New Recent foraminiferal genera and species from the lagoon at Madang, Papua New Guinea

MARTIN R. LANGER
Museum of Paleontology
University of California
Berkeley, CA. 94720, U.S.A.

ABSTRACT
Two new genera and eight new species of benthic foraminifera are described from the shallow water, tropical lagoon of Madang, Papua New Guinea. The new hauerinid genus *Pseudolachlanella* is characterized by juvenile cryptoquinqueloculine, adult almost massiline arranged chambers, and a slitlike, curved aperture with parallel sides and a long, slender, curved miliolid tooth. *Pitella haigi* n. gen., n. sp. is a new foraminifera with cryptoquinqueloculine arranged chambers, an almost entirely pitted shell surface (pseudopores) and a rounded aperture with a short simple tooth. Among the other species described as new are four hauerinids and two agglutinated foraminifera. All new species described here occur sporadically in the shallow water back- and forereef environments of the lagoon (0-55m), and live infaunally and epifaunally in well-oxygenated, fine and coarse grained biogenic sediments. They are absent in muddy, organic-rich, low-oxygen sedimentary environments within bay inlets where variations of salinity are considerable. *J. Microplaeontol.* 11 (1): 85-93, June 1992.

INTRODUCTION
The diverse, tropical foraminiferal faunal community from Papua New Guinea (PNG) represents an important link between the Red Sea—East-African faunal province (Hottinger, 1983; Reiss and Hottinger, 1984, Hottinger and Pecheux (in press) and the biogeographic province of the Great Barrier Reef. Despite a very recent inventory of genera (Loeblich & Tappan, 1987) and a large number of foraminiferal studies carried out in this region (Brady, 1884; Millett, 1898a, b, c; Heron-Allen & Earland, 1915; Cushman, 1921, 1932, 1933, 1942; Said, 1949; Collins, 1958; Graham & Militante 1959; Hofker, 1927, 1930, 1933, 1951, 1968; Rasheed 1971; Margerel, 1981; Baccar, 1987; Debenay, 1986, 1988; Haig, 1988), the systematic status of numerous genera and species is still insufficient (for review see e.g. Haynes, 1990) and open nomenclature has often been used (e.g. Hottinger *et al.*, in press). By studying the distribution patterns of shallow water benthic foraminiferal assemblages from the lagoon at Madang (PNG), 182 species were recorded (Langer & Lipps in prep.). Eight of them are described here as new. Morphological properties of two of the miliolids do not correspond to those of any previously known genera and the new genera *Pseudolachlanella* and *Pitella* are described.

MATERIAL AND METHODS
The present-day barrier, fringing and patch reefs of the lagoon at Madang, represent the largest reef system along the north coast of Papua New Guinea. The barrier reef parallels the N—S trending lagoon, is broken by three major passes, and extends over 17km from the Schering Peninsula in the S to the Ottilien Pass in the N (Fig. 1). The lagoon is 1 to 4km wide and 10 to 52m deep. The central lagoon floor is covered by biogenic rubble, sand and calcareous silt. The reef crest is characterized by digitate, robust *Acropora* corals; the unconsolidated coral

Fig. 1. Sampling sites in the lagoon at Madang, Papua New Guinea.
The four major inlet systems along the west coast of the lagoon (Madang, Nagada, Mililat Harbours and Bostrem Bay), are strongly influenced by the inflow of fresh water from rivers. The inlet bottoms are covered by a dark, organic-rich mud containing locally abundant scaphopods and a highly specialized foraminiferal fauna (Ammonia convexa, Spiroloculina attenuata, Parrellina hispidula and Elphidium sp.).

Fifty-seven samples covering major parts of the lagoon, the bay inlets and the fore reef were collected in summer 1989 at depths ranging from 1 — 52m (Fig. 1). The samples were collected by J.H. Lipps using SCUBA or a small rectangular pipe dredge. All sediment samples were washed over 63μm mesh sieves. Between 50 — 450 specimens were picked out of each sample or sample split, identified to species level and counted. One hundred and eighty-two species were identified and photographed using SEM. The microhabitat distribution pattern of the foraminiferal faunal assemblages within the lagoon and a catalogue of the species identified will be published at a later date (Langer & Lipps, in prep.). In the following taxonomic note, a morphological description is given for the new genera and species. The taxonomy adopted here follows the classification of Loeblich & Tappan (1987).

Holotypes and paratypes are deposited at the Museum of Paleontology, University of California, Berkeley (UCPM).

**SYSTEMATIC TAXONOMY**

Order Foraminifera Eichwald, 1830
Suborder Textularina Delage & Hérouard, 1896
Superfamily Spiroplectamminacea Cushman, 1927
Family Spiroplectamminidae Cushman, 1927
Genus Spiroplectinella Kisel'man, 1972
**Spiroplectinella hottingeri** sp. nov. (Pl. 1, figs 1-3)

**Derivation of name.** This species is named in honour of Prof. Lukas Hottinger (University of Basel, Switzerland) for his fundamental work in the Red Sea — East African faunal province.

**Diagnosis.** A small, heart-shaped species of Spiroplectinella with planispirally arranged initial chambers and biseri ally arranged adult chambers.

**Holotype.** Pl. 1, figs 1-2. Reference UCMP No.39671.

**Paratypes.** Pl. 1, fig. 3. Reference UCMP No. 39672.

**Material.** The holotype and two paratypes.

**Locality.** The holotype is from sample No. L25, Lagoon of Madang, N of Rasch Pass; 14m, Papua New Guinea. The paratypes are from sample No. L34, Lagoon of Madang, S-W of Wongat Island; 24.3m, Papua New Guinea.

**Description.** Test free, heart- to fan-shaped in lateral view, broader than high in the adult stage, laterally compressed with subacute periphery. Initial chambers planispirally arranged and somewhat thickened (3-4 chambers), later chambers biseri ally arranged (15-17 chambers). Chambers rapidly increase in width as added. Sutures are curved and slightly depressed. Wall agglutinated by heterogenous material. The peripheral wall is penetrated by straight and branching parapores (sensu Hottinger et al., 1990). The aperture is a basal slit at the inner margin of the final chamber.

**Dimensions.** Maximum test height of the holotype 0.57mm.

**Occurrence.** Spiroplectinella hottingeri is irregularly distributed in medium grained, back reef sediments (biogenic) in the lagoon of Madang, rare in the fore reef area.

**Remarks.** As has been shown by Bender (1989) and Cimerman & Langer (1991) the type species Spiroplectinella wrightii is both initially planispiral and perforated by minute parapores. Spirorutilus became a junior synonym of Spiroplectinella (compare Hottinger et al., 1990a and Bender, 1989). Therefore the species described here must be placed in Spiroplectinella Kisel’man.

Superfamily Textulariacea Ehrenberg, 1838
Family Textulariidae Ehrenberg, 1838
Subfamily Textularinæ Ehrenberg, 1838
Genus Sahulia Loeblich & Tappan, 1985
*Sahulia lutzei* sp. nov. (Pl. 1, figs 4-6)

**Derivation of name.** This species is named in honour of Prof. Gerhard Lutze (University of Kiel, Germany) for his work on benthic foraminifera in surface sediments of the Persian Gulf.

**Diagnosis.** A subtriangular, coarsely agglutinated species with biseri ally arranged chambers provided with an aperture at the inner margin of the final chamber with a short flaplike lip bordered at its end by apertural reentrants.

**Holotype.** Pl. 1, fig. 5. Reference UCMP No. 39673.

**Paratype.** Pl. 1, figs 4, 6. Reference UCMP No. 396734.

**Material.** The holotype and eight paratypes.

**Locality.** The holotype is from sample No. L22, Lagoon of Madang, N of Rasch Pass; 24.3m, Papua New Guinea. The paratype is from sample No. L23, Lagoon of Madang, N of Rasch Pass; 20.8m, Papua New Guinea.

**Description.** Test free, subtriangular to wedge-shaped in lateral view, broader than high in the adult stage, laterally compressed with subacute periphery. Initial part somewhat thickened. Chambers are biseri ally arranged throughout and rapidly increase in width as added. In adult specimens the number of chambers is between 18 and 24. Sutures are slightly curved and somewhat depressed. Peripheral walls are coarsely agglutinated by heterogenous material. Apertural face more smoothly finished. The peripheral wall is penetrated by straight
New Recent foraminiferal genera from Papua New Guinea
and branching parapores (sensu Hottinger et al., 1990). The aperture is a basal slit at the inner margin of the final chamber with a short flaplike lip bordered at its ends by apertural reentrants.

**Dimensions.** Maximum test height of the holotype 0.56mm.

**Occurrence.** *Sahulia lutzei* is irregularly distributed in medium grained (biogenic) back reef samples in the lagoon of Madang, rare in the perireefal area. The species is lacking in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

**Remarks.** Resembles the specimen figured by Said (1949, Pl. 1, fig. 7) as *Textularia conica* d'Orbigny, but differs distinctly from the original drawings of *Textularia conica* d'Orbigny (1839, Pl. 1, figs 19, 20) and the neotype selected by Le Calvez (1977, Pl. 1, figs 19, 20) in its more V-shaped outline and coarse agglutination and by the form of the apertural face. Interestingly the "short variety" of *Textularia conica* depicted by Brady (1884, Pl. 113, figs 1a-b) and collected off Hong Kong seems to represent a juvenile specimen belonging to the species described here. It differs, however, in its rather fine agglutination, the height of its chambers and in possessing a distinct rim bordering the entire apertural opening.

Suborder *Miliolina* Délage & Hérouard, 1896
Superfamily *Miliolacea* Ehrenberg, 1839
Family *Hauerinidaceae* Schwager, 1876
Subfamily *Hauerininae* Schwager, 1876
Genus *Cycloforina* Luczkowska, 1972
*Cycloforina collinsi* sp. nov.

(Pl. 1, figs 7-11)
1922 *Quinquiloculina* cf. *Q. collumosa* - Cushman, 65, Pl. 10, fig. 10.
1971 *Quinquiloculina* cf. *Q. collumosa* Cushman - Bock, 18, Pl. 5, figs 9-11.
1988 *Quinquiloculina* cf. *Q. collumosa* Cushman - Haig, 233, Pl. 5, figs 11-14.

**Derivation of name.** This species is named in honour of Dr. A.C. Collins (Geelong, Victoria) for his work on foraminifera at the Low Islands (Great Barrier Reef).

**Diagnosis.** A *quinqueloculine*, porcelaneous and imperforate species with numerous anastomosing costae, depressed sutures and a produced neck.

**Holotype.** Pl. 1, figs 10, 11. Reference UCMP No. 396735.

**Paratypes.** Pl. 1, figs 7-9. Reference UCMP No. 396736.

**Material.** The holotype and 6 paratypes.

**Locality.** The holotype is from sample No. L52, Lagoon of Madang, Wongat Island; 13.9m, Papua New Guinea. The paratypes are from sample No. L52, Lagoon of Madang, Wongat Island; 13.9m, Papua New Guinea.

**Description.** Test free porcelainaceous and imperforate, longer than broad, somewhat compressed with subacute periphery. Chambers distinct, arranged in a quinqueloculine pattern, polygonal in section; five chambers visible from the exterior. Sutures are depressed. Wall calcareous; shoulders and lateral parts of the test surface ornamented by numerous anastomosing costae which are parallel to oblique to the periphery of the chamber. Carinate edges of the chambers often becoming sinuous. Aperture produced on a short, slightly tapering neck, bordered by a circular rim and provided with two minute teeth with short bifid termination.

**Dimensions.** Maximum test height of the holotype 0.71mm.

**Occurrence.** *Cycloforina collinsi* is common in medium grained (biogenic) backreef samples in the lagoon of Madang. The species is lacking in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

**Remarks.** Resembles strongly the specimens figured by Koutsoukos and Falowitz (1971, Pl. 1, figs 1-7) described under the name *Adelosina pascuaensis* from Easter Island in the southeast Pacific. The species described herein differs from the latter in having a second, short bifid apertural tooth, more distinctive shoulders, is slightly more sinuate in apertural view and slimmer in side view.

**Genus *Massilinoides* McCulloch, 1977**

**Massilinoides baccaerti** sp. nov.

(Pl. 2, figs 1-3)

**Derivation of name.** This species is named in honour of Dr. Jan Baccaert (University of Liège, Belgium) for his excellent work at the Lizard Island reef complex, Northern Great Barrier Reef.

**Diagnosis.** A *porcelaneous*, slightly flattened species with U-shaped chambers (in horizontal section), and characteristic, anastomosing microridges on the test surface.

**Holotype.** Pl. 2, figs 1, 3. Reference UCMP NO. 39677.

**Paratype.** Pl. 2, fig. 2. Reference UCMP NO. 39678.

**Material.** The holotype and three paratypes.

**Locality.** The holotype is from sample No. L51, Lagoon of Madang, Wongat Island; 20.8m, Papua New Guinea. The paratypes are from sample No. L51, Lagoon of Madang, Wongat Island; 20.8m, Papua New Guinea.

**Description.** Test free, fusiform in outline, slightly flattened, periphery truncate. Chambers one half coil in length, U-shaped in horizontal section. Early chambers arranged in a quinqueloculine pattern, later in a single plane as in

---

**Explanation of Plate 2**

Figs 1-3. *Massilinoides baccaerti* sp. nov. (L51). Fig. 1, apertural view, (holotype) x90; Fig. 2, side view, (paratype) x40; Fig. 3, apertural view (note anastomosing microridges), (holotype) x33.

Figs 4-6. *Pseudolachlanella stillette* gen. nov., sp. nov. (L52). Fig. 4, side view, (holotype) x56; Fig. 5, side view, (paratype) x56; Fig. 6, enlarged portion of the apertural region, (paratype) x200.

Figs 7-8. *Quinquiloculina debneyi* sp. nov., (holotype, L37). Fig. 7, oblique peripheral view (note minute anastomosing microridges), (holotype) x80; Fig. 8, side view, (holotype) x80.

Figs 9-10. *Quinquiloculina stellcarinata* sp. nov., (holotype, L37). Fig. 9, side view, (holotype) x110; Fig. 10, apertural view, (holotype) x130.

Figs 11-14. *Pitella haigi* gen. nov., sp. nov. (L52). Fig. 11, apertural view, (holotype) x120; Fig. 12, oblique side view, (paratype) x80; Fig. 13, side view, (holotype) x80; Fig. 14, enlargement of the pitted shell surface, (holotype) x800.
**Genus Quinqueloculina** d'Orbigny, 1826

*Quinqueloculina debenayi* sp. nov.

(Pl. 2, figs 7-8)

**Paratype.** Reference UCMP No. 39680.

**Material.** The holotype and one paratype.

**Locality.** The holotype from sample No. L48, Lagoon of Madang, N of Kranket Island; 17.4m, Papua New Guinea.

**Occurrence.** Quinqueloculina in New Caledonia. The foraminifera in New Caledonia. The species is lacking in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

**Remarks.** Differ from *Cycloforina crassicarinata* (Collins) in lacking the produced neck.

*Quinqueloculina debenayi* sp. nov.

(Pl. 2, figs 7-8) Reference UCMP No. 39677.

**Material.** The holotype and one paratype.

**Locality.** The holotype from sample No. L48, Lagoon of Madang, N of Kranket Island; 17.4m, Papua New Guinea.

**Occurrence.** Quinqueloculina in New Caledonia. The foraminifera in New Caledonia. The species is lacking in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

**Remarks.** Differ from *Cycloforina crassicarinata* (Collins) in lacking the produced neck.

*Quinqueloculina debenayi* sp. nov.

(Pl. 2, figs 7-8) Reference UCMP No. 39681.

**Material.** The holotype and two paratypes.

**Locality.** The holotype and the paratypes are from sample No. L52, Lagoon of Madang, Wongat Island; 13.9m, Papua New Guinea.

**Occurrence.** Quinqueloculina in New Caledonia. The foraminifera in New Caledonia. The species is lacking in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

**Remarks.** Differ from *Cycloforina crassicarinata* (Collins) in lacking the produced neck.

*Quinqueloculina debenayi* sp. nov.

(Pl. 2, figs 7-8) Reference UCMP No. 39681.

**Material.** The holotype and two paratypes.

**Locality.** The holotype from sample No. L48, Lagoon of Madang, N of Kranket Island; 17.4m, Papua New Guinea.

**Occurrence.** Quinqueloculina in New Caledonia. The foraminifera in New Caledonia. The species is lacking in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

**Remarks.** Differ from *Cycloforina crassicarinata* (Collins) in lacking the produced neck.

*Quinqueloculina debenayi* sp. nov.

(Pl. 2, figs 7-8) Reference UCMP No. 39681.
New Recent foraminiferal genera from Papua New Guinea

Description. Test elongate, periphery subrounded, ovate in horizontal section. Chambers one half coil in length, early stage cryptoquinqueloculine later with planes of coiling increased to almost 180° to become nearly planispiral. Chambers without a floor, broadly overlapping so that only three chambers are visible from the exterior. Wall calcareous, porcelaneous, surface smooth. Aperture very narrow, curved, elongate slit with parallel sides, provided with a long slender tooth with short, thickened termination.

Dimensions. Maximum test height of the holotype 0.56 mm. Occurrence. Pseudolachlanella slitella appears very seldom in medium grained, (biogenic) backreef sediments in the lagoon at Madang. The species is absent in muddy, organic rich sediments and in the low-salinity bay inlets where freshwater input is high.

Family Miliolidae Ehrenberg, 1839
Subfamily Miliolinae Ehrenberg, 1839
Genus Pitella gen nov.

Description. Test free, elongate, multilocular; chambers one half coil in length, arranged in a cryptoquinqueloculine pattern (sensu Bogdanovich, 1969) and slightly inflated. The final three to four chambers visible from the exterior; wall calcareous, porcelaneous; surface pitted by pseudopores (sensu Hottinger et al., 1992); sutures very slightly depressed; aperture circular, bordered by a weakly developed, nonpitted, apertural rim and provided with a short, simple tooth with thickened termination.

Type species. Pitella haigi gen. nov. sp. nov.

Remarks. The pitted surface and the apertural features place this genus in the subfamily Miliolinae Ehrenberg, despite the fact that this subfamily is defined by a terminal aperture with a trematophore. Interestingly Loeblich & Tappan (1987) included in the Miliolinae the genus Rupertianella with its terminal aperture bordered by arched lips. Pitella differs from Triloculinella Riccio, 1950 in having a short, simple tooth and a pitted shell surface rather than an arch-like opening covered by a broad apertural flap. The new genus Pitella differs also from Rupertianella Loeblich & Tappan, 1985 in having a rounded aperture provided with a short tooth rather than a simple narrow and elongate slit bordered by slightly arched lips.

Porcelaneous foraminifera with a pitted test surface belonging to the family Miliolidae Ehrenberg are known since the Eocene. The function of the pseudopores is unknown and needs further investigation.

Pitella haigi gen. nov., sp. nov.
(Pl. 2, figs 11-14)
non 1932 Quinqueloculina semireticulosa - Cushman, 27, Pl. 7, fig. 2.
1988 Quinqueloculina cf. Q. semireticulosa (Cushman) - Haig, 234, Pl. 8, figs 6-9.

Derivation of name. The new species Pitella haigi is named after David W. Haig (University of Western Australia, Nedlands) for his extensive work on miliolids from the Motupore Island, New Guinea. The generic name Pitella refers to the characteristic pitted test surface (pseudopores, sensu Hottinger et al., 1992).

Diagnosis. A small, porcelaneous species with pitted test surface (pseudopores) and rounded aperture.

Holotype. Pl. 2, figs 11, 13-14. Reference UCMP No. 39684.
Paratype. Pl. 2, fig. 12. Reference UCMP No. 39685.
Material. The holotype and four paratypes.

Locality. The holotype and the paratypes are from sample No. L52, Lagoon of Madang, Wongat Island; 13.9 m, Papua New Guinea.

Description. Test small, elongate, ovate in horizontal section, periphery subrounded. Chambers one half coil in length, arranged in a cryptoquinqueloculine pattern. Chambers slightly inflated. The final three to four chambers visible from the exterior. Wall calcareous, porcelaneous; surface pitted by numerous pseudopores (sensu Hottinger et al., 1992). Sutures very slightly depressed. Aperture rounded, bordered by a weakly developed, nonpitted, apertural rim and provided with a short, simple tooth with thickened termination.

Dimensions. Maximum test height of the holotype 0.64 mm. Occurrence. Rare, irregularly distributed in the lagoon. Occurs in patchreef, forereef and lagoon samples between 10 and 50 m.

ECOLOGY
All species described above are rare in sediment samples from shallow water (0-55 m) fore- and back-reef environments at Madang (0-55 m). In the lagoon they are patchily distributed in fine and medium grained, biogenic sand and coarse, coral rubble. In thalatocoenoses their distribution matches the distribution of most of the larger symbiont bearing foraminifera (Assilina spp., Heterostegina depressa, Alveolinella quoyi, Sorites spp., Amphisorus hemprichii, Marginopora vertebralis). However, due to the lack of symbionts in the protoplasm of the new species, their depth and microhabitat requirements are less specific. Furthermore their morphology suggests also different microhabitat preferences (predominantly epifaunal and infaunal, compare Lipps, 1975, Langer, 1988, 1989, Kitazato, 1981, 1988). In the well oxygenated, unconsolidated, coarse coral rubble they probably live sheltered within the pore space. An epifaunal way of life, however, is more probable on fine biogenic sand. They are absent in all bay inlets where fresh water influence is high and the muddy sediments contain a high amount of organic material of terrestrial origin.

ACKNOWLEDGEMENTS
I would like to thank Jere Lipps (Berkeley), Ze’ev Reiss (Jerusalem) and an anonymous reviewer for their helpful comments on the manuscript. Competent technical support was provided by R. Guggenheim and M. Düggelin (SEM-laboratories Basel, Switzerland). Collection of the material by J.H. Lipps was supported by NSF grant EAR 84-08001 and a Cristiansen Research Institute Fellowship. This study was supported by the Swiss Science Foundation, grant-Nr. 8220-028385 and is gratefully acknowledged.

Manuscript received September 1991 Revised manuscript accepted February 1992
REFERENCES

Baccaert, J. 1987. Distribution Patterns and Taxonomy of Benthic Foraminifera in the Lizard island reef complex, Northern Great Barrier Reef, Australia. Unpubl. Ph.D. thesis, University of Liège.

Bender, H. 1989. Gehäuseaufbau, Gehäusegenese und Biologie agglutinierter Foraminiferen (Sarcodeina, Textulariina). Jahrb. Geol. Bundesanstalt. 132 (2), 259-347, Pls 1-17.

Bock, W.D. 1971. A handbook of the benthonic foraminifera of Florida Bay and adjacent waters. In: Jones, J.J. & Bock, W.D. (Eds), A Symposium of Recent south Florida Foraminifera. Miami Geol. Soc. Mem. 1, 1-72.

Bogdanovich, A.K. 1969. To the revision of Milolidae with quinqueloculine and triloculine structure of tests. Rocznik Polskiego Towarzystwa Geologicznego. 39, 351-360.

Brady, H.B. 1884. Report on the Foraminifera dredged by H.M.S. Challenger, during the years 1873-1876. Rep. scient. Results Voy. Challenger, Zoology. 9, 1-814, Pls 1-115.

Cimerman, F. 1987. Mediterranean Foraminifera - Dela. Opera 30. Classis IV: Historia Naturalis, p. 1-119, Pls 1-93, Ljubljana.

Collins, A.C. 1958. Foraminifera. British Museum (Natural History), Great Barrier Reef Expedition 1928-1929. Sci. Rep., 6 (6), 335-437, Pls 1-5.

Cushman, J.A. 1921. Foraminifera of the Philippine and adjacent seas. U.S. Nat. Mus. Bull., Washington, 100 (4), 608pp., Pls 1-100.

Cushman, J.A. 1922. Shallow water foraminifera of the Tortugas Region. Publ. Carnegie Inst. Washington, No.311, Dept. Mar. Biol., 17, 1-85, Pls 1-14.

Cushman, J.A. 1932. The Foraminifera of the tropical Pacific collections of the “Albatross”. 1899-1900: Part 1. Astorhizidae to Trochamminidae. U.S. Nat Mus. Bull. Washington, 161, 1-88, Pls 1-17.

Cushman, J.A. 1933. The Foraminifera of the tropical Pacific collections of the “Albatross”, 1899-1900: Part 2. Lagenididae to Alveolinellidae. U.S. Nat Mus. Bull. Washington, 161, 1-115, Pls 1-19.

Cushman, J.A. 1942. Foraminifera of the tropical Pacific collections of the “Albatross”, 1899-1900: Part 3. Heterohelicidae and Buliminidae. U.S. Nat Mus. Bull., Washington, 161, 1-67, Pls 1-15.

Debenay, J.-P. 1986. Le lagon sud-ouest et la marge insulaire sud de l’ile de Cuba. In: Ramone de la Sagra: Le lagon sud-ouest et la marge insulaire sud de l’ile de Cuba. Roy. Soc., 6 (1), 151-154.

Debenay, J.-P. 1988. Locomotion of some benthic Foraminifera in and on sediments. J. Foram. Res., 18 (4), 344-349.

Koutsoukos, E.A.M. & Falcetta, M.M. 1987. Adelosina pascuaensis, n. sp.: A new species of milolid (Foraminiferida) from the shore sediments of Easter Island (Isla de Pascua), Chile, Southeastern Pacific. Rev. Paléobiol., 6 (1), 151-154.

Langer, M.R. 1988. Recent epiphytic Foraminifera from Vulcano (Mediterranean Sea). Rev. Paléobiol. Vol. Spec. No. 2, BENTHOS ’86, 827-832, Genève.

Langer, M.R. 1989. Distribution, diversity and functional morphology of benthic foraminifera from Vulcano (Mediterranean Sea). Unpubl. Ph.D. thesis, 1-115, Pls 1-31. University of Basel.

Le Calvez, Y. 1977. Révision des foraminifères de la collection d’Orbigny II - Foraminifères de l’ile de Cuba. Cah. Micropal., Tome 1, 1-128.

Lipps, J.H. 1975. Feeding strategies and test function in foraminifera. Proc. “Benthons 1975” p.26, Dalhousie Univ., Halifax.

Loeblich, A.R. & Tappan, H. 1987. Foraminiferal genera and their classification. Van Nostrand Reinhold Co., New York, 2 vols, x+970pp.; vii+212pp., 847 Pls.

Marguerel, J.-P. 1981. Espèces nouvelles de Foraminifères de la baie de St. Vincent (Nouvelle-Calédonie): Cah. Micropal., 4, 67-72.

Millet, F.W. 1898a. Report on the Recent Foraminifera of the Malay Archipelago collected by Mr A. Durrand, F.R.M.S.; Part 2. J. Roy. Microscop. Soc., 258-269, Pls 5-6.

Millet, F.W. 1898b. Report on the Recent Foraminifera of the Malay Archipelago collected by Mr A. Durrand, F.R.M.S.; Part 2. J. Roy. Microscop. Soc., 499-513, Pls 11-12.

Millet, F.W. 1898c. Report on the Recent Foraminifera of the Malay Archipelago collected by Mr A. Durrand, F.R.M.S.; Part 3. J. Roy. Microscop. Soc., 607-614, Pls 13.

Rasheed, D.A. 1971. Some foraminifera belonging to Milolidae and Opalinumidae from the Coral Sea, south of Papua (New Guinea) Part 2. The Madins Univers. J., 37938, 19-68.

Reiss, Z. & Hoitinger, L. 1984. The Gulf of Aqaba - Ecological Micropaleontology. Ecological Studies 50, Springer Verlag, Berlin, Heidelberg, 354pp.

Said, R. 1949. Foraminifera of the Northern Red Sea. Cushman Lab. Foram. Res., Spec. Publ., 26, 1-44, Pls 1-4.
**APPENDIX**

Location of samples (see Fig. 1)

| Sample No. | Locality            | Latitude/Longitude   | Depth in m | Substrate                                              |
|------------|---------------------|----------------------|------------|--------------------------------------------------------|
| L22        | N of Rasch Pass     | 5°09.1'S/145°49.4'E  | 24.3       | Sand, coral rubble Halimeda                            |
| L23        | N of Rasch Pass     | 5°09.2'S/145°49.4'E  | 20.8       | sand, coarse coral rubble                              |
| L25        | N of Rasch Pass     | 5°09.9'S/145°49.2'E  | 14.0       | coral rubble, Halimeda                                 |
| L34        | SW of Wongat Island | 5°08.8'S/145°49.3'E  | 24.3       | biogenic detrital sand, coral rubble                   |
| L37        | SEK Harbour         | 5°05.2'S/145°48.9'E  | 52.1       | dark organic mud, scaphopods                           |
| L48        | N of Kranket Island | 5°11.4'S/145°49.9'E  | 17.4       | fine detrital sand, coral rubble                       |
| L51        | Wongat Island       | 5°08.3'S/145°49.6'E  | 20.8       | detrital sand, mud, Halimeda                          |
| L52        | Wongat Island       | 5°08.4'S/145°49.6'E  | 13.9       | detrital sand                                          |
| L61        | Malamal Anchorage   | 5°05.7'S/145°49.1'E  | 41.7       | detrital sand                                          |
| L87        | N-W of Rasch Pass   | 5°09.7'S/145°49.5'E  | 15.0       | fine sand                                              |