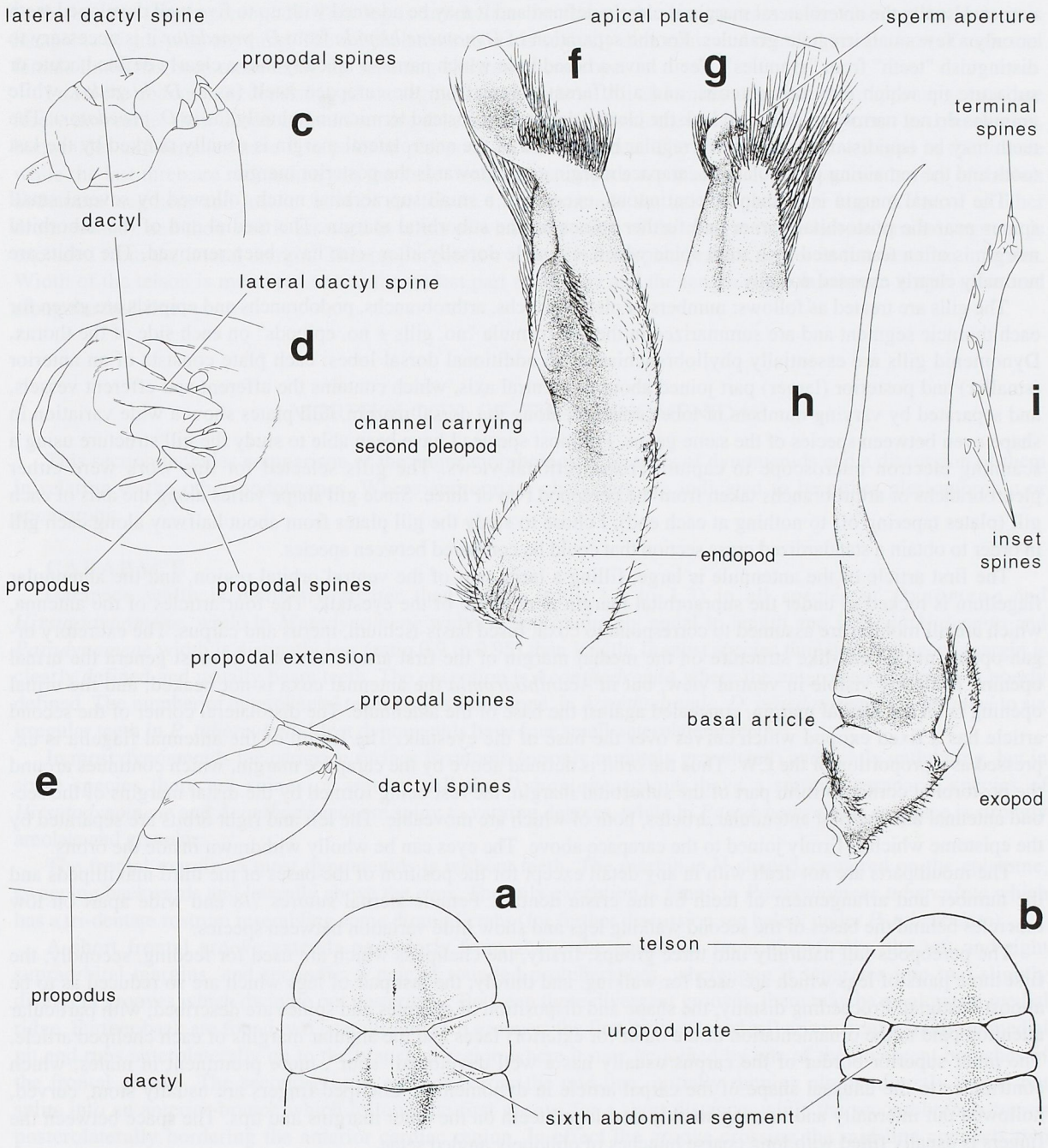


FIG. 2. — Selected figures illustrating the terminology used to describe crabs of the family Dynomenidae : a based on *Dynomene hispida*, b based on *D. filholi*; c-e based on *Metadynomene tanensis*, f-h based on *M. devaneyi* (reprinted from TAKEDA, 1977, *Pacific Science*, vol. 31 (1) by permission of the publisher); i based on *D. praedator*: **a**, ventral view of telson and terminal segments of female abdomen; **b**, ventral view of telson and terminal segments of male abdomen; **c**, lateral view of tip of male fifth pereopod; **d**, apical view of tip of male fifth pereopod; **e**, lateral view of tip of female fifth pereopod; **f**, posterior view of male left first pleopod; **g**, anterior view of tip of male left first pleopod; **h**, posterior view of male left second pleopod; **i**, tip of second pleopod.

Normally, the anterolateral margin begins in close proximity to, and at the same level as, the postorbital corner. Usually the anterolateral margin is clearly defined and it may be adorned with up to five well developed teeth or only a few small irregular granules. For the separation of *Dynomene hispida* from *D. praedator* it is necessary to distinguish "teeth" from "granules". Teeth have a broad base which narrows apically into a clearly defined acute or subacute tip which may be nacreous, and a different colour from the carapace itself (as in *D. hispida*), while granules do not narrow apically and lack the clearly defined tip, instead terminating bluntly (as in *D. praedator*). The teeth may be equidistantly spaced or irregular but the end of the anterolateral margin is usually marked by the last tooth and the remaining posterolateral carapace margin angles towards the posterior margin.

The frontal margin is V-shaped, continuous, except for a small supraorbital notch followed by several small spines near the postorbital corner and further spines on the suborbital margin. The medial end of the suborbital margin is often terminated by a stout spine which is visible dorsally after setae have been removed. The orbits are normally clearly exposed dorsally.

The gills are treated as follows: numbers of pleurobranchs, arthrobranchs, podobranchs and epipods are given for each thoracic segment and are summarized in the gill formula "no. gills + no. epipods" on each side of the thorax. Dynomenid gills are essentially phyllobranchiate with additional dorsal lobes: each plate consists of an anterior (smaller) and posterior (larger) part joined about the central axis, which contains the afferent and efferent vessels, and separated by varying numbers of lobes arranged along the dorsal margin. Gill plates show a wide variation in shape even between species of the same genus. For most species I have been able to study the gill structure using a scanning electron microscope to capture cross-sectional views. The gills selected for this work were either pleurobranchs or arthrobranchs taken from the pereopod two or three. Since gill shape varies along the axis of each gill (plates tapering off to nothing at each end), I chose to study the gill plates from about halfway along each gill in order to obtain a standardized cross section that could be compared between species.

The first article of the antennule is large, filling a large part of the ventral orbital region, and the antennular flagellum is tucked in under the supraorbital margin at the base of the eyestalk. The four articles of the antenna, which are all mobile, are assumed to correspond to coxa, fused basis-ischium, merus and carpus. The excretory organ opens into a beak-like structure on the medial margin of the first article or coxa. In most genera the urinal opening is clearly visible in ventral view, but in *Acanthodromia* the antennal coxa is not beaked, and the urinal opening is on the medial margin, concealed against the base of the antennule. The distolateral corner of the second article has a fixed exopod which curves over the base of the eyestalk. The length of the antennal flagella is expressed as a proportion of the CW. Thus the orbit is defined above by the carapace margin, which continues around the postorbital corner to form part of the suborbital margin, the rest being formed by the distal margins of the second antennal and the first antennular articles, both of which are moveable. The left and right orbits are separated by the epistome which is firmly joined to the carapace above. The eyes can be wholly withdrawn inside the orbits.

The mouthparts are not dealt with in any detail except for the position of the bases of the third maxillipeds and the number and arrangement of teeth on the crista dentata. Female sternal sutures 7/8 end wide apart on low tubercles behind the bases of the second walking legs and show little variation between species.

The pereopods fall naturally into three groups: firstly, the chelipeds which are used for feeding, secondly, the first three pairs of legs which are used for walking, and thirdly, the last pair of legs which are so reduced as to be almost vestigial. Proceeding distally, the shape and disposition of granules and spines are described, with particular attention paid to the ornamentation of the outer (or exterior) faces and the angular margins of each cheliped article. The inner superior border of the carpus usually has a well developed "spur", more prominent in males, which contributes to the unusual shape of the carpal article in dynomenids. Cheliped fingers are usually stout, curved, hollowed out internally and bearing weakly developed teeth on the outer margins and tips. The space between the fingers is usually filled with long coarse bunches of obliquely angled setae.

The first three pairs of walking legs usually decrease in length posteriorly. The arrangement of spines on each article, from merus to propodus, are described, concentrating on the superior border or dorsal surface of each article. On the dactyl particular attention is paid to the small spines on the inferior margin. Presumably, these small spines are used to provide some grip on the substrate which is often dead coral. The ratio of the length (including any spines) of the second walking leg (i.e. the third pereopod) merus to its width and to the CL are given. This character is useful for separating some species.

The size of the last pair of legs is given in terms of how far it extends along the meral article of the preceding limb (i.e. the fourth pereopod). This leg is subchelate but the mechanism appears to be obsolete because it is incapable of grasping anything. The subchelate structure is sexually dimorphic and detailed comparison of male and female limbs has been made using the scanning electron microscope.

I treat the abdomen as consisting of six segments and a telson. All abdominal segments bear appendages and are freely moveable: their shape and surface are described beginning with the most anterior segment. In dynomenids, both males and females have five pairs of pleopods on the abdomen. The first pleopod is vestigial in the female while the last three are rudimentary in the male. Uniramous uropods are inserted at the posterior border of the last abdominal segment and just in front of the telson. In dynomenids the uropod plates are large (relative to other dromiaceans), and their size is assessed in terms of what proportion of the margin of the last abdominal segment is excluded from the lateral margin. This proportion is a sexually dimorphic feature, larger in females than in males. Width of the telson is measured across the widest part at its base and the length is the maximum length measured along the mid-line.

MORPHOLOGY OF THE DYNOMENIDAE

This section includes comparison of the major morphological features of dynomenids and a discussion of them in relation to the other podotremes. Where appropriate characters are indicated to be either plesiomorphic or apomorphic.

CARAPACE

Carapace width is distinctly greater than length (ratio 1.2 to 1.3) in all species of *Dynomene* and *Hirsutodynomene*, while in *Metadynomene* width is approximately equal to length and in *Acanthodromia* and *Paradynomene* width is distinctly less (ratio 0.9 to 0.95) than length. In most species the lateral carapace margin is clearly defined and usually bears teeth. The exception is *Acanthodromia* where the anterolateral margin is poorly defined. The number of anterolateral teeth ranges from none, in *Acanthodromia*, *D. praedator* and *M. devaneyi* to six irregular teeth in *P. tuberculata*. Most dynomenids have four small anterolateral teeth.

In most dynomenids the carapace surface is smooth (or only minutely granulated) and gently undulating, but in some species there are spines or areolae. All the *Dynomene* species have a smooth carapace, species of *Hirsutodynomene* and *Acanthodromia* are spiny to varying degrees, while in *Paradynomene* the carapace is strongly areolate and granular.

The frontal margin in most dynomenids is without teeth. The margin is V-shaped, centered on the epistome, sweeping backwards and laterally above the eyes. The only exception is found in *Paradynomene tuberculata* which has a tri-dentate rostrum resembling some dromiid crabs (for further discussion see below under *P. tuberculata*).

A short frontal groove extends posteriorly from above the epistome, separating firstly, the left and right supraorbital margins, and secondly, a pair of rounded protuberances, whereupon it separates into two slightly divergent grooves which dwindle out posteriorly. Between these divergent grooves, there may be an elongate medial ridge. Further back are found two laterally-directed grooves: the first groove (cervical) arises from a small submedial pit and runs anterolaterally on to the branchial region where it may be joined by one of the divergent branches of the frontal groove. The second groove extends across the mid-line, initially running almost directly lateral but splits into an anterior branch which follows the first groove for a short distance, while the second branch curves posterolaterally bordering the anterior cardiac region. In effect the groove crossing the mid-line connects two crescent-shaped grooves with the second branch joining the branchial groove (if present) which runs towards the lateral carapace margin meeting it just in front of the last anterolateral tooth. The posterior cardiac region may or may not be well defined. The other grooves which may be evident are to be found under the anterolateral margin of the carapace: the pleural suture arises near the base of the antenna, curving around under the branchial region, giving off a short cervical groove which ascends towards the base of the first anterolateral tooth, and then running towards the base of the last anterolateral tooth where it may meet the branchial groove if it is evident.

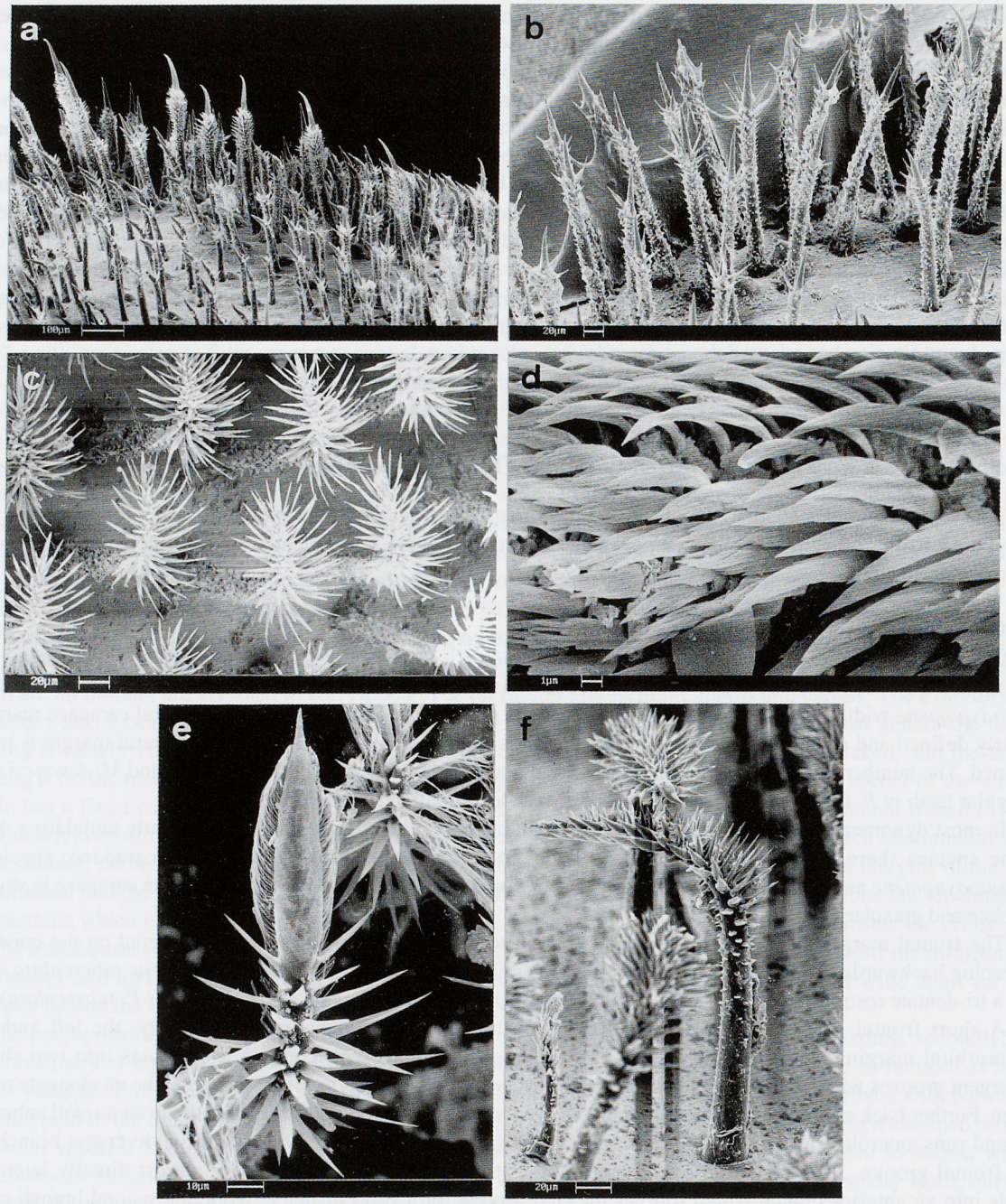


FIG. 3. — **a**, *Dynomene hispida* Guérin-Méneville, 1832, ♂ 11.6 x 9.2 mm, Somalia, Gesira, stn 12, intertidal coral (MZUF): setae on right posterolateral corner of carapace. — **b**, *Dynomene praedator* A. Milne Edwards, 1879, ♂ 9.6 x 7.8 mm, Somalia, Gesira, stn 19, intertidal coral: setae on left posterolateral corner of carapace. — **c-d**, *Dynomene pilumnoides* Alcock, 1900, ♀ 12.8 x 10.3 mm, New Caledonia, VOLSMAR, stn DW 7, 400 m: **c**, short setae from left posterolateral corner of carapace; **d**, setules on long setae from left posterolateral corner of carapace. — **e**, *Dynomene filholi* Bouvier, 1894, ♀ 10.0 x 8.7 mm, Cape Verde Id, CANCAP, stn 7.125, 85-130 m: short setae from right posterolateral corner of carapace. — **f**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♂ 14.2 x 10.8 mm, Cocos Keeling Ids, 0-37 m (WAM 139-94): short setae from left posterolateral corner of carapace. (All pictures taken with scanning electron microscope.)

Compared to homolodromiids the dynomenids have a well developed and calcified carapace on which the lateral margins are well defined and grooves are often evident. In this respect their carapace is very similar to that found amongst dromiids and this overlap has lead to difficulties in assigning fossil material to the correct family.

SETAE (Figs 3 a-f, 4 a-f)

All dynomenids have setae of two sizes: short and long. Most short setae are at least slightly curved near the tip, but in some species they are bent almost at right angles. The long setae can also be curved and assume various shapes, but they are never consistently bent at right angles. The short setae may be sparse or dense enough to completely obscure the body surface. In some species the long setae are arranged in clumps or tufts on the carapace and these may be associated with irregularities in the carapace surface. The shafts of both short and long setae can be divided into four regions: a bare basal region without setules, a region of small sparse setules, a region of larger dense setules, and finally a bare apical region. The percentage of the length occupied by each region varies between species. In *Dynomene hispida*, *D. praedator*, and *Metadynomene tanensis* there are no differences, between short and long setae, in the proportions of the shaft occupied by the four regions. Also the short setae are not bent at right angles and the long setae are not arranged in clumps on the carapace. Clumps of long carapace setae are found in *Dynomene filholi*, *D. pilumnoides*, *Hirsutodynomene spinosa*, *H. ursula*, and *Paradynomene tuberculata*. The short setae are bent in *D. pilumnoides*, and *H. spinosa* (but not in *H. ursula*). The setae of most dynomenids have varying arrangements and sizes of setules along their length, but very unusual setae are found on *D. filholi* and *Paradynomene tuberculata* where there is a marked difference between the structure of short and long setae. The proximal 60% of short setae in *D. filholi* have the normal radiating setules arranged around the shaft, but this is followed by a brush border of long fine setules along only one side of the shaft. In *P. tuberculata* the proximal 40% is bare but the rest of the shaft is feather-like, bearing a row of fine setules on opposite sides. None of the other dynomenids have setae which even closely resemble these aberrant forms, although DE MAN (1889) reported "Federhaar" (feather-like setae) in *D. pugnatrix*. The reasons for these differences are not clear. The setal characteristics are useful in the recognition of such genera as *Hirsutodynomene* and *Metadynomene*, but in *Dynomene* the setal differences are much greater and hence are useful in recognizing the different species. The setae of the dromiid *Dromia personata* (Linnaeus, 1758) bear a close resemblance to many of the dynomenid setae (see JACQUES, 1989, her Fig. 3. 4).

ANTENNULES, ANTENNAE AND ORBITS

The antennules are composed of three articles plus flagellae. The first article is largest, about as long as the greatest width and trapezoidal, remaining articles are much smaller, and the third article is longer than wide. Antennules are very active during feeding. First article of antenna is wider than long, usually beaked medially enclosing the urinary opening, second article is longer than wide bearing a fused exopod, third and fourth articles together are as long as exopod, terminating in a flagellum whose length can be from 23% to 60% of carapace width. The beaked first antennal article is a feature shared with members of the Homolodromiidae and Dromiidae. However, in *Acanthodromia* the first antennal article is not beak-shaped and the urinary opening is on the medial margin, concealed against the first article of the antennule.

The orbits of dynomenids are well formed and separated by the epistome which is joined to the rostrum of the carapace. In dorsal view orbits are obliquely arranged and clearly exposed dorsally. There are well developed supra- and suborbital margins, usually armed with spines or tubercles, which form a well defined cavity which can accommodate the whole of the eyestalk when it is folded away. The gap between the suborbital margin and the epistome is filled by the first article of the antennule and the first two articles of the antenna, thereby covering the base of the eye stalk. The second article of the antennule articulates at a right angle so that the rest of the appendage is folded horizontally above the eye stalk and under the supraorbital border. In a similar way, the fourth article of the antenna is angled so that the flagellum is directed laterally. However, the antennal flagellum is too long to allow the appendage to be entirely folded into the orbit.

MOUTHPARTS

During this study attention has only been paid to the third maxillipeds of dynomenids. Other authors have dealt more or less with all six appendages: see BOUVIER (1896, fig. 23) and A. MILNE EDWARDS & BOUVIER

(1900, pl. VII, figs 1-18) for mouthparts of *Dynomene filholi*, and STEBBING (1921, pl. 14) for mouthparts of *D. pilumnoides* (as *Maxillothrix actaeiformis*). Note that on STEBBING's figure of the third maxilliped the epipod is missing. The maxillae and maxillipeds of *Acanthodromia erinacea* were figured by A. MILNE EDWARDS and BOUVIER (1902, pl. III, figs 6-10). Note that their third maxilliped is also shown without an epipod. ORTMANN (1892, pl. 26, fig. 3i) figured the second maxilliped of *D. praedator* and CHEN (1979, figs 1, 4) figured the external features of the third maxilliped (as *D. sinensis*). The epipods of the maxillipeds have an important role in gill cleaning (see below).

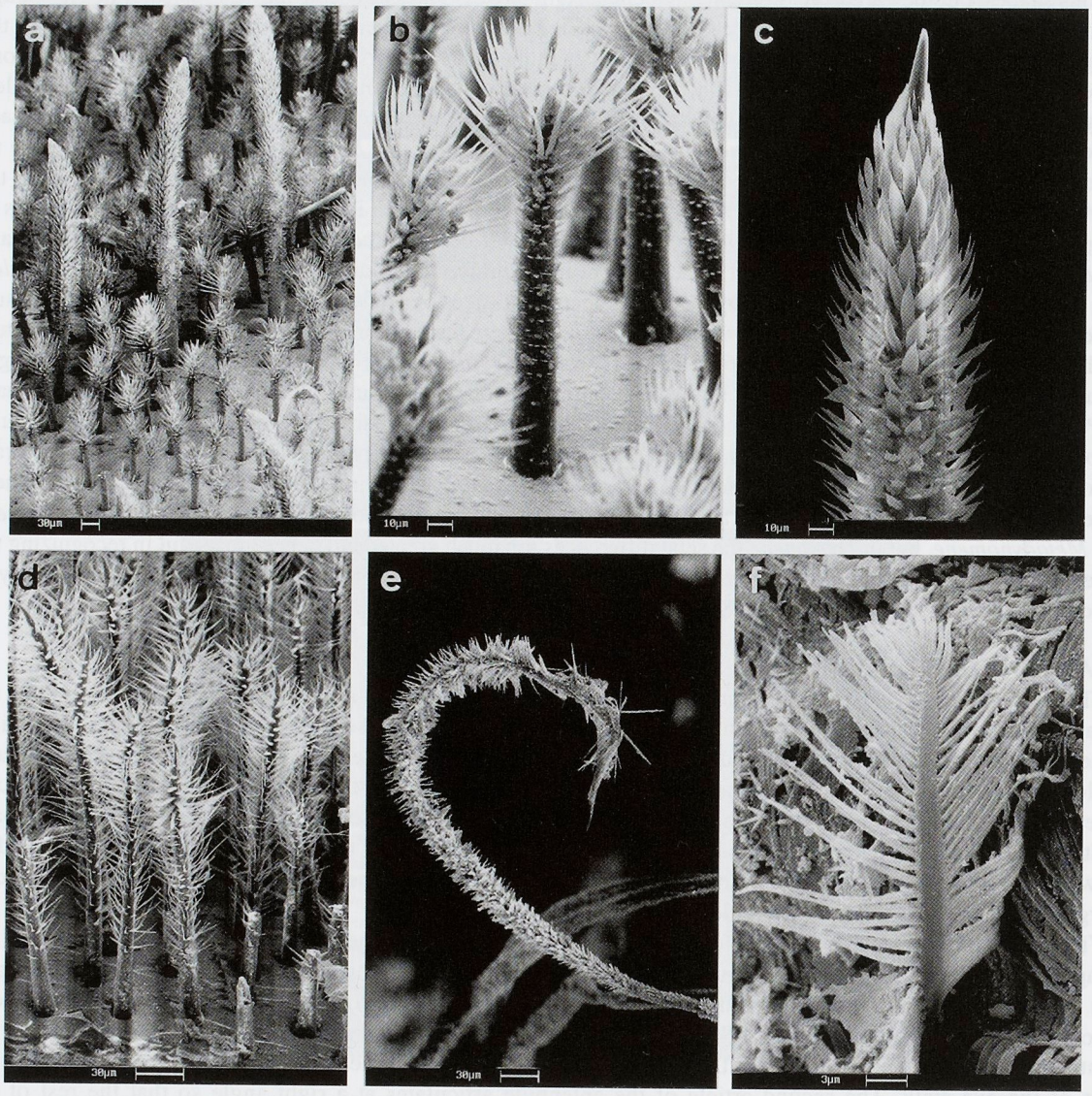


FIG. 4. — **a-c**, *Hirsutodynomene ursula* (Stimpson, 1860), ♂ 13.4 x 10.3 mm, Mexico, Espiritu Santo Id, *"Velero"*, stn 638-37, intertidal: **a**, long and short setae from left posterolateral corner of carapace; **b**, short setae from left posterolateral corner of carapace; **c**, setules on tip of long setae from left posterolateral corner of carapace. — **d**, *Metadynomene tanensis* (Yokoya, 1933), ♂ 16.5 x 15.8 mm, New Caledonia, SMIB 3, stn DW 25, 437 m: setae from right posterolateral corner of carapace. — **e-f**, *Paradynomene tuberculata* Sakai, 1963, ♂ 22.0 x 22.8 mm, New Caledonia, SMIB 3, stn 14, 246 m: **e**, long setae from right posterolateral corner of carapace; **f**, short setae from right posterolateral corner of carapace. (All pictures taken with scanning electron microscope.)

In dynomenids the third maxillipeds are operculiform, the coxal articles are separated by tip of sternum, the basis-ischial articles are fused but with joint still visible, the medial margins of ischia are parallel (or slightly diverging) and close together, the meral article is square or oblong and smaller than the preceding article, followed by a three-articled setose palp, consisting of carpus, propodus and dactyl which is folded along medial margin of merus. The palp grasps food material from the chelipeds passing it on to other mouthparts.

Most dynomenids have a true crista dentata - a crest-like row of corneous teeth on the inner margin of the ischium of the third maxilliped. The crista dentata is found in palinurids, nephropids, astacids, thalassinids, some anomolans, and some podotremes. Working in a coordinated way with the mandibles it is used to grasp and tear food items before they enter the mouth. In dynomenids the teeth are usually of even size, but in some species they tend to increase in size distally. However, none of them have teeth such as is found in some thalassinids and astacids where the crest is curved and terminates in a large hooked tooth. The number of teeth varies from 5-8 in species of *Dynomene* and *Hirsutodynomene*, to 12-13 in *Metadynomene* and *Paradynomene*. A crista dentata is absent in *Acanthodromia*. Amongst the podotreme crabs the crista dentata is present in homolodromiids, dromiids and homolids as well as the dynomenids. The dromiids and dynomenids are the only decapods which have operculiform third maxillipeds with a crista dentata. All other decapods with a crista dentata have pediform third maxillipeds. The true crista dentata is absent from the other brachyurans.

GILLS AND EPIPODS (Figs 5 a-f, 6 a-f, 7 a-b)

In his classic work on the origin of crabs, BOUVIER (1896) compared the gills of *Dynomene filholi* and *Acanthodromia erinacea* with those of *Homarus vulgaris*. Although there were some errors made in the interpretation of the gills (see below under the treatment of these species), the branchial formula was given as 20 gills + 7 epipodites on each side. Subsequently this branchial formula has been assumed to be typical of all dynomenids. The general features of the number of gills and epipods in dynomenids are illustrated by considering the arrangement found in the type species of the family. In *Dynomene hispida* there are 19 gills and 7 epipods present on each side. There are six podobranchs, ten arthrobranchs and three pleurobranchs. The first thoracic segment has no gills and there is only the epipod of the first maxilliped extending into the anterior end of the branchial chamber. The second segment has a single arthrobranch and a podobranch on the epipod of the second maxilliped which lies anterior to the arthrobranch. The third segment has the same number of gills as the second but the epipod of the third maxilliped lies posterior to the arthrobranch. The fourth segment has two arthrobranchs and a podobranch on the epipod which lies between the two arthrobranchs. The same pattern is repeated for segments five through seven except that these segments have an additional pleurobranch. The eighth thoracic segment has no gills or epipods. The podobranchs are attached to the epipods and the hypobranchial margin of each gill is armed with long setae identical to those on the epipod itself. Thus the podobranchs themselves must also have a cleaning role since they overly the bases of the larger gills. The epipods (Fig. 6f) function as gill cleaners and are either flattened plates or elongate lobes which bear long setae. In *Paradynomene tuberculata* these setae (Fig. 7e) have the following structure: the proximal third is smooth, followed by a section covered with digital scales, which are almost identical to those on the hypobranchial setae (see below), and towards the end of the setae these scales are replaced on one side by two rows of closely spaced, short, curved pegs with a channel between them, while for a short distance, digital scales continue on the other side unchanged until they too are replaced by pegs. Near the end of the setae there are two spiralling rows of closely spaced spines on opposite sides of the setal axis. The likely function of these scales is to dislodge debris as the epipods move between the gills. Epipod size is related to the size of the associated gill(s) and all of them extend as far the dorsal limit of the branchial chamber. They have an intimate association with nearby gills with their setae often penetrating the gaps between the gill lamellae. The first epipod (on the first maxilliped) is an elongate plate with few setae, not associated with any gill, but capable of extending back over the epibranchial surface of the first three arthrobranchs. Its role is probably to keep the anterior part of the branchial chamber and the anterior arthrobranchs free of debris. The second epipod is much more setose and lies anterior to the first arthrobranch, cleaning only the anterior face of this gill. The third epipod (on the third maxilliped), which is the longest, lies between the second and third arthrobranchs and cleans the adjacent faces of these gills. Similarly with the fourth epipod which lies between the third and fourth arthrobranchs. Thus the anterior and posterior faces of the third arthrobranch (the largest gill) are cleaned by

different epipods. The fifth epipod (associated with the second pereopod) lies between the fifth and sixth arthrobranchs, cleaning the posterior and anterior faces (respectively) of these gills as well as the posterior face of the first pleurobranch. In the same way the sixth and seventh epipods clean the same faces of the remaining arthrobranchs and pleurobranchs. Apart from the third arthrobranch, all the other gills are only cleaned on one or other side: there is no cleaning limb between the first and second, fourth and fifth, sixth and seventh, eighth and ninth arthrobranchs, and the posterior face of the tenth arthrobranch cannot be cleaned by the eighth epipod because it is absent. It is unclear how these gill surfaces are kept clear of debris, but the setose margin of each podobranch may contribute to this task. The epipods can move in a vertical direction and clean the adjacent gill surfaces, right from the hypobranchial to the epibranchial margins. When they are against the body wall their setae extend under the gill and could help to clean the hypobranchial surface. The podobranchs are cleaned by long setae on the base of the epipod to which the gill is attached.

The epibranchial surface of the posterior gills is cleaned by several long flexible setae extending from the posterior border of the scaphognathite. These setae reach as far as the second pleurobranch (on the third pereopod). In *Metadynomene tanensis* the margin of the scaphognathite carries a dense fringe of short plumose setae with two very long, stout setae (Fig. 7f) inserted on the posterior border. These setae are armed with stiff, acute setules for almost their entire length. The setules project at about 45° from the setal axis, with those on the proximal half directed towards the base, while those on the distal half are directed towards the tip. The setules become denser distally. In adult dynomenids there are normally two or three such long scaphognathite setae.

Besides the epipods and long scaphognathite setae there is another gill cleaning mechanism in dynomenids. This is best developed in *Paradynomene tuberculata* where the hypobranchial wall of the posterior half of the gill chamber is covered by a dense field of long setae. These setae (Fig. 7c) have a range of lengths, are arranged in clumps and project from the body wall into the hypobranchial surface of the gills. Each seta has a complex structure: the proximal half is smooth, followed by a section where opposite sides of the seta are covered by apically-directed digital scales, separated by intervening smooth areas. At about 80% of the length of the seta the digital scales on one side are replaced by closely-spaced short, curved pegs arranged as marginal rows with a channel between them, while the digital scales on the other side continue unchanged. These scales give the setae a comb-like appearance. Comparison with the setae on the epipods (see above) shows that the digital scales are identical and it seems likely that they must also have a cleaning role. Since the setae are fixed, the gills have to move about in order to dislodge debris. It may be that the epipods produce gill movement or perhaps cause the long setae to move from side to side. Besides *Paradynomene tuberculata*, hypobranchial setae are also well developed in *Metadynomene tanensis* and *M. devaneyi*, but in *Hirsutodynomene* and all species of *Dynomene* there are only a few of these setae present. Their status in *Acanthodromia* is unknown. This kind of gill cleaning mechanism has only been reported from the dromiid *Cryptodromiopsis larraburei* (Rathbun, 1910) (BAUER, 1981, as *Dromidia larraburei*). Tufts of setae arising from the body wall beneath the gills have also been observed in some other species of the Dromiidae (McLAY, unpublished). Pereopodal epipods are greatly reduced in dromiids and it may be that these hypobranchial setae take over the role of cleaning gills in the posterior half of the branchial chamber. In *Dromia erythropus* (George Edwards, 1771) the hypobranchial setae (Fig. 7d) have a unique structure: the proximal 80% of each seta is smooth but approaching the tip there are three or four isolated, apically directed acute spines followed by a series of separate paired rows of comb-like pegs, increasing in number distally and spiralling around the setal axis. Near the tip these pegs are transformed into two closely spaced continuous rows of acute spines which continue the spiral right to the end. In profile, the distal region of the setae appear to have three or four rosettes of these acute spines. In his review of decapod grooming BAUER (1989) did not report any setae which resemble those found in *D. erythropus*. The digital scales on the hypobranchial setae of *P. tuberculata* are similar to those found on the setiferous epipods, or setobranchs, of dendrobranchiate and caridean shrimps, as well as achelate and homarid lobsters (BAUER, 1981, 1989), but they are very different from the long barbed setae found on the maxillipedal epipods of the portunid crab, *Cronius tumidulus*. Instead of bearing scales, these setae have a single row of recurved hooks (BAUER, 1989, his Fig. 12 c-d).

Dynomenids, like other Brachyura, have an epipodal gill cleaning mechanism but this is supplemented by the scaphognathite setae over the anterior epibranchial surface and by the body wall setae attending to the posterior hypobranchial gill surface. Compared to the more derived Brachyura, gill cleaning in the Dynomenidae is much

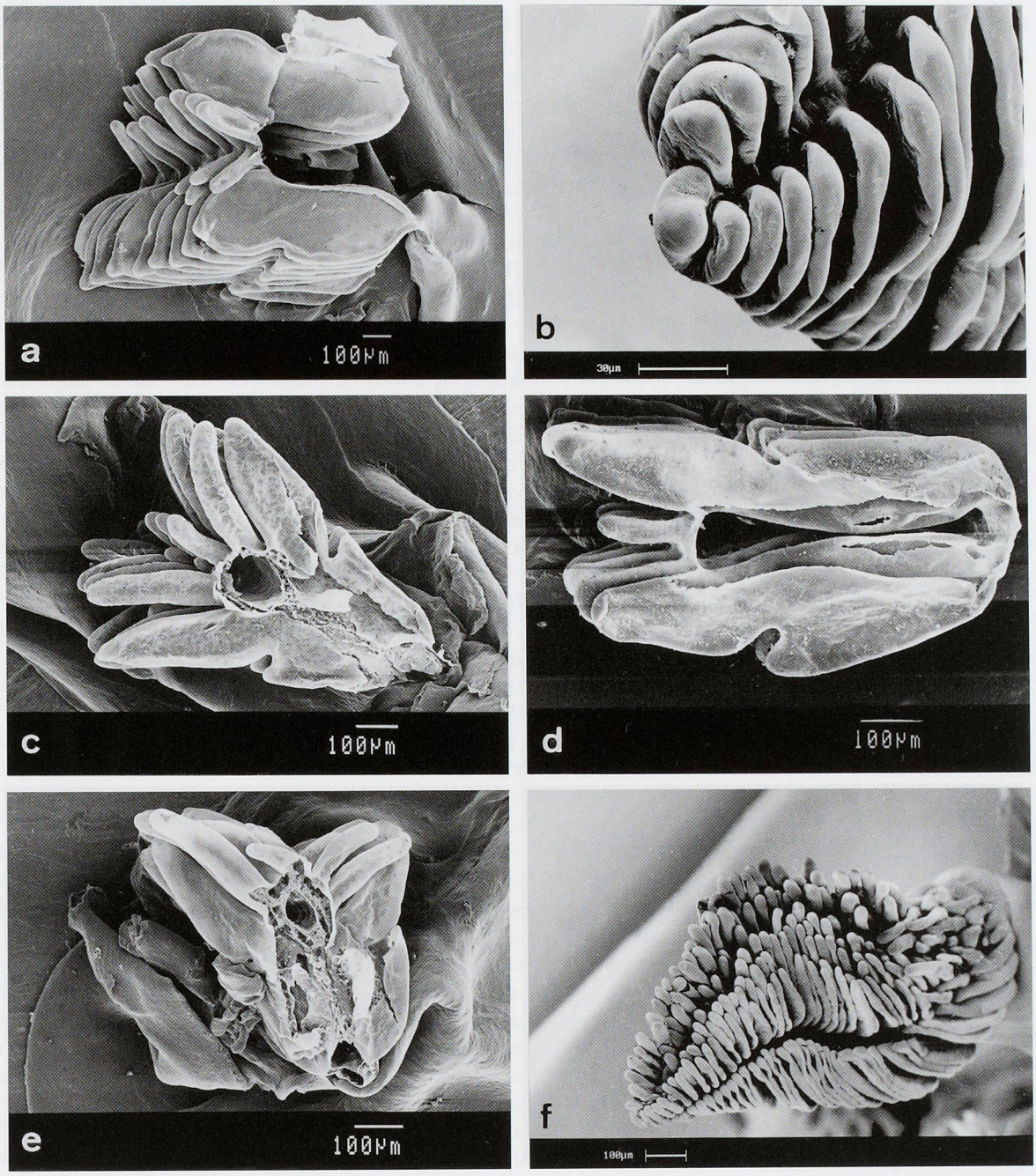


FIG. 5. — **a**, *Dynomene hispida* Guérin-Méneville, 1832, ♀ 14.0 x 10.8 mm, Hawaii, Oahu, (BPBM 658): transverse section through gill. — **b**, *Dynomene hispida* Guérin-Méneville, 1832, ♀ 10.3 x 8.9 mm, Cocos Keeling Ids. (WAM 751-89): apex of gill. — **c**, *Dynomene filholi* Bouvier, 1894, ♀ 10.0 x 8.7 mm, Cape Verde Ids, CANCAP, stn 7.125, 85-130 m: transverse section through gill. — **d**, *Dynomene pugnatrix* de Man, 1889, ♂ 9.8 x 7.2 mm, Mauritius (SMF 4857): transverse section through gill. — **e**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♀ 11.3 x 8.9 mm, Madagascar, Tuléar, stn 14-11-2, 5 m (MNHN-B 22077): transverse section through gill. — **f**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♂ 14.2 x 10.8 mm, Cocos-Keeling Ids., 0-37 m, (WAM 139-94): lateral view of whole gill. (All pictures taken with scanning electron microscope.)

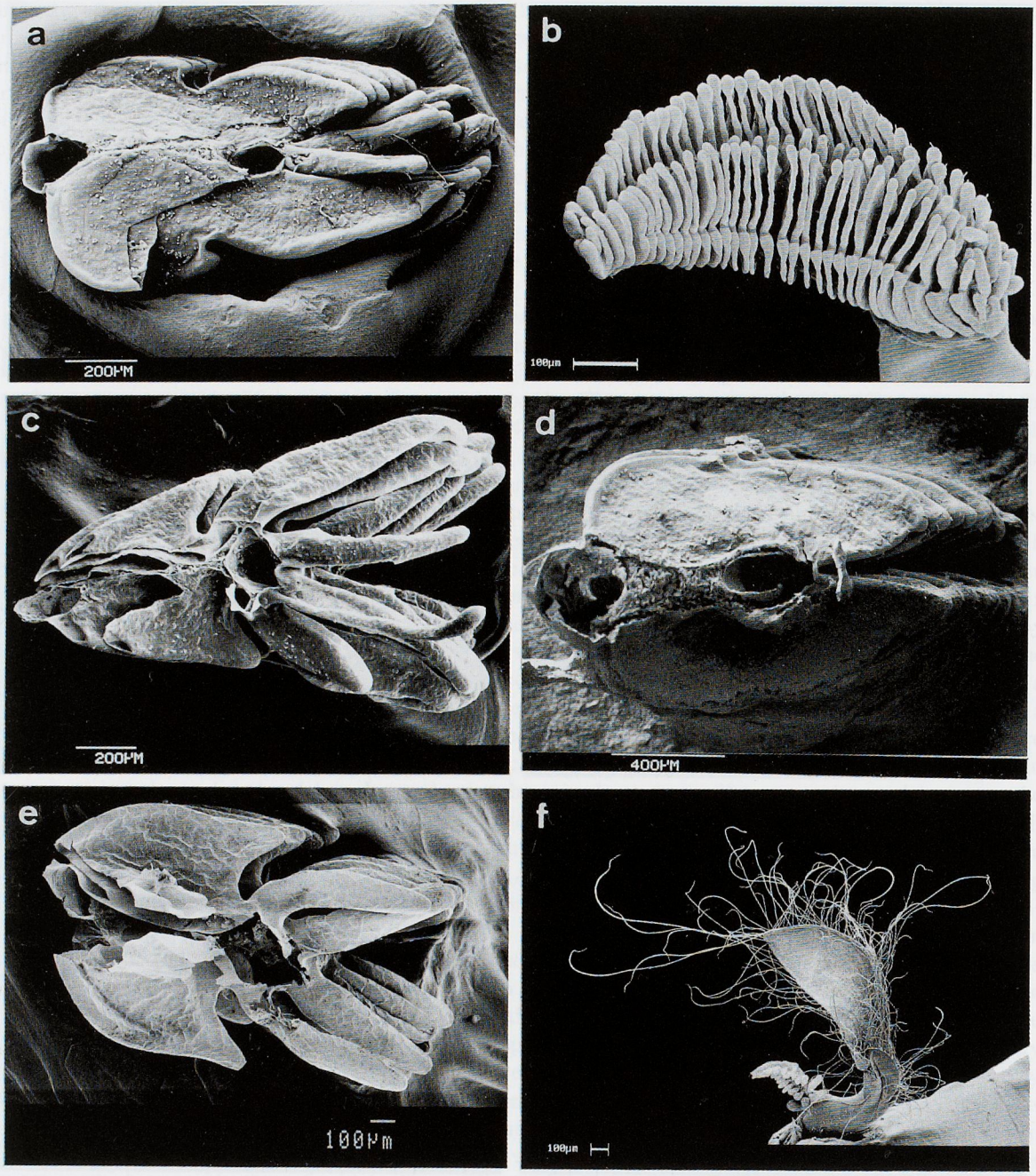


FIG. 6. — **a**, *Hirsutodynomene ursula* (Stimpson, 1860), ♀ ovig. 19.4 x 14.7 mm, ARGOSY 34 (USNM 247230): transverse section through gill. — **b**, *Hirsutodynomene ursula* (Stimpson, 1860), ♀ ovig. 15.0 x 12.2 mm, Ecuador, La Plata Id, *"Askoy"*, stn 80 (LACM): lateral view of whole gill. — **c**, *Metadynomene tanensis* (Yokoya, 1933), ♀ 19.2 x 18.9 mm, New Caledonia, MUSORSTOM 4, stn 215, 485-520 m: transverse section through gill. — **d**, *Acanthodromia erinacea* A. Milne Edwards, 1880, ♀ 16.7 x 17.7 mm, Yucatan, *"Blake"*, stn 166, 275 m (MCZ 6509): transverse section through gill. — **e**, *Paradynomene tuberculata* Sakai, 1963, ♂ 21.0 x 21.9 mm, New Caledonia, SMIB 8, stn DW 189, 400-402 m: transverse section through gill. — **f**, *Paradynomene tuberculata* Sakai, 1963, ♀ 21.5 x 21.2 mm, Loyalty Ids, MUSORSTOM 6, stn DW 406, 373 m (MNHN-B 25249): epipod and podobranch from left third pereopod. (All pictures taken with scanning electron microscope.)

more complex with the task being divided amongst eight appendages (second maxilla plus the seven epipods) as well as the body wall hypobranchial setae, compared to only three appendages (the maxillipeds). At least in part, this must be regarded as a consequence of having more gills. Besides the podobranchs, which are always small, dynomenids have thirteen large gills versus only eight or nine in other Brachyura. In order to transform the method of gill cleaning seen in dynomenids into that seen in more derived Brachyura, it is necessary to remove all the pereopodal epipods, elongate the epipod of the first maxilliped to clean the hypobranchial region, and remove the epipod of the third maxilliped from between the second and third arthrobranchs, and elongate it so that it covers the epibranchial gill surface. This is sufficient to clean the reduced number of gills and no change in the relative size of the second maxilliped epipod is necessary. Since gills are lost from the posterior part of the thorax, the field of setae on the hypobranchial wall is no longer necessary. The relationships between gill structure and gill cleaning mechanisms have been explored by SUZUKI & MCLAY (1998). Dynomenids have retained several plesiomorphic gill and gill cleaning characters.

In cross section the gills are basically violin-shaped, with afferent and efferent vessels in the 'body' of the gill and a notch on each side. Dynomenids show a great deal of variation in the shape of their gills, chiefly in the number of lobes (or filaments) on the epibranchial surface. BOUVIER (1896: 26, footnote) has already noted the variation in number of filaments along the length of each gill. Therefore in order to make comparisons between species it is necessary to standardize the point at which a cross section is taken and the gills which are used. Comparisons were made using a section across an arthrobranch or pleurobranch from the first two pereopods at approximately half the length from the point of attachment. Lobes on the gills are arranged in rows lengthwise, but they do not always lie in the same plane in cross section. This means that while the hypobranchial half of each gill is composed of a series of plates, the lobes do not always correspond exactly to each pair of plates. Furthermore, the lobes on the posterior side of the gill are usually longer than those on the anterior side.

In the type species *Dynomene hispida* and in *D. praedator* the gill cross section shows a pair of plates (or flattened lobes) on the epibranchial surface. In *D. pugnatrix* an additional short median lobe is added to make three. In *D. pilumnoides* there are four long lobes while in *D. filholi* there are six lobes decreasing in size medially. [My interpretation of the gills of *D. filholi* differs from that of BOUVIER (1896) who gave the number of filaments as being eight because he included the portion of the lateral notch as a filament, whereas I have treated them as part of the 'body' of the gill.] In both species of *Hirsutodynomene* there are six lobes decreasing in size medially. In *Metadynomene* the number of lobes increases from four (*M. tanensis*), five (*M. devaneyi*) to six (*M. crosnieri*). The gills of *Paradynomene tuberculata* have four lobes. In both species of *Acanthodromia* the epibranchial extensions consist of two flattened lobes. Thus within the Dynomenidae we have gills ranging from the multilobed trichobranchiate-like condition seen in *Hirsutodynomene* and *D. filholi*, through *D. hispida* and *D. praedator* in which the number of lobes is reduced to only two (which are flattened) and finally to the phyllobranchiate-like condition seen in *Acanthodromia*. But even in *Acanthodromia* the distinctive lateral notch is evident on each lamella of the gill so that they still differ from the condition found in dromiids, such as *Epigodromia*, *Hypoconcha*, and *Conchoecetes*, where the gill plates are rounded in outline, and not interrupted by notches. Dynomenid gills show little variation in numbers but great variation in shape, while gills of the Dromiidae show greater variation in numbers but almost no variation in shape.

BOUVIER (1896, figs 19, 23) compared the gill structure of *Dynomene filholi* which has several rows of "filaments" with *Acanthodromia erinacea* which has only two plates. He made comparisons with *Homarus vulgaris* as well as *Homolodromia paradoxa*, *Dicranodromia ovata*, and *D. mahieuxii*. Like the dynomenids, the latter two homolodromiid species have different numbers of epibranchial "filaments". BOUVIER regarded *D. mahieuxii* as being a little less primitive because it has fewer filaments which are more plate-like and he suggested that these gill plates might have originated by the concrescence of several short "filaments". In making the same comparison between the two dynomenids BOUVIER discussed the interesting problem of how a species such as *D. filholi* could have evolved a more advanced crab-like form and yet still retain such primitive homarid-like gills. He considered that *D. filholi*, more than any other dromiacean, showed close links with the homarids. BOUVIER argued that *D. filholi* cannot be considered as deriving from *Dicranodromia ovata* (BOUVIER used "*Acanthodromia ovata*", but this must be an error for "*Dicranodromia ovata*") which is, in many respects, more

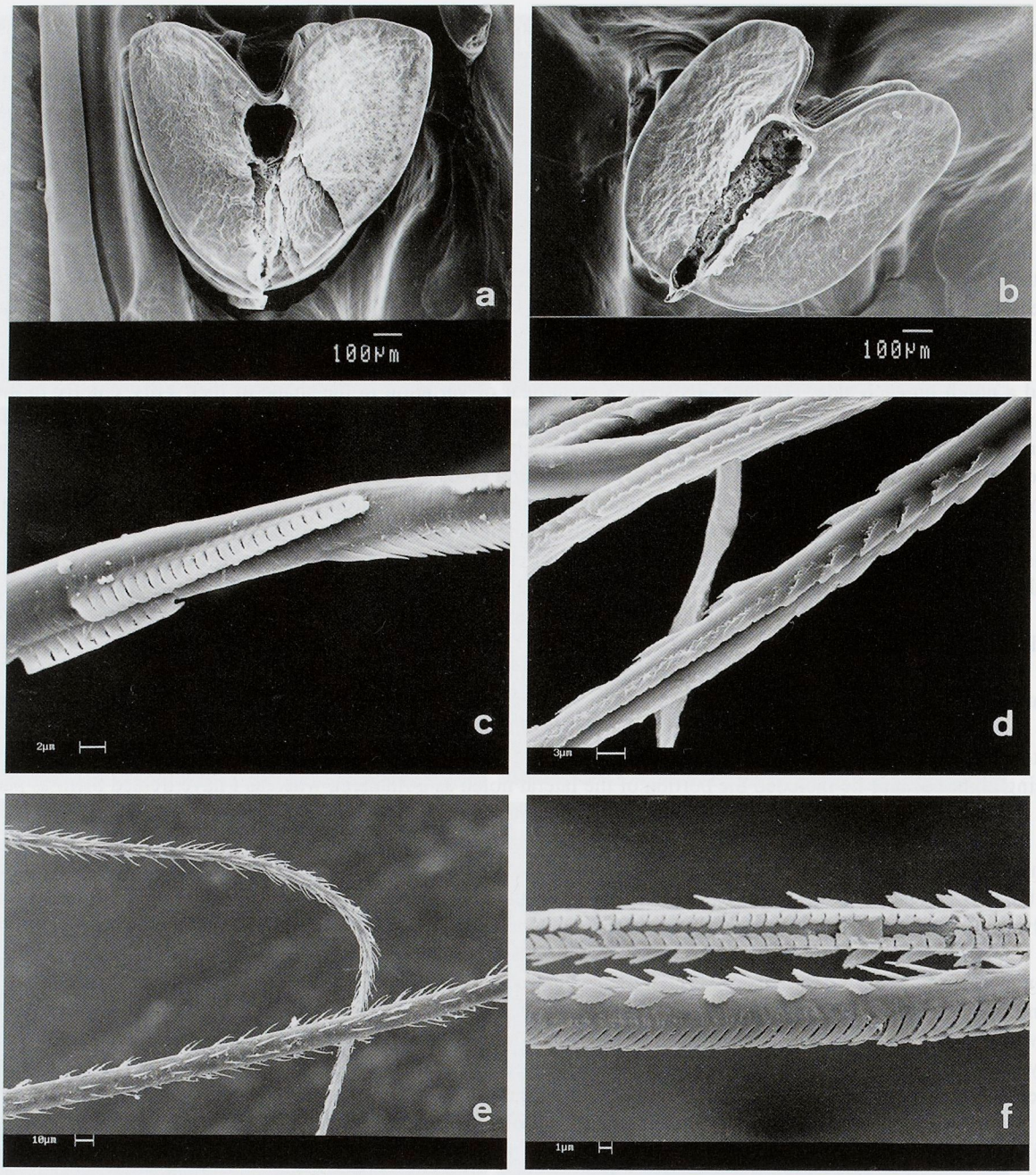


FIG. 7. — **a**, *Epigodromia areolata* (Ihle, 1913), ♂ 14.2 x 12.1 mm, New Caledonia, *"Vauban"*, stn DW 1147, 210 m, 28.10.1989: transverse section through gill. (Dromiidae). — **b**, *Hypoconcha parasitica* (Linnaeus, 1763), ♂ 23.1 x 23.3 mm, Florida, off Panacea, coll. M. WICKSTEN: transverse section through gill. (Dromiidae). — **c**, *Paradynomene tuberculata* Sakai, 1963, ♂ 22.0 x 22.8 mm, New Caledonia, SMIB 3, stn 14, 246 m: cleaning setae from hypobranchial wall of right gill chamber. — **d**, *Dromia erythropus* (George Edwards, 1771), ♂ 81.5 x 62.7 mm, St. Croix, Virgin Ids (USNM 72355): cleaning setae from hypobranchial wall of right gill chamber. (Dromiidae). — **e**, *Paradynomene tuberculata* Sakai, 1963, ♀ 21.5 x 21.2 mm, Loyalty Ids, MUSORSTOM 6, stn DW 406, 373 m (MNHN-B 25249): cleaning setae on epipod from left third pereopod. — **f**, *Metadynomene tanensis* (Yokoya, 1933), ♀ 16.2 x 15.3 mm, New Caledonia, SMIB 8, stn DW 198, 414-430 m: long setae from posterior margin of the left scaphognathite. (All pictures taken with scanning electron microscope.)

primitive. He believed that other dynomenids are probably at a more advanced evolutionary state than *Dynomene praedator*, and it's possible that, as yet undiscovered species of "Acanthodromies", might be more primitive than *D. ovata*, so that it is possible to consider the genus *Acanthodromia* as being the link which connects the genus *Dynomene* to the primitive dromiaceans which originated from the homarids. This hypothesis, which now seems rather unlikely, is largely based on the resemblance of dynomenid gill structure to that found in homarids. Clearly BOUVIER considered phyllobranchiate-like gills as being derived from the trichobranchiate condition. The tendency to evolve phyllobranchiate-like gills seems to have occurred independently in the Homolodromiidae, Dynomenidae and Dromiidae since the last common ancestor of the three groups must have had multi-lobed gills.

PEREOPODS

Anterior pereopods: The first pereopods of dynomenids are longer than walking legs, chelate and sexually dimorphic, being larger in males. The meral article is long and trigonal in section, while the carpal article is distinctive in usually having a prominent sharp spur on the inner superior border. This feature is absent in *Metadynomene*, where there are three small tubercles, and in *Acanthodromia*, where the whole limb is spinous. The fixed finger is straight and is armed with from two to eight small teeth often increasing in size distally. The number of teeth on the dactyl is usually less than on the opposing finger. The tips of both fingers are usually dentate. In *Dynomene*, *Hirsutodynomene* and *Acanthodromia* the dactyl is down-curved so that the fingers gape, but in *Metadynomene* and *Paradynomene* the dactyl is essentially straight so there is little gap and the fingers touch for about half their length. Both fingers are hollowed out internally with a bunch of stiff setae inserted near the base of each finger and projecting across the gap between them. In *Dynomene* and *Hirsutodynomene* these setae are very well developed, forming a screen or sieve behind the outer dentate margins. Observations on *D. praedator* show that these setae help to sift out food particles which are passed to the third maxillipeds (see below).

The second through fourth pereopods are well developed walking legs of similar size to the first pereopods or slightly smaller. They tend to decrease in length posteriorly. Plane of movement of the sternal-coxal articulation is anterior-posterior, for the ischial-basis articulation plane of movement is dorso-ventral, the meral-ischial articulation has a small anterior-posterior plane of movement, the carpal-meral articulation is also dorso-ventral, the propodal-carpal articulation moves anterior-posterior, and finally the propodal-dactyl articulation is dorso-ventral. Dactyli are long and curved with their inner margins usually armed with two to six small spines which are probably used to grasp the substrate on which the crabs live. There is no clear pattern of variation in number of spines between the genera. The only exception is *Dynomene pugnatrix* which has ten dactyl spines. This may indicate that it lives in association with a different kind of host or habitat. At least some of the other shallow water species are known to live among corals and coral debris.

Fifth pereopod (Figs 8 a-f, 9 a-f, 10 a-d, 11): Perhaps the most distinctive feature of the Dynomenidae is the very reduced last pair of pereopods which are carried alongside the posterolateral corners of the carapace, above the base of the fourth pereopods. The reduced leg is directed anteriorly. It is commonly stated that dynomenids, like dromiids, carry their last legs in a dorsal or subdorsal position, but this is not correct. This limb cannot rise above the level of the carapace margin because it is too short and relatively immobile and so cannot be described as dorsal or subdorsal. A more accurate description would be that the limb is "horizontal". Most of the scope for movement in this limb is attributable to the coxo-basal article because the remaining joints are scarcely moveable. The basis-ischium articles are fused in all species, and in *Acanthodromia erinacea* and *Paradynomene tuberculata* the merus is also fused to the preceding articles. The inferior distal margin of the merus is hollowed out as in the previous three limbs. However, it is the anterior distal border of the propodus which is extended to form the fixed finger of the subchelate mechanism and when the limb lies in its natural position the dactyl is almost ventral, the opposite of the cheliped. Observations on live *D. praedator* show that these limbs have a very restricted scope for movement: they are only capable of moving in an anterior-posterior plane above the bases of the preceding pereopods. Most of the time they simply lie alongside the posterolateral corner of the carapace, but when the crab moves using its pereopods, they often move at the same time as though they are part of the coordinated pattern of limb movements. The last legs cannot reach above on to the posterolateral corner of the carapace or beneath the crab into the abdominal cavity. Thus they are not capable of carrying a piece of camouflage or performing a grooming role.

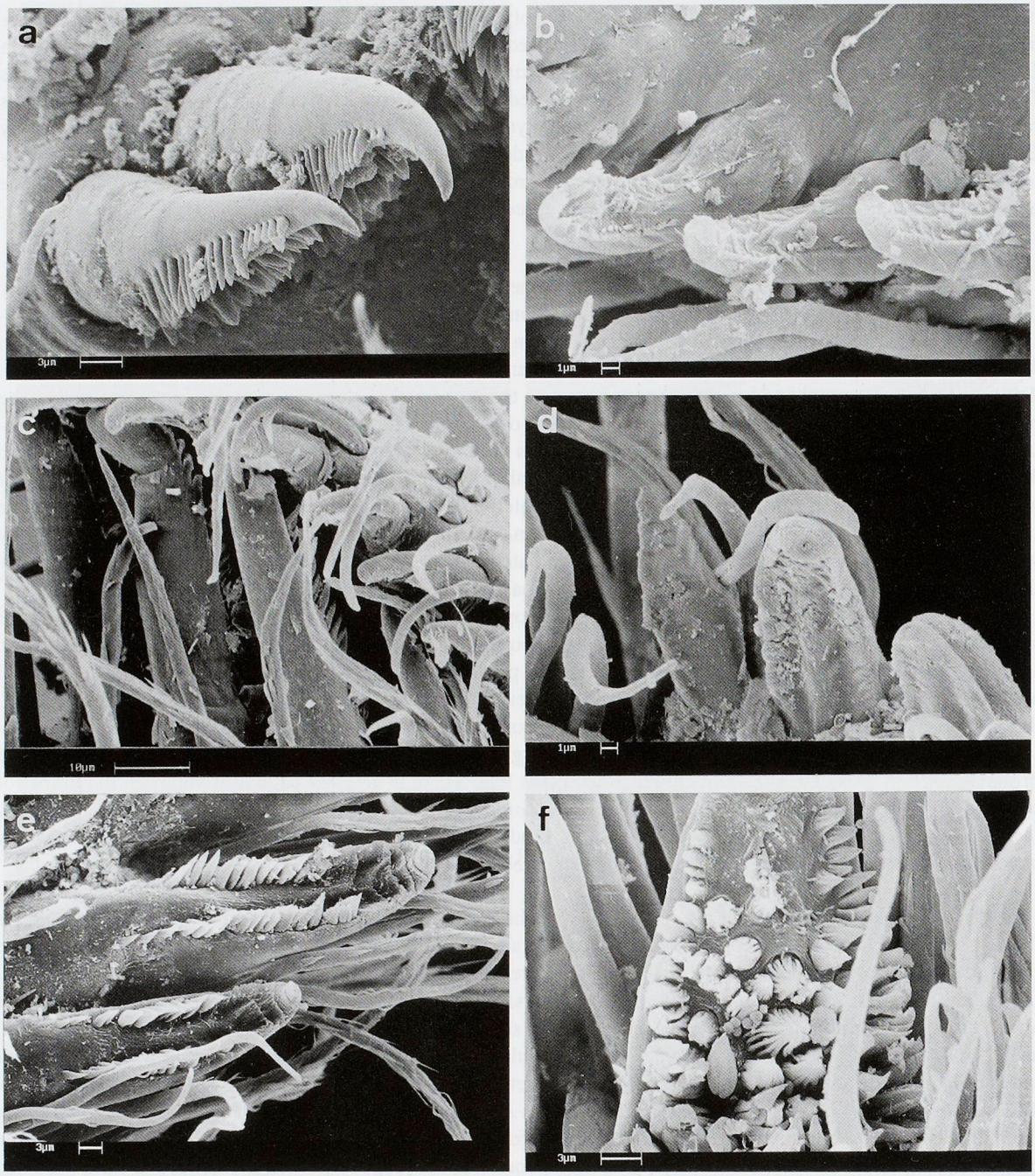


FIG. 8. — **a**, *Dynomene praedator* A. Milne Edwards, 1879, ♂ 9.6 x 7.8 mm, Somalia, Gesira, stn 19, intertidal coral (MZUF): propodal spines from left fifth pereopod. — **b**, *Dynomene praedator* A. Milne Edwards, 1879, ♀ ovig. 9.6 x 7.5 mm, Glorieuses Ids, intertidal: dactyl spines from right fifth pereopod. — **c**, *Dynomene filholi* Bouvier, 1894, ♀ 10.0 x 8.7 mm, Cape Verde Ids, CANCAP, stn 7.125, 85-130 m: dactyl and propodal spines from left fifth pereopod. — **d-e**, *Dynomene pilumnoides* Alcock, 1900, ♀ 12.8 x 10.3 mm, New Caledonia, VOLSMAR, stn DW 7, 400 m: **d**, dactyl spines from left fifth pereopod; **e**, propodal spines from left fifth pereopod. — **f**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♀ 23.8 x 17.8 mm, Cocos Keeling Ids, 0-28 m (WAM 723-89): propodal spine from left fifth pereopod. (All pictures taken with scanning electron microscope.)

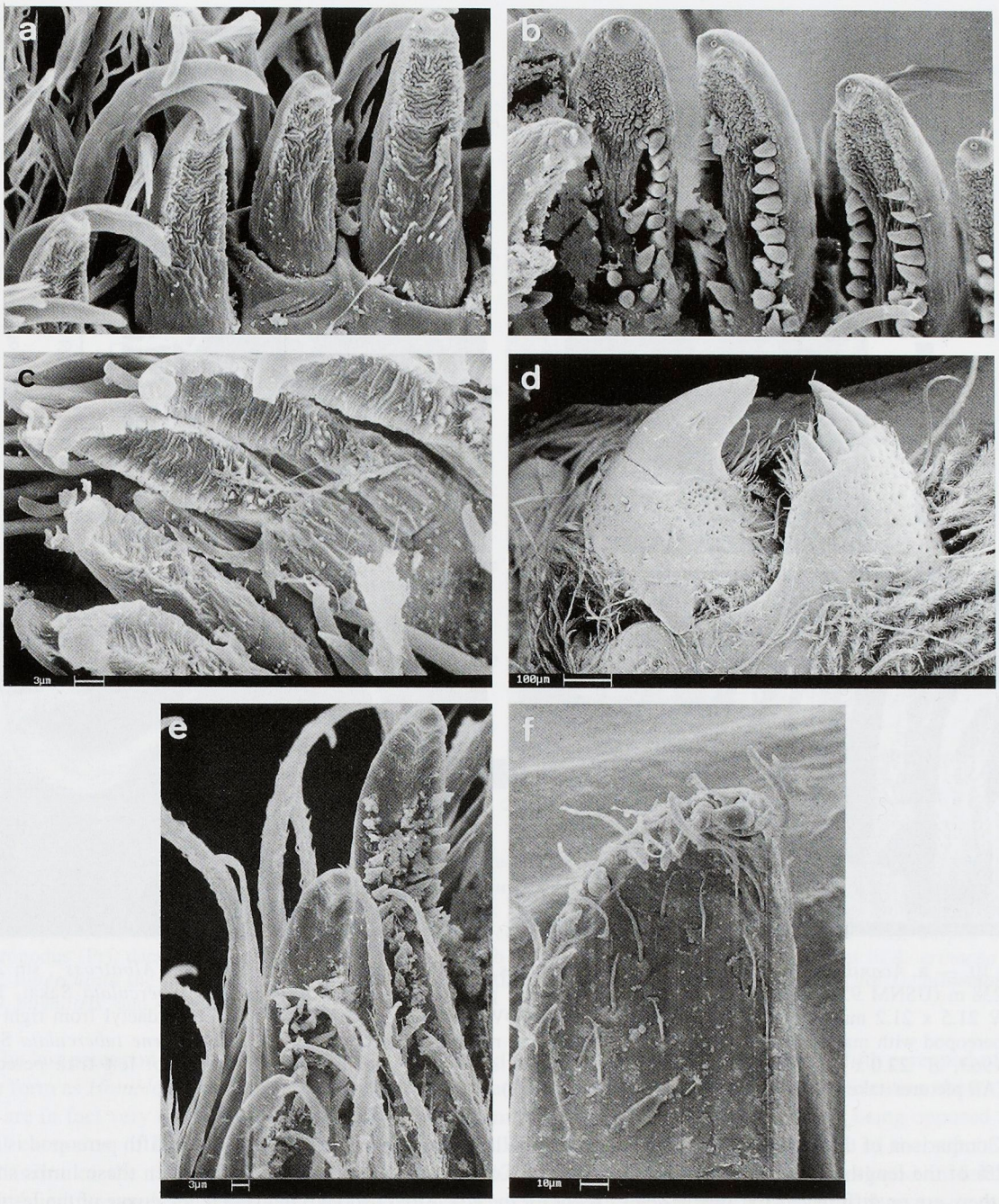


FIG. 9. — **a-b**, *Hirsutodynomene ursula* (Stimpson, 1860), ♀ ovig. 15.0 x 12.2 mm, Ecuador, La Plata Id, *"Askoy"*, stn 80 (LACM): **a**, dactyl spines from right fifth pereopod; **b**, propodal spines from right fifth pereopod. — **c**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♀ 23.8 x 17.8 mm, Cocos Keeling Ids, 0-28 m (WAM 723-89): dactyl spines from left fifth pereopod. — **d**, *Metadynomene tanensis* (Yokoya, 1933), ♂ 16.5 x 15.8 mm, New Caledonia, SMIB 3, stn DW 25, 437m: lateral view of tip of left fifth pereopod. — **e**, *Metadynomene tanensis* (Yokoya, 1933), ♀ 16.2 x 15.3 mm, New Caledonia, SMIB 8, stn DW 198, 414-430 m: propodal spines from right fifth pereopod. — **f**, *Acanthodromia erinacea* A. Milne Edwards, 1880, ♀ 9.5 x 11.5 mm, Yucatan, *"Albatross"*, stn 2354, 238 m (USNM 9547): dactyl from right fifth pereopod with marginal spines. (All pictures taken with scanning electron microscope.)

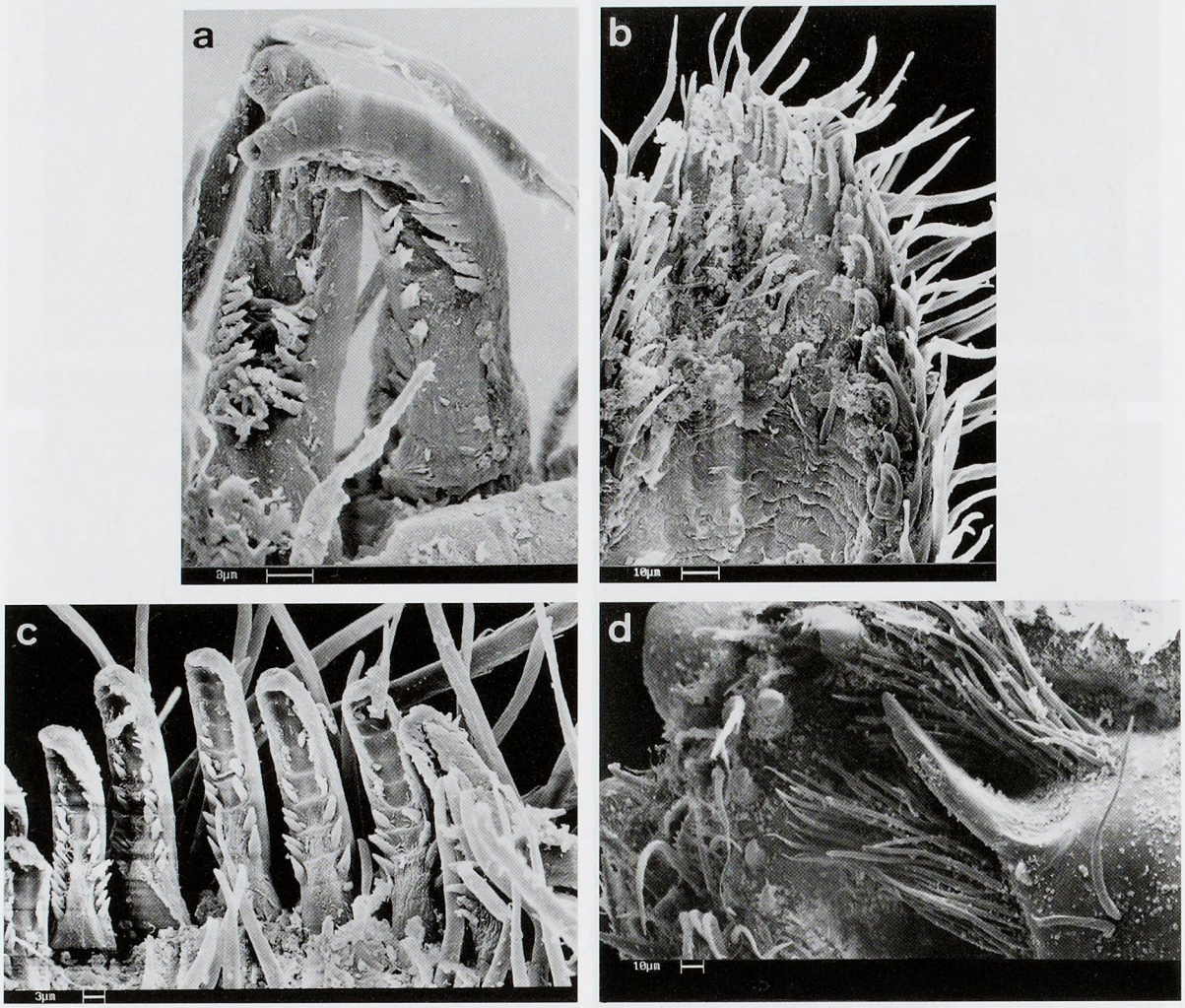


FIG. 10. — **a**, *Acanthodromia erinacea* A. Milne Edwards, 1880, ♀ 9.5 x 11.5 mm, Yucatan, *"Albatross"*, stn 2354, 238 m (USNM 9547): propodal spines from right fifth pereopod. — **b-c**, *Paradynomene tuberculata* Sakai, 1963, ♀ 21.5 x 21.2 mm, Loyalty Ids, MUSORSTOM 6, stn DW 406, 373 m (MNHN-B 25249): **b**, dactyl from right fifth pereopod with marginal spines; **c**, propodal spines from right fifth pereopod. — **d**, *Paradynomene tuberculata* Sakai, 1963, ♂ 22.0 x 22.8 mm, New Caledonia, SMIB 3, stn 14, 246 m: lateral view of tip of left fifth pereopod. (All pictures taken with scanning electron microscope.)

Comparison of the last two pereopods for males of all species shows that on average the fifth pereopod is only 31.2% of the length of the fourth pereopod (Fig. 11). Comparing individual articles between these limbs shows that there are no differences for most articles except for the coxae and dactyli. On average the coxae of the last limb occupy 19.6% of the length but on the preceding leg it is only 10.8%. For the dactyli the reverse is true with the dactyli of the fourth pereopods occupying 17.0% while those of the fifth only occupy 5.3%. Thus except for the articles at each end of the limb the fifth pereopod is just a scaled down version of the preceding limb. The coxa carries the male gonopore, and perhaps cannot be reduced by the same amount as the whole limb and still be functional, while the dactyl is part of a novel subchelate structure. The last pereopod of dynomenids is not reduced as much as found in the cymonomid *Elassopodus stellatus* Tavares, 1993, where both of the last two pairs of pereopods are reduced to tiny stumps, almost concealed by the abdominal segments. It seems that there is scope for a lot of redundancy in the posterior pereopods of decapods.

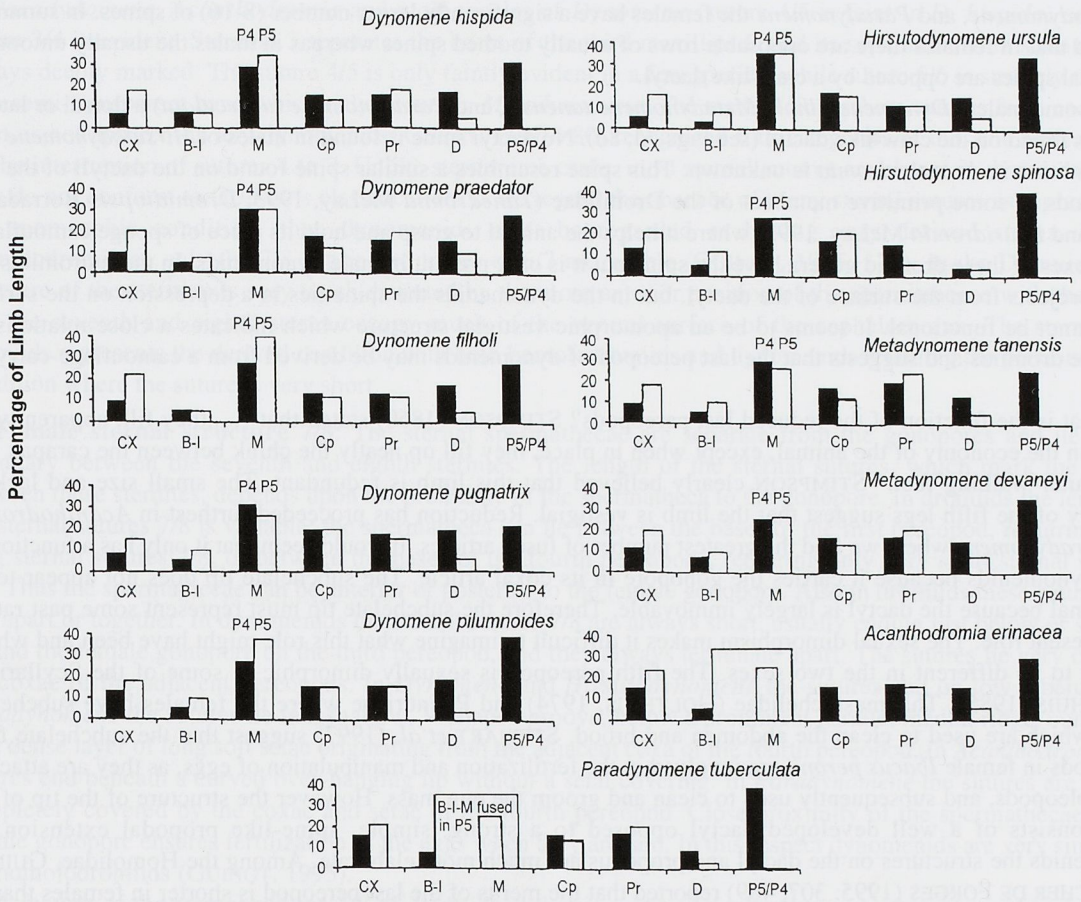


FIG. 11. — Relative size of articles of the last two pereopods of *Dynomene hispida, D. praedator, D. filholi, D. pugnatrix, D. pilumnoides, Hirsutodynomene ursula, H. spinosa, Metadynomene tanensis, M. devaneyi, Acanthodromia erinacea* and *Paradynomene tuberculata*. From left to right, the proportion of total limb length (fourth pereopod followed by fifth pereopod) is shown for coxa (Cx), basis-ischium (B-I), merus (M), carpus (Cp), propodus (Pr), dactyl (D), and the ratio of length of fifth to fourth pereopod (P5 ♀ P4). Note that in *A. erinacea* and *P. tuberculata* the basis-ischium and merus are fused. All measurements made on males except for *D. pilumnoides, D. pugnatrix,* and *A. erinacea*.

The last pereopod is subchelate. BOUVIER (1896) stated that *Acanthodromia erinacea* had a fifth pereopod of the same form as *Homolodromia paradoxa* but their resemblance is only superficial and closer examination shows that they are in fact very different. The subchelate mechanism in dynomenids involves the dactyl being opposed to a distal extension of the propodus which bears toothed or untoothed spines. The structure of the subchelate mechanism of the fifth leg is sexually dimorphic. The propodal extension is better developed in females (resembling the condition found in *Homolodromia*, thus accounting for BOUVIER's observation) than it is in males (resembling the condition found in *Dicranodromia*, see GUINOT, 1995, her fig. 3 A-H, for details). The most obvious difference is in the dactyl: in males the dactyl has the conventional claw shape but in females the dactyl is modified as a flattened plate bearing 5-16 typically untoothed spines. In females there is usually more spines on the dactyl than on the propodus. These spines are hooked and only have a few small proximal teeth or none at all. The surface of the dactyl spines is usually concave and crenulate. Other differences between male and female dynomenids are that in females of all species the propodal spines bear small teeth, but these are only found in males of *D. hispida, D. praedator* and in both species of *Hirsutodynomene.* The number of propodal spines also differs: while both sexes of *Dynomene* have a similar number (approx. 5) of spines, in *Metadynomene*,

Hirsutodynomene, and *Paradynomene* the females have a significantly larger number (8-16) of spines. In summary we find that in females there are opposable rows of usually toothed spines whereas in males the usually untoothed propodal spines are opposed by a claw-like dactyl.

In some males (*Dynomene filholi*, *Metadynomene tanensis*, and *Paradynomene tuberculata*) a dorsal or lateral spine is found on the claw-like dactyl (see Figs 7d, 8d). No dactyl spine is found in males of *Hirsutodynomene* and the condition in *Acanthodromia* is unknown. This spine resembles a similar spine found on the dactyli of the last pereopods of some primitive members of the Dromiidae (*Tunedromia* McLay, 1993, *Dromidiopsis* Borradaile, 1900, and *Lauridromia* McLay, 1993) where it helps the animal to grasp and hold its piece of sponge camouflage. Both sexes of these dromiid genera have the spine but it is only present in male dynomenids. In these dromiids the spine projects from the surface of the dactyl, but in the dynomenids the spine lies in a depression on the surface and cannot be functional. It seems to be an apomorphic vestigial structure which indicates a close relationship with the dromiids and suggests that the last pereopod of dynomenids may be derived from a camouflage-carrying limb.

What is the function of the reduced last pereopods? STIMPSON (1860) stated that ".....they fill, apparently no office in the economy of the animal, except when in place, they fill up neatly the chink between the carapax and the stouter walking feet." STIMPSON clearly believed that this limb is redundant. The small size and lack of mobility of the fifth legs suggest that the limb is vestigial. Reduction has proceeded furthest in *Acanthodromia* and *Paradynomene* where we find the greatest number of fused articles. It would seem that it only has a function in male dynomenids because it carries the gonopore in its coxal article. The subchelate tip does not appear to be functional because the dactyl is largely immovable. Therefore the subchelate tip must represent some past rather than present role. The sexual dimorphism makes it difficult to imagine what this role might have been and why it needed to be different in the two sexes. The fifth pereopod is sexually dimorphic in some of the Scyllaridae (HOLTHUIS, 1985), Thaumastochelidae (HOLTHUIS, 1974) and Palinuridae where the females have subchelate limbs which are used to clean the abdomen and brood. STEWART *et al.* (1997) suggest that the subchelate fifth pereopods in female *Ibacus peronii* are involved in the fertilization and manipulation of eggs, as they are attached to the pleopods, and subsequently used to clean and groom the egg mass. However the structure of the tip of the limb consists of a well developed dactyl opposed to a strong, simple, spine-like propodal extension. In dynomenids the structures on the dactyl and propodus are much more elaborate. Among the Homolidae, GUINOT and RICHER DE FORGES (1995: 307, 469) reported that the merus of the last pereopod is shorter in females than in males of all species of *Homologenus*.

The dynomenid female limb has a structure which resembles some kind of cleaning or grooming appendage which is typical of many anomolans but there the resemblance ends because the structure of anomolan fifth pereopods is quite different (BAUER, 1989; POHLE, 1989). Anomolan fifth pereopods have a well developed subchelate tip, not sexually dimorphic, and can be inserted into the branchial chamber to clean the gills, see for e.g. the Porcellanidae (FLEISCHER *et al.*, 1992), but dynomenids have a closely fitting carapace which would deny these limbs access to the gills. The dynomenid spine structure is somewhat similar to the propodal setae found on the fifth pereopods of carideans such as *Palaemon* and *Betaeus* which are used for body grooming (BAUER, 1989). Furthermore similar setae are found in axiid thalassinideans, astacid and cambarid crayfish, and nephropid lobsters (BAUER, 1981). In none of these cases are the limbs sexually dimorphic. BAUER (1989: 61) points out that no grooming fifth pereopod has ever been described for a brachyuran but a former body or gill grooming function seems the most likely role for the fifth pereopod in dynomenids. It should be noted that one other feature normally accompanies decapod cleaning fifth pereopods: in order for these limbs to be fully functional, and access all the areas in need of cleaning, the sternite of this limb must be mobile and not attached to the preceding sternite. Once the last sternite is attached, as it is in the Brachyura, the last pereopods can no longer perform a cleaning function.

FEMALE STERNAL SUTURES

Apart from the thoracic sternal suture 7/8 in females (see below) which is always evident, several other sutures mark the boundaries of thoracic sterna in some genera. In *Metadynomene* sutures 3/4, 4/5 (faintly), and 5/6 (very strong) are visible. *Hirsutodynomene* is the same as the previous genus except that the suture 5/6 is not apparent.

In *Paradynomene*, *Acanthodromia* and most species of *Dynomene* (suture 4/5 is faint in *D. hispida*) only the suture 3/4 is evident. Sternum 3 separates the bases of the third maxillipeds and its separation from sternum 4 is always deeply marked. The suture 4/5 is only faintly evident in a few species, while suture 5/6 is strongly marked by a semi-transparent band which only occurs in *Metadynomene*. The median line, where sutures from each side meet, is not apparent in any dynomenids. GUINOT (1979: 80) recognized four categories of thoracic sterna based on the interruption of sutures 4 to 7. Unlike sternitreme crabs, most sternal sutures are absent in dynomenids, so they do not conform to GUINOT's classification. If we regard the absence of many sternal sutures as representing the apomorphic condition, then dynomenids must be regarded as having very derived sterna. In the Homolodromiidae only the 7/8 suture and traces of 6/7 are visible (GUINOT, 1995: 174). In the Dromiidae the structure of the sternum is very much distorted by the more anterior position of the spermathecae with the result that the seventh and eighth sterna occupy much of the ventral surface of the cephalothorax. The sternum of dromiids represents the derived condition with both homolodromiids and dynomenids retaining the plesiomorphic condition where the suture is very short.

Female sternal structure 7/8: The sternal spermathecae are separate from the gonopores and lie at the boundary between the seventh and eighth sternites. The length of the sternal sutures, which mark the suture between these sternites, depends upon the proximity of the spermatheca to the gonopore. In dromiids the length of the sternal sutures 7/8 is variable: the spermatheca can lie between the bases of the first pereopod, requiring very long sternal sutures 7/8, or between the bases of the fourth pereopods, requiring only very short sternal sutures 7/8. Thus the spermathecae can be anterior or posterior to the female gonopore. Also in dromiids these sutures can end apart or together. In dynomenids the sternal sutures 7/8 are always short, usually ending just below or slightly behind the female gonopore on the third pereopod, and they always terminate apart. The sutures lie very close to the coxae of the adjacent pereopods. In *Dynomene* and *Hirsutodynomene* the sutures end on low tubercles. In *Metadynomene* the sutures lie in a shallow, V-shaped groove, below a prominent parallel medial ridge, concealed by a dense layer of long soft setae originating from the adjacent coxa of the fourth pereopod. In *Acanthodromia* the sutures end beneath a curved over-hanging lip without a setal covering. In *Paradynomene* the sutures are almost completely covered by the coxae and setae of the fourth pereopod. Close proximity of the spermathecae to the female gonopore ensures fertilization of the eggs when they are laid. In this respect dynomenids are very similar to the homolodromiids (GUINOT, 1995).

A feature of the sternal sutures 7/8 of dromiids is that in mature females they are often covered with a dark gelatinous layer which closes the spermathecae. This substance is probably produced by the male and could act as a sperm plug, preventing other males from inseminating the female. In homolodromiids GUINOT (1995) reported that many females had the broken off tips of male second pleopods blocking the entrance to the spermathecae and perhaps functioning as a different kind of sperm plug. In all the dynomenid females I have examined, I have never seen sperm plugs of either of the above kinds. This may imply that dynomenids have a mating strategy different from dromiids and homolodromiids.

ABDOMEN

Dynomenids have an abdomen of six free segments with no segments fused. Segments increase in length and breadth posteriorly with margins fringed with long setae. The telson is much wider than long, with the anterior margin angled to accommodate the uropods and the posterior margin broadly rounded. Compared to other dromiaceans, the uropods are well developed, visible externally and often completely excluding the penultimate segment from reaching the lateral margin, especially in females. The abdomen and pleopods provide a protected chamber where the eggs are incubated until they hatch. No dynomenids provide parental care for their larvae.

Unlike the Dromiidae, most of the Dynomenidae have no effective abdominal locking mechanism and the abdomen in both males and females is simply curled under the cephalothorax and held loosely in position by its own musculature. There are differences between dynomenid genera in the nature of abdomen-restricting structures. In *Dynomene* males and immature females there is a small rounded sternal tubercle at the lateral margins, below the articulation of the first walking legs, and adjacent to the uropods when the abdomen is in its natural position (see also GUINOT, 1979: 125-126). These tubercles simply restrict sideways movement of the abdomen and they

disappear in mature females where the abdomen occupies all the ventral surface. The same arrangement as in *Dynomene* is found in *Hirsutodynomene*. However *Metadynomene* has small spines (can be bifid) or ridges on the coxae of the second and third pereopods, adjacent to the margins of the telson and penultimate abdominal segments, which restrict lateral movement. In *Paradynomene* small rounded granules cover the coxal articles of the pereopods, leaving the surface of the abdominal cavity smooth. The margins of the abdomen are neatly surrounded by many granules (several on each coxa) which restrict sideways movement. In *Acanthodromia* the abdomen of mature females is confined between tuberculate coxal projections on pereopods and under projections on the coxae of the third maxillipeds. Use of the pereopod coxae to restrain the abdomen resembles the situation found amongst many dromiids and use of maxilliped spines resembles the condition found in the Poupiniidae. Clearly, the abdomen locking mechanism of *Acanthodromia* is very different from that found in the other dynomenid genera. There is a gradation from abdomen maintaining mechanisms as found in *Dynomene* + *Hirsutodynomene* where sternal tubercles are used, through *Metadynomene*, using coxal ridges or spines on the second and third pereopods, and *Paradynomene* using coxal granules, to the abdominal locking mechanism found in *Acanthodromia* which uses well developed coxal projections on the third maxillipeds and first three pereopods. (See also below under Uropods.)

Observations of live *Dynomene praedator* show that the abdomen is not always held closely against the sternum and when the crab moves, it often makes "flicking" movements similar to those seen in for e.g. porcellanids. By themselves these abdominal movements would tend to propel the crab backwards but they occur when the crab moves both forwards and backwards. Locomotion is achieved using the three pairs of walking legs. The motor pattern causing abdominal movements is probably a vestige of the past when the abdomen was involved in locomotion.

In mature females the abdomen covers the entire sternum and coxae of all pereopods with the telson covering the proximal half of the third maxillipeds. In males the abdomen is not quite so broad and the telson only extends as far as the bases of the third maxillipeds. While mature dynomenid females are clearly recognizable by their wide abdomens, immature female and male abdomens are not greatly different. Therefore abdomen width is not as reliable a method of sexing specimens as it is in eubrachyurans. The relative size of *Metadynomene tanensis* male and female abdomens is shown in Fig. 28b. In this species females seem to have a pubertal moult at a CW of around 11.0 mm and males have a pubertal moult around 15.0 mm. In both sexes the pubertal moult is not terminal.

In order to ensure sperm transfer, the female abdomen must be flexible enough to expose the posteriorly placed spermathecae. Males only need short pleopods, but because their abdomen must fit inside that of the female, it must be relatively short and/or flexible, so that it can be folded or curled to allow the pleopods to come into contact with the spermathecal openings and deposit the sperm.

PLEOPODS (Figs 12 a-f, 13 a-f, 14 a-e)

Dynomenid crabs are unusual in having five pairs of pleopods in both sexes. The first pair of female pleopods are uniramous and reduced in length, and do not carry eggs, while the remainder are normal biramous egg-bearing limbs. In males the first pair are a semi-rolled tube, with an oval apical plate surrounded by setae, while the second pair are needle-like with an exopod on the basis, and the last three pairs of pleopods are rudimentary.

Dynomenid male pleopods have been previously illustrated as follows:

Dynomene hispida : PEYROT-CLAUSADE & SERÈNE (1976, text-fig. 1, pl. 5, A-B, F), GUINOT (1979, fig. 60 e-f), DAI *et al.* (1986, fig. 11, 2-3), and DAI & YANG (1991, fig. 11, 2-3). As *D. granulobata*, DAI, YANG & LAN (1981, figs 13-14), DAI *et al.* (1986, fig. 12, 1-2), and DAI & YANG (1991, fig. 12, 1-2).

D. praedator : CHEN (1979, fig. 1, 5-6) (as *D. sinensis*). And DAI, YANG & LAN (1981, figs 8-9), DAI *et al.* (1986, fig. 12, 3-4), DAI & YANG (1991, fig. 12, 3-4) (as *D. tenuilobata*).

D. filholi : MONOD (1956, figs 84-88).

D. pilumnoides : STEBBING (1921, pl. 14) (as *Maxillothrix actaeiformis*).

Metadynomene devaneyi: TAKEDA (1977, text-fig. 1 A-C).

In *M. tanensis*, some of the sexually mature females have their first pair of pleopods developed as in males rather than being vestigial, but in all other respects they appear to be normal (see Discussion under this species).

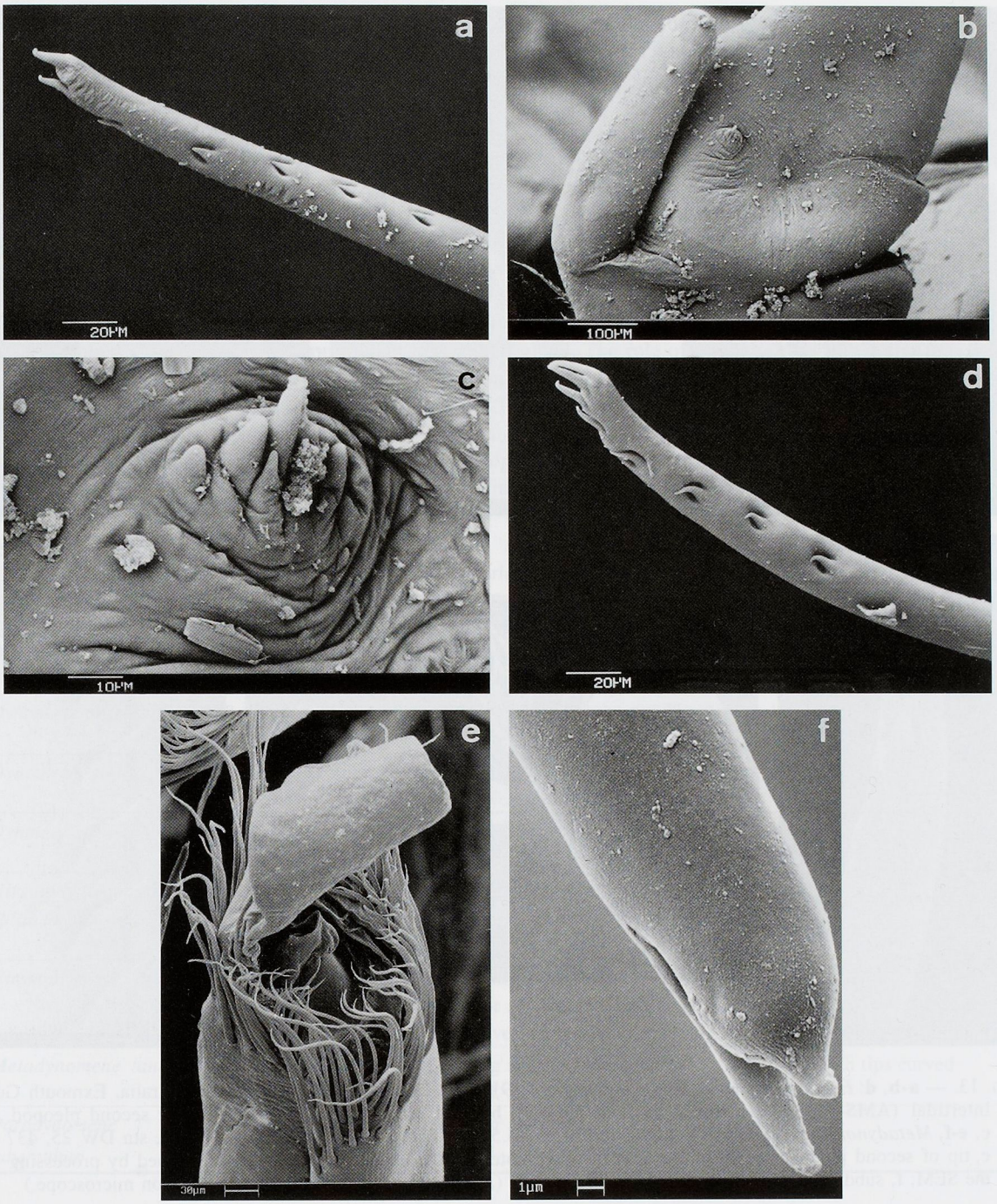


FIG. 12. — **a-c**, *Dynomene hispida* Guérin-Méneville, 1832, ♂ 11.6 x 9.2 mm, Somalia, Gesira, stn 12, intertidal coral (MZUF): **a**, tip of right second pleopod; **b**, inner surface of exopod and base of left second pleopod showing location of secretory tegumental gland; **c**, close up of secretory tegumental gland shown in previous figure. — **d**, *Dynomene praedator* A. Milne Edwards, 1879, ♂ 10.8 x 8.5 mm, Somalia, Gesira, stn 14, intertidal coral (MZUF): tip of right second pleopod. — **e-f**, *Dynomene pilumnoides* Alcock, 1900, ♂ 23.5 x 19.0 mm, New Caledonia, SMIB 3, stn 18, 338 m: **e**, tip of right first pleopod, note that the apical plate has been curled and deformed by processing for the SEM; **f**, tip of right second pleopod. (All pictures taken with scanning electron microscope.)

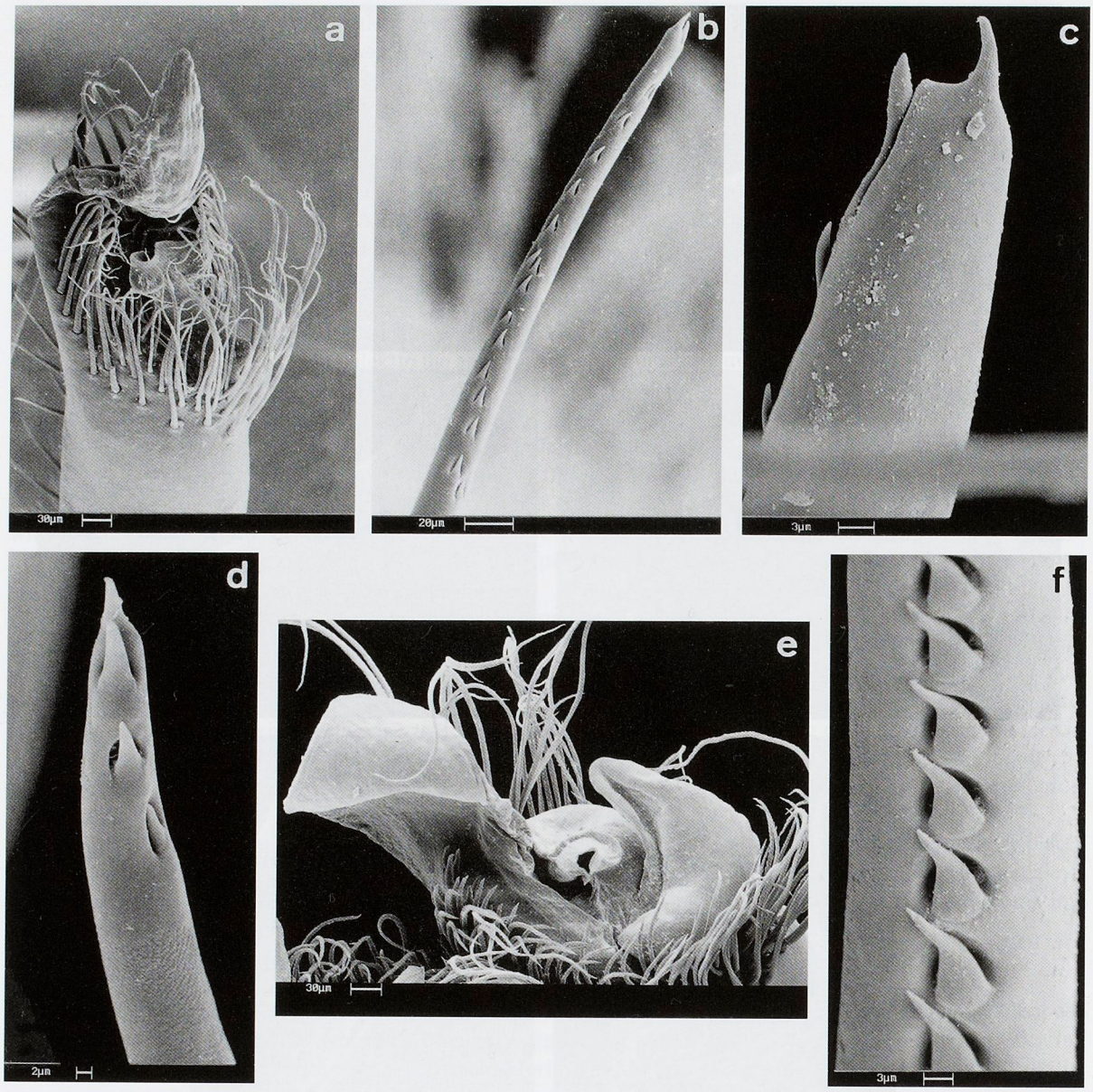


FIG. 13. — **a-b**, **d**: *Hirsutodynomene spinosa* (Rathbun, 1911), ♂ 19.6 x 14.5 mm, Western Australia, Exmouth Gulf, intertidal (AMS-P19118): **a**, tip of left first pleopod; **b**, right second pleopod; **d**, tip of left second pleopod. — **c**, **e-f**, *Metadynomene tanensis* (Yokoya, 1933), ♂ 16.5 x 15.8 mm, New Caledonia, SMIB 3, stn DW 25, 437 m: **c**, tip of second pleopod; **e**, tip of left first pleopod, note that the apical plate has been deformed by processing for the SEM; **f**, subdistal spines from second male pleopod. (All pictures taken with scanning electron microscope.)

The first male pleopod consists of two articles: the base of the proximal article forms a flattened plate, lying beside the genital opening of the coxa, while the distal article is narrower and forms a semi-rolled tube accessed by the second pleopod on the medial side. The distal article ends in an oval-shaped flattened plate, borne on the medial corner, which is surrounded by a dense fringe of long setae. The aperture for sperm delivery lies at the base of the plate, amongst the setae. The second pleopod is about as long as the first, and is borne on a sternal plate which is produced anteriorly at the corners. The basal article of the second pleopod bears an exopod and an endopod.

The proximal article of the exopod is very short while the distal article is longer, narrowing to a blunt point and has a setose lateral margin. The proximal article of the endopod is broad but very short while the distal article is much longer and narrows quickly to a needle-like shaft. When both pleopods are in their natural position, the extended coxa ("penis"), bearing the gonopore, opens between the plates formed by the proximal article of the first pleopod (above) and the flattened basal articles of the second pleopod (below). The exopod of this pleopod, lying in front of and below the genital opening, has an important role in channeling the sperm from the genital opening into the base of the first pleopod. Meanwhile, a conical swelling on the extension of the sternal plate at the base of the second pleopod, closes the posterior limit of the chamber into which the sperm is delivered. The action of the spines on the anterior surface of the needle-like part of the second pleopod may propel the spermatophores into the first pleopod where they are delivered through the setose tip into the female spermatheca. The oval medial plate on the first pleopod may help to guide the sperm into the spermatheca. Thus the exopod of the second pleopod, far from being vestigial, may be an integral part of the sperm delivery process. Near the base of the endopod of the second pleopod is the opening of a prominent tegumental gland. The role of this accessory sex gland may be to provide extra seminal fluid aiding sperm transfer. MINIGAWA (1993) has reported the presence of secretory glands in both the first and second pleopods of *Ranina ranina*. These glands normally secrete mucopolysaccharides and could also be present in the first male pleopod of dynomenids, but to establish this would require sectioning and staining. It is interesting to note that in *Chionoecetes opilio* (Majidae) rosette type accessory sex glands only appear in mature crabs and are concentrated in the proximal region of the first pleopod, with ducts leading to the ejaculatory canal (BENNINGER *et al.*, 1995).

TABLE 1. — Morphological variation in male second pleopods.

	Terminal spines	Subterminal spines	Direction of subterminal spines
Dynomene hispida	2 straight spines	5 arranged sinuously over 180°, none overlapping	Apical
Dynomene praedator	3 straight spines	5 arranged sinuously over 90°, none overlapping	Apical but with tips curved laterally
Dynomene filholi	1 straight spine	10 arranged sinuously over 90°, none overlapping	Apical
Dynomene pilumnoides	2 curved spines	15 arranged sinuously over 180°, none overlapping	Apical
Hirsutodynomene spinosa	2 straight spines	16 curving from anterior to posterior surface and back again, some overlapping	Apical
Hirsutodynomene ursula	2 curved spines	20 curving from anterior to posterior surface and back again, some overlapping	Apical
Metadynomene tanensis	2 curved spines	24 along anterior surface of pleopod, none overlapping	Apical but with tips curved laterally
Paradynomene tuberculata	2 straight spines	14 along anterior surface of pleopod, none overlapping	Apical

In most groups of the Brachyura the male pleopods show wide variation and differences between species which have proved taxonomically valuable. However there is little variation in structure of the first pleopods of different dynomenid species. Under the normal light microscope the second male pleopods simply appear to be needle-like, but examination at higher magnifications, using the scanning electron microscope, reveals some fine detail and variation in structure. The fine structure of the second pleopods of eight out of the thirteen species (representing four of the genera) have been examined (see Table 1). The basic plan for dynomenid pleopods consists of a shaft bearing a row of tiny inset spines running along the length and ending with two or three

terminal spines. The main sources of variation are the number of subterminal spines, their disposition to each other, and their direction. The number of spines ranges from 5 to 24, which can be arranged in a straight line or variously curving around the shaft axis, and in some cases the spines overlap so that two adjacent spines can be side by side. In most cases the spines are directed apically but in two species (*Dynomene praedator* and *Metadynomene tanensis*) they are curved towards one side. The differences between the genera are not dramatic: in *Dynomene* there tend to be fewer spines (usually directed apically) than in the other genera, whereas in *Metadynomene* there are a large number of quite curved spines. In the cases of two pairs of species which, for other reasons, are believed to be closely related, viz. *Dynomene filholi - D. pilumnoides*, and *Hirsutodynomene spinosa - H. ursula*, the only difference between them is in the number of subterminal spines. The species of *Hirsutodynomene* have a unique arrangement of spines and it is the only genus in which spines overlap. In spite of its dromiid-like features, *Paradynomene tuberculata* has pleopods which are typical of dynomenids (see Discussion under this species). The second pleopods of two dromiids, *Stimdromia lamellata* (Ortmann, 1894) and *Epigodromia gilesii* (Alcock, 1899), examined in the same way, show no evidence of ornamentation. The distal part of the second pleopod of *Dicranodromia felderi* has minute scattered spinules (MARTIN, 1990, his fig. 3g). As far as is presently known, the dynomenids are the only dromiaceans with ornamented second male pleopods.

The tube (i.e. "penis") carrying sperm to the base of the pleopods is well developed in podotreme crabs. Dromiid males have a long soft penis extending from the coxal article but in dynomenids this is absent. Instead the corner of the coxal article itself is extended to carry the sperm to the pleopods (see Fig. 14 f). Thus the dynomenids could be said to have a calcified "penis" and they share this character with the homolodromiids (GUINOT, 1995), although the shape is a little different. Using the implied vertebrate analogy, the name "penis" is not really very accurate since it is not this structure which is responsible for introducing sperm into the female. The so-called "penis" of all crabs is analogous to the vas deferens and should perhaps be called the "sperm duct". The first male pleopod should be referred to as the pleopod or "penis".

Male dynomenids have rudimentary pleopods on segments three to five. In the species that have been examined closely, the last three pairs of pleopods are biramous. Only *Dynomene praedator* has uniramous pleopods. The exopod is usually longer and connected to the basal article by a joint. However, the other article is not jointed and appears to simply be an extension of the basal article. If it is regarded as representing the endopod, then we must assume that the joint has been lost as a result of fusion. In *Metadynomene tanensis* both articles are about the same length and fused to the base. The presence of rudimentary male pleopods is also found in homolodromiids and some dromiids. GUINOT (1995) recorded rudimentary pleopods in both *Homolodromia* A. Milne Edwards, 1880, and *Dicranodromia* A. Milne Edwards, 1880 where they varied in size between species, and sometimes asymmetrically on each segment, but in all cases they were uniramous. Dromiids with rudimentary male pleopods include *Sphaerodromia* Alcock, 1899, *Exodromidia* Stebbing, 1905, and some species of *Dromia* Weber, 1795 where they are symmetrical and uniramous (McLAY, 1993). Retention of these pleopods in males must be regarded as a plesiomorphic character.

The first female pleopod is vestigial and consists of a proximal calcified basal article, attached to the sternum, and a distal article which is soft and flexible, bearing long marginal setae and narrowing to a blunt tip. This pleopod does not carry eggs and when the abdomen is closed it overlies the sternal suture 7/8 which harbours the spermatheca. Their proximity to the spermathecae may mean that these pleopods have some role in ensuring that eggs from the coxal gonopore, and sperm from the spermathecae, come into contact with each other. Since possession of vestigial first pleopods by females is a character of all podotremes, a similar role could be hypothesized for these pleopods in other families where there is close proximity of spermathecae, gonopores and first pleopods. This could be true in primitive dromiids like *Sphaerodromia* and *Eodromia* for example, but in more derived dromiids the spermathecae are moved to a much more anterior position in front of the gonopores, making this liaison unlikely. The other four pleopods in female dynomenids are biramous, the basal article is very reduced, and both the exopod and endopod consist of six articles. The endopods have long filiform setae for egg attachment while the exopods have dense fine setae (as on the first pleopod) along the margins for brood protection.

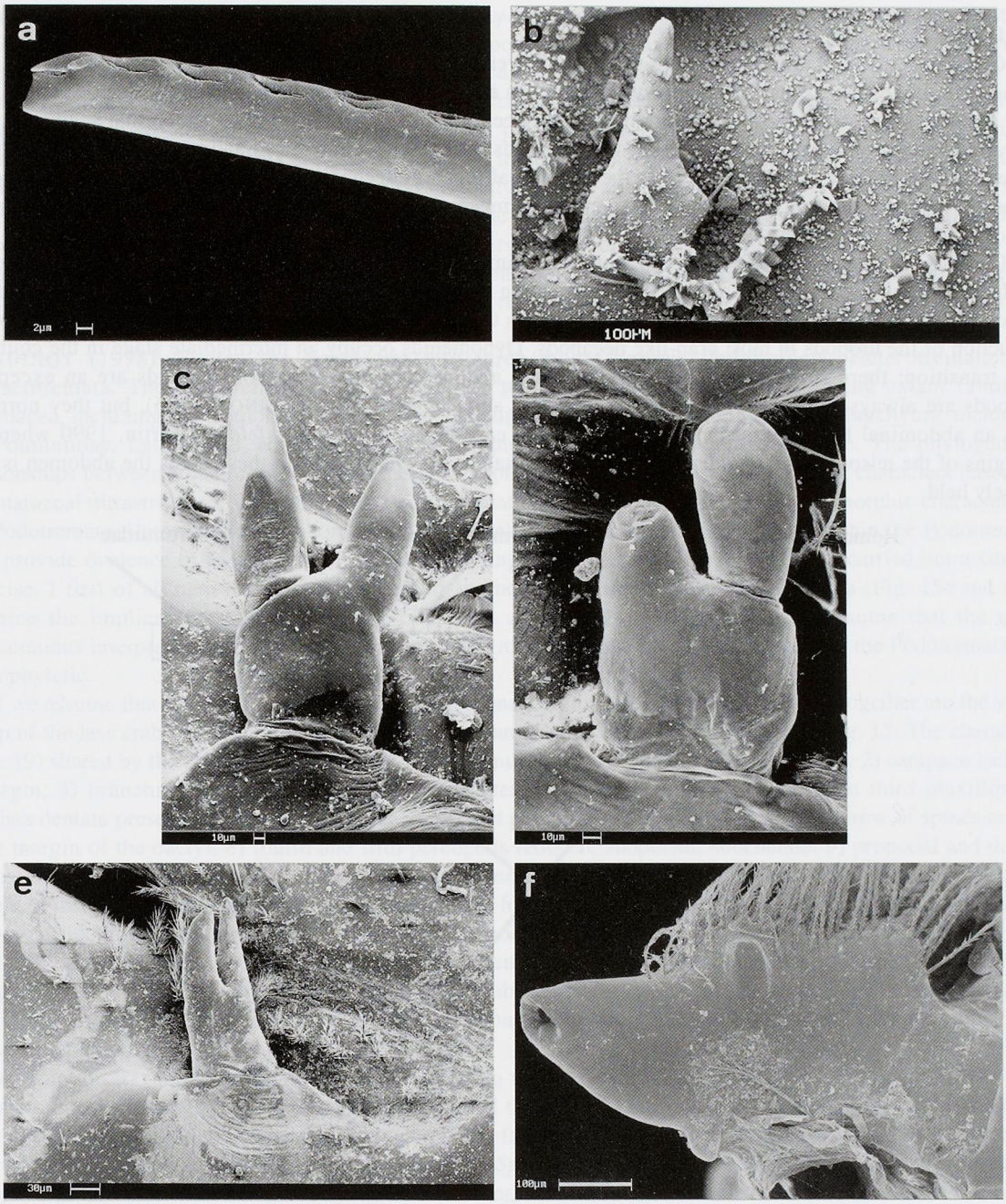


FIG. 14. — **a**, *Paradynomene tuberculata* Sakai, 1963, ♂ 22.0 x 22.8 mm, New Caledonia, SMIB 3, stn 14, 246 m: tip of second pleopod. — **b**, *Dynomene praedator* A. Milne Edwards, 1879, ♂ 10.8 x 8.5 mm, Somalia, Gesira, stn 14, intertidal coral (MZUF): male right fifth pleopod. — **c**, *Dynomene pilumnoides* Alcock, 1900, ♂ 23.5 x 19.0 mm, New Caledonia, SMIB 3, stn 18, 338 m: male left fifth pleopod. — **d**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♂ 19.6 x 14.5 mm, Western Australia, Exmouth Gulf, intertidal (AMS-P19118): male right fifth pleopod. — **e**, *Metadynomene tanensis* (Yokoya, 1933), ♂ 16.5 x 15.8 mm, New Caledonia, SMIB 3, stn DW 25, 437 m: male left fifth pleopod. — **f**, *Hirsutodynomene ursula* (Stimpson, 1860), ♂ 13.4 x 10.3 mm, Mexico, Espiritu Santo Id, *"Velero"*, stn 638-37, intertidal: coxal article of right fifth pereopod. (All pictures taken with scanning electron microscope.)

UROPODS

Compared to other dromiaceans the uropods are very well developed in dynomenids and usually sexually dimorphic. In *Dynomene* and *Hirsutodynomene* uropods are larger in females than in males. Uropods in both male and female *Metadynomene* fill the entire margin between the telson and penultimate abdominal segment and in *Paradynomene* about half the margin. In some dromiids the uropods are reduced and in some cases vestigial or absent. When present they have a role in the abdominal locking mechanism but this is not true in dynomenids because, for the most part, they do not have effective means of locking their abdomen. Compared to dromiids, dynomenid uropods are plesiomorphic.

Uropods are the uniramous remnant of a biramous limb which formed part of the tail-fan in a distant ancestor. Reduction of this appendage is associated with reduction in the size of the whole abdomen and its folding beneath the cephalothorax. There is an obvious trade off between the development of an abdominal locking mechanism and reduction of the uropods in most crab-like decapods. Dynomenids occupy an intermediate stage in the course of this transition: there is only minimal restraint of the abdomen. However homolodromiids are an exception: uropods are always rudimentary, represented by only small ventral lobes (GUINOT, 1995), but they normally lack an abdominal locking mechanism (except in the case of *Dicranodromia felderi* Martin, 1990 where the margins of the telson are held under flanges on the coxae of the chelipeds). In these crabs the abdomen is only loosely held.

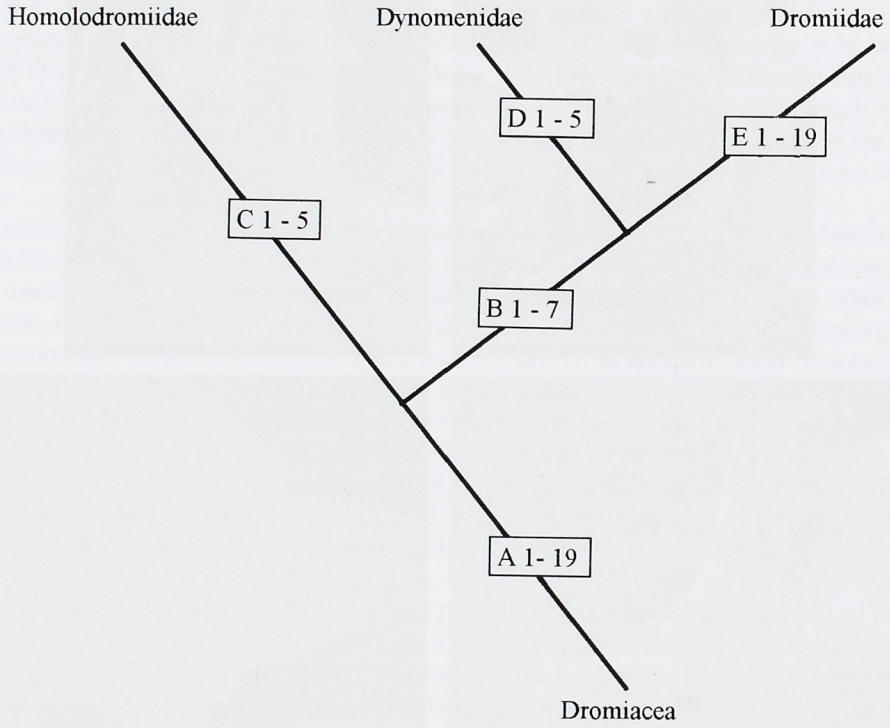


FIG. 15. — Cladogram showing the assumed relationships between the families of the Dromiacea. Numbers refer to apomorphic and plesiomorphic characters mapped on to this hypothesis (see text).

PHYLOGENETIC RELATIONSHIPS

I do not intend to closely examine the question of brachyuran monophyly. In their analysis of the relationships of reptant Decapoda, SCHOLTZ & RICHTER (1995) list the morphological apomorphies of the Brachyura as: a fossa orbito-antennularis surrounds the eyestalk and antennule, third maxilliped operculate or semi-operculate, orientation of the cheliped fingers so that the dactyl is external, all thoracic sternites fused to form the sternum, an

abdomen which is reduced, ventrally flexed and sexually dimorphic, and uropods are reduced or absent. BAUER (1989) considered the use of setiferous maxillipedal epipods for gill cleaning to be a strong character confirming brachyuran monophyly. I agree with this suggestion, although the more elaborate nature of podotreme gill cleaning, with the retention of several plesiomorphic characters, does make the explanation more complex. Proposals to remove some podotreme families from the Brachyura do not seem to be worthy of serious consideration since the arguments are usually based on the occurrence of plesiomorphic larval characters and if followed would create even greater mayhem than currently exists. I accept the argument, by SCHOLTZ & RICHTER, that evolution has proceeded faster in the adult than in the larval characters so that some podotreme families show a mosaic of plesiomorphic and apomorphic characters. The morphological apomorphies listed above and spermatological apomorphies (see JAMIESON, 1994; JAMIESON *et al.*, 1995) seem to provide convincing evidence of brachyuran monophyly. The questions about the relationships within the Brachyura seem much more interesting.

GUINOT (1978) divided the Brachyura into three major groups: Podotremata, Heterotremata and Thoracotremata. The Podotremata were divided into two groups containing the following extant families: Dromiacea, including the Homolodromiidae, Dynomenidae and Dromiidae, and the Archaeobrachyura, including the Poupiniidae, Latreillidae, Homolidae, Cyclodorippidae, Cymonomidae and Raninidae. The phylogenetic relationships between some of these groups has been explored by GUINOT *et al.* (1994) using characters based on spermatozoal ultrastructure. They were able to differentiate between apomorphic and plesiomorphic characters of the Podotremata, Heterotremata + Thoracotremata as well as the Brachyura as a whole. Within the Podotremata they provide evidence of monophyly of this group. Using morphological characters I have carried out a similar exercise. I first of all map the plesiomorphic and apomorphic characters of the Dromiacea (Fig. 15) and then examine the implications of these characters for the Archaeobrachyura (Fig. 16). I assume that the most parsimonious interpretation of characters is correct. The main question here is whether or not the Podotremata are monophyletic.

If we assume that the more crab-like Dynomenidae and Dromiidae are sister groups and together are the sister group of the less crab-like Homolodromiidae, then we can display their relationships as in Fig. 15. The characters (A1 - 19) shared by the ancestor of these three families must be: 1) carapace longer than wide, 2) carapace lacking a margin, 3) branchiostegite membranous, 4) first antennal article beak-like, 5) pediform third maxillipeds, 6) crista dentata present, 7) propodus of second and third pereopods with a distal spine and a row of spines on the inner margin of the dactyl, 8) fourth and fifth pereopods reduced, subdorsal, subchelate, 9) propodal and dactyl spines on last two pairs of pereopods as found in *Dicranodromia*, 10) fifth pereopod with a spine on the outer margin of the dactyl, 11) abdomen large and only loosely folded under the body, 12) well developed uropods and no abdominal locking mechanism, 13) five pairs of pleopods in both sexes (first pair vestigial in the female and last three pairs rudimentary in the male), 14) short female sternal sutures 7/8, 15) needle-like second male pleopods without spines, 16) calcified coxal sperm tube carrying sperm to the base of the second pleopod, 17) twenty trichobranchiate-like notched gills, 18) long setae on posterior margin of scaphognathite, and 19) seven epipods.

Assumption 9) (above) implies that the dromiacean ancestor was well equipped to carry camouflage. It is assumed that the last two pairs of pereopods resembled those found in *Dicranodromia* (Homolodromiidae) but camouflage-carrying is unknown in this genus (or this family for that matter) (GUINOT *et al.*, 1995). Since the structure of these limbs is very similar to that found in *Sphaerodromia* (Dromiidae), which does carry pieces of sponge, I predict that camouflage-carrying homolodromiids will be found. Thus I assume that the dromiacean ancestor was a camouflage crab and that the particular kind of camouflage behaviour is an apomorphy of the Dromiacea.

The shared characters (B1 - 7) of the crab-like ancestor of the Dynomenidae and Dromiidae are: 1) carapace margin present, 2) carapace wider than long, 3) operculiform third maxillipeds, 4) abdomen reduced and folded more tightly under the body, 5) rudimentary abdominal locking mechanism, and 6) development of hypobranchial cleaning setae on the inner wall of the branchial chamber. An additional character (7) shared by all dynomenids and some of the primitive dromiids (e.g. *Sphaerodromia*) is the presence of an oval apical plate on the tip of the first male pleopod. The presence of this plate may be correlated with the fact that the females have posteriorly located

spermathecae and consequently very short sternal sutures 7/8. The apical plate may help to ensure efficient transfer of sperm into the spermathecae.

The apomorphies (D1 - 5) of the Dynomenidae are: 1) the lack of distal propodal spines on the second to fourth pereopods, 2) development of a unique vestigial fifth pereopod carried horizontally, 3) sexually dimorphic chelate structure of the fifth pereopod, 4) reversion of the fourth pereopod to being a fully developed walking leg and 5) development of a row of spines on the second male pleopod. Perhaps the most controversial point here is the implied reversion of the fourth pereopod to being a fully functional walking leg. *Acanthodromia* lacks a beak-like first antennal article, characteristic of the Dromiacea, and a crista dentata. These must be regarded as secondary modifications.

The apomorphies (E1 - 9) of the Dromiidae are: 1) usually only two pairs of pleopods in the male (but some species of *Sphaerodromia*, *Eodromia* and *Dromia* for e.g. have retained the ancestral three pairs of rudimentary pleopods on abdominal segments 3-5), 2) soft tube-like extension of coxal article carrying sperm to the base of first pleopod, 3) spermathecae often located anterior to female genital openings and consequently the sternal sutures 7/8 are much longer, 4) gills are phyllobranchiate, 5) gill numbers reduced because there are only three or four epipods (although *Sphaerodromia* species have up to seven epipods), 6) loss of long setae on posterior margin of scaphognathite (still present in *Sphaerodromia*), 7) abdomen reduced, 8) uropods reduced (sometimes absent), and 9) a well developed locking mechanism for the abdomen involving the bases of the first two pereopods and sometimes the uropods. It is apparent that there are exceptions to several of these characters some of which have evolved within the Dromiidae. Strictly speaking, the only apomorphies, shared by all members of the family, are the possession of phyllobranch gills and a well developed abdominal locking mechanism. Since *Sphaerodromia* obviously provides several exceptions to the above list of characters, it could be proposed that this genus should shifted to the Homolodromiidae, but this would require the assumption that phyllobranchiate gills and the coxal abdominal locking mechanism had evolved independently within this family. By themselves these assumptions are not necessarily unreasonable because, after all, phyllobranch gills and an abdominal locking mechanism have evolved independently in *Acanthodromia* (Dynomenidae), so why couldn't this have also occurred in the Homolodromiidae? GUINOT (1979, p. 256) noted that the homolodromiid thoracic endophragmal skeleton is of a unique type and is different from the dromiid + dynomenid skeleton. This skeletal difference provides the strongest evidence for retaining *Sphaerodromia* in the Dromiidae (GUINOT, pers. comm.). This hypothesis is more parsimonious but it requires the assumption that the species in this genus have retained several plesiomorphic characters. Further aspects of the dromiid-homolodromiid relationship are discussed by GUINOT (1995: 168-185).

Finally, the Homolodromiidae: the only apomorphic characters (C1 - 5) which this group has are 1) reduction of uropods (GUINOT, 1993), 2) loss of the long setae from the scaphognathite, 3) presence of well developed abdominal pleurae, 4) possession of a very elongate telson, and 5) development of a spine-bearing distal propodal extension on the last two pairs of legs. However, both of the first two are shared with the Dromiidae. It is difficult to know whether the unusually elongate telson, which forms the floor of the sterno-abdominal cavity, and the abdominal pleurae are apomorphies or plesiomorphies. Along with the membranous branchiostegite, they may well have been features of the dromiacean ancestor and therefore plesiomorphies. The development of a spine-bearing distal propodal extension on the last two pairs of legs might be regarded as an apomorphy, but it only occurs in *Homolodromia* while *Dicranodromia* retains the assumed ancestral condition. The semi-crab-like Homolodromiidae can only be defined by a combination of plesiomorphic characters and synapomorphies. It is interesting to note that JAMIESON *et al* (1995) concluded that "*Homolodromia* displays a remarkable mixture of dromiid and dynomenid spermatozoal features while lacking any distinctive apomorphy.... ". Therefore the morphological and spermatological features of the Homolodromiidae are in close agreement.

The question of monophyly of the Podotremata is more difficult to decide. Are the Dromiacea the sister group of the rest of the Brachyura (see Fig. 16 b) or are they the sister group of only the Archaeobrachyura (see Fig. 16a)? If the first alternative is true then the Dromiacea and each of the major groups within the Archaeobrachyura must be independently derived from the brachyuran line and all these crab-like animals must be paraphyletic. Another possibility is that the Archaeobrachyura are monophyletic and are the sister group

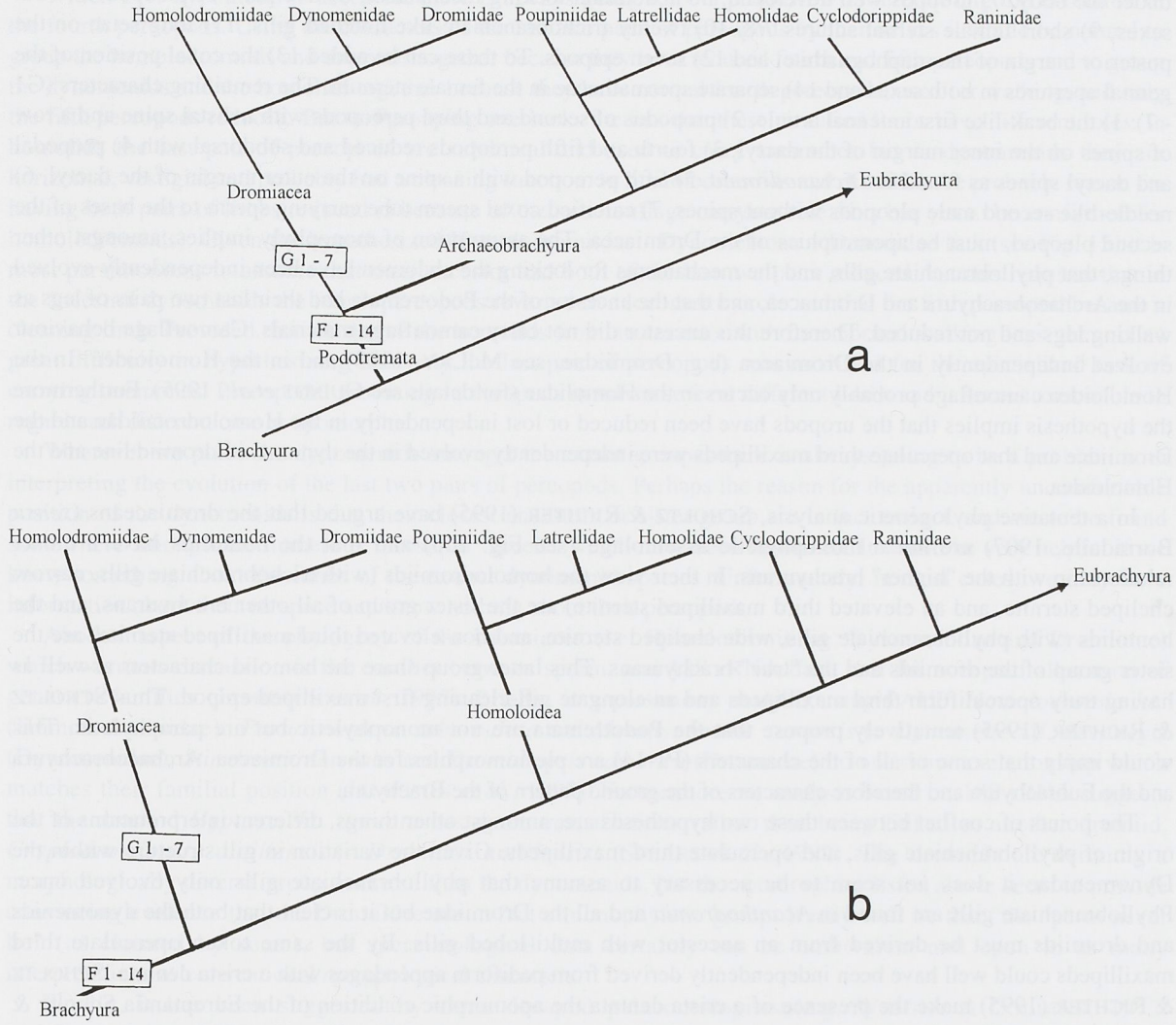


FIG. 16. — Cladogram showing two different relationships between the families of the Podotremata: **a**, the Podotremata are assumed to be monophyletic (modified after GUINOT *et al.*, 1994); **b**, the Podotremata are assumed to be paraphyletic (modified after SCHOLTZ & RICHTER, 1995). Numbers refer to apomorphic and plesiomorphic characters mapped on to these hypotheses (see text).

of the Eubrachyura. Since it is beyond the scope of this work to examine the detailed relationships within the Archaeobrachyura, I confine my attention to the case represented in Fig. 16b. JAMIESON (1994) and JAMIESON *et al.* (1995) have argued that spermatologically the Podotremata Guinot, 1977 is monophyletic and its constituent groups, the Dromiacea de Haan, 1833 and Archaeobrachyura Guinot, 1977 are also monophyletic.

The sperm data seem to support the monophyletic hypothesis depicted in Fig. 16a. If this is true then we must examine the suite of ancestral dromiacean characters to see which of them could be ancestral to all of the Podotremata and which could be apomorphies of the Dromiacea (see Fig. 16a). The ancestral characters (F1 - 14) would include: 1) carapace longer than wide, 2) carapace lacking an anterolateral margin, 3) branchiostegite membranous, 4) third maxillipeds pediform, 5) crista dentata present, 6) abdomen large and only loosely folded

under the body, 7) uropods well developed, no abdominal locking mechanism, 8) five pairs of pleopods in both sexes, 9) short female sternal sutures 7/8, 10) twenty trichobranchiate-like notched gills, 11) long setae on the posterior margin of the scaphognathite, and 12) seven epipods. To these can be added 13) the coxal position of the genital apertures in both sexes and 14) separate spermathecae in the female sternum. The remaining characters (G1 - 7): 1) the beak-like first antennal article, 2) propodus of second and third pereopods with a distal spine and a row of spines on the inner margin of the dactyl, 3) fourth and fifth pereopods reduced and subdorsal with 4) propodal and dactyl spines as found in *Dicranodromia*, 5) fifth pereopod with a spine on the outer margin of the dactyl, 6) needle-like second male pleopods without spines, 7) calcified coxal sperm tube carrying sperm to the bases of the second pleopod, must be apomorphies of the Dromiacea. The assumption of monophyly implies, amongst other things, that phyllobranchiate gills, and the mechanisms for locking the abdomen have been independently evolved in the Archaeobrachyura and Dromiacea, and that the ancestor of the Podotremata had their last two pairs of legs as walking legs and not reduced. Therefore this ancestor did not carry camouflage materials. Camouflage behaviour evolved independently in the Dromiacea (e.g. Dromiidae, see McLAY, 1993) and in the Homoloidea. In the Homoloidea camouflage probably only occurs in the Homolidae (for details see GUINOT *et al.*, 1995). Furthermore the hypothesis implies that the uropods have been reduced or lost independently in the Homolodromiidae and the Dromiidae and that operculate third maxillipeds were independently evolved in the dynomenid-dromiid line and the Homoloidea.

In a tentative phylogenetic analysis, SCHOLTZ & RICHTER (1995) have argued that the dromiaceans (*sensu* Borradaile, 1907) are not a monophyletic assemblage (see Fig. 16b) and that the homolids have a closer relationship with the "higher" brachyurans. In their view the homolodromiids (with trichobranchiate gills, narrow cheliped sternite, and an elevated third maxilliped sternite) are the sister group of all other brachyurans, and the homolids (with phyllobranchiate gills, wide cheliped sternite, and non-elevated third maxilliped sternite) are the sister group of the dromiids and the "true" brachyurans. This latter group share the homolid characters as well as having truly operculiform third maxillipeds and an elongate gill-cleaning first maxilliped epipod. Thus SCHOLTZ & RICHTER (1995) tentatively propose that the Podotremata are not monophyletic but are paraphyletic. This would imply that some or all of the characters (F1-14) are plesiomorphies for the Dromiacea, Archaeobrachyura and the Eubrachyura and therefore characters of the ground pattern of the Brachyura.

The points of conflict between these two hypotheses are, amongst other things, different interpretations of the origin of phyllobranchiate gills, and operculate third maxillipeds. Given the variation in gill structure within the Dynomenidae it does not seem to be necessary to assume that phyllobranchiate gills only evolved once. Phyllobranchiate gills are found in *Acanthodromia* and all the Dromiidae but it is clear that both the dynomenids and dromiids must be derived from an ancestor with multi-lobed gills. By the same token operculate third maxillipeds could well have been independently derived from pediform appendages with a crista dentata. SCHOLTZ & RICHTER (1995) make the presence of a crista dentata the apomorphic condition of the Eureptantia Scholtz & Richter, 1995. It should be noted that there are many examples amongst the Brachyura where the crista dentata is absent. It has been lost in some Dynomenidae (e.g. *Acanthodromia*), in all Cyclodorippidae (e.g. *Tymolus*, *Xeinostoma*, and *Krangalangia*), Latreillidae (e.g. *Latreillia*), Raninidae (e.g. *Lyreidus*, *Ranina*, *Raninoides*), and all of the Eubrachyura. The polarity of this character depends upon what assumptions are made about the ancestral decapod, and whether the absence of a crista dentata in natants is ancestral or derived. SCHOLTZ & RICHTER (1995) argue that the absence of the crista dentata in some Achelata Scholtz & Richter, 1995, (e.g. *Scyllarus*), thalassinids (e.g. *Callianassa*) and anomolans should be regarded as being "secondary". Loss of the crista dentata is a synapomorphy of many groups within the Eureptantia.

The paraphyletic hypothesis also assumes that camouflage carrying was ancestral to all the Brachyura whereas the monophyletic hypothesis assumes that it is a synapomorphy of only a few of the podotrematous families. McLAY (1991: 465) put forward an hypothesis about how the camouflage-bearing limbs of dromiids might have evolved from walking legs. This hypothesis needs to be modified in the light of the hypothesis presented above that the ancestor of the Dromiacea was a camouflage-carrying crab. Thus the argument presented by McLAY (1991) should be applied to the dromiacean ancestor rather than the dromiid ancestor. Although further analysis of this complex question is required, the weight of evidence seems to favour monophyly of the Podotremata.

Which ever hypothesis is accepted, there is always going to be a problem with interpreting the evolution of the fourth pereopods. Using the characters of the last two pairs of pereopods by themselves it would be natural to group the homolodromiids and dromiids together because they have reduced fourth and fifth pereopods and to group the dynomenids and the homolids together because they have normal fourth pereopods, used for walking, and only the fifth pereopods reduced. But this grouping overlooks the fact that these modified limbs have different roles. In homolids the last pair of pereopods are subdorsal and used to carry anemones but in dynomenids they are horizontal, vestigial and probably had a cleaning function. In homolodromiids and dromiids the probable reason for having both pairs of limbs reduced is because of their camouflage carrying role (this has yet to be confirmed for homolodromiids). Given the hypothesized Homolodromiidae - Dynomenidae + Dromiidae link (see Fig. 15) it is most parsimonious to assume that their ancestor had both of the last two pairs reduced, but this requires that in the ancestral dynomenids the fourth pereopods reverted to a locomotory role and that the fifth pereopod became a cleaning limb. Provided that we derive the homolids from an ancestor with four normal walking legs, there is no great difficulty in hypothesizing that only the last pair of pereopods was modified for the specialized task of carrying anemones. Pereopodal grooming in decapods involves several different limbs and it seems reasonable to regard each different case as apomorphic.

Wherever we place the dynomenids amongst the extant groups, there is always going to be a problem with interpreting the evolution of the last two pairs of pereopods. Perhaps the reason for the apparently uncomfortable position of the dynomenids is that their closest ancestors or sister group are in fact extinct, and are to be found somewhere amongst the numerous "prosopid" species which have been described. It would be very helpful if we knew something about the limbs of the extinct dynomenid species. Unfortunately, in most cases, we only have information about their carapace and know nothing about their pereopods.

Another aspect of the phylogeny of the Dromiacea (i.e. Homolodromiidae, Dynomenidae and Dromiidae) which warrants discussion is the conflict between sperm, and 18S rRNA data, and the accepted allocation of genera to families (JAMIESON *et al.*, 1995). Briefly, in a parsimony analysis using PAUP, *Homolodromia kai* (Homolodromiidae), *Paradynomene tuberculata* and *Metadynomene tanensis* (= *Dynomene* aff. *devaneyi*) (Dynomenidae), *Stimdromia lateralis* and *Dromidiopsis edwardsi* (Dromiidae) do not show a relationship which matches their familial position (JAMIESON *et al.*, 1995). Furthermore an analysis based on 18S rRNA suggests that the dromiid *Hypoconcha arcuata* has anomuran affinities rather than being linked to another dromiid, *Cryptodromiopsis antillensis* (= *Dromidia antillensis*) (SPEARS *et al.*, 1992). The dromiids are certainly a morphologically diverse group, more so than the dynomenids, but the apomorphies listed above seem to provide convincing evidence that the Dromiidae are in fact a monophyletic group. It may well be that "the sperm never lie" (as claimed by some), but spermatological data certainly can be ambivalent and open to as many interpretations as conventional morphological characters.

Finally, it has been suggested by some decapod palaeontologists (e.g. WRIGHT & COLLINS, 1972, and GLAESSNER, 1980) that the family Xanthidae was derived from amongst the Dynomenidae. Admittedly, some extant dynomenids do resemble some xanthids (e.g. *Pilumnus* and *Panopeus*), in their chelipeds and the conformation of their carapace (see Discussion below under *Hirsutodynomene ursula*), but it should be clearly apparent from the above arguments that any resemblance of xanthids and dynomenids must be convergent and not evidence of a close relationship. It may be significant that at least some members of each of these families inhabit corals, so that their similarities may be attributable to colonization of the same habitat.

Family DYNOMENIDAE Ortmann, 1892

Dynomenidae Ortmann 1892: 541; 1898: 1155. — ALCOCK 1899: 127; 1901: 34. — STEBBING, 1905: 58. — RATHBUN, 1937: 51. — BALSS, 1957: 1605. — GLAESSNER, 1969: R487. — WRIGHT & COLLINS, 1972: 48. — TAKEDA, 1973: 80. — SAKAI, 1976: 28. — GUINOT, 1993: 1226.

Dynomeninae A. Milne Edwards & Bouvier, 1899: 9; 1902: 22.

Carapace shape usually wider than long, but can be longer than wide, generally moderately convex, commonly subcircular, ovoid or may be oblong. Surface may be smooth, spinous or areolate and is usually densely covered with setae. Lateral carapace margin usually well defined and armed with distinct teeth. Frontal groove well marked, split in two posteriorly, cervical, postcervical and branchial grooves evident. Frontal carapace margin broadly triangular, continuous, and usually without rostrum or teeth. Eyestalks short, eyes protected by well defined orbits. Sternal sutures 7/8 of female end well apart on low tubercles behind bases of second walking legs.

Antennule can be concealed inside the orbit at the base of the eyestalk. Antennal flagella shorter than carapace width. All articles of antenna moveable, first article (urinal) usually beaked medially and second article has an exopod firmly fixed. Third maxillipeds opercular, completely covering the buccal cavern, separated at their bases by a plate at the same level as the sternum; basis and ischium of endopod fused but joint always marked by a shallow groove. Pereopods include chelipeds, three pairs of walking legs, and reduced last pereopods. Chelipeds equal, stouter than walking legs, last pair of legs very reduced, dactyl rudimentary, forming an obsolete subchelate mechanism with an extension of the propodus. Gills usually 19 (including 6 podobranchs) + 7 epipods. Gill structure basically phyllobranchiate but the plates are very variable in shape with different numbers of epibranchial lobes.

Abdomen of six segments and telson, folded loosely under the thorax, uropods large, an effective abdominal locking mechanism usually absent. Both sexes have five pairs of pleopods, first pair vestigial in female, last three pairs rudimentary in the male. Male first pleopods very uniform in structure, consisting of a stout, setose semi-rolled tube with an apical plate, second pair needle-like bearing tiny inset spines, termination with two or more stouter spines.

TYPE GENUS. — *Dynomene* Desmarest, 1823 designated by ORTMANN (1892). PEYROT-CLAUSADE & SERÈNE (1976) attribute the first use of the latinized name *Dynomene* to DESMAREST (1825), but MANNING & HOLTHUIS (1981) have shown that it should be attributed to DESMAREST (1823) where a latinized version was used in the index to his article in the *"Dictionnaire des Sciences Naturelles"*.

DISCUSSION. — The above definition of the family Dynomenidae encompasses all the characters listed by ORTMANN (1892). When he defined the family, ORTMANN was chiefly interested in separating it from the Dromiidae, and Homolidae. ORTMANN regarded the following characters as being primitive: 1) incomplete connection of the pterygostomial region and the epistome, 2) margin of carapace clearly defined, 3) fifth pereopod small and simple with rudimentary dactyl, 4) uniramous uropods present, and 5) four mastigobranchs (i.e. epipods) and four pleurobranchs on the pereopods, while on all the thoracic segments there are six rudimentary podobranchs. Other characters which he regarded as important, but not necessarily primitive, were that the eyes could be completely withdrawn into the orbits, the antennule could be folded away into a groove between eyestalk and supraorbital margin, and finally the third and fourth articles of third maxillipeds are slightly widened while the fifth, sixth and seventh articles are significantly smaller. In fact all of these characters, except for the reduced fifth pereopods and presence of four epipodites, are shared with the Dromiidae De Haan, 1833. Thus it is not surprising that some dromiids have initially been described as dynomenids (see below).

Perhaps through an over-sight, ORTMANN (1892) did not include *Acanthodromia* Milne Edwards, 1880 in his new family. A. MILNE EDWARDS (1880) originally placed *Acanthodromia* in his family "Dromiens" which included *Dromia* Weber, 1795, *Dromidia* Stimpson, 1858, and *Dicranodromia* Milne Edwards, 1880. He considered that *Acanthodromia* should be placed between *Dromia* and *Dynomene*. ALCOCK (1899) placed *Acanthodromia* in the Dromiidae along with *Dromia* and *Arachnodromia*. However, ALCOCK (1901) was the first to put *Acanthodromia* in the Dynomenidae, along with *Dynomene*, and to provide a formal definition of the family. He expanded the family definition so as to include *Acanthodromia* and simply commented that it differed from *Dynomene* in that its carapace was longer than wide, convex, and closely covered with spines instead of setae. ALCOCK also noted that dynomenid gills are phyllobranchiae but sometimes showing the transition from tricho- to phyllobranchiae. A. MILNE EDWARDS & BOUVIER (1899: 10) believed the branchial formula to be the same as that of *Homarus vulgaris*. WRIGHT & COLLINS (1972) suggested that *Acanthodromia* should be placed in the fossil family Prosopidae Von Meyer, 1860. The proposal is discussed further in the section on this genus.

STEBBING (1905) added *Dynomene platyarthrodes*, from South Africa, with the idea that it was intermediate between *Dynomene* and *Acanthodromia*, believing that the characters of the front, the orbits, and the antennae were sufficiently similar to *Dynomene filholi* to justify inclusion. He did not modify or provide a definition of the family. However BALSS (1938) noted that the fourth pereopods were subchelate and the female sternal sutures 7/8 extended as far as the cheliped segment and realized that *D. platyarthrodes* in fact belonged to the Dromiidae. BARNARD (1947) erected the genus *Speodromia* Barnard, 1947, for this crab (see McLAY, 1993).

In her review RATHBUN (1937) essentially restated the family definition of ALCOCK (1901) except that she noted that the gills were phyllobranchiate, eliminating any reference to the gills being "transitional". This is true of both species of *Acanthodromia*, but the other dynomenids are different. BALSS (1957) gave the same features as ALCOCK (1901).

GLAESSNER (1969) gave a family definition which highlighted the features preserved in fossil dynomenids, concentrating on the orbits, carapace shape and incised grooves, and added the intercalated lateral platelets (i.e. the uropods) and the essential character of the reduced last pair of legs, even though these are most unlikely to ever be preserved in a fossil. The same definition was repeated by WRIGHT & COLLINS (1972). Carapace grooves have had little importance in the description of modern species but they assume more importance in fossil species.

The last genus to be added was *Paradynomene* Sakai, 1963, but SAKAI never modified the definition of the Dynomenidae to accommodate this new form, and SAKAI (1976) simply repeated the definition of RATHBUN (1937). The only substantial change that is necessary, is to include a very areolate carapace surface. TAKEDA (1973) noted that the dynomenids are distinguished from the Dromiidae by having an epipod on each of the first three pairs of walking legs and only the last pair of legs small and subdorsal.

Therefore, the modern definition of the Dynomenidae owes a lot to ALCOCK (1901). I have added the character of three rudimentary pleopods in males because it seems to be true of all dynomenids so far examined. It is interesting to note that the same condition is found in some dromiids: *Sphaerodromia* Alcock, 1899, *Eodromia* McLay, 1993, and *Exodromidia* Stebbing, 1905 (see McLAY, 1993).

CANO (1893) described a zoea larva which he assigned to ? *Dynomene* Desmarest, but WILLIAMSON (1965) stated that it was more likely that this larva belonged to *Blepharipoda* Randall or a closely allied genus of the Albuneidae. The only dynomenid larva known is a pre-zoea dissected from late stage eggs of *Acanthodromia erinacea* by RICE (1981).

The genera of the Dynomenidae have enjoyed a fairly stable existence. Only four generic names have been used to group the species in this family. *Dynomene* Desmarest, 1823 was the first to be established followed by *Acanthodromia* Milne Edwards, 1880, *Maxillothrix* Stebbing, 1921, and *Paradynomene* Sakai, 1963. Both *Acanthodromia* and *Paradynomene* are very distinctive and consequently have not caused any taxonomic problems. However species have been added to *Dynomene* in a rather haphazard way, without reference to the generic definition, and some revision is required if all three genera are to have equal status. *Maxillothrix* was shown by ODHNER (1925) to be a junior synonym of *Dynomene* (see Discussion below).

Identification keys to genera and/or species can be found in ALCOCK (1901), SAKAI (1936, 1965, 1976), RATHBUN (1937), and DAI & YANG (1991). PEYROT-CLAUSADE and SERÈNE (1976) give a key to five Indo-Pacific species of *Dynomene*. The characteristics which they used in their key were: carapace surface smooth, spinous, tuberculate or granulate, number and size of teeth on anterolateral border, tomentum length and clumping, spines on anterior border of P2-4, length/width ratio of P3 merus, presence of spines on borders of orbit, presence of a toothed lobe on the cheliped carpus. Below I present a key to all known species of extant dynomenids.

Key to the species of the family DYNOMENIDAE

1. Carapace width less than length; surface largely devoid of setae, strongly tuberculate or densely covered with long sharp spines **2**
— Carapace width greater than length; surface setose to varying degrees, not strongly tuberculate and without long spines **4**

2. Carapace surface densely granulated and strongly tuberculate; rostrum tridentate, median tooth on a lower level, lateral teeth at beginning of supraorbital margin; anterolateral margins with six irregular teeth ..... ***Paradynomene tuberculata*** Sakai, 1963
— Carapace surface densely covered with long spines; rostrum terminated by a strong spine; anterolateral margins with numerous spines **3**

3. Supraorbital spines near corner of the orbit are long and bent posteriorly; fourth abdominal segment with a small, median, pearl-like lobe only partially divided by a short median groove; a similar smaller lobe on the fifth segment ..... ***Acanthodromia erinacea*** A. Milne Edwards, 1880
— Supraorbital spines near corner of orbit are short, blunt and not bent posteriorly; fourth abdominal segment with a pair of large, smooth pearl-like median lobes separated by a groove and occupying almost the entire width of the segment; fifth segment spinous ..... ***Acanthodromia margarita*** (Alcock, 1899)

4. Carapace width only slightly greater than length (ratio ≤ 1.10), densely covered with short, soft setae which give the surface an uneven, undulating appearance, with transverse troughs; no long setae on the carapace; dactyl of P1 not strongly curved; margins of fingers touching for about half their length; less than five spines on inferior margin of P2-P4 dactyli **5**
— Carapace width much greater than length (ratio > 1.10); long and short setae present on carapace; dactyl of P1 strongly curved; fingers touching only at the tips; five or six spines on inferior margin of P2-P4 dactyli **7**

5. Anterolateral carapace margin without teeth but interrupted by a faint notch mid-way between postorbital corner and where the branchial groove meets the margin ..... ***Metadynomene devaneyi*** (Takeda, 1977)
— Anterolateral carapace margin with teeth **6**

6. Three well developed, unequal (posterior margin of second tooth extended and may bear two smaller denticles) and blunt anterolateral teeth; strong posterolateral tooth behind branchial groove; suborbital margin shelf-like, projecting and easily visible dorsally ..... ***Metadynomene tanensis*** (Yokoya, 1933)
— Four tiny subacute anterolateral teeth, first pair separated from second pair by a blunt swelling, similar posterolateral tooth behind branchial groove; suborbital margin not projecting, scarcely visible dorsally ..... ***Metadynomene crosnieri*** sp. nov.

7. Carapace surface areolate, granulate and spinous (especially near margins) under the surface tomentum **8**
— Carapace surface smooth or only minutely granulated; tomentum may be sparse or dense in which case the setae are short and bent at right angles near the tip **9**

8. Tomentum consists of a dense cover of filiform long setae, arranged in clumps associated with areolae or spines, and a dense understory of short serrated setae bent at right angles near the tip; projection on inner carpal margin of cheliped consists of a sharp spine; suborbital margin bears small acute spines..... ***Hirsutodynomene spinosa*** (Rathbun, 1911)
— Tomentum consists of a sparse cover of long and short, slightly clumped, serrate setae, which are unbent; projection on inner carpal margin of cheliped is a broad blunt lobe; suborbital margin bears small blunt granules ..... ***Hirsutodynomene ursula*** (Stimpson, 1860)

9. Anterolateral teeth absent or only represented by two or three small granules not terminated by a sharp tooth ..... ***Dynomene praedator*** A. Milne Edwards, 1879
— Anterolateral teeth present, well developed, and sharply pointed **10**

10. Carapace tomentum sparse, setae filiform, surface not obscured; ratio of length of antennal flagellum to CW > 0.60; carpus and propodus of P1 smooth; ratio of length of merus of P3 to CL > 0.7 ..... ***Dynomene pugnatrix*** de Man, 1889
— Carapace tomentum not sparse, setae serrate, long setae may be arranged in clumps; ratio of length of antennal flagellum to CW < 0.60; carpus and propodus of P1 granulated; ratio of length of merus of P3 to CL < 0.7 ..... **11**

11. Carapace tomentum consists of dense short setae, bent at right angles, obscuring the surface, and fifteen to seventeen tufts of long (> 0.2 x CW) setae; ratio of length to width of merus of P3 > 2.0 ..... ***Dynomene pilumnoides*** Alcock, 1900
— Short setae not obscuring carapace surface, long setae may be arranged in clumps but length < 0.2 x CW; ratio of length to width of merus of P3 < 2.0 ..... **12**

12. Carapace surface smooth, coarse serrate setae, longer setae arranged in about twenty clumps, ratio of CW to CL approx. 1.2; notch present in supraorbital margin; no spines on postorbital margin; cervical groove branching off subhepatic groove; granules on carpi of P2-P4 not arranged in rows ..... ***Dynomene filholi*** Bouvier, 1894
— Carapace surface minutely granulated, coarse serrate setae, longer setae not arranged in clumps, ratio of CW to CL approx. 1.3; no notch in the supraorbital margin; five small acute spines around postorbital margin; no cervical branch from the subhepatic groove; granules on carpi of P2-P4 arranged in three rows ..... ***Dynomene hispida*** Guérin-Méneville, 1832

Genus ***DYNOMENE*** Desmarest, 1823

Dynomene Desmarest, 1823: 252, pl. (18) fig. 2; 1825: 133, pl. 18, fig. 1. — Latreille, 1825: 273; 1829: 69.
Dynomene Desmarest, 1823: 422; 1825: 442. — Jarocki, 1825: 26. — Berthold, 1827: 258. — H. Milne Edwards, 1837: 179. — Stimpson, 1858: 226. — A. Milne Edwards, 1879: 1; 1899: 90. — Alcock, 1899: 133; 1901: 35. — Ortmann, 1898 : 1155. — Stebbing, 1905: 58. — Rathbun, 1937: 54. — Balss, 1938: 6. — Sakai, 1936: 43; 1965: 12; 1976: 29. — Barnard, 1947: 371; 1950: 336. — Takeda, 1973: 80; 1977: 31. — Manning & Holthuis, 1981: 23. — Dai & Yang, 1991: 31.
Dynomena Eydoux & Souleyet, 1842: 239 (err.).
Maxillothrix Stebbing, 1921: 456 (type species *Maxillothrix actaeiformis* Stebbing, 1921, a subjective junior synonym of *Dynomene pilumnoides* Alcock, 1900, by monotypy, gender feminine).

Diagnosis. — Carapace shape wider than long, moderately convex, commonly subcircular. Surface may be smooth or sparsely granulate, covered with coarse setae, which may short or long, and often arranged in tufts. Lateral carapace margin always well defined and armed with distinct small teeth or granules. Frontal groove well marked, split in two posteriorly; cervical, postcervical and branchial grooves usually evident. Frontal carapace margin broadly triangular, continuous; no rostrum or teeth. Eyestalks short; eyes protected by well defined orbits. Sternal sutures 7/8 of female end well apart on low tubercles behind bases of second walking legs.

Antennule can be concealed inside orbit at base of eyestalk. Antennal flagella shorter than carapace width. All articles of antenna moveable; first article (urinal) always beaked medially and second article with an exopod firmly fixed. Third maxillipeds opercular completely covering buccal cavern, separated at their bases by a plate at same level as sternum; basis and ischium of endopod fused but joint always marked by a shallow groove. Crista dentata present. Chelipeds equal, stouter than walking legs; dactyl strongly curved; fingers gaping basally. Last pair of legs very reduced; dactyl rudimentary, forming an obsolete subchelate mechanism with an extension of propodus. Gills usually 19 (including 6 podobranchs) + 7 epipods. Gills variable in shape.

Abdomen of six segments and telson folded loosely under thorax; uropods large. No effective abdominal locking mechanism. Lateral movement of abdomen restricted by small sternal tubercle, at base of each of first walking legs, which lies alongside each uropod. In both sexes, five pairs of pleopods; first pair vestigial in female; last three pairs rudimentary in male. First male pleopods very uniform in structure, consisting of a stout,

setose semi-rolled tube with an apical plate; second pair simple, needle-like, with varying numbers of subterminal spines.

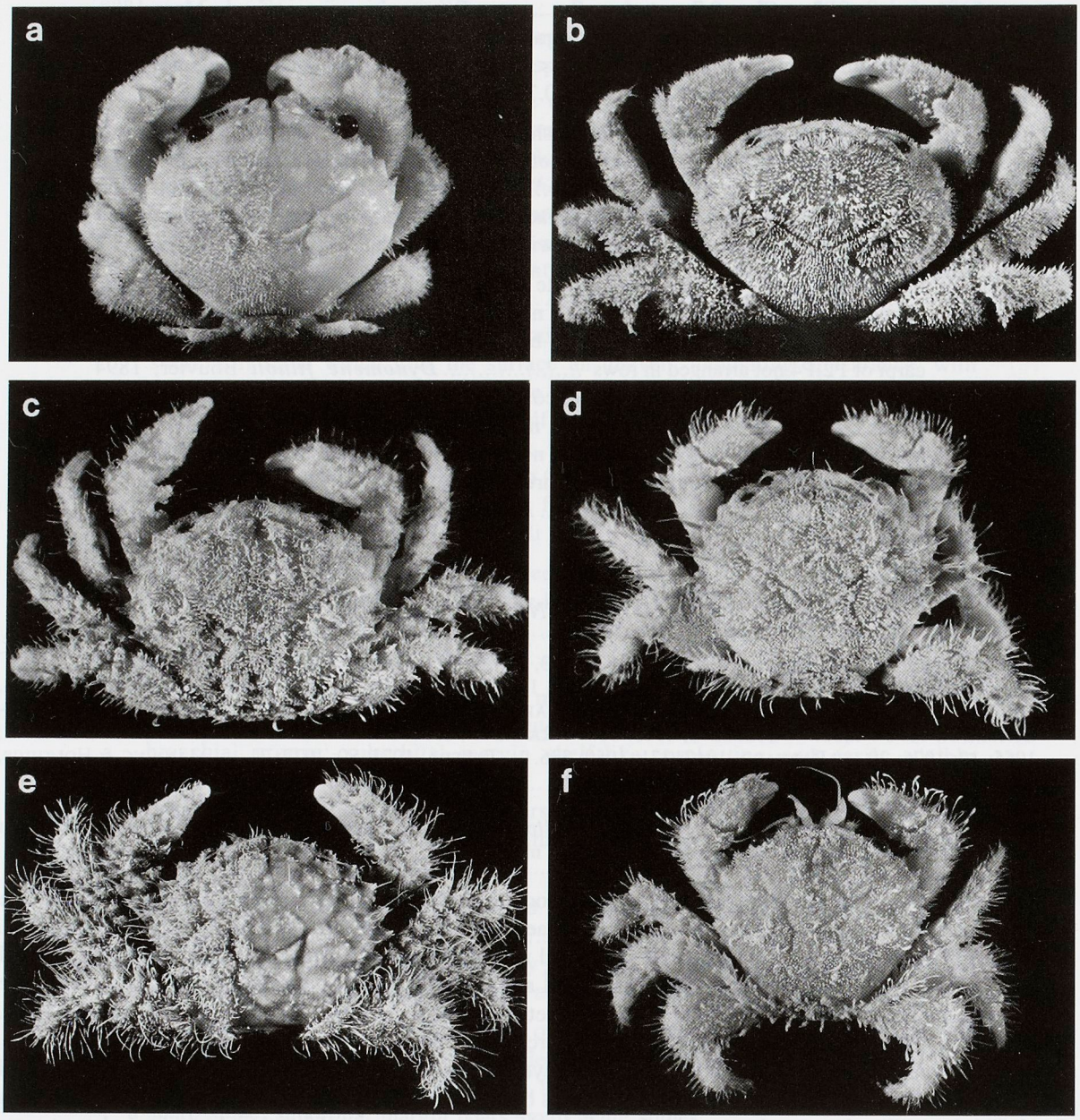


FIG. 17. — **a**, *Dynomene hispida* Guérin-Méneville, 1832, ♂ 9.2 x 7.6 mm, Madagascar, Tuléar, stn 13-3, reef flat (MNHN-B 22087): dorsal view of whole crab, setae removed from right half of carapace, right second pereopod missing. — **b**, *Dynomene praedator* A. Milne Edwards, 1879, ♂ 10.4 x 8.2 mm, New Caledonia, Île des Pins, stn 585, 43 m: dorsal view of whole crab. — **c**, *Dynomene filholi* Bouvier, 1894, ♀ ovig. 10.4 x 8.0 mm, Gulf of Guinea, Annobon Id, 35-55 m (MNHN-B 22093): dorsal view of whole crab. — **d**, *Dynomene pilumnoides* Alcock, 1900, ♀ ovig. 12.7 x 10.6 mm, Sulu Archipelago, 99-108 m, (MNHN-B 10374): dorsal view of whole crab, left fourth pereopod and right fifth pereopod are missing. — **e**, *Hirsutodynomene spinosa* (Rathbun, 1911), ♂ 17.5 x 14.0 mm, Gorong, East of Seram, RUMPHIUS II (MNHN-B 9906): dorsal view of whole crab, some setae removed from right half of carapace. — **f**, *Hirsutodynomene ursula* (Stimpson, 1860), ♀ 15.0 x 12.3 mm, Galapagos, Hood Id, HANCOCK GALAPAGOS EXPEDITION, stn 30-33 (ex USNM 68313 but gifted to MNHN, Paris): dorsal view of whole crab.

TYPE SPECIES. — A genus without included nominal species; type species *Dynomene hispida* Guérin-Méneville, 1832, by subsequent monotypy, gender feminine.

OTHER SPECIES. — *Dynomene filholi* Bouvier, 1894, *D. pilumnoides* Alcock, 1900, *D. praedator* A. Milne Edwards, 1879, *D. pugnatrix* de Man, 1889 (including *D. pugnatrix brevimana* Rathbun, 1911).

DISCUSSION. — There has been considerable confusion over the authorship of the generic name *Dynomene* because at the outset it was sometimes used in the vernacular and other times in the latinized form. In DESMAREST's (1823, 1825) texts (and on the plates) the name *Dynomene* is given in the vernacular (French). In the indices to these two papers (the second paper being only a new version of the first), the name, however, is given in latin. In the 1823 index the latin names are italicized and the vernacular names are in roman type, e.g. "Langouste (Voy. *Palinurus*)". This is confirmed in the 1825 index, that starts with "Nota. Les noms latins des genres sont en italiques". Other uses of the latin *Dynomene* are found in JAROCKI's (1825) general zoology book and BERTHOLD's (1827) German translation of LATREILLE's (1825) "Familles naturelles du Règne Animal". (I am indebted to Prof. L. B. HOLTHUIS for the preceding information.) Thus DESMAREST (1823: 422) is the author of the genus *Dynomene* which was first used in the index to this publication.

There has also been confusion about the authorship of the type species of the genus *Dynomene*. Like many authors before them, PEYROT-CLAUSADE and SERÈNE (1976) attributed the name *Dynomene hispida* to DESMAREST (1825) but they point out that it was GUÉRIN-MÉNEVILLE who first used the full latinized form in his *"Iconographie du règne animal de G. Cuvier"*, published between 1829-1844. MANNING and HOLTHUIS (1981) state that livraison 22 of this series was published in July 1832. The latinized form was first used on pl. 14 of GUÉRIN-MÉNEVILLE (1832).

Maxillothrix Stebbing, 1921 was erected for a supposed new species of the Xanthidae, collected from the Cape Region, South Africa. But ODHNER (1925: 85) established that *Maxillothrix*, type species *Maxillothrix actaeiformis* Stebbing, 1921, is not a xanthid, but in fact a dynomenid, which he recognized as being a species of *Dynomene*. Subsequently, BARNARD (1947) placed *M. actaeiformis* in synonymy with *Dynomene pilumnoides* Alcock, 1900.

Dynomene hispida Guérin-Méneville, 1832

Figs 3 a, 5 a-b, 11, 12 a-c, 17 a, 18 a-g

Dynomene hispide Desmarest, 1823: pl. (18), fig. 2; 1825: 432, pl. 18, fig 2. — LATREILLE, 1829: 69.

Dynomene hispida Guérin-Méneville, 1832: 10, pl. 14, fig 2. — GRIFFITH, 1833: 175, pl. 14, fig. 2. — H. MILNE EDWARDS, 1837: 180; 1848 (in CUVIER): 180, pl. 14, fig. 2. — LAMARCK, 1838: 482. — A. MILNE EDWARDS, 1879: 5, pl. 12, figs 1-9, pl. 13, figs 10-15. — RICHTERS, 1880: 158. — MIERS, 1884: 13. — DE MAN, 1888: 408. — ORTMANN, 1892: 543; 1894: 33. — ALCOCK, 1901: 74 (list). — NOBILI, 1907: 378. — RATHBUN, 1911: 195. — IHLE, 1913: 92 (list). — BOUVIER, 1915: 38. — BALSS, 1922: 105; 1938: 7. — EDMONDSON, 1925: 30; 1933: 265, fig. 141; 1946: 269, fig. 165. — SAKAI, 1936: 43, pl. 8, fig 3; 1940: 29 (list); 1965: 660, text-fig. 1130; 1976: 29, pl. 6, fig. 4. — BUITENDIJK, 1939: 227. — MIYAKE, 1939: 198 (list); 1983: 195 (list). — HORIKAWA, 1940: 28. — WARD, 1942: 71. — LIN, 1949: 12. — TWEEDIE, 1950: 106. — GUINOT, 1967: 241 (list); 1985: 448 (list). — SUZUKI & KURATA, 1967: 95. — SERÈNE, 1968: 36 (list); 1973: 119. — TAKEDA, 1973: 80; 1977: 35 (list). — PEYROT-CLAUSADE & SERÈNE, 1976: 1340, fig. 1, pl. 5 A-B,F. — PEYROT-CLAUSADE, 1977: 212; 1981: 750; 1984: 114. — GUINOT, 1979: 125, pl. 21, figs 8-9. — CHEN, 1980: 118, text-fig. 1, pl. 1, fig. 3. — HIGHSMITH, 1981: 369. — BABA, 1986: 310. — DAI, YANG, SONG & CHEN, 1986: 28, pl. 3-4, text-fig. 11, 1-4. — GARTH, HAIG, & KNUDSEN, 1987: 241. — NAGAI & NOMURA, 1988: 92. — NAGAI, 1989: 43. — DAI & YANG, 1991: 32, text-fig 11, pl. 3, fig. 2. — POUPIN, 1996a: 24 (list).

Dynomena latreillii Eydoux & Souleyet, 1842: 239, pl. 3, figs 3-5. — TAKEDA, 1977: 35 (list).

Dynomene granulobata Dai, Yang & Lan 1981: 119, figs 10-14. — DAI, YANG, SONG & CHEN, 1986: 29, text-fig. 12, 1-2, pl. 3, fig. 3. — DAI & YANG, 1991: 33, text-fig. 12, 1-2, pl. 3, fig. 3.

Not *Dynomene hispida* - DE MAN, 1902: 689 [= *Hirsutodynomene spinosa* (Rathbun, 1911)].

Not *Dynomene hispida* - YOKOYA, 1933: 95, text-fig. 37 [= *D. pilumnoides* Alcock, 1900].

MATERIAL EXAMINED. — **New Caledonia**. No locality, probably intertidal, 1873: 1 ♂ 15.2 x 11.3 mm; 1 ♀ ovig. 13.7 x 10.1 mm (MNHN-B 22086). — No locality, probably intertidal, M. BALANSA coll., 1873: 7 ♂ 7.7 x

6.1 - 12.0 x 8.9 mm; 6 ♀ 8.2 x 6.6 - 10.9 x 8.5 mm; 1 ♀ ovig. 13.0 x 10.0 mm (MNHN-B 22091). — No locality, leg. A. MILNE EDWARDS, probably part of the M. BALANSA collection: 1 ♂ 13.0 x 10.4 mm; 1 ♀ 7.6 x 6.0 mm (ZMB 4324).

Mauritius. Port Louis, probably intertidal, M. THIRIOUX coll., 1913, E. BOUVIER det.: 1 ♀ ovig. 12.9 x 9.9 mm (MNHN-B 22088). — No date or locality: 1 ♀ 10.3 x 8.4 mm, dry (ANSP-CA3315, originally part of the collection of GUÉRIN-MÉNEVILLE, No. 209).

Madagascar. West coast, Tuléar, stn 13-3, external reef flat, M. PEYROT-CLAUSADE coll., 1968, R. SERÈNE det. : 1 ♂ 9.2 x 7.6 mm (MNHN-B 22087) (see PEYROT-CLAUSADE & SERÈNE, 1976 and PEYROT-CLAUSADE, 1984).

Somalia. (M. VANNINI coll.). Gesira, 18 km south of Mogadishu: stn 1, on live *Pocillopora* sp., low tide level, 1981: 1 ♀ 8.3 x 6.6 mm. — Stn 2, on live *Pocillopora* sp., low tide level, 1981: 1 ♀ 4.4 x 3.6 mm. — Stn 3, on dead *Pocillopora* sp., low tide level, 1981: 1 ♂ 6.5 x 5.2 mm. — Stn 4, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ ovig. 11.7 x 8.7 mm. — Stn 5, on dead *Pocillopora* sp., low tide level, 1981: 2 ♀ 3.6 x 3.3, 3.9 x 3.3 mm. — Stn 6, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ 5.4 x 4.7 mm. — Stn 11, on dead *Pocillopora* sp., low tide level, 1981: 2 ♂ 6.0 x 5.3, 8.5 x 6.8 mm; 1 ♀ 3.9 x 3.2 mm. — Stn 12, on dead *Pocillopora* sp., low tide level: 3 ♂ 6.7 x 5.4 - 11.6 x 9.2 mm. — Stn 13, on dead *Pocillopora* sp., low tide level: 1 ♂ 7.6 x 6.0 mm; 2 ♀ 3.9 x 3.3, 7.2 x 5.9 mm. — Stn 15, on dead *Pocillopora* sp., low tide level, 1981: 1 ♂ 9.7 x 7.9 mm; 1 ♀ 7.5 x 6.4 mm; 1 ♀ ovig. 10.0 x 7.8 mm. — Stn 16, on dead *Pocillopora* sp., low tide level, 1981: 1 ♂ 8.8 x 7.0 mm. — Stn 17, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ 8.0 x 6.6 mm. — Stn 18, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ 3.9 x 3.4 mm (all Somalia material from MZUF, see VANNINI, 1985).

Aldabra. Takora. Seaward Cove, low tide level, J. D. TAYLOR coll., 5.01.1967: 1 ♀ 11.7 x 9.0 mm (BMNH).

Cocos Keeling Islands. No locality, no depth, C. A. GIBSON-HILL coll., 1941, M. TWEEDIE det.: 1 ♀ 9.3 x 7.6 mm (ZRC 196461211). See TWEEDIE (1950). — Horsburgh Id, 0-37 m, 9.02.1989: 1 ♂ 5.7 x 4.9 mm (WAM 375-89). — Home Id, ocean side, no depth, 21.02.1989: 1 ♂ 13.8 x 10.9 mm; 1 ♀ 10.7 x 8.3 mm (WAM 751-89).

Northwest New Guinea. Salawatti Id, no depth, no date: 1 ♂ 6.0 x 5.0 mm (ZMB 5139).

Elizabeth Reef (east of Australia). Tasman Sea, 29°58'S, 159°05.1'E, no depth, 12.1987: 1 ♀ 9.0 x 7.5 mm (AMS-P 39155).

Middleton Reef (east of Australia). Tasman Sea, 29°29.5'S, 159°05.1'E, intertidal, 9.05.1987: 1 ♀ ovig. 15.6 x 12.3 mm (QM W13033).

Samoa. Pago Pago, no locality, no depth, 1924: 1 ♂ 14.0 x 11.0 mm (BPBM 2388).

French Polynesia. *Tuamotu Ids*: Marutea, Maitutaki, eastern reef, no locality, probably intertidal, M. SEURAT coll., 1905, G. NOBILI det.: 1 ♂ 8.5 x 6.7 mm (MNHN-B 22089) (see NOBILI , 1907). — *Austral Ids*. Marotiri, 27°35'S, 144°25'W, 9-5 m, D. M. DEVANEY coll., 20.02.1971: 1 ♀ ovig. 13.5 x 10.6 mm (BPBM 71.201).

Howland Island. WHIPP EXP., 0°48'N, 176°38'W, no locality, no depth, 1924: 2 ♂ 9.1 x 7.6, 13.0 x 10.0 mm; 1 ♀ ovig. 10.6 x 8.4 mm (BPBM 2353).

Johnston Island. 16°45'N, 169°30'W, no locality, no depth, C. EDMONDSON coll., 1923: 2 ♂ 8.5 x 6.8, 10.0 x 8.5 mm; 1 ♀ ovig. 11.5 x 9.6 mm (BPBM 1363).

Hawaii. No locality, no depth, 1836: 1 unknown sex. 7.9 x 6.0 mm (MNHN dry collection no. 23, type of *Dynomena latreillii* Eydoux & Souleyet, 1842). — No locality, no depth, no date: 1 ♀ ovig. 10.1 x 8.0 mm (AMS-P 5478). — Honolulu, no depth, Th MORTENSEN coll., April 1915: 2 ♂ 9.3 x 7.6 (damaged), 10.8 x 8.8 mm; 1 ♀ 15.0 x 10.5 mm (ZMUC - unregistered).

Oahu, Waikiki: no depth, 1928: 1♀ ovig. 14.1 x 10.9 mm (BPBM 1587). — No depth, 1928: 1 ♀ 11.5 x 10.2 mm (BPBM 3024). — No depth, no date: 1 ♂ 10.2 x 8.0 mm (BPBM 2883). — No depth, C. EDMONDSON coll., 1930: 1 ♀ 8.4 x 7.1 mm (BPBM 3131). — No depth, 24.04.1942: 1 ♀ ovig. 12.6 x 10.0 mm (USNM 182729). — No depth, 2.05.1942: 1 ♀ 11.7 x 9.4 mm (USNM 182729). — No depth, 29.05.1942: 1 ♀ 4.3 x 3.9 mm (USNM 182729).

Oahu, Waikiki Reef (C. EDMONDSON coll.): no depth, 1921: 3 ♂ 11.4 x 9.0 - 15.1 x 11.6 mm; 4 ♀ ovig. 9.7 x 7.7 - 10.6 x 8.6 mm (BPBM 572). — No depth, 16.02.1922: 4 ♂ 8.6 x 6.5 - 12.2 x 9.8 mm; 2 ♀ 10.0 x 7.9, 14.0 x 10.8 mm; 1 ♀ ovig. 12.5 x 9.7 mm (BPBM 658).

Oahu, Waialee: no depth, C. EDMONDSON coll., 6.07.1921: 1 ♂ 9.8 x 7.9 mm; 1 ♀ ovig. 14.3 x 11.6 mm (BPBM 510).

Oahu, Kahala Bay (C. EDMONDSON coll.): no depth, 7.03.1930: 16 ♂ 5.8 x 4.7 - 12.4 x 10.0 mm; 11 ♀ 5.2 x 4.2 - 10.8 x 8.3 mm; 4 ♀ ovig. 6.5 x 5.4 - 8.9 x 7.1 mm (BPBM 3168). — No depth, 1913: 2 ♂ 5.7 x 4.7, 10.7 x 8.6 mm (BPBM 3554). — No depth, 05.1931: 7 ♂ 9.7 x 7.8 - 12.3 x 9.7 mm (BPBM 3414). — No depth, 28.06.1934: 9 ♂ 8.3 x 6.8 - 11.5 x 9.6 mm; 2 ♀ 7.0 x 5.8, 10.8 x 8.6 mm; 7 ♀ ovig.) 9.3 x 7.5 - 10.5 x 8.6 mm (BPBM 3780).

Oahu, Pearl and Hermes Bay: no depth, 02.1928: 1 ♂ 10.0 x 8.3 mm; 1 ♀ 10.8 x 8.5 mm (BPBM 3043).

Oahu, Barbers Point: no depth, 1.09.1936: 1 ♂ 12.7 x 9.9 mm; 2 ♀ 10.7 x 8.6, 12.5 x 10.3 mm (BPBM 4234).

Oahu, Rabbit Id: no depth, 13.11.1936: 2 ♂ 10.1 x 8.2, 10.5 x 8.6 mm; 1 ♀ 12.2 x 9.5 mm (BPBM 4255).

Oahu, Kawela Bay: no depth, C. EDMONDSON coll., 15.07.1935: 4 ♂ 10.7 x 8.8 - 13.0 x 10.5 mm; 5 ♀ ovig. 9.9 x 7.7 - 13.0 x 10.3 mm, (BPBM 4038). — No depth, 10.07.1937: 5 ♂ 9.9 x 8.1 - 15.0 x 11.5 mm; 6 ♀ 9.0 x 7.2 - 13.5 x 11.1 mm (BPBM 4312).

Oahu: no locality, no depth, 10.01.1924: 2 ♂ 11.3 x 8.9, 12.6 x 10.2 mm (ZMUC). — No locality, no depth, no date: 2 ♂ 5.6 x 4.6, 13.2 x 10.1 mm; 2 ♀ 8.2 x 6.5, 11.2 x 9.1 mm; 3 ♀ ovig. 10.0 x 8.0 - 13.8 x 10.8 mm (BPBM

2186). — No locality, no depth, 1932: 5 ♂ 8.0 x 6.5 - 12.7 x 10.0 mm; 2 ♀ ovig. 8.4 x 6.6, 10.5 x 8.5 mm, C. EDMONDSON coll. (BPBM 3601). — No locality, no depth: 3 ♀ 6.4 x 5.2 -10.2 x 8.3 mm (BPBM 3683). — No locality, no depth, 1973: 4 ♂ 7.7 x 6.0 - 13.9 x 10.8 mm; 6 ♀ 5.2 x 4.3 - 12.7 x 10.0 mm; 2 ♀ ovig. 9.7 x 8.1, 11.2 x 9.1 mm (BPBM 510491). — No depth, 1973: 1 ♂ 8.0 x 6.7 mm; 1 ♀ 6.4 x 5.5 mm; 1 ♀ ovig. 11.6 x 9.3 mm. (BPBM 510492). — No locality, 12.2 m, 03.1996: 1 ♂ 6.8 x 5.2 mm (QM).

Oahu, Paile Point: no depth, 7.07.1952: 1 ♂ 11.1 x 8.5 mm; 1♀ ovig. 9.0 x 7.0 mm (BPBM 5804).

Oahu, Maili Point: no depth, 13.05.1953: 1 ♂ 10.0 x 8.6 mm; 1 ♀ 8.5 x 6.9 mm; 1 ♀ ovig. 11.0 x 9.6 mm (BPBM 6055). — No depth, 10.07.1953: 2 ♀ ovig. 9.3 x 7.6 , 10.0 x 7.8 mm (BPBM 5900).

Oahu, Kahe Point: no depth, S. COLES coll., 6-07.1977: 1 juv. 2.0 x 1.7 mm; 2 ♀ 3.6 x 3.1, 5.0 x 4.2 mm (BPBM 1977.554).

Ocean Island (= Kure Id), 80 km NW of Midway Id: no locality, no depth, 1923: 1 ♀ 4.0 x 3.3 mm (BPBM 1133).

Taiwan. Nan-Wan, Pingtung County, no locality, 6 m, from coral *Seriatopora hystrix* Dana, M. S. JENG coll., 5.12.1985: 1 ♀ 7.7 x 6.4 mm (NTOU). — Wan-li-Fong, low tide level, PING-HO-HO coll., 2.06.1992: 1 ♂ 6.6 x 5.2 mm; 1 ♀ ovig. 10.4 x 8.2 mm (NTOU).

TYPES. — *Dynomene hispida* Guérin-Méneville, 1832: according to PEYROT-CLAUSADE and SERÈNE (1976) the male 14.0 x 11.5 mm, from Mauritius was probably considered the holotype by DESMAREST. The specimen is part of the dry collection held by the Muséum national d'Histoire naturelle, Paris, registration number MP-B 245.

Dynomena latreillii Eydoux & Souleyet, 1842: holotype is a small, mounted, dry specimen 7.9 x 6.0 mm, collected from Hawaii, 1836, held by the Muséum national d'Histoire naturelle, Paris, registration number MP-B 235. As the specimen is mounted on a stub it is not possible to determine the sex.

Dynomene granulobata Dai, Yang & Lan, 1981: holotype is a male 6.2 x 5.4 mm, collected from Dongdao, Xisha Ids, South China Sea, 04.1965, held by the Beijing Natural History Museum, registration number 65079.

DESCRIPTION. — Carapace wider than long (CW/CL = 1.3 approx.), broadly rounded in outline but frontal and posterior margins truncated, surface minutely granulated and quite convex. Carapace surface and pereopods covered with coarse, plumose setae of two lengths: short setae clothing surface, but interspersed with slightly longer (0.08 x CW) setae which also fringe limbs. Setae not arranged in clumps. Density of setae not sufficient to completely obscure body surface. Structure of setae identical for both sizes: proximal 20% mostly smooth, followed by a region occupying about 40% with very short setules arranged in closely spaced bands, then a region occupying about 25% where setules increase rapidly in size distally forming a dense bunch, and finally the distal 15% is smooth, slightly curved or angled, and narrows to an acute tip.

A shallow frontal carapace groove separates a pair of low rounded protuberances, and then divides into separate grooves which gradually become more faint. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately from small pits curving anteriorly on to branchial region, while second groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally, bordering anterior cardiac region. In effect groove crossing mid-line, connects two crescent-shaped grooves. Mid-way along cardiac groove begins a faint branchial groove which runs towards base of last tooth on lateral margin. Posterior cardiac area outlined by a faint groove. Anterolateral carapace margin begins at level of postorbital corner, is evenly convex and bears four distinct, sharply pointed, equidistant teeth, first two of which are directed anteriorly and last two directed more laterally. Near beginning of posterolateral border there is another smaller tooth which lacks a sharp spine. Thus lateral margin has five teeth in total. Posterior carapace margin recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin continuous without orbital notch, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits; towards postorbital corner are about five small acute spines and another five spines continued on suborbital margin, which is essentially straight. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral region; distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth above opening of antennal gland is scarcely produced. Second article wider than long, distal margin widest, to which exopod is fixed, curving over base of eyestalk and becoming broader but terminating as a sharp point.

Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and together with small fourth article just matches length of exopod. Remaining antennal articles directed laterally, extending about as far as postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.24. Eyestalk can be completely folded into orbit, and the cornea is well developed, occupying all of tip. Epistome broadly triangular, surface concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace marked by a suture which can be clearly seen on inner surface of orbit.

Subhepatic area slightly convex. A groove begins near base of antenna, curving round under branchial region without a cervical branch and meeting lateral carapace margin just anterior to tooth on posterolateral border and connecting with branchial groove. Third maxillipeds operculiform; bases widely separated by tip of sternum. Crista dentata has only five or six small, distally placed teeth on each side. Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

The branchial formula is 19 gills and 7 epipodites on each side:

Somite	VII (Mxp1)	VIII (Mxp2)	IX (Mxp3)	X (P1)	XI (P2)	XII (P3)	XIII (P4)	XIV (P5)
Pleurobranchiae	-	-	-	-	1	1	1	-
Arthrobranchiae	-	1	1	2	2	2	2	-
Podobranchiae	-	1	1	1	1	1	1	-
Epipods	1	1	1	1	1	1	1	-

Gills are unequal (anterior half larger) violin-shaped plates, marginally notched, and joined together along central axis which carries afferent and efferent blood channels. Epibranchial corners thickened and bluntly pointed. Towards base of each arthrobranch and pleurobranch there are pairs of elongate epibranchial lobes which increase in length proximally. A transverse section near base shows two plates separated, on epibranchial surface, by two lobes, while a section mid-way shows only two plates. Hypobranchial setae at posterior end of branchial chamber poorly developed. Posterior margin of scaphognathite with two long setae. Hypobranchial margin of podobranchs bears same setae as on epipod.

Cheliped only slightly longer than first leg. Merus trigonal; inner face smooth and fitting closely against pterygostomial region of carapace; borders with small granules; outer face with a subterminal groove separating a thickened ridge on which there are three larger granules. Outer face of carpus convex with several small granules, two more prominent distal tubercles; inner superior border with a flattened, distomedially directed, granulated spur which abuts against distal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin is produced as a smooth obtuse flange fitting against merus when limb is withdrawn. These two structures give carpal article an unusual shape. Transverse section of propodus decreases in area distally; outer and superior faces with 6-7 rows of small granules, inner and inferior faces smooth. Fixed finger almost straight with two large teeth; moveable finger curved with a single, large tooth opposite first tooth on fixed finger; both fingers, thick, hollowed out internally, touching only at tips which are without interlocking teeth. Just below teeth on fixed finger is a distinct pit in which several long setae are inserted with a similar group of setae on inner margin. Larger groups of long stiff setae, inserted near base of dactyl and fixed finger, are directed across space between the two fingers. On dorsal surface of dactyl there are several small distal granules.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with a row of four or five small teeth and scattered granules, and a shallow subterminal restriction; length of merus of second leg about 1.5 times its width and equal to about a third of CL. Carpi inflated, dorsal surface bearing three longitudinal rows of granules, and produced distally to overhang base of propodi. Dorsal surface of propodi granulated. Dactyli curved, inferior margin armed with 5-6 small spines, tip brown and subacute.

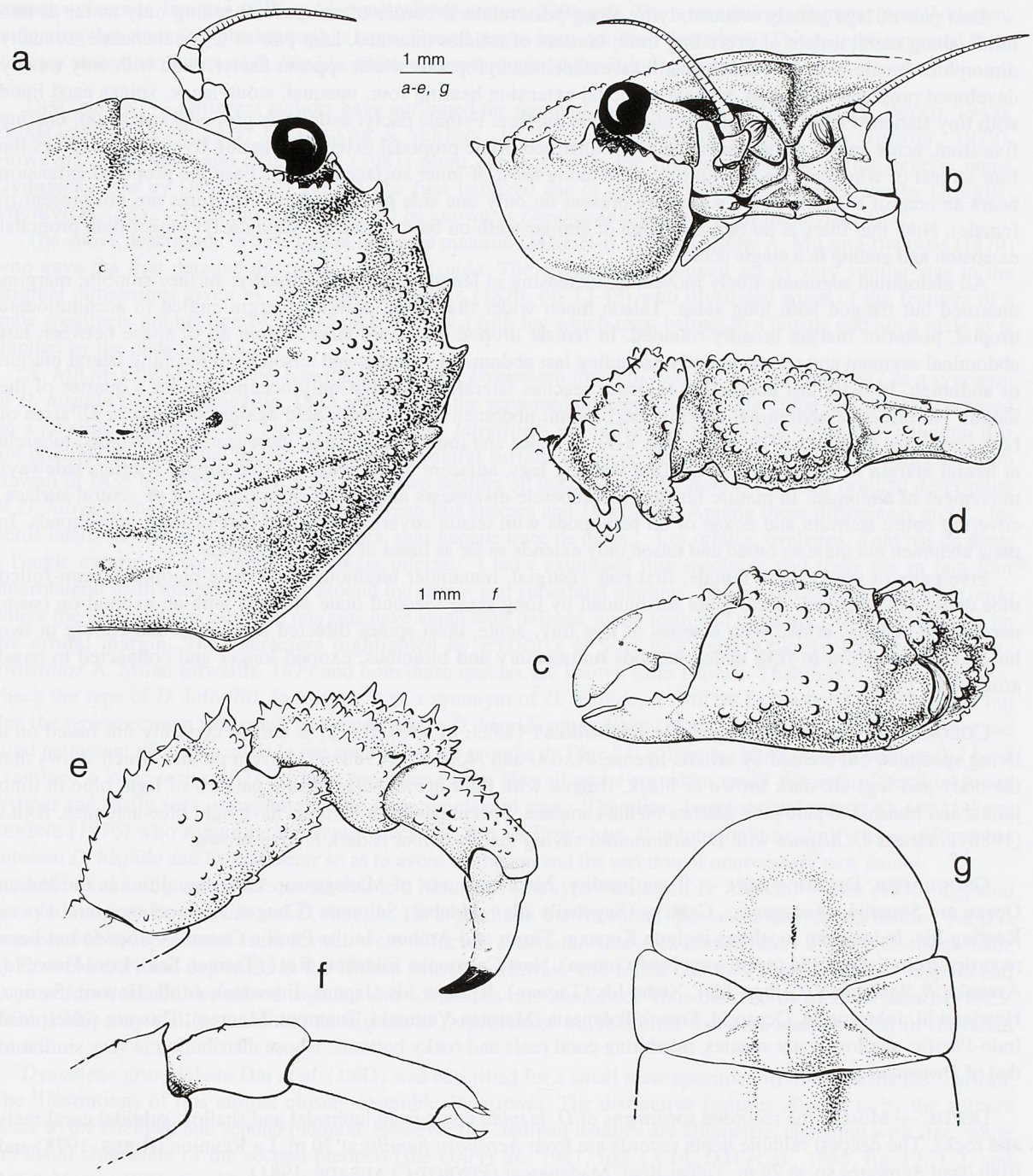


FIG. 18. — *Dynomene hispida* Guérin-Méneville, 1832: **a-g**, ♀ ovig. 12.9 x 9.9 mm, Port Louis, Mauritius, M. THIRIOUX coll. (MNHN-B 22088): **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of left cheliped; **d**, dorsal view of left cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of female abdomen.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching only as far as two thirds along meral article of preceding limb; borders of articles unarmed. Last pair of legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing four, unequal, stout, acute, spines each lined with tiny flattened teeth along almost entire inner surface. Female dactyl as long as propodal extension, bearing five stout, acute spines whose inner surface is unarmed. Male propodal extension bearing five unequal spines the four largest of which are lined with tiny teeth along most of inner surface. Near its base the propodal extension bears an area of rasp-like teeth which are present on only one side of limb (these structures are not present in female). Note that there is no opposing area of similar teeth on base of dactyl. Male dactyl longer than propodal extension and ending in a single acute claw.

All abdominal segments freely moveable, increasing in length and breadth distally; surface smooth; margins unarmed but fringed with long setae. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In female uropod plates are large, filling all of space between last abdominal segment and telson, entirely excluding last abdominal segment and telson from reaching lateral margin of abdomen. In male last abdominal segment reaches lateral margin but only occupies about a quarter of the length. No effective abdominal locking mechanism: abdomen only loosely held against sternum in all sizes of both sexes (see GUINOT, 1979, pl. 21, figs 8-9). In males and immature females, there is a small rounded tubercle at lateral margin of sternum, between first walking legs, adjacent to uropods, but this simply restricts sideways movement of abdomen. In mature females this tubercle disappears and abdomen occupies all of ventral surface, covering entire sternum and coxae of all pereopods with telson covering proximal half of third maxillipeds. In male abdomen not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. First male pleopod a semi-rolled tube ending in a curved apical plate surrounded by long setae. Second male pleopod with an exopod on basis, needle-like distally, armed with a series of five tiny, acute, inset spines directed terminally and ending in two hooked spines. Third to fifth male pleopods rudimentary and biramous; exopod longer and connected to basal article by a joint.

COLOUR. — The coloured figure by DESMAREST [1823, pl. (18), fig. 2] is almost certainly not based on a living specimen but created by artistic license. NAGAI and NOMURA (1988: 92) have a picture which shows that the body and legs are dark brown or black, fringed with light brown setae. Some patches of light blue in limb joints, and bluish and pale pink patches on the carapace. Specimens from Somalia have light blue antennae. BABA (1986) contrasts *D. hispida* with *D. pilumnoides* saying that its colour is dark blue or brown.

GEOGRAPHIC DISTRIBUTION. — Type locality: Mauritius, east of Madagascar. Other localities in the Indian Ocean are Somalia, Madagascar, Coetivy (Seychelle Ids), Aldabra, Salomon (Chagos Archipelago), and Cocos Keeling Ids. Indonesian localities include Kupang, Timor and Ambon. In the Pacific Ocean *D. hispida* has been recorded from Salawati Id (north west New Guinea), New Caledonia, Elizabeth Reef (Tasman Sea), Lord Howe Id, Aranuka & Apamama (Gilbert Ids), Xisha Ids (Taiwan), Ryukyu Ids (Japan), Enewetak Atoll, Hawaii, Samoa, Howland Id, Johnston Id, Ocean Id, French Polynesia (Marutea-Vaitutaki, Tuamotu, Moorea). This is a widespread Indo-Pacific, shallow water species, inhabiting coral reefs and rocky bottoms, whose distribution is very similar to that of *Dynomene praedator*.

DEPTH. — Most of the recorded specimens of *D. hispida* come from intertidal and shallow subtidal coral reefs and rocks. The deepest reliable depth records are from *Acropora humilis* at 30 m, La Réunion (RIBES, 1978) and from dead *Acropora* sp. at 24 m, Tuléar Reef, Madagascar (PEYROT-CLAUSADE, 1981).

SIZE. — The maximum size for males is greater than for females: 19.0 x 14.0 mm (SAKAI, 1976) and 15.6 x 12.3 mm (this study). The smallest ovigerous female is 6.5 x 5.4 mm recorded from Oahu, Hawaii (this study). Records of ovigerous females (mostly from Hawaii) extend from January to July. Despite living in tropical waters *D. hispida* seems to be a seasonal breeder. Newly laid eggs were found on females throughout the period January to July, suggesting that the egg bearing season extends beyond July. The only females with eggs ready to hatch were recorded in May and June. The smallest ovigerous females (CW = 8 mm) carried around 70 eggs and the

largest ovigerous females (CW = 14 mm) carried around 900 eggs. The average egg diameter was 0.44 mm, indicating that there is a planktotrophic larvae (larval stages have not been described). This is to be expected from the very wide distribution of *D. hispida* which occurs throughout the Indo-Pacific area.

DISCUSSION. — Different authors have attributed the name of this species to LATREILLE (e.g. WARD, 1942), DESMAREST (e.g. PEYROT-CLAUSADE & SERÈNE, 1976), or H. MILNE EDWARDS (e.g. GUINOT, 1979). However, MANNING and HOLTHUIS (1981) point out that while the first latinized use of the generic name *Dynomene* was by DESMAREST (1823), the first latinized use of the specific name *hispida* was by GUÉRIN-MÉNEVILLE (1832). Thus this species should be known as *Dynomene hispida* Guérin-Méneville, 1832.

The above description is based upon the same material (MNHN-B 22086) used by A. MILNE EDWARDS (1879) who gave the first detailed description of *D. hispida*. The specimens examined are of very similar size to the original dimensions given by A. MILNE EDWARDS (1879, pls 12-13) who illustrated some of the features of a male specimen, but his figs 14 and 15 clearly show a fifth leg which must belong to a female and not a male as is implied by the plate caption.

A. MILNE EDWARDS (1879) was the first to treat *Dynomena latreillii* Eydoux & Souleyet, 1842 as a synonym of *D. hispida* Guérin-Méneville, 1832, stating that the supposed differences were due to the fact that it was based on a juvenile specimen. The type specimen of *D. latreillii* is not in fact a juvenile (7.9 x 6.0 mm, although it is not possible to determine the sex because the ventral surface has been glued to a stub) and was collected from Hawaii in 1836 by EYDOUX and SOULEYET, two doctors on the corvette *"La Bonite"*. In their original description of *D. latreillii* they list the differences between this species and *D. hispida*. Among these differences are: ".. les bords latéro-antérieurs sont courbes, entiers, sans aucune trace de dents,... Les orbites, ovalaires, n'ont pas de dents à l'angle externe et sont ouverts à l'angle interne." I have examined this specimen and there are in fact four anterolateral teeth and small spines around the supra- and suborbital margins. Thus it agrees well with *D. hispida* where the anterolateral carapace margins have small well defined, acute teeth and there are small acute spines on the orbital margin. The characters highlighted by EYDOUX & SOULEYET are in fact typical of *Dynomene praedator* A. Milne Edwards, 1879 and both these species are known from Hawaii. Therefore it was essential to check the type of *D. latreillii*. In treating it as a synonym of *D. hispida*, A. MILNE EDWARDS (1879) pointed out that the type specimen was small and stated that in *D. hispida* anterolateral teeth "..les bords antérieurs ne sont pas aussi nettement découpés qu'ils le deviennent par les progrès de l'âge." (i.e. become more distinct with age). I have examined a large series of *D. hispida* specimens from Hawaii and even when small the anterolateral teeth are distinct and easily seen, provided that the setae are cleared away. Therefore, I agree with PEYROT-CLAUSADE and SERÈNE (1976) who supported the synonymy of A. MILNE EDWARDS. It is important to clarify these differences between *D. hispida* and *D. praedator* so as to avoid confusion and the erection of unnecessary new names.

After examining material from Hawaii and Mauritius (the type locality of *D. hispida*) WARD (1942) disputed the synonymy of *D. latreillii* and *D. hispida*. He argued that the Hawaiian species should remain distinct but it is possible that his specimens from Hawaii were in fact *D. praedator*. I have examined many of the collections made by EDMONDSON and deposited in the Bishop Museum, Hawaii, and found that they contain both *D. hispida* and *D. praedator*, sometimes mixed together and sometimes mis-identified. Thus the records of EDMONDSON (1925, 1933, 1946) may well be for either *D. hispida* or *D. praedator* but it is clear that both species occur in Hawaiian waters.

Dynomene granulobata Dai *et al.* (1981) was described for a small male specimen from the Xisha Ids, Taiwan. The illustrations of this animal closely resemble *D. hispida*. The distinctive features alluded to by the authors relate to the cheliped and second pleopod. However the cheliped features are allometric, changing with size, while the distal characters of the second pleopod (see DAI *et al.*, 1981, figs 13-14, DAI *et al.*, 1986, fig. 12, 1-2, and DAI & YANG, 1991, fig. 12, 1-2) are the same as found in *D. hispida*. The habitat of *D. granulobata*, "coral reefs in shallow waters", is the same as that of *D. hispida*. For these reasons I think that *D. granulobata* is a synonym of *D. hispida*.

A detailed discussion of the gills and epipods of *Dynomene hispida* is given above (see Morphology of the Dynomenidae). The branchial formula is 19 gills + 7 epipods. The gill structure of *D. hispida* is especially interesting since they show both phyllobranchiate and "trichobranchiate" shapes. A section mid-way along an arthrobranch or pleurobranch shows a pair of plates surrounding the afferent and efferent blood vessels as seen in

the phyllobranchiate Brachyura. The only differences are that the plates are bluntly pointed, as well as being thickened, at their epibranchial corners and mid-way along each side is a notch. The thickening probably helps to keep the lamellae separated. However, a section near the base of the gill shows the same two plates separated by a pair of elongate epibranchial lobes thus giving the gill a "trichobranchiate-like" appearance. The podobranchs bear only elongate lobes and their hypobranchial margins bear the same cleaning setae as found on the epipods to which the gills are attached. Thus within one species and one gill we have both kinds of gill structure present. As in all dynomenids, *D. hispida* has an epipodal gill cleaning mechanism aided by two long setae extending from the posterior end of the scaphognathite. The field of hypobranchial setae on the posterior body wall of the branchial chamber seen in some other dynomenids, e.g. *Paradynomene tuberculata*, is scarcely developed in *D. hispida*.

Previous work by PEYROT-CLAUSADE and SERÈNE (1976, text-fig. 1, pl. 5, A-B, F) showed the general features of the male pleopods including light microscope photo-micrographs. Further details were provided by DAI *et al.*, (1986, fig. 11, 2-3) and DAI and YANG (1991, fig. 11, 2-3). This study presents the first scanning electron microscope pictures of the male pleopods of *D. hispida* and these confirm the observations of DAI and YANG (1991): there is a well developed curved apical plate on the tip of the first pleopod and there are five subterminal and two terminal spines on the second pleopod. The subterminal spines are arranged in a series which curves around to the inferior margin of the pleopod. Each spine is apically directed and lies in a triangular depression. The terminal spines are larger than the others, unequal and curved sharply upwards at their tips. Near the base of this article, beside the exopod, is the opening of a secretory gland which may provide additional seminal fluid to aid sperm transfer. MINIGAWA (1993) has reported similar tegumental glands in the first and second pleopods of *Ranina ranina*. The last three pairs of pleopods in *D. hispida* are rudimentary and biramous with the exopod being longer. The endopod lacks a joint and appears to be an extension of the basal article. This condition is found in most of the other dynomenids.

A. MILNE EDWARDS (1879) illustrated examples of the long and short plumose setae found on the carapace. His figures (pl. 12, figs 8-9) show the fine setules forming the dense distal band on the long setae as being similar to more proximal setules, while those forming the dense band on the short setae are shown as being much stouter. Furthermore, the tip of the short setae is shown as being angled while that of the long setae is shown as being straight. Examination with a scanning electron microscope confirms most of the features illustrated by A. MILNE EDWARDS but shows that stout distal setules are found on both setal types and the tips of the both setae can be angled. There is a great deal of variation in setule development between setae.

In both females and males the tip of the last leg is fashioned into an obsolete subchelate mechanism but there are significant differences between the sexes. The female has a dactyl which bears several unarmed spines while the male has only a simple dactyl. The female propodal extension has four toothed spines while the male has five spines on which the teeth are fewer and smaller, and there is an area of rasp-like teeth near the base of the propodal extension. Perhaps these structures are a vestige of what was a grasping or cleaning limb and perhaps the female has lost the rasp-like teeth but still has better developed remnants of the claws. It does not seem sensible to hypothesize that formerly these limbs had different roles in males and females. What their exact role was is still a matter for speculation.

Marco VANNINI kindly supplied the *D. hispida* specimens from the coast of Somalia and data about their habitat. Whole coral heads (n=119) of *Pocillopora* sp. were enclosed in plastic bags, removed and the fauna extracted. A total of 36 dynomenid specimens were collected: 22 *D. hispida* and 14 *D. praedator*. Of the 19 corals inhabited by dynomenids only 2 were alive, the others being encrusted and more or less dead. Despite being relatively common, the dynomenids did not co-occur with the typical decapod inhabitants of live *Pocillopora* sp. such as *Trapezia* spp., *Cymo* spp., *Alpheus lottini* and *Synalpheus charon*. Perhaps these data indicate that more recently evolved brachyurans have replaced the ancient dynomenids from the more productive live-coral habitat. Furthermore, *D. hispida* occurred in 13 corals and *D. praedator* in 7 corals so that in only one case did the two species occur together, suggesting that there may be some competitive exclusion between these two species.

EDMONDSON (1946) found that Hawaiian *D. hispida* are very abundant in crevices of porous rocks. Gut contents of two specimens (CW = 13.5 and 15.0 mm) from Hawaii included mostly fine organic particles, sand grains, a few cut lengths of tubular hydroid(?) and a chitinous fragment that may have come a decapod leg. The groups of stiff setae on the cheliped fingers may act as a sieving device for collecting food particles.

Massive corals from Enewetak Atoll contained relatively few dynomenids: *Goniastrea retiformis*, only one *D. hispida* among 36 decapods from 18 coral heads; *Porites lutea*, no dynomenids amongst 77 decapods from 43 coral heads (HIGHSMITH, 1981). Of 2722 Brachyura and Anomura (except pagurids), collected from seven stations on the barrier reef of Moorea, PEYROT-CLAUSADE (1977) found only three specimens of *D. hispida* (approx. 0.11%). The fauna was dominated by xanthid crabs (approx. 70%), and galatheids (approx. 17%). PEYROT-CLAUSADE (1981) recorded *D. hispida* from clumps of dead *Acropora* from 1.5-24 m, Tuléar Reef, Madagascar, and RIBES (1978) found only single specimens in *Pocillopora damicornis*, *Favia stelligera*, *Acropora clathra*, *A. humilis*, *A. variabilis*, and *Oulophyllia crispa* from La Réunion. Above is also listed a Taiwan specimen collected from *Seriatopora hystrix*. These data suggest that *D. hispida* inhabits a variety of corals but is comparatively rare in some reef communities.

Dynomene praedator A. Milne Edwards, 1879

Figs 3 b, 8 a-b, 11, 12 d, 14 b, 17 b, 19 a-g

Dynomene praedator A. Milne Edwards, 1879: 8, pl. 14, figs 20-26. — MIERS, 1884: 13. — DE MAN, 1888: 409. — ORTMANN, 1892: 543, pl. 26, fig. 3. — ALCOCK, 1901: 75 (list). — RATHBUN, 1911: 196. — IHLE, 1913: 92 (list). — BALSS, 1938: 7. — MIYAKE, 1938: 194, text-fig. 4, 2; 1939: 198 (list); 1983: 195 (list). — BUITENDIJK, 1939: 227, pl. 7, fig. 4. — TWEEDIE, 1947: 30; 1950: 106. — LIN, 1949: 12. — GUINOT, 1967: 241 (list). — SERÈNE, 1968: 36 (list). — TAKEDA, 1973: 81; 1977: 35 (list). — MONOD & SERÈNE, 1976: 25 (list). — MIYAKE, 1983: 195 (list). — GUINOT, 1985: 448 (list). — GARTH, HAIG & KNUDSEN, 1987: 241. — RODGERS & OLEROD, 1988: 302. — POUPIN, 1996a: 24 (list).

Dynomene sinense Chen, 1979: 9, fig. 1; 1980: 119, pl. 1, fig. 1. — DAI & YANG, 1991: 31 (key).

Dynomene sinensis - ODINETZ, 1983: 208. — GUINOT, 1985: 448 (list).

Dynomene sp. - NAIM, 1980: 55.

Dynomene tenuilobata Dai, Yang & Lan, 1981: 118, figs 5-9. — DAI, YANG, SONG & CHEN, 1986: 29, text-fig. 12, 3-4, pl. 3, fig. 4. — DAI & YANG, 1991: 33, text-fig. 12, 3-4, pl. 3, fig. 4.

Dynomene huangluensis Dai, Cai & Yang, 1996: 234, fig. 1.

Dynomene hungluensis - DAI, CAI & YANG, 1996: 251 (err.).

?*Dynomene* sp. - CALMAN, 1909: 703.

Not *Dynomene praedator* - SAKAI, 1976: text-fig. 17. — NAGAI & TSUCHIDA, 1995: 108, pl. 1, fig. 2 [= *Metadynomene tanensis* (Yokoya, 1933)].

MATERIAL EXAMINED. — **Somalia**. Gesira, 18 km south of Mogadishu: stn 20, habitat unknown, low tide level, G. CHELAZZI coll., 1980: 1 ♀ ovig. 9.0 x 7.0 mm (MZUF).

M. VANNINI coll.: stn 7, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ 6.0 x 5.0 mm. — Stn 8, on dead *Pocillopora* sp., low tide level, 1981: 1 ♂ 9.5 x 7.2 mm (bopyrid isopod in right gill chamber, *Gigantione* sp. nov.). — Stn 9, on dead *Pocillopora* sp., 1981: 1 ♂ 6.7 x 6.1 mm. — Stn 10, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ 8.7 x 6.7 mm. — Stn 14, on dead *Pocillopora* sp., low tide level, 1981: 1 ♂ 10.8 x 8.5 mm. — Stn 15, on dead *Pocillopora* sp., low tide level, 1981: 1 ♀ 10.0 x 8.0 mm. — Stn 19, reef locality, low tide level, 1981: 3 ♂ 5.9 x 5.1 - 9.6 x 7.8 mm; 4 ♀ 5.1 x 4.2 - 8.0 x 6.4 mm. (All Somalia material from MZUF, see VANNINI, 1985).

Glorieuses Islands. Intertidal zone, low tide level, A. CROSNIER coll., 29.01.1971: 1 ♂ 8.7 x 6.7 mm; 1 ♀ ovig. 9.6 x 7.5 mm.

Madagascar. *Nosy Be*: stn 899, no location, low intertidal, 02.1962: 1 ♂ 12.0 x 9.6 mm (MNHN-B 6863). — Stn 961, no location, low intertidal, 02.1962: 3 ♂ 5.1 x 4.4 - 12.4 x 9.5 mm; 2 ♀ 8.7 x 7.2, 11.0 x 8.0 mm; 1 ♀ ovig. 9.0 x 7.5 mm (MNHN-B 6864). — Intertidal zone, 03.1971: 2 ♀ 9.1 x 7.3, 9.5 x 7.7 mm (MNHN-B 6903). — Madirokely, intertidal zone, no date: 1 ♂ 13.5 x 10.7 mm.

Seychelles (Aldabra). Reef West, A. J. BRUCE coll., no date: 1 ♂ 9.8 x 8.0 mm; 1 ♀ 7.8 x 6.5 mm; 1 ♀ ovig. 8.2 x 6.6 mm.

Reunion. On *Acropora* sp., no locality, 10 m, no date: 1 ♂ 6.8 x 6.0 mm. — On coral, no locality, 20 m, no date: 1 ♂ 5.0 x 4.2 mm. — On *Pocillopora* sp., no locality, 10 m, S. RIBES coll., no date: 1 ♀ 5.0 x 4.1 mm.

Cocos Keeling Islands. No locality, no depth, C.A. GIBSON-HILL coll., 1941, M. W. F. TWEEDIE det.: 1 ♂ 8.0 x 6.4 mm; 1 ♀ 6.2 x 5.1 mm. (ZRC 19646129-10). See TWEEDIE (1950). — NW end of N. Keeling Id, 0-28 m, 23.02.1989: 1 ♂ 5.9 x 4.8 mm; 2 ♀ 6.7 x 5.4, 7.0 x 5.7 mm; 1 ♀ ovig. 6.9 x 5.5 mm (WAM 137-94).

Christmas Island. No locality, no depth, C.A. GIBSON-HILL coll., 1940, M. W. F. TWEEDIE det.: 5 ♂ 6.1 x 5.0 - 7.9 x 6.4 mm; 1 ♀ 6.7 x 5.3 mm; 2 ♀ ovig. 6.5 x 5.0, 7.0 x 5.8 mm (ZRC 19646121-8). — No locality, no depth, C.A. GIBSON-HILL coll., 1947, M. W. F. TWEEDIE det.: 2 ♂ 7.3 x 6.1, 7.5 x 6.1 mm; 1 ♀ ovig. 10.0 x 7.9 mm (ZRC 1970.1.20.51-54). See TWEEDIE (1947).

Indonesia. *Moluccas*. RUMPHIUS 2: stn 902 (26), Gorong, east of Seram, on *Porites*, 1975: 1 ♂ 5.4 x 4.3 mm. — *Amboina*. No details (see DE MAN, 1888), J. BROCK coll., 7.09.1885: 1 ♂ 9.8 x 7.9 mm (SMF 163). — *North Celebes*. Lembek Strait, no depth, no date: 1 ♀ 9.8 x 7.9 mm (USNM 122953).

Mariana Islands (coll. H. T. CONLEY). Guam, Piti Reef, 13°27'N, 144°47'E, among rocks, 1.5 m, 22.07.1993: 2 ♂ 8.5 x 6.5, 13.0 x 10.3 mm (UGM). — *Ibidem*, among rocks, 1 m, 1.08.1993: 1 ♀ 7.8 x 7.0 mm (UGM).

Solomon Islands. Bougainville, Tiop, no depth, coll. H. SCHOEDE, 4.11.1909: 10 ♂ 4.1 x 3.6 - 9.3 x 7.6 mm, 14 ♀ 4.3 x 3.6 - 7.5 x 6.2 mm (ZMB 14407).

New Caledonia. Exact locality unknown, probably intertidal, M. BALANSA coll., 1873: 1 ♀ (probably the ♀ paratype) 10.2 x 8.1 mm (MNHN-B 7029). — Exact locality unknown, probably intertidal, M. BALANSA coll., 1873: 6 ♂ 6.5 x 5.4 - 9.6 x 7.5 mm; 2 ♀ 6.5 x 5.5, 9.8 x 7.3 mm (MNHN-B 22075).

LAGON: stn 585, île des Pins, 22°46.0'S, 167°32.0'E, 43 m, B. RICHER DE FORGES coll., 18.07.1985: 1 ♂ 10.4 x 8.2 mm; 1 ♀ 5.7 x 4.2 mm.

Récif Mbéré: 22°19.9'S, 166°13.2'E, 10 m, P. BOUCHET coll., 5.05.1993: 2 ♂ 6.2 x 5.1, 8.7 x 6.8 mm; 4 ♀ 5.0 x 4.1 - 10.4 x 8.1 mm.

OPÉRATION MONTROUZIER. Koumac, récif Infernet, B. RICHER DE FORGES coll., 7.10.1993: 1 ♂ 8.7 x 7.1 mm.

French Polynesia. *Society Ids*. Tahiti. No details, 2 ♂ 9.8 x 8.1, 11.2 x 9.3 mm; 2 ♀ ovig. 10.2 x 8.3, 11.6 x 9.1 mm. (SMF 4855). ORTMANN (1892) reported 2 ♂ from Tahiti, but under *Dynomene hispida* he also reported 2 ♂ and 2 ♀ from Oshima, Japan, so it is possible that he confused the material of these two species. — *Moorea*. On algae (*Amphiroa foliacea*), O. NAIM coll., 1978, : 1 ♀ ovig. 11.6 x 8.9 mm (MNHN-B 20203) (see NAIM, 1980). — Associated with *Pocillopora damicornis* and *P. elegans*, O. ODINETZ coll., 1981, D. GUINOT det. in 1982 as *Dynomene sinensis*. : 1 ♂ 11.2 x 9.1 mm (MNHN-B 17090) (see ODINETZ, 1983).

McDonald Volcano. 28°58'S, 140°16'W, approx. 50 m, B. RICHER DE FORGES coll., 19.05.1979: 3 ♀ 4.3 x 3.9 - 4.4 x 4.0 mm.

Line Islands. WHIPP EXPEDITION: *Washington Id*, 4°43'N, 160°21'W, no depth, 1924: 1 ♂ 5.0 x 4.3 mm (BPBM 2359). — *Christmas Id*, 1°51'N, 157°23'W, no depth, 1924: 1 ♂ 11.1 x 8.2 mm (BPBM 2313).

Johnston Island. 16°45'N, 169°30'W, northwest side of outer reef, F. M. BAYER coll., 28.08.1947: 3 ♀ 4.8 x 4.0 - 5.7 x 4.5 mm (USNM 176603).

Hawaii. *Oahu Id*, Kawela Bay: no depth, C. EDMONDSON coll., 17.07.1935: 2 ♂ 8.0 x 6.6, 9.0 x 7.0 mm (BPBM 4038). — No depth, 03.1936: 3 ♂ 7.0 x 5.7 - 10.0 x 8.1 mm, 1 ♀ 10.0 x 8.0 mm (BPBM 4212). — No depth, 10.07.1937: 2 ♂ 8.6 x 7.2, 10.7 x 8.4 mm; 3 ♀ 7.6 x 6.4 - 10.4 x 8.4 mm (BPBM 4312).

Oahu Id, Black Point: no depth, C. EDMONDSON coll., 12.07.1937: 1 ♂ 9.2 x 7.3 mm (BPBM 3844). — No depth, L. R. WOODWARD coll., 1937: 1 ♂ 5.6 x 4.5 mm (USNM 175882).

Oahu Id, Waikiki Reef: no depth, C. EDMONDSON coll., 1921: 1 ♂ 10.6 x 8.8 mm, 1 ♀ ovig. 12.0 x 9.6 mm (BPBM 572). — No depth, C. EDMONDSON coll., 1922: 1 ♂ 12.0 x 10.2 mm (BPBM 739). — Off Waikiki, 5 m, 1.01.1945: 2 ♂ 6.0 x 5.0, 6.6 x 5.7 mm; 2 ♀ 5.2 x 4.0, 7.7 x 6.6 mm; 1 ♀ ovig. 9.7 x 7.3 mm (BPBM 5096).

Oahu Id, Kahala Bay: no depth, C. EDMONDSON coll., 7.03.1930: 10 ♂ 6.2 x 5.5 - 10.3 x 8.4 mm; 8 ♀ 6.4 x 5.2 - 9.8 x 7.4 mm; 3 ♀ ovig. 9.4 x 7.4 - 9.5 x 7.7 mm (BPBM 3168). — No depth, C. EDMONDSON coll., 05.1931: 1 ♀ ovig. 10.3 x 8.1 mm (BPBM 3414). — No depth, C. EDMONDSON coll., 28.06.1934: 5 ♂ 7.0 x 5.7 - 12.0 x 9.8 mm; 1 ♀ 8.6 x 7.3 mm; 2 ♀ ovig. 8.2 x 6.8, 8.6 x 7.2 mm (BPBM 3780).

Oahu Id, Kahe Point: no depth, S. COLES coll., 06-07.1977: 2 ♂ 4.6 x 4.0, 4.8 x 4.0 mm; 7 ♀ 4.5 x 3.8 (parasitic isopod attached to pleopods) - 7.0 x 5.6 mm (BPBM 1977.554).

Oahu Id, no locality, no depth, C. EDMONDSON coll., 1932: 1 ♂ 9.2 x 7.4 mm; 1 ♀ ovig. 9.4 x 7.5 mm (BPBM 3601). — No locality, no depth, W.A. BRYAN coll., no date: 1 ♂ 11.0 x 9.3 mm (BPBM 184). — No depth, 1973: 1 ♂ 9.0 x 7.2 mm (BPBM 510492).

Kauai, Anahola Bay, 15 m, 7.09.1959: 1 ♂ 7.6 x 6.1 mm; 1 ♀ 8.8 x 7.1 mm (BPBM 6819).

Hawaii, no locality, no depth, B. DEGENER coll., 21.09.1929: 1 ♀ 5.6 x 4.4 mm (USNM 108395).

Japan. Kuroshima Ids. In dead coral branches, inner reef, 1992: 1 ♀ 10.3 x 8.0 mm; 1 ♀ ovig. 9.1 x 7.3 mm. — No locality, coll. M. OSAWA, 1993, 1 ♀ 10.1 x 7.8 mm (collection of C. McLAY).

TYPES. — *Dynomene praedator* A. Milne Edwards, 1879: holotype is a male 13.0 x 10.0 mm, collected by M. BALANSA from the intertidal, New Caledonia, 1873, but it probably no longer exists (see Discussion below under this species). However there is a paratype female 10.2 x 8.1 mm, from the same collection, and held at the Muséum national d'Histoire naturelle, Paris, registration number MNHN-B 7029.

Dynomene sinense Chen, 1979: holotype is a female 9.2 x 7.5 mm, collected from Shenhang Dao, Xisha Ids, South China Sea, 13.04.1958, held by the Beijing Natural History Museum, registration number IOAS-C00801. A paratype male collected from Shi Dao, Xisha Ids, 6.04.1958, is held at the same institution, registration number IOAS-C00802.

Dynomene tenuilobata Dai, Yang & Lan, 1981: holotype is a male 6.4 x 5.6 mm, collected from Jinyindao, Xisha Ids, South China Sea, 5.12.1974, held by the Beijing Natural History Museum, under number 74073.

Dynomene huangluensis Dai, Cai & Yang, 1996: holotype not designated from among the five specimens (4 males and 1 female) collected from three different reefs of the Nansha Ids, South China Sea (6°56'N, 113°35'E - 10°50'N, 114°10'E). Specimens deposited in the Bejing Natural History Museum.

DESCRIPTION. — Carapace wider than long (CW/CL = 1.25 approx.), broadly rounded in outline but frontal and posterior margin truncated, surface minutely granulated and evenly convex. Carapace surface and pereopods covered with coarse, plumose setae of two lengths: short setae clothing surface, but interspersed with longer setae (0.08 x CW) which also fringe limbs. Setae not arranged in clumps. The setae give this crab a yellowish colour but their density is not sufficient to completely obscure body surface. Structure of setae identical in both sizes: proximal 65% of shaft with many short setules, then a region occupying about 10% where there are approximately a dozen long setules projecting almost at right angles to setal axis, and finally the distal 25% which is smooth, slightly curved, and narrows to an acute tip.

A shallow frontal carapace groove separates a pair of low rounded protuberances, and then divides into separate grooves which gradually become more faint. Just in front of cardiac region two laterally-directed grooves originate: the first groove (cervical) arises separately from small pits curving anteriorly on to branchial region, while second groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally bordering the anterior cardiac region. In effect the groove crossing the mid-line, connects two crescent-shaped grooves. No branchial groove is evident. Anterolateral carapace margin begins at level of postorbital corner, evenly convex and usually adorned with small granules, although there are two (sometimes three) larger blunt granules interrupting margin at equidistant intervals and near beginning of postero-lateral border there is a small group of similarly prominent granules. Development of granules on anterolateral margin is quite variable among individuals collected from the same site and often differs between the left and right sides of the carapace of individual crabs. But there are never well defined, acute teeth as found in *D. hispida*. Posterior carapace margin is recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits without a notch, towards postorbital corner are a few minute granules which are continued on suborbital margin, which is bluntly produced as a small lobe, making the border sinuous. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral region; distal margin almost adjacent to distal margin of second antennal article, the two of them continuing the line of the suborbital margin. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth above opening of antennal gland is scarcely produced. Second article wider than long; distal margin longest, to which is fixed exopod curving over base of eyestalk and becoming broader. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in beside exopod, and together with small fourth article just matches length of exopod. Remaining antennal articles directed laterally, extending about as far as postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.23. Eyestalk can be completely folded into orbit, and cornea well developed, occupying all of tip. Epistome broadly triangular, surface concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker.

Subhepatic area slightly convex with a few minute granules. A groove begins near ventromedial corner of carapace, curving round, without a cervical branch, under branchial region and meeting lateral carapace margin just anterior to tubercle on posterolateral border. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has only five or six small, distally placed teeth on each side. Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

There are 19 gills and 7 epipodites on each side. Distribution of gills and epipods as for *D. hispida*. Gills are unequal (anterior half larger) violin-shaped plates, marginally notched, and joined together along central axis which carries afferent and efferent blood channels. Epibranchial corners thickened and bluntly pointed. Towards base of each arthrobranch and pleurobranch there are pairs of elongate epibranchial lobes which increase in length proximally. A transverse section near base shows two plates separated, on epibranchial surface, by two lobes,

while a section mid-way shows only two plates. Setae on inner posterior wall of branchial chamber poorly developed. Posterior margin of scaphognathite with two long setae. Hypobranchial margin of podobranchs bear same setae as on epipod.

Cheliped only slightly longer than first leg, merus trigonal, inner face smooth and fitting closely against pteryogostomial region of carapace; borders with small granules; outer face has a subterminal groove separating a thickened ridge without granules. Outer face of carpus convex with several small granules, two more prominent distal tubercles; inner superior border with a flattened, distomedially directed, unornamented spur which abuts against distal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin produced as a smooth obtuse flange fitting against merus when limb is withdrawn. These two structures give carpal article an unusual shape. Transverse section of propodus decreases in area distally; outer and superior faces covered in small granules; inner and inferior faces smooth. Fixed finger of female almost straight with two small teeth; moveable finger curved with a single, larger tooth opposite first tooth on fixed finger; both fingers hollowed out internally, touching only at tips which may be faintly divided into three or four blunt, interlocking teeth. In mature male (CW = 12.0 mm) chelipeds more massive and teeth are similar to female except that near point of articulation with dactyl there is a tooth-like projection directed distally. This projection seems to occur in males with CW > 10.0 mm. Left and right chelipeds are sometimes different in number of teeth. Just below teeth on fixed finger is a distinct pit in which several long setae are inserted with a similar group of setae on inner margin. Small groups of long stiff setae, inserted mid-way along dactyl and fixed finger, are directed across space between the two fingers.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate; both faces of meri of first two legs and anterior face third leg merus smooth and nacreous; inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with several minute granules, a shallow subterminal restriction; length of merus of second leg about three times its width and equal to about half CL. Carpi inflated and produced distally to overhang base of propodi. Dactyli curved, inferior margin armed with 5-6 small spines, tip brown and subacute. Borders of all leg articles minutely granulated.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching only as far as mid-way along meral article of preceding limb; borders of articles unarmed. Last pair of legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing four, unequal, stout, acute, spines each lined with tiny flattened teeth along almost entire inner surface. Female dactyl as long as propodal extension, bearing fourteen unequal, stout, hooked spines (arranged asymmetrically around perimeter of the dactyl) whose inner surface is wrinkled and mostly devoid of tiny teeth. Male propodal extension bearing five unequal hooked spines the four largest of which are lined with many tiny flattened teeth along most of inner surface. Male dactyl longer than propodal extension and ending in a single acute claw.

All segments of abdomen freely moveable, increasing in length and breadth distally, surface smooth, margins unarmed but fringed with long setae. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In female uropod plates large, filling almost all space between last abdominal segment and telson, excluding most of last abdominal segment and telson from reaching lateral margin of abdomen. In male last abdominal segment reaches lateral margin but only occupies about a quarter of the space. No effective abdominal locking mechanism: abdomen only loosely held against sternum in all sizes of both sexes. In males and immature females, there is a small rounded sternal tubercle between first walking legs, adjacent to uropods, but this simply restricts sideways movement of abdomen. In mature females this tubercle disappears and abdomen occupies all of ventral surface, covering entire sternum and coxae of all pereopods with telson covering proximal half of third maxillipeds. In male, abdomen not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. First male pleopod a semi-rolled tube with a very small apical plate surrounded by long setae. Second male pleopod with an exopod on basis, needle-like distally, armed with a series of five tiny, curved, acute, inset spines and ending in three larger spines. Terminal spines slightly curved at their tips and last two form a cheliped-like structure. Third to fifth male pleopods uniramous and rudimentary.

COLOUR. — Light yellowish-brown body and limbs, fingers white. Antennae same colour as the body, not light blue as in *Dynomene hispida.*

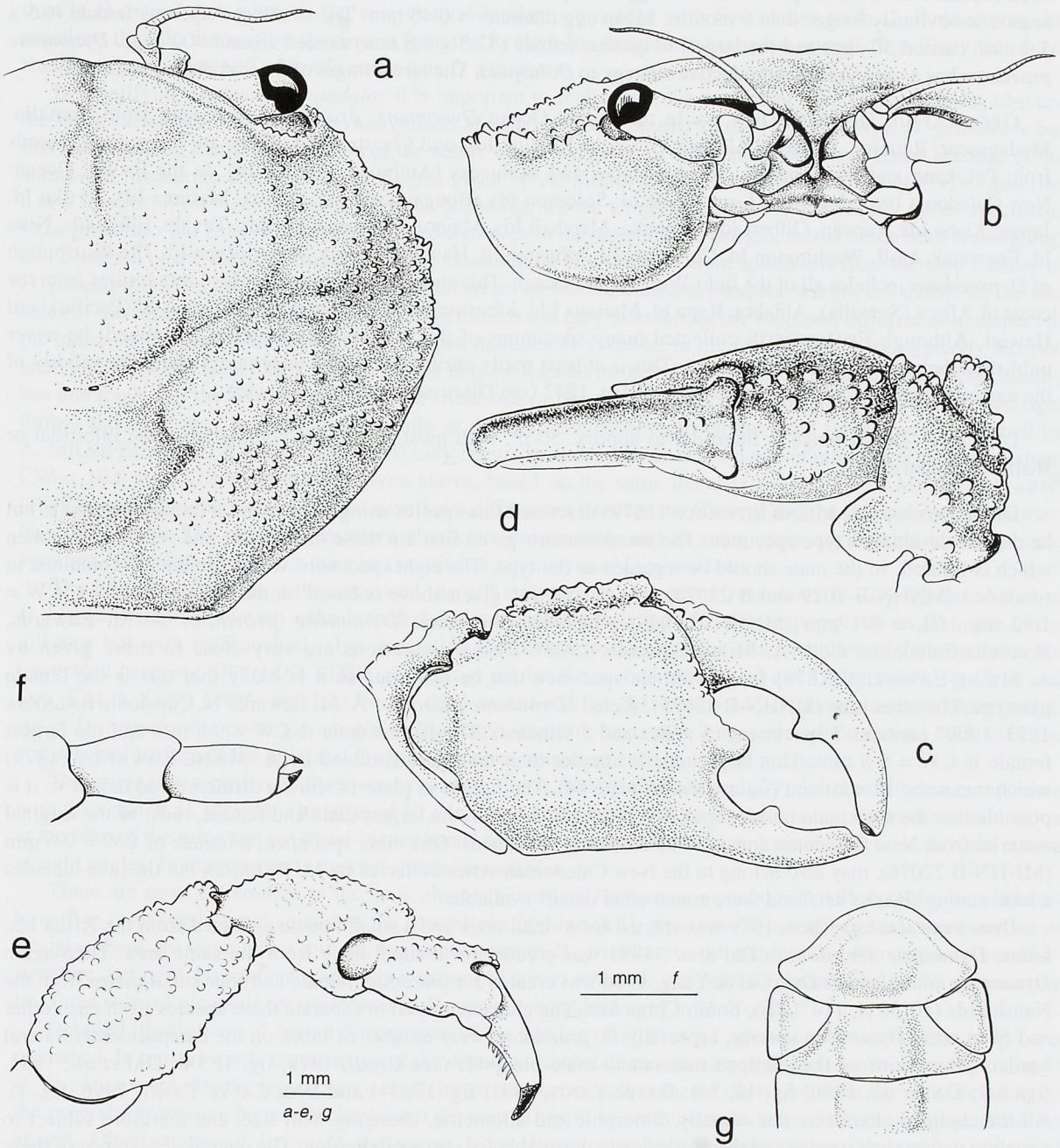


FIG. 19. — *Dynomene praedator* A. Milne Edwards, 1879: **a-g**, ♂ 13.5 x 10.7 mm, Nosy Be, Madagascar, A. CROSNIER coll.: **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of male abdomen.

SIZE. — The maximum size for males is 13.5 x 10.7 mm, for females 12.0 x 9.6 mm, while the smallest ovigerous female is 6.5 x 5.0 mm. SAKAI (1976) gives the maximum size for males as 16.0 x 13.0 mm, but this is probably based on the misidentification of *Metadynomene tanensis* (Yokoya, 1933). Ovigerous females have been recorded from January to June with eggs ready to hatch in January and new eggs in June so the breeding season is obviously longer than 6 months. Mean egg diameter = 0.46 mm. The smallest ovigerous female (6.5 x 5.0 mm) carried 50 eggs and the largest ovigerous female (12.3 x 9.6 mm) carried around 900 eggs. *Dynomene praedator* has a very similar reproductive strategy to *D. hispida*. The larval stages of these crabs are unknown.

GEOGRAPHIC DISTRIBUTION. — In the Indian Ocean *Dynomene praedator* is known from Somalia, Madagascar, Reunion, Coetivy, Aldabra Id, Cocos Keeling Ids, and Christmas Id. There are Indonesian records from Pelokang and Postiljon Ids, North Celebes and Moluccas (Amboina, Obilatu Id). In the Pacific Ocean: New Caledonia (type locality), Lord Howe Id, Solomon Ids (Bougainville Id), Samoa, Mariana Ids, Ryuku Id, Japan, Xisha Ids, Taiwan, Gilbert Ids, Aranuka, Marshall Ids, Majeru, Viti Levu, Fiji Ids, Tuvalu, Ellice Ids, Niue Id, Enewetak Atoll, Washington Id, Christmas Id, Johnston Id, Hawaii, Moorea, Tahiti, Rapa Id. The distribution of *D. praedator* includes all of the Indo-West Pacific Ocean. This study reports new records of this species from the coast of Africa (Somalia), Aldabra, Rapa Id, Mariana Ids, Johnston Id, Washington Id, Christmas Id (Pacific), and Hawaii. Although EDMONDSON collected many specimens of this species (see Material Examined) he never published their occurrence from Hawaii. This is at least partly attributable to the uncertainty about the validity of the name *Dynomene latreillii* Eydoux & Souleyet, 1842 (see Discussion under *D. hispida*).

DEPTH. — Depth range is intertidal to approx. 50 m, with most specimens coming from the intertidal or shallow subtidal depths.

DISCUSSION. — A. MILNE EDWARDS (1879) described this species using a male and a female specimen, but he did not designate a type specimen. The measurements given first are those of the male and it is this specimen which is figured, so the male should be regarded as the type. The eight specimens which remain are contained in two tubes (MNHN-B 7029 and B 22075). The description given above is based on the female specimen, CW = 10.2 mm, CL = 8.1 mm (MNHN-B.7029) which has the label "*Dynomene praedator* A. M. Edwards, Nouvelle Caledonie. Coll. A. Milne Edwards, 1903". These dimensions are very close to those given by A. MILNE EDWARDS (1879) for the female specimen that he mentions so it is likely that this is the female paratype. The other tube (MNHN-B 22075) labeled "*Dynomene praedator* A. M. Edwards N. Caledonie BALANSA 1873. 1900" contains 7 specimens (5 males and 2 females). The largest male is CW = 9.6 mm and the largest female is CW = 9.8 mm. This large male is smaller than the one mentioned by A. MILNE EDWARDS (1879) which measured 13 x 10 mm (figured on his plate 14). The figures in plate 14 show a dismembered thorax so it is possible that the type male no longer exists. In fact, apart from the largest male and female, most of the original material from New Caledonia consisted of immature specimens. One other specimen, a female of CW = 9.6 mm (MNHN-B 22076), may also belong to the New Caledonian series collected by M. BALANSA but the tube includes a label stating "BALSS det." and there are no other details available.

Dynomene sinensis Chen, 1979 was erected for a small male and a small female collected from the Xisha Ids. Later, *Dynomene tenuilobata* Dai *et al.*, 1981 was erected for a small male from the same area. Then again *Dynomene huangluensis* Dai, Cai & Yang, 1996 was created for one small female and four small males from the Nansha Ids (10°50'N, 114°10'E), South China Sea. The characters used to separate these species from each other and from other *Dynomene* species, especially *D. praedator*, were number of lobes on the carapace anterolateral border, proportions of the cheliped manus and male pleopods (see CHEN, 1979, fig. 1, 5-6; DAI *et al.*, 1981, figs 8-9; DAI *et al.*, 1986, fig. 12, 3-4; DAI & YANG, 1991, fig. 12, 3-4 and DAI, CAI & YANG, 1996, fig. 1). All the cheliped characters are sexually dimorphic and allometric, changing with size, and therefore subject to variation within each species and therefore clearly unsuitable for species definition. The overall appearance of these three species is very close to that of *D. praedator* and the male pleopods of *D. tenuilobata* and *D. huangluensis* are identical to those described above. Furthermore, the development of lobes or granules on the anterolateral margin of *D. praedator* is variable and, as noted above, it is the absence of distinct teeth on the anterolateral margin that

separates this species from *D. hispida*. All three species from the Xisha and Nansha Ids must be regarded as synonyms of *D. praedator*.

When studying the dynomenids from the Palau Ids, TAKEDA (1973) recorded both *Dynomene hispida* and *D. praedator*. He noted that in *D. hispida* ".. the anterolateral teeth are more prominent, regular and equidistant,..." than in *D. praedator*, where "..the anterolateral border is provided with five obtuse teeth...". Furthermore, he mentions that "In the smaller specimens from the Ryukyu Ids those teeth are spine-tipped". It is likely that these small specimens may be *D. hispida* rather than *D. praedator*.

In identifying *Dynomene praedator* it is important to realize that the tomentum does not completely obscure the body surface. SAKAI (1976) synonymized *Metadynomene tanensis* (Yokoya, 1933) with *D. praedator* but this was based on a misinterpretation of the nature of the tomentum. Further problems have arisen because of the somewhat inaccurate description and figures given by A. MILNE EDWARDS. This led CHEN (1979) to describe a new species, *Dynomene sinensis*, from the Xisha Ids, China. CHEN recognized the similarity of her specimens to *D. praedator* but believed that there were differences in the anterolateral margin, merus of the third walking leg, and dentition of the cheliped fingers. A close examination of a series of eight specimens from the type locality of *D. praedator* shows that the arrangement of tubercles on the anterolateral carapace margin is variable on the two sides of the carapace and also between specimens. It is not easy to ascertain the supposed differences in respect of the merus of the third walking leg, but cheliped dentition is variable: in the female, the dactyl typically has two teeth and the fixed finger only one, but these may be located proximally or distally; in males, the dactyl usually has one tooth, but the fixed finger can have either one or two teeth (these can be different between left and right limbs) and these may be located proximally or distally. The basal tooth on the fixed finger (well illustrated by A. MILNE EDWARDS, 1879, pl. 14, fig. 3) only occurs in males and does not develop until the size reaches about CW = 10.0 mm. The redescription given above, based on the same material as used by A. MILNE EDWARDS (1879), shows that there are in fact no significant differences between the Chinese and the original specimens from New Caledonia. The cheliped dentition characters are variable and in some cases attributable to ontogenetic variation. Therefore *D. sinensis* must be regarded as a synonym of *D. praedator*.

The branchial formula is the same and the gill structure of *Dynomene praedator* is very similar to that of *D. hispida* with most of each arthrobranch and pleurobranch consisting of violin-shaped plates on each side of the gill axis but with epibranchial lobes separating the plates proximally. For other features of *D. praedator* not illustrated here, see ORTMANN (1892, pl. 26, fig. 3i) for the second maxilliped and CHEN (1979, fig. 1, 4) and DAI, CAI & YANG (1996, fig. 1,1) for the third maxilliped (as *D. sinensis* and *D. huangluensis* respectively). As in *D. hispida*, the posterior margin of the scaphognathite bears two long setae which extend back over the epibranchial surface of the gills, and the hypobranchial margin of each podobranch is setose.

The original description of *Dynomene praedator* by A. MILNE EDWARDS (1879) did not include a comparison with the setae of *D. hispida*. The setae of *D. praedator* differ in several ways: there is no proximal smooth region at the base of the setae and the distal "dense band" consists of only a dozen or so long stout setules directed almost at right angles. In other respects the two species are similar.

There are some differences in the male pleopods between *Dynomene praedator* and *D. hispida*: both species have five inset subterminal spines on the second pleopod but in *D. praedator* these spines are curved instead of straight; there are three larger curved, terminal spines in *D. praedator*, with the last two forming a "pince-like" structure, but in *D. hispida* there are only two hooked spines which do not form a "pince"; finally, the rudimentary last three pairs of pleopods are uniramous in *D. praedator* but biramous in *D. hispida*.

Detailed illustrations of sexual dimorphism of the last leg of *Dynomene praedator* have not previously been published. In most respects the structure of the obsolete subchelate mechanism in *D. praedator* is similar to that of *D. hispida* except that the female has a much larger number of spines on the dactyl while in the male the teeth on the propodal spines are better developed and the area of rasp-like teeth near the base of the propodal extension is absent. Observations of living *D. praedator* from Hawaii (see below) suggest that the last leg is carried horizontally above the bases of the preceding legs and is only capable of a very restricted range of movements. The limb cannot be placed in a subdorsal position over the posterolateral corner of the carapace and cannot reach under the legs or under the abdomen. When the other legs move the last legs also move in an anterior-posterior direction

to a very limited extent. There is no evidence that the last legs are capable of carrying pieces of camouflage or that they could be used for grooming or cleaning.

Dynomene praedator has been collected from reefs on corals such as *Pocillopora damicornis*, *P. elegans*, *Pocillopora* sp., *Acropora* sp., *Porites* sp., and from the crustose alga *Amphiroa foliacea*. The specimens collected by B. RICHER DE FORGES from the McDonald volcanic seamount came from near the top of this active volcano where there are no corals and only fresh volcanic rocks and gravels. For discussion of the co-occurrence of *D. praedator* and *D. hispida* in *Pocillopora* corals see Discussion under the latter species.

A male specimen from Somalia contained a bopyrid parasite which is a new species of *Gigantione* (Daniel ADKISON, pers. comm.). It is similar to the bopyrid specimens from *Petalomera pulchra* Miers, 1884 (from the Chesterfield Ids, see McLAY, 1993: 166) which are being described by John MARKHAM as a new species of the same genus. Both these new species are similar to *G. mortenseni* Adkison, 1984 which is known from *Cryptodromiopsis antillensis*, *Hypoconcha sabulosa*, and *H. spinosissima*.

With the help of Ron HOLCOM, who video-taped *Dynomene praedator* in its natural habitat and in an aquarium in Hawaii, I have been able to study the feeding behaviour of this dynomenid. During feeding the antennules are especially active and are periodically cleaned by the third maxillipeds. There are two modes of feeding: firstly, grazing algal covered rocks using the chelipeds to pick up food items, and secondly sifting through sand to remove organic material. The latter feeding method is performed while the crab hangs upside-down from a rock or coral with its third maxillipeds very close to the sand. One cheliped is used to shovel sand to the outer maxillipeds which pick it up and sift out organic material using the setose palps and inner margins. Then the sand is pushed aside using the other cheliped. In this way sand is moved across the mouth-field and the food extracted from it. Examination of the stomach contents of four *Dynomene praedator* from Hawaii, ranging in size from 8.6 x 7.3 to 12.0 x 9.8 mm (two males and two females, BPBM 3780 and 4312), revealed unidentifiable soft organic material and sand grains. The stomach contents of crabs, caught at a different time, confirm the observed feeding behaviour and suggest that separation of organic material from sand (deposit feeding) is the main mode of feeding.

Dynomene filholi Bouvier, 1894

Figs 3 e, 5 c, 8 c, 11, 17 c, 20 a-g

Dynomene filholi Bouvier, 1894: 6; 1896: 57, figs 22-23. — A. MILNE EDWARDS & BOUVIER, 1900: 5, pl. 3 (col.), fig. 3, pl. 8, figs 1-18. — ALCOCK, 1901: 75 (list). — ORTMANN, 1899, pl. 119, fig. 11. — IHLE, 1913: 92 (list). — BALSS, 1921: 47. — BOUVIER, 1922: 50. — MONOD, 1956: 76, figs 84-88, 873. — FOREST & GUINOT, 1966: 48. — MANNING & HOLTHUIS, 1981: 23. — FRANSEN, 1991: 93.

MATERIAL EXAMINED. — **Cape Verde Islands**. *"Talisman"*: no stn number, îlot Branco, 60 m, July 1883: 1 ♂ 14.6 x 12.0 mm (used as the basis for the description and illustrated by A. MILNE EDWARDS and BOUVIER, 1900, see Discussion below); 2 ♀ 6.3 x 5.1, 7.2 x 5.9 mm (one of these specimens was listed as a male by A. MILNE EDWARDS and BOUVIER, 1900) (MNHN-B 22080); 1 ♀ 4.0 x 3.6 mm (ZMUC). — Stn 103, near la Praya, red coral banks, 275-150 m, 23.07.1883: 1 ♀ 8.7 x 7.0 mm (used for describing the color) (MNHN-B 22087). — Stn 107, about 16°56'N, channel between Saint Vincent and Saint Antoine, 75 m, 29.07.1883: 6 ♂ 3.6 x 3.3 - 9.4 x 7.8 mm; 1 ♀ 4.9 x 4.0 mm; 1 ♀ ovig. 5.8 x 4.9 mm (MNHN-B 22081); 2 ♂ 5.4 x 4.8, 6.8 x 5.0 mm (MNHN-B 22083); 1 ♀ 6.4 x 5.2 mm (ZMUC).

IFAN (Institut Français d'Afrique Noire): N Maio Id, 42 m, J. CADENAT coll., 11.06.1955: 1 ♀ 3.8 x 3.6 mm. (MNHN-B 22079).

CANCAP: stn 6.069, 15°52'N, 13°00'W, 76-90 m, 13.06.1982: 1 ♂ 7.5 x 5.8 mm. — Stn 7.125, 16°36'N, 24°36'W, 85-130 m, 1.09.1986: 1 ♀ 10.0 x 8.7 mm (RMNH) (see FRANSEN, 1991).

Guinea Bissau. *"Gazelle"*: 10°60'N, 17°16'W, 274 m, 1.08.1874: 1 ♂ 8.5 x 7.0 mm (ZMB 16722).

Gulf of Guinea, Annobon Island. *"Calypso"*: stn 52, 1°27.5'S, 5°36.5'E, 35 m, 13-06-1956: 1 ♂ 6.8 x 5.9 mm (MNHN-B 22085) (reported as a female by FOREST & GUINOT, 1966). — Stn 107, 1°26.15'S, 5°35.40'E, 60 m, 4.07.1956: 1 ♀ 5.6 x 4.5 mm (MNHN-B 22082) (see FOREST & GUINOT, 1966: 48).

ANNOBON 3: Drague 2, 1°28.40'S, 5°35.50'E, 40 m, A. CROSNIER coll., 11.12.1965: 1 megalopa 3.2 x 3.2 mm (MNHN-B 22090). — Drague 3, 1°25.30'S, 5°39.00'E, 52 m, A. CROSNIER coll., 11.12.1965: 2 ♂ 8.4 x 7.0, 8.6 x 6.8 mm; 2 ♀ 8.0 x 6.6, 9.2 x 7.6 mm; 1 ♀ ovig. 10.5 x 8.2 mm. (MNHN-B 22092).

ANNOBON 5: chalutage au sud de l'île Annobon, 1°28.50'S, 5°37.50'E, 35-55 m, F. POINSARD coll., 16.06.1967: 3 ♂ 6.0 x 5.0 - 10.2 x 7.7 mm; 1 ♀ 8.0 x 6.5 mm; 1 ♀ ovig. 10.4 x 8.0 mm. (MNHN-B 22093)

Gulf of Guinea, Principe Island. *"Calypso"*: stn 86, 1°35'N, 7°28'E, 45 m, 26-06-1956: 2 ♂ 9.4 x 7.3, 10.9 x 8.6 mm; 3 ♀ 6.9 x 5.4 - 9.2 x 7.0 mm (MNHN-B 7028). — Stn 95, 1°38.35'S, 7°21.35'E, 35 m, 1956: 1 ♂ 12.3 x 9.9 mm (MNHN-B.22084) (see FOREST & GUINOT, 1966: 48).

TYPES. — The specimen dissected by BOUVIER in 1894 for describing the gills cannot be found and very likely has disappeared. So I designate as neotype the male 14.6 x 12.0 mm collected near îlot Branco, Cape Verde Islands, 60 m, in July 1883, registered at the Paris Museum under MNHN-B 22080, which was chosen by A. MILNE EDWARDS and BOUVIER amongst the 28 specimens collected by the *"Talisman"* at the Cape Verde Islands, as the basis of the first complete description of the species.

DESCRIPTION. — Carapace wider than long (CW/CL = 1.2 approx.), broadly rounded in outline but frontal and posterior margins truncated, surface smooth and quite convex. Carapace surface and pereopods covered with coarse, plumose setae of two lengths: short setae clothing surface, but interspersed with slightly longer setae (0.07 x CW) which also fringe limbs and tend to be arranged in clumps, especially on carapace where there are about twenty distinct tufts. Density of setae is not sufficient to completely obscure body surface. Structure of short and long setae is different. In short setae the proximal 35% of shaft has very short setules, then a region occupying about 25% where long, stout setules are directed almost at right angles to shaft, forming a dense bunch, then the next 30% which bears a brush of long fine setules on only one side, and finally the distal 10% which is smooth, slightly curved, and narrows to an acute tip. In long setae the proximal 25% is sparsely setose, 70% is covered with small setules which distally increase in density, but not in size, and last 5% is smooth, slightly curved and narrows to an acute tip.

A shallow frontal carapace groove separates a pair of low rounded protuberances, and then divides into separate grooves which gradually become more faint. Just in front of cardiac region two laterally-directed grooves originate: the first groove (cervical) arises separately from small pits curving (slightly sinuously) anteriorly on to branchial region, while the second groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally, bordering anterior cardiac region. In effect the groove crossing the mid-line, connects two crescent-shaped grooves. Mid-way along cardiac groove begins a faint branchial groove which runs towards base of last tooth on lateral margin. Posterior cardiac area is outlined by a faint groove. Anterolateral carapace margin begins at level of postorbital corner, evenly convex and bears four distinct, broad-based, equidistant teeth, each ending in a short spine; first two teeth directed anteriorly and last two directed more laterally. Near beginning of posterolateral border there is another smaller tooth without a terminal spine. Posterior carapace margin is recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates the orbits). Supraorbital margin not projecting, continuous above orbits with a small notch closer to postorbital corner, without granules; suborbital margin essentially straight, but terminating as a subacute tooth. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral region; distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth above opening of antennal gland is smaller. Second article wider than long; distal margin widest, to which is fixed the exopod curving over base of eyestalk and becoming broader and terminating bluntly. Third antennal article is longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and together with small fourth article just matches length of the exopod. Remaining antennal articles are directed laterally, extending well beyond postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.45. Eyestalk can be completely folded into orbit, and cornea is well developed, occupying all of tip. Epistome broadly triangular, surface concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace marked by a narrow suture.

Subhepatic area slightly convex. A groove begins near base of the antenna, curving round under branchial region, giving off a cervical groove which passes under base of second anterolateral tooth, and meeting lateral

carapace margin just anterior to tooth on posterolateral border and connecting with branchial groove. Third maxillipeds operculiform; bases widely separated by tip of sternum. Crista dentata has six or seven well developed, distally placed teeth on each side. [BOUVIER (1896, fig. 23) and A. MILNE EDWARDS and BOUVIER (1902, pl. 8, figs 1-18) figure some of mouthparts.] Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

Branchial formula 19 gills + 7 epipods on each side. There is no podobranch on fifth pereopod. In cross section gills have the lateral margin deeply notched, dividing gill into a hypobranchial plate (containing efferent vessel) and an epibranchial lobe (anterior lobe longer). Between these marginal lobes are two pairs of lobes, first similar and second much shorter than marginal lobes. Thus the epibranchial surface shows six rows of blunt lobes, decreasing in size medially, which are arranged above the afferent blood vessel.

Cheliped stout (especially in male) only slightly longer than first leg; merus trigonal, inner face smooth and fitting closely against pterygostomial region of carapace, borders with a few small granules, outer face has a subterminal broad, restriction which separates a thickened ridge on which there are three small blunt granules. Outer face of carpus convex with three small granules, two more prominent tubercles on distal margin, inner superior border with a flattened, distomedially directed, spur which abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, the inferior carpal margin is produced as a smooth obtuse flange fitting against merus when limb is withdrawn. These two structures give the carpal article an unusual and distinctive shape. Transverse section of propodus decreases in area distally; outer and superior faces with very small granules which tend to be arranged in two or three longitudinal rows; inner and inferior faces smooth. Fixed finger almost straight with six teeth increasing in size distally; moveable finger curved with four teeth, first mid-way and separated from the remainder which are on tip; both fingers, thick, hollowed out internally, touching only at tips where teeth interlock. Just below proximal teeth on fixed finger are two distinct pits in which several long setae are inserted with a group of similar setae on inner margin. Groups of long stiff setae, inserted near base of dactyl and fixed finger, are directed across space between the two fingers. Collectively, these setae form a sieving screen.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with two or three small granules, length of merus of second leg about 1.7 times its width and equal to almost a half of CL. Dorsal surface of carpi bearing three small granules on anterior margin and two on posterior margin, and produced distally to overhang base of propodi. Dorsal surface of propodi smooth. Dactyli curved, inferior margin armed with 5-6 small spines, tip brown and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching only as far as two-thirds along meral article of preceding limb; borders of articles unarmed. Last pair of legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing four, unequal, stout, acute, spines each lined with tiny flattened teeth along almost the entire inner surface. Female dactyl as long as propodal extension, bearing eight unequal, stout, hooked spines (arranged asymmetrically around perimeter of dactyl) whose inner surface is concave, wrinkled and devoid of teeth. Male propodal extension bearing two unequal hooked spines without teeth. Male dactyl longer than propodal extension, bearing a single spine on lateral margin and ending in an acute claw.

All segments of abdomen freely moveable, increasing in length and breadth distally; surface smooth; margins unarmed but fringed with long setae. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In female uropod plates are large, filling about two thirds of space between last abdominal segment and telson, excluding most of last abdominal segment and telson from reaching lateral margin of abdomen. In male last abdominal segment occupies about a half of length. No effective abdominal locking mechanism: abdomen only loosely held against sternum in all sizes of both sexes. In mature female it occupies all the ventral surface, covering coxae of all pereopods with telson covering proximal half of third maxillipeds. In male the abdomen is not quite so broad and telson only extends as far as bases of third maxillipeds.

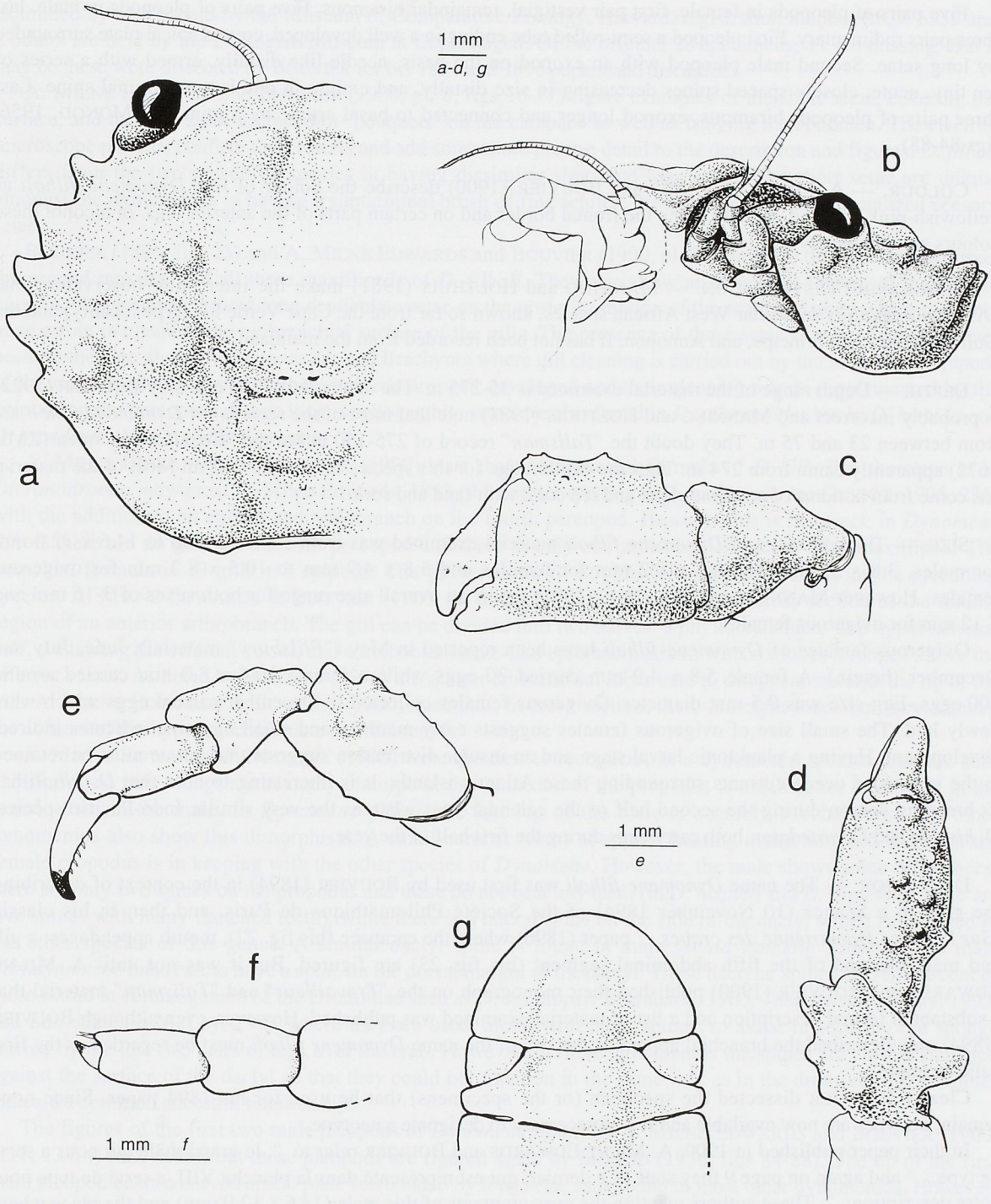


FIG. 20. — *Dynomene filholi* Bouvier, 1894: **a-g**, ♂ 12.3 x 9.9 mm, Principe Island, Gulf of Guinea, *"Calypso"* (MNHN-B 22084): **a**, dorsal view of left half of carapace; **b**, ventral view of left orbital area; **c**, outer face of left cheliped; **d**, dorsal view of left cheliped; **e**, posterior view of terminal articles of left fourth pereopod; **f**, posterior view of terminal articles of left fifth pereopod; **g**, ventral view of telson and terminal segments of male abdomen.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. Five pairs of pleopods in male, last three pairs rudimentary. First pleopod a semi-rolled tube ending in a well developed, curved apical plate surrounded by long setae. Second male pleopod with an exopod on the basis, needle-like distally, armed with a series of ten tiny, acute, closely spaced spines decreasing in size distally, and ending in one larger terminal spine. Last three pairs of pleopods biramous, exopod longer and connected to basal article by a joint (see MONOD, 1956, figs 84-88).

COLOUR. — A. MILNE EDWARDS and BOUVIER (1900) describe the colour of live *Dynomene filholi* as yellowish-pink with red, notably along the frontal border and on certain parts of the anterior legs. In alcohol these colours are completely lost.

GEOGRAPHIC DISTRIBUTION. — MANNING and HOLTHUIS (1981) make the interesting observation that *Dynomene filholi* is an insular West African species, known so far from the Cape Verde Ids (type locality) and the Gulf of Guinea Ids, Principe, and Annobon. It has not been recorded from the mainland.

DEPTH. — Depth range of the material examined is 35-275 m. The depth of 1477 m given by BOUVIER (1922) is probably incorrect and MANNING and HOLTHUIS (1981) note that most of the records for *Dynomene filholi* are from between 23 and 75 m. They doubt the *"Talisman"* record of 275-150 m but the *"Gazelle"* specimen (ZMB 1672) apparently came from 274 m. Thus the depth range for this species is from 35-275 m. Most of the material has come from bottoms of coralline algae and red coral with sand and rock.

SIZE. — The size range of *Dynomene filholi* material examined was from 3.6 x 3.3 mm to 14.6 x 12.0 mm for males, 3.8 x 3.6 mm to 10.5 x 8.2 mm for females and 5.8 x 4.9 mm to 10.5 x 8.2 mm for ovigerous females. However MANNING and HOLTHUIS (1981) report an overall size range for both sexes of 3-16 mm and 7-12 mm for ovigerous females.

Ovigerous females of *Dynomene filholi* have been reported in May (*"Pillsbury"* material), June, July and December (herein). A female 5.8 x 4.9 mm carried 30 eggs while a female 10.4 x 8.0 mm carried around 300 eggs. Egg size was 0.5 mm diameter. Ovigerous females collected in December carried eggs which were newly laid. The small size of ovigerous females suggests early maturity and small egg size indicates indirect development. Having a planktonic larval stage and an insular distribution suggests that larvae must be retained in the system of ocean currents surrounding these Atlantic islands. It is interesting to note that *D. filholi* has its breeding season during the second half of the calendar year whereas the very similar Indo-Pacific species, *D. hispida* and *D. praedator,* both carry eggs during the first half of the year.

DISCUSSION. — The name *Dynomene filholi* was first used by BOUVIER (1894) in the context of describing the gills to a Séance (10 November 1894) of the Société Philomathique de Paris, and then in his classic *"Sur l'origine Homarienne des crabes..."* paper (1896) where the carapace (his fig. 22), mouth appendages, a gill and male pleopod of the fifth abdominal segment (his fig. 23) are figured. But it was not until A. MILNE EDWARDS and BOUVIER (1900) published their monograph on the *"Travailleur"* and *"Talisman"* material that a substantial formal description and a list of material examined was published. However, even although BOUVIER (1894) only described the branchial apparatus, his use of the name *Dynomene filholi* must be regarded as the first valid example.

Clearly BOUVIER dissected the specimen (or the specimens) that he used for his 1894 paper. Since none remain, no types are now available and it was necessary to designate a neotype.

In their paper published in 1900, A. MILNE EDWARDS and BOUVIER refer to "..le grand mâle qui nous a servi de type,..." and again on page 9 they state "Ce dernier, qui est représenté dans la planche VIII, a servi de type pour notre description;..". These authors mention the measurements of this male (14.6 x 12.0 mm) and the place where it was collected (Cape Verde Islands, îlot Branco, 60 m). This male specimen is registered under MNHN-B 22080, along with two females. It is this male that I designate as neotype.

According to the list published by A. MILNE EDWARDS and BOUVIER, 28 specimens of *D. filholi* were collected by the *"Talisman"* from 4 stations. Only 14 remain at the Paris Museum. One from the station 107 (not

examined by me) is held by the Museum of Comparative Zoology, Harvard, registration number MCZ 6559 and 2 others are held by the Zoologisk Museum at Copenhagen. Of the original 28 specimens, 11 are missing. But it may be these were dissected by BOUVIER for his 1894 and 1896 papers and discarded.

A. MILNE EDWARDS and BOUVIER (1900, pl. 8, figs 16-17) figure examples of the short setae, covering the surface, and the long setae arranged in "bouquets" on the carapace as well as fringing the abdomen. The electron microscope pictures confirm their results and add some more precise detail to the description and figures. *D. filholi* differs from the two preceding species in having dissimilar short and long setae. The short setae are unique amongst the dynomenids in having a subterminal brush of fine setules. Presumably these are specialized sensory setae.

BOUVIER (1896, fig. 23) and A. MILNE EDWARDS and BOUVIER (1900, pl. 7, figs 1-18) describe and illustrate the second maxilla, and all three maxillipeds of *D. filholi*. They also show an important feature of the second maxilla: the presence of three long denticulate setae on the posterior margin of the scaphognathite which probably have a role in cleaning the epibranchial surface of the gills. The presence of these setae is a primitive character because they are absent in the more derived Brachyura where gill cleaning is carried out by the long setose epipods of the maxillipeds. In *D. filholi* these epipods are well developed and their cleaning role is supplemented by the epipods on the pereopods. Three long scaphognathite setae are also found in *D. pilumnoides* but in *D. hispida* and *D. praedator*, there are only two setae.

A. MILNE EDWARDS and BOUVIER (1900) state that the branchial formula of *D. filholi* is the same as in *Dicranodromia mayheuxii* A. Milne Edwards, 1883 (the correct spelling is *D. mahieuxii*, see GUINOT, 1995, 236) with the addition of an epipod and podobranch on the fourth pereopod. However this is incorrect: in *Dynomene filholi* there are no gills on the fifth pereopod and there is only one arthrobranch on the third maxilliped. The branchial formula is 19 gills + 7 epipods. The gill structure of *D. filholi* is very different from the preceding species. A. MILNE EDWARDS & BOUVIER (1900, pl. 8, fig 18) provide an accurate cross section of the middle region of an anterior arthrobranch. The gill can be divided into two halves: a phyllobranchiate-like hypobranchial half, containing the efferent vessel, and a trichobranchiate-like epibranchial half, with six lobes arranged above the afferent vessel. As noted by BOUVIER (1896) the shorter epibranchial lobes tend to disappear towards the tip of the gill. A. MILNE EDWARDS & BOUVIER (1900) state that, in cross section, there are eight lobes but they counted the corners of the hypobranchial plate as "filaments".

A. MILNE EDWARDS & BOUVIER (1900) were the first to recognize, in a dynomenid species, that the subcheliform last pair of legs are sexually dimorphic: the extension of the propodus is much better developed in the female than in the male. In *Dynomene filholi* the last leg of the male is scarcely subcheliform. All other dynomenids also show this dimorphism. A small number (four) of spines, bearing many flattened teeth, on the female propodus is in keeping with the other species of *Dynomene*. However, the male shows some differences: there are only two spines on the propodus and these do not bear any teeth (in *D. hispida* and *D. praedator* there are five spines with many flattened teeth), while there is a lateral spine on the side of the dactyl which is unarmed in the other species of this genus. A similar dactyl spine is found in male *Metadynomene tanensis* and male *Paradynomene tuberculata* have a spine on the dorsal margin of the dactyl. These dactylar spines are reminiscent of those found in certain genera of the Dromiidae such as *Dromidiopsis* Borradaile, 1900, *Tunedromia* McLay, 1993, and *Lauridromia* McLay, 1993 where they are used, along with other spines, to assist in securing the sponge carried by the last two pairs of legs over the crab. However, in these dynomenids the spines are closely flattened against the surface of the dactyl so that they could not function in the same way as in the dromiids. These spines indicate a common ancestral relationship.

The figures of the first two male pleopods of *Dynomene filholi* by A. MILNE EDWARDS and BOUVIER (1900, pl. 7, 13-14) lack detail, but these pleopods are figured again by MONOD (1956, figs 84-88). The tip of the first male pleopod bears a curved apical plate surrounded by long setae as is found in most other dynomenids. However, MONOD's figures show that the second pleopod is armed with twice the number of subterminal spines seen in *D. hispida* and *D. praedator*, but there is only one long terminal spine. MONOD (1956, fig. 88) is inaccurate in the number of subterminal spines because it shows more than are there. BOUVIER (1896, fig. 23, V) includes a figure of one of the fifth pair of rudimentary male pleopods showing that it is biramous. There are two unequal lobes shown but one lobe (endopod) is an extension of the penultimate article while the other lobe (exopod) is

separated by a joint. If the shorter inner lobe is regarded as the endopod then it must be assumed that fusion has occurred and the joint has been lost. The same situation is found in *D. hispida* and *D. pilumnoides*.

Examination of the stomach of a *Dynomene filholi* male 10.9 x 8.6 mm (MNHN-B 7028) from Principe Id, Guinea Gulf, revealed unidentifiable soft particulate organic fragments and some soft calcareous granules. The groups of stiff setae on the cheliped fingers may act as a sieving device for collecting food particles.

Dynomene filholi is most similar to *D. pilumnoides* (see Discussion below under the latter species). Since *D. filholi* is the only species of this genus inhabiting the Atlantic it is interesting to speculate about its origins. It seems to be a reasonable assumption that species of the genus *Dynomene* originated in the Tethys Sea so that the ancestors of *D. filholi* were Tethyan crabs. A southern colonization route for these crabs could have been available as early as the Upper Cretaceous (90-80 mybp) or sometime thereafter. *D. pilumnoides* has been recorded from the coast of Natal although no further south than this. At least at present there does not seem to be a dispersal route via the Cape because it is blocked by the local oceanic circulation pattern. This self-contained circulation pattern seems to have been in existence for a considerable time because there is a suite of endemic South African dromiid genera and species (see McLAY, 1993) which have been isolated perhaps since the Upper Cretaceous or Palaeocene (65 mybp). This interpretation requires that the Atlantic colonization by *Dynomene* must have been during the late Mesozoic or very Early Tertiary.

Dynomene pilumnoides Alcock, 1900

Figs 3 c-d, 8 d-e, 11, 12 e-f, 14 c, 17 d, 21 a-g

Dynomene pilumnoides Alcock, 1900: 133; 1901: 35, pl. 1, fig. 2. — STEBBING, 1905: 58 (list). — BARNARD, 1947: 371; 1950: 337, fig. 65 a-c. — SAKAI, 1965: 12, pl. 6, fig. 2; 1976: 29, pl. 6, fig. 3. — GUINOT, 1967: 242 (list). — SERÈNE, 1968: 37 (list). — PEYROT-CLAUSADE & SERÈNE, 1976: 1344 (key). — TAKEDA, 1977: 35 (list). — SERÈNE & VADON, 1981: 121. — KENSLEY, 1981: 37 (list). — MIYAKE, 1983: 11, pl. 4, fig. 2, 195 (list). — BABA, HAYASHI, & TORIYAMA, 1986: 310, fig. 163. — GARTH, HAIG & KNUDSEN, 1987: 241. — NAGAI, 1989: 43.
Maxillothrix actaeiformis Stebbing, 1921: 457, pl. 14 (Crust. pl. 109).
Dynomene hispida - YOKOYA, 1933: 95, text-fig. 37. Non Guérin-Méneville, 1832.
Dynomene actaeiformis - SERÈNE, 1968: 37 (list). — TAKEDA, 1977: 35 (list).

MATERIAL EXAMINED. — **Madagascar**. *"Vauban"* (A. CROSNIER coll.). *N.W. coast*: 12°41.50'S, 48°17.00'E, dredge, 160-170 m, 1.08.1973: 1 ♀ 14.6 x 12.0 mm; 1 ♀ ovig. 13.7 x 12.0 mm (MNHN-B 6913). — *W coast*: Dredge, about 18°50'S, no depth, 24.02.1973: 1 ♂ 10.0 x 8.2 mm (MNHN-B 6914). — *S.E. coast*: stn 72, 25°09.0'S, 17°14.2'E, 80-85 m, 3.03.1973: 1 ♀ 8.7 x 7.4 mm; 1 ♀ ovig. 10.0 x 8.3 mm. (MNHN-B 6904). — Fort-Dauphin, 90 m, no date: 1 ♂ 8.1 x 6.8 mm; 1 ♀ 6.9 x 6.2 mm (MNHN-B 6858).

Reunion. No locality, no depth, S. RIBES coll., no date: 1 ♂ 11.8 x 10.1 mm (MNHN).

Australia. *New South Wales*: Port Stephens, 32°42'S, 152°6'E, no depth, no date: 1 ♂ 17.2 x 14.1 mm (small balanomorph barnacle on dorsal surface of carapace); 1 ♀ ovig. 14.8 x 12.0 mm (AMS-P 42233). — Crowdy Head, 31°54'S, 153°00'E, 100 m, K. J. GRAHAM coll., 17.08.1977: 3 ♂ 8.0 x 6.5 - 22.8 x 17.4 mm; 1 ♀ 14.4 x 11.4 mm (AMS-P 26583).

Indonesia. DANISH EXPEDITION KEI ISLANDS: stn 3, 5°32'S, 132°36'E, 245 m, Th. MORTENSEN coll., 31.03.1922: 1 ♂ 10.0 x 8.9 mm (ZMUC).

Philippines. *"Pele"* (B. R. WILSON coll.). *Sulu Archipelago*. Pearl Bank: 3.2 km and 349° from Zal Id, 18 m, 22.02.1964: 1 ♀ ovig. 9.5 x 7.5 mm (MNHN-B 10376). — 6.4 km and 212° from Zal Id, 90 m, 22.02.1964: 1 ♀ 7.8 x 6.6 mm (MNHN-B 10375). — 14.4 km and 242° from Zal Id, 99-108 m, 22.02.1964: 1 ♀ 14.6 x 11.7 mm; 1 ♀ ovig. 12.7 x 10.6 mm (MNHN-B 10374). — 4 km and 182° from Zal Id, 90 m, 22.02.1964: 1 ♂ 9.2 x 7.8 mm (MNHN-B 10483).

MUSORSTOM 1: stn 57, 13°53.10'N, 120°13.20'E, 107-96 m, 26.03.1976: 1 ♂ 7.2 x 5.8 mm (see SERÈNE & VADON, 1981 who reported the specimen as a female).

Japan. Honshu Mie-Ken Wagu: 34°04.00'N, 136°51.30'E, no depth, no date: 2 ♂ 24.4 x 19.6, 28.5 x 22.1 mm (SMF 17127).

East of Toshima: 34°59.5'N, 139°36.3'E, 93-95 m, 1991: 1 ♂ 6.4 x 5.6 mm. — 34°19.79'N, 139°01.37'E, 134 m, coll. M. OSAWA, 1993: 1 ♀ 7.1 x 6.0 mm.

Hawaii Islands. *"Albatross"*: stn 3823, south coast of Molokai, Lae-O Ka Laau Light, 21°02'10"N, 157°15'45"W, 142-406 m, 1.04.1902: 1 ♂ 6.9 x 5.7 mm (USNM).

New Caledonia. LAGON: stn 393 bis, 22°46.00'S, 167°4.00'E, 284 m, 22.01.1985: 1 ♂ 8.0 x 6.6 mm.

MUSORSTOM 4: stn 164, 18°33.2'S, 163°13.0'E, 255 m, 16.09.1985: 1 ♀ 19.2 x 15.5 mm. — Stn 227, 22°46.00'S, 167°20.00'E, 300 m, 30.09.1985: 1 ♀ 5.0 x 4.5 mm.

CHALCAL 2: stn DW 69, 24°43.70'S, 168°07.90'E, 260 m, 27.10.1986: 1 ♀ 4.8 x 4.0 mm. — Stn DW 70, 24°46.00'S, 168°09.00'E, 232 m, 27.10.1986: 1 juv. 5.4 x 4.5 mm; 1 ♂ 5.6 x 4.6 mm. — Stn DW 84, 23°23.80'S, 168°07.00'E, 170 m, 31.10.1986: 2 ♂ 6.3 x 5.2, 7.2 x 6.0 mm.

SMIB 3: stn 18, 23°41.50'S, 167°59.40'E, 338 m, 23.05.1987: 1 ♂ 23.5 x 19.0 mm.

SMIB 4: stn DW 40, 24°46.20'S, 168°8.70'E, 260 m, 7.03.1989: 1 juv. 4.2 x 3.8 mm.

VOLSMAR: stn DW 7, 22°26.00'S, 171°44.10'E, 400 m, 1.06.1989: 2 ♀ 4.6 x 4.2, 12.4 x 10.3 mm.

SMIB 5: stn DW 94, 22°19.60'S, 168°42.80'E, 275 m, 12.09.1989: 1 ♀ ovig. 20.7 x 17.6 mm.

SMIB 8: stn DW 163, 24°49.10'S, 168°08.90'E, 310-460 m, 28.01.1993: 1 ♂ 13.2 x 10.6 mm; 1 ♀ 7.8 x 6.5 mm. — Stn DW 175, 23°14.10'S, 168°00.40'E, 235-240 m, 29.01.1993: 1 ♀ 10.3 x 9.0 mm.

Lagon, récif Laregnère, 12-16 m, 3.05.1993: 1 ♀ 7.5 x 6.2 mm.

BATHUS 3: stn CH 801, 23°39.00'S, 168°00'E, 270-300 m, 27.11.1993: 1 ♀ 9.8 x 8.9 mm. — Stn DW 836, 23°02'S, 166°59'E, 295-306 m, 30.11.1993: 1 ♀ 6.7 x 5.9 mm.

BATHUS 4: stn DW 943, 20°12.28'S, 164°30.58'E, 347-316 m, 09.08.1994: 1 ♀ 8.2 x 6.8 mm.

SMIB 10: stn DW 209, 24°49'S, 168°09'E, 329-560 m, 10.01.1995: 1 ♂ 27.0 x 22.0 mm.

Loyalty Islands. MUSORSTOM 6: stn DW 423, 20°20.85'S, 166°40.50'E, 280 m, 16.02.1989: 2 ♀ 10.1 x 8.6, 10.3 x 8.7 mm. — Stn DW 451, 20°59.60'S, 167°24.50'E, 330 m, 20.02.1989: 1 ♂ 9.7 x 8.2 mm. — Stn DW 472, 21°8.60'S, 167°54.70'E, 300 m, 22.02.1989: 1 ♂ 8.1 x 7.0 mm.

TYPES. — *Dynomene pilumnoides* Alcock, 1900: holotype is a male 11.0 x 10.0 mm, collected by the *"Investigator"*, from 11°27'N, 73°1.00'E, off Kiltan Id, Laccadive Ids, 90-54 m, held by the Indian Museum, Calcutta, registration number 9000/6.

Maxillothrix actaeiformis Stebbing, 1921: holotype not designated from amongst the four specimens, based on the number of carapaces in the container (at least two males and one female according to STEBBING, 1921), collected by the SS *"Pieter Faure"* from off the coast of Natal, located NW by N 12.6 km from the Umhlangakulu River, north of Durban (approximate coordinates 29°44'S, 31°5'E), stn PF-12348, 90 m, 4.04.1901, held by the South African Museum, registration number SAM-A839. This type material is in poor condition (Liz HOENSON pers. comm.). Two syntypes are held by the British Museum, registration number 1928. 12. 1. 10. According to the index card there is one specimen and fragments of another but the material in the container is just a lot of fragments (Miranda LOWE, pers. comm.). Thus all of the original material is in very poor condition.

DESCRIPTION. — Carapace wider than long, ratio of CW/CL 1.20-1.25, broadly rounded in outline but frontal and posterior margins truncated, surface smooth, quite convex, with a few minute granules in branchial area. Carapace surface and pereopods densely covered with setae of two kinds: short plumose setae, bent at right angles near the tip, clothing surface, but interspersed with longer filiform setae (6 x length of short setae and 0.20-0.25 x CW) which also fringe limbs and arranged in clumps on carapace where there are about fifteen to seventeen distinct groups (each with up to about four setae) which tend to be associated with rounded surface elevations. Density of setae completely obscures body surface but most of this is attributable to short rather than long setae. Structure of short and long setae is different. In short setae proximal 45% of shaft has very short setules (at end of which setae are sharply angled), then a region occupying about 45% where long, stout setules are directed almost at right angles to shaft, forming a dense bunch, and finally the distal 10% of setae which is smooth, slightly curved, and narrows to an acute tip. In long setae almost entire length is covered with small dendritic setules, all about same size, and setae are acutely tipped.

A shallow frontal carapace groove separates a pair of low rounded protuberances, and then divides into separate grooves which gradually become more faint. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately from small pits curving (slightly sinuously) anteriorly on to branchial region, while second shallower groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally, bordering anterior cardiac region. In effect the groove crossing the mid-line, connects two crescent-shaped grooves. Branchial groove not evident. Posterior cardiac area not defined. Anterolateral carapace margin begins just below level of postorbital corner, is evenly convex and bears four distinct, broad-based, equidistant teeth, each ending in a small, acute spine, and accompanied by a tuft of long

setae. First two teeth directed anteriorly, third directed anterolaterally, and last directed more laterally. A posterolateral tooth, smaller than preceding anterolateral teeth, marks beginning of convergent posterolateral border alongside which lies the reduced last leg. Posterior carapace margin is recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supra-orbital margin not projecting, continuous above orbits, interrupted by a distinct notch closer to postorbital corner which is without granules; suborbital margin has a few small granules and angles towards an acute tooth (visible dorsally when setae are removed) then drops sharply into a notch before ending in a much smaller, blunt tooth at its inner corner. This tooth abuts second article of antenna. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region; distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth, above opening of antennal gland, is smaller. Second article wider than long; distal margin widest, to which is fixed the exopod curving over base of eyestalk and becoming broader and terminating bluntly. Exopod has a tuft of setae on its lateral margin. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and just matching length of exopod. Fourth antennal article smaller, as long as wide; remaining antennal articles directed laterally, extending well beyond postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.33. Eyestalk can be completely folded into orbit, and cornea is well developed, occupying all of tip. Epistome broadly triangular, surface slightly concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace marked by a narrow suture.

Subhepatic area smooth, very convex. A groove begins near base of the antenna, curving round under branchial region and meeting lateral carapace margin just anterior to last tooth at beginning of posterolateral border. A short cervical groove branches off and ascends towards gap between first and second anterolateral teeth, branching, with one branch meeting first anterolateral tooth ventrally and the other passing around behind second tooth. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has six or seven well developed, distally placed teeth on each side and a granulated border on outer margin. Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

Gill formula 19 gills + 7 epipods on each side, as found in *Dynomene hispida*. There is no podobranch on last pereopod. In cross section gills have the lateral margin deeply notched, dividing it into a hypobranchial plate (containing efferent vessel) and an epibranchial lobe (anterior lobe longer). Between these marginal lobes are a pair of lobes, similar to marginal lobes. Thus the epibranchial surface shows four rows of blunt lobes, decreasing in size from anterior to posterior side, which are arranged above afferent blood vessel. Hypobranchial setae poorly developed. Posterior margin of scaphognathite with three long setae. Hypobranchial margin of podobranchs bears same setae as on epipod.

Cheliped stout, much longer than first leg and stouter in the male, only slightly longer and stouter than first leg in the female; merus trigonal, inner face smooth and fitting closely against pterygostomial region of carapace, borders granulate, superior border has a subterminal broad, restriction which separates a thickened distal ridge, on which there are three small granules, from a row of three to five similar granules on superior border. Inner inferior margin of merus has an acute lateral spine distally which is especially prominent in large (CW > 20 mm) males where the spine forms a tooth which may itself be granulated. Outer face of carpus convex with six small granules, two more prominent acute tubercles on distal margin, inner superior border with a flattened, distomedially directed, spur (granulated in large males) which abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin is produced as a smooth obtuse flange fitting against merus when limb is withdrawn. These two structures give carpal article an unusual and distinctive shape. Outer face of propodus with two or three very small granules; superior face with three parallel rows of small granules; inner and inferior faces smooth, except that there is a small proximal spur on the inner propodal face. Fixed finger almost straight with six teeth increasing in size distally (large males have an additional basal tooth and some of the other teeth can be rudimentary); moveable

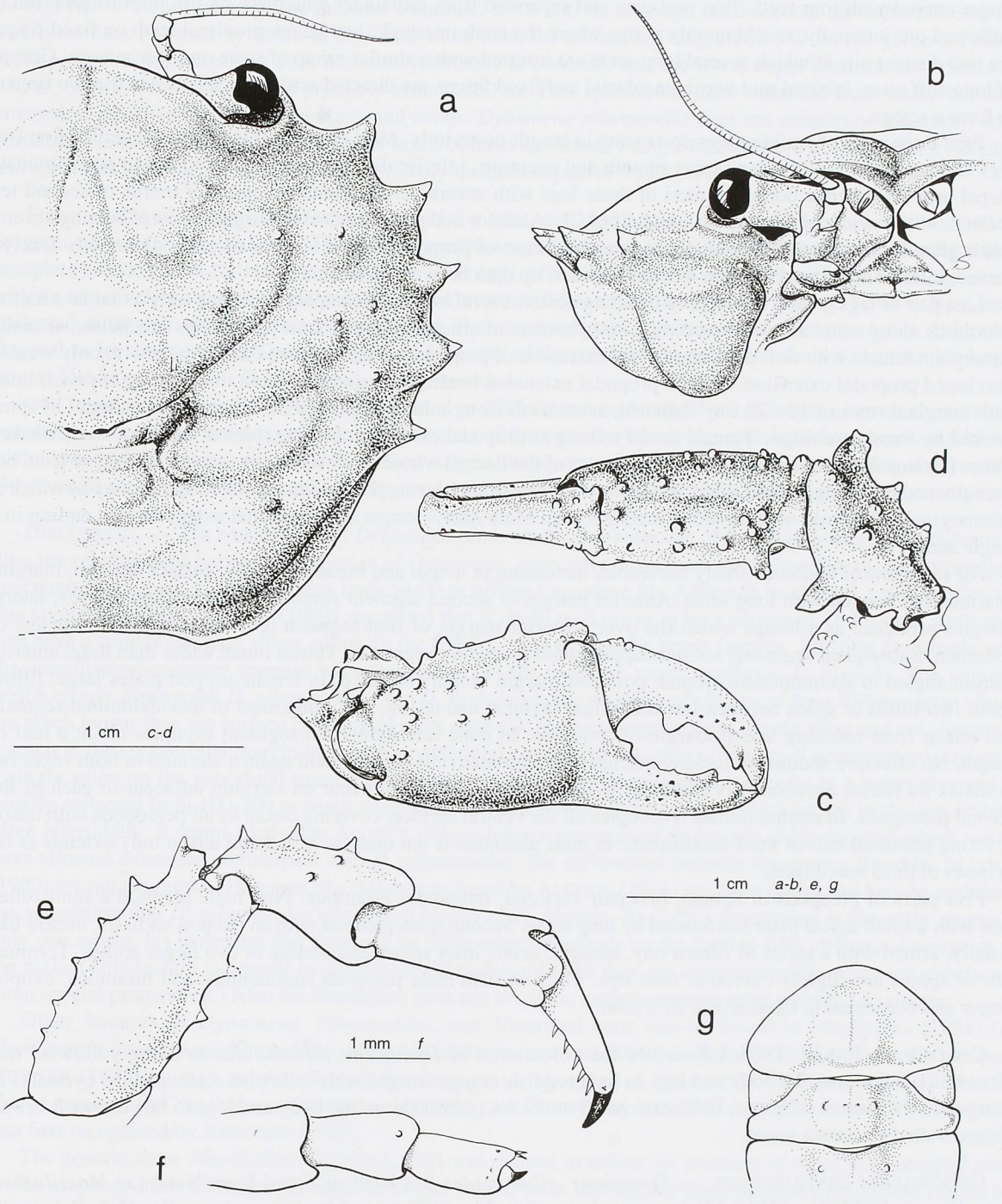


FIG. 21. — *Dynomene pilumnoides* Alcock, 1900: **a-g**, ♀ 14.6 x 11.7 mm, Sulu Archipelago, B. R. WILSON coll. (MNHN-B 10374): **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of female abdomen.

finger curved with four teeth, first mid-way and separated from remainder which are on tip; both fingers, thick, hollowed out internally, touching only at tips where the teeth interlock. Just below proximal teeth on fixed finger are two distinct pits in which several long setae are inserted with a similar group of setae on inner margin. Groups of long stiff setae, inserted mid-way along dactyl and fixed finger, are directed across space between the two fingers to form a screen.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with several small granules, length of merus of second leg about 2.0-3.0 x width and equal to about half of CL. Anterior and posterior dorsal margins of carpi bearing several small granules, and produced distally to overhang base of propodi. Dorsal surface of propodi smooth. Dactyli curved, inferior margin armed with 4-5 small spines, tip dark brown and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching only as far as a half to two-thirds along meral article of preceding limb; borders of articles unarmed. Last pair of legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing six, unequal, stout, hooked, spines each lined with marginal rows of 12 - 20 tiny flattened, acute teeth along middle region of inner surface, remainder of spine marked by transverse ridges. Female dactyl as long as propodal extension, bearing thirteen unequal, stout, hooked spines (arranged asymmetrically around perimeter of the dactyl) whose inner surface is smooth, devoid of teeth but strengthened by a longitudinal ridge. Male propodal extension bearing five unequal hooked spines, one of which is submarginal, all devoid of teeth along inner surface. Male dactyl longer than propodal extension and ending in a single acute claw.

All segments of abdomen freely moveable, increasing in length and breadth distally; surface smooth; margins unarmed but fringed with long setae. Anterior margin of second segment sinuous, medial region convex, lateral margins produced as a flange which fits over posterior margin of first segment preventing forward slippage of abdomen. Subsequent segments not overlapping with preceding segments. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In female uropod plates large, filling about two-thirds of space between last abdominal segment and telson, excluding most of last abdominal segment and telson from reaching lateral margin of abdomen. In male last abdominal segment occupies about a half of length. No effective abdominal locking mechanism: abdomen only loosely held against sternum in both sexes but in males its lateral movement is restricted by presence of a small tubercle on sternum adjacent to each of the second pereopods. In mature female it occupies all the ventral surface, covering coxae of all pereopods with telson covering proximal half of third maxillipeds. In male abdomen is not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. First male pleopod a semi-rolled tube with a small apical plate surrounded by long setae. Second male pleopod with an exopod on basis, needle-like distally, armed with a series of fifteen tiny, straight, acute, inset spines and ending in two larger spines. Terminal pair of spines are slightly curved at their tips. Third to fifth male pleopods rudimentary and biramous, exopod longer and connected to basal article by a joint.

COLOUR. — SAKAI (1965a) described the colouration of *Dynomene pilumnoides* as being yellowish red. MIYAKE (1983) shows the body and legs as light reddish-orange fringed with yellowish setae, and the eyestalks as being red. The picture of BABA, HAYASHI, and TORIYAMA (1986) shows the body and legs to be yellowish-brown fringed with dark brown setae.

GEOGRAPHIC DISTRIBUTION. — *Dynomene pilumnoides* has been recorded from Natal (as *Maxillothrix actaeiformis* Stebbing, 1921), Madagascar, Laccadive Ids, Philippine Ids, Japan, Australia, New Caledonia, Loyalty Id, Norfolk Ids, Enewetak Atoll, Marshall Ids and Hawaii. The material reported here from Australia, Norfolk Id, New Caledonia and Loyalty Ids represent new records and the specimen collected by the USFC Steamer *"Albatross"* in 1902, from Hawaii, has languished unrecognized in the collection of the U. S. National Museum for more than 90 years. This is a widespread Indo-Pacific species.

DEPTH. — Depth range of the material examined is 18-400 m, although most records are from 100-300 m. The specimens reported by BABA *et al* (1986) came from the Okinawa Trough, 362-540 m, but given the other more precise depth records, it does not seem justifiable to conclude that the lower depth limit for this species is 540 m. The lower depth limit is probably around 400 m. This species has been collected from rocky bottoms covered in lithothamnion algae, sponges, and corals. *Dynomene pilumnoides* does not seem to be associated with particular corals, although this could be the result of most specimens being collected from deeper water by dredge and separated from their host. The range obviously includes depths at which corals do not occur.

SIZE. — The maximum size for males is 28.5 x 22.1 mm, for females 20.7 x 17.6 mm, and the smallest ovigerous female is 9.5 x 7.5 mm. This female carried around 590 eggs while the largest ovigerous female with a complete brood (14.8 x 12.0 mm) carried about 1600 eggs. Mean egg diameter was 0.49 mm. The breeding season may be tentatively estimated as extending from February to September although no ovigerous females have been collected during the months from April to July. The maximum size for *Dynomene pilumnoides* is somewhat larger than for the preceding *Dynomene* spp. and the size of the smallest ovigerous female is also correspondingly larger. The larval stages of *D. pilumnoides* are unknown.

One female specimen (7.5 x 6.2 mm) collected in 1993 from a reef in the New Caledonia lagoon shows some peculiar features: there are no gonopores on the coxae of the second walking legs and the only indication of its sex is the presence of sternal sutures 7/8, terminating in the spermathecal openings, and five pairs of pleopods. However all pleopods are remarkably poorly developed, perhaps indicating that it has been parasitized.

DISCUSSION. — The exact status of *Dynomene pilumnoides* has been one of the main problems in understanding the relationships between the species of *Dynomene*, especially those from the Indian Ocean. ALCOCK's type specimen was a male 11.0 x 10.0 mm from 54-90 m off the Laccadive Ids. Although he created a new species for this single specimen, ALCOCK (1900) suggested that it could well prove to be a variety of *D. hispida*. Both species have a similar carapace shape, although the CW/CL ratio tends to be larger (approx. 1.30) for *D. hispida*, and the anterolateral carapace margins have four teeth, but the teeth are much smaller in *D. hispida*. The features which clearly distinguish *D. pilumnoides* from *D. hispida* are the presence of clumps of long filiform setae which are much longer than the surface covering of short setae (*D. hispida* carapace setae mostly short and not clumped), a notch in the supraorbital margin (no notch), postorbital corner without spines (five small acute spines), and only a single spine on the suborbital margin (five small acute spines). *D. pilumnoides* grows to a larger size and is usually collected from 100-300 m depth whereas *D. hispida* is a small dynomenid which occurs in shallow waters, often intertidally. It seems likely that ALCOCK did not have a specimen of *D. hispida* at his disposal which would have allowed a detailed comparison with *D. pilumnoides*. The differences between the species listed by ALCOCK (1900) are not diagnostic. However, the differences listed by ALCOCK (1901) are more useful and here he withdrew the suggestion that *D. pilumnoides* might be a variety of *D. hispida*. ALCOCK's description is seriously wrong in only one aspect: his statement that there are no rudimentary pleopods on the third to fifth abdominal segments in the male. (This feature is present in all dynomenid males although they are sometimes difficult to see clearly without special preparation.) Also his illustration does not show the longer carapace setae arranged in clumps.

Other features of *Dynomene pilumnoides*, not illustrated here, can be found in STEBBING (1921) (as *Maxillothrix actaeiformis*): mandible, second maxilla, second and third maxillipeds, and the first male pleopod. ODHNER (1925) pointed out that *Maxillothrix* is a junior synonym of *Dynomene* and therefore should not be placed amongst the Xanthidae as STEBBING had proposed. The synonymy of *M. actaeiformis* and *D. pilumnoides* was first recognized by BARNARD (1947).

The generic name *Maxillothrix* Stebbing, 1921 was created to reflect the presence of three long, unequal setae on the scaphognathite of the second maxilla. In fact similar setae had already been reported by BOUVIER (1896) for *Dynomene filholi* (see above) but STEBBING had placed his new genus amongst the Xanthidae, comparing the second maxilla with that found in *Nursia*, so the apparent uniqueness of these setae is understandable. STEBBING (1921) noted that the setae were reminiscent of the long scaphognathite spine in *Axius longispina* and he drew attention to the two long terminal setae on the second maxilla of *Homola andamanicus* (ALCOCK, 1901, pl. A). These setae probably have a role in cleaning the epibranchial surface of the gills.

BARNARD (1947, and 1950) continued to suggest that *Dynomene pilumnoides* is probably a synonym of *D. hispida,* but this cannot be correct because the suborbital margin is visible dorsally (suborbital margin straight and not projecting), CW/CL = 1.17-1.2 (CW/CL = 1.3), and the longer setae on carapace are clumped (setae not clumped). The specimens available to BARNARD were collected from 90 m depth, whereas *D. hispida* is an intertidal-shallow water species. The confusion about the status of the name *D. pilumnoides* Alcock, 1900 arose, at least in part, because of the errors and omissions of the original descriptions of ALCOCK and STEBBING (for *Maxillothrix actaeiformis*).

BARNARD (1950: 336) gave the branchial formula for *Dynomene pilumnoides* as 18 gills + 3 epipods. But this is incorrect because he missed the two arthrobranchs on the third maxilliped and overlooked the epipods on the pereopods. The branchial formula is 19 gills + 7 epipods. The gill structure of *D. pilumnoides* more closely resembles that of *D. filholi* than of *D. hispida* and *D. praedator*. The epibranchial surface of the gills is made up of four rows of elongate lobes which radiate out from the afferent vessel. The epipods and hypobranchial setae are similarly developed in all these species. Another character which *D. pilumnoides* and *D. filholi* share, is the presence of three long setae on the posterior margin of the scaphognathite. The other species of *Dynomene* only have two setae. In *D. pilumnoides* the hypobranchial margin of each podobranch carries long cleaning setae as found in *D. hispida* and *D. praedator*.

The subchelate structure of the last pairs of legs of females shows several differences from the other species of *Dynomene*: the propodal extension of the female bears six spines (four in the other species), and the teeth on the inner surface of these spines are fewer in number (12-20 teeth) and arranged in marginal rows in the middle region (rather than scattered along most of the spine). The dactylar spines of the female are strengthened by a longitudinal ridge. Male *D. pilumnoides*, along with *D. filholi*, lack the teeth on the propodal spines which are found in the other two species.

The second male pleopod of *Dynomene pilumnoides* is similar to that of *D. filholi* in having a large number (15) of subterminal spines. Also the rudimentary last three pairs of pleopods are biramous in both species.

Examination of the stomach contents of a *Dynomene pilumnoides* female 14.6 x 12.0 mm (MNHN-B 6913) from Madagascar revealed mostly soft amorphous material with a few sand grains and some chitinous brown tube-like fragments that may be hydroid in origin. It may be that this crab uses its chelae to spoon up sediment from which organic fragments are separated by the groups of setae on the cheliped fingers.

Dynomenid crabs very rarely have epizoites on their exoskeleton, perhaps because of the dense layer of setae. However, one large *Dynomene pilumnoides* male 28.5 x 22.1 mm (SMF 17127) from Japan, had a small polychaete tube on the right dorsal side of the carapace. It may be possible for fouling organisms to colonize larger crabs because of their longer intermoult intervals.

Dynomene pugnatrix de Man, 1889

Figs 5 d, 11, 22 a-g

Dynomene pugnatrix de Man, 1889: 444, pl. 10, fig. 13. — ALCOCK, 1901: 75 (list). — IHLE, 1913: 92 (list). — GUINOT, 1967: 242 (list). — SERÈNE, 1968: 36 (list). — TAKEDA, 1977: 35 (list).
Dynomene pugnatrix brevimana Rathbun, 1911: 196. — GUINOT, 1967: 242 (list). — SERÈNE, 1968: 37 (list).

MATERIAL EXAMINED. — **Mauritius**: No details, no depth, no date: 1 ♂ 9.8 x 7.2 mm, type specimen (SMF 4857).

Providence Island. PERCY SLADEN TRUST EXPEDITION: stn D4, 9°14.00'S, 51°02.00'E, 90-140 m, 4.10.1905: 1 ♀ ovig. 6.3 x 4.8 mm. type specimen of *D. pugnatrix brevimana* (USNM 41047).

TYPES. — *Dynomene pugnatrix* de Man, 1889: holotype is a male 9.8 x 7.2 mm, from Mauritius, held by the Natur-Museum Senckenberg, Frankfurt, registration number SMF 4857.

Dynomene pugnatrix brevimana Rathbun, 1911: holotype is an ovigerous female 6.3 x 4.8 mm, collected by the R/V *"Sealark"*, Percy Sladen Trust Expedition, from stn D4, 9°14.00'S, 51°02.00'E, Providence Id, north of Madagascar, 90-140 m, 4.10.1905, held at the Smithsonian Institute, Washington, registration number USNM 41047.

DESCRIPTION. — Carapace wider than long, ratio of CW/CL approx. 1.30, squarish in outline, surface convex, minutely granular. Carapace surface and pereopods sparsely covered with two kinds of setae of varying lengths up to 0.3 x CW. There are short stiff setae and longer "feathered" setae. The density of setae does not completely obscure body surface. Microscopic details of setae not examined.

Frontal carapace groove very faint, extending only a short distance from frontal margin. The normal pair of prominent rounded protuberances, separated by frontal groove, absent. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) crosses mid-line and runs directly anterolateral on to branchial region and mid-way along its length there is a short groove in the direction of median frontal margin. The second, shallower groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into a short anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally, bordering anterior cardiac region. In effect this second groove connects two crescent-shaped grooves. No branchial groove evident and posterior cardiac area only faintly defined. Anterolateral carapace margin begins below level of postorbital corner, initially it is a horizontal margin directed laterally, with two or three small granules, until meeting two small, subacute anterolateral teeth close together at corner. Behind these teeth margin runs posteriorly and has three similar equidistant teeth, first directed almost anteriorly, next two directed laterally, and finally there is a smaller submarginal tooth part-way along convergent posterolateral margin alongside which lies the reduced last leg. This gives a total of six teeth on the right-hand side, but on the left-hand side there is only one initial tooth, giving the more normal pattern for this genus of five teeth (the last of which is treated as being posterolateral). In the case of this species, absence of the branchial groove makes this distinction rather arbitrary. Posterior carapace margin recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits, interrupted by a distinct notch closer to postorbital corner, following margin minutely granulated; suborbital margin with two small granules. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region, distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked, inferior tooth well developed, blunt, superior tooth above the opening of antennal gland slightly smaller. Second article wider than long, distal margin widest, to which is fixed the exopod curving over base of eyestalk and becoming broader and terminating bluntly. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and just matching length of exopod. Fourth antennal article smaller, as long as wide, remaining antennal articles directed laterally, extending well beyond postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.67. Eyestalk can be completely folded into orbit, and cornea well developed, occupying all of tip. Epistome broadly triangular, surface slightly concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace is marked by a narrow suture. Antennae, antennules and epistome fit closely together.

Subhepatic area convex, minutely granulated. A groove begins near base of antenna, curving round under branchial region and meeting lateral carapace margin just anterior to last tooth at beginning of posterolateral border. A short cervical groove branching off and ascending towards first anterolateral tooth. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has five or six small, blunt, distally placed teeth on each side. Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

No information about gill formula due to insufficient material, but structure of an arthrobranch taken from the cheliped is as follows: in cross section, the anterior and posterior margins of the gill are notched, dividing it into hypobranchial plates and epibranchial plates which end bluntly. The epibranchial plate on the anterior margin is larger and between these plates is a single row of short elongate lobes.

Cheliped slender, slightly longer than first leg. Merus trigonal, inner face smooth and fitting closely against pterygostomial region of carapace, borders granulate, outer face has a subterminal shallow, restriction which separates a thickened distal ridge devoid of granules from a pair of small subacute granules, preceded by a row of

several smaller granules on superior border. Inner inferior margin of merus has an acute lateral spine. Outer face of carpus convex, smooth, inner superior border with a distomedially directed, sharp spur which abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin is produced as a smooth, obtuse, flange fitting against merus when limb is withdrawn. These two structures give carpal article an unusual and distinctive shape: inner face very narrow and outer face much broader. Surface of propodus smooth; fixed finger almost straight with three teeth at tip; moveable finger strongly curved with a single, blunt proximal tooth and three teeth at tip. Both fingers, thick, hollowed out internally, touching only at tips where last three teeth interlock. Just below proximal teeth on fixed finger are two distinct pits in which several long setae are inserted.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with five well developed spines in a row, increasing in size distally, separated by a gap from a single distal spine, and five well developed spines on posterior margin; length of merus of second leg about 2.4 x its width and equal to about three-quarters of CL. Dorsal surface of carpi bearing a row of five acute spines, and produced distally to overhang base of propodi. Dorsal surface of propodi with a row of four small spines. Dactyli curved, inferior margin armed with 10 small spines, tip brown and subacute.

Last pair of legs greatly reduced, adorned with long setae distally, lying along posterolateral border of carapace, reaching only as far as one third along meral article of preceding limb; borders of articles unarmed. Legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl; male with only weakly developed propodal extension. Structural details of dactyl and propodus have not been investigated.

All segments of abdomen freely moveable, surface smooth, margins unarmed but fringed with setae. Second segment narrowest, anterior margin sinuous, medial region convex, lateral margins produced as a flange which fits over posterior margin of first segment (which is the shortest) preventing forward slippage of abdomen. Subsequent segments increasing in length and breadth distally, not overlapping with preceding segments. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In male, uropod plates large, filling about three-quarters of the space between last abdominal segment and telson, excluding much of last abdominal segment and telson from reaching lateral margin of abdomen. No effective abdominal locking mechanism: abdomen only loosely held against sternum. Abdomen extends as far as bases of the third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. Five pairs of pleopods in male, first pleopod a semi-rolled tube ending in a curved, blunt apical plate surrounded by long setae, second pleopod needle-like with an exopod on the basis, remaining pleopods rudimentary. Microscopic details of second male pleopod unavailable.

COLOUR. — Unknown.

GEOGRAPHIC DISTRIBUTION. — The type locality is Mauritius and the other specimens reported by RATHBUN (1911) as *Dynomene pugnatrix brevimana* came from Providence Id, both of which are in the vicinity of Madagascar, although *D. pugnatrix* is not known from Madagascar itself. Thus *D. pugnatrix* is a western Indian Ocean species. It is interesting to compare this species with *D. filholi* which is an insular South Atlantic species.

DEPTH. — The depth range for *Dynomene pugnatrix* is 90-140 m (based on the specimens reported by RATHBUN (1911), as *D. pugnatrix brevimana*.

SIZE. — Only three specimens of *Dynomene pugnatrix* are known: one male, 9.8 x 7.2 mm (the type specimen), and two ovigerous females, one of which is 6.2 x 5.0 mm. The size of the other ovigerous female reported by RATHBUN (1911) is unknown. It is evident that this species reaches sexual maturity at a small size as do *D. hispida* and *D. praedator*. The specimen of *D. pugnatrix* examined carried 30 eggs but some eggs may have been lost because the brood did not fill the entire abdominal space. Egg diameter is 0.4 mm. These reproductive aspects are similar to the other *Dynomene* species.

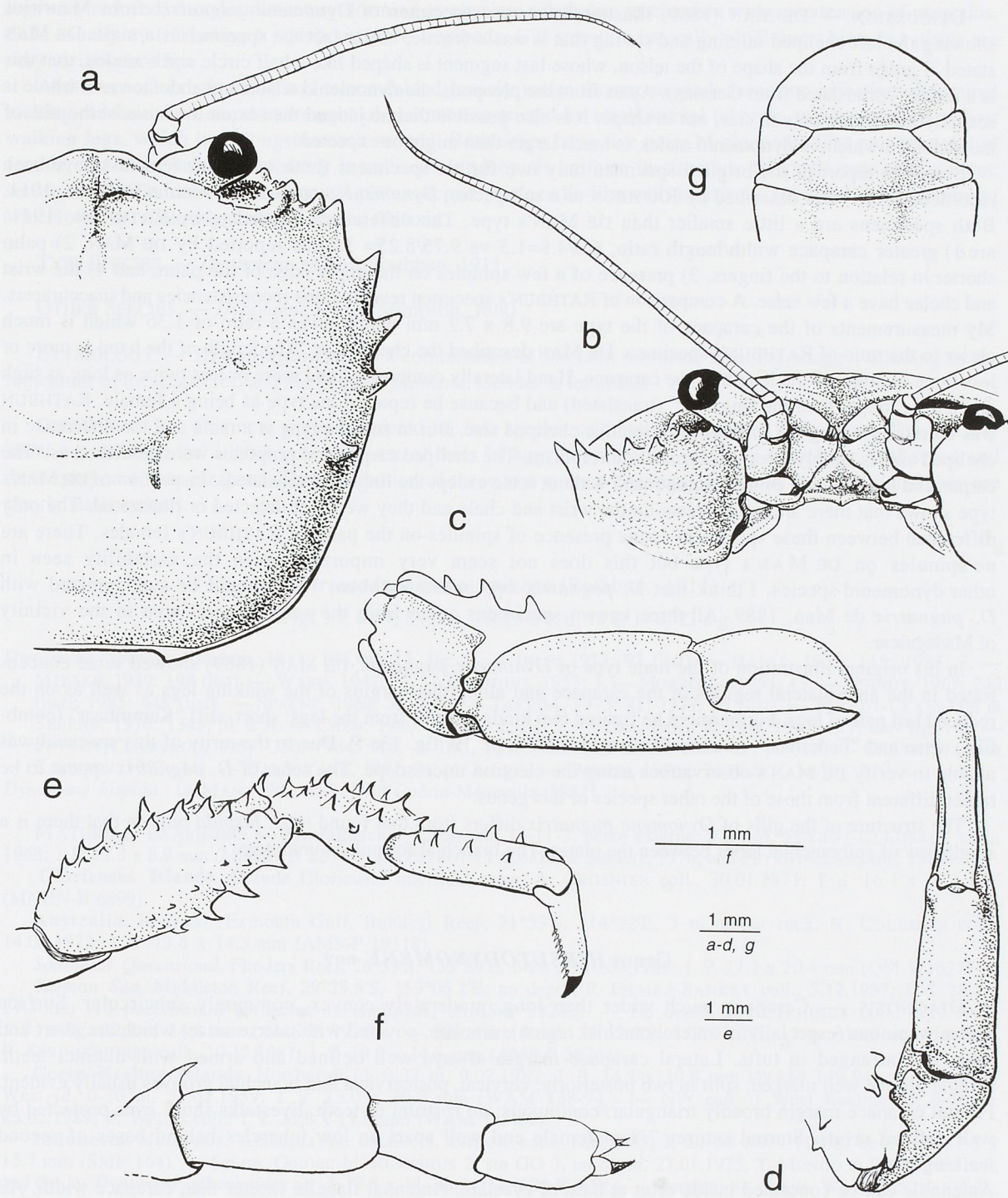


FIG. 22. — *Dynomene pugnatrix* de Man, 1889: **a-g**, ♂ 9.8 x 7.2 mm, type specimen, Mauritius (SMF 4857): **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of male abdomen.

DISCUSSION. — DE MAN (1889) illustrated the type specimen of *Dynomene pugnatrix* from Mauritius showing the left cheliped missing and stating that it was a female, but in fact the specimen is a male. DE MAN stated "I judge from the shape of the telson, whose last segment is shaped like a half circle and rounded, that this is a female" (translated from German). Apart from the pleopods, the dynomenid telson and abdomen as a whole is sexually dimorphic only in size, not in shape. It is also possible that he judged the sex on the basis of the size of the abdomen which, in dynomenid males, is much larger than might be expected.

Since the report of the original specimen only two further specimens (both ovigerous females) have been recorded. These were described by RATHBUN as a subspecies, *Dynomene pugnatrix brevimana* Rathbun, 1911. Both specimens are a little smaller than DE MAN's type. The differences alluded to by RATHBUN (1911) are 1) greater carapace width/length ratio, 6.3/4.8=1.3 vs 9.75/8.25= 1.2 (as reported by DE MAN, 2) palm shorter in relation to the fingers, 3) presence of a few spinules on the upper edge of the palm, and 4) the wrist and chelae have a few setae. A comparison of RATHBUN's specimen reveals some inconsistencies and inaccuracies. My measurements of the carapace of the type are 9.8 x 7.2 mm which gives a ratio of 1.36 which is much closer to the ratio of RATHBUN's specimen. DE MAN described the cheliped as "The length of the hand is more or less three-quarters of the length of the carapace. Hand laterally compressed and more or less twice as long as high and a little longer than the fingers..." (translated) and because he reported his type as being a female, RATHBUN was correct in noting the difference in relative cheliped size. But in fact the type is a male and the difference in cheliped size is simply a result of sexual dimorphism. The cheliped carpus and propodus were described as "The carpus and the hand are entirely smooth and without setae except the fingers" (translated). Inspection of DE MAN's type shows that there are in fact setae on the wrist and chela and they were not detected or illustrated. The only difference between these specimens is the presence of spinules on the palm of RATHBUN's females. There are no spinules on DE MAN's type but this does not seem very important given the variability seen in other dynomenid species. I think that *D. pugnatrix brevimana* Rathbun, 1911 should be synonymized with *D. pugnatrix* de Man, 1889. All three known specimens come from the same general area in the vicinity of Madagascar.

In his original illustration of the male type of *Dynomene pugnatrix*, DE MAN (1889) showed setae concentrated in the anterolateral regions of the carapace and along the margins of the walking legs as well as on the reduced last pair of legs. Furthermore he figured two kinds of setae from the legs: short, stiff "Kammhaar" (comb-like) setae and "Federhaar" (feather-like") setae (1889, pl. 10, fig. 13e-f). Due to the rarity of this species I was unable to verify DE MAN's observations using the electron microscope. The setae of *D. pugnatrix* appear to be rather different from those of the other species of this genus.

The structure of the gills of *Dynomene pugnatrix* differs from that found in *D. hispida* only in that there is a single row of epibranchial lobes between the plates. The branchial formula is unknown.

Genus ***HIRSUTODYNOMENE*** nov.

DIAGNOSIS. — Carapace much wider than long, moderately convex, commonly subcircular. Surface sparsely spinous (especially in anterobranchial region), areolate, covered with coarse setae, which are short and long, and arranged in tufts. Lateral carapace margin always well defined and armed with distinct teeth. Frontal groove well marked, split in two posteriorly; cervical, postcervical and branchial grooves usually evident. Frontal carapace margin broadly triangular, continuous; no rostrum or teeth. Eyestalks short, eyes protected by well defined orbits. Sternal sutures 7/8 of female end well apart on low tubercles behind bases of second walking legs.

Antennule can be concealed inside orbit at base of eyestalk. Antennal flagella shorter than carapace width. All articles of antenna moveable; first article (urinal) always beaked medially; second article has an exopod firmly fixed. Third maxillipeds opercular, completely covering buccal cavern, separated at their bases by a plate at same level as sternum; basis and ischium of endopod fused but joint always marked by a shallow groove. Crista dentata present. Chelipeds equal, stouter than walking legs; dactyl strongly curved; fingers gaping basally. Last pair of

legs very reduced; dactyl rudimentary, forming an obsolete subchelate mechanism with an extension of propodus. Gills usually 19 (including 6 podobranchs) + 7 epipods. Gill structure basically phyllobranchiate but plates are very variable in shape.

Abdomen of six segments and telson folded loosely under thorax; uropods large; no effective abdominal locking mechanism. Lateral movement of abdomen restricted by small sternal tubercle, at base of each of first walking legs, which lies alongside each uropod. Both sexes have five pairs of pleopods; first pair vestigial in female; last three pairs rudimentary in male. Male pleopods uniform in structure; first pair consist of a stout, setose semi-rolled tube with an apical plate; second pair needle-like with numerous subdistal spines, some of which overlap, sinuously arranged around the axis.

TYPE SPECIES. — *Dynomene spinosa* Rathbun, 1911.

OTHER SPECIES. — *Dynomene ursula* Stimpson, 1860.

ETYMOLOGY. — *Hirsutodynomene* is a combination of the latin *hirsutus*, meaning shaggy, alluding to the tomentum of these species, and the genus *Dynomene*. Gender is feminine.

DISCUSSION. — This new genus is erected for two species originally assigned to *Dynomene*. They clearly stand out amongst the other species because of their "shaggy" appearance, resulting from long, stiff setae, and their spiny, areolate carapace. The distribution of these two species does not overlap in the Pacific and they are clearly sister species.

Hirsutodynomene spinosa (Rathbun, 1911)

Figs 3 f, 5 e-f, 8 f, 9 c, 11, 13 a-b, d, 14 d, 17 e, 23 a-g

Dynomene spinosa Rathbun, 1911: 196, pl. 17, fig. 1. — IHLE, 1913: 92 (list). — BALSS, 1935: 115; 1938: 7. — MIYAKE, 1939: 198 (list). — WARD, 1942: 71. — HOLTHUIS, 1953: 3. — MORRISON, 1954: 13. — GUINOT, 1967: 242 (list); 1985: 448 (list). — SERÈNE, 1968: 36 (list). — TAKEDA, 1973: 81; 1977: 35 (list). — PEYROT-CLAUSADE & SERÈNE, 1976: 1343, pl. 2 A. — CHEN, 1980: 119, pl. 1, fig. 2. — DAI, YANG & LAN, 1981: 117, tex- fig. 1-4. — PEYROT-CLAUSADE, 1981: 750; 1984: 114. — DAI, YANG, SONG & CHEN, 1986: 27, pl. 3, 1. — GARTH, HAIG & KNUDSEN, 1987: 241. — DAI & YANG, 1991: 31, pl. 3, fig. 3. — POUPIN, 1996a: 24 (list).

Dynomene hispida - DE MAN, 1902: 689. [Not Guérin-Méneville, 1832].

MATERIAL EXAMINED. — **Madagascar**. Tuléar, stn 14-11-2, pente externe, 5 m, M. PEYROT-CLAUSADE coll., 1968: 1 ♀ 11.3 x 8.9 mm (MNHN-B 22077) (see PEYROT-CLAUSADE & SERÈNE, 1976; and PEYROT-CLAUSADE, 1984).

Glorieuses Islands. Grande Glorieuse. Intertidal zone, A. CROSNIER coll., 30.01.1971: 1 ♂ 16.4 x 14.3 mm (MNHN-B 6899).

Australia. *W coast*: Exmouth Gulf, Bundegi Reef, 21°53'S, 114°22'E, 3 m, under rock, N. COLEMAN coll., 14.08.1972: 1 ♂ 19.6 x 14.5 mm (AMS-P 19118).

Southeast Queensland, Flinders Reef, 26°59'S, 153°29'E, 6-20 m, 10.03.1989: 1 ♀ 27.7 x 20.4 mm (QM W16277).

Tasman Sea, Middleton Reef, 29°29.5'S, 159°06.2'E, no depth, P. FILMER-SANKEY coll., 5.12.1987: 1 ♂ 28.7 x 21.3 mm (10 poecilasmid barnacles on chelipeds) (AMS-P 39242). — No depth, P. HUTCHINGS coll., 8.12.1987: 1 ♀ ovig. 32.3 x 24.4 mm (AMS-P 39245). — Elizabeth Reef, 29°57.2'S, 159°01.2'E, 12 m, dead coral rubble, R. SPRINGTHORPE coll., 10.12.1987: 1 ♀ 19.5 x 14.8 mm (AMS-P 38264).

Cocos Keeling Islands. Horsburgh Id, 0-37 m, 9.02.1989: 1 ♂ 14.2 x 10.8 mm (WAM 139-94). — N end of West Id, 0-30 m, 21.02.1989: 1 ♀ 13.0 x 10.3 mm (WAM 138-94.). — NW end of West Keeling Id, 0-28 m, 23.02.1989, F. WELLS coll.: 1 ♀ 23.8 x 17.8 mm (WAM 723-89).

Indonesia. *Moluccas*. Amboina: no details, J. BROCK coll., 7.09.1885, J. G. DE MAN (1888) det.: 1 ♂ 17.8 x 13.7 mm (SMF 164). — Seram, Gorong Id. RUMPHIUS 2, stn GO 3, no depth, 27.01.1975, T. MONOD & R. SERÈNE coll. and det. as *Dynomene pilumnoides* : 1 ♂ 17.5 x 14.0 mm (MNHN-B 9906). — Ternate: no details, W. KUKENTHAL coll., 1894: 1 ♀ 18.5 x 14.3 mm (SMF 4856) (See DE MAN, 1902 who reported this specimen as *Dynomene hispida*). — *Timor*, Atapupu, coral reef, leg. *"Gazelle"*, no depth, no date: 1 ♂ 24.3 x 18.8 mm (ZMB 5138).

Vietnam. Institut océanographique, Nhatrang (coll. and det. R. SERÈNE): stn 1060, no locality, no depth, 1950: 1 ♂ 18.0 x 14.3 mm (ION. 9265) (ZRC 1970.6.20.1). — Stn. 87, no locality, no depth, 1950: 1 ♂ (dry) 7.4 x 6.0 mm (ION 1556) (ZRC 1970.6.20.2).

Mariana Islands. *Asuncion Id*, 19°40'N, 145°24'E, 1-6 m along rock wall in holes and corals, P. SCHUPP coll., 7.06.1992: 1 ♀ 24.2 x 18.0 mm (UGM).

Guam, Piti Lagoon, 13°27'N, 144°47'E, 1.0-2.5 m among dead coral, 20.09.1992: 1 ♂ 20.3 x 15.9 mm. — 1-2 m under rubble, H. T. CONLEY coll., 04.1997: 1 ♂ 10.2 x 8.1 mm. — Tumon Bay, 11 m on dead finely branched coral, R. K. KROPP & J. H. DOMINGUEZ coll., 7.11.1984: 1 ♀ 4.4 x 3.9 mm (UGM)

Japan. Kurashima Ids, Yaeyama Id, Okinawa, in dead coral branches, inner reef, M. OSAWA coll., 1993: 1 ♂ 22.2 x 17.0 mm.

Line Islands. WHIPP EXPEDITION: Palmyra Id, 5°52'N, 162°6'W, no depth, 1924: 1 ♂ 10.5 x 8.6 mm (BPBM 2297).

French Polynesia. *Tuamotu Ids*, Raroia Atoll, Homohomo Id, 16°3'S, 142°23'W, under rocks near shore in pavement pool zone, J. P. E. MORRISON coll., 21.07.1952: 1 ♀ 25.0 x 19.8 mm (USNM 94559) (see HOLTHUIS, 1953).

TYPES. — *Dynomene spinosa* Rathbun, 1911: holotype is a male 24.7 x 19.6 mm, collected by the R/V *"Sealark"*, Percy Sladen Trust Expedition, from 7°08.00'S, 56°16.00'E, Coetivy Id, 1905, held at the Smithsonian Institution, Washington, registration number USNM 41048 (note that there are two dry specimens in this lot, but the larger specimen is the holotype).

DESCRIPTION. — Carapace wider than long, ratio of CW/CL approx. 1.25-1.30, broadly rounded in outline but frontal and posterior margins truncated; surface convex, areolate, granulate, and spinous. There are about twenty five to thirty distinct areolae, more medial areolae smooth or minutely granulate, more lateral areolae adorned with larger acute granules, and those above anterolateral margin are adorned with short, acute spines. Behind branchial groove is a laterally directed region of granules, grading into spines towards last marginal tooth. Carapace surface and pereopods covered with setae of two kinds: short setae, bent at right angles near tip, clothing surface, but interspersed with longer filiform setae (6 x length of short setae and 0.20-0.25 x CW) which fringe limbs and are arranged in clumps on carapace where there are about twenty five distinct tufts, each with up to seven setae, which tend to be associated with areolae. The density of setae almost completely obscures body surface but most of this is attributable to short setae which, in some places, are separated by narrow areas lacking setae. Structure of short and long setae are different. In short setae proximal 40% of shaft is erect and lacks ornamentation, then a region occupying about 55% where setae are bent at right angles and long, stout setules radiate from shaft only on external side, forming a dense bunch, and finally distal 5% which is smooth, slightly curved, and narrows to an acute tip. In long setae proximal 95% is covered with small setules which distally increase in density, but not in size, and last 5% is smooth, slightly curved and narrows to an acute tip.

A narrow frontal carapace groove separates a pair of prominent rounded protuberances, and then divides into separate grooves which diverge and then curve back medially. Between these grooves is an elongate granulate ridge. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately from small pits and runs directly anterolateral on to branchial region and mid-way along their length they are joined by grooves running back from frontal groove The second, shallower groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows first groove for a short distance, while second portion curves posterolaterally, bordering anterior cardiac region. In effect groove crossing mid-line, connects two crescent-shaped grooves. A faint branchial groove is evident and posterior cardiac area is defined. Anterolateral carapace margin begins at level of postorbital corner, is evenly convex and bears four distinct, broad-based, equidistant teeth, each ending in a well developed, upwardly curved, acute spine; first tooth directed anterolaterally and remainder directed laterally. Each anterolateral tooth has an associated tuft of long setae. A posterolateral tooth, which is smaller than preceding anterolateral teeth, marks beginning of convergent posterolateral border alongside which lies the reduced last leg. Posterior carapace margin is recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits, interrupted by a distinct notch closer to postorbital corner, followed by four or five acute spines; suborbital margin with three similar spines followed by an acute tooth (visible dorsally when setae are removed) and then descending to a much smaller tooth at its inner corner. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region; distal margin bearing a dense fringe of longer setae, obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well

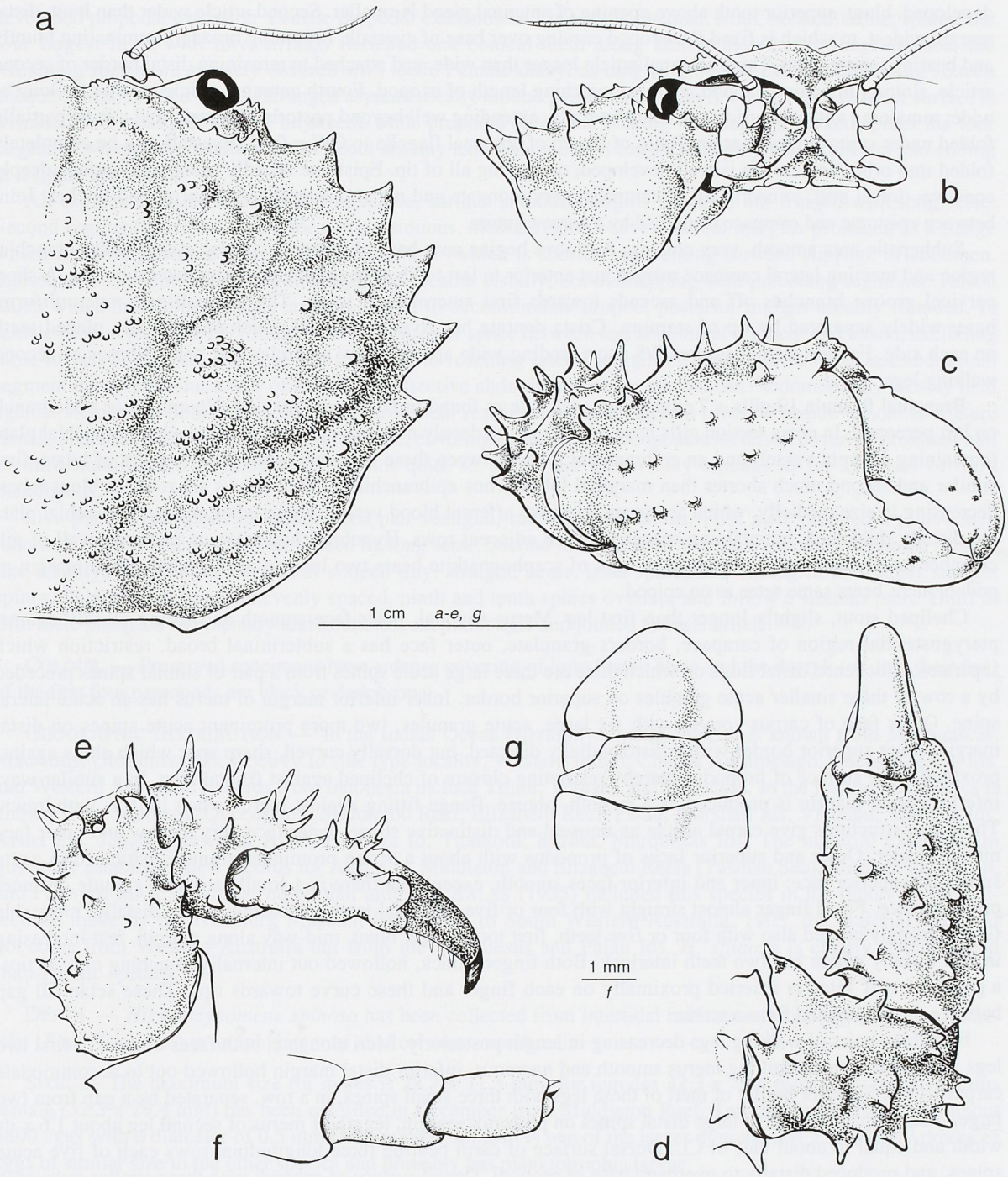


FIG. 23. — *Hirsutodynomene spinosa* (Rathbun, 1911): **a-g**, ♂ 16.4 x 14.3 mm, Glorieuses Ids (MNHN-B 6899): **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of male abdomen.

developed, blunt, superior tooth above opening of antennal gland is smaller. Second article wider than long, distal margin widest, to which is fixed the exopod curving over base of eyestalk, becoming broader, terminating bluntly and bearing longer setae. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and just matching length of exopod. Fourth antennal article smaller, as long as wide; remaining antennal articles directed laterally, extending well beyond postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.45. Eyestalk can be completely folded into orbit, and cornea is well developed, occupying all of tip. Epistome broadly triangular, surface deeply concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace is marked by a narrow suture.

Subhepatic area smooth, very convex. A groove begins near base of antenna, curving round under branchial region and meeting lateral carapace margin just anterior to last tooth at beginning of posterolateral border. A short cervical groove branches off and ascends towards first anterolateral tooth. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has five or six well developed, distally placed teeth on each side. Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

Branchial formula 19 gills + 7 epipods on each side as found in *Dynomene hispida*. No epipod or podobranch on last pereopod. In cross section gills have lateral margin deeply notched, dividing gill into a hypobranchial plate (containing efferent vessel) and an epibranchial lobe. Between these marginal lobes are two pairs of lobes, first similar and second much shorter than marginal lobes. Thus epibranchial surface shows six rows of blunt lobes, decreasing in size medially, which are arranged above afferent blood vessel. These lobes and hypobranchial plate are distally thickened, maintaining spaces between adjacent rows. Hypobranchial setae on posterior wall of gill chamber poorly developed. Posterior margin of scaphognathite bears two long setae. Hypobranchial margin of podobranchs bears same setae as on epipod.

Cheliped stout, slightly longer than first leg. Merus trigonal, inner face smooth and fitting closely against pterygostomial region of carapace, borders granulate, outer face has a subterminal broad, restriction which separates a thickened distal ridge on which there are three large acute spines from a pair of similar spines preceded by a row of three smaller acute granules on superior border. Inner inferior margin of merus has an acute lateral spine. Outer face of carpus convex with six large, acute granules, two more prominent acute spines on distal margin; inner superior border with a distomedially directed, but dorsally curved, sharp spur which abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin is produced as a smooth, obtuse, flange fitting against merus when limb is withdrawn. These two structures give carpal article an unusual and distinctive shape: inner face very narrow and outer face much broader. Outer and superior faces of propodus with about a dozen prominent granules which form acute spines on superior face; inner and inferior faces smooth, except that there is a small proximal granule on inner propodal face. Fixed finger almost straight with four or five proximal teeth increasing in size distally; moveable finger strongly curved also with four or five teeth; first tooth large, blunt, mid-way along margin, rest increasing in size distally where last two teeth interlock. Both fingers, thick, hollowed out internally, touching only at tips; a group of stiff setae is inserted proximally on each finger and these curve towards tips. These setae fill gap between the fingers and form a screen.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with three small spines, in a row, separated by a gap from two larger distal spines, and three large distal spines on posterior margin, length of merus of second leg about 1.6 x its width and equal to about half of CL. Dorsal surface of carpi bearing three longitudinal rows each of five acute spines, and produced distally to overhang base of propodi. Dorsal surface of propodi with three similar rows each of two or three spines. Dactyli curved, inferior margin armed with 4-5 small spines, tip brown (in some cases the whole dactyl is black) and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching only as far as half way along meral article of preceding limb, borders of articles unarmed. Last pair of legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly

developed propodal extension. Female propodal extension bearing eight, unequal, stout, hooked, acute, spines, the four largest lined with tiny, striated flattened and conical teeth along almost their entire inner surface, the remaining four more sparsely covered with teeth. Female dactyl as long as propodal extension, bearing sixteen unequal, stout, hooked spines (arranged asymmetrically around perimeter of dactyl) whose concave inner surface is wrinkled and mostly devoid of tiny teeth. Male propodal extension bearing five unequal curved spines the four largest of which have lateral rows of about six tiny teeth. Male dactyl longer than propodal extension and ending in a single acute claw.

All segments of abdomen freely moveable, surface smooth, margins unarmed but fringed with long setae. Second segment narrowest, anterior margin sinuous, medial region convex, lateral margins produced as a flange which fits over posterior margin of first segment (which is shortest) preventing forward slippage of abdomen. Subsequent segments increasing in length and breadth distally, not overlapping with preceding segments. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In female uropod plates large, filling about two thirds of space between last abdominal segment and telson, excluding most of last abdominal segment and telson from reaching lateral margin of abdomen. In male last abdominal segment occupies about a half of length. No effective abdominal locking mechanism: abdomen only loosely held against sternum in both sexes; sideways movement restricted by small sternal tubercle beside telson. In mature female abdomen occupies all of ventral surface, covering coxae of all pereopods with telson covering proximal half of third maxillipeds. In male abdomen not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. First male pleopod a semi-rolled tube with a small apical plate surrounded by long setae. Second male pleopod with an exopod on the basis, needle-like distally, armed with a series of sixteen tiny, straight, acute, inset spines and ending in two larger straight spines. Subterminal spines unevenly spaced, ninth and tenth spines overlap, and follow a sinuous path. Third to fifth male pleopods rudimentary and biramous, exopod longer and jointed to basal article.

COLOUR. — Preserved specimens have a dense covering of light brown setae and the dactyli (or only their tips) of the first four pereopods are black or dark brown.

GEOGRAPHIC DISTRIBUTION. — In the Indian Ocean *Hirsutodynomene spinosa* is known from Madagascar, Mauritius, Glorieuses Ids, Coetivy Id (the type locality, Western India), Chagos Archipelago, Cocos Keeling Ids, and Western Australia. Records from Indonesia include Timor, Ternate, and Moluccas. In the Pacific this species is known from Southeast Queensland, Middleton Reef, Elizabeth Reef, Palau, Marshall Ids, Vietnam, Mariana Ids, Xisha Ids, Japan, Enewetak Atoll, Palmyra Id, Tuamotu, Raroia, Marquesas Ids. The material examined in this study establishes new records for Australia, Middleton and Elizabeth Reefs (Tasman Sea), Mariana Ids, Japan, and Palmyra Id. It should be noted that although BALSS (1935) included this species in his report on the collections made by the Hamburg Museum Expedition to South Western Australia, 1905, the material cited did not come from Western Australia but from the Marquesas and Palau Ids. *H. spinosa* is clearly a widespread Indo-Pacific species.

DEPTH. — *Hirsutodynomene spinosa* has been collected from intertidal habitats and to a depth of approximately 15 m. *H. spinosa* is an inhabitant of shallow water coral reefs.

SIZE. — The maximum size for males is 28.7 x 21.3 mm, for females 32.3 x 29.4 mm. Only one ovigerous female (32.3 x 29.4 mm) has been recorded in December from Middleton Reef, Tasman Sea and it carried about 3800 eggs with a diameter of 0.5 mm. Although *H. spinosa* is one of the larger dynomenids, it evidently produces eggs of similar size to the other species and probably has planktotrophic larvae.

DISCUSSION. — *Hirsutodynomene spinosa* (Rathbun, 1911) was first described by RATHBUN on the basis of three males collected from Coetivy Id by the Percy Sladen Trust Expedition of 1905. The first female was reported by BALSS (1935) from the Marquesas Ids.

RATHBUN (1911) referred to the shorter setae of *Hirsutodynomene spinosa* as being "club-shaped" and the bunches of setae as being long and slender. Microscopic examination shows that the distal portion of the short

setae is bent at right angles and ornamented, on the outer side, with sharp setules which might give the setae a club-shaped appearance. The long setae are clothed for almost their entire length with much smaller setules.

The gills of *Hirsutodynomene spinosa* are similar to those of *Dynomene filholi*. On the epibranchial surface there are sequential rows of six lobes along the length of the gill, except towards the tip where the smaller medial lobes are lost. In prepared material the lobes tend to be clumped together, even interlocking, but in live animals the lobes are probably free, kept apart by their thickened tips. As in the species of *Dynomene*, the hypobranchial setae in the posterior region of the branchial chamber of *H. spinosa* are poorly developed. The posterior margin of the scaphognathite bears two long setae and the hypobranchial margin of each podobranch carries cleaning setae as found in *H. ursula*.

The male pleopods of *Hirsutodynomene spinosa* are similar to those of the species of *Dynomene*. The tip of the first pleopod bears a dense ring of long setae surrounding an oval apical plate. The second pleopod has a large number of subterminal spines, not all evenly spaced, which follow a sinuous path along the shaft and it ends with two straight terminal spines. Also the last three pairs of pleopods are biramous and the connection of the exopod with the basal article is marked by a joint.

The two species in this genus have non-overlapping distributions with *Hirsutodynomene spinosa* being a widespread Indo-West Pacific species and *H. ursula* being restricted to the eastern Pacific. The main differences between these species (see Table 2) are discussed below under *H. ursula*.

The habitat of *Hirsutodynomene spinosa* seems to be dead coral branches and rubble. MORRISON (1954) recorded *H. spinosa* from the inshore, more pooled area of the leeward outer reef at Raroia, Tuamotu along with hermit crabs, *Cryptodromia canaliculata*, *Pachygrapsus plicatus*, *Micippoides angustifrons*, *Thalamita picta*, *Eriphia sebana* and several xanthids. PEYROT-CLAUSADE (1981) recorded it from dead clumps of *Acropora* sp. on Tuléar Reef, Madagascar where (along with *Dynomene hispida*) it made up only about 1-2% of the anomuran and brachyuran fauna. On both the Tuléar and Reunion reefs *H. spinosa* was always less common than *D. hispida* which had a greater depth range (PEYROT-CLAUSADE, 1984). Although both these species are shallow water dynomenids, *H. spinosa* grows to a much larger size.

Examination of the gut contents of a male *Hirsutodynomene spinosa* 14.2 x 10.8 mm from the Cocos Keeling Ids revealed a stomach packed almost entirely with sand grains and a small amount of aggregated amorphous organic material. There were no recognizable animal or plant fragments. Food is probably obtained by using the spooned cheliped fingers and their stiff setae to sift out fine particulate organic material from coral sediments.

Hirsutodynomene ursula (Stimpson, 1860)

Figs 4 a-c, 6 a-b, 9 a-b, 11, 14 f, 17 f, 24 a-g

Dynomene ursula Stimpson, 1860: 239. — A. MILNE EDWARDS, 1879: 9, figs 16-19. — ALCOCK, 1901: 74 (list). — RATHBUN, 1937: 54, pl. 12, figs 1-4. — SCHMITT, 1939: 25. — GARTH, 1946: 349, pl. 61, figs 5-6; 1948: 16; 1961: 121 (list); 1965: 6; 1966: 5; 1991: 125. — BIRKELAND *et al.*, 1975: 67. — TAKEDA, 1977: 35 (list). — PRAHL & ALBERICO, 1986: 98 (list). — PRAHL, 1986: 96. — RODRIGUEZ DE LA CRUZ, 1987: 113. — VILLALOBOS-HIRIART *et al.*, 1989: 53 (list). — CORREA-SANDOVAL, 1991: 2. — LEMAITRE & ALVAREZ-LEON, 1992: 50. — AGUILERA & GUZMAN, 1992: 4 (list). — HENDRICKX, 1995: 127 (list); 1997: 29, fig. 39 a-c. — VARGAS *et al.*, 1996: 99 (list).

MATERIAL EXAMINED. — **Galapagos**. ALLAN HANCOCK GALAPAGOS EXPEDITION: stn 30-33, Hood Id, Gardner Bay, no depth, W. L. SCHMITT coll., 26.01.1933, M. J. RATHBUN id.: 1 ♂ 11.7 x 9.6 mm; 1 ♀ 15.0 x 12.3 mm (USNM 68313). — Charles Id, no depth, W. L. SCHMITT coll., 27.01.1933, M. J. RATHBUN id.: 2 ♂ 9.1 x 7.4 mm, 11.1 x 8.6 mm (USNM 68314).

Mexico. *Espiritu Santo Id. "Velero"*: stn 638-37, San Gabriel Bay, shore, 7.03.1937: 1 ♂ 13.4 x 10.3 mm; 1 ♀ 13.0 x 10.3 mm (LACM). — Stn 1110-40, 2-4 m, 14.02.1940, J. GARTH id.: 1 ♀ 7.2 x 5.7 mm (LACM).

Panama. *Secas Ids.* Stn 252-34, on *Porites* coral, 22.02.1934, M. J. RATHBUN id.: 1 ♀ ovig. 10.9 x 8.8 mm (LACM).

"Velero": stn 867-38, shore, 2.03.1938: 8 ♂ 8.4 x 6.6 - 12.7 x 10.0 mm; 5 ♀ ovig. 9.5 x 7.5 - 12.3 x 9.8 mm (LACM).

Ecuador. *La Plata Id. "Askoy"*: stn 80, 12.04.1941, J. GARTH id.: 3 ♂ 7.5 x 6.3 - 19.4 x 15.7 mm; 1 ♀ 5.0 x 4.4 mm; 1 ♀ ovig. 15.0 x 12.2 mm (LACM).

ARGOSY 34: no depth, J. GARTH coll., 5.03.1963: 1 ♀ ovig. 19.4 x 14.7 mm (USNM 247230).

TYPES. — *Dynomene ursula* Stimpson, 1860: holotype is a male 15.2 x 12.7 mm, collected by Mr J. XANTUS from 22°50.00'N, 109°55.00'W, Cape St. Lucas, Baja California, and according to the original paper is held by the Smithsonian Institute, Washington, but RATHBUN (1937) stated that the specimen is not extant. However there is a syntype held by the Museum of Comparative Zoology, Harvard, registration number MCZ 1378.

DESCRIPTION. — Carapace wider than long, ratio of CW/CL approx. 1.25-1.30, broadly rounded in outline but frontal and posterior margins truncated; surface convex, areolate, sparsely granulate, and spinous. There are about twenty to twenty five distinct areolae, more medial areolae smooth or minutely granulate, more lateral areolae adorned with larger acute granules, and those above anterolateral margin adorned with short, acute spines. Behind branchial groove is a laterally directed region of granules ending at base of last marginal tooth. Carapace surface and pereopods covered with setae of two kinds: short erect serrate setae clothing surface, but interspersed with longer serrate setae (3 x length of short setae and 0.05-0.07 x CW) which also fringe limbs and arranged in clumps on carapace where there are about twenty distinct tufts, each with up to five setae, which tend to be associated with areolae. Density of setae does not completely obscure body surface. Structure of short and long setae differs. In short setae the proximal 23% of shaft lacks ornamentation, followed by a region of 45% where tiny setules arranged in bands, then a region occupying about 22% where long, stout setules radiate from all sides of shaft, forming a dense bunch, and finally the distal 5% which is smooth, and narrows to an acute tip. The whole seta may be slightly curved but is not bent at right angles. In long setae the proximal 15% is smooth, following 80% covered with small setules which increase distally in density and size (but not reaching size of setules on short setae), and the last 5% is smooth, slightly curved and narrows to an acute tip.

A narrow frontal carapace groove separates a pair of prominent rounded protuberances, and then divides into separate grooves which diverge and then curve back medially. Between these grooves is an elongate granulate ridge. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately from small pits and runs directly anterolateral on to branchial region and mid-way along their length they are joined by grooves running back from frontal groove. Second shallower groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally, bordering anterior cardiac region. In effect groove crossing mid-line, connects two crescent-shaped grooves. A faint branchial groove is evident and posterior cardiac area is defined. Anterolateral carapace margin begins at level of postorbital corner, evenly convex and bears four distinct, broad-based, equidistant well developed teeth, each ending bluntly; first tooth directed anteriorly, second anterolaterally, and remainder directed laterally. Each anterolateral tooth has an associated tuft of long setae. A posterolateral tooth marks beginning of convergent posterolateral border alongside which lies the reduced last leg. Posterior carapace margin recessed in order to accommodate first segment of abdomen visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits, interrupted by a distinct notch closer to postorbital corner, followed by three small blunt granules before corner; suborbital margin with three larger blunt granules, first two visible dorsally, second and third (tooth-like) closer together but separated by a deep notch with third terminating the suborbital margin. Orbits clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region; distal margin bearing a dense fringe of longer setae, obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit behind second antenna. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed; blunt, superior tooth above opening of antennal gland smaller. Second article about as wide as long; distal margin widest, to which is fixed the exopod curving over base of eyestalk, becoming broader, terminating bluntly and bearing longer setae. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod. Fourth antennal article smaller, as long as wide, together with third article just matching length of exopod; remaining antennal articles directed laterally, extending well beyond postorbital corner, and partially folded under supraorbital margin. Ratio of length of antennal flagella to CW = 0.45. Eyestalk can be completely folded into orbit, and the cornea is well developed,

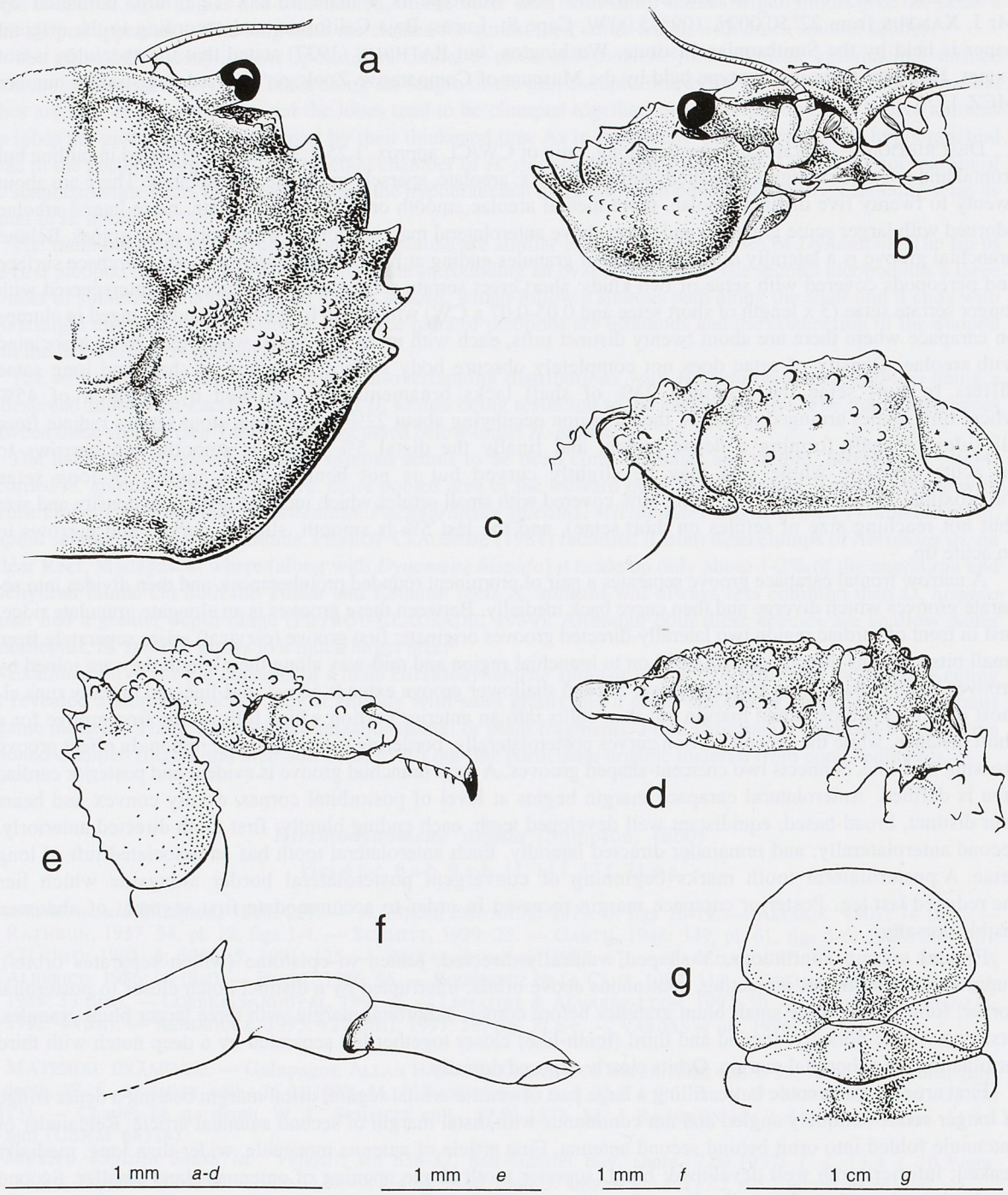


FIG. 24. — *Hirsutodynomene ursula* (Stimpson, 1860), ♀ ovig. 19.4 x 14.7 mm, La Plata Island, Ecuador (USNM 247230): **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of female abdomen.

occupying all of tip. Epistome broadly triangular, surface deeply concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace marked by a narrow suture.

Subhepatic area very convex with a few scattered granules. A groove (pleural suture) begins near base of antenna, curving round under branchial region and meeting lateral carapace margin just anterior to last tooth at beginning of posterolateral border. A short cervical groove branches off and ascends towards first anterolateral tooth before dividing into two branches, one curving towards postorbital corner and the other curving beneath second anterolateral tooth. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has seven or eight well developed, distally placed teeth on each side. Female sternal sutures 7/8 short, ending wide apart on low tubercles just behind bases of second walking legs.

Branchial formula 19 gills + 7 epipods on each side. There is no podobranch or epipod on last pereopod. Gill structure is variable. In cross section the anterior of each pair of arthrobranchs show maximum development of epibranchial lobes: there are a series of six elongate lobes developed above afferent vessel, two narrow, short median lobes flanked by longer lobes, with wider and longer lobes on the outside. The short median lobes are lost towards the tip of gill. At base of outer lobes there is a deep notch on each side dividing off the hypobranchial plate containing the efferent vessel. On posterior arthrobranchs, and all pleurobranchs, there are only four epibranchial lobes and the median lobes are lost towards tip of gill. Hypobranchial setae at posterior end of branchial chamber poorly developed. Posterior margin of scaphognathite with two long setae. Hypobranchial margin of podobranchs bear same setae as on epipod.

Cheliped stout, slightly longer than first leg. Merus trigonal; inner face smooth fitting closely against pterygostomial region of carapace, borders granulate; outer face has a subterminal broad, restriction which separates a thickened distal ridge, on which there are three spines, from a pair of similar spines preceded by a row of six smaller granules on superior border. Inner inferior margin of merus has a small blunt lateral spine. Outer face of carpus convex with six small blunt granules, two more prominent blunt spines on distal margin; inner superior border with a distomedially directed, but dorsally curved, blunt spur which abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin is produced as a smooth, obtuse, flange fitting against merus when limb is withdrawn. These two structures give carpal article an unusual and distinctive shape: inner face very narrow and outer face much broader. Outer and superior faces of propodus with about a dozen small blunt granules, inner and inferior faces smooth, except that there is a small proximal granule on inner propodal face. Fixed finger almost straight with four or five teeth increasing in size distally, second tooth placed midway and prominent, last three teeth dividing up tip of finger; moveable finger strongly curved bearing four teeth, first blunt, second more acute directed towards tip and last two interlocking with teeth of fixed finger. Both fingers, thick, hollowed out internally, touching only at tips; a group of stiff setae inserted proximally on each finger and these curve towards tips filling gap between fingers.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate; both faces of meri of first two legs and anterior face third leg merus smooth and nacreous; inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with a row of three or four small spines increasing in size distally, separated by a gap from two small distal spines; no spines on distal posterior margin; length of merus of second leg about 1.2 x its width and equal to about 0.4 x CL. Dorsal surface of carpi armed with seven or eight small spines not arranged in rows, and produced distally to overhang base of propodi. Dorsal surface of propodi armed with four or five small spines. Dactyli curved, inferior margin armed with 4-5 small spines, tip brown (in some cases whole dactyl is black) and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching only as far as half way along meral article of preceding limb; borders of articles unarmed. Last pair of legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing ten, unequal, stout, hooked, acute, spines with lateral rows of 8-10 tiny, flattened teeth proximally, separated by a striated ridge. Distally the striae of this ridge grade into a surface that is densely convoluted. Female dactyl as long as propodal extension, bearing thirteen unequal, stout, hooked spines (arranged asymmetrically around perimeter of dactyl) whose concave inner surface is wrinkled or convoluted and mostly devoid of tiny teeth except for a few small blunt marginal teeth on distal

two-thirds. Male propodal extension bearing six unequal curved spines which have tiny scattered marginal teeth. These spines are not arranged in the typical manner for dynomenids: instead of lying in an asymmetrical row around the perimeter, they are very disorganized, facing in different directions and leaning at different angles. Male dactyl longer than propodal extension and ending in a single acute claw.

All segments of abdomen freely moveable, surface smooth, margins unarmed but fringed with long setae. Second segment narrowest; anterior margin sinuous, medial region convex, lateral margins produced as a flange which fits over posterior margin of first segment (which is shortest) preventing forward slippage of abdomen. Subsequent segments increasing in length and breadth distally, not overlapping with preceding segments. Telson much wider than long, anterior margin angled to accommodate uropod, posterior margin broadly rounded. In female uropod plates are large, filling about ninety percent of space between last abdominal segment and telson, excluding most of last abdominal segment and telson from reaching lateral margin of abdomen. In male last abdominal segment occupies about three quarters of peripheral margin. No effective abdominal locking mechanism: abdomen only loosely held against sternum in both sexes, sideways movement restricted by small sternal tubercle beside telson or uropods. In mature females sternal tubercles absent; abdomen occupies all of ventral surface, covering coxae of all pereopods with telson covering proximal half of third maxillipeds. Male abdomen not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. First male pleopod a semi-rolled tube with a small apical plate surrounded by long setae. Second male pleopod with an exopod on basis, needle-like distally, armed with a series of twenty prominent, straight, acute, spines and ending in two larger curved spines. Subterminal spines unevenly spaced, seventh, eighth, and ninth spines form an overlapping group as do thirteenth and fourteenth spines, and follow a sinuous path. Third to fifth male pleopods rudimentary and biramous, exopod longer and jointed with basal article.

COLOUR. — In his original description STIMPSON (1860) noted that the color of *Hirsutodynomene ursula* is more or less reddish or crimson, the setae a light golden color, and the ambulatory legs have sharp, black, curved unguiles (claws). A. MILNE EDWARDS (1879) gave the colour as being crimson, and in places carmine. RATHBUN (1937) noted that the dactyli of the last pair of legs are without pigment.

GEOGRAPHIC DISTRIBUTION. — The type locality for *Hirsutodynomene ursula* is Cape San Lucas, Baja California. RATHBUN (1937) states that the type specimen is not extant. The range extends from the Gulf of California in the north to La Plata Id, Ecuador in the south, and offshore it occurs on the Galapagos Ids and Clipperton Id. Thus *H. ursula* is an eastern Pacific species.

DEPTH. — The depth range for *Hirsutodynomene ursula* is 0-99 m (rarely 125 m). Most specimens have been collected from rocks and dead coral, and some have been recorded as coming from *Porites* sp. and *Pocillopora* sp. but it is not clear whether these were living or dead colonies. There is no strong evidence of dependence on living corals. *H. ursula* has a much greater depth range than *H. spinosa* which has not been recorded deeper than 15 m.

SIZE. — The maximum sizes for *Hirsutodynomene ursula* are 27.2 x 20.4 mm for males, and 21.8 x 16.5 mm for females. The smallest ovigerous female examined was 9.5 x 7.5 mm, carrying around 120 eggs, and the largest ovigerous female, 19.4 x 14.7 mm, carrying around 2800 eggs. Mean egg diameter was 0.45 mm. This egg size suggests that this species has planktotrophic larvae. Ovigerous females have been mainly collected during December to April with one female from Clipperton Id collected in August (GARTH, 1965). Concentration of breeding in the early part of the calendar year is similar to the *Dynomene* species.

DISCUSSION. — GARTH (1946) remarked upon the remarkable similarity of *Hirsutodynomene ursula* to the xanthids: "With no other Galapagos species of Brachyura is the field collector so likely to be misled as to identity as with *D. ursula.* Unless he notices that the fourth pair of walking legs are reduced to minute size and carried dorsally, he will believe himself to have found a species of *Pilumnus.*" Indeed, initial sorting of the Galapagos collections resulted in all the dynomenid specimens being placed with the Xanthidae. An untrained observer would be easily misled by the black pereopod dactyli. (It should be noted here that dynomenids do not in fact carry their last pereopods "dorsally". They are carried horizontally).

The main differences between the two species in this genus (see Table 2) are that in *Hirsutodynomene spinosa* there are about 12 spines (and associated areolae) on the carapace (only about 6 in *H. ursula*), the suborbital margin has 5 short acute spines (only blunt granules), the carpal projection on the cheliped is a sharp spine (a blunt lobe), the carapace is densely covered with setae (sparsely covered), and the short setae are bent at right angles near the tip (short setae not bent).

Other differences between *Hirsutodynomene spinosa* and *H. ursula* are seen in the last pair of legs: both have a similar number of propodal spines in the female but those of *H. spinosa* are densely covered with teeth while in *H. ursula* the teeth are confined to the proximal lateral margins and the rest of the spine has a roughened, convoluted surface. In both species these spines are opposed by concave, wrinkled dactylar spines with a few small teeth but *H. spinosa* has more spines. The males have a similar number of propodal spines but in *H. ursula* these spines are very disorganized and arranged irregularly around the distal perimeter. There are no differences in the male dactyli. Commenting about the last pair of legs of *H. ursula*, STIMPSON (1860) said they are "... not prehensile, since the animal does not cover itself with a foreign body like the Dromiae; and they fill, apparently no office in the economy of the animal, except when in place, they fill up neatly the chink between the carapax and the stouter walking feet." This is the earliest speculation about the role of the last leg of a dynomenid. STIMPSON clearly believed that this limb is vestigial and redundant.

RATHBUN (1937) describes the two kinds of setae on the surface of *Hirsutodynomene ursula*: "...the first kind very short, clavate, or even pedicellate, and densely crowded; the second long and nearly as thick as the first, but fusiform, with pointed extremities, and sparsely distributed over the surface, generally in groups of three or four, of unequal lengths." The short erect setae are in fact plumose with a dense distal zone of long setules and most of the shaft only sparsely covered with short setules. The long setae are mostly covered with short setules. These long setae are very similar in *H. ursula* and *H. spinosa* but the short setae show several differences in their shape and setule ornamentation.

The gill structure of *Hirsutodynomene ursula* is similar to that of *H. spinosa* but shows more variation between gills. The anterior arthrobranchs of *H. ursula* are the same, but the other large gills show a reduced number of median lobes. These are more phyllobranchiate-like because more of the gill consists of flattened plates. The gills of *H. spinosa* are more trichobranchiate-like in having a large number of elongate epibranchial lobes. Both species show the pattern seen in other dynomenids of a tendency to lose epibranchial lobes towards the tip of the gills. Hypobranchial setae at the back of the gill chamber are poorly developed and there are two long setae on the posterior margin of the scaphognathite. Setae on the hypobranchial margin of each podobranch aid the cleaning role of the epipods.

The second male pleopod of *Hirsutodynomene ursula* has a larger number of subterminal spines than *H. spinosa* and these spines are longer, and not inset into the surface of the pleopod. In both species these spines are unevenly distributed along the pleopod, but more so in *H. ursula*, where there are two overlapping groups. Both species have the last three pairs of pleopods biramous and rudimentary but in *H. ursula* the articles are of similar length, whereas in *H. spinosa* the exopod is longer. The junction of the exopod and basal article is marked by a joint in both species.

The two species have mutually exclusive distributions: *Hirsutodynomene ursula* in the Eastern Pacific and along the coast of the Americas, and *H. spinosa* across the Western Pacific and the Indian Ocean. The western-most locality for *H. ursula* is Clipperton Id (109°W), while the eastern-most locality for *H. spinosa* is the Tuamotu Ids (142°W).

The stomach of a male *Hirsutodynomene ursula*, 13.4 x 10.3 mm, from Espiritu Santo Id, was almost en tirely filled with sand grains and some amorphous aggregates of organic material. There were no recognizable plant or animal fragments present. Food is probably obtained by using the spooned cheliped fingers and their stiff setae to sift out fine particulate organic material from coral sediments. The contents are identical to those found in *H. spinosa* (see above). In the body cavity, beside the stomach, two encysted nematodes were observed.

On the Galapagos Ids, GARTH (1991) found that in a sample (n = 169) of 20 species of rocky shore Brachyura from Sullivan Bay, Isla Santiago, *Hirsutodynomene ursula* was common, making up 5.3% of the total. This species is the only dynomenid known from the Galapagos Ids.

Character	*H. spinosa*	*H. ursula*
Density of setae	Very dense over most of carapace	Some areas of sparse setae on carapace
Short setae	Bent at right angles	Not bent at right angles
Carapace surface	Areolate and bearing about 12 spines	Areolate and bearing about 6 spines
Suborbital margin	Armed with about 5 short, acute spines	Armed with only a few blunt granules
Inner carpal margin of cheliped	Bearing a sharp spine	Bearing a blunt lobe
P5 ♀ Propodus	8 spines with numerous teeth on inner margin	10 spines with marginal rows of teeth
P5 ♀ Dactyl	16 spines	13 spines
P5 ♂ Propodus	5 spines arranged around distal perimeter	6 spines not arranged around perimeter
Second ♂ Pleopod	16 short, inset subterminal spines	20 long subterminal spines, not inset

TABLE 2. — Comparison of the two species of *Hirsutodynomene*.

Genus ***METADYNOMENE*** nov.

DIAGNOSIS. — Carapace as wide as long or slightly wider than long, moderately convex, subcircular; surface smooth. Tomentum composed of uniformly short, soft setae, which accentuate unevenness of carapace forming transverse troughs. Lateral carapace margin well defined and marked by indentations or armed with distinct teeth. Frontal groove well marked, split in two posteriorly; cervical, postcervical and branchial grooves usually evident. Frontal carapace margin broadly triangular, continuous, no rostrum or teeth Eyestalks short; eyes protected by well defined orbits. Sternal sutures 7/8 of female end well apart on low tubercles behind bases of second walking legs.

Antennule can be concealed inside orbit at base of eyestalk. Antennal flagella shorter than carapace width. All articles of antenna moveable; first article (urinal) always beaked medially; second article has an exopod firmly fixed. Third maxillipeds opercular, completely covering buccal cavern, separated at their bases by a plate at same level as sternum; basis and ischium of endopod fused but joint always marked by a shallow groove. Crista dentata present. Chelipeds equal, stouter than walking legs; fingers not strongly curved and touching for at least half their length. Last pair of legs sexually dimorphic, very reduced; dactyl rudimentary, forming an obsolete subchelate mechanism with an extension of propodus. Gill structure basically phyllobranchiate but plates have a variable number of epibranchial lobes.

Abdomen of six segments and telson folded loosely under thorax; uropods large, no effective abdominal locking mechanism. Sideways movement restricted by small spines or ridges on coxae of second and third pereopods, adjacent to the margins of telson and penultimate abdominal segments. Both sexes have five pairs of pleopods; first pair vestigial in female; last three pairs rudimentary in male. Male pleopods uniform in structure; first pair consist of a stout, setose semi-rolled tube with an apical plate; second pair needle-like, bearing a row of curved spines on anterior surface.

TYPE SPECIES. — *Dynomene devaneyi* Takeda, 1977.

OTHER SPECIES. — *Dynomene tanensis* Yokoya, 1933, *Metadynomene crosnieri* sp. nov.

ETYMOLOGY. — *Metadynomene* is a combination of *meta*, meaning *after*, and the genus *Dynomene*. Gender is feminine.

DISCUSSION. — This new genus is erected for a group of three species, two of which were originally assigned to *Dynomene*. The third species is newly described herein. All of these species are characterized by having a

carapace about as wide as long, or only slightly wider than long, densely covered with short, soft setae which give the surface an uneven, undulating appearance with transverse troughs, and chelipeds with fingers not strongly down-curved and touching for about half their length. All the known species are substantially larger than the other dynomenids and occur in deeper waters. *Metadynomene crosnieri* sp. nov. is known only from the type locality, *M. devaneyi* (Takeda, 1977) from the type locality and Marquesas Islands, whereas the third species, *M. tanensis* (Yokoya, 1933), is widespread in the Pacific.

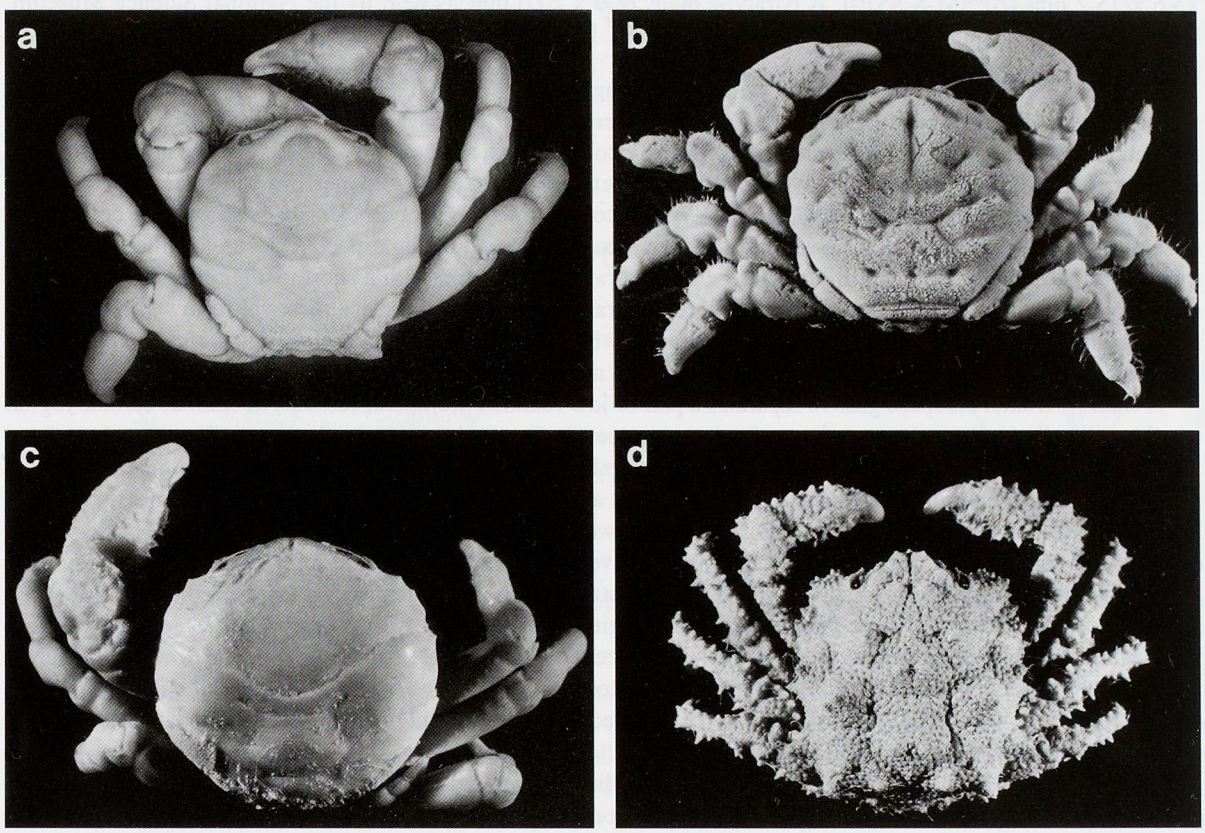


FIG. 25. — **a**, *Metadynomene devaneyi* (Takeda, 1977) ♂ 21.2 x 20.1 mm, holotype, S. E. Oahu, Hawaii, *"Star II"*, 367 m (BPBM-S 8509): dorsal view of whole crab, left second pereopod and right fourth pereopod not shown. — **b**, *Metadynomene tanensis* (Yokoya, 1933), ♀ 13.5 x 12.5 mm, New Caledonia, SMIB 8, 305-355 m: dorsal view of whole crab. — **c**, *Metadynomene crosnieri* sp. nov., ♂ 23.2 x 22.7 mm, Glorieuses Ids, BENTHEDI, 330-440 m (MNHN-B 22510): dorsal view of whole crab, setae removed from right half of carapace, right cheliped, left third pereopod and left fifth pereopod are missing. — **d**, *Paradynomene tuberculata* Sakai, 1963, ♂ 21.5 x 22.3 mm, Loyalty Ids, MUSORSTOM 6, stn DW 406, 373 m: dorsal view of whole crab.

Metadynomene devaneyi (Takeda, 1977)

Figs 11, 25 a, 26 a-c

Dynomene devaneyi Takeda, 1977: 31, figs 1-3; 1978, fig. 1. — McLAY, 1991: 465, fig. 4b.
Not *Dynomene devaneyi* - GUINOT, 1993: 1227 (= *Metadynomene crosnieri* sp. nov.).

MATERIAL EXAMINED. — **Hawaii**. *"Star II Submersible"*: S.E Oahu, off Makapuu Point, Kaiwi Channel, 21°18'N, 157°39'W, 367 m, 28.02.1974, collected from precious coral (*Corallium* sp.) beds: 1 ♂ 21.2 x 20.1 mm, holotype (BPBM-S 8509); 1 ♀ 15.6 x 15.2 mm, allotype (BPBM-S 8510).

Marquesas Islands. MUSORSTOM 9: stn CP 1290, Ua Huka, 8°53'S, 139°38'W, 341-344 m, 8.09.1997: 1 ♀ 18.4 x 18.3 mm. — Stn CP 1306, Nuka Hiva, 8°55.2'S, 140°14'W, 283-448 m, 10.09.1997: 1 ♂ 29.0 x 28.3 mm; 1 ♀ ovig. 25.0 x 25.3 mm.

TYPES. — *Dynomene devaneyi* Takeda, 1977: holotype is a male 21.2 x 20.1 mm, collected by the submersible *"Star II"* from 21°18'N, 157°39'W, Southeastern Oahu, off Makapuu Point, Kaiwi Channel, Hawaii, 367 m, 28.02.1974, held by the Bernice P. Bishop Museum, Honolulu, registration number BPBM-S 8509. The same institution holds a paratype male 22.7 x 21.6 mm (BPBM 1975.77, lot no. 2), and an allotype female 15.6 x 15.2 mm (BPBM-S 8510). A paratype male 21.0 x 20.0 mm, is held by the National Science Museum, Tokyo, registration number NSMT Cr. 5075 (ex BPBM 1974.04, lot no. 4).

DESCRIPTION. — Carapace slightly wider than long, ratio of CW/CL = 1.03-1.05, rectangular in outline; surface mostly flat, convexity greater in anterior-posterior direction than laterally, smooth, except for deeply marked grooves (see below). Carapace surface densely covered with setae of only one kind: very short, soft setae, clothing entire surface. Pereopods covered with short setae as well as a few longer filiform setae (5 x length of short setae and 0.10 x CW) which fringe limbs, locally concentrated on dactyli. Density of short setae completely obscures body surface and on carapace they present a symmetrical undulating aspect, reflecting gentle undulations in carapace surface: one oblique trough lies behind supraorbital margin, with a short median longitudinal trough extending posteriorly, then a trough curving anterolaterally which marks cervical groove, followed by a trough running across midline, just in front of cardiac area, which splits into two lateral troughs, and finally a short trough crossing cardiac area. Microscopic details of setae not investigated.

A shallow frontal carapace groove separates a pair of low rounded protuberances. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately (but very close together) from small gastric pits curving (slightly sinuously) anterolaterally on to branchial region towards a faint notch mid-way along anterolateral margin, while second groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows posterior to the first groove but does not reach lateral carapace margin, while second portion curves posterolaterally, bordering anterior cardiac region, to become branchial groove, meeting margin at posterolateral tooth. Posterior cardiac area marked by a shallow groove crossing mid-line. Anterolateral carapace margin begins at level of postorbital corner, evenly convex, without teeth, and interrupted by a shallow notch where cervical groove meets the edge, midway towards branchial notch which marks beginning of posterolateral border. Reduced last leg lies alongside posterolateral border which angles obliquely towards rear of carapace. Posterior carapace margin recessed in order to accommodate distal section of first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits, not interrupted by a notch, and without granules. Suborbital margin, convex, without teeth, projecting, shelf-like and visible dorsally. Orbits oblique and clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region, distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth, above the opening of antennal gland, smaller but more acute and directed ventrally. Second article wider than long, distal margin widest, to which is fixed the exopod curving over base of eyestalk, becoming broader and terminating bluntly. Third antennal article is longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and just matching length of exopod. Fourth antennal article smaller, as long as wide; remainder of the antennal articles directed laterally, extending well beyond postorbital corner, and can be partially folded under the supra-orbital margin. Ratio of length of antennal flagella to CW = 0.33. Eyestalk can be completely folded into orbit; cornea well developed, occupying all of tip. Epistome broadly triangular, surface slightly concave; dorsal arm, joined to tip of carapace, narrow; lateral arms longer and thicker. Joint between epistome and carapace is marked by a narrow suture.

Subhepatic area smooth, very convex. A groove begins near base of antenna, curving round under branchial region and meets branchial groove at posterolateral notch. A short continuation of cervical groove bends anteriorly

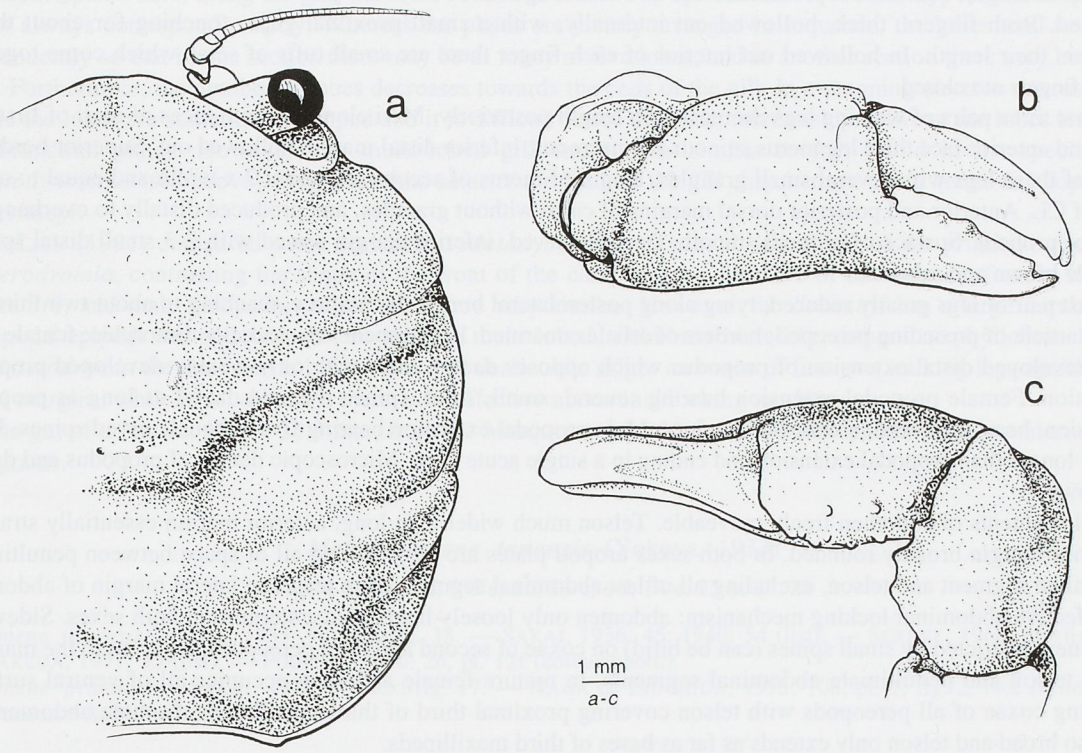


FIG. 26. — *Metadynomene devaneyi* (Takeda, 1977): **a-c**, ♀ 15.6 x 15.2 mm, allotype, S. E. Oahu, Hawaii, *"Star II"*, 367 m (BPBM-S 8510): **a**, dorsal view of right half of carapace; **b**, outer face of right cheliped; **c**, dorsal view of right cheliped.

to meet groove at margin of branchial area. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has twelve teeth increasing in size distally. Female sternal grooves short, ending wide apart in a V-shaped groove created by a low medial parallel ridge, just behind bases of second walking legs. Sternal sutures 7/8 concealed by a dense layer of long soft setae from adjacent coxa of third walking leg.

Branchial formula same as *M. tanensis*, except than there is no podobranch on last pereopod. A cross section of an arthrobranch shows lateral margin deeply notched, dividing gill into a hypobranchial plate (containing efferent vessel) and an epibranchial lobe. Between these marginal lobes are a pair of shorter lobes. Thus the epibranchial surface shows four rows of blunt lobes, which are arranged above afferent blood vessel. Towards tip of gill the length and number of lobes is gradually reduced. Hypobranchial setae in posterior region of branchial chamber well developed.

Cheliped stout, much longer and stouter than first leg. Merus trigonal, inner face smooth and fitting closely against pterygostomial region of carapace; borders granulate, superior border has a subterminal broad, restriction which separates a thickened, smooth distal ridge, from a row of three small granules; inferior face has three subdistal, blunt tubercles. Outer face of carpus convex, smooth, no longitudinal channel, two prominent blunt tubercles on distal margin; inner superior border with three blunt tubercles, distal one largest which abuts against the proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, the inferior carpal margin is produced as a smooth obtuse flange fitting against merus when limb is withdrawn. Outer face of propodus smooth, superior face with three small granules, inner and inferior faces smooth, except that there is a small proximal tubercle on inner propodal face. Fixed finger almost straight with seven or eight almost obsolete teeth increasing in size distally; moveable finger not strongly curved, with one small proximal tooth and three teeth at tip, interlocking with opposing teeth. A narrowing band of setae extend on to outer face of

moveable finger. Just below proximal teeth of fixed finger are two small pits in which several long setae are inserted. Both fingers, thick, hollowed out internally, with a small proximal gape, touching for about three-quarters their length. In hollowed out interior of each finger there are small tufts of setae which come together when fingers are closed.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out. Superior border of meri of these legs with several small granules, length of merus of second leg about 2 x width and equal to about half of CL. Anterior and posterior dorsal margins of carpi without granules, and produced distally to overhang the base of propodi. Surface of propodi smooth. Dactyli curved, inferior margin armed with 2-3 small distal spines, tip pale brown and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching to about two-thirds of meral article of preceding pereopod; borders of articles unarmed. Legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing several, small, stout, spines. Female dactyl as long as propodal extension, bearing several, small, stout, spines. Male propodal extension bearing five unequal curved spines. Male dactyl longer than propodal extension and ending in a single acute claw. Microscopic details of propodus and dactyl unknown.

All segments of abdomen freely moveable. Telson much wider than long, anterior margin essentially straight, posterior margin broadly rounded. In both sexes uropod plates are large, filling all of space between penultimate abdominal segment and telson, excluding all of last abdominal segment from reaching lateral margin of abdomen. No effective abdominal locking mechanism: abdomen only loosely held against sternum in both sexes. Sideways movement restricted by small spines (can be bifid) on coxae of second and third pereopods, adjacent to the margins of the telson and penultimate abdominal segments. In mature female abdomen occupies all of ventral surface, covering coxae of all pereopods with telson covering proximal third of third maxillipeds. In male abdomen not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial and uniramous, remainder biramous. Five pairs of pleopods in male; first pleopod a semi-rolled tube ending in a curved apical plate surrounded by long setae; second pleopod needle-like with an exopod on basis (as illustrated by TAKEDA, 1977, fig. 1A-C). Microscopic details of second pleopod unavailable. Remaining pleopods rudimentary. Third pleopod comparatively well developed, fourth and fifth pleopods smaller, all are biramous.

COLOUR. — Covered in a pale tan velvet tomentum.

GEOGRAPHIC DISTRIBUTION. — *Metadynomene devaneyi* is known from Oahu Id, Hawaii (type locality) where it was collected from precious coral (*Corallium* sp.) beds, and the Marquesas Islands (new record).

DEPTH. — The depth off southeast Oahu was 367 m, and at the Marquesas Islands 283-448 m and 341-344 m.

SIZE. — Seven specimens of *Metadynomene devaneyi* (4 males and 3 females) are known: maximum size for males is 29.0 x 27.3 mm and for females is 25.0 x 25.3 mm. An ovigerous female has been collected from the Marquesas in September. It carried approximately 2200 eggs, diameter 0.7 mm, a smaller number than comparable *M. tanensis* females.

DISCUSSION. — Some details can be added to the original description. TAKEDA (1977, fig. 1A-C) figured the first two male pleopods of *Metadynomene devaneyi* but did not show any details, especially of the second pleopods, which are only visible under high magnification. The male type specimen has three pairs rudimentary biramous pleopods. The dactyli of the walking legs are armed with two or three small distal spines. The major differences between the three species of this genus are discussed below (see Table 3) under *M. crosnieri* sp. nov.

The branchial formula of *Metadynomene devaneyi* (19 gills + 7 epipods) is very similar to *M. tanensis* except that there is no podobranch on the last pereopod. McLAY (1991, fig. 4b, as *Dynomene devaneyi*) described the structure of the gills of *M. devaneyi* showing several asymmetrical epibranchial lobes. The number of lobes is

dependent upon where, along the gill, the cross section is made. The epibranchial lobes and hypobranchial plates do not always correspond exactly. Whereas the plates are clearly arranged in sequence, the lobes tend to arise independently so that in one section there may be as many as five lobes, and in another section there may be only three. Furthermore, the number of lobes decreases towards the ends of the gill. In a scanning electron microscope picture the lobes are sometimes clumped and it is difficult to see the exact relationship between the lobes and the hypobranchial plates. However, the multi-lobed gill structure is similar to that found in the species of *Hirsutodynomene* (see above). Hypobranchial setae at the back of the gill chamber are much better developed in *M. devaneyi*.

McLAY (1991) compared some features of *Metadynomene devaneyi* with those of the primitive dromiid *Sphaerodromia*, contrasting the shape of the front of the carapace, the structure of the antenna, female sternal sutures 7/8, and male pleopods - all of which are very similar. However, *M. devaneyi* has a large number of pereopodal epipods and podobranchs, the gills are multi-lobed, trichobranchiate-like, rather than phyllobranchiate. In *Sphaerodromia* the abdomen is held in place by denticulate ridges on coxae of first two walking legs against the lateral margins, while in *M. devaneyi* there is no effective abdominal locking mechanism.

The gut of a female, 18.4 x 18.3 mm, from the Marquesas Islands contained amorphous organic material and sand grains.

Metadynomene tanensis (Yokoya, 1933)

Figs 4 d, 6 c, 7 f, 9 d-e, 11, 13 c, e-f, 14 e, 25 b, 27, 28

Dynomene tanensis Yokoya, 1933: 96, text-fig. 38. — SAKAI, 1936: 45; 1940: 54 (list). — SERÈNE, 1968: 36 (list). — TAKEDA, 1977: 35 (list). — POUPIN, 1996b: 26, pl. 12f (colour photo).

Dynomene praedator - SAKAI, 1976: 30, text-fig. 17. — NAGA & TSUCHIDA, 1995: 108, pl. 1, fig. 2. Not *Dynomene praedator* A. Milne Edwards, 1879.

MATERIAL EXAMINED. — **Taiwan**. Nan-Fan-Auo Fishing Harbour, from a boat, no locality, no depth, no date, coll. J. F. HUANG : 1 ♂ 9.0 x 8.0 mm. (only colour photo seen) (NTOU).

Indonesia. DANISH EXPEDITION KEI ISLANDS: stn 12, 5°31'S, 132°35'E, 325 m, coll. T. MORTENSEN, 9.04.1922: 1 ♀ 5.5 x 5.0 mm (ZMUC).

KARUBAR: stn DW 18, 5°18'S, 133°01'E, 205-212 m, 24.10.1991: 1 ♂ 9.0 x 8.2 mm; 1 ♀ 10.9 x 10.0 mm.

New Caledonia. Dragage du *"Vauban"*: stn D 15, 22°49'S, 167°12'E, 390-395 m, 10.04.1978: 1 ♀ 6.4 x 6.0 mm. — Stn D 24, 22°48'S, 167°12'E, 355-360 m, 13.04.1978: 3 ♀ 11.2 x 10.5 - 13.4 x 12.6 mm.

BIOCAL: stn DW 50, 23°06.50'S, 167°53.74'E, 240-260 m, 31.08.1985: 1 ♀ 22.8 x 20.5 mm.

MUSORSTOM 4: stn 193, 18°56.30'S, 163°23.20'E, 415 m, 19.09.1985: 1 ♀ 15.9 x 14.6 mm. — Stn 212, 22°47.40'S, 167°10.50'E, 375-380 m, 28.09.1985: 1 ♂ 7.2 x 6.8 mm; 1 ♀ 13.0 x 12.1 mm. — Stn 213, 22°51.30'S, 167°12.00'E, 405-430 m, 28.09.1985: 1 ♂ 18.9 x 18.1 mm. — Stn 214, 22°53.80'S, 167°13.90'E, 425-440 m, 28.09.1985: 1 ♂ 13.6 x 12.6 mm; 1 ♀ 13.0 x 12.2 mm. — Stn 215, 22°57.70'S, 167°17.00'E, 485-520 m, 28.09.1985: 3 ♂ 7.2 x 7.0 - 16.9 x 16.0 mm; 4 ♀ 14.4 x 13.9 - 19.2 x 18.9 mm. — Stn 230, 22°52.50'S, 167°11.80'E, 390-420 m, 30.09.1985: 1 ♂ 22.8 x 21.6 mm; 1 ♀ 15.8 x 14.6 mm.

SMIB 2: stn DW 1, 22°52.7'S, 167°12.6'E, 438-444 m, 17.09.1986: 2 ♂ 13.5 x 12.5, 17.8 x 16.6 mm. — Stn DW 3, 22°56.0'S, 167°18.8'E, 412-428 m, 17.09.1986: 1 ♂ 13.1 x 12.3 mm. — Stn DW 5, 22°56.3'S, 167°14.4'E, 398-410 m, 17.09.1986: 2 ♀ 11.0 x 10.4, 13.1 x 12.6 mm. — Stn DW 6, 22°56.2'S, 167°15.9'E, 442-460 m, 17.09.1986: 1 ♀ 16.7 x 15.2 mm. — Stn DW 16, 22°51.2'S, 167°11.7'E, 390 m, 19.09.1986: 1 ♀ 19.6 x 17.5 mm. — Stn DW 17, 22°55.1'S, 167°14.5'E, 428-448 m, 19.09.1986: 2 ♂ 12.9 x 12.0, 18.4 x 17.5 mm; 1 ♀ 13.7 x 12.6 mm.

SMIB 3: stn DW 25, 22°56.1'S, 167°16.2'E, 437 m, 24.05.1987: 1 ♂ 16.5 x 15.8 mm. — Stn DW 27, 22°55.2'S, 167°16.2'E, 457 m, 24.05.1987: 1 ♀ ovig. 17.6 x 16.3 mm.

SMIB 4: stn DW 65, 22°55.3'S, 167°14.5'E, 420 m, 10.03.1989: 1 ♀ 15.6 x 14.4 mm.

SMIB 6: stn DW 125, 18°57.4'S, 163°23.5'E, 335-350 m, 3.03.1990: 1 ♂ 19.8 x 18.0 mm.

BERYX 11: stn CP 46, 23°42'S, 168°01'E, 300-350 m, 20.10.1992: 2 ♀ 11.2 x 10.0, 20.0 x 18.0 mm.

SMIB 8: stn DW 163, 24°49'S, 168°09'E, 310-460 m, 28.01.1993: 1 ♂ 11.9 x 11.0 mm. — Stn DW 185, 23°16'S, 168°04'E, 311-355 m, 31.01.1993: 3 ♀ 4.8 x 4.8 - 16.0 x 15.4 mm. — Stn DW 190, 23°18'S, 168°05'E, 305-310 m, 31.01.1993: 1 ♀ 16.2 x 14.8 mm. — Stn DW 193, 22°59'S, 168°19'E, 500-508 m, 1.02.1993: 1 ♂ 7.4 x 6.8 mm. — Stn DW 197, 22°51'S, 168°12'E, 414-436 m, 1.02.1993: 1 ♂ 22.1 x 21.2 mm; 4 ♀ 8.6. x 7.5 - 19.0 x 18.4 mm. — Stn DW 198, 22°52'S, 168°12'E, 414-430 m, 1.02.1993: 2 ♀ 5.0 x 4.8, 16.2 x 15.3 mm. — Stn DW 199, 22°52'S, 168°12'E, 408-410 m, 1.02.1993: 2 ♀ 11.3 x 10.6, 21.0 x 19.8 mm.

BATHUS 2: stn CP 736, 23°03'S, 166°58'E, 452-464 m, 13.05.1993: 1 ♀ ovig. 16.3 x 15.4 mm.

BATHUS 3: stn CP 805, 33°41'S, 168°01'E, 278-310 m, 27.11.1993: 1 ♂ 23.7 x 21.4 mm. — Stn CP 811, 23°41'S, 168°15'E, 383-408 m, 28.11.1993: 1 ♀ 24.8 x 22.4 mm. — Stn DW 829, 23°21'S, 168°02'E, 386-390 m, 29.11.1993: 1 ♂ 17.4 x 16.1 mm. — Stn DW 830, 23°20'S, 168°01'E, 361-365 m, 29.11.1993: 1 ♂ 8.7 x 8.2 mm, 7 ♀ 4.6 x 4.5 - 17.3 x 16.3 mm.

HALICAL 1: stn DW 01, 18°56'S, 163°24'E, 380-400 m, 23.11.1994: 1 ♂ 12.9 x 12.0 mm. — Stn DW 04, 18°55'S, 163°24'E, 350-365 m, 26.11.1994: 1 ♀ 14.5 x 13.7 mm.

Loyalty Islands. MUSORSTOM 6: stn DW 459, 21°01.39'S, 167°31.45'E, 420 m, 20.02.1989: 1 ♀ 16.8 x 15.4 mm. — Stn 460, 21°01.72'S, 167°31.45'E, 420 m, 20.02.1989: 1 ♂ 16.4 x 15.2 mm. — Stn 464, 21°02.30'S, 167°31.60'E, 430 m, 21.02.1989: 2 ♀ 15.5 x 14.6, 16.9 x 15.8 mm.

Chesterfield Islands. CHALCAL 1: stn CP 8, 19°43.80'S, 158°35.25'E, 348 m, 19.07.1984: 1 ♀ ovig. 16.0 x 14.3 mm.

MUSORSTOM 5: stn 361, 19°52.50'S, 158°38.10'E, 400 m, 19.10.1986: 1 ♂ 19.8 x 17.9 mm.

Vanuatu. MUSORSTOM 8: stn DW 965, 20°20'S, 169°51'E, 361-377 m, 21.09.1994: 1 ♀ 9.0 x 8.4 mm. — Stn CP 982, 19°22'S, 169°26'E, 408-410 m, 23.09.1994: 1 ♂ 7.7 x 7.2 mm.

French Polynesia (coll. SMSRB and J. POUPIN). *Tuamotu Archipelago*, Fangatafu: stn 487, 22°14.1'S, 138°47.2'W, 310 m, 25.04.1995: 1 ♂ 29.1 x 27.6 mm.

TYPES. — *Dynomene tanensis* Yokoya, 1933: holotype is an ovigerous female 23.5 x 22.2 mm, collected by the S.S. *"Soyo-Maru"*, from 30°06'N, 130°50'E (approximate coordinates), east of Tanegasima Id, Japan, 219 m, between 1923 and 1930. I have been unable to trace the specimen so I assume that the specimen no longer exists.

DESCRIPTION. — Carapace slightly wider than long, ratio of CW/CL 1.05-1.10, rectangular in outline, surface smooth, quite convex, with a few minute granules in branchial area. Carapace surface densely covered with setae of only one kind: very short, soft setae, which are minutely serrated, clothing entire surface. Pereopods covered with short setae as well as a few longer filiform setae (5 x length of short setae and 0.10 x CW) which fringe limbs. Density of short setae completely obscures body surface and on carapace they present a symmetrical undulating aspect reflecting gentle undulations in carapace surface: one oblique trough lies behind supraorbital margin, with a short median longitudinal trough extending posteriorly, then a trough curving anterolaterally which marks cervical groove, followed by a trough running across midline, just in front of cardiac area, which splits into two lateral troughs, and finally a short trough crossing cardiac area. All setae have same structure: proximal 20% of shaft smooth, followed by a region covered in long setules which increase in size distally, projecting almost at right angles to shaft, and finally an unornamented region, slightly curved and narrowing to an acute tip.

A shallow frontal carapace groove separates a pair of low rounded protuberances, and then divides into two separate, short, faint grooves on a flattened area. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately (but very close together) from small gastric pits curving (slightly sinuously) anterolaterally on to branchial region towards gap between second and third anterolateral teeth, while second, shallower groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows first groove but does not reach lateral carapace margin, while second portion curves posterolaterally, bordering anterior cardiac region, meeting a branchial groove running to base of last anterolateral tooth. Posterior cardiac area marked by a distinct groove crossing mid-line. Anterolateral carapace margin begins at level of postorbital corner, slightly convex and bears three distinct, broad-based blunt teeth. First tooth smallest and close to postorbital corner followed closely by second tooth, both directed almost anteriorly. Third tooth (largest) more distant and directed laterally. A posterolateral tooth marks beginning of convergent posterolateral border alongside which lies reduced last leg. Posterior carapace margin recessed in order to accommodate distal section of first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, minutely granulated, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits, not interrupted by a notch, and without granules. Suborbital margin, convex, without teeth, projecting, shelf-like and easily visible dorsally. Orbits oblique and clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region; distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth, above the opening of antennal gland, smaller but more acute and directed ventrally. Second article wider than long, distal

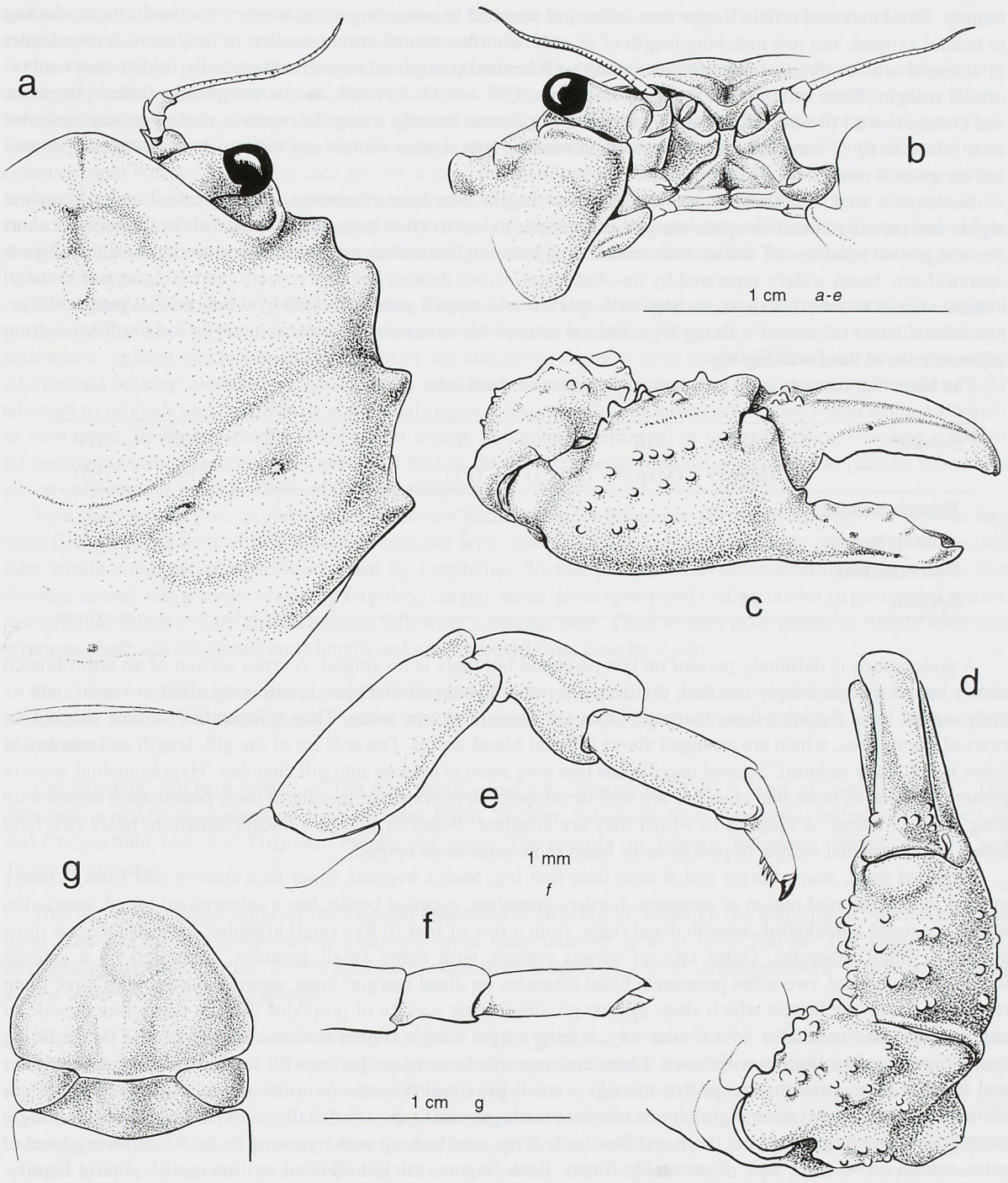


FIG. 27. — *Metadynomene tanensis* (Yokoya, 1933), ♀ 19.2 x 18.9 mm, New Caledonia, MUSORSTOM 4, stn 215, 485-520 m: **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of female abdomen.

margin widest, to which is fixed the exopod curving over base of eyestalk and becoming broader and terminating bluntly. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and just matching length of exopod. Fourth antennal article smaller, as long as wide; remainder of antennal articles directed laterally, extending well beyond postorbital corner, and partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.33. Eyestalk can be completely folded into orbit, and cornea is well developed, occupying all of tip. Epistome broadly triangular, surface slightly concave; dorsal arm, joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace is marked by a narrow suture.

Subhepatic area smooth, very convex. A groove begins near base of antenna, curving round under branchial region and meeting lateral carapace margin just anterior to last tooth at beginning of posterolateral border. A short cervical groove branches off and ascends towards gap between first and second anterolateral teeth. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has twelve teeth increasing in size distally. Female sternal sutures 7/8 short, ending wide apart in a V-shaped groove created by a low medial parallel ridge, just behind bases of second walking legs. Sternal sutures 7/8 concealed by a dense layer of long soft setae from adjacent coxa of third walking leg.

The branchial formula is 20 gills and 7 epipodites on each side:

Somite	VII (Mxp1)	VIII (Mxp2)	IX (Mxp3)	X (P1)	XI (P2)	XII (P3)	XIII (P4)	XIV (P5)
Pleurobranchiae	-	-	-	-	1	1	1	-
Arthrobranchiae	-		2	2	2	2	2	-
Podobranchiae	-	1	1	1	1	1	1	1
Epipods	1	1	1	1	1	1	1	-

A podobranch is definitely present on last pereopod but there is no epipod. A cross section of an arthrobranch shows lateral margin deeply notched, dividing gill into a hypobranchial plate (containing efferent vessel) and an epibranchial lobe. Between these marginal lobes are a pair of shorter lobes. Thus epibranchial surface shows four rows of blunt lobes, which are arranged above afferent blood vessel. Towards tip of the gill, length and number of lobes is gradually reduced. Second maxilla has two long setae extending into gill chamber. Hypobranchial setae in posterior region of branchial chamber are well developed. Hypobranchial margin of each podobranch armed with long setae as found on epipods to which they are attached. Posterior margin of scaphognathite bears two long setae. Hypobranchial margin of podobranchs bears same setae as on epipod.

Cheliped stout, much longer and stouter than first leg. Merus trigonal, inner face smooth and fitting closely against pterygostomial region of carapace; borders granulate, superior border has a subterminal broad, restriction which separates a thickened, smooth distal ridge, from a row of four to five small granules; inferior face has three subdistal, blunt tubercles. Outer face of carpus convex with many small granules, separated by a smooth longitudinal channel, two more prominent blunt tubercles on distal margin; inner superior border with three blunt tubercles, distal one largest which abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin is produced as a smooth obtuse flange fitting against merus when limb is withdrawn. Outer and superior faces of propodus with several small granules, inner and inferior faces smooth, except that there is a small proximal tubercle on inner propodal face. Fixed finger almost straight with seven or eight almost obsolete teeth increasing in size distally; moveable finger not strongly curved, with one large proximal tooth and four teeth at tip, interlocking with opposing teeth. A narrowing band of setae extend on to outer face of moveable finger. Both fingers, thick, hollowed out internally, gaping basally, touching for about half their length. In hollowed out interior of each finger there are prominent small tufts of long setae which come together when fingers are closed.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with several small granules, length of merus of second leg

about 2.5 x width and equal to about half of CL. Anterior and posterior dorsal margins of carpi without granules, and produced distally to overhang base of propodi. Surface of propodi smooth. Dactyli curved, inferior margin armed with 3-4 small distal spines, tip dark brown and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching almost to end of meral article of preceding limb; borders of articles unarmed. Legs subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male with only weakly developed propodal extension. Female propodal extension bearing eight, unequal, stout, hooked, spines with tiny flattened teeth along most of concave inner surface, and distal area free of teeth. Female dactyl as long as propodal extension, bearing eleven unequal, stout, hooked spines (arranged asymmetrically around perimeter of the dactyl) whose concave inner surface is devoid of tiny teeth. Male propodal extension bearing five unequal curved spines without teeth. Male dactyl longer than propodal extension and ending in a single acute claw which has a tiny acute spine on its outer margin.

All segments of abdomen freely moveable. Telson much wider than long, anterior margin essentially straight, posterior margin broadly rounded. In both sexes uropod plates are large, filling all of space between penultimate abdominal segment and telson, excluding all of last abdominal segment from reaching lateral margin of abdomen. Abdominal locking mechanism consists of a small ridge or spine on coxae of first and second walking legs adjacent to uropods and penultimate abdominal segment respectively. Abdomen only loosely held against sternum in both sexes. In mature female, coxal spines absent; abdomen occupies all of ventral surface, covering coxae of all pereopods with telson covering proximal half of third maxillipeds. In male, abdomen not quite so broad and telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. (Seventeen percent of females had male first pleopods instead of the normal vestigial type. See discussion below). First male pleopod a semi-rolled tube with a small apical plate surrounded by long setae. Second pleopod with an exopod on basis, needle-like distally, armed with a series of twenty four tiny, curved, acute, inset spines and ending in two larger curved spines. Subterminal spines evenly spaced and not following a sinuous path. Third to fifth male pleopods rudimentary and biramous, both articles about same length and not separated from base by a joint.

COLOUR. — The colour picture in POUPIN (1996b) shows the whole body covered with a pale tan velvet tomentum, which is a darker brown colour on the carpi of each pereopod. Cheliped fingers may have a pink colouration.

GEOGRAPHIC DISTRIBUTION. — The type locality given by YOKOYA (1933) is "east of Tanegasima Id". The distribution of *Metadynomene tanensis* includes Japan, Taiwan, Indonesia, New Caledonia (including Loyalty Ids, and Chesterfield Ids), and Tuamotu, French Polynesia. The records for Taiwan, Indonesia, New Caledonia and Tuamotu are new.

DEPTH. — The depth range of the material examined is 205-520 m, although the majority of specimens come from 300-400 m. The lower depth limit is a little uncertain but it is at least 500 m. The type specimen, an ovigerous female approx. 23.5 x 22.2 mm, came from a depth of 219 m. *Metadynomene tanensis* is clearly a deep water western Pacific species.

SIZE. — The maximum size for males is 29.1 x 27.6 mm, for females 24.8 x 22.4 mm, and the smallest ovigerous female is 16.0 x 14.3 mm. Although sexually mature females have been recorded from almost every month, only 4 ovigerous females are known. These females were collected in May, when the eggs were newly laid or showed little development, and July, when the eggs were eyed and ready to hatch. This suggests that the breeding season of *Metadynomene tanensis* may be restricted to a short period and that females may only have a single brood of eggs each year. This may be a consequence of living at a depth where water temperatures are much lower. Only one female, 17.6 x 16.3 mm, gave a reliable egg count of 2800. The mean egg diameter is 0.62 mm, which is somewhat larger than for the shallow water dynomenids, but probably still consistent with the assumption that this species has planktotrophic larvae. The largest female with an immature sized abdomen was 11.2 x 10.5 mm, and the smallest female with a mature sized abdomen was 11.3 x 10.6 mm. Therefore females probably mature at a size within the range of 11.0-12.0 mm CW.

DISCUSSION. — This enigmatic species has been largely ignored and in the Japanese carcinological literature its status has been uncertain (see below). The only report of *Metadynomene tanensis* is the original description by YOKOYA (1933). The description is brief and his figure 38 is not entirely in agreement with the text which is as follows:

" Carapace and appendages of legs covered with short and dense hairs; and with a few long setae on the margins of the legs. Carapace subcircular, regions marked by some transverse grooves; five anterolateral teeth very shallow and obtuse. Front broad triangular, grooved in the medial line. Upper and lower margin of orbit smooth, outer angle rounded. Meri and carpi of legs irregularly tuberculated. Chelipeds subequal, stouter and longer than succeeding legs; fingers naked near the extremities, with deeply excavated extremities, inner edges dentate, gaping at the base when closed; last leg slender and shorter than one half of the preceding leg, the tip minutely chelate."

YOKOYA (1933, fig. 38) shows an ovigerous female which still has all the setae and the last pair of legs is shown as having the same orientation as the other walking legs. However this cannot be accurate because in all dynomenids the last pair of legs are always straight and lie alongside the posterolateral margins of the carapace. Most of the text could apply to any of the other species in this genus except for the details about the anterolateral teeth. Thus the interpretation of these teeth is critical to establishing the use of this name. The text states that there are five shallow and obtuse anterolateral teeth, but the figure shows only two teeth plus the posterolateral tooth. In their natural state the specimens examined here closely resemble YOKOYA's figure and they agree in having the stated number of teeth. If it is assumed that there were indeed five teeth on the type specimen, then they must have been made up as follows: the first tooth close to the orbit (shown in his figure), the second and smaller third teeth (not shown in the figure), the fourth tooth (shown), and the fifth tooth (shown) must be the posterolateral tooth. Thus the features of the present material can be reconciled with both the text and the figure. One additional feature of YOKOYA's figure, which is not mentioned in the text, is the shape of the cheliped carpal article. The outer face of this article appears deeply sculptured because of the arrangement of tubercles and apart from the differences in the anterolateral margin, this characteristic is sufficient to separate it from *M. devaneyi* in which the surface of the carpal article is much less sculptured. For these reasons it seems valid to identify the present material as being *Metadynomene tanensis* (Yokoya, 1933). The major differences between the three species of this genus are discussed below (see Table 3) under *M. crosnieri* sp. nov..

Although the two species are clearly different, there has been some confusion between *Dynomene praedator* and *Metadynomene tanensis* from Japan. SAKAI (1936) listed *Dynomene tanensis* but stated that he had not seen any specimens. Without giving any reasons, SERÈNE (1968) stated that these two species were synonyms. For *D. praedator* from Japan, SAKAI (1976) used a text-figure which showed *M. tanensis* and placed *Dynomene tanensis* Yokoya, 1933 in the list of synonyms for *Dynomene praedator*. The habitat information which he gives is almost certainly for *D. praedator*, i.e. "coral reefs, shallow waters", and the records of material examined (from Yoron Id, Taketomi Id, and the Bonin Ids) are probably for this species. There is no record from Sagami Bay (SAKAI, 1965) and it is only in 1976 that there is any evidence he had seen a specimen of *M. tanensis* (from Ishigaki Id, depth not given, 1 male approx. 15.0 x 13.5 mm) which he referred to *D. praedator*. In his list of the Japanese fauna MIYAKE (1983) also assumed that *D. tanensis* is a synonym of *D. praedator*. Thus it is important to clearly establish that these are two valid species and that both occur in Japanese waters. *D. praedator* is a shallow water species (0-50 m) while *M. tanensis* occurs in much deeper water (205-520 m).

The setae of *M. tanensis* clothe almost the entire body surface and are for the most part densely covered in long setules, giving the surface of the crab a soft velvet-like appearance. Although there are a few longer setae, all setae have the same microscopic structure. In this respect *M. tanensis* is similar to *Dynomene hispida* and *D. praedator* but the setules are longer and cover more of the shaft. Also the bare tip is relatively much shorter.

Metadynomene tanensis is the only dynomenid examined in which the branchial formula is 20 gills + 7 epipods. This species has a small podobranch on the last pereopod but this is absent in the other dynomenids. Besides the seven epipods *M. tanensis* has two long setae on the posterior margin of the scaphognathite and a well developed field of hypobranchial setae at the back of the gill chamber. These are all part of the mechanism used for gill cleaning and they are aided by the presence of long cleaning setae on the hypobranchial margin of each podobranch. These setae probably clean the bases of the adjacent gills. The structure of the gills is very similar to that of *M. devaneyi* with four epibranchial lobes associated with each gill plate.

The propodus and dactyl of the last pair of legs in females show some similarity to those found in the species of *Dynomene*: they have dentate propodal spines, and edentate dactylar spines. Similarly, the males have five edentate propodal spines, as in *D. filholi* and *D. pilumnoides*, but the dactyl is most unusual in having an acute spine on one side. This identical structure has only been observed in one other dynomenid species, *D. filholi*, although a similar spine on the dorsal margin is present in *Paradynomene tuberculata*. The structure is reminiscent of that found in some dromiids (see Discussion under *D. filholi*).

The first two pairs of male pleopods agree closely with those of *Metadynomene devaneyi* as figured by TAKEDA (1977, fig. 1a-c). Examination of the *M. tanensis* second pleopod, using the scanning electron microscope, shows that it is armed with a large number (24) of tiny curved spines. Similar large numbers of spines are found in *Hirsutodynomene ursula*, *H. spinosa*, and *Dynomene pilumnoides* although in these species the spines are not curved. As with most of the other dynomenids the last three pairs of pleopods in *M. tanensis* are biramous but there is no sign of any joint between the separate articles and the basal article.

Examination of the stomach contents of a male, 19.8 x 17.9 mm, from New Caledonia showed mostly fine sand grains, soft unidentifiable organic material as well as chopped dark brown chitinous fragments. Like most of the other dynomenids, *Metadynomene tanensis* may obtain most of its food by sieving sand, using the setae on the cheliped fingers and third maxillipeds, and perhaps some by scavenging.

OCCURRENCE OF GYNANDROMORPH FEMALES

Metadynomene tanensis was one of the more common species in the collection studied. A total of 73 specimens were examined: 25 males and 48 females. The sex ratio was 1.92 females/male, but the most interesting feature was the occurrence of females with male first pleopods. While the second to fifth biramous pleopods were developed in the normal way, these gynandromorphic females had male pleopods in place of the normally vestigial uniramous first pleopods. Seventeen percent of the females were gynandromorphs and most of them were sexually mature: the smallest was CW = 13.0 mm and the largest was CW = 19.2 mm. One female, CW = 13.7 mm, had one male pleopod and one normal vestigial pleopod. Although it was not possible to examine the internal organs, these abnormal females seemed to be normal in every other respect, having well developed genital apertures in the coxae of the third pereopods and an abdomen as well developed as in normal females. They are probably reproductively successful, although none were carrying eggs. The female pleopods on the second to fifth abdominal segments were of the normal size and structure, and there was no evidence of parasitism. The male pleopods of the gynandromorphs were only about half the size that would be expected for a male of the same size. None of the females of any of the other dynomenid species examined showed any evidence of developing male first pleopods.

Relative growth of the abdomen and chelipeds in *Metadynomene tanensis* is shown in Fig. 28 a-b. The size of normal females ranged from CW = 4.8 to CW = 24.8 mm and included three ovigerous females. Relative width of the last abdominal segment for small crabs shows no difference between females and males, but there is a sudden increase for females larger than about CW = 11.0 mm, suggesting a pubertal moult. The abdomen of males continues to grow at the same relative rate as for small crabs. The abnormal crabs do not differ in their abdomen size from mature females. With cheliped propodus length (or depth for that matter), both males and females show a similar pattern until they reach about CW = 15.0 mm when male chelipeds become relatively larger. This suggests that males may reach sexual maturity at a larger size than females. For abnormal crabs, the relative growth of both the abdomen and the chelipeds shows a pattern which conforms to that of females.

The smallest of the abnormal specimens, CW = 6.4 mm, was unusual in that the male pleopods were the longest while the remaining female pleopods (biramous) were very small. Since the genital apertures are not developed at this size, and both sexes have five pairs of pleopods, the only criterion for deciding on gender is whether the last four pairs of pleopods are biramous (female) or uniramous (male). Since the abdomen size of males and females up to about CW = 11.0 mm does not differ, it is unclear whether this specimen is a masculinized female or a feminized male. In Fig. 28 a-b this specimen is shown as an abnormal female. Another small female, CW = 8.6 mm, had uniramous vestigial first pleopods with the rest biramous but all the pleopods were very small and not properly developed. Again, the original sex of this specimen is uncertain because it is the same as the first case, except that its first pleopod did not show any male characteristics.

Assuming that the mature abnormal crabs have passed through the same stages as the two small crabs discussed above, then it is not clear whether they represent crabs which started out as males or as females. If we assume that they were originally males, then this would help to explain why the overall sex ratio is biased in favour of females. Perhaps there are some individuals in the population which have delayed sex determination, retaining the potential to become either male or female. While the rate of occurrence of abnormal crabs would be 17% if we assume that they are masculinized females, it would be 8/40 = 20% if they were feminized males and the overall sex ratio would be 1.21 females/male rather than 1.92. There is no evidence of sex change such as would be found in a sequential hermaphrodite because females reach sexual maturity at about CW = 11 mm and males at about 15 mm CW. Another hypothesis is that these abnormal crabs represent "errors in development", but 17% seems to be a very high rate of occurrence. An alternative explanation is that the development of these two small abnormal crabs has been modified by a parasite, but there was no external evidence of parasitism. Moreover, the parasite hypothesis would not account for the occurrence of the abnormal mature females.

The occurrence of gynandromorphic individuals is rare amongst Malacostraca and appears to be limited to the decapods (CHARNIAUX-COTTON, 1975). Bilateral gynandromorphs have been reported for *Metapenaeus monoceros* (GEORGE, 1963), a species of *Lucifer* (see MANNING & HOLTHUIS, 1981), *Nephrops norvegicus* (FARMER, 1972), *Homarus americanus* (CHACE & MOORE, 1959) and *H. gammarus* (GORDON, 1957), *Jasus frontalis* (reported as *Palinurus frontalis* by BURGEN, 1902) and *J. edwardsii* from New Zealand (pers. obs.), and *Cambarus propinquus* (reported as *Orconectes propinquus* by HAY, 1905). Some cases involve the presence of supernumerary genital openings e.g. *Astacus astacus* (reported as *A. fluviatilis* by BENHAM, 1891). Immature female *Procambarus clarkii* which received androgenic gland implants developed male first pleopods and, when mature, vitellogenesis was inhibited (TAKETOMI & NISHIKAWA, 1996).

Bilateral gynandromorphs have also been reported in brachyurans such as *Chionoecetes opilio* (TAYLOR, 1986), and *Callinectes sapidus* (CARGO, 1980; JOHNSON & OTTO, 1981). More complex and peculiar malformations have been found in several other brachyurans. VEILLET (1945) described an unusual *Carcinus maenas* (Portunidae) in which there were two male pleopods and a male genital aperture on the right side, while on the left side there was a male first pleopod and four female pleopods, with a female genital aperture in the thorax. FROGLIA and MANNING (1978) reported a gynandromorph specimen of the grapsid *Brachynotus gemmellari* which had male first pleopods but female second pleopods. MANNING (1993) reported a similar case of a segmental gynandromorph in the pinnotherid *Nepinnotheres androgynus* which had a wide abdomen with male pleopods and female pleopods, but lacked female gonopores. Another peculiar case was reported by GORDON (1963) for a male *Pleistacantha moseleyi* which had five pairs of pleopods: normal male first and second pleopods, except that the second carried an exopodite, followed by three pairs of semi-biramous pleopods. MANNING and HOLTHUIS (1981) found one gynandromorph specimen of *Ebalia tuberculata* Miers (Leucosiidae) which had one half of the abdomen with female characteristics while the other half had male characteristics. Sternal female gonopores were present and four normal female pleopods were found on the right hand side of the abdomen, but on the left hand side there were male pleopods on the first two segments, followed by normal female pleopods on the third to fifth segments. Evidently, female characters were dominant in this crab. ROPER (1979) found that around 1% of *Leptomithrax longipes* (Majidae) had poorly developed female gonopores, abdomens of intermediate size and varying degrees of development of male pleopods on the first abdominal segment while the third to fifth segments had normal female pleopods. He concluded that these specimens were males showing various degrees of feminization which may have been attributable to the effects of a bacterium. HARTNOLL (1960) found a specimen of *Hyas coarctatus* Leach (Majidae) which had both female and male genital openings while there was a pair of male pleopods followed by three pairs of female pleopods on the abdomen. Several morphological features were intermediate in size between typical males and females. This crab most closely approximates the hermaphroditic condition.

In the abnormal specimens of *Metadynomene tanensis* only the pleopods of the first abdominal segment were modified to the male form. Whereas in *Ebalia tuberculata* the first male pleopod was of normal size, in *M. tanensis* the pleopods were only about half the size that would be expected in a male of the same size. In both these species female characters were evidently dominant. The *E. tuberculata* specimen is a case of bilateral gynandromorphism while *B. gemmellari*, *N. androgynus* and most of the *M. tanensis* specimens, were segmental gynandromorphs, although one *M. tanensis* female had one male first pleopod as well as a typical female

first pleopod. In most of the decapods mentioned above, gynandromorphism is very rare, except in the case of *Nephrops norvegicus* where up to 12% of males can be affected (RIDEWOOD, 1909). CHARNIAUX-COTTON (1975) concludes that, at least in the case of bilateral gynandromorphs, the cause of feminization is genetic in origin, resulting from the loss of the male chromosome from a blastomere at an early stage of cleavage, so that

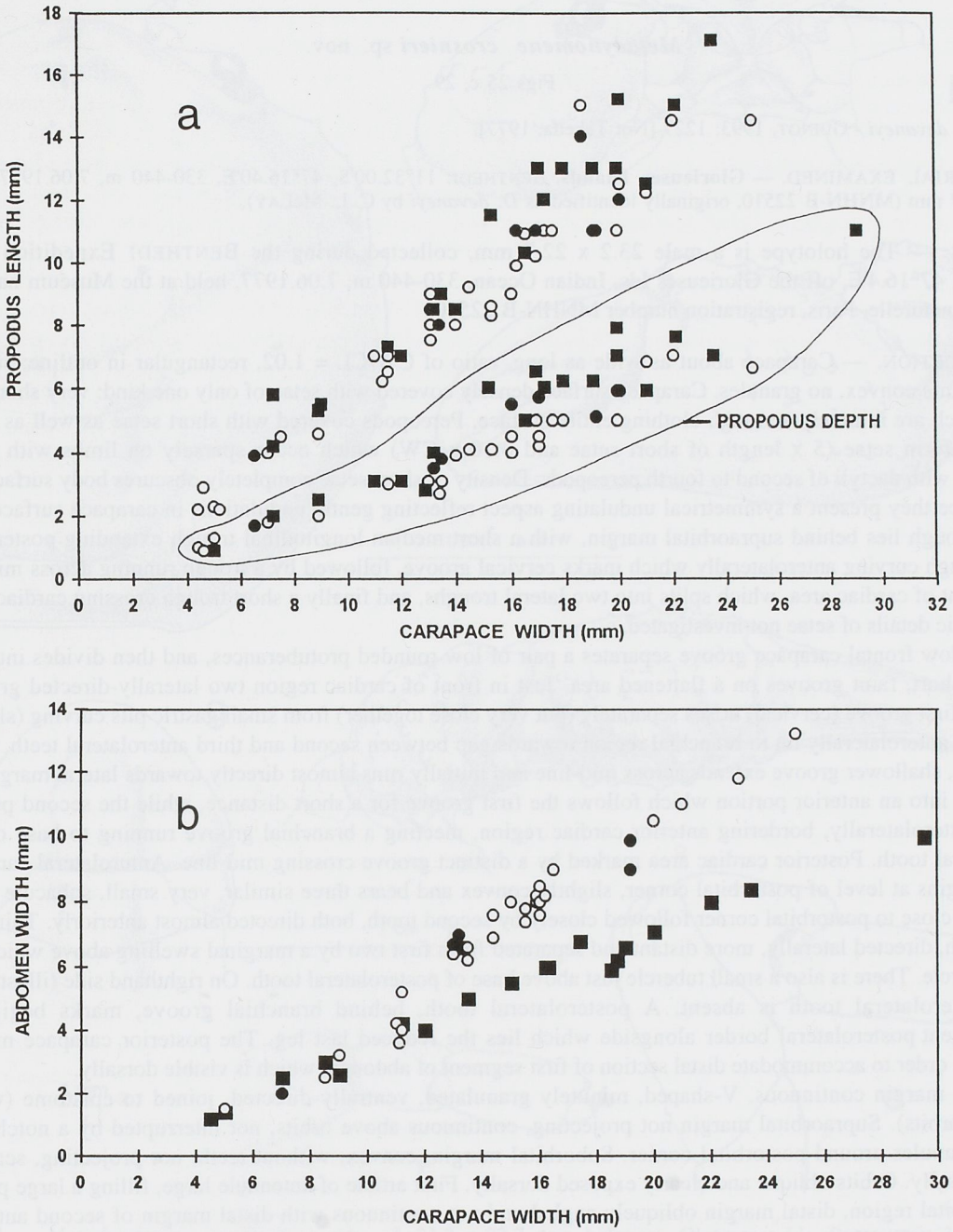


FIG. 28. — Relative growth of *Metadynomene tanensis* (Yokoya, 1933): **a**, cheliped propodus length and depth plotted against carapace width; **b**, width of penultimate abdominal segment plotted against carapace width (mm). Open circles are for males, closed circles are for females, and triangles are for gynandromorphic individuals.

one half of the animal develops as a male while the other develops as female. It seems most likely that the cause of the pleopod abnormalities in *M. tanensis* is also genetic in origin and may be environmentally induced. Given that male decapods are usually the heterogametic sex (LECHER *et al.*, 1995), it may well be that the abnormal animals are feminized males rather than masculinized females.

Metadynomene crosnieri sp. nov.

Figs 25 c, 29

Dynomene devaneyi - GUINOT, 1993: 1227 [Not Takeda, 1977].

MATERIAL EXAMINED. — **Glorieuses Islands**. BENTHEDI: 11°32.00'S, 47°16.40'E, 330-440 m, 7.06.1977: 1 ♂ 23.2 x 22.7 mm (MNHN-B 22510, originally identified as *D. devaneyi* by C. L. McLAY).

TYPES. — The holotype is a male 23.2 x 22.7 mm, collected during the BENTHEDI Expedition from 11°32.0'S, 47°16.4'E, off the Glorieuses Ids, Indian Ocean, 330-440 m, 7.06.1977, held at the Muséum national d'Histoire naturelle, Paris, registration number MNHN-B 22510.

DESCRIPTION. — Carapace about as wide as long, ratio of CW/CL = 1.02, rectangular in outline; surface smooth, quite convex, no granules. Carapace surface densely covered with setae of only one kind: very short, soft setae, which are minutely serrated, clothing entire surface. Pereopods covered with short setae as well as a few longer filiform setae (5 x length of short setae and 0.10 x CW) which occur sparsely on limbs with a tuft associated with dactyli of second to fourth pereopods. Density of short setae completely obscures body surface and on carapace they present a symmetrical undulating aspect reflecting gentle undulations in carapace surface: one oblique trough lies behind supraorbital margin, with a short median longitudinal trough extending posteriorly, then a trough curving anterolaterally which marks cervical groove, followed by a trough running across midline, just in front of cardiac area, which splits into two lateral troughs, and finally a short trough crossing cardiac area. Microscopic details of setae not investigated.

A shallow frontal carapace groove separates a pair of low rounded protuberances, and then divides into two separate, short, faint grooves on a flattened area. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately (but very close together) from small gastric pits curving (slightly sinuously) anterolaterally on to branchial region towards gap between second and third anterolateral teeth, while the second, shallower groove extends across mid-line and initially runs almost directly towards lateral margin but then splits into an anterior portion which follows the first groove for a short distance, while the second portion curves posterolaterally, bordering anterior cardiac region, meeting a branchial groove running to base of last anterolateral tooth. Posterior cardiac area marked by a distinct groove crossing mid-line. Anterolateral carapace margin begins at level of postorbital corner, slightly convex and bears three similar, very small, subacute teeth. First tooth close to postorbital corner followed closely by second tooth, both directed almost anteriorly. Third and fourth teeth, directed laterally, more distant and separated from first two by a marginal swelling above which is a small tubercle. There is also a small tubercle just above base of posterolateral tooth. On righthand side (illustrated) fourth anterolateral tooth is absent. A posterolateral tooth, behind branchial groove, marks beginning of convergent posterolateral border alongside which lies the reduced last leg. The posterior carapace margin recessed in order to accommodate distal section of first segment of abdomen which is visible dorsally.

Frontal margin continuous, V-shaped, minutely granulated, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin not projecting, continuous above orbits, not interrupted by a notch, and without granules around postorbital corner. Suborbital margin, convex, without teeth, not projecting, scarcely visible dorsally. Orbits oblique and clearly exposed dorsally. First article of antennule large, filling a large part of ventral orbital region, distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit.

First article of antenna moveable, wider than long, medially beaked; inferior tooth well developed, subacute; superior tooth, above opening of antennal gland, blunt, smaller and directed ventrally. Second article wider than

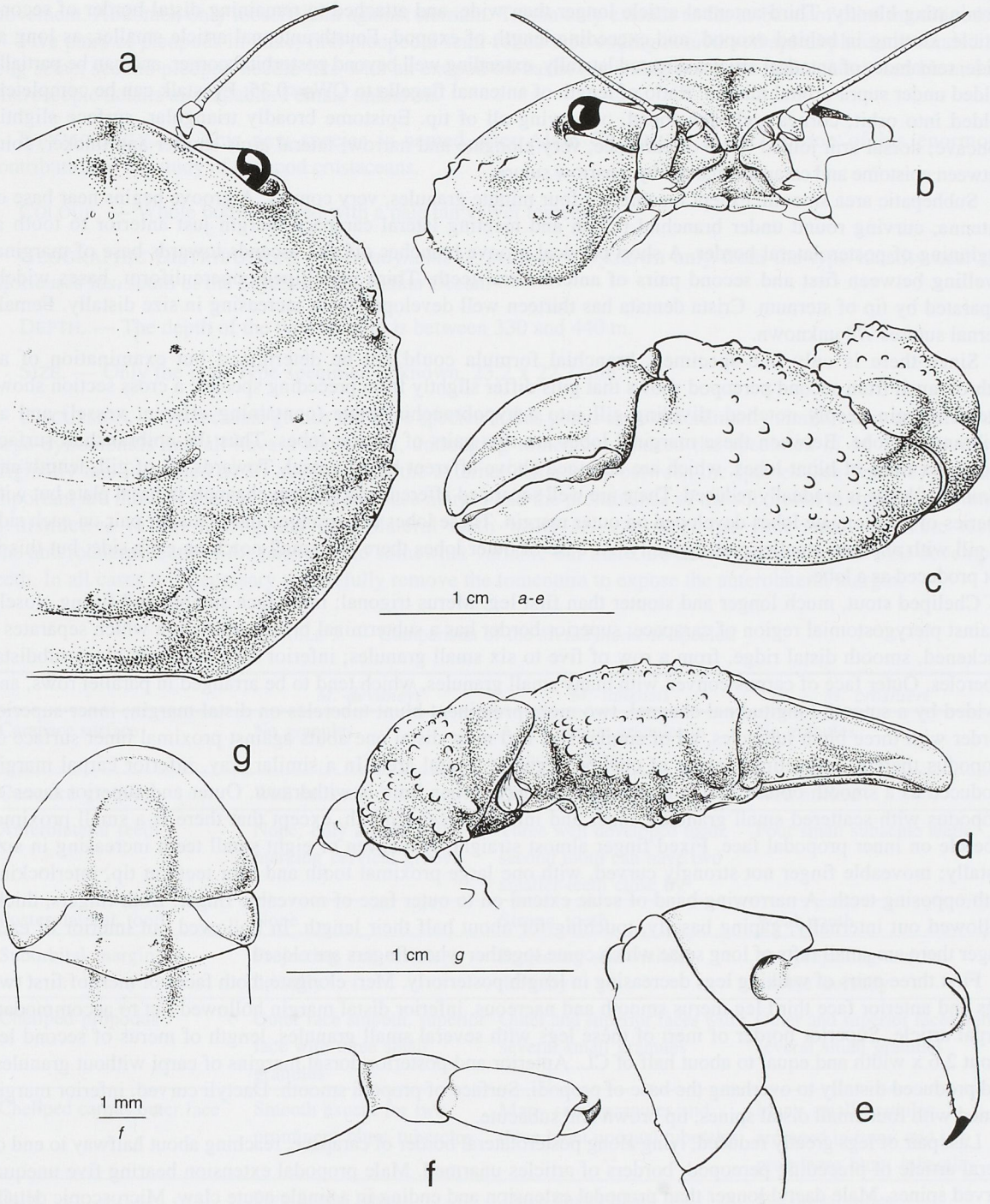


FIG. 29. — *Metadynomene crosnieri* sp. nov., ♂ 23.2 x 22.7 mm, holotype, Glorieuses Ids, BENTHEDI, 330-440 m: **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of left cheliped; **d**, dorsal view of left cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of male abdomen.

long, distal margin widest, to which is fixed the exopod curving over base of eyestalk and becoming broader and terminating bluntly. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and exceeding length of exopod. Fourth antennal article smaller, as long as wide, remainder of antennal articles directed laterally, extending well beyond postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.35. Eyestalk can be completely folded into orbit; cornea well developed, occupying all of tip. Epistome broadly triangular, surface slightly concave; dorsal arm joined to tip of carapace, very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace marked by a narrow suture.

Subhepatic area smooth, except for three or four minute granules, very convex. A groove begins near base of antenna, curving round under branchial region and meeting lateral carapace margin just anterior to tooth at beginning of posterolateral border. A short cervical groove branches off and ascends towards base of marginal swelling between first and second pairs of anterolateral teeth. Third maxillipeds operculiform, bases widely separated by tip of sternum. Crista dentata has thirteen well developed teeth increasing in size distally. Female sternal sutures 7/8 unknown.

Since there is only one specimen, branchial formula could not be determined but examination of an arthrobranch from second pereopod shows that gills differ slightly from preceding species: a cross section shows lateral margin deeply notched, dividing gill into a hypobranchial plate (containing efferent vessel) and an epibranchial lobe. Between these marginal lobes are two pairs of shorter lobes. Thus the epibranchial surface shows six rows of blunt lobes, which are arranged above afferent blood vessel. Towards tip of gill, length and number of lobes is gradually reduced. There are well separated afferent and efferent channels in basal plate but with a series of six elongate lobes developed on outer margin. These lobes are arranged into a longer pair on each side of gill with another, smaller pair medially. At base of outer lobes there is a small notch on each side, but this is not produced as a lobe.

Cheliped stout, much longer and stouter than first leg. Merus trigonal; inner face smooth and fitting closely against pterygostomial region of carapace; superior border has a subterminal broad, restriction which separates a thickened, smooth distal ridge, from a row of five to six small granules; inferior face has three blunt subdistal tubercles. Outer face of carpus convex with many small granules, which tend to be arranged in parallel rows, and divided by a smooth longitudinal channel, two more prominent blunt tubercles on distal margin; inner superior border with three blunt tubercles, all of similar size and most distal one abuts against proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin produced as a smooth obtuse flange fitting against merus when limb is withdrawn. Outer and superior faces of propodus with scattered small granules; inner and inferior faces smooth, except that there is a small proximal tubercle on inner propodal face. Fixed finger almost straight with seven or eight small teeth increasing in size distally; moveable finger not strongly curved, with one large proximal tooth and four teeth at tip, interlocking with opposing teeth. A narrowing band of setae extend on to outer face of moveable finger. Both fingers, thick, hollowed out internally, gaping basally, touching for about half their length. In hollowed out interior of each finger there are small tufts of long setae which come together when fingers are closed.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus smooth and nacreous, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with several small granules, length of merus of second leg about 2.6 x width and equal to about half of CL. Anterior and posterior dorsal margins of carpi without granules, and produced distally to overhang the base of propodi. Surface of propodi smooth. Dactyli curved, inferior margin armed with four small distal spines, tip brown and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace, reaching about halfway to end of meral article of preceding pereopod; borders of articles unarmed. Male propodal extension bearing five unequal curved spines. Male dactyl longer than propodal extension and ending in a single acute claw. Microscopic details of dactyl and propodal spines unknown. Female unknown.

All segments of abdomen freely moveable. Telson much wider than long, anterior margin essentially straight; posterior margin broadly rounded. Uropod plates large, filling all of space between penultimate abdominal segment and telson, excluding all of last abdominal segment from reaching lateral margin of abdomen. No effective

abdominal locking mechanism: small bifid tubercle on coxa of first walking leg beside uropods restricts sideways movement. Abdomen only loosely held against sternum. Telson only extends as far as bases of third maxillipeds.

Five pairs of pleopods in male; first pleopod a semi-rolled tube ending in a curved apical plate surrounded by long setae; second pleopod needle-like with an exopod on basis, remaining pleopods rudimentary and biramous. Microscopic details unavailable. Female unknown.

ETYMOLOGY. — This new species is named after Alain CROSNIER in recognition of his enormous contribution to the study of decapod crustaceans.

COLOUR. — Whole body covered with a pale tan velvet tomentum.

GEOGRAPHIC DISTRIBUTION. — *Metadynomene crosnieri* is known only from the type locality near the Glorieuses Ids, south of the Seychelle Ids, Indian Ocean.

DEPTH. — The depth of the type locality is between 330 and 440 m.

SIZE. — Only the male type specimen is known, 23.2 x 22.7 mm.

DISCUSSION. — At a casual glance the three species in this genus are extraordinarily similar: they are relatively large dynomenids and all have a short, soft, undulating tomentum. Indeed the specimen of *M. crosnieri* was originally mis-identified as *M. devaneyi*. Of the external differences between the species (see Table 3) the most important are those of the anterolateral carapace margin and the prominence of the suborbital margin. *M. devaneyi* is distinctive in not having any anterolateral teeth while *M. crosnieri* has four small subacute teeth. The anterolateral teeth in *M. tanensis* are somewhat variable but there are usually at least three well developed teeth. In all cases it is necessary to carefully remove the tomentum to expose the anterolateral margin.

TABLE 3. — Comparison of the *Metadynomene* species.

	M. devaneyi	*M. tanensis*	*M. crosnieri*
Carapace surface	No granules	A few minute granules in branchial area	No granules
Carapace grooves	Well marked	Only faintly marked	Well marked
Anterolateral teeth	None: only a faint notch marking cervical groove	Three well developed teeth, second tooth can have two smaller teeth close by	Four small subacute teeth
Posterolateral tooth	None	Strong tooth	Weak tooth
Suborbital margin	Projecting and visible dorsally	Projecting and visible dorsally	Not projecting and not visible dorsally
Cheliped propodus	Outer face smooth, superior face with three small granules	Outer and superior faces with several small granules	Outer and superior faces with several small granules
Cheliped carpus outer face	Smooth except for two prominent blunt tubercles	Many small granules and three blunt unequal tubercles	Many small granules, arranged in rows, and two prominent blunt tubercles
Gills	Five dorsal lobes	Three dorsal lobes	Six dorsal lobes

There are some minor differences between the gills of the three species of *Metadynomene*. *M. crosnieri* has the largest number of epibranchial lobes (six) while the other two species have four. Thus in all species the epibranchial portion of the gills is trichobranchiate-like, while the hypobranchial portion is more

phyllobranchiate-like. In *M. devaneyi* and *M. tanensis* the hypobranchial cleaning setae are well developed. In *M. tanensis* there is a podobranch on the last pereopod, but this gill is absent in *M. devaneyi*.

GUINOT (1993, as *Dynomene devaneyi*) described the abdominal locking structures of *Metadynomene crosnieri* and the rudimentary third male pleopod. The male abdomen is only loosely retained by small bifid teeth on the coxae of the second pereopods. The rudimentary third to fifth male pleopods are biramous as in the other two species of this genus.

The species of *Metadynomene* show a remarkable resemblance to the dromiid *Dromia wilsoni* (Fulton & Grant, 1902). The short undulating tomentum gives a superficial similarity, but inspection of the last two pairs of legs reveals that these dynomenids are very different. Material sorted by a non-specialist often has these species mixed together. Since all these species live in deeper water, these features may be convergent.

None of the species of *Metadynomene* have overlapping distributions: *M. crosnieri* is known from the Indian Ocean, *M. tanensis* from the western Pacific and *M. devaneyi* from much further east at Hawaii. Given their high degree of similarity it may be that these species are of quite recent origin.

Genus *ACANTHODROMIA* A. Milne Edwards, 1880

Acanthodromia A. Milne Edwards, 1880: 31. — BOUVIER, 1896: 56. — ALCOCK, 1899: 134; 1901: 36. — ORTMANN, 1899: 1155. — A. MILNE EDWARDS & BOUVIER, 1902: 22. — RATHBUN, 1937: 55.

DIAGNOSIS. — Carapace longer than wide, convex, ovoid; surface bristling with long spines. Lateral carapace margin poorly defined, without distinct teeth but bearing numerous spines. Carapace grooves not well marked, but lateral cardiac and branchial grooves faintly evident. Frontal carapace margin broadly triangular, spinous; eyestalks short; eyes protected by well defined orbits. Sternal sutures 7/8 of female end well apart on low tubercles behind bases of second walking legs.

Antennule can be concealed inside orbit at base of eyestalk. Antennal flagella shorter than carapace width. All articles of antenna moveable, first article (urinal) not beaked medially and second article has an exopod firmly fixed. Third maxillipeds opercular, completely covering buccal cavern, separated at their bases by a plate at same level as sternum; basis and ischium of endopod fused but joint always marked by a shallow groove. Crista dentata absent. Chelipeds equal, stouter than walking legs; last pair of legs very reduced; dactyl rudimentary, forming an obsolete subchelate mechanism with an extension of propodus. Gills usually 19 (including 6 podobranchs) + 7 epipods. Gill structure basically phyllobranchiate.

Abdomen of six segments and telson folded loosely under thorax, uropods large. Abdominal locking mechanism present, using well developed coxal projections. Surface of abdominal segments spinous, except for fourth segment which bears one or more large, pearl-like, medial tubercles. Females have five pairs of pleopods, first pair vestigial, remainder biramous and of normal size. Male pleopods unknown.

TYPE SPECIES. — *Acanthodromia erinacea* A. Milne Edwards, 1880, by monotypy. Gender is feminine.

OTHER SPECIES. — *Dynomene margarita* Alcock, 1899.

DISCUSSION. — The original definition of *Acanthodromia* by A. MILNE EDWARDS (1880) included reference to the shape of the carapace (narrow and ovoid) and its fronto-orbital region, third maxillipeds, walking legs, and the rudimentary and cheliform last legs. A. MILNE EDWARDS placed this genus in his family "Dromiens", between *Dromia* and *Dynomene*, along with other dromiids and the homolodromiid genus *Dicranodromia* A. Milne Edwards, 1880. Later A. MILNE EDWARDS and BOUVIER (1902) separated these into three sub-families, retaining *Dynomene* and *Acanthodromia* in the Dynominae. They noted that *Acanthodromia* represented a curious mixture of primitive (e.g. carapace longer than wide) and "secondary" (e.g. non filamentous gills) characters which distinguished it from *Dynomene*. To these can be added the absence of a beaked first antennal article and a crista dentata. The main reason for including *Acanthodromia* in the Dynomenidae is the structure of the reduced last pair of legs. To include it any where else would require the assumption that these limbs had evolved more than once.

WRIGHT and COLLINS (1972: 24) have suggested that the genus *Acanthodromia* should be included in the fossil family Prosopidae Von Meyer, 1860, sub-family Pithonothinae Glaessner, 1933, thus making it the only genus of this family to survive to recent times. They considered that "*Acanthodromia* appears to be no more than a spinose *Plagiophthalmus* Bell, 1863 in which the main furrows are obsolescent." However this seems ill-advised because, although the carapace of *Acanthodromia* is longer than wide, it lacks a distinct carapace margin which is a feature of *Plagiophthalmus*. Thus the indication by BRIGGS *et al* (1993) that the Prosopidae have a fossil record extending from the mid Jurassic to the present day is incorrect.

Acanthodromia erinacea A. Milne Edwards, 1880

Figs 6 d, 9 f, 10 a, 30

Acanthodromia erinacea A. Milne Edwards, 1880: 31. — BOUVIER, 1896: 56, figs 18-21. — YOUNG, 1900: 336. — ALCOCK, 1901: 75 (list). — A. MILNE EDWARDS & BOUVIER, 1902: 23, text-figs 7-8, pl. 3, figs 5-15, pl. 4, figs 1-4. — IHLE, 1913: 92 (list). — RATHBUN, 1937: 55, pl. 12, figs 5-6. — RICE, 1981: 174.

MATERIAL EXAMINED. — **Guadeloupe**. *"Blake"*: stn 166, 275 m, coll. A. AGASSIZ, 21.01.1878: 1 ♀ ovig. 16.7 x 17.7 mm, holotype (MCZ 6509).

Mexico. *Yucatan*. *"Albatross"*: stn 2354, Arrowsmith Bank, 238 m, 22.01.1885: 1 ♀ 9.5 x 11.5 mm. (USNM 9547).

TYPES. — The holotype is an ovigerous female 16.7 x 17.7 mm, collected by A. AGASSIZ from *"Blake"* stn 166, 15°55.50'N, 61°37.05'W, Leeward Ids, off Guadeloupe, 275 m, 21.01.1878, held at the Museum of Comparative Zoology, Harvard University, registration number MCZ 6509. A paratype specimen, consisting of only a carapace, was collected from *"Blake"* stn 232, 13°6.45'N, 61°6.55'W, Windward Ids, off St. Vincent, 158 m, 21.02.1879, registration number MCZ 2641.

DESCRIPTION. — Carapace longer than wide, ratio of CW/CL = 0.90-0.94, ovoid in outline, surface evenly convex, with a dense cover of acute spines and spinules with occasional long setae. Microscopic details of setae not investigated. Density of spines completely obscures body surface. Frontal, cervical, and post-cervical grooves not evident, crescentic lateral cardiac grooves and branchial groove faint, posterior cardiac area not defined. Anterolateral carapace margin poorly defined, begins below level of postorbital corner, subparallel and adorned with longer spines but these are not arranged in a well-defined row. Posterolateral border convergent alongside which lies the reduced last leg. Posterior carapace margin recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin V-shaped, spinous, ventrally-directed, joined to epistome (which separates orbits). Supraorbital margin projecting, continuous above orbits, eave-like, not interrupted by a notch, adorned with long spines which become smaller near postorbital corner and curved posteriorly. Suborbital margin concave adorned by long spines with a larger spine at inner corner. Cornea of eye and suborbital margin clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region; prominent spine mid-way along length; distal margin spinous, obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, bearing a row of three or four spines, not medially beaked, opening of antennal gland is on medial margin and concealed against base of antennule. Second article spinous, longer than wide; medial margin longest produced as a spine, to which third article is fixed. Exopod short, spinous, blunt extending behind third antennal article and curving over base of eyestalk. Third and fourth antennal articles as wide as long, lying over distal end of exopod and continued as a flagellum which is 0.6 x CW. Eyestalk can be completely folded into orbit (where it is well protected by marginal spines), outer surface spinous; cornea light brown, well developed, occupying all of tip. Epistome triangular, surface slightly concave; dorsal arm joined to tip of carapace, margins bearing spines; lateral arms shorter. Joint between epistome and carapace marked by a narrow suture.

Subhepatic area inflated, covered with tubercles. A groove (pleural suture or linea dromica) begins near base of the antenna, curving round under branchial region and towards anterolateral carapace margin about mid-way along

its length. A short groove branches off, ascending and curving towards postorbital corner marking posterior margin of inflated subhepatic area. Third maxillipeds operculiform, bases separated by tip of sternum, without crista dentata; coxae armed with prominent medial projections under which telson fits when at rest. Female sternal sutures 7/8 short, ending wide apart under an overhanging lip immediately below female gonopores.

Branchial formula according to A. MILNE EDWARDS and BOUVIER (1902: 24) is 19 gills + 7 epipods (see Discussion below). In cross section gills consist of pairs plates, one on each side of gill axis, with epibranchial tips of each plate ending in a blunt thickened lobe. Lateral margins of each plate faintly notched about mid-way along their length.

Cheliped stouter and longer than first leg. Merus trigonal, inner face roughened with rounded tubercles and fitting closely against pterygostomial region of carapace; borders spinous, superior border has a faint subterminal restriction which separates a thickened distal ridge, on which there are several spines, from a row of five or six similar spines on superior border. Outer face of carpus convex with small blunt tubercles interspersed among longer, sharper spines; inner superior border lacks a flattened, distomedially directed, spur restricting closure of cheliped. Instead, both superior and inferior inner margins of carpus are spinous like outer face. Entire surface of propodus covered with spines which are longer on superior and outer faces. Outer surface of fingers covered with tubercles and small spines. Dactyl strongly downcurved, margin sinuous but not interrupted by teeth except at tip where there are two blunt teeth, roof of finger strongly concave. Fixed finger almost straight with three evenly spaced, blunt teeth on outer margin, three further teeth on tip (interlocking with pair of teeth on dactyl), inner margin without teeth and floor strongly concave. Small groups of long stiff setae, inserted near base of dactyl and fixed finger, are directed across space between the two fingers. Spoon-shaped fingers gape proximally on internal face but there is only a small gape externally.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus covered with low rounded tubercles; inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with numerous long spines, length of merus of second leg about 1.5 x width and equal to about one third of CL. Dorsal margins of carpi bearing several long spines, and produced distally to overhang base of propodi. Propodi bearing numerous long spines. Dactyli curved, bearing numerous shorter spines; inferior margin armed with five small spines similar to tip which is dark brown and subacute.

Last pair of legs greatly reduced, lying along posterolateral border of carapace above bases of walking legs, reaching to about half-way along meral article of preceding limb; borders of articles spinous; basis-ischium and merus fused. In female last pair of legs subchelate with well developed distal extension of propodus which opposes dactyl. Propodal extension bearing seven, unequal, stout, hooked, spines facing laterally, with marginal rows of 6-10 tiny flattened teeth proximally on concave inner surface, and distal area free of teeth. These marginal teeth are curved inwards, without meeting the opposite row, and directed distomedially. Female dactyl as long as propodal extension, bearing eight unequal, stout, hooked spines (arranged asymmetrically around perimeter of dactyl) whose inner surface is edentate. Male unknown.

All segments of abdomen freely moveable, length and breadth of all segments similar, surface spinous, with occasional setae, margins unarmed. First segment partially concealed under posterior border of carapace, visible portion fits into recess and articulates with carapace margin; anterior margin of second segment sinuous; medial region convex and inserted under margin of preceding segment; lateral margins produced as a flange which fits over posterior margin of first segment thereby preventing forward slippage of abdomen. Subsequent segments articulated in a similar manner. Anterior half of fourth segment with two small pearl-like medial tubercles almost totally united except for a narrow proximal fissure. Rest of medial region behind these two rounded tubercles bears several spines. Fifth abdominal segment has a pair of similar but smaller tubercles, separated by a fissure which extends posteriorly on to sixth segment, between the tubercles. Telson spinous, much wider than long; anterior margin angled to accommodate uropod; posterior margin broadly rounded. In female uropod plates are large, filling about half of the space between last abdominal segment and telson, excluding much of last abdominal segment from reaching lateral margin of abdomen. Male characters unknown. Abdominal locking mechanism well developed: when at rest, abdomen of mature female lies between bordering flanges on first three pereopods with telson beneath coxal projections of third maxillipeds.

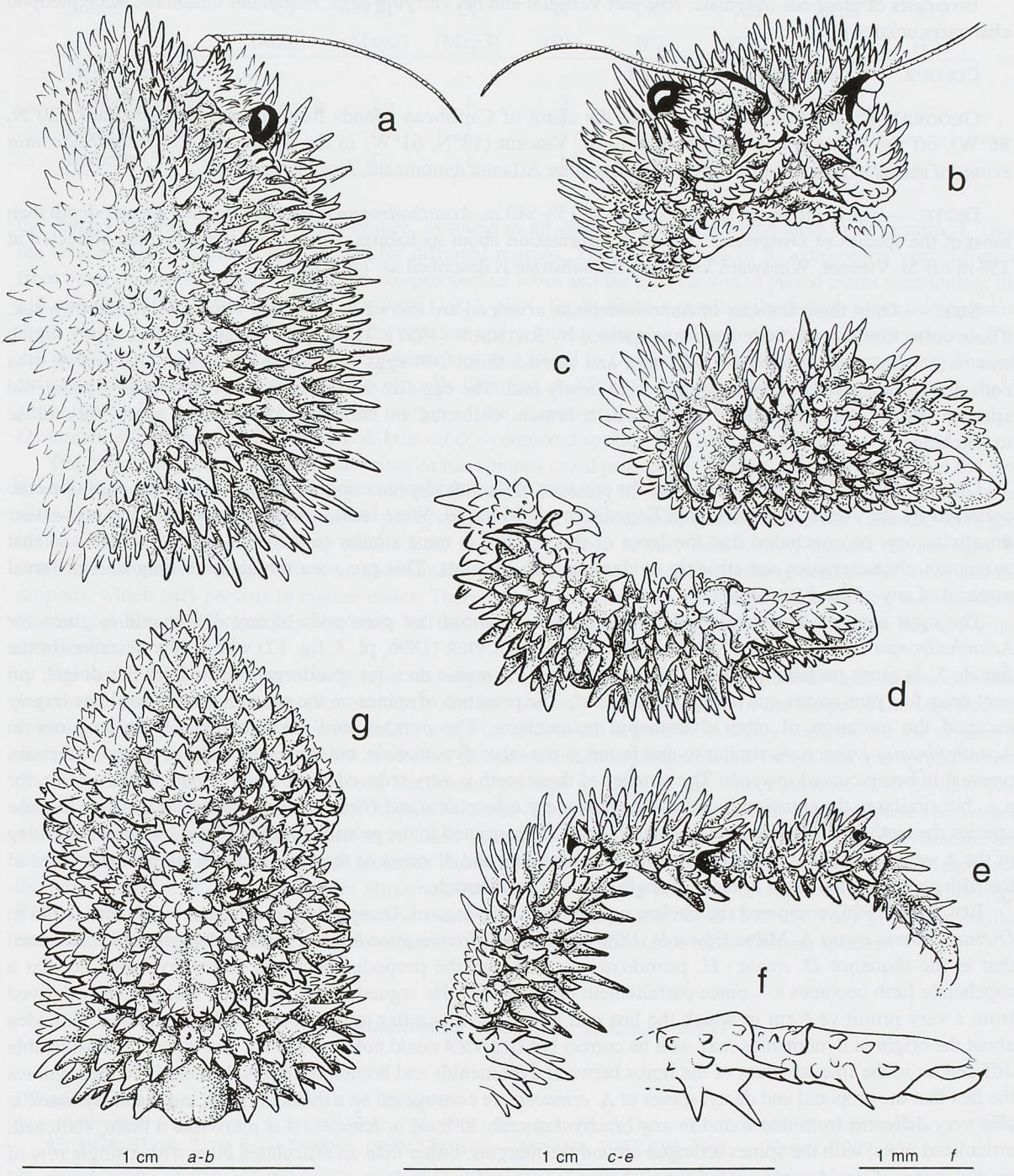


FIG. 30. — *Acanthodromia erinacea* A. Milne Edwards, 1880, ♀ ovig. 16.7 x 17.7 mm, holotype, Guadeloupe, *"Blake"*, stn 166, 275 m (MCZ 6509): **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of female abdomen (uropods concealed by strong spinulation).

Five pairs of pleopods in female, first pair vestigial and not carrying eggs, remainder biramous. Male pleopod characters unknown.

COLOUR. — Pale cream when preserved.

GEOGRAPHIC DISTRIBUTION. — Along the chain of Caribbean islands from the Arrowsmith Bank (20°N, 86°W), off the Yucatan coast of Mexico, to St. Vincent (13°N, 61°W) in the Windward Ids. *Acanthodromia erinacea* seems to be an insular species like the other Atlantic dynomenid, *Dynomene filholi*.

DEPTH. — The depth range for this species is 158-540 m. *Acanthodromia erinacea* lives at a greater depth than most of the species of *Dynomene*. The only information about its habitat comes from the specimen collected at 158 m off St. Vincent, Windward Ids where the substrate is described as "coral bottom".

SIZE. — Only three females of *Acanthodromia erinacea* are known as well as a carapace of unknown sex. These collection records have been summarized by RATHBUN (1937). The largest female (the holotype), which was ovigerous, measured 16.7 x 17.7 mm and carried about 100 eggs of 0.5 mm diameter. This female was collected in January, 1878 and the eggs were newly laid. The egg size is similar to that of the other dynomenid species. RICE (1981) examined eggs from a female collected in February 1933 which were very close to hatching.

DISCUSSION. — RICE (1981) described the pre-zoea of *Acanthodromia erinacea* dissected from the eggs of a crab collected by the Johnson-Smithsonian Expedition off Mona Id, West Indies. Although the material was rather unsatisfactory, he concluded that the larva of this species is most similar to those of the Dromiidae and that anomuran characteristics are strongly evident in both families. This pre-zoea remains the only known larval material of any of the dynomenids.

The most accurate and detailed description of the reduced last pereopods of any dynomenid is given for *Acanthodromia erinacea* by A. MILNE EDWARDS and BOUVIER (1896, pl. 3, fig. 12) where they describe for the female "...la pince parfaite qui termine ces appendices est munie de soies spiniformes sur le bord des doigts, qui sont deux fois plus courts que la région palmaire". The presence of spines on the propodus and dactyl has largely escaped the attention of other dynomenid researchers. The number and arrangement of these spines in *Acanthodromia erinacea* is similar to that found in the other dynomenids, but the teeth on the propodal spines are unusual in being curved inwards. The number of these teeth is very reduced compared to *Dynomene hispida*, for e.g., but similar to the situation found in *Paradynomene tuberculata* and *Hirsutodynomene ursula* females. In these species the teeth are only found on the margins and are restricted to the proximal region of the spines. The last leg of the *A. erinacea* male is unknown. In both *P. tuberculata* and *A. erinacea* the basis-ischium and merus articles of the fifth pereopods are fused to make a single bent or curved article.

BOUVIER (1896) compared the chelate nature of the last legs of *Acanthodromia erinacea* with that found in *Dicranodromia ovata* A. Milne Edwards, 1880 and *Homolodromia paradoxa* A. Milne Edwards, 1880. He noted that in the sequence *D. ovata* - *H. paradoxa* - *A. erinacea* the propodus becomes more developed so that a subchelate limb becomes a "..pince parfaitement caracterisée". He argued that *A. erinacea* was probably derived from a very primitive form in which the last pair of legs were similar to that found in *H. paradoxa*. This idea about the origin of dynomenids may well be correct but BOUVIER could not have known that there are considerable differences in the fine structure of the limbs between dynomenids and homolodromiids. His intuitive idea ignores the fact that the propodal and dactyl spines of *A. erinacea* are constructed on a different plan, and the dactyl itself is also very different from that found in any brachyuran crab: at least in females, it is more like a blunt, flattened, articulated plate, with the spines arranged around the margins, rather than an articulated claw with a single row of medial spines. Considerable evolutionary change is required to transform a camouflage-carrying homolodromiid limb into what may have been some kind of cleaning appendage.

The branchial formula of *Acanthodromia erinacea* is summarized in the table at the top of the next page.

The branchial formula given by A. MILNE EDWARDS and BOUVIER (1902) for this species is 19 gills + 7 epipods. However there seem to some errors in this interpretation. Firstly, they omitted the podobranch of the second maxilliped and secondly, they indicated that the third maxilliped had two arthrobranchs. It seems likely that

Somite	VII (Mxp1)	VIII (Mxp2)	IX (Mxp3)	X (P1)	XI (P2)	XII (P3)	XIII (P4)	XIV (P5)
Pleurobranchiae	-	-	-	-	1	1	1	-
Arthrobranchiae	-	1	1	2	2	2	2	-
Podobranchiae	-	1	1	1	1	1	1	-
Epipods	1	1	1	1	1	1	1	-

the correct number is only one arthrobranch, as found in all other dynomenids which have been examined. Thus the total number of gills is still 19, but for different reasons. The gill structure of *A. erinacea* is very different from other dynomenid species: there are no epibranchial lobes and the gills consist of paired plates surrounding the gill axis. A. MILNE EDWARDS and BOUVIER (1902, pl. 4, fig 4) show a small epibranchial projection between these plates, but I could not find this. The anterior and posterior margins of each plate are slightly notched. The gill structure of *A. erinacea* most closely resembles that found in *Dynomene hispida* and *D. praedator*. The gill structure of *Acanthodromia margarita* is virtually identical. A. MILNE EDWARDS and BOUVIER (1902, pl. 3, fig 7) show three long setae on the posterior margin of the scaphognathite. This number of setae is only found in *Dynomene filholi* and *D. pilumnoides*. All the other dynomenid species only have two such setae.

The mature female *Acanthodromia erinacea* has spinous coxal projections on the third maxillipeds and the first three pereopods which appear to help hold the abdomen in place. In order to release the abdomen, it would be necessary for these pereopods to move posteriorly. In other dynomenids, neither males nor females, have any really effective abdominal locking mechanism, and the abdomen is only held loosely against the sternum. In immature dromiids both sexes have an abdominal locking mechanism, usually involving pereopodal coxae and the uropods, which only persists in mature males. Therefore *A. erinacea* is unusual in having a locking mechanism in mature females. Unfortunately the male of this species is unknown but presumably it also has a similar mechanism.

For two species inhabiting widely separated regions (Indo-West Pacific and Caribbean Sea), *Acanthodromia margarita* and *A. erinacea* are extraordinarily similar: the only differences are in the shape of the supraorbital spines, and the pearl-like lobes on the fourth and fifth abdominal segments. A likely scenario for the origins of these two species might be as follows: species of *Acanthodromia* originated in the Tethys Sea and spread to seas that eventually became the Atlantic and Caribbean, perhaps as early as the Upper Jurassic (145 mybp). This dispersal could have been as late as the Middle Miocene (25 mybp), when connections between these two oceans was severed, but an earlier date seems more likely because even by Palaeocene times (65 mybp) the Atlantic was already well formed and the Caribbean isolated. Therefore these two species could have been separated at least since the Palaeocene (or at latest the Middle Miocene), but there has scarcely been any divergence in their morphology. Both are deeper water species although *A. erinacea* extends to a greater depth (540 m). They grow to a similar maximum size and inhabit muddy coral bottoms. *A. erinacea* appears to be a relict Tethyan species.

Acanthodromia margarita (Alcock, 1899)

Fig. 31

Dynomene margarita Alcock, 1899: 19, pl. 2, fig 3.

Acanthodromia margarita - ALCOCK, 1900: 134; 1901: 36, pl. 1, fig. 3, 3a. — IHLE, 1913: 92 (list). — SAKAI, 1965b: 43; 1976: 31, pl. 7, fig 2. — SERÈNE, 1968: 37 (list). — MIYAKE, 1983: 196 (list). — NAGAI, 1989: 43.

MATERIAL EXAMINED. — **Japan**. Wakayama, 120 m, 1989, S. NAGAI coll.: 1 ♀ 12.0 X 13.0 mm (see NAGAI, 1989).

TYPES. — *Dynomene margarita* Alcock, 1899: holotype is a male 4.5 x 5.0 mm, collected by the *"Investigator"*, from 13°16.00'N, 93°08.00'E, Andaman Sea, 135 m, held by the Indian Museum, Calcutta, registration number 2690/10.

DESCRIPTION. — Carapace longer than wide, ratio of CW/CL = 0.92, ovoid in outline; surface evenly convex, with a dense cover of acute spines and spinules with occasional long setae. Microscopic details of setae not investigated. Density of spines completely obscures body surface. Frontal, cervical, and post-cervical grooves not evident, crescentic lateral cardiac grooves and branchial groove faint, posterior cardiac area not defined. Anterolateral carapace margin poorly defined, begins below level of postorbital corner, subparallel and adorned with longer spines but these are not arranged in a well-defined row. Posterolateral border convergent alongside which lies the reduced last leg. Posterior carapace margin recessed in order to accommodate first segment of abdomen which is visible dorsally.

Frontal margin V-shaped, spinous, ventrally-directed, joined to epistome. Supraorbital margin projecting, continuous above orbits, eave-like, not interrupted by a notch, adorned with long spines which become smaller and blunter near postorbital corner and are not curved posteriorly. Suborbital margin concave, adorned by small spines with a larger spine at inner corner. Cornea of eye and suborbital margin clearly exposed dorsally.

First article of antennule large, filling a large part of ventral orbital region, prominent spine mid-way along length; distal margin spinous, obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. First article of antenna moveable, wider than long, bearing a row of spines, not medially beaked, opening of antennal gland is on medial margin and concealed against base of antennule. Second article spinous, longer than wide, medial margin longest produced as a spine, to which is fixed the third article. Exopod short, spinous, blunt extending behind third antennal article and curving over base of eyestalk. Remaining antennal articles absent from specimen. Eyestalk can be completely folded into orbit, outer surface spinous; cornea light brown, well developed, occupying all of tip. Epistome triangular, surface slightly concave; dorsal arm joined to tip of carapace margins bearing spines; lateral arms shorter. Joint between epistome and carapace marked by a narrow suture.

Subhepatic area inflated, covered with tubercles. A groove (pleural suture or linea dromica) begins near base of antenna, curving round under branchial region and on to carapace to meet faint branchial groove. A short groove branches off, ascending and curving towards postorbital corner marking posterior margin of inflated subhepatic area. Third maxillipeds operculiform, bases widely separated by tip of sternum. Female sternal sutures 7/8 short, ending wide apart under an overhanging lip immediately below female gonopores.

Branchial formula unknown. In cross section gills consist of pairs plates, one on each side of the gill axis, with epibranchial tips of each plate ending in a blunt thickened lobe. Lateral margins of each plate are faintly notched about mid-way along their length.

Cheliped stouter and longer than first leg. Merus trigonal, inner face roughened with rounded tubercles and fitting closely against pterygostomial region of carapace; borders spinous, superior border has a faint subterminal restriction which separates a thickened distal ridge, on which there are several spines, from a row of five or six similar spines on the superior border. Outer face of carpus convex with small blunt tubercles interspersed among longer, sharper spines; inner superior border lacks a flattened, distomedially directed, spur restricting closure of cheliped. Instead, both superior and inferior inner margins are spinous like the outer face. Entire surface of propodus covered with spines which are longer on superior and outer faces. Outer surface of fingers covered with small spines. Dactyl strongly downcurved, margin sinuous but not interrupted by teeth except at tip where there are two blunt teeth, roof of finger strongly concave. Fixed finger almost straight with three evenly spaced blunt teeth on the outer margin, three further teeth on tip (interlocking with pair of teeth on dactyl), inner margin without teeth and floor strongly concave. Small groups of long stiff setae, inserted near base of dactyl and fixed finger, are directed across the space between the two fingers. Spoon-shaped fingers gape proximally on internal face but there is no gape externally.

First three pairs of walking legs decreasing in length posteriorly. Meri elongate, both faces of meri of first two legs and anterior face third leg merus covered with low rounded tubercles, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of second to fourth pereopods with numerous long spines, length of merus of third pereopod about 2.0 x width and equal to about one quarter of CL. Dorsal margins of carpi bearing several long spines, and produced distally to overhang base of propodi. Propodi bearing numerous long spines. Dactyli curved, bearing numerous shorter spines; inferior margin armed with four small spines similar to tip which is dark brown and subacute.

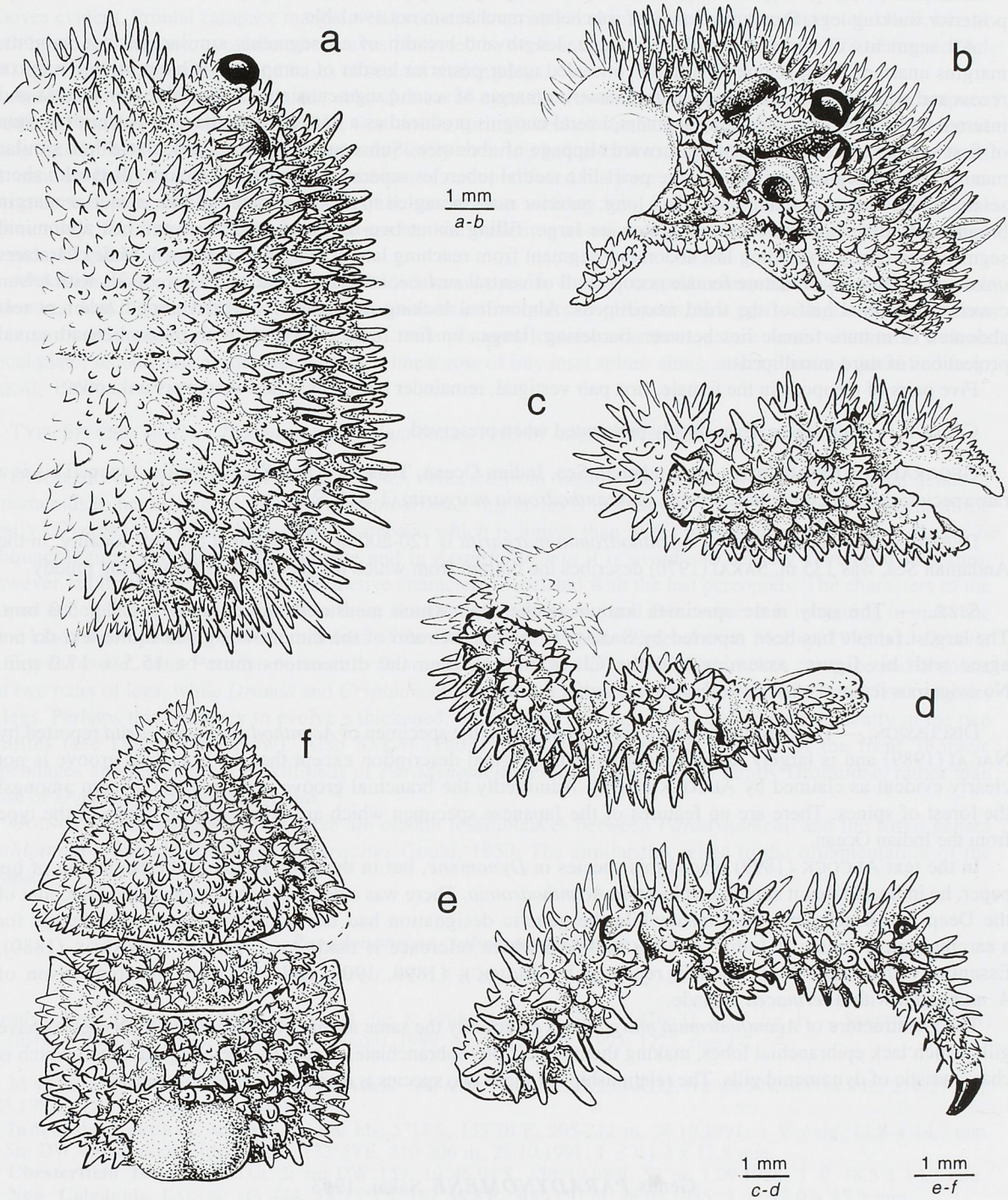


FIG. 31. — *Acanthodromia margarita* (Alcock, 1899): **a-f**, ♀ 12.0 x 13.0 mm, Wakayama, Japan, 120 m: **a**, dorsal view of right half of carapace; **b**, ventral view of left orbital area (note that most of antenna is missing) ; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, ventral view of telson and terminal segments of female abdomen (note that uropod plates are missing).

Last pair of legs greatly reduced; articles spinous, lying along posterolateral carapace border above bases of posterior walking legs. Structural details of subchelate mechanism not available.

All segments of abdomen freely moveable, length and breadth of all segments similar, surface spinous, margins unarmed. First segment partially concealed under posterior border of carapace, visible portion fits into a recess and articulates with carapace margin, anterior margin of second segment sinuous, medial region convex and inserted under margin of preceding segment, lateral margins produced as a flange which fits over posterior margin of first segment thereby preventing forward slippage of abdomen. Subsequent segments articulated in a similar manner. Fourth segment with two large pearl-like medial tubercles separated by a narrow fissure filled with short setae. Telson spinous, much wider than long; anterior margin angled to accommodate uropod; posterior margin broadly rounded. In female uropod plates are large, filling about two-thirds of space between last abdominal segment and telson, excluding last abdominal segment from reaching lateral margin of abdomen. Male characters unknown. Abdomen of mature female occupies all of ventral surface, covering coxae of all pereopods with telson covering proximal half of the third maxillipeds. Abdominal locking mechanism well developed: when at rest abdomen of mature female lies between bordering flanges on first three pereopods with telson beneath coxal projections of third maxillipeds.

Five pairs of pleopods in the female, first pair vestigial, remainder biramous. Male characters unknown.

COLOUR. — Pale cream. Eyes deeply pigmented when preserved.

GEOGRAPHIC DISTRIBUTION. — Andaman Sea, Indian Ocean, Tosa Bay, and Kii Peninsula, Japan. This is a rare species: there are only three records of *Acanthodromia margarita* (1 ♂, 2 ♀).

DEPTH. — The depth range for *Acanthodromia margarita* is 120-200 m. The depth at the type locality, in the Andaman Sea, was 135 m. SAKAI (1976) describes the bottom from which his specimen came as being muddy.

SIZE. — The only male specimen known is the type which measured approximately 4.5 x 5.0 mm. The largest female has been reported by SAKAI (1976) but the ratio of the dimensions given in the text do not agree with his figure: assuming that the CL is correct, then the dimensions must be 15.5 x 17.0 mm. No ovigerous females of *Acanthodromia margarita* are known.

DISCUSSION. — The description given above is based on the specimen of *Acanthodromia margarita* reported by NAGAI (1989) and is largely in agreement with the original description except that the branchial groove is not clearly evident as claimed by ALCOCK (1899). Admittedly the branchial groove is difficult to discern amongst the forest of spines. There are no features of the Japanese specimen which are different from those of the type from the Indian Ocean.

In the text ALCOCK (1899) placed this species in *Dynomene*, but in the Corrigenda, at the beginning of his paper, he indicated that it should be placed in *Acanthodromia*. There was a delay in publication of the "Account of the Deep-Sea Brachyura..."and meanwhile the generic designation had been corrected in his "Materials for a carcinological fauna of India" (ALCOCK, 1900) where reference is made to A. MILNE EDWARDS (1880). Essentially the same description is repeated by ALCOCK (1899, 1900, and 1901) but no comparison of *A. margarita* with *A. erinacea* is made.

The gill structure of *Acanthodromia margarita* is essentially the same as that of *A. erinacea*. Both species have gills which lack epibranchial lobes, making them almost phyllobranchiate, except for the marginal notch which is characteristic of dynomenid gills. The relationships of these two species is discussed under *A. erinacea*.

Genus ***PARADYNOMENE*** Sakai, 1963

Paradynomene Sakai, 1963: 230; 1965a: 13. — GUINOT, 1993: 1226.

DIAGNOSIS. — Carapace subquadrangular in shape, slightly longer than wide; surface convex, granulate, well areolated; individual areolae each having one or two low conical tubercles. Lateral carapace margins well defined,

subparallel and armed with irregular teeth. Narrow frontal groove split in two posteriorly; cervical, postcervical grooves evident. Frontal carapace margin well produced anteriorly, cut into three teeth; median tooth small; lateral teeth broad and cristate; eyestalks short; eyes protected by well defined orbits. Sternal sutures 7/8 of female end well apart on low tubercles behind bases of second walking legs.

Antennule can be concealed inside orbit at base of eyestalk. Antennal flagella shorter than half of carapace width. All articles of antenna moveable; first article (urinal) beaked medially and second article has an exopod firmly fixed. Third maxillipeds opercular, completely covering buccal cavern, separated at their bases by a plate at the same level as the sternum; basis and ischium of endopod fused but joint always marked by a shallow groove. Crista dentata present. Chelipeds robust, equal, stouter than walking legs. Last pair of legs very reduced; dactyl rudimentary, forming an obsolete chelate mechanism with an extension of propodus only in female. Branchial formula 19 gills + 7 epipods.

Abdomen of six segments and telson folded loosely under thorax; uropods comparatively small; effective abdominal locking mechanism absent. Both sexes have five pairs of pleopods, first pair vestigial in female, last three pairs rudimentary in male. First pair of male pleopods consist of a stout, setose semi-rolled tube with an apical plate; second pair needle-like bearing a linear row of tiny inset spines along anterior surface (modified from SAKAI, 1963).

TYPE SPECIES. — *Paradynomene tuberculata* Sakai, 1963 by original designation and monotypy.

DISCUSSION. — *Paradynomene* Sakai, 1963, collected from Sagami Bay, Japan, was the third extant genus of dynomenids to be discovered. As with *Acanthodromia*, this genus is radically different from the type genus of the family (*Dynomene*). While both have a carapace which is longer than wide, in *Paradynomene* the carapace is subquadrangular with tuberculate areolae and in *Acanthodromia* it is ovoid and densely covered with spines. However, all three genera share the distinctive characters associated with the last pereopods. The characters of the second male pleopod are also similar to those found in *Metadynomene* and *Dynomene*. It is intriguing to make the same kind of comparison between members of the Dromiidae: the genus *Epigodromia* McLay, 1993 is to *Dromia* or *Cryptodromia*, what *Paradynomene* is to *Dynomene*. *Epigodromia* has a highly areolate carapace and obsolete last two pairs of legs, while *Dromia* and *Cryptodromia* have a smooth setose carapace and functional last two pairs of legs. Perhaps this tendency to evolve a thickened, ornamented carapace has occurred independently in the two families (see Discussion below). Also SAKAI (1963) noted that the general features of the front, thoracic appendages and the external maxillipeds of *Paradynomene* resemble those of the family Dromiidae, rather than those of *Dynomene* or *Acanthodromia*.

GUINOT (1993) suggested that there are certain resemblances between *Paradynomene* and the fossil genera *Rathbunopon* Stenzel, 1945 and *Mithracites* Gould, 1859. The similarities relate to the ornamentation of the carapace.

Paradynomene tuberculata Sakai, 1963

Figs 4 e-f, 6 e-f, 7 c, e, 10 b-d, 14 a, 25 d, 32

Paradynomene tuberculata Sakai, 1963: 231, fig. 8; 1965a: 13, pl. 6, fig. 1; 1976: 31, pl. 7, fig. 1. — SERÈNE, 1968: 37 (list). — MIYAKE, 1983: 196 (list). — NAGAI, 1989: 43. — GUINOT, 1993: 1227, figs 1-2.

MATERIAL EXAMINED. — **Gulf of Aden.** *"Meteor"*: stn Me 5/230-KD2, 12°43.5'N, 43°14.8'E, 214-277 m, 5.03.1987: 1 ♂ 7.8 x 8.6 mm (SMF).

Indonesia. KARUBAR: stn DW 18, Kai Ids, 5°18'S, 133°01'E, 205-212 m, 24.10.1991: 1 ♀ ovig. 13.8 x 14.5 mm. — Stn DW 49, Tanimbar Ids, 8°00'S, 132°59'E, 210-206 m, 29.10.1991: 1 ♂ 11.2 x 12.5 mm.

Chesterfield Islands. CORAIL 2: stn DW 159, 19°46.04'S, 158°19.98'E, 52 m, 1.09.1988: 1 ♀ 18.5 x 18.3 mm.

New Caledonia. LAGON: stn 444, 18°15.3'S, 162°58.8'E, 300-350 m, 28.02.1985: 1 ♂ 17.0 x 17.2 mm.

SMIB 3: stn DW 14, 23°40.1'S, 167°59.7'E, 246 m, 22.05.1987: 1 ♂ 22.0 x 22.8 mm.

SMIB 4: stn DW 44, 24°46.0'S, 168°8.2'E, 300 m, 8.03.1989: 1 ♂ 17.0 x 17.8 mm.

SMIB 8: stn DW 184, 23°18'S, 168°05'E, 305-320 m, 31.01.1993: 1 ♂ 19.2 x 19.0 mm. — Stn DW 189, 23°18'S, 168°05'E, 400-402 m, 31.01.1993: 2 ♂ 12.2 x 13.1, 21.0 x 21.9 mm.

BATHUS 3: stn DW 830, 23°19'S, 168°01'E, 361-365 m, 23.11.1993: 1 ♂ 14.7 x 15.8 mm.

BATHUS 4: stn DW 931, 18°55'S, 163°24'E, 360-377 m, 7.08.1994: 1 ♂ 23.7 x 23.0 mm.
HALICAL 1: stn DW 02, 18°54'S, 163°24'E, 352-397 m, 23.11.1994: 1 ♀ 23.2 x 24.0 mm.
Loyalty Islands. MUSORSTOM 6: DW 406, 20°40.65'S, 167°06.80'E, 373 m, 15.02.1989: 1 ♂ 21.5 x 22.3 mm; 1 ♀ 21.5 x 21.2 mm; 1 ♀ ovig. 20.6 x 21.4 mm.
Guam (H. T. CONLEY coll.). Piti Lagoon, 13°27'N, 144°47'E, 1.2-7.5 m deep in dead coral, 26.05.1994: 1 ♂ 21.7 x 20.0 mm (UGM). — *Ibidem*, 4-8 m, among dead coral, 5.06.1994: 1 ♂ 17.2 x 16.4 mm (UGM). — *Ibidem*, 1.5-5 m, in coral rubble, 12.05.1997: 1 ♀ ovig. 20.5 x 19.4 mm (UGM).

TYPES. — The holotype is a male 9.5 x 10.5 mm, collected by His Majesty the Emperor of Japan, from 35°08.00'N, 139°37.00'E, west of Jogashima Misaki, Sagami Bay, Japan, 85 m, deposited in His Majesty's Museum at the Imperial Palace.

DESCRIPTION. — Carapace sparsely setose, longer than wide, ratio of CW/CL approx. 0.95, oblong in outline; posterior margin truncate; surface convex, areolate and granulate. There are about eighteen to nineteen swellings each marked by a subacute tubercle carrying three or four long (0.11 x CW), stiff serrate setae, and whole surface is covered in evenly distributed, rounded granules. Largest tubercles on inner branchial area. Pereopods also carry a few stiff setae, and abdomen margins and bases of third maxillipeds are densely covered with long, soft serrate setae. General body surface thickly covered with short setae, although these are only evident under high magnification. Structure of short and long setae are different. In short setae the proximal 40% of shaft is erect and lacks ornamentation, then the setae bend at about 45° and bear two opposite rows of fine setules decreasing in size distally. These setae are feather-like, lack an acute smooth tip, and are especially common in areas between carapace swellings. In long setae the proximal 50% of shaft is covered with small setules, then next 45% bears longer setules, projecting at right angles, increasing distally in size and finally last 5% is smooth, narrowing to an acute tip. Distal 50% of each setae curved, forming a U-shape, so that tip of setae is directed towards body.

A narrow frontal carapace groove separates a pair of small tubercles behind frontal margin, and then divides into separate grooves which terminate beside a similar median tubercle. Just in front of cardiac region two laterally-directed grooves originate: first groove (cervical) arises separately (but close together) from small gastric pits and runs directly anterolateral just in front of the largest tubercles on to branchial region. Second, shallower groove extends across mid-line and joins two deep, longitudinal pits bordering anterior cardiac region. Cardiac area is defined by grooves and adorned by two large tubercles. Branchial groove not evident. A row of four large tubercles curve across posterior region of carapace. Anterolateral carapace margin begins below level of postorbital corner, is slightly convex and bears six rather irregular, laterally directed, subacute teeth or tubercles. First, fourth and sixth teeth largest, and about equidistant, while second, third and fifth are mere tubercles in between. Posterolateral margin bears two teeth which are much larger than any of preceding anterolateral teeth. Posterior carapace margin is recessed in order to accommodate first segment of abdomen part of which is visible dorsally.

Frontal margin projecting, tridentate, ventrally-directed, joined to epistome (which separates orbits). Median tooth on a lower level, lateral teeth lie above on beginning of the orbital margin. Supraorbital margin has two small tubercles followed by a small notch closer to postorbital corner, which is granulated; suborbital margin with similar granules followed by a subacute tooth (visible dorsally) and then notched before inner corner. Orbits obliquely arranged, clearly exposed dorsally.

First article of antennule large, granulated, filling a large part of ventral orbital region; distal margin obliquely angled and not continuous with distal margin of second antennal article. Remainder of antennule folded into orbit. Antennal articles granulated; first article moveable, wider than long, medially beaked; inferior tooth well developed, blunt; superior tooth above opening of antennal gland is much smaller. Second article wider than long; distal margin widest, to which exopod is fixed, curving over base of eyestalk and becoming broader and terminating bluntly. Third antennal article longer than wide, and attached to remaining distal border of second article, slotting in behind exopod, and along with fourth article just surpassing length of exopod. Fourth antennal article smaller, as long as wide; remaining antennal articles directed laterally, extending well beyond postorbital corner, and can be partially folded under supra-orbital margin. Ratio of length of antennal flagella to CW = 0.35. Eyestalk can be completely folded into orbit, and cornea is well developed, occupying all of tip. Epistome broadly triangular, surface granulate and concave; dorsal arm, joined to tip of carapace, is very elongate and narrow; lateral arms shorter and thicker. Joint between epistome and carapace is marked by a faint suture.

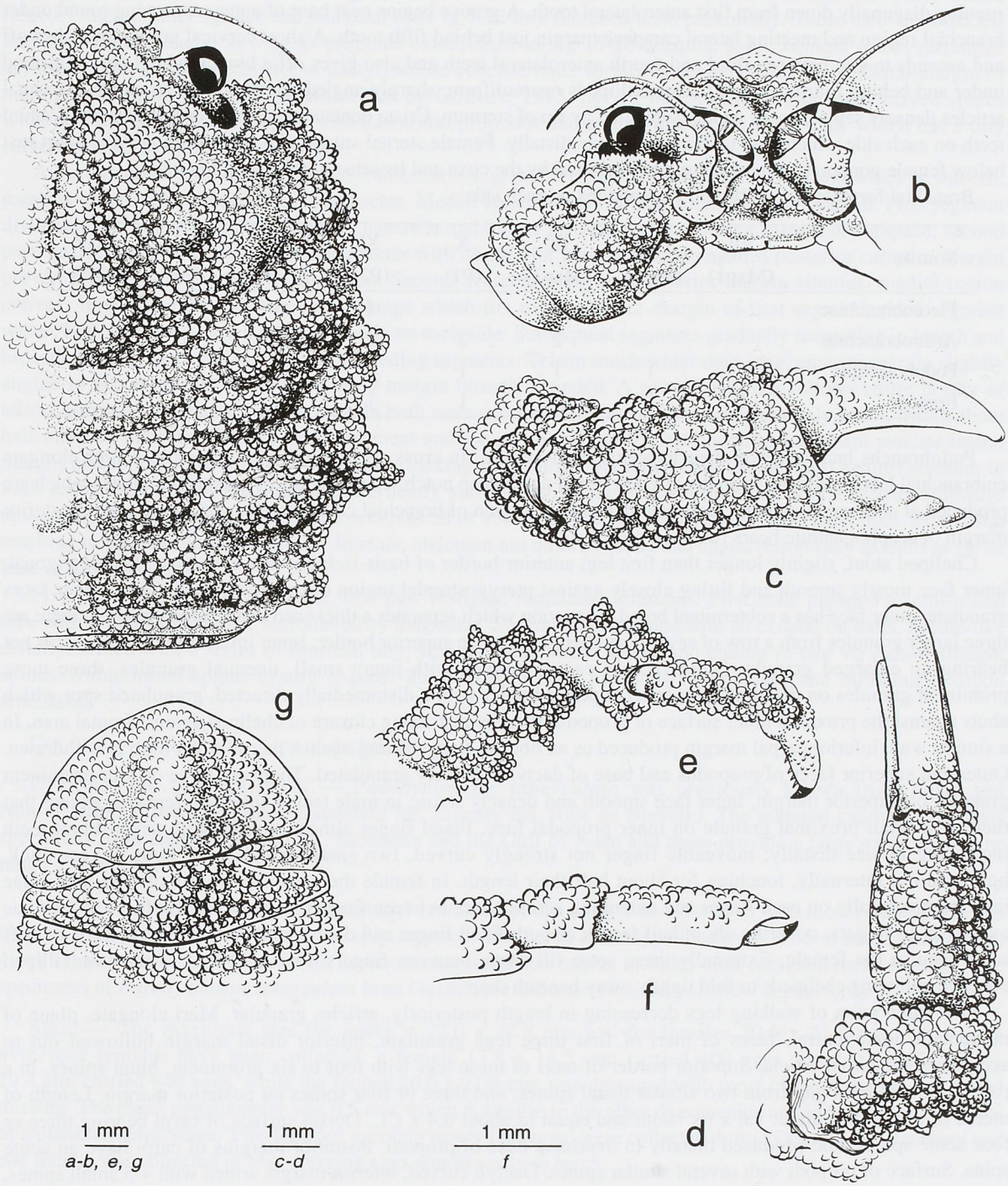


FIG. 32. — *Paradynomene tuberculata* Sakai, 1963, ♀ ovig. 13.8 x 14.5 mm, Kai Ids, Indonesia, KARUBAR, stn DW 18, 205-212 m: **a**, dorsal view of right half of carapace; **b**, ventral view of right orbital area; **c**, outer face of right cheliped; **d**, dorsal view of right cheliped; **e**, posterior view of terminal articles of right fourth pereopod; **f**, posterior view of terminal articles of right fifth pereopod; **g**, ventral view of telson and terminal segments of female abdomen.

Subhepatic area granulate, very inflated to an acute angle which is adorned with two or three larger granules running diagonally down from first anterolateral tooth. A groove begins near base of antenna, curving round under branchial region and meeting lateral carapace margin just behind fifth tooth. A short cervical groove branches off and ascends to gap between third and fourth anterolateral teeth and also gives off a branch which curves around under and behind fourth tooth. Third maxillipeds operculiform, sharply angled, distal articles granular, proximal articles densely setose, bases widely separated by tip of sternum. Crista dentata has twelve or thirteen small, blunt teeth on each side which tend to increase in size distally. Female sternal sutures 7/8 short, ending wide apart just below female gonopore, almost completely covered by the coxa and its setae of third walking legs.

Branchial formula is 19 gills and 7 epipodites on each side:

Somite	VII (Mxp1)	VIII (Mxp2)	IX (Mxp3)	X (P1)	XI (P2)	XII (P3)	XIII (P4)	XIV (P5)
Pleurobranchiae	-	-	-	-	1	1	1	-
Arthrobranchiae	-	-	2	2	2	2	2	-
Podobranchiae	-	1	1	1	1	1	1	-
Epipods	1	1	1	1	1	1	1	-

Podobranchs lack setae on their hypobranchial margin. In cross section, gill structure shows four elongate epibranchial lobes radiating from the afferent vessel and a deep notch separating off hypobranchial plates which are produced at corners. Hypobranchial setae in posterior region of branchial chamber very well developed. Posterior margin of scaphognathite bears two long setae.

Cheliped stout, slightly longer than first leg; anterior border of basis-ischium densely setose. Merus trigonal, inner face mostly smooth and fitting closely against pterygostomial region of carapace; borders and other faces granulate; outer face has a subterminal broad, restriction which separates a thickened distal ridge on which there are three larger granules from a row of several smaller granules on superior border. Inner inferior margin of merus not bearing an enlarged granule. Outer face of carpus convex with many small, unequal granules, three more prominent granules on distal margin; inner superior border with a distomedially directed, granulated spur which abuts against the proximal inner surface of propodus thereby restricting closure of cheliped against frontal area. In a similar way, inferior carpal margin produced as an obtuse, flange fitting against merus when limb is withdrawn. Outer and superior faces of propodus and base of dactylus densely granulated. There are three or four prominent granules on superior margin, inner face smooth and densely setose in male (setae absent in female), except that there is a small proximal granule on inner propodal face. Fixed finger almost straight with seven blunt teeth increasing in size distally; moveable finger not strongly curved, two small apical teeth, both fingers thick, hollowed out internally, touching for about half their length. In female there are small tufts of long stiff setae inserted proximally on each finger and extending across space between fingers. In male long soft propodal setae extend on to fingers, covering about half length of both fixed finger and dactyl, and embedding the tufts of stiff setae seen in the female. Externally these setae fill angle between fingers. Proximal half of third maxilliped concave, allowing chelipeds to fold tightly away beneath them.

First three pairs of walking legs decreasing in length posteriorly, articles granular. Meri elongate, plane of movement dorsoventral, faces of meri of first three legs granulate, inferior distal margin hollowed out to accommodate carpal article. Superior border of meri of these legs with four to six prominent, blunt spines, in a row, separated by a gap from two similar distal spines, and three or four spines on posterior margin. Length of merus of second leg about 1.6 x its width and equal to about 0.4 x CL. Dorsal surface of carpi bearing three or four acute spines, and produced distally to overhang base of propodi. Posterior margins of carpi have an acute spine. Surface of propodi with several similar spines. Dactyli curved, inferior margin armed with 4-5 small spines, tip brown and subacute.

Last pair of legs greatly reduced; surface granular but not spinous; basis-ischium and merus fused, lying along posterolateral border of carapace, reaching only as far as half-way along meral article of preceding limb. Subchelate, sexually dimorphic: female with well developed distal extension of propodus which opposes dactyl, male

without a propodal extension. Female propodal extension bearing 14-16, unequal, stout, hooked, spines with a ridged, concave inner surface and marginal rows of 7-12 tiny flattened teeth proximally. These teeth are directed laterally. Female dactyl as long as propodal extension, bearing 15-16 unequal, stout, hooked spines (arranged asymmetrically around perimeter of dactyl) whose concave inner surface is devoid of tiny teeth. Distal margin of male propodus not produced (as illustrated by GUINOT, 1993, fig. 1), but bearing five unequal curved spines without teeth. Male dactyl largely withdrawn into propodus and ending in a single acute claw which has a tiny subterminal spine on its dorsal margin.

All segments of abdomen freely moveable; surface granular except for central area of telson which is smooth: margins unarmed but fringed with short setae. Medial area of abdomen convex and clearly marked. First segment divided into two parts: first part hidden, narrower and longer inserted under posterior margin of carapace; second part, bearing four tubercles, wider and shorter with its anterior margin abutting against posterior carapace margin preventing forward slippage of abdomen. Second segment narrowest, anterior margin sinuous, medial region convex, lateral margins produced as a flange which fits over posterior margin of first segment; third segment wider; both segments have a lateral tubercle on each side. Subsequent segments gradually increasing in length and breadth distally, not overlapping with preceding segments. Telson much wider than long, anterior margin slightly angled to accommodate uropod, posterior margin broadly rounded. A row of granules follows entire border of telson, surrounding central smooth area. In both male and female uropod plates comparatively small, filling about half of space between last abdominal segment and telson, so that part of last abdominal segment reaches lateral margin of abdomen. No effective abdominal locking mechanism: abdomen only loosely held against sternum in both sexes. Margins of the abdomen are neatly surrounded by many coxal granules which restrict sideways movement. In mature female abdomen occupies all of ventral surface, covering coxae of all pereopods with telson reaching to base of third maxillipeds. In male, abdomen not quite so broad and again, telson only extends as far as base of third maxillipeds.

Five pairs of pleopods in female, first pair vestigial, remainder biramous. First male pleopod a semi-rolled tube with a small apical plate surrounded by long setae. Second male pleopod with an exopod on basis, needle-like distally, armed with a series of fourteen tiny, straight, acute, inset spines and ending in two very short straight spines. Subterminal spines evenly spaced. Third to fifth male pleopods rudimentary and biramous, exopod articulated.

COLOUR. — Pale brown. Tips of dactyli black.

GEOGRAPHIC DISTRIBUTION. — *Paradynomene tuberculata* was previously known from Japan and New Caledonia (including the Chesterfield Ids, Loyalty Ids, Ride de Norfolk). The material examined includes specimens from Guam, Mariana Ids, Indonesia and the Gulf of Aden and these provide a large extension of the range of this species.

DEPTH. — The depth range of the material examined in this study was 1.5-402 m with most of the specimens coming from greater depths than previously reported. The depth at the type locality was 85 m and SAKAI (1976) gives a depth range of 35-85 m for his Japanese material. Their habitat includes dead coral and rocky bottoms. The specimens of *Paradynomene tuberculata* from Guam were collected from very shallow depths: only 1.5 - 8 m.

SIZE. — The maximum size for males is 22.0 x 22.8 mm and for females 20.6 x 21.4 mm. Only three ovigerous females have been collected: a female 13.8 x 14.5 mm carried 400 eggs, another female 20.5 x 19.4 mm carried 840 eggs, while the female 20.6 x 21.4 mm was damaged with most of the abdomen and brood missing. The mean egg diameter was 0.5 mm which is similar to the other dynomenids and indicates the existence of a planktotrophic stage. Two females, carrying newly laid eggs, were collected during October and February and one female was collected in May carrying eggs almost ready to hatch.

DISCUSSION. — The description of *Paradynomene tuberculata* given here differs somewhat from that of SAKAI (1963). In the original description SAKAI stated that the lateral carapace borders are armed with six principal teeth, of which the third is somewhat dorsal in position and the last located on the posterolateral border, with several additional small teeth between the principal teeth. It is debatable whether the third tooth mentioned above should

be regarded as being marginal or not. In my description I have not treated it as being part of the anterolateral margin and I have treated the last two teeth as being on the posterolateral border because the carapace margin begins to curve inwards posteriorly. Exact enumeration of the anterolateral teeth is made difficult by the fact that there are a variable number of small teeth/tubercles following the first lacinated tooth. SAKAI also stated that the dactyli of second to fourth pereopods are unarmed, but 4-5 very small spines are present.

As found in all the other genera of the Dynomenidae, there are two sizes of setae and as in most species (except for *Dynomene hispida* and *D. praedator*) there are morphological differences between the two types of setae in *Paradynomene tuberculata*. While the long setae are similar to those found in other species, the short setae are very different. They are feather-like, lack an acute tip, and because they are bent, form a dense mat over the body surface. The only other dynomenid with feather-like setae is *Dynomene pugnatrix* as described by DE MAN (1889). The rarity of this species prevents a comparative microscopic study to confirm this similarity. The unusual short setae of *D. filholi* have a subterminal brush of fine setules, but in other respects they are quite different from the setae of *P. tuberculata*.

The gills of *Paradynomene tuberculata* have the typical dynomenid structure: there are four epibranchial lobes separated from the hypobranchial plate by a notch. This similar to that found in *Dynomene pilumnoides* and the species of *Metadynomene*. The posterior margin of the scaphognathite bears two long setae and there are no cleaning setae on the hypobranchial margin of the podobranchs. *P. tuberculata* is the only dynomenid in which these podobranch setae are absent. Particularly noteworthy is the extensive development of hypobranchial setae on the wall at the back of the gill chamber. These tufts of setae have also been reported from some dromiids.

In his original description, SAKAI (1963) did not include a description of the male pleopods. Although *Paradynomene tuberculata* is, in many respects, very different from the other dynomenids, its pleopods are clearly built on the same plan. The first pleopod has an apical oval lobe surrounded by a dense fringe of long setae and the second pleopod has an exopod at its base and is armed with a row of small inset distal spines. The terminal spines are reduced making the tip almost blunt as is found in dromiids such as *Stimdromia lamellata* (Ortmann, 1894) and *Epigodromia gilesii* (Alcock, 1899) (unpublished photos). The second male pleopods in these species lack spines of any description.

Several authors have commented upon the similarities between *Paradynomene* and certain dromiids. JAMIESON *et al.* (1993) described the structure of *Paradynomene* sperm and listed four or five synapomorphies with the sperm of some dromiids. With respect to the general features of the carapace front, thoracic appendages, and external maxillipeds, SAKAI (1963) noted the resemblance of *Paradynomene* to some dromiids rather than to *Dynomene* or *Acanthodromia*. The front or "face" of *Paradynomene* is different to the other dynomenids and remarkably similar to some dromiids like *Epigodromia* spp. In both these genera the rostrum is clearly tridentate, a feature seen only in *Paradynomene* and no other dynomenids. Also the "face" in these two genera is much flatter because the rostrum, inflated pterygostomial areas, and third maxillipeds all extend further forward compared to *Dynomene* spp. The longer coxa of the third maxilliped results in the whole of the endopod extending more anteriorly. In *Paradynomene* the merus of the third maxilliped forms almost a right angle with the preceding basis-ischium article whereas it forms a much greater angle in *Dynomene* with all of the articles lying more or less in the same plane. In both *Paradynomene* and *Epigodromia* the third maxilliped is much more strongly operculiform and fits more closely against the epistome so that there is a much narrower gap. Furthermore the chelipeds of these two genera are modified so as to fit compactly against the body and the bases of the third maxillipeds. In *Epigodromia* the anterior surface of the cheliped basis-ischium and merus is flattened so that the remainder of the cheliped can be folded tightly away. In *Paradynomene* the modification goes even further because the basis-ischium is sculptured so that the inferior surface of the cheliped propodus fits closely against a raised ridge (see also GUINOT, 1993). These two genera are also similar in having strongly calcified, areolate and tuberculate exteriors.

In both *Paradynomene tuberculata* and *Acanthodromia erinacea* the basis-ischium and merus articles of the fifth pereopods are fused to make a single bent or curved article. GUINOT (1993) examined closely the last pair of legs in *P. tuberculata*, noting the coxal extension which conducts sperm to the base of the male insemination organs, a feature unique to all dynomenids, and the extreme reduction of the dactyl, which is almost totally withdrawn inside the end of the propodus. However this is only true of the male. In the female the propodal extension, and opposing dactyl, are better developed (see figs 10b-d, 32f) and equipped with 14-16 hooked spines, amongst the

largest number of such spines found in any dynomenid. In the male the propodal extension is absent but still bears five spines (as found in most other dynomenid males) while the very small dactylus has a spine on its dorsal margin. This kind of dactyl spine is only found in males and besides *P. tuberculata*, only found in *Dynomene filholi* and *Metadynomene tanensis* (see these species for further discussion). However in the latter two species the spine, although similar in shape, is not on the dorsal margin but on the lateral margin of the dactylus. The dactylar spines are reminiscent of those found in both males and females of dromiids such as *Dromidiopsis* Borradaile, 1900, *Tunedromia* McLay, 1993, and *Lauridromia* McLay, 1993 where they are used, along with other spines, to assist in securing the sponge carried by the last two pairs of legs over the crab. However, in the dynomenids the spines are closely flattened against the surface of the dactyl so that they could not presently function in the same way as in the dromiids. These spines indicate a common ancestral relationship.

All these characters seem to indicate evolutionary convergence in *Paradynomene* and *Epigodromia*. It may be that the species of both these genera normally live partially buried in the surface coral fragments and that by tightly folding away their pereopods they resemble their surroundings because the rugose subquadrangular carapace resembles a piece of coral. It should be noted that *P. tuberculata* and *E. areolata* (Ihle, 1913), for example, have a similar depth range and specimens of both species have been collected from similar depths during the New Caledonia Lagoon survey, 1985 and the MUSORSTOM 6, 1989, expedition to the Loyalty Ids (see McLAY, 1993). *Epigodromia* has the last two pairs of pereopods very reduced, carried subdorsal and they are not used for carrying camouflage as seen in many other dromiids. *Paradynomene*, like all the other dynomenids, has only the last pair of pereopods reduced but they are held horizontally. Thus while the reduced limbs may be an adaptation to a cryptic way of life in *Epigodromia*, the reduced limb in *Paradynomene* is an ancestral character. Observation of living specimens in natural surroundings would allow the hypothesis of cryptic convergence to be tested.

Examination of the stomach contents of a large male 21.0 x 21.9 mm (SMIB, 8 stn DW 189, 400-402 m) showed sand grains, soft unidentifiable organic material and chopped fragments of a hydroid coenosarc. One specimen of *Paradynomene tuberculata* was associated with the stylasterine hydrocoral *Stylaster* (New Caledonia, LAGON, stn 444, 300-350 m).

DISCUSSION

HABITAT. — In most collections, dynomenid crabs are usually comparatively rare (RICHER DE FORGES, pers. comm.). The habitat of the shallow water dynomenids (maximum depth < 100 m) , i.e. *Dynomene hispida*, *D. praedator*, *Hirsutodynomene spinosa* and *H. ursula,* seems to be rocky substrates and corals such as *Acropora* spp., *Pocillopora damicornis*, *P. elegans*, *Seriatopora hystrix*, *Goniastrea retiformis*, *Favia stelligera*, *Oulophyllia crispa*, *Porites* sp. and crustose alga such as *Amphiora foliacea* (EDMONDSON, 1946; PEYROT-CLAUSADE, 1977, 1981; RIBES, 1978; NAIM, 1980; ODINETZ, 1983, and HIGHSMITH, 1981). They seem to occur more often in dead than in live coral. Dynomenids living in deeper water (maximum depth > 100 m), such as *D. filholi*, *D. pilumnoides*, *Metadynomene* spp., *Acanthodromia* spp., and *Paradynomene tuberculata*, seem to live on lithothamnion algae, red coral, precious coral (e.g. *Corallium* sp.) as well as rock and sand. The deepest living dynomenids are *M. tanensis* (520 m) and *A. erinacea* (540 m). Thus most dynomenids show some association with corals but this link does not appear to be obligatory.

DIET. — Guts of nine dynomenid species, *Dynomene hispida*, *D. praedator*, *D. filholi*, *D. pilumnoides*, *Hirsutodynomene spinosa*, *H. ursula*, *Metadynomene tanensis*, *M. devaneyi*, and *Paradynomene tuberculata*, were examined (usually only one or two specimens for each species). The most common material found was sand grains along with soft unidentifiable particulate organic material and, in some species, chopped chitinous fragments which could have come from hydroids or perhaps other crustaceans. It seems likely that most of their food was obtained by sieving organic fragments from the substrate, or in the case of coral inhabiting crabs, perhaps from coral mucous. This is consistent with the presence of a well developed screen of stiff setae in the hollowed out interior of the cheliped fingers and the setose palps of the third maxillipeds. The chopped chitinous fragments suggest that some food might be also obtained by direct grazing. Based on the shape of the chelae, BALSS (1938)

suggested that dynomenids consume coral polyps in the same way as, for example the xanthids, *Chlorodiella* and *Chlorodopsis*, but this is not supported by the stomach contents. Feeding behaviour has only been observed for *D. praedator* which seems to obtain most of its food by deposit feeding in sand. The gut contents of the other dynomenids would be consistent with feeding behaviour similar to that of *D. praedator*.

REPRODUCTIVE STRATEGY. — The concept of reproductive strategy includes size at sexual maturity, maximum size, relationship of egg numbers to female size, egg size, and extent of the reproductive season. The extremes of this strategy are brooding or broadcasting progeny. Some information about these characteristics are available for all the dynomenid species except *Metadynomene crosnieri*, and *Acanthodromia margarita*. Egg size is a useful indicator of whether the species has direct or indirect development. In terms of maximum body size the dynomenids fall into two groups: small species whose maximum CW is less than 20 mm (*D. hispida*, *D. praedator*, *D. filholi*, *D. pugnatrix*, *Acanthodromia erinacea* and *A. margarita*), and larger species whose maximum CW is greater than 20 mm (*D. pilumnoides*, *Hirsutodynomene spinosa*, *H. ursula*, *M. devaneyi*, *M. tanensis*, *M. crosnieri*, and *Paradynomene tuberculata*). For all species males have on average a CW 19% larger. Size at sexual maturity is roughly related to maximum size: for the small species sexual maturity occurs at 5.8 - 8.0 mm CW while for the large species it is at 9.5 - 13.0 mm CW. Egg numbers increase logarithmically with CW with a brood size of 30 to 900 eggs for small species and 120 to 3800 for large species. Mean egg diameter for the small species is 0.46 mm, for large species 0.51 mm and for all species together it is 0.49 mm. These egg sizes suggest that all dynomenids have indirect development with planktonic larvae, i.e. a broadcast strategy. The only larvae reported are from *Acanthodromia erinacea* but these were dissected from eggs (RICE, 1981). No dynomenid larvae have ever been reported from plankton collections. Only a limited amount of information about the timing of reproduction is available. Despite the fact that dynomenids are tropical crabs all of the species for which there are adequate sample sizes have their reproduction confined to only part of the year. *D. hispida* and *D. praedator* (from the Indo-Pacific) are ovigerous from January to July, *D. filholi* (from the Atlantic) is ovigerous from May until December, *D. pilumnoides* from February to September, *H. ursula* from April to December, and *P. tuberculata* from October to February (all Indo-Pacific species). Therefore larvae could be expected in the plankton in any month, but the average reproductive period for all species is only 6.7 months.

Amongst the dynomenids we do not find species which have unusually large eggs, such as are seen in homolodromiids (see GUINOT, 1995), and a small number of dromiids (see McLAY, 1993). The modal size class for dromiid eggs is within 0.7-0.8 mm diameter, and direct development (brooding) has been found in *Dromidiopsis globosa* (Lamarck, 1818), *Austrodromidia octodentata* (Haswell, 1882), and *Stimdromia lateralis* (Gray, 1931) all of which have eggs >1.0 mm diameter. Homolodromiids have large eggs which are 2.0-2.5 mm diameter and brooding is known in *Dicranodromia nagaii* Guinot, 1995. When we examine these features in relation to the hypothesized sister group relationships of these families (see Fig. 15), it becomes obvious that the ancestral condition must have been females carrying small numbers of very large eggs (probably brooding the young), as in the homolodromiids, and the derived condition must be females carrying much larger numbers of smaller eggs (broadcasting the young). Viewed in this way, the dynomenids are the most derived group, having the smallest eggs with indirect development, and the dromiids are intermediate. Judging by their egg size, most dromiids must have indirect development (the development of more than ten species is known) with only a few retaining the ancestral condition of large eggs. One Australian dromiid, *Haledromia bicavernosa* (Zietz, 1887) has the largest eggs known for any brachyuran i.e. 2.8 mm diameter. It is interesting to note that all dromiids known to have direct development live in Australian waters. Also the endemic dromiid genera, *Dromidia* Stimpson, 1858, *Exodromidia* Stebbing, 1905, *Pseudodromia* Stimpson, 1858, and *Speodromia* Barnard, 1947, from South Africa all have large eggs, implying direct development, although their mode of development is unknown (McLAY, 1993: 159). Therefore we could hypothesize that the common ancestor shared by the dynomenids and dromiids also had a reproductive strategy of a small number of large eggs. If this is true then the broadcast strategy, seen in dynomenids and most dromiids, must have evolved independently. This interpretation is no doubt contrary to accepted wisdom, but it is the most parsimonious conclusion.

DEPTH DISTRIBUTION. — The greatest diversity of dynomenids occurs in the 0-50 m depth range. Seven species from three of the genera, *Dynomene* (4), *Hirsutodynomene* (2) and *Paradynomene* (1) are shallow water

inhabitants (see Fig. 33). Four species (*D. hispida*, *D. praedator*, *H. spinosa*, and *H. ursula*) have been collected from the lower intertidal range, and between 25 and 50 m, six species are known. Between 50 and 400 m all five genera are represented with no more than five species at any one depth interval. Below 400 m the number of species begins to decline with two species at 500 m and none at 550 m. The species of *Dynomene* and *Paradynomene* occur from 0-400 m, those of *Hirsutodynomene* are shallow water inhabitants (<100 m), and species of *Metadynomene* and *Acanthodromia* all inhabit deeper waters down to a maximum depth of 540 m. *D. pugnatrix*, *M. devaneyi* and *M. crosnieri* are only known from a few specimens and so their depth range is uncertain. The average depth range (maximum - minimum) for all the more common species (n = 10) is 196 m.

The bathymetric distribution of dynomenids is very similar to that of the dromiids (see McLAY, 1993) where the majority of species are found in shallow waters from 0 to 150 m, with a maximum of around 500 m. By contrast most of the homolodromiids are found in depths of 300 to 900 m, with a maximum of 1330 m (see GUINOT, 1995), and the homolids are mostly found in depths from 200 to 1500 m, with a maximum of 2200 m (see GUINOT & RICHER DE FORGES, 1995). So we have a depth "zonation" of these three families with dynomenids + dromiids in shallow water, followed by homolodromiids and lastly the homolids at the greatest depths. Thus the hypothesized sister group relationship of dynomenids and dromiids is supported by the depth distribution data which shows that these two families share the same "habitat". Furthermore, if these two families shared a common ancestor with the homolodromiids, as is hypothesized above for the Dromiacea, then it would seem that dynomenids and dromiids evolved from ancestors which must have lived in deep waters (approx. 300-900 m). Similarly, if the Dromiacea and Archaeobrachyura shared a common ancestor then it must also have lived in deep water, perhaps at even greater depths than the dynomenid - dromiid ancestor, with descendants radiating into very deep water. Thus, the dynomenids and dromiids are families of the continental shelves while the homolodromiids and archaeobrachyurans are inhabitants of the continental slopes.

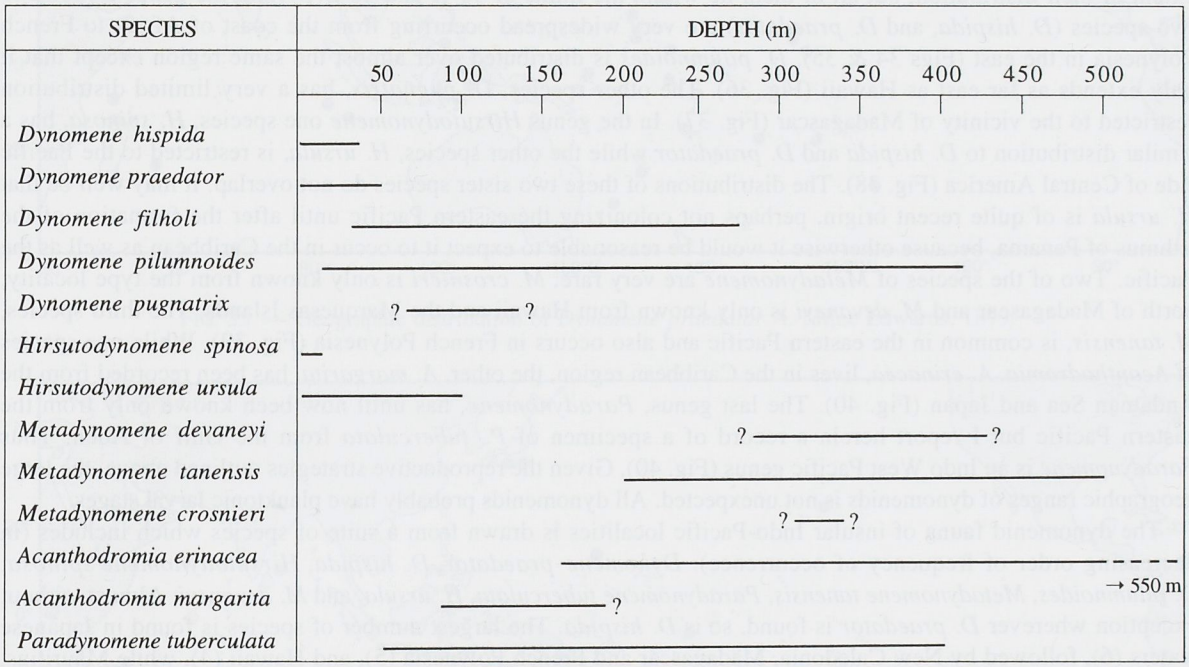


FIG. 33. — Depth distribution of dynomenid species. The "?" indicates an uncertain depth range because of a very small sample size.

The hypothesis that dynomenids and dromiids represent shallow-water evolutionary radiations from ancestors living in deeper water is similar to the hypothesis put forward by GEORGE and MAIN (1967) to explain the Cretaceous evolutionary radiation of the Palinuridae which is supported by an analysis of phyllosoma characters of the whole Palinuroidea by BAISTRE (1994).

BIOGEOGRAPHY. — Only two dynomenid species, representing two genera, are known from the Atlantic Ocean: *Dynomene filholi* and *Acanthodromia erinacea*. Both of these are insular species (Figs 37, 40). *A. erinacea* is restricted to the Caribbean area and *D. filholi* to the South Atlantic. In overall appearance, their obvious Indo-Pacific counterparts are *A. margarita* and *D. pilumnoides* respectively.

The species of *Acanthodromia* no doubt originated from a tethyan ancestor and spread to seas that eventually became the Atlantic and Caribbean, perhaps as early as the Upper Jurassic (145 mybp). This dispersal could have been as late as the Middle Miocene (25 mybp), when connections between these two oceans were severed, but an earlier date seems more likely because even by Palaeocene times (65 mybp) the Atlantic was already well formed and the Caribbean isolated (HOWARTH, 1981). Therefore these two species could have been separated at least since the Palaeocene (or at latest the Middle Miocene). The remarkable thing about *A. erinacea* and *A. margarita* is how similar they are because there has scarcely been any divergence in their morphology (see Discussion under *A. erinacea*).

Similarly, it seems to be a reasonable assumption that the ancestor of *Dynomene filholi* was a Tethyan crab which also gave rise to *D. pilumnoides*. A southern colonization route for these crabs could have been open as early as the Upper Cretaceous (90-80 mybp) or sometime later. At present there does not seem to be a dispersal route via the Cape because it is blocked by the local Agulhas oceanic circulation pattern. This self-contained circulation pattern seems to have been in existence for a considerable time because there is a suite of endemic South African dromiid genera and species (see McLAY, 1993) which have been isolated perhaps since the Upper Cretaceous or Palaeocene (65 mybp). This interpretation would imply that colonization of the Atlantic by *Dynomene* must have been during the late Mesozoic or very Early Tertiary. Again there are many features in common between *D. filholi* and *D. pilumnoides* (see Discussion under *D. pilumnoides*).

Eleven species, representing all five genera, are known from the Indo-Pacific region. These species vary in the extent of their distribution, but all of them lie within the limits of 40°N and 40°S. Within the genus *Dynomene* two species (*D. hispida*, and *D. praedator*) are very widespread occurring from the coast of Africa to French Polynesia in the east (Figs 34 & 35). *D. pilumnoides* is distributed over almost the same region except that it only extends as far east as Hawaii (Fig. 36). The other species, *D. pugnatrix*, has a very limited distribution restricted to the vicinity of Madagascar (Fig. 37). In the genus *Hirsutodynomene* one species, *H. spinosa*, has a similar distribution to *D. hispida* and *D. praedator* while the other species, *H. ursula,* is restricted to the Pacific side of Central America (Fig. 38). The distributions of these two sister species do not overlap. It may well be that *H. ursula* is of quite recent origin, perhaps not colonizing the eastern Pacific until after the formation of the isthmus of Panama, because otherwise it would be reasonable to expect it to occur in the Caribbean as well as the Pacific. Two of the species of *Metadynomene* are very rare: *M. crosnieri* is only known from the type locality, north of Madagascar and *M. devaneyi* is only known from Hawaii and the Marquesas Islands. The third species, *M. tanensis*, is common in the eastern Pacific and also occurs in French Polynesia (Fig. 39). While one species of *Acanthodromia*, *A. erinacea*, lives in the Caribbean region, the other, *A. margarita*, has been recorded from the Andaman Sea and Japan (Fig. 40). The last genus, *Paradynomene*, has until now been known only from the eastern Pacific but I report herein a record of a specimen of *P. tuberculata* from the Gulf of Aden. Thus *Paradynomene* is an Indo West Pacific genus (Fig. 40). Given the reproductive strategies outlined above, the large geographic ranges of dynomenids is not unexpected. All dynomenids probably have planktonic larval stages.

The dynomenid fauna of insular Indo-Pacific localities is drawn from a suite of species which includes (in decreasing order of frequency of occurrence): *Dynomene praedator*, *D. hispida*, *Hirsutodynomene spinosa*, *D. pilumnoides*, *Metadynomene tanensis*, *Paradynomene tuberculata*, *H. ursula*, and *M. devaneyi*. Almost without exception wherever *D. praedator* is found, so is *D. hispida*. The largest number of species is found in Japanese waters (6), followed by New Caledonia, Madagascar and French Polynesia (5), and Hawaii (4), while Mauritius, Taiwan, Mariana Ids, Cocos Keeling Ids, Marshall Ids (Eniwetak) have 3 species. All other localities have only 1 or 2 species, usually *D. praedator* and/or *D. hispida*.

Although there are two shared genera (*Dynomene* and *Acanthodromia*) in the Atlantic, there are no dynomenid species which occur in both the Atlantic and Indo-Pacific regions. It can be safely assumed that the two Atlantic species are derived from Indo-Pacific stocks and that their origin could have been as late as about 25 mybp before the destruction of the Tethyan connection between these two oceans (ADAMS, 1981), although they could have

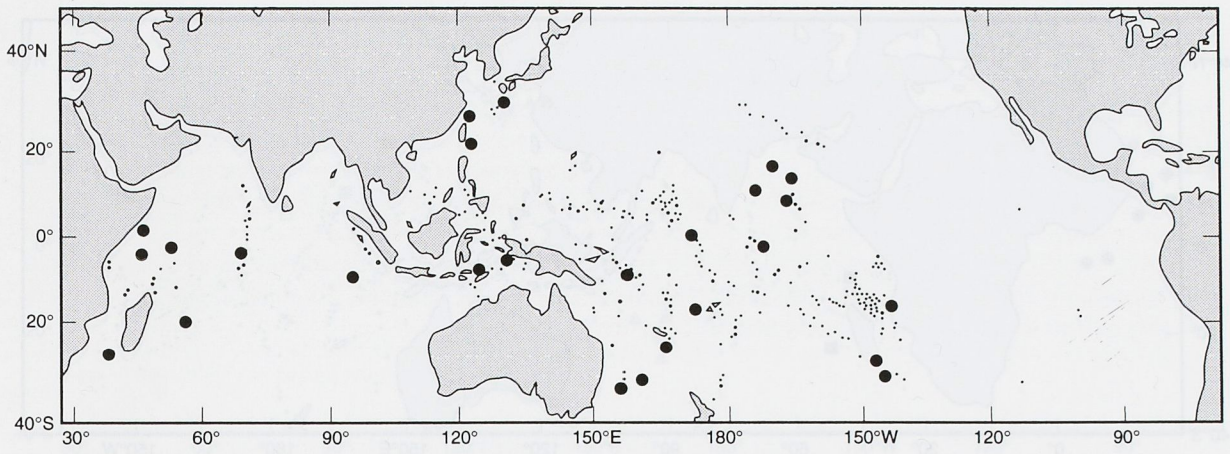


FIG. 34. — Geographic distribution of *Dynomene hispida* Guérin-Méneville, 1832.

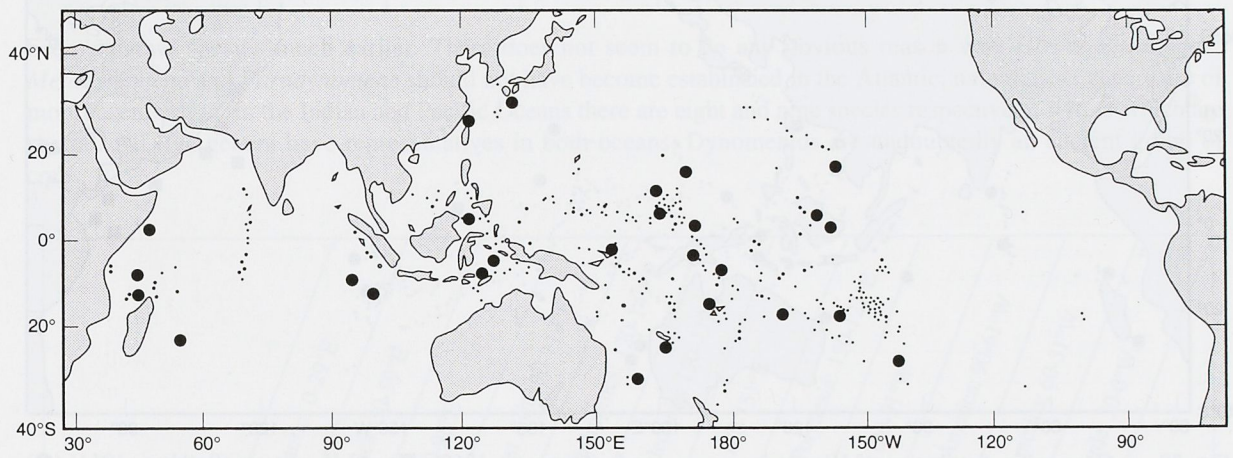


FIG. 35. — Geographic distribution of *Dynomene praedator* A. Milne Edwards, 1879.

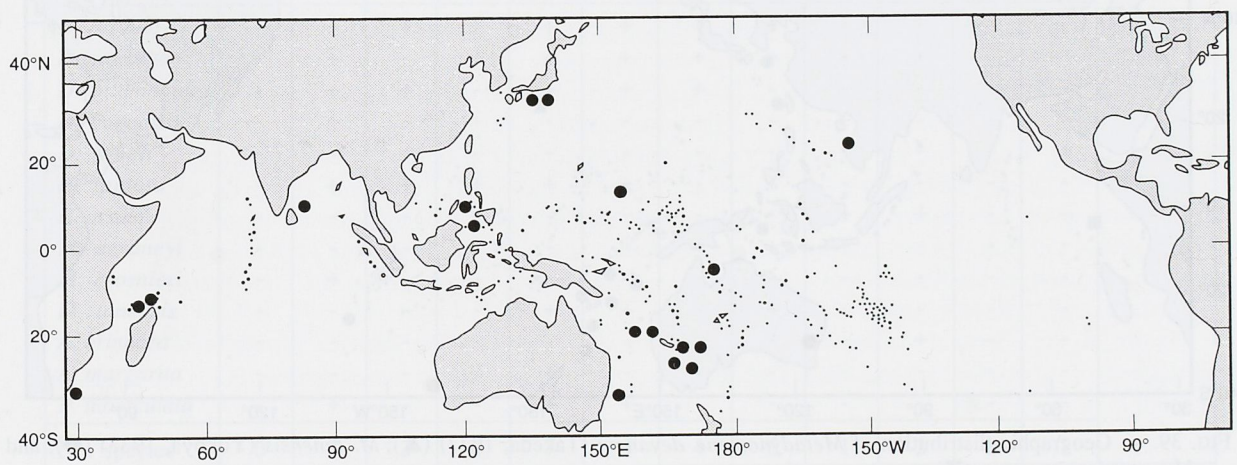


FIG. 36. — Geographic distribution of *Dynomene pilumnoides* Alcock, 1900.

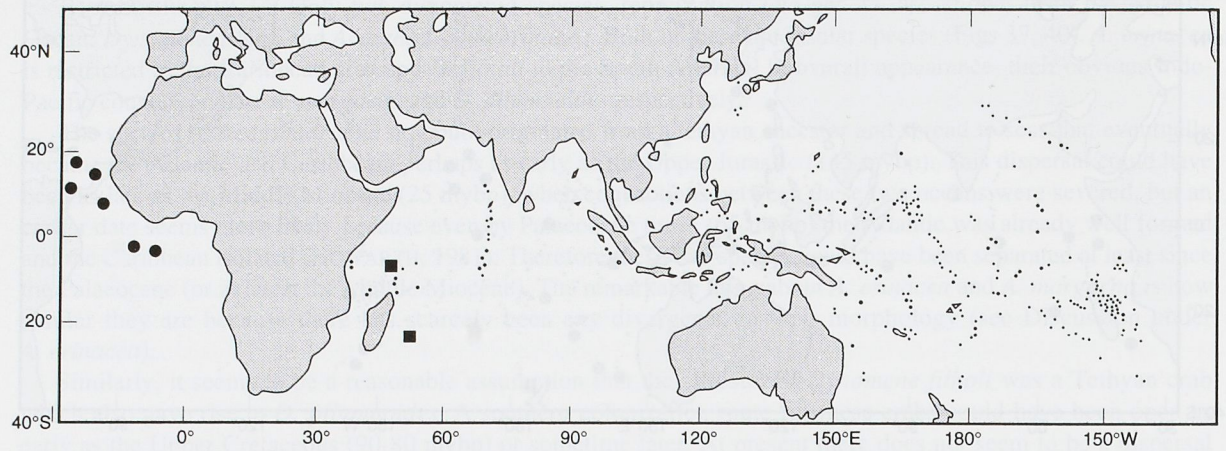


FIG. 37. — Geographic distribution of *Dynomene pugnatrix* de Man, 1889 (■), and *D. filholi* Bouvier, 1894 (●).

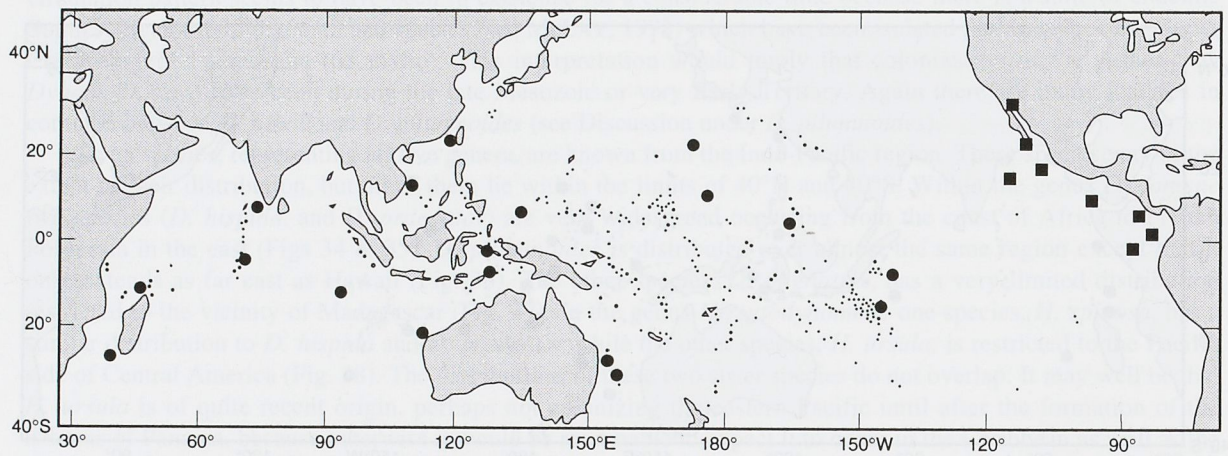


FIG. 38. — Geographic distribution of *Hirsutodynomene ursula* (Stimpson, 1860) (■) and *H. spinosa* (Rathbun, 1911) (●).

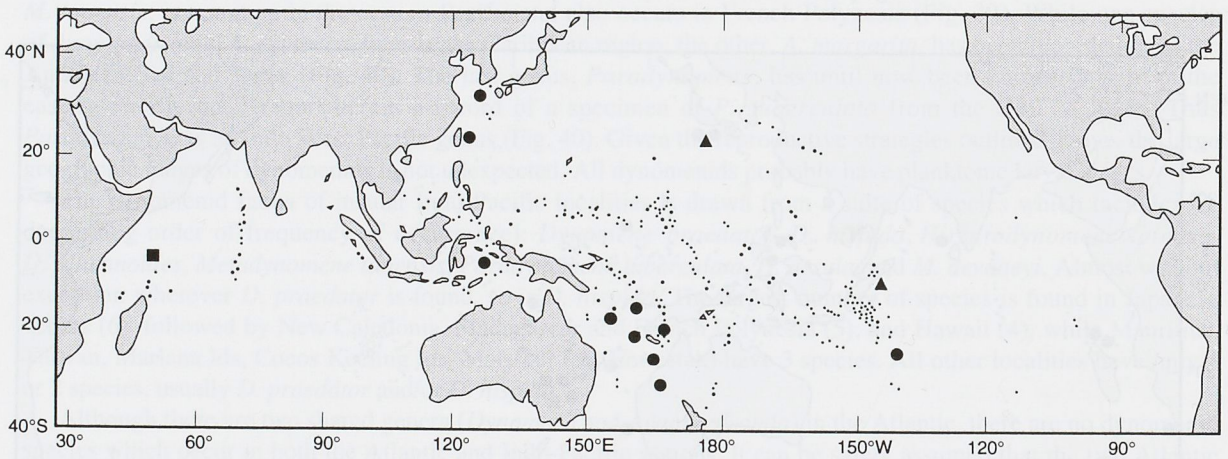


FIG. 39. — Geographic distribution of *Metadynomene devaneyi* (Takeda, 1977) (▲), *M. tanensis* (Yokoya, 1933) (●), and *M. crosnieri* sp. nov. (■).

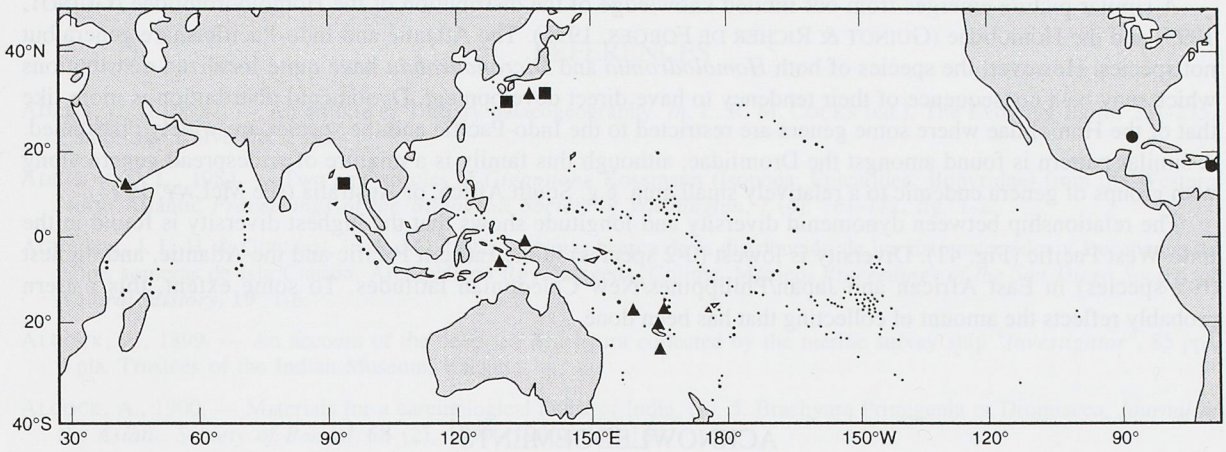


FIG. 40. — Geographic distribution of *Acanthodromia erinacea* A. Milne Edwards, 1880 (●), *A. margarita* (Alcock, 1899) (■), and *Paradynomene tuberculata* Sakai, 1963 (▲).

been separate species much earlier. There does not seem to be any obvious reason why *Hirsutodynomene*, *Metadynomene* and *Paradynomene* should not have become established in the Atlantic, unless these genera are of more recent origin. In the Indian and Pacific Oceans there are eight and nine species respectively, five of which are shared. All five genera have representatives in both oceans. Dynomenids are undoubtedly an ancient group of crabs.

	East Atlantic: 0-29°E	East Africa: 30-59°E	India: 60-98°E	Southeast Asia: 90-119°E	Japan-Philippines: 120-149°E	New Caledonia: 150-179°E	Hawaii: 180-151°E	French Polynesia: 150-121°E	Mexico:120-91°W	Central America: 90-61°W	South America: 60-31°W	Cape Verde: 30-0°W
D. hispida	-	+	+	+	+	+	+	+	-	-	-	-
D. praedator	-	+	-	+	+	+	+	+	-	-	-	-
D. pilumnoides	-	+	+	-	+	+	+	-	-	-	-	-
D. pugnatrix	-	+	-	-	-	-	-	-	-	-	-	-
D. filholi	-	-	-	-	-	-	-	-	-	-	-	+
H. spinosa	-	+	+	+	+	+	-	+	-	-	-	-
H. ursula	-	-	-	-	-	-	-	-	+	+	-	-
M. devaneyi	-	-	-	-	-	-	+	+	-	-	-	-
M. crosnieri	-	+	-	-	-	-	-	-	-	-	-	-
M. tanensis	-	-	-	-	+	+	-	+	-	-	-	-
A. erinacea	-	-	-	-	-	-	-	-	-	+	-	-
A. margarita	-	-	-	+	+	-	-	-	-	-	-	-
P. tuberculata	-	+	-	-	+	+	-	-	-	-	-	-
No. species	0	7	3	4	7	6	4	5	1	2	0	1

FIG. 41. — Longitudinal distribution of the Dynomenidae.

A similar picture emerges from our limited knowledge of the distribution of the Homolodromiidae (GUINOT, 1995) and the Homolidae (GUINOT & RICHER DE FORGES, 1995). The Atlantic and Indo-Pacific share genera but not species. However, the species of both *Homolodromia* and *Dicranodromia* have quite localized distributions which may be a consequence of their tendency to have direct development. Dynomenid distribution is more like that of the Homolidae where some genera are restricted to the Indo-Pacific and the species are widely distributed. A similar pattern is found amongst the Dromiidae, although this family is a mixture of widespread genera along with groups of genera endemic to a relatively small area. e.g. South Africa, or Australia (see McLAY, 1993).

The relationship between dynomenid diversity and longitude shows that the highest diversity is found in the Indo-West Pacific (Fig. 41). Diversity is lowest (0-2 species) in the Eastern Pacific and the Atlantic, and highest (6-7 species) in East African and Japan/Philippines/New Caledonian latitudes. To some extent, this pattern probably reflects the amount of collecting that has been done.

ACKNOWLEDGEMENTS

Many people have made this project possible by kindly loaning material from their collections and providing answers to my questions. I would to particularly thank Michael TÜRKAY, Forschungsinstitut Senckenberg, Frankfurt; Charles FRANSEN, Nationaal Natuurhistorisch Museum, Leiden; Danièle GUINOT, NGUYEN NGOC HO, Michèle DE SAINT LAURENT, and Sylvie SECRETAN, Muséum national d'Histoire naturelle, Paris; Joseph POUPIN, Laboratoire d'Océanographie, École Navale du Poulmic, Brest; Niel BRUCE, Zoologische Museum, Copenhagen; Marco VANNINI, Museo Zoologico de "La Specola", Firenze; Oliver COLEMAN, Museum fur Naturkunde, Institut fur Systematische Zoologie, Berlin; Paul CLARK, The Natural History Museum, London; Austin WILLIAMS and Ray MANNING, Smithsonian Institution, Washington; David WIEDNER, The Academy of Natural Sciences, Philadelphia; Hans KUCK, Natural History Museum of Los Angeles County; Ardis JOHNSTON, Museum of Comparative Zoology, Harvard; Tin-Yam CHAN, National Taiwan Ocean University, Taiwan; Masayuki OSAWA, Tokyo University of Fisheries; Seiji NAGAI, Wakayama-ken, Japan; Roy KROPP, Battelle Ocean Sciences, U.S.A.; Gustav PAULAY, Guam; Lu ELDREDGE, Bishop Museum, Honolulu; YANG CHANG MAN, Zoological Reference Collection, University of Singapore; Diana JONES, Western Australian Museum, Perth; Alexander BRUCE and Peter DAVIE, Queensland Museum, Brisbane; Penny BERENTS, Australian Museum, Sydney, and Bertrand RICHER DE FORGES, Institut français de Recherche scientifique pour le Développement en Coopération (ORSTOM), Nouméa.

Peter NG, University of Singapore, provided invaluable assistance with the literature from China, and LI DAI QIN and WU RONGMEI, University of Canterbury, kindly translated these papers. Keiji BABA, Kumamotu University, and Hiroshi SUZUKI, Kagoshima University helped me by translating the Japanese literature. Volker NEUMAN, Forschungsinstitut Senckenberg, Frankfurt and Franz DITZ, University of Canterbury willingly translated German papers for me. The photos in this paper were made by Jacques REBIÈRE, Muséum national d'Histoire naturelle, Paris, and Terry WILLIAMS, University of Canterbury. I also acknowledge the help of Françoise THEUREAU, Muséum national d'Histoire naturelle, Paris, who expertly prepared the figures. Jan McKENZIE, University of Canterbury gave invaluable help with the scanning electron microscope. Gerhard SCHOLTZ, and Stefan RICHTER, Institut fur Biologie, Humboldt Universitat zu Berlin helped to clarify my thinking about the phylogeny of podotreme crabs and provided valuable comments on the manuscript. John HOOVER and Ron HOLCOM kindly collected Hawaiian specimens of *Dynomene praedator* and provided me with a video tape of their behaviour. The manuscript was greatly improved by the comments of Professors D. GUINOT, and L. B. HOLTHUIS.

Finally, all the efforts of the above persons would have been in vain if it were not for the tireless efforts and enthusiasm of Alain CROSNIER, ORSTOM and Muséum national d'Histoire naturelle, Paris, to ensure the completion of this project.

REFERENCES

ADAMS, C. G., 1981. — An outline of Tertiary palaeogeography. *In*: L. R. M. COCKS (ed.), The Evolving Earth: 221-235. Cambridge University Press.

ADKISON, D. L., 1984. — Two new species of *Gigantione* Kossmann (Isopoda: Epicaridea: Bopyridae) from the Western North Atlantic *Proceedings of the Biological Society of Washington*, **7** (4): 761-772, fig. 1-2.

AGUILERA, J. L. H. & GUZMAN, L. A. M., 1992. — Notas acerca de la distribución de los Estomatopodos y Decapodos de aguas someras de Isla Clarión, Archipiélago Revillagigeda, Colima, México. *Proceedings of the San Diego Society of Natural History*, **19**: 1-6.

ALCOCK, A., 1899. — An account of the deep-sea Brachyura collected by the marine survey ship *"Investigator"*, 85 pp., 4 pls. Trustees of the Indian Museum, Calcutta.

ALCOCK, A., 1900. — Materials for a carcinological fauna of India. No. 5. Brachyura Primigenia or Dromiacea. *Journal of the Asiatic Society of Bengal*, **68** (2), 1899 (1900): 123-169.

ALCOCK, A., 1901. — Catalogue of the Indian Decapod Crustacea in the collection of the Indian Museum. Part I. Brachyura. Fasc. I. Introduction and Dromides or Dromiacea (Brachyura Primigenia), 80 pp., pl. 1-8. Trustees of the Indian Museum, Calcutta.

BABA, K., 1986. — Reptantia Macrura, Anomura and Brachyura. *In*: K. BABA, K.-I. HAYASHI & M. TORIYAMA, Decapod crustaceans from continental shelf and slope around Japan, 336 pp., fig. 1-22, 176 photos in color + 4 figs. Japan Fisheries Resource Conservation Association, Tokyo.

BAISTRE, J. A., 1994. — Phyllosoma larvae and the phylogeny of Palinuroidea (Crustacea: Decapoda): a review. *Australian Journal of Marine & Freshwater Research*, **45**: 925-944, fig. 1-9.

BALSS, H., 1921. — Decapoda Anomura (Paguridea) und Brachyura (Dromiacea bis Brachygnatha): Crustacea. VI. *In*: W. MICHAELSEN, *Beiträge zur Kenntnis der Meeresfauna Westafrika*, **3** (2): 39-67, fig. 1-7.

BALSS, H., 1922. — Ostasiatische Decapoden. III. Die Dromiaceen, Oxystomen und Parthenopiden. *Archiv für Naturgeschichte*, **88** A (3): 104-140, fig. 1-9.

BALSS, H., 1935. — Brachyura of the Hamburg Museum Expedition to South-Western Australia 1905. *Journal of the Royal Society of Western Australia*, **21**: 113-151, fig. 1-5, pl. 13.

BALSS, H., 1938. — Die Dekapoda Brachyura von Dr Sixten Bocks Pazifik-Expedition 1917-1918. *Göteborgs Kungl. Vetenskaps och Vitterhets Samhälles Handlingar*, (5B), **5** (7): 1-85, fig. 1-18, pl. 1-2.

BALSS, H., 1957. — Dr. H. G. BRONNS Klassen und Ordnungen des Tierreichs. Fünfter Band, I. Abteilung, 7. Buch, Decapoda, Lieferung 12: 1505-1672, fig. 1131-1199. Akademische Verlagsgesellschaft, Leipzig.

BARNARD, K. H., 1947. — Descriptions of new species of South African Decapod Crustacea, with notes on synonymy and new records. *Annals and Magazine of Natural History*, (11), **13** (102), 1946 (1947): 361-392.

BARNARD, K. H., 1950. — Descriptive Catalogue of South African Crustacea (Crabs and Shrimps). *Annals of the South African Museum*, **38**: 1-837, fig. 1-154.

BATE, S. C., 1888. — Report on the Crustacea Macrura collected by H. M. S. Challenger during the years 1873-1876. *Reports of the scientific Results of the Voyage of H.M.S. Challenger*, **24**: 1-942, 76 figs, 150 pls.

BAUER, R. T., 1981. — Grooming behavior and morphology in the decapod Crustacea. *Journal of Crustacean Biology*, **1** (2): 153-173, fig. 1-8.

BAUER, R. T., 1989. — Decapod crustacean grooming: functional morphology, adaptive value, and phylogenetic significance. *In*: B. E. FELGENHAUER, L. WATLING & A. B. THISTLE (eds), Functional morphology of feeding and grooming in Crustacea. *Crustacean Issues*, **6**: 49-73, fig. 1-19. Balkema, Rotterdam.

BELL, T., 1863. — A monograph of the fossil malacostracous Crustacea of Great Britain. 2. Crustacea of the Gault and Greensand. *Monograph of the Palaeontological Society of London*, 1863, viii + 40 pp.

BENHAM, W. B., 1891. — Note on a couple of abnormalities. *Annals and Magazine of Natural History*, (6), **7**: 256-258, pl. 3, fig. 1-2.

BENINGER, P. G., FERGUSON, A. & LANTEIGNE, C. L., 1995. — The gonopod tegumental glands of snow crab (*Chionoecetes opilio*) are accessory reproductive glands. *Journal of Shellfish Research*, **14**: 365-370, fig. 1-3.

BERTHOLD, A. A., 1827. — Latreille's Naturliche Familien des Thierreichs. Aus dem Französischen mit Anmerkungen und Zusätzen: i-x + 1-606.

BEURLEN, K., 1928. — Die fossilen Dromiaceen und ihre Stammesgeschichte. *Palaeontologische Zeitschrift*, **10**: 144-183.

BIRKELAND, C., MEYER, D. L., STAMES, J. P., & BUFORD, C. L., 1975. — Subtidal communities of Malpelo Island. *Smithsonian Contributions to Zoology*, (176): 55-68, fig. 20-27.

BITTNER, A., 1883. — Neue Beiträge zur Kenntnis der Brachyurenfauna des Alttertiärs von Vicenza und Verona. *Denkschriften Oesterreichische Akademie der Wissenschaften Philosophisch-Historische Klasse, Wien*, **46**: 299-316, pl. 1.

BORRADAILE, L. A., 1907. — On the classification of the decapod Crustaceans. *Annals and Magazine of Natural History*, (7), **19**: 457-486.

BOSQUET, J., 1854. — Les Crustacés fossiles du Terrain Crétacé du Limborg. *In*: *Verhandelingen uttgegeven door de commissie belast met het vervaardigen eener geologischen beschryving en kaart van Nederland,* Tweede deet: 1-127, A. C. Kruseman, Haarlem.

BOUVIER, E.-L., 1894. — Sur l'appareil branchial d'un crabe du groupe des Dromiens, la *Dynomene filholi*. *Compte Rendu sommaire des séances de la Société philomathique de Paris,* (8), **7** (2): 6.

BOUVIER, E.-L., 1896. — Sur l'origine homarienne des crabes: étude comparative des Dromiacés vivants et fossiles. *Bulletin de la Société philomathique de Paris*, (8), **8** (2), 1895 (1896): 34-110 [1-77], fig. 1-43.

BOUVIER, E.-L., 1915. — Décapodes marcheurs (Reptantia) et Stomatopodes, recueillis à l'île Maurice par M. Paul Carié. *Bulletin scientifique de la France et de la Belgique,* (7), **48** (3): 178-318 [1-141], fig. 1-42, pl. 4-7.

BOUVIER, E.-L., 1922. — Observations complémentaires sur les Crustacés décapodes (abstraction faite des Carides) provenant des campagnes de S.A.S. le Prince de Monaco. *Résultats des campagnes scientifiques accomplies sur son yacht par Albert Ier, Prince souverain de Monaco*, **62**, 106 pp., 6 pls.

BRIGGS, D. E. G., WEEDON, M. J. & WHYTE, M. A., 1993. — Arthropoda (Crustacea excluding Ostraocoda). *In*: M. J. BENTON, The Fossil Record, vol. 2: 321-342. M. J. Chapman & Hall, London.

BUITENDIJK, A. M., 1939. — Biological results of the Snellius Expedition. V. The Dromiacea, Oxystomata, and Oxyrhyncha of the Snellius Expedition. *Temminckia*, **4**: 223-276, pl. 7-11, fig. 1-27.

BUITENDIJK, A. M., 1950. — On a small collection of Decapoda Brachyura, chiefly Dromiidae and Oxyrhyncha, from the neighbourhood of Singapore. *Bulletin of the Raffles Museum,* **21**: 59-82.

BÜRGER, O., 1902. — Ein Fall von lateralem Hermaphroitismus bei *Palinurus frontalis* M.-E. *Zeitschrift für Wissenschaftliche Zoologie*, **71**: 702-707.

CALMAN, W. T., 1909. — On decapod Crustacea from Christmas Island, collected by Dr. C. W. Andrews, F.R.S., F.Z.S. *Proceedings of the Zoological Society, London*, 1909: 703-713, pl. 72.

CANO, G., 1893. — Sviluppo dei Dromidei. *Atti Accademia della Scienze Fisiche e Matematiche di Napoli*, (2), **6**: 1-23, pls 1-2.

CARGO, D. G., 1980. — A bisexual blue crab, *Callinectes sapidus*, Rathbun, from Chesapeake Bay. *American Midland Naturalist,* **104**: 378-382, fig. 1-4.

CHACE, F. R., & MOORE, G. M. 1959. — A bicolored gynandromorph of the lobster, *Homarus americanus*. *Biological Bulletin*, **116**: 226-231, fig. 1-4.

CHARNIAUX-COTTON, H., 1975. — Hermaphroditism and gynandromorphism in malacostracan Crustacea. *In*: R. REINBOTH (ed.), Intersexuality in the Animal Kingdom: 91-105, fig. 1-7. Springer-Verlag, Berlin.

CHECCHIA-RISPOLI, C., 1905. — I Crostacei del Eocene dei dintori di Monreale in provincia di Palermo. *Giornale della Societa Scienze Naturale Economico di Palermo*, **25**: 309-325.

CHEN, H., 1979. — Two new species of crabs from the Xisha Islands, Guangdong Province, China. *Oceanologia et Limnologia Sinica*, **10**: 77-81, 2 text-figs.

CHEN, H., 1980. — Studies on the crabs of the Xisha Islands, Guangdong Province, China. II. *Studia Marina Sinica*, **17**: 117-147, 25 text-figs, 4 pls.

COLLINS, J. S. H. & JAKOBSEN, S. L., 1994. — A synopsis of the biostratigraphic distribution of the crab genera (Crustacea, Decapoda) of the Danian (Palaeocene) of Denmark and Sweden. *Bulletin of the Mizunami Fossil Museum*, **21**: 35-46, fig. 1-16.

COLLINS, J. S. H., FRAAYE, R. H. B. & JAGT, J. W. M., 1995. — Late Cretaceous anomurans and brachyurans from the Maastrichtian type area. *Acta Palaeontologica Polonica*, **40** (2): 165-210, fig. 1-12.

CORREA-SANDOVAL, F., 1991. — Catalogo y bibliografía de los cangrejos (Brachyura) del golfo de California. *Comunicaciones Academicas*, CICESE. Serie de Acuicultura, 117 pp. B. C., Mexico.

DAI, A.-Y., CAI, Y. & YANG, S.-L., 1996. — New species and records of crabs (Crustacea: Brachyura) from Nansha Islands, China. *Studies on Marine Fauna and Flora and Biogeography of the Nansha Islands and Neighbouring Waters*, **2**: 234-257, fig. 1-10.

DAI, A.-Y. & YANG, S.-L., 1991. — Crabs of the China seas: 1-682, fig. 1-295, 74 pls. China Ocean Press, Beijing and Springer-Verlag, Berlin.

DAI, A.-Y., YANG, S.-L. & LAN, J., 1981. — On the crabs of the Xisha Islands - *Dynomene. Nanhai Studia Marina Sinica*, **2**: 117-124, 14 text-figs.

DAI, A.-Y., YANG, S.-L., SONG, Y.-Z. & CHEN, G.-X., 1986. — Crabs of China Seas, 642 pp., fig. 1-295, 74 pls. Ocean Press, Beijing (in Chinese).

DESMAREST, A. G., 1823. — Crustacés Malacostracés. *In*: Dictionnaire des Sciences naturelles, **28**: 138-425; atlas, vol. 4, pl. 1-58. F. G. Levrault et Le Normant, Strasbourg & Paris.

DESMAREST, A. G., 1825. — Considérations générales sur la classe des Crustacés, et description des espèces de ces animaux, qui vivent dans la mer, sur les côtes, ou dans les eaux douces de la France. xix + 446 pp., 56 pls. F. G. Levrault, Paris.

EDMONDSON, C. H., 1925. — Crustacea. *In*: Marine zoology of tropical central Pacific (Tanager Expedition Publ. 1). *Bernice P. Bishop Museum Bulletin*, **27**: 3-62, fig. 1-8, pl. 1-2.

EDMONDSON, C. H., 1933. — Reef and shore fauna of Hawaii. *Special Publications of the Bishop Museum*, **22**: 1-295, fig. 1-163.

EDMONDSON, C. H., 1946. — Reef and shore fauna of Hawaii. *Special Publications of the Bishop Museum*, **22** (2nd ed.): i-iii + 1-381, fig. 1-223.

EYDOUX, F. & SOULEYET, L. F. A., 1842. — Crustacés. *In*: Voyage autour du monde exécuté pendant les années 1836 et 1837 sur la corvette "La Bonite", commandée par M. Vaillant, etc. Zoologie, **1** (2): 219-250; 1846-49, atlas, 150 pls.

FARMER, A. S., 1972. — A bilateral gynandromorph of *Nephrops norvegicus* (Decapoda: Nephropidae). *Marine Biology*, **15**: 344-349, fig. 1-3.

FLEISCHER, J., GRELL, M., HOEG, J. T. & OLESEN, J., 1992. — Morphology of grooming limbs in species of *Petrolisthes* and *Pachycheles* (Crustacea: Decapoda: Anomura: Porcellanidae): a scanning electron microscopy study. *Marine Biology*, **113**: 425-435, fig. 1-6.

FOREST, J. & GUINOT, D., 1966. — Crustacés Décapodes: Brachyoures. *In*: Campagnes de la Calypso dans le golfe de Guinée et aux îles Principe, Sao Tomé et Annobon (1956), 16. *Annales de l'Institut océanographique*, **44**: 23-124, fig. 1-19.

FRANSEN, C. H. J. M., 1991. — Preliminary report on Crustacea collected in the eastern part of the North Atlantic during the CANCAP and MAURITANIA Expeditions of the former Rijksmuseum van Natuurlijke Historie, 93 pp. Nationaal Natuurhistorisch Museum. Leiden.

FROGLIA, C. & MANNING, R. B., 1978. — *Brachynotus gemmellari* (Rizza, 1839), the third Mediterranean species of the genus (Crustacea, Decapoda, Brachyura). *Proceedings of the Biological Society of Washington*, **91**: 691-705, fig. 1-5.

GARTH, J. S., 1946. — Littoral brachyuran fauna of the Galapagos Archipelago. *Allan Hancock Pacific Expeditions*, **5** (10): i-iv + 341-601, pl. 49-87.

GARTH, J. S., 1965. — The brachyuran decapod crustaceans of Clipperton Island. *Proceedings of the California Academy of Science,* (4), **33** (1): 1-46, 26 figs, 1 tabl.

GARTH, J. S., 1966. — Eastern Pacific Expeditions of the New York Zoological Society. XLVI. Oxystomatous and allied crabs from the West Coast of tropical America. *Zoologica*, **51**: 1-16, fig. 1-2.

GARTH, J. S., 1991. — Taxonomy, distribution, and ecology of Galapagos Brachyura. *In*: M. J. JAMES (ed.), Galapagos Marine Invertebrates: 123-145. Plenum Publ. Co., New York.

GARTH, J. S., HAIG, J., & KNUDSEN, J. W. 1987. — Crustacea Decapoda (Brachyura and Anomura) of Enewetak Atoll. *In*: D. M. DEVANEY, E. S. REESE, B. L. BURCH & P. HELFRICH (eds), The Natural History of Enewetak Atoll. Volume II, Biogeography and Systematics: 236-261. U. S. Department of Energy, Office of Scientific and Technical Information, Oak Ridge, Tennessee.

GEORGE, M. J., 1963. — Note on an abnormality in the penaeid prawn *Metapenaeus monoceros* Fabricius. *Journal of the Marine Biological Association of India*, **5**: 145-146.

GEORGE, R. W. & MAIN, A. R., 1967. — The evolution of spiny lobsters (Palinuridae): a study of evolution in the marine environment. *Evolution*, **21**: 803-820, fig. 1-3.

GLAESSNER, M. F., 1969. — Decapoda. *In*: R. C. MOORE (ed.), Treatise on Invertebrate Paleontology, Part R, Arthropoda, **4** (2): R399-R533, R626-R628, fig. 1-340. University of Kansas Press and Geological Society of America.

GLAESSNER, M. F., 1980. — New crustaceans and Tertiary crabs (Crustacea: Brachyura) from Australia and New Zealand. *Transactions of the Royal Society of South Australia*, **104**: 171-192, fig. 1-22.

GORDON, I., 1957. — A pseudo-hermaphrodite specimen of the lobster, *Homarus gammarus* (Linnaeus). *Annals and Magazine of Natural History,* (12) **10**: 524-528, fig. 1-5.

GORDON, I., 1963. — An anomalous adult male spider crab with five pairs of pleopods. *Crustaceana*, **5** (2): 151-154, fig. 1-5.

GOULD, C., 1859. — Description of a new fossil crustacean from the Lower Greensand. *Quarterly Journal of the Geological Society, London*, **15**: 237-238.

GRIFFITH, E., 1833. — The classes Crustacea and Arachnida. *In:* The Animal Kingdom arranged in conformity with its organization, by The Baron Cuvier, with supplementary additions to each order, **13**: viii + 540 pp. London.

GUÉRIN-MÉNEVILLE, F. E., 1829-1844. — Iconographie du Règne Animal de G. Cuvier. 450 pls in 45 livraisons, Crustacea: 36 pls, 48 pp. Paris. (Livraison 22, published 14 July, 1832).

GUINOT, D., 1967. — La faune carcinologique (Crustacea Brachyura) de l'océan Indien occidental et de la mer Rouge. Catalogue, remarques biogéographiques et bibliographie. *In*: Réunion de spécialistes C.S.A. sur les Crustacés. Zanzibar, 1964. *Mémoires IFAN,* (77), 1966 (1967): 237-352, fig. 1-70, 27 pls.

GUINOT, D., 1977. — Propositions pour une nouvelle classification des Crustacés Décapodes Brachyoures. *Comptes Rendus de l'Académie des Sciences, Paris, Sciences de la Vie* , (D), **285**: 1049-1052.

GUINOT, D., 1978. — Principes d'une classification évolutive des Crustacés Décapodes Brachyoures. *Bulletin biologique de la France et de la Belgique,* n.s., **112** (3): 211-292, fig. 1-3.

GUINOT, D., 1979. — Données nouvelles sur la morphologie, la phylogenèse et la taxonomie des Crustacés Décapodes Brachyoures. *Mémoires du Muséum national d'Histoire naturelle,* **112**: 1-354.

GUINOT, D., 1985. — Crustacea: Fauna and Flora, a first compendium of French Polynesian sea-dwellers. *Proceedings of the Fifth international Coral Reef Symposium, Tahiti*, 1985: 446-455.

GUINOT, D., 1993. — Données nouvelles sur les crabes primitifs (Crustacea Decapoda Brachyura Podotremata). *Comptes Rendus de l'Académie des Sciences, Paris, Sciences de la vie*, **316**: 1225-1232, fig. 1-8.

GUINOT, D., 1995. — Crustacea Decapoda Brachyura: Révision des Homolodromiidae Alcock, 1900. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, volume 13. *Mémoires du Muséum national d'Histoire naturelle*, **163**: 155-282, fig. 1-42.

GUINOT, D., DOUMENC, D. & CHINTIROGLOU, C.C., 1995. — A review of the carrying behaviour in brachyuran crabs, with additional information on the symbioses with sea anemones. *Raffles Bulletin of Zoology*, **43**: 377-416, fig. 1-8, pl. 1-3.

GUINOT, D., JAMIESON, B. G. M. & RICHER DE FORGES, B., 1994. — Relationship of Homolidae and Dromiidae: evidence from spermatozoal ultrastructure (Crustacea, Decapoda). *Acta Zoologica*, **75** (3): 255-267, fig. 1-7.

GUINOT, D. & RICHER DE FORGES, B., 1995. — Crustacea Decapoda Brachyura: Revision de la famille des Homolidae de Haan, 1839. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, volume 13. *Mémoires du Muséum national d'Histoire naturelle*, **163**: 283-517, fig. 1-76.

HARTNOLL, R. G., 1960. — An hermaphrodite specimen of the spider crab *Hyas coarctatus* Leach. *Crustaceana*, **1**: 326-330, fig. 1-4.

HAY, W. F., 1905. — Instances of hermaphroditism in crayfishes. *Smithsonian Miscellaneous Collections*, **48**: 222-228, text-fig. 27.

HENDRICKX, M. E., 1995. — Checklist of brachyuran crabs (Decapoda: Brachyura) from the eastern tropical Pacific. *Bulletin Institut Royal des Sciences Naturelles de Belgique*, **65**: 125-150.

HENDRICKX, M. E., 1997. — Los cangrejos braquiuros (Crustácea: Brachyura: Dromiidae, hasta Leucosiidae) del Pacifico Mexicano, 178 pp., fig. 1-115. Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, México.

HIGHSMITH, R. C., 1981. — Coral bioerosion at Enewetak: agents and dynamics. *Internationale Revue der gesamten Hydrobiologie*, **6** (3): 335-375, fig. 1-21.

HOLTHUIS, L. B., 1953. — Enumeration of the Decapod and Stomatopod Crustacea from Pacific Coral Islands. *Atoll Research Bulletin*, (24): 1-66. Mimeogr.

HOLTHUIS, L. B., 1974. — Biological results of the University of Miami Deep-sea Expeditions. 106. The lobsters of the superfamily Nephropidea of the Atlantic Ocean (Crustacea: Decapoda). *Bulletin of Marine Science*, **24**(4): 723-884, fig. 1-35.

HOLTHUIS, L. B., 1985. — A revision of the family Scyllaridae (Crustacea: Decapoda: Macrura). I. Subfamily Ibacinae. *Zoologische Verhandelingen*, (218): 1-130, fig. 1-27.

HORIKAWA, Y., 1940. — On crabs in Taiwan. *Science in Taiwan*, **8** (1): 28.

HOWARTH, M. K., 1981. — Palaeogeography of the Mesozoic. *In*: COCKS, L. R. M. (ed.), The Evolving Earth: 197-220. Cambridge University Press.

IHLE, J. E. W., 1913. — Die Decapoda Brachyura der Siboga-Expedition I. Dromiacea. *Siboga Expedition Monographs*, 39(b), Livr. 71: 1-96. fig. 1-38, pl. 1-4.

JACQUES, F., 1989. — The setal system of crustaceans: types of setae, groupings, and functional morphology. *In*: B. E. FELGENHAUER, L. WATLING & A. B. THISTLE (eds), Functional morphology of feeding and grooming in Crustacea. *Crustacean Issues*, **6**: 1-13, fig. 1-4. Balkema, Rotterdam.

JAMIESON, B. G. M., 1994. — Phylogeny of the Brachyura with particular reference to the Podotremata: evidence from a review of spermatozoal ultrastructure (Crustacea, Decapoda). *Philosophical Transactions of the Royal Society of London*, **345**: 373-393, fig. 1-10.

JAMIESON, B. G. M., GUINOT, D. & RICHER DE FORGES, B., 1993. — The ultrastructure of the spermatozoon of *Paradynomene tuberculata* Sakai, 1963 (Crustacea, Brachyura, Dynomenidae): synapomorphies with dromiid sperm. *Helgolaender Meeresuntersuchungen*, **47**: 311-322, fig. 1-2.

JAMIESON, B. G. M., GUINOT, D. & RICHER DE FORGES, B., 1995. — Phylogeny of the Brachyura (Crustacea, Decapoda): evidence from spermatozoal ultrastructure. *In* : B. G. M. JAMIESON, J. AUSIO & J.-L. JUSTINE (eds), Advances in spermatozoal phylogeny and taxonomy. *Mémoires du Muséum national d'Histoire naturelle*, **166**: 265-285, fig. 1-6.

JAROCKI, F. P., 1825. — Zoologiia czyli zwierzetopismo ogolne podlug naynowszego systematu ulozone, **5**: 1-434, pl. 1-7.

JOHNSON, P. T. & OTTO, S. V., 1981. — Histology of a bilateral gynandromorph of the blue crab, *Callinectes sapidus* Rathbun (Decapoda: Portunidae). *Biological Bulletin*, **161**: 236-245, fig. 1-8.

KENSLEY, B., 1981. — On the zoogeography of Southern African decapod Crustacea, with a distributional checklist of the species. *Smithsonian Contributions in Zoology*, (338): 1-64, fig. 1-4.

KIM, W., & KIM, H. S., 1982. — Classification and geographical distribution of Korean crabs (Crustacea, Decapoda, Brachyura). *Proceedings of the College of Natural Science, Seoul National University*, **7** (1): 13-159, fig. 1.

LAMARCK, J. B. P. A. DE, 1838. — Histoire naturelle des Animaux sans vertèbres, présentant les caractères généraux et particuliers de ces animaux, leur distribution, leurs classes, leurs familles, leurs genres, et la citation des principales espèces qui s'y rapportent. 2nd ed., **5**, Decapoda : 348-498. Paris.

LATREILLE, P. A., 1825. — Familles naturelles du Règne Animal, exposées succinctement et dans un ordre analytique, avec l'indication de leurs genres, 570 pp. [Décapodes brachyoures: 267-273]. Baillère, Paris.

LATREILLE, P. A., 1829. — Les Crustacés, les Arachnides et les Insectes, distribués en familles naturelles. *In*: G. CUVIER, Le Règne Animal, distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée, édition 2, **4**: i-xxvii + 1-584. Paris.

LECHER, P., DEFAYE, D. & NOEL, P., 1995. — Chromosomes and nuclear DNA of Crustacea. *Invertebrate Reproduction & Development,* **27**: 85-114, fig. 1-7.

LEMAITRE, R. & ALVAREZ-LEON, R., 1992. — Crustáceos Decapodos del Pacifico Colombiana: lista de especies y consideraciones zoogeograficas. *Anales Instituto de Investigaciones Marinas de Punta de Betin*, **21**: 33-76, fig. 1-2.

LIN, C. C., 1949. — A catalogue of brachyurous Crustacea of Taiwan. *Quarterly Journal of the Taiwan Museum*, **2** (1): 10-33.

McLAY, C. L., 1991. — A small collection of deep water sponge crabs (Brachyura: Dromiidae) from French Polynesia, including a new species of *Sphaerodromia* Alcock, 1899. *Bulletin du Muséum national d'Histoire naturelle, Paris*, (4), **13**, sect. A, (3-4): 457-481, fig. 1-8, pl. 1.

McLAY, C. L., 1993. — Crustacea Decapoda: The sponge crabs (Dromiidae) of New Caledonia and the Philippines with a review of the genera. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, volume 10. *Mémoires du Muséum national d'Histoire naturelle*, **156**: 11-251, fig. 1-19.

MAN, J. G. DE, 1888. — Bericht über die von Herrn Dr. J. Brock im indischen Archipel gesammelten Decapoden und Stomatopoden. *Archiv für Naturgeschichte*, **53**, 1887 (1888): 215-600, pl. 7-22a.

MAN, J. G. DE, 1889. — Über einige neue oder seltene indopacifische Brachyuren. *Zoologische Jahrbücher* (Systematik) **4**: 409-452, pl. 9-10.

MAN, J. G. DE, 1902. — Die von Herrn Professor Kükenthal im Indischen Archipel gesammelten Dekapoden und Stomatopoden. *In*: W. KÜKENTHAL, Ergebnisse einer Zoologischen Forschungsreise im den Molukken und Borneo. *Abhandlungen hrsg. Senckenbergischen Naturforschende Gesellschaft*, **25** (3): 467-929, pl. 19-27.

MANNING, R. B., 1993. — West African pinnotherid crabs, subfamily Pinnotherinae (Crustacea, Decapoda, Brachyura). *Bulletin du Muséum national d'Histoire naturelle,* Paris, (4), **15** (1-4): 125-177, fig. 1-33.

MANNING, R. B. & HOLTHUIS, L. B., 1981. — West African Brachyuran crabs (Crustacea: Decapoda). *Smithsonian Contributions in Zoology*, (306): 1-379, 88 figs.

MARTIN, J. W., 1990. — Crabs of the family Homolodromiidae, II. *Dicranodromia felderi*, new species, from the Western Atlantic, with notes on the type species of *D. ovata* A, Milne Edwards, 1880. *Journal of Crustacean Biology*, **10**(4): 708-720, fig. 1-5.

MIERS, E. J., 1884. — On some crustaceans from Mauritius. *Proceedings of the Zoological Society, London,* (1884): 10-17, pl. 1.

MILNE EDWARDS, A., 1865. — Monographie des crustacés fossiles de la famille des Cancériens. *Annales des Sciences naturelles,* Zoologie, (5), **3**: 297-351, pl. 5-13.

MILNE EDWARDS, A., 1879. — Mémoire sur les Crustacés Décapodes du genre *Dynomene*. *Annales des Sciences naturelles*, Zoologie, (6), **8**: 1-11, pl. 12-14.

MILNE EDWARDS, A., 1880. — Études préliminaires sur les Crustacés, 1ère Partie. *In*: Reports on the results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico, and in the Caribbean Sea, 1877, 1878, 1879, by the U. S. coast survey steamer "Blake", Lieut.-Commander C. D. Sigsbee, U.S.N., and Commander J. S. Bartlett, U.S.N. commanding. *Bulletin of the Museum of Comparative Zoology, Harvard,* **8** (1): 1-68, pl. 1-2.

MILNE EDWARDS, A. & BOUVIER, E.-L., 1899. — Crustacés Décapodes provenant des campagnes de l'Hirondelle (Supplément) et de la Princesse-Alice (1891-1897). *Résultats des Campagnes scientifiques accomplies sur son yatch par Albert I, Prince Souverain de Monaco*, **13**: 1-106, pl. 1-4.

MILNE EDWARDS, A. & BOUVIER, E.-L., 1900. — Brachyures et Anomoures. *In*: Crustacés Décapodes, Première Partie. Expéditions scientifiques du Travailleur et du Talisman pendant les années 1880, 1881, 1882, 1883. 396 pp., 32 pls, Paris.

MILNE EDWARDS, A. & BOUVIER, E.-L., 1902. — Les Dromiacés et Oxystomes. *In*: Reports on the Results of dredging under the supervision of Alexander Agassiz, in the Gulf of Mexico (1877-78), and in the Caribbean Sea (1878-79), and along the Atlantic coast of the United States (1880), by the U. S. Coast survey steamer "Blake", Lieut.-Commander C. D. Sigsbee, U.S.N., and Commander J. S. Bartlett, U.S.N. commanding, 39. *Memoirs of the Museum of Comparative Zoology, Harvard*, **27** (1): 1-127, fig. 1-23, pl. 1-25.

MILNE EDWARDS, H., 1837. — Histoire Naturelle des Crustacés, comprenant l'anatomie, la physiologie et la classification de ces animaux, **2**: 1-532. Paris.

MILNE EDWARDS, H., 1848. — Crustacés. *In:* G. CUVIER, Le Règne Animal distribué d'après son organisation, pour servir de base à l'histoire naturelle des animaux et d'introduction à l'anatomie comparée. Édition accompagnée de planches gravées... par une réunion des disciples de Cuvier. Paris. Texte: 1-278. Atlas, pl. 1-80.

MINIGAWA, M., 1993. — Gonopods of the red frog crab *Ranina ranina* Linnaeus (Decapoda: Raninidae). *Crustacean Research*, **2**: 45-54, fig. 1-5.

MIYAKE, S., 1938. — Unrecorded crabs from Formosa collected by Prof. Hiroshi Ohshima in 1932. *Transactions of the Natural History Society, Formosa*, **28** (177): 187-196, fig. 1-4 (In Japanese).

MIYAKE, S., 1939. — Notes on Crustacea Brachyura collected by Prof. Teiso Esaki's Micronesia Expeditions 1937-1938 together with a check list of Micronesian Brachyura. *Records of Oceanographic Works in Japan*, **10** (2): 168-247, pl. 12-17 [1-6], 1 tabl.

MIYAKE, S., 1983. — Japanese Crustacean Decapods and Stomatopods in Color. Vol. II. Brachyura (Crabs), viii + 277 pp., 64 pls. Hoikusha, Osaka (In Japanese).

MONOD, T., 1956. — Hippidea et Brachyura ouest-Africains. *Mémoires de l'Institut francais d'Afrique noire*, (**45**): 1-674, fig. 1-884.

MONOD, T. & SERÈNE, R., 1976. — Parasitic, commensal, and inquiline crustaceans collected during the Rumphius Expedition II. *Oseanologi di Indonesia*, **6**: 22-27.

MORRISON, J. P. E., 1954. — Animal ecology of Raroia Atoll, Tuamotus. Part 1. Ecological notes on the mollusks and other animals of Raroia. *Atoll Research Bulletin*, **34**: 1-18.

NAGAI, S., 1989. — Brachyuran fauna of Wakayama Prefecture I. *Nankiseibutu: The Nanki Biological Society*, **31**: 39-44 (In Japanese).

NAGAI, S. & NOMURA, K., 1988. — Crustacea, 250 pp. Shinsei, Tokyo (In Japanese).

NAGAI, S. & TSUCHIDA, E., 1995. — Crabs dredged from the sea around Miyake Island by R/V Tansei-maru and fishing boat, I. *Nanki Seibutu*, **37**: 107-113, pl. 1, fig. 1-9.

NAIM, O., 1980. — Étude qualitative et quantitative de la faune mobile associée aux algues du lagon Tiahura, île de Moorea, Polynésie francaise. *Thèse 3ème cycle, Université de Paris* VI: 1-105, fig. 1-40, tabl. 1-17.

NOBILI, G., 1907. — Richerche sui Crostacei della Polinesia. Decapodi, Stomatopodi, Anisopodi e Isopodi. *Memorie Accademia delle Scienze di Torino*, **57** (2): 351-430, pl. 1-3.

ODINETZ, O., 1983. — Écologie et structure des peuplements de Crustacés Décapodes associés aux coraux du genre *Pocillopora* en Polynésie française et en Micronésie (Guam). *Thèse de 3ème cycle, Université de Paris* VI: 1-221, fig. 1-48, tabl. 1-9.

ODHNER, T., 1925. — Monographie der Gattungen der Krabbenfamilie Xanthidae. I. *Göteborgs Kungliga Vetenskaps och Vitterhet Samhälles Handlingar*, (4), **29** (1): 1-92, fig. 1-7, pl. 1-5.

ORTMANN, A. E., 1892. — Die Decapoden-Krebse des Strassburger Museums. Theil 5, Die Abtheilungen Hippidea, Dromiidea und Oxystomata. *Zoologische Jahrbücher*, Abteilung für Systematik, **6**: 532-588, pl. 26.

ORTMANN, A. E., 1894. — Crustacea. *In*: R. SEMON, Zoologische Forschungsreisen in Australien und dem Malayischen Archipel. *Denkschriften der Medizinisch-naturwissenschaftlichen Gesellschaft, Jena*, **8:** 1-80, pl. 1-3.

ORTMANN, A. E., 1898. — Crustacea, Zweite Halfte: Malacostraca. *In*: H. G. BRONN, Klassen und Ordnungen des Thier-Reichs, **5**, Abtheilung II (Gliederfussler: Arthropoda), Lieferung 50-52: 1121-1168, pl. 112-116. C. Winter, Leipzig.

ORTMANN, A. E., 1899. — Crustacea, Zweite Halfte: Malacostraca. *In*: H. G. BRONN, Klassen und Ordnungen des Thier-Reichs, **5**, Abtheilung II (Gliederfussler: Arthropoda), Lieferung 53-56: 1169-1232, pl. 117-122. C. Winter, Leipzig.

ORTMANN, A. E., 1900. — Crustacea, Zweite Halfte: Malacostraca. *In*: H. G. BRONN, Klassen und Ordnungen des Thier-Reichs, **5**, Abtheilung II (Gliederfussler: Arthropoda), Lieferung 57-59: 1233-1280, pl. 123-125. C. Winter, Leipzig.

PEYROT-CLAUSADE, M., 1977. — Décapodes Brachyoures et Anomoures (à l'exception des Paguridae) de la cryptofaune de Tiahura, île de Moorea. *Cahiers du Pacifique*, **20**: 211-222, fig. 1-3.

PEYROT-CLAUSADE, M., 1981. — Motile cryptofauna of Tulear Great Reef outer slope: Brachyura and Anomura distribution. *Proceedings of the Fourth International Coral Reef Symposium,* Manila, **2**: 745-754, fig. 1-4.

PEYROT-CLAUSADE, M., 1984. — Cryptofaune carcinologique des pentes externes des récifs de l'île de La Réunion et de l'île Maurice. *Mauritius Institute Bulletin*, **10** (1): 103-121, fig. 1-3.

PEYROT-CLAUSADE, M. & SERÈNE, R., 1976. — Observations sur quelques espèces de Brachyoures (Crustacés Décapodes) de Madagascar. *Bulletin du Muséum national d'Histoire naturelle, Paris,* 3e sér., (416), Zool. 293: 1339-1371, fig. 1, pl. 1-5.

POHLE, G., 1989. — Gill and embryo grooming in lithodid crabs: comparative functional morphology based on *Lithodes maja*. *In*: B. E. FELGENHAUER, L. WATLING & A. B. THISTLE (eds), Functional morphology of feeding and grooming in Crustacea. *Crustacean Issues*, **6**: 75-94, fig. 1-14. Balkema, Rotterdam.

POUPIN, J., 1996a. — Crustacea Decapoda of French Polynesia (Astacidea, Palinuridea, Anomura, Brachyura). *Atoll Research Bulletin*, **442**: 1-14.

POUPIN, J., 1996b. — Atlas des crustacés marins profonds de Polynésie Française récoltes du navire MARARA (1986/1996). Report Service Mixte de Surveillance Radiologique et Biologique (SMSRB), 59 pp., 20 pls.

PRAHL, H. VON, 1986. — Crustáceos Decapodos, asociados a diferentes hábitats en La Ensenada De Utria, Choco, Colombia. *Actualidades Biologicas*, 15 (57): 95-99.

PRAHL, H. VON & ALBERICO, M., 1986. — Isla de Gorgona, 252 pp. Universidad del Valle, Biblioteca Banco Popular, Bogota.

RATHBUN, M. J., 1911. — Marine Brachyura. *In*: The Percy Sladen Trust Expedition to the Indian Ocean in 1905 under the Leadership of Mr. J. Stanley Gardiner. Vol. 3 (9). *Transactions of the Linnean Society, London*, (Zool.), (2), **14** (2): 191-261, pl. 15-20.

RATHBUN, M. J., 1937. — The Oxystomatous and allied crabs of America. *Bulletin of the United States national Museum,* (166): i-vi + 1-278, 86 pls.

REMES, M., 1895. — Beiträge zur Kenntnis der Crustaceen der Stramberger Schichten. *Bulletin international de l'Académie des Sciences de Bohème*, **2**: 200-204, pl. 1-3.

REUSS, A. E., 1859. — Zur Kenntniss fossiler Krabben. *Denkschrifte der koniglichen Akademie der Wissenschaften zu Wien*, **17**: 1-90, pl. 1-24.

RIBES, S., 1978. — La macrofaune vagile associée à la partie vivante des Scléractiniaires sur un récif frangeant de l'île de La Réunion (Océan Indien). *Thèse de Doctorat de 3ème cycle en Océanographie, Université d'Aix-Marseille II*: 1-167.

RICE, A. L., 1981. — The zoea of *Acanthodromia erinacea* A. Milne Edwards: the first description of a dynomenid larva (Decapoda, Dromioidea). *Journal of Crustacean Biology*, **1** (2): 174-176, fig. 1.

RICHTERS, F., 1880. — Decapoda. *In*: K. MÖBIUS, Beiträge zur Meeresfauna der Insel Mauritius und der Seychellen: 139-178, pl. 15-18.

RIDEWOOD, W. G., 1909. — A case of abnormal oviducts in *Homarus vulgaris*. *Annals and Magazine of Natural History*, (8) **3**: 1-7, fig.1-2.

RODGERS, K. A. & OLEROD, R., 1988. — A catalogue of zoological specimens collected from Tuvalu (Ellice Islands) by Sixten Bock, 1917. *Pacific Science*, **42**: 300-305.

RODRIGUEZ DE LA CRUZ, M.C., 1987. — Crustáceos decapodos del golfo de California, 306 pp. Secretaría de Pesca, Mexico.

ROEMER, F. A., 1887. — *Graptocarcinus texanus*, ein Brachyure aus der oberen Kreide von Texas. *Neues Jahrbuch fur Mineralogie, Geologie und Palaontologie*, **1**: 173-176.

ROPER, D. S., 1979. — Distribution of the spider crab, *Leptomithrax longipes*, and evidence of bacterially induced feminisation. *New Zealand Journal of Marine & Freshwater Research*, **13**: 303-307, fig. 1-5.

SAKAI, T., 1936. — Studies on the crabs of Japan. I. Dromiacea. *Scientific Reports of the Tokyo Bunrika Daigaku*, Sect. B, **3**, suppl. 1: 1-66, fig. 1-13, pl. 1-9.

SAKAI, T., 1940. — Bio-geographic review on the distribution of crabs in Japanese waters. *Records of Oceanographic Works in Japan*, **11** (1): 27-63, fig. 1-3.

SAKAI, T., 1963. — Description of two new genera and fourteen new species of Japanese crabs from the collection of His Majesty the Emperor of Japan. *Crustaceana*, **5** (3): 213-233, fig. 1-8.

SAKAI, T., 1965a. — The crabs of Sagami Bay collected by His Majesty the Emperor of Japan. English text, xvi + 206 pp.; Japanese text, 92 pp., fig. 1-27, pl. 1-100. Maruzen Co, Tokyo.

SAKAI, T., 1965b. — Notes from the carcinological fauna of Japan (II). *Researches on Crustacea*, **2**: 41-46, frontispiece 2-3, text-fig. 1-2, pl. 5-6.

SAKAI, T., 1965c. — Crustacea, Decapoda, Brachyura. *In*: Y. K. OKADA, S. UCHIDA, & T. UCHIDA (eds), New Illustrated Encyclopedia of the Fauna of Japan, vol. 2: 653-721. Hokuryu-kan, Tokyo.

SAKAI, T., 1976. — Crabs of Japan and the adjacent seas, [In 3 volumes: (1) English text, xxxix + 773 pp., fig. 1-379; (2) Plates volume, 16 pp., pl. 1-251; (3) Japanese text, 461 pp., fig. 1-2]. Kodansha Ltd, Tokyo.

SCHOLTHEIM, E. F. VON, 1820. — Die Petrefaktenkunde auf ihrem jetzigen Standpunkte, durch die Beschreibung seiner Sammlung versteinerter und fossiler Überreste des Thier und Pflanzenreiches der Vorwelt erläutert. xii + 437 pp. Becker, Gotha.

SCHOLTZ, G. & RICHTER, S., 1995. — Phylogenetic systematics of the reptantian Decapoda (Crustacea, Malacostraca). *Zoological Journal of the Linnean Society*, **113**: 289-328, fig. 1-21.

SCHMITT, W. L., 1939. — Decapod and other Crustacea collected on the Presidential cruise of 1938 (with Introduction and Station Data). *Smithsonian Miscellaneous Collections*, **98** (6): 1-29, fig. 1-2, pl. 1-3.

SERÈNE, R., 1968. — The Brachyura of the Indo-West Pacific region. *In*: Prodromus for a Check List of the (non-planktonic) Marine Fauna of Southeast Asia. Unesco Singapore, Special publication N° 1, Fauna IIICc3: 33-112.

SERÈNE, R., 1973. — Notes sur quelques espèces de Brachyoures de Nouvelle-Calédonie. *Cahiers du Pacifique*, **17**: 119-161, fig. 1-31, 8 pls.

SERÈNE, R. & VADON, C., 1981. — Crustacés Décapodes: Brachyoures. Liste préliminaire, description de formes nouvelles et remarques taxonomiques. *In*: Résultats des Campagnes MUSORSTOM. I. Philippines (18-28 Mars 1976), volume 1. *Mémoires ORSTOM*, (91): 117-140, fig. 1-3, pl. 1-4.

SPEARS, T., ABELE, L. G. & KIM, W., 1992. — The monophyly of the brachyuran crabs: a phylogenetic study based on 18S rRNA nucleotide sequences. *Systematic Biology*, **41**: 446-461, fig. 1-4.

STEBBING, T. R. R., 1905. — South African Crustacea. Part III. *In*: Marine Investigations in South Africa, **4**: 21-123, pl. 17-26. Cape Times Ltd, Cape Town.

STEBBING, T. R. R., 1921. — South African Crustacea: Part XI of S. A. Crustacea, for the Marine Investigations of South Africa. *Annals of the South African Museum*, **18**: 453-464, pl. 13-20 (Crust. pl. 108-115).

STENZEL, H. B., 1945. — Decapod crustaceans from the Cretaceous of Texas. *Bulletin of the University of Texas, Bureau of Economic Geology and Technology*, (4401): 401-476, pl. 34-45.

STEWART, J., KENNELY, S. J. & HOEGH-GULDBERG, O. D., 1997. — Size at sexual maturity and the reproductive biology of two species of scyllarid lobsters from New South Wales and Victoria, Australia. *Crustaceana*, **70** (3): 344-367, fig. 1-8.

STIMPSON, W., 1858. — Prodromus descriptionis animalium evertebratorum, quae in Expeditione ad Oceanum Pacificum Septentrionalem, a Republica Federata missa, Cadwaladaro Ringgold et Johanne Rodgers ducibus, observavit et descripsit W. Stimpson, Pars VII. Crustacea Anomura. *Proceedings of the Academy of Natural Science, Philadelphia*, **10**, 4: 225-252 (63-90).

STIMPSON, W., 1860. — Notes on North American Crustacea, in the museum of the Smithsonian Institution. No. II. *Annals of the Lyceum of Natural History of New York*, **7**: 177-246 [49-118], pl. 2, 5.

STRAELEN, V. VAN, 1944. — Anomures et brachyures du Cenomanien de la Navarre. *Bulletin du Musée royal d'Histoire naturelle de Belgique*, **20**: 1-12.

SUZUKI, H. & McLAY, C. L., 1998. — Gill-cleaning mechanisms of *Paratya curvirostris* (Caridea: Atyidae) and comparisons with seven species of Japanese atyid shrimps. *Journal of Crustacean Biology*, **18**(2): 253-270, fig. 1-10.

SUZUKI, K. & KURATA, Y., 1967. — On the carcinological fauna of the Izu-Oshima and its adjacent islands. *Researches on Crustacea*, **3**: 86-104, fig. 1-2, pl. 8-9 (In Japanese).

TAKEDA, M., 1973. — Studies on the Crustacea Brachyura of the Palau Islands I. Dromiidae, Dynomenidae, Calappidae, Leucosiidae, Hymenosomatidae, Majidae and Parthenopidae. *Bulletin of the Liberal Arts & Science Course, Nihon University School of Medicine,* **1**: 75-122, fig. 1-6, pl. 2-3.

TAKEDA, M., 1977. — Two interesting crabs from Hawaii. *Pacific Science,* **31**: 31-38, fig. 1-4.

TAKEDA, M., 1978. — Ecology and Observations of Crabs. Green Books 41. iv + 94 pp. New Science Ltd, Tokyo (In Japanese).

TAKETOMI, Y. & NISHIKAWA, S., 1996. — Implantation of androgenic glands into immature female crayfish, *Procambarus clarkii*, with masculization of sexual characteristics. *Journal of Crustacean Biology,* **16**: 232-239, fig. 1-5.

TAVARES, M., 1993. — Crustacea Decapoda: Les Cyclodorippidae et Cymonomidae de l'Indo-Ouest-Pacifique à l'exclusion du genre *Cymonomus*. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, volume 10. *Mémoires du Muséum national d'Histoire naturelle*, **156**: 253-313, fig. 1-20.

TAYLOR, D. M., 1986. — A bilateral gynandromorph of the snow crab, *Chionoecetes opilio*, from Newfoundland, Canada. *Crustaceana*, **51**: 309-312, fig. 1-3.

TWEEDIE, M. W. F., 1947. — On the Brachyura of Christmas Island. *Bulletin of the Raffles Museum*, **18**: 27-42, fig. 1.

TWEEDIE, M. W. F., 1950. — The fauna of the Cocos-Keeling Islands, Brachyura and Stomatopoda. *Bulletin of the Raffles Museum*, **22**: 105-48, 4 figs, pl. 16-17.

VANNINI, M., 1985. — A shrimp that speaks crab-ese. *Journal of Crustacean Biology*, **5**: 160-167, fig. 1-4.

VARGAS, C.R., JESSE, S., & CASTRO, M., 1996. — Checklist of crustaceans (Decapoda and Stomatopoda), collected during the Victor Hensen Costa Rica Expedition (1993/1994). *Revista de Biologia Tropical*, **44**: 97-102.

VEILLET, A., 1945. — Recherches sur le parasitisme des crabes et galathées par les rhizocéphales et les épicarides. *Annales de l'Institut océanographique*, **22**: 194-341, fig. 1-31.

VILLALOBOS-HIRIAT, J.L., NATES-RODRIGUEZ, J.C., DIAZ-BARRIGA, A.C., VALLE-MARTINEZ, M.D., FLORES-HERNANDEZ, E., LIRA-FERNANDEZ, E. & SCHIMDTSDORF-VALENCIA, P., 1989. — Listados faunisticos de México. I. Crustáceos estomatopodos y decapodos intermareales de las Islas del golfo de California, 114 pp. Instituto de Biología, Universidad Nacional Autónoma de México.

WARD, M., 1942. — Notes on the Crustacea of the Desjardins Museum, Mauritius Institute, with descriptions of new genera and species. *Bulletin of the Mauritius Institute*, **2** (2): 49-113. pl. 5-6.

WILLIAMSON, D. I., 1965. — Some larval stages of three Australian crabs belonging to the families Homolidae and Raninidae, and observations on the affinities of these families (Crustacea: Decapoda). *Australian Journal of Marine and Freshwater Research,* **16**: 369-398, fig. 1-7.

WRIGHT, C. W. & COLLINS, J. S. H., 1972. — British Cretaceous crabs. *Palaeontographical Society Monographs*, (126): 1-114, pls 1-22.

YOKOYA, Y., 1933. — On the Distribution of decapod Crustaceans inhabiting the Continental Shelf around Japan, chiefly based on materials collected by S. S. Soyo-Maru, during the years 1923-1930. *Journal of the College of Agriculture, Tokyo*, **12** (1): 1-226, fig. 1-70, tabl. 1-4.

YOUNG, C. G., 1900. — The Stalk-eyed Crustacea of British Guiana, West Indies, and Bermuda, 514 pp. John M. Watkins, London.

INDEX

Family and genus names are given in capital letters, species names in italics. Bold family, genus and species names indicate that the taxa are treated in detail.

Bold numbers indicate the pages where the subject is treated in detail.

Abdomen 439; **455**
  locking mechanism 455; 462; 539
  sexual dimorphism 456
  uropods 439
ACANTHODROMIA 432; 433; 438; 439; 441; 443; 447; 449; 456; 464; 466; 468; 469; **534**
  A. erinacea 431; 432; 433; 442; 443; 453; 469; **470**; **535**
  A. margarita 432; 433; **470**; **539**
Acanthodromies 449
Achelata 466
ALBUNEIDAE 469
Alpheus lottini 480
Anomola 454; 466
Antennae 438; **441**
Antennules 438; **441**
Anterolateral teeth **439**
  variation 483; 501; 530; 544
ARACHNODROMIA 468
Archaeobrachyura 463; 551
Astacus astacus 528
Austrodromidia octodentata 550
Axius longispina 499

BETAEUS 454
BLEPHARIPODA 469
BOPYRIDAE
  GIGANTIONE 488
Brachynotus gemmellari 528
Brachyurites rugosus 434
Branchial formula **443**; 476; 493; 500; 524; 526; 538; 546

CALLIANASSA 466
Callinectes sapidus 528
Cambarus propinquus 528
Camouflage behaviour 463; 466
Carapace **439**
  grooves 435; 439
Carcinus maenas 528
Chelipeds 438; **449**
Chionoecetes opilio 459; 528
CONCHOECETES 447
Corals **549**
  ACROPORA 478; 481; 488; 510
  CORALLIUM 520
  FAVIA 481
  GONIASTREA 481
  OULOPHYLLIA 481
  POCILLOPORA 480; 488; 514
  PORITES 481; 488; 514
  red coral 492
  SERIATOPORA 481
Crista dentata 438; 443
Cronius tumidulus 444
CRYPTODROMIA 543
  C. canaliculata 510
CRYPTODROMIOPSIS
  C. antillensis 467; 488
  C. larraburei 444
Cyamocarcinus angustifrons 434
CYCLODORIPPIDAE 463; 466
Cyclothyreus strambergensis 434
CYMONOMIDAE 463

Depth distribution 478; 486; 492; 499; 502; 509; 514; 525; 533; 538; 542; 547; **550**
DICRANODROMIA 460; 463; 464; 468; 534; 556
  D. felderi 460; 462
  D. mahieuxii 447; 493
  D. nagaii 550
  D. ovata 447; 538
Diet 480; 494; 500; 510; 515; 527; 549
DROMIA 460; 464; 468; 543
  D. erythropus 444
  D. personata 441
  D. wilsoni 534
Dromiacea 463; 464; 551
  ancestor 463
DROMIDIA 468; 550
  D. larraburei 444
  D. spongiosa 433
DROMIDIOPSIS 454; 493; 549
  D globosa 550
  D. edwardsi 467
Dromiens 468
DROMIIDAE 439; 441; 443; 444; 447; 454; 455; 460; 463; **464**; 466; 468; 488; 493; 494; 538; 543; 548; 550; 551; 556
  ancestor 466
DROMIOPSIS 434
DYNOMENE 433; 434; 439; 441; 443; 444; 449; 453; 455; 463; **471**; 543
  D. actaeiformis 432; 433; 494
  D. depressa 433
  D. devaneyi 432; 433; 530

D. filholi 432; 433; 441; 442; 443; 447; 454; 460; **471**; **488**; 549
D. granulobata 432; 433; 473; 479
D. hispida 431; 432; 433; 438; 441; **443**; 447; 453; **471**; **473**; 499; 505
D. hispide 473
D. huangluensis 432; 433; 481; 486
D. latreillii 432; 433; 473; 479
D. margarita 432; 433; 539
D. pilumnoides 432; 433; 441; 442; 447; 460; **471**; 494
D. platyarthrodes 432; 433; 469
D. praedator 432; 433; 438; 441; 442; 447; 453; 456; 460; **470**; 479; 480; **481**; 521; 526
D. pugnatrix 433; 441; 447; 449; **471**; **500**
D. pugnatrix brevimana 432; 433; 500
D. sinense 481
D. sinensis 432; 433; 486
D. spinosa 432; 433
D. tanensis 432; 433; 526
D. tenuilobata 432; 433; 481; 486
D. ursula 432; 433; 510
DYNOMENIDAE 434; 444; 449; **464**; 467
DYNOMENINAE 467

Ebalia tuberculata 528
Elassopodus stellatus 452
EODROMIA 460; 464
EPIGODROMIA 447; 543; 549
E. gilesii 460; 548
Epipods **443**
Eubrachyura 466
Evolution 449; 494; 539; 543; 550; 551; 552
convergence 549
EXODROMIDIA 460; 550

Feeding behaviour 488; **550**
Fossils 434; 441; 535

Gemmellarocarcinus loerentheyi 434
Geographic distribution 478; 486; 492; 498; 502; 509; 514; 515; 520; 525; 533; 538; 542; 547; **552**
Gill cleaning **443**; 447; 463
Gills 438; **443**; 444; **447**; 449; 479; 515; 548
evolution 466
Glyptodynomene alsasuensis 434
Graptocarcinus texanus 434
Gynandromorphs **527**

Habitat **549**
Haledromia bicavernosa 550
HIRSUTODYNOMENE 433; 434; 439; 441; 443; 444; 447; 449; 453; 455; **504**
H. spinosa 433; 441; 460; **470**; 473
H. ursula 433; 441; 460; 467; **510**
HOMARUS
H. americanus 528
H. gammarus 528
H. vulgaris 443; 447
Homola andamanicus 499
HOMOLIDAE 443; 454; 463; 466; 467; 468; 556
HOMOLODROMIA 460; 464; 556
H. kai 467
H. paradoxa 447; 453; 538
HOMOLODROMIIDAE 441; 443; 447; 455; 460; 463; **464**; 466; 550; 551
HOMOLOGENUS 454
Hyas coarctatus 528
Hypobranchial setae **444**; 526; 548
HYPOCONCHA 447
H. arcuata 467
H. sabulosa 488
H. spinosissima 488

Identification key 469

JASUS
J. edwardsii 528
J. frontalis 528

KRANGALANGIA 466

Larvae 432; 469; 538; **550**
LATREILLIA 466
LATREILLIDAE 463; 466
LAURIDROMIA 454; 493; 549
Leptomithrax longipes 528
LUCIFERA 528
LYREIDUS 466

MAXILLOTHRIX 471
M. actaeiformis 432; 433; 494
Measurements **435**
abdomen 435; 439
carapace 435
cheliped propodus 435
pereopods 435
setae 435
METADYNOMENE 433; 434; 439; 441; 443; 449; 453; 455; **516**
M. crosnieri 433; 447; **470**; **530**
M. devaneyi 433; 444; 447; **470**; **517**
M. tanensis 433; 441; 444; 447; 454; 456; 460; 467; **470**; 481; 487; 493; **521**
Metapenaeus monoceros 528
MITHRACITES 543
Mouthparts 438; **441**; 487; 493
maxillipeds 443

Nephrops norvegicus 528
Nepinnotheres androgynus 528

Orbits **441**

PALAEMON 454
Palaeodromites octodentatus 434
PALINURIDAE 454; 551
PARADYNOMENE 433; 439; 443; 449; 455; 469; **542**
P. tuberculata 433; 439; 441; **443**; 444; 447; 454; 460; 467; **470**; 493; **543**
Penis **460**
Pereopods 438; **449**; 467
article fusion **449**; 538; 548
dactyl spine 493; 527; 549
sexual dimorphism 453
vestigial 439; **449**; **453**; **454**; 467; 493; 500; 515; 527; 538; 548
Petalomera pulchra 488
Phylogeny **462**
brachyuran monophyly 463
Dromiacea 466
dromiacean monophyly 463
homolodromiid monophyly 464
Podotremata 466
PILUMNUS 514
PLAGIOPHTHALMUS 535
Pleistacantha moseleyi 528
Pleopods 439; **456**; 515
female **460**
gynandromorphs 456
male first 458
male function 459
male second **459**
rudimentary **460**; 499; 527
structure 460
tegumental gland 459
Podotremata **463**
ancestor 466
monophyly 464
paraphyly 466
PORCELLANIDAE 454
POUPINIIDAE 463
Procambarus clarkii 528
PROSOPIDAE 467; 535
PSEUDODROMIA 550

RANINA 466
R. ranina 459
RANINIDAE 463; 466
RANINOIDES 466
RATHBUNOPON 543
Relative growth **527**
Reproductive strategy 478; 486; 492; 499; 502; 509; 514; 525; 538; 547; **550**

Scaphognathite setae **444**; 499; 539
SCYLLARIDAE 454
SCYLLARUS 466
Setae 435; **441**; 443; 449; 480; 493; 515; 526; 548
setules 441; 444
Sexual dimorphism
abdomen **456**; **527**
cheliped 449; **527**
fifth pereopod **453**; 480; 487; 493; 500; 515; 527; 538; 549
pleopods **456**
rudimentary pleopods 460
sternal sutures 7/8 455
uropods 462
SPEODROMIA 469; 550
S. platyarthrodes 433
Sperm duct **460**
SPHAERODROMIA 460; 463; 464; 521
Stephanometopon granulatum 434
Sternal Sutures **454**
Sternal sutures 7/8 **455**
STIMDROMIA
S. lamellata 460; 548
S. lateralis 467; 550
Synalpheus charon 480

Tegumental gland 480
THAUMASTOCHELIDAE 454
Trachynotocarcinus sulcatus 434
TUNEDROMIA 454; 493; 549
TYMOLUS 466

Uropods **462**
sexual dimorphism 462

XANTHIDAE 467; 550
XEINOSTOMA 466

10

Pisces Anguilliformes: Deepwater snake eels (Ophichthidae) from the New Caledonia region, Southwest Pacific Ocean

John E. McCOSKER

California Academy of Sciences
Golden Gate Park, San Francisco, California 94118
USA

ABSTRACT

This paper reports upon the snake eels collected by trawl during the 1985 MUSORSTOM 4 New Caledonia Expedition. The 14 specimens comprised five new ophichthid taxa which are described herein: *Ophichthus exourus* sp. nov. from 400-520 m (also from Fiji); *O. genie* sp. nov. from 430-500 m (also from Maldives); *O. mystacinus* sp. nov. from 450-580 m; *Yirrkala insolitus* sp. nov. from 59 m; and *Rhinophichthus penicillatus* gen. et sp. nov. from 435 m. The dorsal fin location of the new species of *Yirrkala* provides an expanded character state within the genus. *Rhinophichthus* differs from other generalized ophichthins in its very conical snout, and includes *Ophichthys unicolor* Regan from South Africa. The affinities of the new taxa are with Indo-west Pacific ophichthids, however the collections are too few to allow significant conclusions about the bathyal ophichthid fauna of the region.

RÉSUMÉ

Pisces Anguilliformes: Poissons-serpents d'eau profonde (Ophichthidae) de la région néo-calédonienne (Pacifique sud-ouest).

Les 14 spécimens de poissons-serpents (famille des Ophichthidae) récoltés en 1985, au cours de la campagne de chalutage profond MUSORTOM 4, au large de la Nouvelle-Calédonie, sont étudiés et cinq espèces nouvelles sont décrites : *Ophichthus exourus* sp. nov. récoltée entre 400 et 520 m de profondeur (et aussi aux Fidji); *O. genie* sp. nov. récoltée entre 430 et 500 m (et aussi aux Maldives); *O. mystacinus* sp. nov. récoltée à 450-580 m; *Yirrkala insolitus* sp. nov. récoltée à 59 m et *Rhinophichthus penicillatus* gen. et sp. nov. récoltée à 435 m. La position de la nageoire dorsale de la nouvelle espèce de *Yirrkala* constitue un état évolué de ce caractère. De même le genre *Rhinophichthus*, par son museau très conique, semble particulièrement évolué; il inclut *Ophichthys unicolor* Regan décrite d'Afrique du Sud. Ces nouveaux taxa ont des affinités indo-pacifiques, cependant la collection est trop réduite pour permettre des conclusions significatives sur la faune ophichthienne bathyale de la région.

McCOSKER, J.E., 1999. — Pisces Anguilliformes: Deepwater snake eels (Ophichthidae) from the New Caledonia region, Southwest Pacific Ocean. *In*: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Volume 20. *Mémoires du Muséum national d'Histoire naturelle*: **180**: 571-588. Paris ISBN 2-85653-520-8.

INTRODUCTION

The 1985 MUSORSTOM oceanographic survey of the bathyal fauna of New Caledonia resulted in many interesting ichthyological discoveries. The specimens of ophichthid eels were captured from depths well below those normally inhabited by most ophichthid species. They were forwarded to me by Bernard SÉRET for identification and, although few in number - only 14 representing five taxa - the quality far exceeded the quantity, in that those specimens comprise three genera (one undescribed) and five undescribed species of ophichthid eels. The affinities of those new species seem to lie with Indo-west Pacific congeners. The new genus and its two species cannot yet be identified with any known sister group.

TAXONOMY

The snake eels and worm eels of the anguilliform family Ophichthidae are the most diverse and speciose of true eels (McCOSKER *et al.*, 1989). The more than 260 species distributed among 57 genera inhabit all tropical oceans and seas. They occupy habitats ranging from the intertidal zone to depths of 750 m or more, living amongst coral and rock reefs and sand and mud bottoms, some entering estuaries and rivers, and others having adapted to life in midwater. Ophichthids are of limited direct economic importance, however all seem to be edible and several large species are taken as a bycatch of trawl and trap fisheries and are consumed. In that they are abundant in many habitats, it is reasonable to assume that they are of indirect importance to commercial fisheries in their role as both predator and prey.

A systematic revision of the family Ophichthidae has yet to be achieved on a worldwide basis, although McCOSKER (1977) provided a comprehensive treatment of the genera. Several species are so widespread in distribution that they occupy both the Indian and Pacific oceans, however none are worldwide and others seem to be limited to island archipelagos or to limited coastal zones. Faunal treatments of ophichthids that may be helpful for the identification of genera and species have been prepared for: the western Atlantic (McCOSKER *et al.*, 1989); southeast Africa (McCOSKER & CASTLE, 1986); Indian Ocean and Red Sea (SMITH, 1962); Hawaii (McCOSKER, 1979); eastern Pacific (McCOSKER & ROSENBLATT, 1995); and Australia (McCOSKER in preparation).

Deepwater trawling and trapping in recent years has resulted in the collection of many new species of ophichthids. Because of their secretive, burrowing behavior, many species are able to avoid capture, particularly in deep water. If the success of the MUSORSTOM project is any indication, it is likely that many species will be discovered as a result of future deepwater surveys.

MATERIALS AND METHODS

All of the specimens collected from New Caledonia resulted from the 1985 MUSORSTOM 4 Expedition.

The first half of that expedition, aboard R. V. *"Vauban"*, investigated the "Grand Passage" between the northern lagoon of the mainland and Surprise Atoll. A total of 57 stations were sampled with beam trawls (stations "CP"), otter trawls (stations "CC"), Warren dredges, and Charcot dredges between 34-720 m depth (see RICHER DE FORGES, 1990). The otter trawl had a 15 m headrope and is known as a "shrimp trawl"; the beam trawl was 4 m wide and fitted with 20 mm mesh, lined with 5 mm mesh for the bag. The habitat, described by RICHER DE FORGES & BARGIBANT (1985) and RICHER DE FORGES (1990), is that of a "narrow sill situated at about 600 m depth. The bottoms encountered were mostly rocky, but with some soft areas carpeted with pumice stones. At the far extremity of the northern lagoon, sand with *Halimeda* was found as deep as 550 m and more. To the south of the Mainland, New Caledonia extends in a gentle sloping valley from 200 to 500 m. Here the bottoms are of sandstone slabs, relatively flat, and trawling is possible." These efforts resulted in numerous congrid eels but only 14 specimens of ophichthids, captured during five beam trawls and three otter trawls.

Specimen measurements are straight-line, made either with a 300 mm ruler with 0.5 mm gradations (for total length, trunk length, and tail length) and recorded to the nearest 0.5 mm, or with dial calipers (all other measurements) and recorded to the nearest 0.1 mm. Body length comprises head and trunk lengths. Head length is measured from the snout tip to the posterodorsal margin of the gill opening; trunk length is taken from the end of the head to mid-anus; maximum body depth does not include the median fins. Head pore terminology follows that of McCOSKER *et al.* (1989: 257) such that the supraorbital pores are expressed as the ethmoidal pore + pores in supraorbital canal, *i.e.*, 1 + 3, and the infraorbital pores are expressed as pores along the upper jaw + those in vertical part of canal behind eye (the "postorbital pores"), *i.e.*, 4 + 2, in that frequently the last pore included along the upper jaw is part of the postorbital series. Radiographic techniques are described in BÖHLKE (1989). Gill arch examination was accomplished after removal and clearing and counterstaining with alcian blue and alizarin red dyes (DINGERKUS & UHLER, 1977). The mean vertebral formula (MVF) is expressed as the average of predorsal, preanal, and total vertebrae (BÖHLKE, 1982). Vertebral counts (which include the hypural) are taken from radiographs. Institutional abbreviations follow the Standard Symbolic Codes for Institutional Research Collections in Herpetology and Ichthyology (LEVITON *et al.*, 1985). Other abbreviations are as follows: DFO = dorsal fin origin; HL = head length; IO = interorbital width; TL = total length.

RESULTS

Key to the species of deepwater MUSORSTOM ophichthid eels from the New Caledonia region*

1. Pectoral fins present; body moderately elongate, its depth < 45 times in total length **2**
— Pectoral fins absent; body elongate, its depth > 45 times in total length ..... ***Yirrkala insolitus***

2. Snout conical, sharply pointed; jaw teeth uniserial ... ***Rhinophichthus penicillatus***
— Snout rounded at tip, not conical and extended; maxillary teeth biserial **3**

3. Pectoral fin short, paddle-shaped, about 1.3-1.4 in upper jaw; posterior margin of orbit above rictus of jaw; teeth of mandible uniserial ..... ***Ophichthus exourus***
— Pectoral fin elongate, nearly as long as jaw; posterior margin of orbit well in advance of rictus or jaw; jaw teeth biserial **4**

4. Dorsal fin origin about mid-trunk; body depth 23-28 times in total length ..... ***Ophichthus mystacinus***
— Dorsal fin origin above pectoral fins; body depth 31-42 times in total length ..... ***Ophichthus genie***

*This key concerns only those ophichthids captured during the MUSORSTOM collections. It is not meant to be comprehensive in that the numerous shallow-water ophichthids from New Caledonia are not included.

FAMILY OPHICHTHIDAE

DIAGNOSIS. — Body elongate, snake-like in large species, worm-like in some smaller species; cylindrical anteriorly, generally laterally compressed posteriorly. Snout pointed to blunt, mouth either terminal or inferior. Jaw teeth variable, from molariform to conical to large and fanglike; from single to multiple rows, a few species without teeth on vomer. Nostrils widely separated, the posterior inside the mouth or penetrating through a valve or hole in or above the upper lip, the anterior usually in a short tube. Gill openings midlateral to entirely ventral,

a constricted opening in one subfamily (Myrophinae), variable in the other (Ophichthinae). Branchial region supported by numerous overlapping branchiostegal rays. Gill arches uniquely developed with first epibranchial connected by a continuous cartilaginous strap to the second infrapharyngobranchial; no more than first basibranchial ossified; the third hypobranchial usually cartilaginous. Dorsal and anal fins, when present, continuous around the caudal in one subfamily (Myrophinae) and absent, forming a hard finless point in the other (Ophichthinae); pectoral fins present or absent; pelvic fins absent. Lateral line system extends onto head, the sides connected through a frontal and a temporal canal. Coloration variable, from uniform (although usually darker dorsally) to mottled, spotted, barred or striped.

REMARKS. — As currently recognized, the Ophichthidae comprise two subfamilies, the Myrophinae and the Ophichthinae, and six tribes, the Myrophini, the Benthenchelyini, the Bascanichthyini, the Callechelyini, the Sphagebranchini, and the Ophichthini (McCOSKER, 1977; McCOSKER *et al.*, 1989). Ophichthid eels also differ from related eel families in the following manner:

1) Congridae, which possess posterior nostrils at the level of the eye;

2) Muraenidae, which lack pectoral fins, possess small branchial openings, and have posterior nostrils at the level of the eye;

3) Muraenesocidae, which possess posterior nostrils at the level of the eye, and have the vomer bearing a median series of large teeth flanked by a row of small teeth;

4) Chlopsidae (previously the Xenocongridae), which usually have multiple rows of vomerine teeth and an incomplete lateral line, limited to one or two pores in the branchial region.

Genus ***OPHICHTHUS*** Ahl, 1789

Innominado Parra, 1787: 96 (a junior synonym of *Muraena ophis* Linnaeus, 1758, non-binomial).

Ophichthus Ahl, 1789: 5 (type species *Muraena ophis* Linnaeus, 1758, by original designation. Improperly emended to *Ophichthys* by other authors).

Ophis Turton, 1807: 87 (type species "*O. maculata* ... Spotted Serpent. Shaw Zool., iv. p. 22 ... Bloch t. 154," = *Muraena ophis* Linnaeus, 1758, by monotypy).

Cogrus Rafinesque, 1810: 62 (type species *Cogrus maculatus* Rafinesque, 1810, by monotypy).

Ophithorax McClelland, 1844: 212 (type species *Ophisurus ophis* Lacépède, 1800 = *Muraena ophis* Linnaeus, 1758, by JORDAN, 1919, as first reviser).

Centrurophis Kaup, 1856: 42 (type species *Ophisurus spadiceus* Richardson, 1844 = *Ophichthys cephalazona* Bleeker, 1864, by JORDAN, 1919, as first reviser).

Poecilocephalus Kaup, 1856: 43 (type species *Poecilocephalus bonaparti* Kaup, 1856, by monotypy).

Microdonophis Kaup, 1856: 43 (type species *Microdonophis altipinnis* Kaup, 1856, by monotypy).

Coecilophis Kaup, 1856: 44 (type species *Ophisurus compar* Richardson, 1844 = *Ophisurus apicalis* Bennett, 1830, by monotypy).

Scytalophis Kaup 1856: 46 (type species *Scytalophis magnioculis* Kaup, 1856 = *Ophisurus gomesii* Castelnau, 1855, by JORDAN, 1919, as first reviser).

Leptorhinophis Kaup, 1856: 46 (type species *Ophisurus gomesii* Castelnau, 1855, by JORDAN 1919, as first reviser).

Cryptopterus Kaup, 1860: 11 (type species *Cryptopterus puncticeps* Kaup, 1860, by monotypy).

Uranichthys Poey, 1867: 256 (type species *Muraena hauannensis* Bloch & Schneider, 1801 = *Muraena ophis* Linnaeus, 1758, by JORDAN & DAVIS, 1891, as first revisers).

Paramyrus Günther, 1870: 51 (type species *Conger cylindroideus* Ranzani, 1839, by JORDAN & DAVIS, 1891, as first revisers).

Oxyodontichthys Poey, 1880: 254 (type species *Ophichthys macrurus* Poey, 1867 = *Ophisurus gomesii* Castelnau, 1855, by original designation).

Omochelys Fowler, 1918: 3 (type species *Pisodonophis cruentifer* Goode & Bean, 1896, by original designation; described as a subgenus of *Pisodonophis* Kaup, 1856).

Syletor Jordan, 1919: 343 (type species *Pisodonophis cruentifer* Goode & Bean, 1895, by original designation).

Styletor Jordan, 1919, in JORDAN, EVERMANN & CLARK, 1930: 86 (*lapsus pro Syletor* Jordan, 1919).

Acanthenchelys Norman, 1922: 296 (type species *Acanthenchelys spinicauda* Norman, 1922, by original designation).

Cryptopterenchelys Fowler, 1925: 1 (substitute name for *Cryptopterus* Kaup, 1860, preoccupied; described as a subgenus of *Ophichthus* Ahl, 1789).

Zonophichthus Whitley, 1930: 250 (type species *Ophichthys cephalazona* Bleeker, 1864, by original designation).
Gisenchelys Fowler, 1944: 188 (type species *Ophichthys zophochir* Jordan & Gilbert, 1881, by original designation; described as a subgenus of *Ophichthus* Ahl, 1789).
Syletophis Whitley, 1950: 44 (substitute name for *Syletor* Jordan, 1919, preoccupied).
Antobrantia Pinto, 1970: 13 (type species *Antobrantia ribeiroi* Pinto, 1970 = *Muraena ophis* Linnaeus, 1758, by original designation).

DIAGNOSIS. — Moderately to very elongate ophichthid eels of the subfamily Ophichthinae, tribe Ophichthini, with head and trunk shorter than tail; dorsal fin origin above or behind gill openings; pectoral fins present and developed; snout and jaws moderately elongate; lips without numerous barbels or fringes; anterior nostrils opening via a tube; posterior nostrils opening into mouth or along lower edge of lip; eye moderately developed; gill openings lateral, elongate, nearly vertical and crescentic; teeth conical and numerous, but never caniniform; tail tip a finless point; and coloration variable, often marked, but generally uniform and darker dorsally.

REMARKS. — The genus *Ophichthus (sensu lato)* is the most speciose of ophichthids, with approximately 55 tropical and subtropical species worldwide. Several subgenera are recognizable within *Ophichthus,* though a worldwide revision has yet to be attempted (McCOSKER, 1977).

Ophichthus exourus sp. nov.

Figs 1-2a; Tabl. 1

MATERIAL EXAMINED AND TYPES. — 2 specimens.
New Caledonia. MUSORSTOM 4: stn CP 178, 18°56,30'S, 163°12,90'E, 520 m, 18.09.1985: holotype, 590 mm TL (MNHN 1995-425).
Fiji. Viti Levu, off Suva Barrier Reef, prawn trap set in 400 m, 28.08.1980: 1 paratype, 429 mm TL (CAS 89552).

OTHER MATERIAL EXAMINED. — *Ophichthus brachynotopterus*: Madagascar, 1971: 1 paratype, 442 mm TL (MNHN 1979-22); 1 paratype, 413 mm TL (MNHN 1979-23).
Ophichthys serpentinus: Cape of Good Hope, 1860: holotype, 495 mm TL (MCZ 9200).
Ophichthus mystacinus: holotype and paratypes, described below.

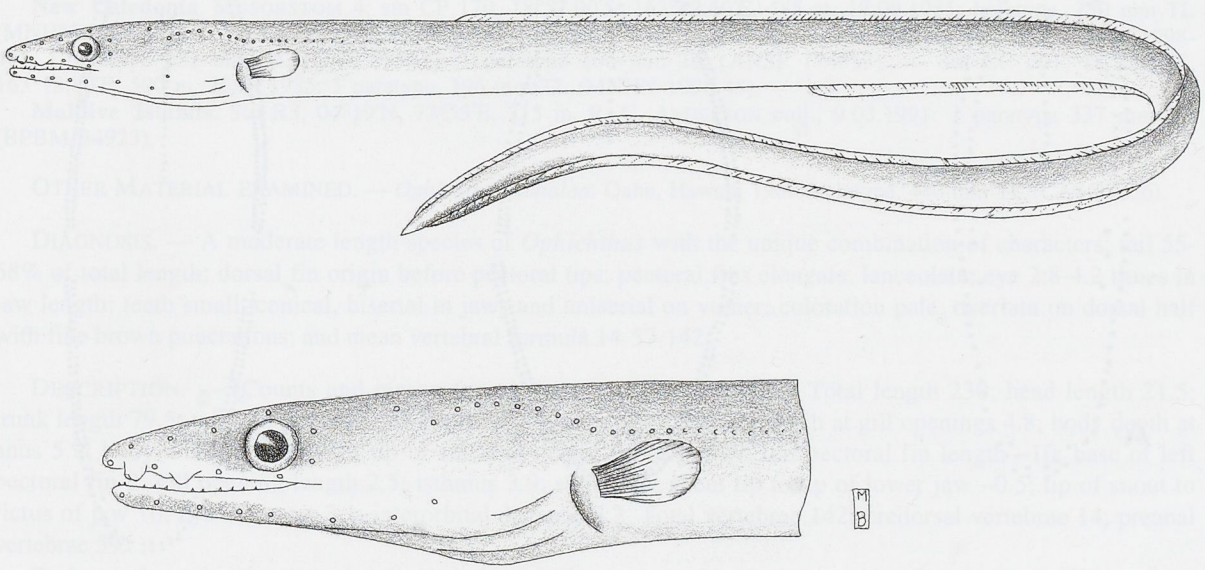


FIG. 1. — *Ophichthus exourus* sp. nov., holotype, 590 mm TL (MNHN 1995-425), New Caledonia, 18°56,30'S, 163°12,90'E, MUSORSTOM 4, stn CP 178, 520 m.

DIAGNOSIS. — A moderate length species of *Ophichthus* with the unique combination of characters: head and trunk robust, tapering evenly to tail tip; tail 59-60% of total length; dorsal fin origin in anterior third of trunk; pectoral fins small, paddle-shaped; jaw not elongate; eye large, above end of jaw; teeth conical, numerous and small, biserial in maxillary, uniserial on mandible and vomer; coloration yellowish tan, brown dorsally, the fins pale; and mean vertebral formula 20.5-60.5-176.5.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 590; head length 47.6; trunk length 185.4; tail length 357; body depth at gill openings 20; body width at gill openings 17; body depth at anus 15; body width at anus 14.5; tip of snout to dorsal fin origin 89; left pectoral fin length 12.7; base of left pectoral fin 4.5; gill opening length 6; isthmus 6.7; snout 13.5; tip of snout to rictus of jaw 17.9; eye diameter 6.1; interorbital distance 6.7. Total vertebrae 176; predorsal vertebrae 20; preanal vertebrae 61.

Body moderately elongate, its depth behind gill openings 26-29 times and width behind gill openings 35-38 times in TL. Body cylindrical anteriorly, laterally compressed in tail region, tapering evenly from robust head and trunk to much reduced tail tip. Head and trunk 2.5 times and head 12-12.5 times in TL. Head elongate, conical when viewed from above, somewhat flattened dorsally. Snout pointed, conical from above. Lower jaw reaches snout tip. Anterior nostrils in a short tube; posterior nostril in outer edge of upper lip and covered by a flap, appearing as a slit in the upper lip well before and beneath the orbit. A small but obvious protuberance in lip between anterior and posterior nostrils. Eye large, its posterior margin slightly behind rictus of jaw.

Median fins moderately developed. Dorsal fin origin above anterior third of trunk and less than a head length behind gill opening. Pectoral fins short and paddle-shaped. Median fins expanded before naked tail tip, lying within a groove.

Cephalic pores (Fig. 1) small and difficult to discern. Six mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 3 + 2 infraorbital, and single interorbital and supratemporal pores. Nine lateral line pores above branchial region. Lateral line pores of trunk and tail minute.

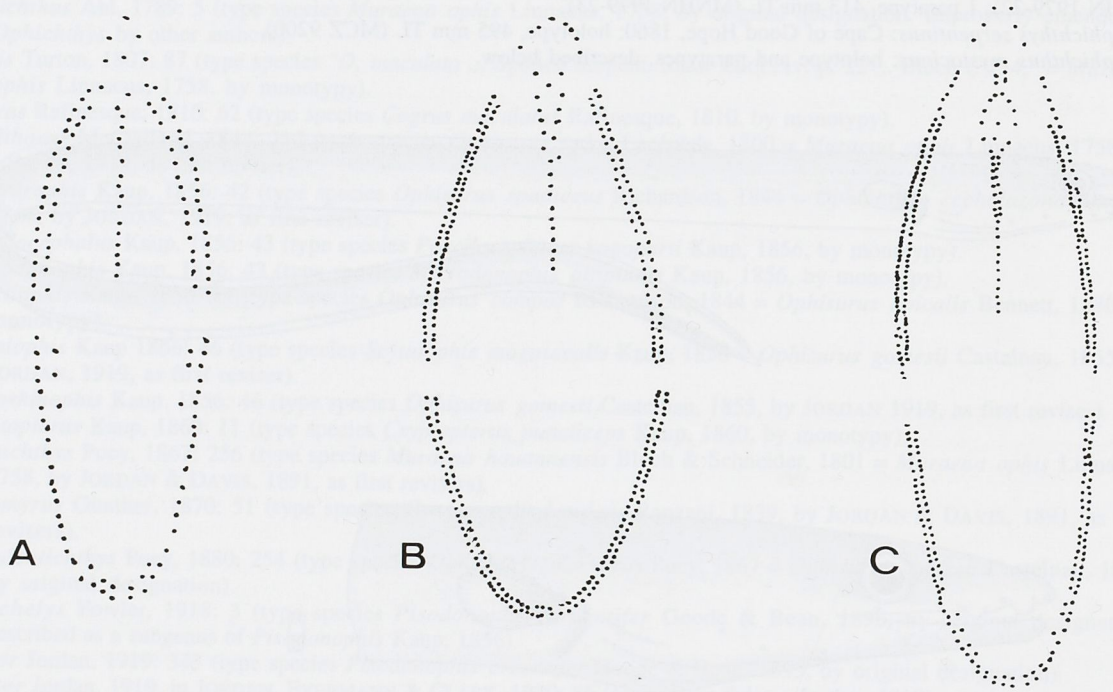


FIG. 2. — Schematic diagram of dentition of: **A**, *Ophichthus exourus* sp. nov., holotype, 590 mm TL (MNHN 1995-425); **B**, *O. genie* sp. nov., paratype, 337 mm TL (BPBM 34923); **C**, *O. mystacinus* sp. nov., paratype, 429 mm TL (CAS 89552).

Teeth (Fig. 2a) small, nearly equal in size, conical, and separated at their bases. A small rosette of 7 teeth at snout tip, followed by 15 neatly-aligned uniserial vomerine teeth. Maxillary teeth biserial, an outer row of 20-21 small teeth, flanked by 16 larger, more widely-spaced teeth. Lower jaw teeth uniserial, about 21-23 on each side, with 4-5 inner teeth scattered on inner edge.

Body coloration in ethyl alcohol yellow, overlain on upper flanks with a dusting of microscopic brown spots which are denser above the lateral midline. Median fins arise from pale longitudinal bands, the dorsal band becoming darker in posterior half of body such that fin appears as a sharp white line along the dorsum. Fins colorless except membrane of anal fin which is darkened before the tail tip. Peritoneum black.

SIZE. — To 669 mm. The holotype, 590 mm, and the paratype are females with developing ova, approximately 0.5 mm in diameter.

ETYMOLOGY. — From the Greek, *exourus*, ending in a tapered point.

DISTRIBUTION. — Known from the MUSORSTOM New Caledonia collections and from Fiji, between 450-520 m depth.

REMARKS AND COMPARISONS. — *Ophichthus exourus* is within the subgenus *Coecilophis* Kaup (*cf.* McCOSKER, 1977). It appears most closely related to the deepwater species *O. serpentinus* Seale (1917) from Madagascar, and *O. mystacinus*, described herein from deepwater off New Caledonia. I have compared the holotypes and paratypes of those species to the new species, and find *O. exourus* to differ from *O. brachynotopterus* and *O. mystacinus* by having a shorter pectoral fin and uniserial (rather than biserial) mandibular teeth. Both *exourus* and *serpentinus* have uniserial mandibular dentition, however they differ in their vomerine dentition (strictly uniserial vs. biserial anteriorly, respectively) and in their vertebral numbers (176-177 vs. 165-167, respectively).

Ophichthus genie sp. nov.

Figs 2b-3; Tabl. 1

MATERIAL EXAMINED AND TYPES. — 6 specimens.

New Caledonia. MUSORSTOM 4: stn CP 170, 18°57,00'S, 163°12,60'E, 485 m, 17.09.1985: holotype, 230 mm TL (MNHN 1998-43). — Stn CP 171, 18°57,80'S, 163°14,00'E, 435 m, 17.09.1985: 1 paratype, 217 mm TL (MNHN 1998-44); 1 paratype 232 mm TL (CAS 89551); 1 paratype 206 mm TL (ANSP 174853). — Stn CC 201, 18°55,80'S, 163°13,80'E, 500 m, 20.09.1985: 1 paratype, 196 mm TL (MNHN 1998-45).

Maldive Islands. Stn R3, 04°19'N, 72°55'E, 215 m, R. C. ANDERSON coll., 9.03.1991: 1 paratype 337 mm TL (BPBM 34923).

OTHER MATERIAL EXAMINED. — *Ophichthus kunaloa*: Oahu, Hawaii, 1969: holotype, 440 mm TL (CAS 29136).

DIAGNOSIS. — A moderate length species of *Ophichthus* with the unique combination of characters: tail 55-58% of total length; dorsal fin origin before pectoral tips; pectoral fins elongate, lanceolate; eye 2.8-4.2 times in jaw length; teeth small, conical, biserial in jaws and uniserial on vomer; coloration pale, overlain on dorsal half with fine brown punctations; and mean vertebral formula 14-57-142.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 230; head length 21.5; trunk length 79.5; tail length 129; body depth at gill openings 7.3; body width at gill openings 4.8; body depth at anus 5.9; body width at anus 4.5; tip of snout to dorsal fin origin 29; left pectoral fin length ~10; base of left pectoral fin 2; gill opening length 2.5; isthmus 3.9; snout 4.6; snout tip to tip of lower jaw ~0.5; tip of snout to rictus of jaw 10; eye diameter 3.1; interorbital distance 3.2. Total vertebrae 142; predorsal vertebrae 14; preanal vertebrae 59.

Body moderately elongate, its depth behind gill openings 31-42 times and width behind gill openings 35-54 times in TL. Body cylindrical in anterior trunk region, laterally compressed posteriorly. Head and trunk 2.2-2.4 times and head 10.0-10.7 times in TL. Snout short, broad and swollen in appearance at anterior nostril

bases. Lower jaw included, nearly reaches snout. Anterior nostrils in forward-directed tubes that reach snout tip; posterior nostril in lip, covered by a flap with an anterior barbel that extends to or below the lip (see Fig. 1). Eye large, its center above posterior 1/3 of upper jaw.

Dorsal fin low in anterior trunk region, elevated posteriorly. Its origin just in advance of end of pectoral rays. Pectoral fins elongate, lanceolate, the middle rays longest.

Cephalic pores (Fig. 3) very reduced but discernible. Six or seven mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Eight lateral line pores above branchial region. Lateral line pores of trunk and tail not possible to discern, minute and covered with a waxy exudate.

Teeth (Fig. 2b) small and conical, nearly subequal. An intermaxillary rosette of 7 teeth, followed by a gap, then a patch of 8 teeth followed by 15 uniserial vomerine teeth. Jaw teeth biserial, the rows irregular, each with approximately 38-40 pairs.

Body coloration of small (195-232 mm) specimens in ethanol pale yellow, overlain on snout, nape, and dorsal half with a fine peppering of minute brown punctations which end, particularly in smaller specimens, abruptly at the lateral line. All fins clear. Body coloration of largest specimen (337 mm) in isopropanol pale yellow, with a pale brown band across shoulders beginning behind temporal pore band, becoming diffuse in region of lateral line before end of pectoral fins. Cheeks bright yellow. Body and tail covered throughout with a fine peppering of minute brown spots. Peritoneum white with a fine gray/black speckling. Median fins and posterior half of pectoral fins clear.

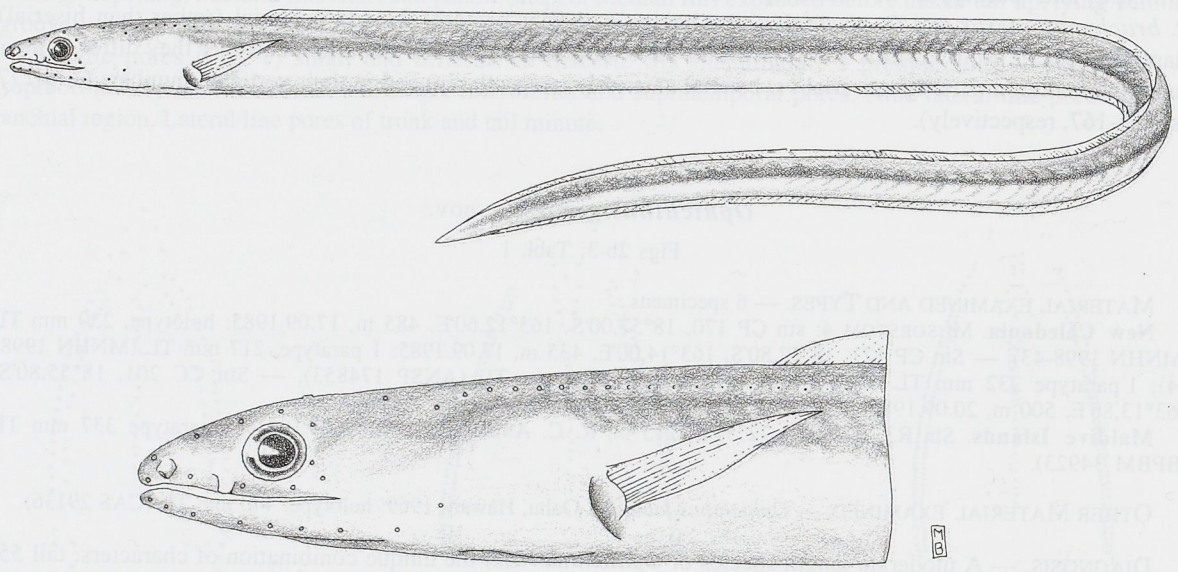


FIG. 3. — *Ophichthus genie* sp. nov., holotype, 230 mm TL (MNHN 1998-43), New Caledonia, 18°57,00'S, 163°12,60'E, MUSORSTOM 4, stn CP 170, 485 m.

SIZE. — To 337 mm. The holotype, 230 mm TL, is a female with developing ova (~0.5 mm egg diameter). The largest known specimen, BPBM 34923, is also a female with developing ova (slightly smaller in diameter than those of the holotype).

ETYMOLOGY. — Named in honor of Eugenia B. BÖHLKE, friend and contributor to knowledge of apodal fishes.

DISTRIBUTION. — Known from the type series, collected between 435-500 m depth in New Caledonia and from the Maldives.

REMARKS AND COMPARISONS. — The new species is similar to other species of *Ophichthus*, subgenus *Coecilophis* Kaup (*cf.* McCOSKER, 1977), which share a preference for deep sand and mud substrates. All possess small dentition, posterior nostrils along the lip (rather than opening into the mouth) and preceded by a flap, two rather than three preopercular pores, and a plain coloration, often with a dark smudge along the anal fin near the tail tip. Its closest relatives appear to be *O. kunaloa* McCosker, 1979, a deepwater Hawaiian species that has more vertebrae (MVF 17.5-66.5-183 vs. 14-57-142 for *O. genie*) and appears to be more robust (depth 27.5-31.5 times in total length vs. 31-42 times for *O. genie*).

	O. genie		*O. mystacinus*		*O. exourus*	
	mean	range	mean	range	mean	range
Total length (in mm)	-	196-337	-	336-429	-	590-669
Head/TL	96.8	93-101	110	107-117	82	81-83
Trunk/TL	334	317-356	295	293-298	318	314-321
Tail/TL	569	552-582	595	590-598	600	596-605
Depth/TL	30.2	24-32	40	36-43	36	34-38
DFO/TL	139	126-155	243	235-258	158	151-166
Pectoral fin/HL	423	388-471	430	392-458	283	267-300
Snout/HL	208	197-226	246	227-280	268	252-284
Upper jaw/HL	437	382-482	537	499-561	373	369-376
Eye/HL	134	115-144	126	110-141	120	112-128
IO/HL	117	101-156	142	119-170	138	135-141
Vertebrae						
Predorsal	14	12-16	33.8	31-35	20.5	20-21
Preanal	57	56-59	61.8	60-63	60.5	60-61
Total	143.3	139-147	172.8	169-174	176.5	176-177

TABLE 1. — Proportions (in thousandths) and counts of the holotypes and paratypes of *Ophichthus genie*, *O. mystacinus* and *O. exourus*. Abbreviations are: TL = total length; HL = head length; DFO = dorsal fin origin; IO = interorbital width.

Ophichthus mystacinus sp. nov.

Figs 2c, 4; Tabl. 1

MATERIAL EXAMINED AND TYPES. — 4 specimens.

New Caledonia. MUSORSTOM 4: stn CC 202, 18°58,00'S, 163°10,50'E, 580 m, 20.09.1985: holotype, 426 mm TL (MNHN 1998-46); 1 paratype, 429 mm TL (CAS 89552). — Stn CP 180, 18°56,0'S, 163°17,70'E, 450 m, 18.09.1985: 1 paratype, 336 mm TL (BPBM 37308). — Stn CC 201, 18°55,80'S, 163°13,80'E, 500 m, 20.09.1985: 1 paratype, 383 mm TL (MNHN 1998-47).

OTHER MATERIAL EXAMINED. — *Ophichthus brachynotopterus*: Madagascar, 1971: 1 paratype, 442 mm TL (MNHN 1979-22); 1 paratype, 413 mm TL (MNHN 1979-23).

DIAGNOSIS. — A moderate length species of *Ophichthus* with the unique combination of characters: tail 59-60% of total length; dorsal fin origin about mid-trunk; pectoral fins elongate, the central rays threadlike; jaw elongate; eye large; teeth conical, numerous and small, biserial in jaws and anteriorly on vomer; coloration yellowish tan, brown dorsally, the fins pale; and mean vertebral formula 33.8-61.8-172.8.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 426; head length 47.1; trunk length 125; tail length 254; body depth at gill openings 16; body width at gill openings 14; body depth at

anus 13; body width at anus 11; tip of snout to dorsal fin origin 110; left pectoral fin length 20.3; base of left pectoral fin 3.8; gill opening length 4.3; isthmus 8.7; snout 11; snout tip to tip of lower jaw 2.5; tip of snout to rictus of jaw 26; eye diameter 6; interorbital distance 5.6. Total vertebrae 174; predorsal vertebrae 35; preanal vertebrae 62.

Body moderately elongate, its depth behind gill openings 23-28 times and width behind gill openings 29-35 times in TL. Body cylindrical anteriorly, laterally compressed in tail region. Head and trunk 2.4-2.5 and head 8.6-9.3 in TL. Head elongate, conical when viewed from above, somewhat flattened dorsally. Snout pointed, sharply conical from above. Lower jaw nearly reaches snout tip. Anterior nostrils in a short tube; posterior nostril in upper lip and covered by a flap, appearing as a slit in the upper lip before and beneath the orbit. Eye large, its center above middle of upper jaw.

Median fins low and poorly developed, lying within a groove for most of their length. Dorsal fin origin just anterior to mid-trunk. Pectoral fins elongate, the central rays threadlike and longest. Median fins expanded before naked tail tip, lying within a groove.

Cephalic pores (Fig. 4) small and very difficult to discern. Six mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Nine lateral line pores above branchial region. Lateral line pores of trunk and tail minute, not possible to discern.

Teeth (Fig. 2c) small, nearly equal in size, conical and sharply pointed, and separated at their bases. A small rosette of 5 teeth at snout tip, followed by 12 neatly-aligned pairs extending nearly to mid-vomer, followed by about 14 uniserial teeth. Six uniserial, closely-spaced teeth in the outer row of the upper jaw, followed by two rows of about 45 teeth which form pairs for most of their length, the last few becoming more randomly placed. Lower jaw with about 4-5 pairs anteriorly, followed by a row of about 15 teeth, then about 25-30 irregular pairs.

Body coloration in ethyl alcohol tan, overlain with a dusting of microscopic brown spots which are denser above the lateral midline, giving the body and tail a brown dorsal cast. Area surrounding base of anterior nostril tubes has a high density of dark punctations, particularly as seen from above, appearing like a faint mustache. Chin, throat, belly, and lower edge of tail and tail tip yellow. Peritoneum white with a fine black speckling. Median fins clear. Pectoral fins yellow. The hindmost (ca. the length of the head) ventral surface of the tail is black, including a black smudge on the membrane of the anal fin.

SIZE. — To 429 mm. The holotype, 426 mm, is a male with undeveloped gonads.

ETYMOLOGY. — From the Greek, *mystacinus*, mustachioed.

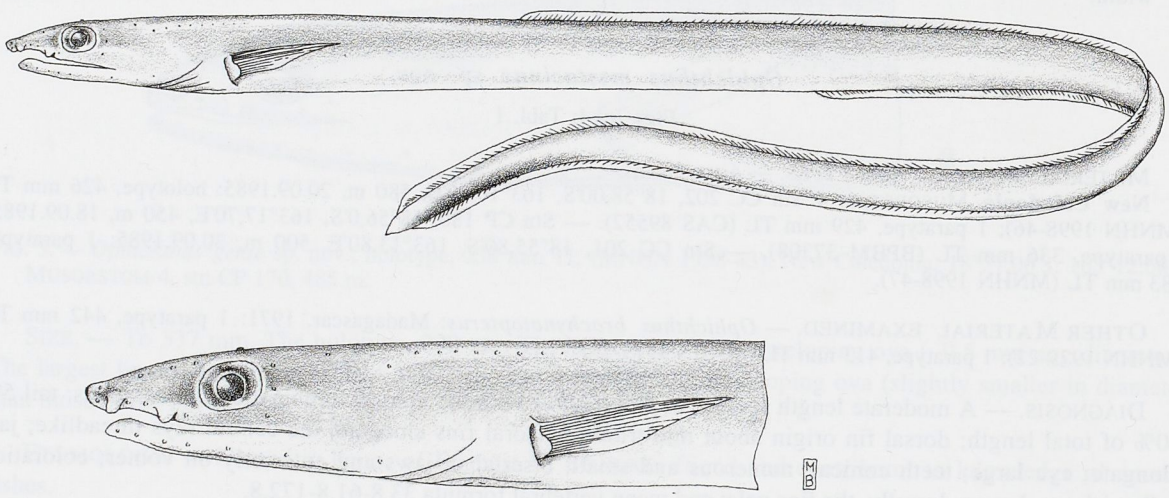


FIG. 4. — *Ophichthus mystacinus* sp. nov., holotype, 426 mm TL (MNHN 1998-46), New Caledonia, 18°58,00'S, 163°10,50'E, MUSORSTOM 4, stn CC 202, 580 m.

DISTRIBUTION. — Known only from the MUSORSTOM New Caledonia collections, between 450-580 m depth.

REMARKS AND COMPARISONS. — *Ophichthus mystacinus* is similar to other species of *Ophichthus* of the subgenus *Coecilophis* Kaup (*cf.* McCOSKER, 1977). It appears most closely related to *O. brachynotopterus* Karrer, 1982, a deepwater (355-478 m) species from northwest Madagascar. I have compared the paratypes of that species to the new species, and find *O. brachynotopterus* easily separable from *O. mystacinus* by the former's: vertebral number (178 vs. 169-174); shorter pectoral fin (3.6-4.0 times in head vs. 2.2-2.6); and shorter snout (4.6-4.7 times in head vs. 3.6-4.4). As well, *O. brachynotopterus* appears to have a somewhat shorter head and larger eye.

Genus ***RHINOPHICHTHUS*** nov.

TYPE SPECIES. — *Rhinophichthus penicillatus* sp. nov.

DIAGNOSIS. — Elongate ophichthids, subfamily Ophichthinae, tribe Ophichthini (sensu McCOSKER, 1977), with tail much longer than head and trunk; median fins low; dorsal fin arising behind pectoral fin; pectoral fin base arising above and occupying less than half of gill opening; gill openings lateral, elongate, nearly vertical and crescentic; eye moderately developed, above posterior third of jaw; jaws moderately developed, but not elongate; snout conical, tapering evenly to a sharp point; underside of snout separated in advance of anterior nostril bases exposing the teeth; teeth conical, numerous and small, uniserial or biserial; 2 preopercular pores; gill arches developed, similar to those of *Ophichthus*, however fifth ceratobranchial present and ossified as a thin rod for anterior 80 %, the remainder cartilaginous, and upper pharyngeal tooth plates fused. Other characters those of the two species.

ETYMOLOGY. — From the Greek, *rhinos*, snout, and *Ophichthus*, a genus of snake eel; gender masculine.

REMARKS. — In general appearance, the species of *Rhinophichthus* appear similar to that of the elongate-snouted species of *Ophisurus*. They differ in the condition of the snout (clavate rather than conical) and in their dentition (enlarged and fanglike, particularly those of the intermaxillary). With the exception of the condition of the snout and its associated tissues, *Rhinophichthus* is very similar to the generalized species of *Ophichthus*. The appearance of the snout of *Rhinophichthus* is more comparable to that of species within the tribe Sphagebranchini, particularly those of the genera *Apterichtus* and *Ichthyapus*. Those eels generally occupy shallow water sand habitats and are capable of burrowing quickly into the substrate with either end, an adaptation which I presume that *Rhinophichthus penicillatus* enjoys as well. Other adaptations displayed by the new species, such as the nearly uniform coloration, small and numerous teeth, fairly large eye, posterior nostril along upper lip and covered by a flap, and poorly developed median fins, are typical of other deep-dwelling ophichthids.

An additional taxon that I can assign to *Rhinophichthus* is *Ophichthys unicolor* Regan, 1908. It, and its synonym *Ophichthys algoensis* Barnard, 1925 (a replacement name for *Ophichthys triserialis* Barnard, 1923, preoccupied) were described from Algoa Bay, South Africa, from 40 and 50 fathoms, respectively (SMITH, 1962; McCOSKER & CASTLE, 1986). Differences between *O. unicolor* and the new species are described in the Remarks below. A complete osteological analysis of *Rhinophichthus* may demonstrate that its ancestry is shared with that of species of *Ophichthus*.

Rhinophichthus penicillatus sp. nov.

Figs 5-6a; Tabl. 2

MATERIAL EXAMINED. — 3 specimens.

New Caledonia. MUSORSTOM 4: stn CP 171, 18°57,80'S, 163°14,00'E, 435 m, 17.09.1985: holotype, 457 mm TL (MNHN 1998-48); 1 paratype, 359 mm TL (MNHN 1998-49); 1 paratype, 427 mm TL, gill arches removed and cleared and counterstained (CAS 89553).

OTHER MATERIAL EXAMINED. — *Ophichthys unicolor*: Algoa Bay, South Africa, 1906: holotype ~ 271 mm TL (BMNH 1906.11.19.39).

Ophichthys algoensis: Algoa Bay, South Africa, 1904: holotype, 300 mm TL (SAM 12776).

DIAGNOSIS. — An elongate ophichthine, genus *Rhinophichthus*, with the unique combination of characters: tail 66-67 % of total length: dorsal fin origin behind pectoral tips; pectoral fins small and paddle-shaped, not elongate; eye large; dentition small, conical and uniserial throughout; coloration pale, slightly darker dorsally, fins pale; and mean vertebral formula 12-54-173.

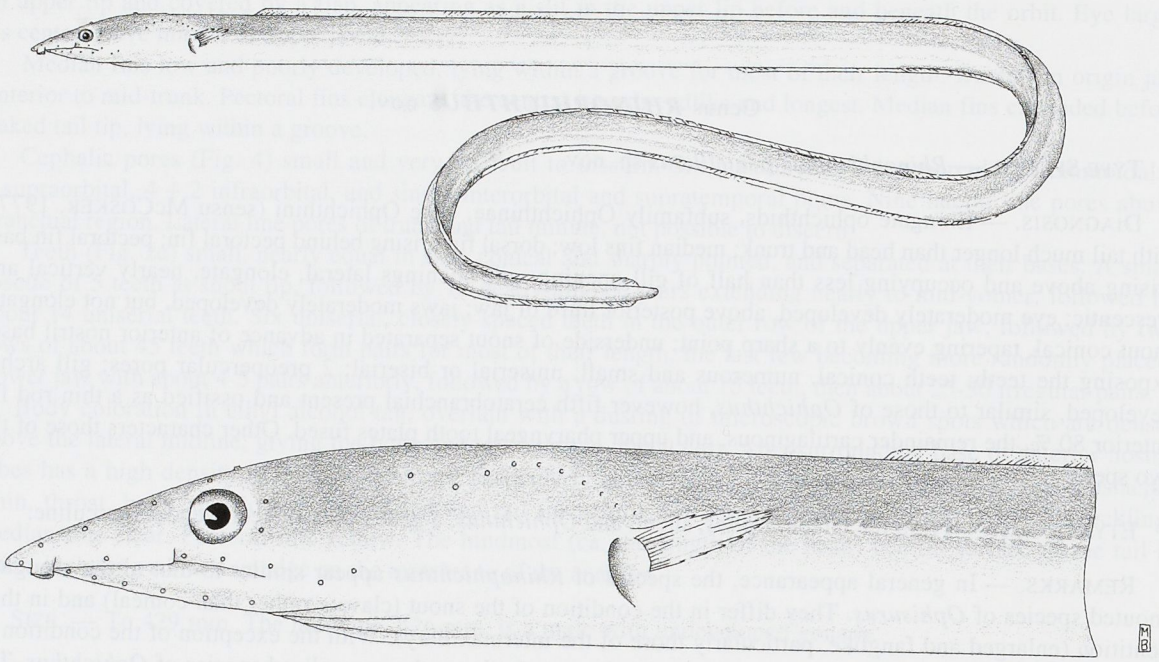


FIG. 5. — *Rhinophichthus penicillatus* sp. nov., holotype, 457 mm TL (MNHN 1998-48), New Caledonia, 18°57,80'S, 163°14,00'E, MUSORSTOM 4, stn CP 171, 435 m.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 457; head length 35; trunk length 119; tail length 303; body depth at gill openings 10.2; body width at gill openings 8.5; body depth at anus 10.5; body width at anus 9.5; tip of snout to dorsal fin origin 47; left pectoral fin length 6.7; base of left pectoral fin 2.3; gill opening length 5.2; isthmus 4.5; snout length 9.7; snout tip to tip of lower jaw 2.8; tip of snout to rictus of jaw 14.3; eye diameter 3.2; interorbital distance 3.4. Total vertebrae 173; predorsal vertebrae 12; preanal vertebrae 54.

Body elongate, its depth behind gill openings 45-53 times and width behind gill openings 39-59 times in TL. Body cylindrical, laterally compressed only posteriorly. Head and trunk 3 times and head 13-14 times in TL. Snout elongate, conical, and split on its underside with lateral folds extending ahead of the nostril bases. Lower jaw included, extending just beyond posterior base of anterior nostrils. Anterior nostrils tubular; posterior nostril in upper lip, visible externally as a slit beneath anterior edge of orbit. Eye large, the posterior edge of the orbit only slightly in advance of corner of jaw. Branchial basket expanded; head shape evenly tapered.

Median fins low, lying within a groove and slightly expanded before tail tip. Dorsal fin origin behind pectoral tips. Pectoral fins small and paddle-shaped, their central rays the longest. Caudal fin tip naked, pointed but not sharp.

Cephalic pores small but visible (Fig. 5). Six mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Seven lateral line pores above branchial region. Lateral line pores of trunk and tail too small to accurately discern.

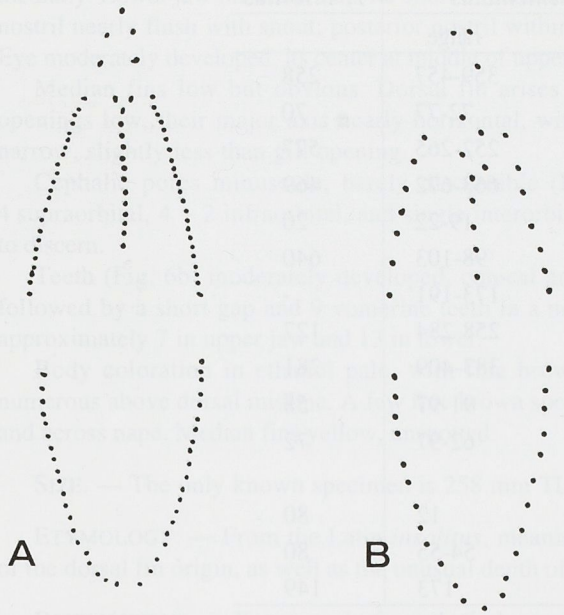


FIG. 6. — Schematic diagram of dentition of holotypes of **A**, *Rhinophichthus penicillatus* sp. nov., 457 mm TL (MNHN 1998-48), and **B**, *Yirrkala insolitus* sp. nov., 258 mm TL (MNHN 1998-50).

Teeth (Fig. 6a) small, conical and nearly subequal, evenly spaced but not close-set. A narrow rosette of 5 teeth just behind snout tip, followed by a space, 3 teeth, and 12 uniserial vomerine teeth. Jaw teeth neatly uniserial; 20-22 in upper jaw and 15-17 in lower jaw.

Body coloration in ethanol uniformly pale yellow, overlain on upper half of head, trunk, and tail with numerous fine brown punctations. Chin, throat, belly and underside of snout pale. Peritoneum white. All fins clear.

SIZE. — The largest known specimen, the holotype, is 457 mm long. It is a female with developing ova (egg diameter ~0.5 mm).

ETYMOLOGY. — From the Latin *penicillus*, a pencil, and *-atus*, having the nature of, in reference to the sharpened-pencil appearance of both ends of this eel.

DISTRIBUTION. — Known only from the MUSORSTOM New Caledonia collections, from 435 m depth.

REMARKS AND COMPARISONS. — The new species is easily separable from any known ophichthid. Although quite generalized in most of its external morphology, its conical snout and other ophichthin characters are shared only by the poorly-known *Ophichthus unicolor* Regan, which I assign to the genus *Rhinophichthus*. I examined the dried and poorly-preserved holotype of *O. unicolor* in 1982 and recently compared the holotype of its synonym, *Ophichthys algoensis* Barnard, to specimens of *R. penicillatus*. *R. unicolor* differs in having fewer vertebrae (156 vs. 173) and biserial rather than uniserial dentition.

Genus *YIRRKALA* Whitley, 1940

Yirrkala Whitley, 1940: 410 (type species *Y. chaselingi* Whitley, 1940, by original designation).
Pantonora Smith, 1964: 719 (type species *Ophichthys tenuis* Günther, 1870, by original designation).

DIAGNOSIS. — Ophichthin eels, tribe Sphagebranchini, with the following characteristics: body elongate, cylindrical, shorter than tail; snout conical; dorsal fin arises above head, along trunk, or above anus; pectoral fins absent; gill openings ventral, longer than isthmus; teeth conical, generally uniserial; coloration usually uniform or darker dorsally, although striped in one species.

REMARKS. — In earlier works (McCOSKER, 1977: 69; McCOSKER & CASTLE, 1984: 185), I considered the type species, *Y. chaselingi*, to be a junior synonym of *Sphagebranchus lumbricoides* Bleeker. Subsequent examination of additional material has demonstrated that WHITLEY's *chaselingi* is a valid species. My revision of the genus, recognizing approximately 10 valid Indo-Pacific species, is currently in preparation.

The new species shares all of the external morphological characteristics of the genus *Yirrkala*, however its dorsal fin origin is far posterior to that of its congeners. Such a condition is not significant enough to merit generic recognition, and that character state within the genus should therefore be expanded to range from before the gill openings to above the anus.

	R. penicillatus		*Y. insolitus*
	mean	range	
Total length (in mm)	-	359-457	258
Head/TL	75	72-77	70
Trunk/TL	259	252-265	577
Tail/TL	666	663-672	469
Depth/TL	21	19-22	20
DFO/TL	101	98-103	640
Pectoral fin/HL	182	173-191	-
Snout/HL	273	258-284	127
Upper jaw/HL	395	383-409	281
Eye/HL	95	91-97	58
IO/HL	81	62-97	72
Vertebrae			
Predorsal	12	12	80
Preanal	54.7	54-55	80
Total	173	173	149

TABLE 2. — Proportions (in thousandths) and counts of the holotype and paratypes of *Rhinophichthus penicillatus* and the holotype of *Yirrkala insolitus*. Abbreviations are: TL = total length; HL = head length; DFO = dorsal fin origin; IO = interorbital width.

Yirrkala insolitus sp. nov.

Figs 6b-7; Tabl. 2

MATERIAL EXAMINED. — 1 specimen.

New Caledonia. MUSORSTOM 4: stn CP 148, 19°23,40'S, 163°31,90'E, 59 m, 14.09.1985: holotype, 258 mm TL (MNHN 1998-50).

OTHER MATERIAL EXAMINED. — *Yirrkala chaselingi*: Queensland, Australia: holotype, 610 mm TL (AM IB.481).
Sphagebranchus gjellerupi: New Guinea, 1910: holotype, 153 mm TL (ZMA 104.146).
Sphagebranchus lumbricoides: Timor: holotype, 230 mm TL (BMNH 1867.11.28.300).
Ophichthys misolensis: Misol Island: holotype, 283 mm TL (BMNH 1870.8.3.112).
Dalophis moluccensis: Ceram: holotype, 405 mm TL (BMNH 1867.11.28.289).
Ophichthys tenuis: locality unknown, possibly Mauritius: lectotype ~530 mm TL (BMNH 1965:1.2.1).
Ophichthys timorensis: Timor: holotype ~205 mm TL (BMNH 1867.11.28.322).

DIAGNOSIS. — An elongate species of *Yirrkala* with the unique combination of characters: head 7% of total length (TL); tail 47% of TL; dorsal fin origin above anus; teeth conical, moderately developed, uniserial on jaws and vomer; coloration pale, overlain with fine brown punctations above midline; and vertebral formula 80-80-149.

DESCRIPTION. — (Counts and measurements in mm of the holotype). Total length 258; head length 18; trunk length 149; tail length 121; body depth at gill openings 5.3; body depth at anus 4.6; body width at gill openings 3.3; body width at anus 3.3; origin of dorsal fin 165; left gill opening length 1.4; isthmus 1.2; snout length 2.3; snout tip to tip of lower jaw ~ 1.8; tip of snout to rictus of jaw 5.0; eye diameter 1.0; interorbital distance 1.3. Total vertebrae 149; predorsal vertebrae 80; preanal vertebrae 80.

Body very elongate, its depth at gill openings 49 times in TL, tapering posteriorly to an acute, finless point. Body and tail nearly cylindrical throughout, becoming laterally compressed in posterior 10%. Head and trunk 1.55 times and head 14.3 times in TL. Snout acute at tip, conical from above, rounded on underside and split

medially. Lower jaw included, falls far short of anterior nostril edge and barely exceeds anterior pupil edge. Anterior nostril nearly flush with snout; posterior nostril within upper lip, visible externally as a slit beneath center of eye. Eye moderately developed, its center at middle of upper jaw.

Median fins low but obvious. Dorsal fin arises above level of anus and ends 1/2 HL from tail tip. Gill openings low, their major axis nearly horizontal, without an anterior lateral membrane or duplication. Isthmus narrow, slightly less than gill opening.

Cephalic pores minuscule, barely discernible (Fig. 7). Four mandibular, 2 preopercular, 1 ethmoidal + 4 supraorbital, 4 + 2 infraorbital, and single interorbital and supratemporal pores. Lateral line pores not possible to discern.

Teeth (Fig. 6b) moderately developed, conical and uniserial. An anterior chevron of 3 intermaxillary teeth, followed by a short gap and 9 vomerine teeth in a nearly uniserial row, descending in size. Jaw teeth uniserial, approximately 7 in upper jaw and 13 in lower.

Body coloration in ethanol pale, with fine brown punctations above the lateral midline, becoming more numerous above dorsal midline. A few fine brown spots on throat and chin, forming fine dotted lines between eyes and across nape. Median fins yellow, unspotted.

SIZE. — The only known specimen is 258 mm TL, a female with unripe gonads.

ETYMOLOGY. — From the Latin *insolitus*, meaning unusual or strange, in reference to the posterior location of the dorsal fin origin, as well as the unusual depth of capture of an *Yirrkala*.

DISTRIBUTION. — Known only from the holotype, from 59 m off New Caledonia.

REMARKS AND COMPARISONS. — The new species differs from all its known congeners in the location of its dorsal fin origin, far posterior to that of all other species. Other body characteristics differ little from the condition of other known species of *Yirrkala*, and I find no reason to not consider it congeneric. Its habitat is deeper than that of most of its congeners, which are known from shallow water sand and mud bottoms, and some enter freshwater streams.

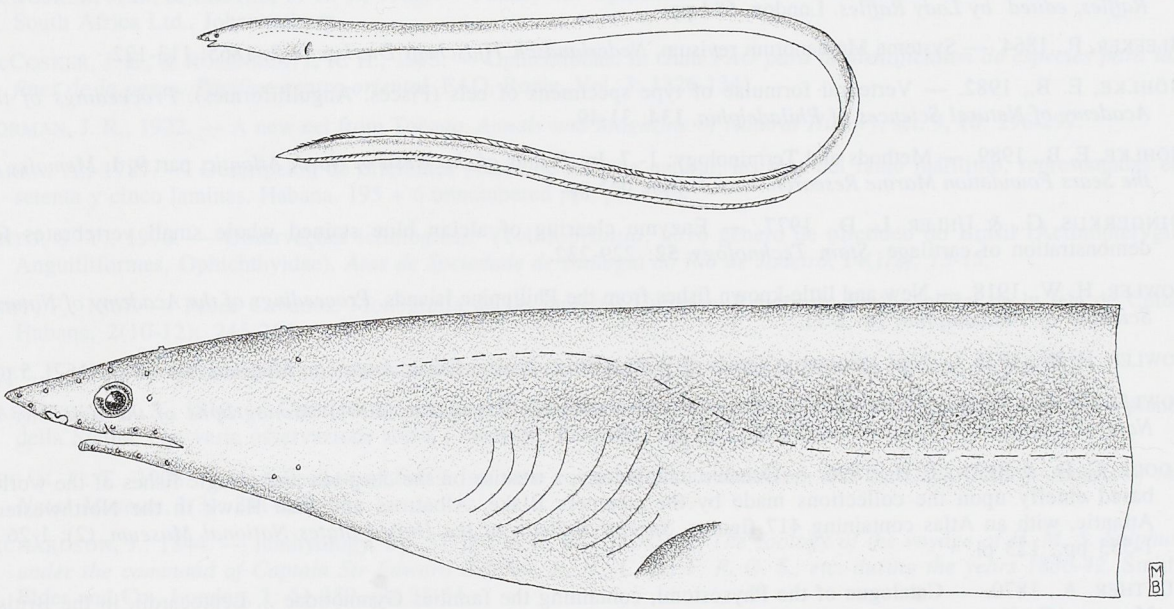


FIG. 7. — *Yirrkala insolitus* sp. nov., holotype, 258 mm TL (MNHN 1998-50), New Caledonia, 19°23,40'S, 163°31,90'E, MUSORSTOM 4, stn CP 148, 59 m.

ACKNOWLEDGMENTS

I am most grateful to Bernard SÉRET for making the MUSORSTOM eels and other specimens from the Muséum national d'Histoire naturelle available for study. R. Charles ANDERSON (Marine Research Section, Male, Maldives) kindly provided the Maldives type specimen. J. SEETO kindly donated the Fijian type specimen. For permission to examine specimens in their care, I also thank: D. F. HOESE, J. R. PAXTON, M. McGROUTHER and others at the Australian Museum; E. BÖHLKE and others at the Academy of Natural Sciences of Philadelphia; the curatorial staff of The Natural History Museum (London); J. E. RANDALL and A. SUZUMOTO at the Bernice P. Bishop Museum; W. N. ESCHMEYER, T. IWAMOTO, D. CATANIA, J. FONG and others at the California Academy of Sciences; A. GRAHAM and A. R. WILLIAMS at CSIRO; M. F. GOMON at the Museum of Victoria (Melbourne); M. E. ANDERSON at the J.L.B. Smith Institute of Ichthyology (Grahamstown); the curatorial staff of the South African Museum; R. ROSENBLATT at the Scripps Institution of Oceanography; and the ichthyological staff of the National Museum of Natural History (Washington). Tomio IWAMOTO (California Academy of Sciences) read a draft of this manuscript and provided valuable advice. Molly BROWN prepared the illustrations. Other individuals assisted in many ways, including but not limited to Mysi HOANG, Dong LIN, Roy EISENHARDT, and Carl FERRARIS of the California Academy of Sciences.

REFERENCES

AHL, J. N., 1789. — Dissertatio de Muraena et Ophichtho. *Dissertationes Academicae Upsaliae habitae sub praesidio C. P. Thunberg*, **3**(1): 1-12.

BARNARD, K. H., 1923. — Diagnoses of new species of marine fishes from South African waters. *Annals of the South African Museum*, **13**: 439-445.

BARNARD, K. H., 1925. — Descriptions of new species of marine fishes from South Africa. *Annals and Magazine of Natural History*, ser. 9, **15** (87): 498-504.

BENNETT, E. T., 1830. — Catalogue of the fishes of Sumatra. In: *Memoir of the Life and Public Services of Sir Stamford Raffles, edited by Lady Raffles*. London. 694 pp.

BLEEKER, P., 1864. — Systema Muraenorum revisum. *Nederlandsch Tijdschrift Dierkunde*, **2**, 1865: 113-122.

BÖHLKE, E. B., 1982. — Vertebral formulae of type specimens of eels (Pisces: Anguilliformes). *Proceedings of the Academy of Natural Sciences of Philadelphia*, **134**: 31-49.

BÖHLKE, E. B., 1989. — Methods and Terminology: 1- 7. In: *Fishes of the Western North Atlantic*, part 9, **1**. *Memoirs of the Sears Foundation Marine Research*. New Haven. 655 pp.

DINGERKUS, G., & UHLER, L. D., 1977. — Enzyme clearing of alcian blue stained whole small vertebrates for demonstration of cartilage. *Stain Technology*, **52**: 229-232.

FOWLER, H. W., 1918. — New and little-known fishes from the Philippine Islands. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **70**: 2-71.

FOWLER, H. W., 1925. — New taxonomic names of West African marine fishes. *American Museum Novitates*, (162), 5 pp.

FOWLER, H. W., 1944. — Results of the fifth George Vanderbilt Expedition (1941). *Monographs of the Academy of Natural Sciences of Philadelphia*, (6): 57-529, pls 1-20.

GOODE, G. B., & BEAN, T. H., 1896. — Oceanic ichthyology, a treatise on the deep-sea and pelagic fishes of the world, based chiefly upon the collections made by the steamers Blake, Albatross and Fish Hawk in the Northwestern Atlantic, with an Atlas containing 417 figures. *Special Bulletin of the United States National Museum*, (2): 1-26 + 1-553 pp., 123 pl.

GÜNTHER, A., 1870. — Catalogue of the Physostomi, containing the families Gymnotidae ... Leptocardii, in the British Museum. *Catalogue of the fishes in the British Museum*, **8**. British Museum, London. 549 pp.

JORDAN, D. S., 1919. — New genera of fishes. *Proceedings of the Academy of Natural Sciences of Philadelphia*, **70**: 341-344.

JORDAN, D. S., & DAVIS, B. M., 1891. — A preliminary review of the apodal fishes or eels inhabiting the waters of America and Europe. *Report of the Commissioner, United States Commission of Fish and Fisheries for 1888*, **16**: 581-677, pls 73-80.

JORDAN, D. S., EVERMANN, B. W. & CLARK, H. W., 1930. — Check list of the fishes and fish-like vertebrates of North and Middle America north of the northern boundary of Venezuela and Colombia. *Report of the United States Commissioner of Fisheries* for 1928, Part 2, 670 pp.

JORDAN, D. S. & GILBERT, C. H., 1882. — Descriptions of thirty-three new species of fishes from Mazatlan, Mexico. *Proceedings of the United States National Museum*, **4**: 338-365.

KARRER, C., 1982. — Anguilliformes du Canal de Mozambique (Pisces, Teleostei). *Faune Tropicale*, **23**: 1-116.

KAUP, J. J., 1856. — Ubersicht der Aale. *Archiv für Naturgeschichte*, **22**(1): 41-77.

KAUP, J. J., 1860. — Neue aalaehnliche Fische des Hamburger Museums. *Abhandlungen des Naturwissenschaftlichen Vereins in Hamburg*, **4**(2): 1-29.

LACÉPÈDE, B. G. E., 1800. — *Histoire naturelle des Poissons*. Vol. 2. Paris. 632 pp., pls 1-20.

LEVITON, A. E., GIBBSR, H., HEAL, Jr., E. & DAWSON, C. E., 1985. — Standards in herpetology and ichthyology: part I. Standard symbolic codes for institutional resources collections in herpetology and ichthyology. *Copeia*, 1985(3): 802-832.

LINNAEUS, C., 1758. — *Systema naturae per regna tria naturae, secundum Classes, Ordines, Genera, Species, cum characteribus, differentilis, synonymis, locis*. Editio Decima, Reformata. Tomo 1. Guilielmi Engelman, Holmiae. 824 pp.

McCLELLAND, J., 1844. — Apodal fishes of Bengal. *Calcutta Journal of Natural History*, **5**(18): 151-226, pls 5-14.

McCOSKER, J. E., 1977. — The osteology, classification, and relationships of the eel family Ophichthidae. *Proceedings of the California Academy of Sciences,* ser. 4, **41**(1): 1-123.

McCOSKER, J. E., 1979. — The snake eels (Pisces, Ophichthidae) of the Hawaiian Islands, with the description of two new species. *Proceedings of the California Academy of Sciences,* **42**(2): 57-67.

McCOSKER, J. E., BÖHLKE, E. B. & BÖHLKE, J. E., 1989. — Family Ophichthidae: 254-412. In *Fishes of the Western North Atlantic*, part 9, **1**. *Memoirs of the Sears Foundation Marine Research*. New Haven. 655 pp.

McCOSKER, J. E., & CASTLE, P. H. J., 1986. — Family 42: Ophichthidae: 176-186. In *Smiths' Sea Fishes*. Macmillan, South Africa Ltd., Johannesburg.

McCOSKER, J. E., & ROSENBLATT, R. H., 1995. — Ophichthidae. In *Guia FAO para la identification de especies para los fines de la pesca. Pacifico centro-oriental*. FAO, Rome. Vol. 3: 1326-1341.

NORMAN, J. R., 1922. — A new eel from Tobago. *Annals and Magazine of Natural History*, ser. 9, **10**: 296-297.

PARRA, A., 1787. — Descripción de diferentes piezas de historia natural, las mas del ramo marítimo, representadas en setenta y cinco laminas. Habana. 195 + 6 unnumbered pp., pls 1-73.

PINTO, S. Y., 1970. — Observações ictiologicas. VI-*Antobrantia*, nôvô gênero de ofictídeo do Brasil (Actinopterygii, Anguilliformes, Ophichthyidae). *Atas de Sociedade de Biologia do Rio de Janeiro*, **14**(1/2): 13-15.

POEY, F., 1867. — Peces Cubanos. Monografía de las morenas Cubanas. Repertorio Fisco-Natural de la Isla de Cuba, Habana, **2**(10-12): 245-264.

POEY, F., 1880. — Revisio piscium cubensium. *Anales de la Sociedad Española de Historia Natural*, **9**: 243-263.

RAFINESQUE, C. S., 1810. — Caratteri di alcuni nuovi generi e nuove specie di animali (principalmente di pesci) e piante della Sicilia, con verie osservazione sopra i medismi. Palermo. 105 pp., pls 1-20.

REGAN, C. T., 1908. — A collection of fishes from the coasts of Natal, Zululand, and the Cape Colony. *Annals of the Natal Museum*, **1**(3): 241-255.

RICHARDSON, J., 1844. — Ichthyology. Pp. 51-150 in R. B. HINDS, ed., *The zoology of the voyage of H. M. S. Sulphur, under the command of Captain Sir Edward Belcher, R. N., C. B., F. R. G. S., etc. during the years 1836-42*. Smith, Elder and Co., London, **1**: 51-150, pls 35-64.

RICHER DE FORGES, B., 1990. — Les campagnes d'exploration de la faune bathyale dans la zone économique de la Nouvelle-Calédonie. In: A. CROSNIER (ed.), Résultats des Campagnes MUSORSTOM, Vol. 6. *Mémoires du Muséum national d'Histoire naturelle*, ser. A, **145**: 9-54.

RICHER DE FORGES, B. & BARGIBANT, G., 1985. — Le lagon nord de la Nouvelle-Calédonie et les atolls de Huon et Surprise. *Rapports scientifiques et techniques. Centre ORSTOM de Nouméa*, (37): 1-23.

SEALE, A., 1917. — New species of apodal fishes. *Bulletin of the Museum of Comparative Zoology, Harvard College*, **61**(4): 79-94.

SMITH, J. L. B., 1962. — Sand-dwelling eels of the western Indian Ocean and the Red Sea. *Ichthyological Bulletin. Rhodes University*, **24**: 447-466, pls 63-68.

SMITH, J. L. B., 1964. — The discovery in Mozambique of the little known eel *Ophichthys tenuis* Günther, 1870, a redescription of the type of *Caecula pterygera* Vahl, 1794, notes on other species and on generic relationships. *Annals and Magazine of Natural History*, ser. 13, **7**: 711-723, pls 15-16.

TURTON, W., 1807. — The British fauna, containing a compendium of the zoology of the British Islands; arranged according to the Linnaean system. Swansea, London. 230 pp.

WHITLEY, G. P., 1930. — Five new generic names for Australian fishes. *Australian Zoologist*, **6**(3): 250-251.

WHITLEY, G. P., 1940. — Illustrations of some Australian fishes. *Australian Zoologist*, **9**(4): 397-428.

WHITLEY, G. P., 1950. — New fish names. *Proceedings of the Royal Society of New South Wales* for 1948-49: 44.



REMERCIEMENTS AUX RAPPORTEURS / *ACKNOWLEDGEMENTS TO REFEREES*

La Rédaction tient à remercier les experts extérieurs au Muséum national d'Histoire naturelle dont les noms suivent, d'avoir bien voulu contribuer, avec les rapporteurs de l'Établissement, à l'évaluation des manuscrits (1995/1998) :
The Editorial Board acknowledges with thanks the following referees who, with Muséum referees, have reviewed papers submitted to the Mémoires du Muséum (1995/1998):

AFZELIUS, B.	Stockholm	Suède
AKAM, M.	Cambridge	Grande-Bretagne
ANDERSEN, N.	Copenhague	Danemark
AUGELLI, I.	Milan	Italie
BABA, K.	Kumamoto	Japon
BACHMANN, G.H.	Halle-Wittenberg	Allemagne
BALLY, A.W.	Houston	USA
BANKS, T.	Egham	Grande-Bretagne
BARRIER, E.	Paris	France
BAUD, A.	Lausanne	France
BELLIDO, A.	Paimpont	France
BERGGREN, M.	Fiskebackskil	Suède
BERNET-ROLLANDE, M.C.	Paris	France
BERNOULLI, D.	Zürich	Suisse
BERTOTTI, G.	Amsterdam	Pays-Bas
BESSE, J.	Paris	France
BESSEREAU, G.	Rueil-Malmaison	France
BEST, M.	Leiden	Pays-Bas
BIJU-DUVAL, B.	Rueil-Malmaison	France
BONAVIA, F.	Paris	France
BOURSEAU, J.P.	Villeurbanne	France
BRUCE, J.	Helensvale	Australie
BRUCE, N.	Copenhague	Danemark
BRUNTON, H.	Londres	Grande-Bretagne
CARPENTER, J.	New York	USA
CASSAGNEAU, P.	Toulouse	France
CHACE, F.A.	Washington	USA
CHERIX, D.	Lausanne	Suisse
CHILD, C.A.	Washington	USA
CLOBERT, J.	Paris	France
CLOETINGH, S.	Amsterdam	Pays-Bas
COHEN, D.	Los Angeles	USA
COOK, P.L.	Victoria	Australie
CORDEY, F.	Lyon	France
CORNUDELLA, L.	Barcelona	Espagne
CUZIN-ROUDY, J.	Villefranche/Mer	France
DANCHIN, E.	Paris	France
DARLU, P.	Paris	France
DAVIE, P.	Brisbane	Australie
DEJEAN, A.	Villetaneuse	France
DELEPORTE, P.	Paimpont	France
DIETRICH, C.	Champaign	USA
DUFFELS, J.P.	Amsterdam	Pays-Bas
ELDREDGE, L.L.	Hawaii	USA
ELLOUZ, N.	Rueil-Malmaison	France
FAHAY, M.	Highlands	USA
FLEURY, A.	Orsay	France
FLOQUET, M.	Marseille	France
FODOR, L.	Budapest	Hongrie
FRANSEN, C.	Leiden	Pays-Bas
GAGNÉ, R.	Washington	USA
GALTIER, J.	Montpellier	France
GORIN, G.	Genève	Suisse
GRANATH, J.	Houston	USA
GUGLIELMO, L.	Messina	Italie
GULLAN, P.	Canberra	Australie
GUNZENHAUSER, B.	Zürich	Suisse
HANCOCK, P.	Bristol	Grande-Bretagne
HARMELIN, J.G.	Marseille	France
HEALY, J.	Brisbane	Australie
HEEMSTRA, P.	Grahamstown	Afrique du Sud
HODGSON, C.	Ashford	Grande-Bretagne
HOLTHUIS, L.B.	Leiden	Pays-Bas
HORVÀTH, F.	Budapest	Hongrie
HUC, A.Y.	Rueil-Malmaison	France
INGRISCH, S.	Frankfurt	Allemagne
JORDAN, P.	Solothurn	Suisse
KABAT, A.	Washington	USA
KENSLEY, B.	Washington	USA
KERP, H.	Munster	Allemagne
KIELAN-JAWOROWSKA, Z	Oslo	Norvège
KOMAI, T.	Chiba	Japon
KRAPP, F.	Bonn	Allemagne
KRISTENSEN, N.	Copenhague	Danemark
LAGARDÈRE, J.P.	La Rochelle	France
LAUBSCHER, H.P.	Bâle	Suisse
LEDOUARAN, S.	Paris	France
LEMAITRE, R.	Washington	USA
LOVELOCK, P.E.R.	La Haye	Pays-Bas
LOWRIE, J.	Zürich	Suisse
MACHIDA, Y.	Kochi	Japon
MACKINNON, D.	Christchurch	Nouvelle-Zélande
MACPHERSON, E.	Barcelona	Espagne
MADDISON, D.	Tucson	USA
MANNING, R.	Washington	USA
MARKLE, D.	Oregon	USA
MASAKI, S.	Hirosaki	Japon
MASCLE, A.	Rueil-Malmaison	France
MASSE, P.	Paris	France
MAUCHLINE, J.	Oban	Grande-Bretagne
MCLAUGHLIN, P.	Washington	USA
MCLENNAN, D.	Toronto	Canada
MERRETT, N.	Londres	Grande-Bretagne
MESSING, C.	Dania	USA
MEULENKAMP, J.	Utrecht	Pays-Bas
MORAND, S.	Perpignan	France
MORETTI, I.	Rueil-Malmaison	France
MOUTY, M.	Damas	Syrie
MUGNIER, J.L.	Grenoble	France
NAKAMURA, I.	Kyoto	Japon
NAUMANN, C.	Bonn	Allemagne
NEWMAN, W.A.	San Diego	USA
NG, P.	Singapore	Singapour
OLIVA, R.	Barcelona	Espagne
OROUSSET, J.	Paris	France
PACKER, L.	York	Canada
PLATEAUX, C.	Nancy	France
POCCIA, D.L.	Amherst	USA
POORE, G.	Victoria	Australie
PROUST, J.N.	Lille	France
RAIKOVA, O.	Saint-Pétersbourg	Russie
RAVENNE, C.	Rueil-Malmaison	France
RENTZ, D.C.R.	Canberra	Australie
REYMANE, J.	Neuchâtel	Suisse
RICHARDS, W.	Miami	USA
ROBERTS, C.	Wellington	Nouvelle-Zélande
ROURE, F.	Rueil-Malmaison	France
SALOMON, M.	Marseille	France
SAZONOV, Y.	Moscou	Russie
SCHAER, J.P.	Neuchâtel	Suisse
SCHOLTZ, C.	Pretoria	Afrique du Sud
SCHMID, S.M.	Bâle	Suisse
SCHWANDER, M.	La Haye	Pays-Bas
SPIRIDONOV, V.	Moscou	Russie
STAMPFLI, G.	Lausanne	Suisse
STEFANESCU, M.O.	Bucarest	Roumanie
STEPHENSON, R.A.	Amsterdam	Pays-Bas
STEWART, A.	Wellington	Nouvelle-Zélande
TAKEDA, M.	Tokyo	Japon
TAN, C.G.S.	Singapore	Singapour
THIERRY, J.	Dijon	France
THORNE, B.	Maryland	USA
TRIBOVILLARD, N.	Paris	France
TUDGE, C.	Brisbane	Australie
VAN AMERON, H.W.J.	Krefeld	Allemagne
VAN BAAREN, J.	Rennes	France
VERNON, P.	Paimpont	France
VIALLY, R.	Rueil-Malmaison	France
VICKERY VERNON, R.	Ste-Anne/Bellevue	Canada
VUL, M.A.	Lvov	Ukraine
WÄGELE, J.W.	Bielefeld	Allemagne
WARÉN, A.	Stockholm	Suède
WATSON, N.	Armidale	Australie
WENZEL, J.	Colombus	USA
WIEGMANN, B.	Maryland	USA
WILSON, M.	Cardiff	Grande-Bretagne
WILSON, S.	Warrensburg	USA
YEATES, D.	Brisbane	Australie
YOUNG, S.	Rio de Janeiro	Brésil
ZAPPATERA, E.	Londres	Grande-Bretagne
ZEZINA, O.	Moscou	Russie
ZIEGLER, P.A.	Binningen	Suisse

Achevé d'imprimer en janvier 1999 sur les presses de l'Imprimerie de Montligeon
61400 La Chapelle Montligeon - Dépôt légal 1er trimestre 1999 - N° Imp. 19185 - Distribué le 10 février 1999

2 2 FEV. 1999

DERNIERS TITRES PARUS

RECENTLY PUBLISHED MEMOIRS

À partir de 1993 (Tome 155), les *Mémoires du Muséum* sont publiés sans indication de série.
From 1993 (Volume 155), the Mémoires du Muséum *are published without serial titles.*

Tome 179 : Sylvie CRASQUIN-SOLEAU & Éric BARRIER (eds), 1998. — Peri-Tethys Memoir 4: Epicratonic Basins of Peri-Tethyan Platforms. 294 pp. (ISBN : 2-85653-518-4) 300 FF.

Tome 178 : Alan G. BEU, 1998. — Indo-West Pacific Ranellidae, Bursidae and Personidae (Mollusca: Gastropoda). A monograph of the New Caledonian fauna and revisions of related taxa. Résultats des Campagnes MUSORSTOM. Volume 19. 255 pp. (ISBN 2-85653-517-8) 350 FF.

Tome 177 : Sylvie CRASQUIN-SOLEAU & Éric BARRIER (eds), 1998. — Peri-Tethys Memoir 3 : Stratigraphy and Evolution of Peri-Tethyan Platforms. 262 pp. (ISBN : 2-85653-512-7) 260 FF.

Tome 176 : Alain CROSNIER (ed.), 1997. — Résultats des campagnes MUSORSTOM. Volume 18, 570 pp. (ISBN : 2-85653-511-9) 600 FF.

Tome 175 : Isabel PÉREZ FARFANTE & Brian KENSLEY, 1997. — Penaeoid and Sergestoid Shrimps and Prawns of the World: Keys and Diagnoses for the Families and Genera. 233 pp. (ISBN : 2-85653-510-0) 350 FF.

Tome 174 : Bernard SÉRET (ed.), 1997. — Résultats des Campagnes MUSORSTOM. Volume 17. 213 pp. (ISBN : 2-85653-500-3) 245,04 FF.

Tome 173 : Philippe GRANCOLAS (ed.), 1997. — The Origin of Biodiversity in Insects: Phylogenetic Tests of Evolutionary Scenarios. 356 pp. (ISBN: 2-85653-508-9) 490 FF.

Tome 172 : Alain CROSNIER & Philippe BOUCHET (eds), 1997. — Résultats des Campagnes MUSORSTOM. Volume 16. 667 pp. (ISBN : 2-85653-506-2) 612,60 FF.

Tome 171 : Judith NAJT & Loïc MATILE (eds), 1997. — Zoologia Neocaledonica, Volume 4. 400 pp. (ISBN : 2-85653-505-04) 450 FF.

Tome 170 : Peter A. ZIEGLER & Frank HORVÀTH (eds), 1996. — Peri-Tethys Memoir 2: Structure and Prospects of Alpine Basins and Forelands. 552 pp. + atlas. (ISBN : 2-85653-507-0) 450 FF.

Informations sur les Publications Scientifiques du Muséum national d'Histoire naturelle :
Informations about the Scientific Publications of the Muséum national d'Histoire naturelle:
Internet http://www.mnhn.fr/

Prix TTC, frais de port en sus.
Prices in French Francs, postage not included.

Résultats des Campagnes MUSORSTOM is an ongoing series on the deep-sea fauna of the tropical Indo-Pacific. Initially focussed on the New Caledonia region, the series has now expanded to cover other South Pacific islands and island groups, in particular Vanuatu, Wallis and Futuna, Fiji and the Marquesas. MUSORSTOM, which rests on an international network of collaborating taxonomists, is the most ambitious ongoing program of deep-sea zoological exploration.

The present volume contains contributions by eleven authors from Japan, New Zealand, USA and Europe, and deals with deep-sea corals (1 paper), bryozoans (1), isopod and decapod crustaceans (6), and snake eels (1). The results present new data on the morphology, systematics and distribution of more than 250 species. One new subfamily, five new genera and 60 new species are described. Of broader biological interest are the descriptions of new biological associations, e.g., between hermit crabs and Zoanthidea, and between acrothoracican cirripedes and corals. Carrier shells *(Xenophora)* were found to incorporate into their shells species of deep-sea corals that have otherwise never been collected by conventional means, which draws attention to the still inadequate sampling intensity of the tropical deep-sea benthos. The bryozoan genus *Pseudothyracella*, previously known as a Paleogene fossil in Europe and North America, is added to the list of "living fossils", being represented by a new, living species.

The MUSORSTOM series is a joint program of the Muséum national d'Histoire naturelle and the Institut Français de Recherche Scientifique pour le Développement en Coopération (ORSTOM).

PUBLICATIONS
SCIENTIFIQUES
DU MUSÉUM
57, RUE CUVIER
75005 PARIS
ISBN 2-85653-520-8
ISNN 1243-4442

600 FF TTC

1999

MÉMOIRES DU MUSÉUM NATIONAL D'HISTOIRE NATURELLE **180**

RÉSULTATS DES CAMPAGNES MUSORSTOM
Volume 20
Coordonné par Alain CROSNIER