

Mollusca Gastropoda : The Typhinae (Muricidae) from the New Caledonian region with description of five new species

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ABSTRACT

The New Caledonian species of Typhinae are revised. A total of 11 species are recorded; 5, all from deep-sea, are new: *Siphonochelus* (*S.*) *angustus*; *S.* (*S.*) *boucheti*; *S.* (*S.*) *saltantis*; *S.* (*S.*) *unicornis* and *S.* (? *Siphonochelus*) *undulatus*. All the species are described and illustrated together

with comparative material. The radulae of 3 species are illustrated: *Typhis* (*Typhina*) *carolinae* Houart, 1987; *Siphonochelus* (*S.*) *boucheti* sp. nov. and *S.* (*S.*) *saltantis* sp. nov. Position and angle of anal tubes are considered to be a good criterion for the separation of species.

RÉSUMÉ

Mollusca Gastropoda : Les Typhinae (Muricidae) de la région néo-calédonienne. Description de cinq espèces nouvelles.

L'étude des Typhinae récoltés au cours des différentes campagnes entreprises depuis 1978 en Nouvelle-Calédonie a permis de recenser 11 espèces, dont 5 nouvelles, toutes d'eau profonde: *Siphonochelus* (*S.*) *angustus*; *S.* (*S.*) *boucheti*; *S.* (*S.*) *saltantis*; *S.* (*S.*) *unicornis* et *S.* (? *Siphonochelus*) *undulatus*. Les 11 espèces sont décrites, comparées et illustrées. Les figures reprennent également quelques espèces comparées provenant d'autres régions du Pacifique,

notamment du Japon et d'Australie. La radula de 3 espèces est illustrée: *Typhis* (*Typhina*) *carolinae* Houart, 1987; *Siphonochelus* (*S.*) *boucheti* sp. nov. et *S.* (*S.*) *saltantis* sp. nov. La position des tubes aperturax (canal anal) et l'angle qu'ils forment sont considérés comme de bons critères pour la séparation des espèces. Par ailleurs d'autres points ont été retenus et ont servi à la comparaison et à la séparation d'espèces: forme et taille de la protoconque, sculpture et morphologie des varices, sculpture axiale intervaricale et sculpture spirale.

INTRODUCTION

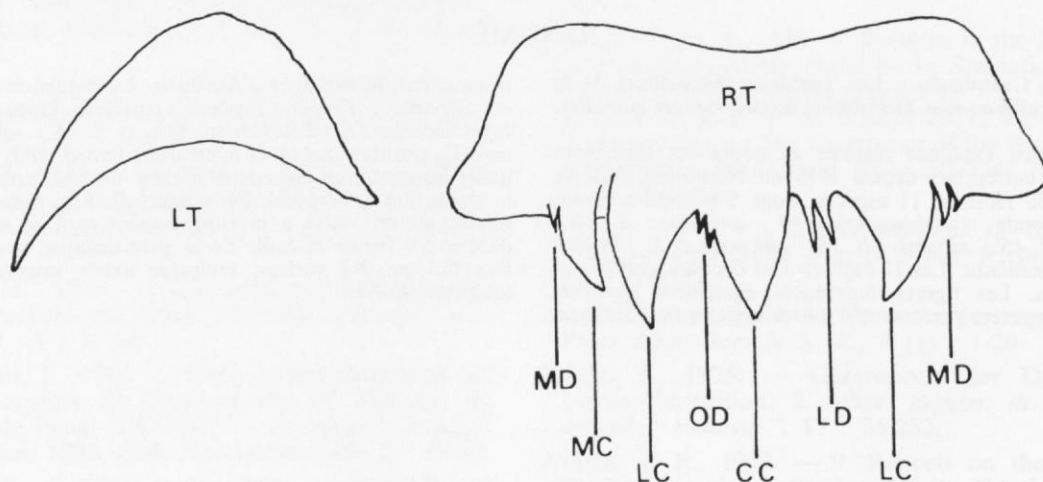
Several French expeditions have collected a considerable amount of marine material from deep water in the New Caledonian region, including many species of Muricidae. Among that material it has been possible to select an important collection of Typhinae, including many unknown species. Other Muricidae from the New Caledonian region are being studied by the author (in press) or have already been reported in other papers (HOUART, 1983, 1986, 1987a, 1987b, 1990).

The subfamily Typhinae is well studied and several authors (KEEN, 1944; VELLA, 1961; GERTMAN, 1969; D'ATTILIO, 1975, 1976, 1979 and D'ATTILIO & HERTZ, 1988) have done much for a better understanding of this group and its classification. The classification and methods used in the present paper are based mainly on the conclusions of these previous authors, but also on personal observations.

In their recent paper, D'ATTILIO & HERTZ (1988) reinstate the family Typhidae Cossmann, 1903, which they divide into two subfamilies: Typhinae and Tripterotyphinae. The purpose of this paper being not the discussion of the supraspecific classification of Typhinae, but only the review of the New Caledonian species, no other remarks will be given here on that study.

The Typhinae include a total of 45 Recent and 77 fossil species. No records were known from the New Caledonian waters before HOUART (1986), except one or two lots in European Museums (IRSNB I.G. 10591) but to my knowledge nothing has been published about them. Most Typhinae live in deep water, between 100 and 500 m, with an important radiation around 300-450 m, although some species occur in shallower waters (in New Caledonia *Typhis carolinae* Houart, 1987, and *Typhis neocaledonicus* Houart, 1987).

The species are characterized by their small size, whitish coloured shell and by the presence of hollow tubes, situated between each pair of varices, of which the function is not precisely known, although it is certain they are anal tubes. These anal tubes are gradually closed and broken during the growth of the shell, only the last tube is open and generally long to very long when intact. Other constant characteristics are the closed siphonal canal and the 4 (very rarely 5) varices per whorl. The group of species with three varices per whorl, formerly considered Typhinae, and consisting of the genera *Pterotyphis* Jousseume, 1880, *Tripterotyphis* Pilsbry & Lowe, 1932, *Prototyphis* Ponder, 1972, and *Cinclidotyphis* du Shane, 1969, have been transfe-



FIGS 1. — Schematic drawing of a Typhinae radula. — RT : rachidian tooth ; LT : lateral tooth ; MD : marginal denticle ; MC : marginal cusp ; LC : lateral cusp ; OD : outer denticle ; CC : central cusp ; LD : lateral denticle. Terminology mainly based on FUJIOKA (1985) and KOOL (1987).

red to the subfamily Muricinae by D'ATTILIO (1982), and recently (D'ATTILIO & HERTZ, 1988) to the subfamily Tripterotyphinae, with the exception of *Cinclidotyphis*.

The protoconch of all known Recent species is smooth and paucispiral, formed by 1.25 to 2 whorls, indicating non-planktotrophic larval development, and thus a short to non-existent free swimming larval stage. The operculum has an apical nucleus.

The radula consists of a rachidian tooth generally bearing 3 main cusps and 2 lateral denticles, and a pair of broad and curved lateral

tooth. Lateral denticles of the central tooth are not always symmetrical, sometimes they are bifid or divided into 2 or more, smaller denticles. The presence and placement of the marginal denticles or cusps are erratic. Aberrant radular features in Typhinae can be observed in *Haustellotyphis cumingii* (Broderip, 1833) or *Typhisopsis coronatus* (Broderip, 1833) from the eastern Pacific region (RADWIN & D'ATTILIO, 1976 : 195, 213). Otherwise stated, the material is housed in the Muséum national d'Histoire Naturelle, Paris (MNHN).

MATERIAL AND METHODS

The material was collected during the following cruises (see RICHER DE FORGES, 1990, for additional data) :

- (1) Aboard R. V. "Vauban", off South New Caledonia, by P. BOUCHET and A. WAREN (1978-79).
- (2) Programme LAGON, aboard R. V. "Vauban", conducted by B. RICHER DE FORGES (1984-1989).
- (3) BIOCAL cruise, aboard R. V. "Jean Charcot", under the direction of C. LÉVI (1985).
- (4) MUSORSTOM 4 cruise, aboard R. V. "Vauban", under the direction of B. RICHER DE FORGES (1985).
- (5) MUSORSTOM 5 cruise, aboard R. V. "Coriolis", under the direction of B. RICHER DE FORGES (1986).
- (6) CHALCAL 2 cruise, aboard R. V. "Coriolis", under the direction of B. RICHER DE FORGES (1986).

Abbreviations :

- a) preceding station numbers :
 DW : Drague Waren (Waren Dredge)
 CC : Chalut à crevettes (Shrimp Trawl)
 CP : Chalut à perche (Beam Trawl)
 DC : Drague Charcot (Charcot Dredge)
 All stations of programme LAGON are dredgings using a Charcot dredge.

- b) after data :
 spm(s) : live-taken specimen(s) present in sample
 sh(s) : only empty shells present in sample

The main features here retained for the separation of species are the form and size of the

protoconch, the position, form and angle of the anal tubes, the sculpture and morphology of the varices, the intervarical axial sculpture (except growth lines) and the spiral sculpture.

The following measurements are used (Fig. 2) :

- A. Length of the shell : taken from the apex to the tip of the siphonal canal.
- B. Breadth of the shell : largest breadth, not including anal tubes.
- C. Length and breadth of the aperture : largest measurements, taken from the inner side of the peristome.
- D. Length of the siphonal canal.
- E. Length of apertural anal tube.
- F. Breadth of the apertural anal tube : largest breadth, taken near the base.
- G. Tube angle : the shell is placed with the apex above, the aperture facing left ; the angle is measured between the axis of the shell and the axis of the anal tube, near its point of exit.

Museums where material is deposited are :

- AMS : The Australian Museum, Sydney.
 MNMZ : National Museum of New Zealand, Wellington.
 NSMT : National Science Museum, Tokyo.
 MNHN : Muséum national d'Histoire naturelle, Paris.
 USNM : National Museum of Natural History, Washington, D.C.
 IRSNB : Institut Royal des Sciences Naturelles de Belgique, Bruxelles.

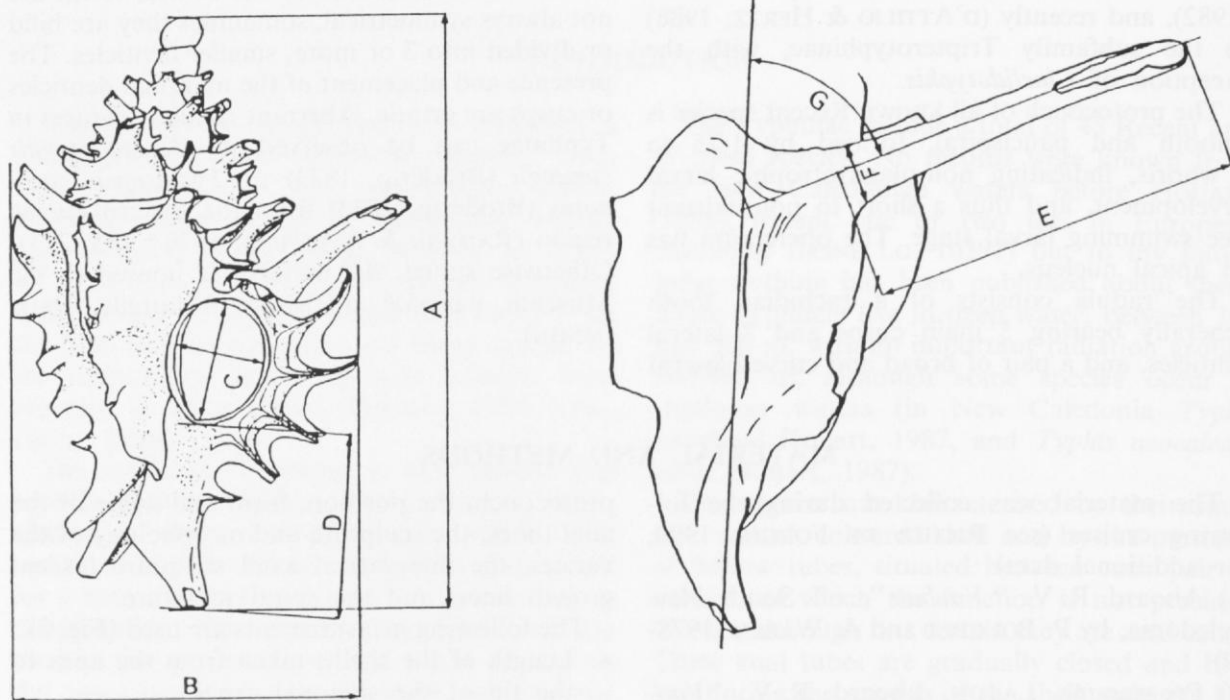


FIG. 2. — Illustration of measurements used.

SYSTEMATIC ACCOUNT

Family MURICIDAE Rafinesque, 1815

Subfamily TYPHINAE Cossman, 1903

Genus *TYPHIS* Montfort, 1810

Subgenus *TYPHINA* Jousseau, 1880

Type-species by original designation : *Typhis belcheri* Broderip, 1833.

Typhis (Typhina) imperialis

Keen & Campbell, 1964

Figs 10, 40, 60

Typhis (Typhina) imperialis Keen & Campbell, 1964 : 46, pl. 8, figs 1-4. — RADWIN & D'ATTILIO, 1976 : 207, pl. 32, fig. 8.

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 64, 24°48' S, 168°09' E, 250 m, 3 September 1985 : 2 shs.

MUSORSTOM 4 : stn DW 222, 22°58' S, 167°33' E, 410-440 m, 30 September 1985 : 1 sh.

Chesterfield Islands. MUSORSTOM 5 : stn DW 274, 24°45' S, 159°41' E, 285 m, 9 October 1986 : 1 sh.

TYPE LOCALITY. — Trawled off Tosa, Japan, 33°20' N, 138°40' E, 200 m.

DESCRIPTION. — Shell moderately large and shouldered, up to 13.5 mm (MNHN, MUSORSTOM 4, stn DW 222). Spire high, consisting of 1.5 protoconch whorls and 5 shouldered teleoconch whorls. Suture of whorls deeply impressed. Protoconch elongate, somewhat keeled and smooth. Last whorl bearing 4 foliated varices, ventrally ornamented with crenulations with strong upward, curved, sealed spine on shoulder. No spiral sculpture. Axial sculpture consisting only of fine

growth striae. A rounded anal tube originates nearest to preceding varix, forming an angle of approximately 70° with the axis of the shell.

Aperture roundly ovate, edge erect and smooth, forming an entire peristome. Siphonal canal long and broad, sealed, ornamented with a broad fluted spine near its base. Colour creamy-white with brown-coloured last anal tube in juvenile specimens.

MEASUREMENTS (illustrated specimen). — A-B : 13.5 × 7.1 mm. — C : 2.5 × 1.9 mm. — D : 5.3 mm. — E : tube broken. — F : 1.1 mm. — G : 70°.

DISCUSSION. — This species is related to *Typhis montforti* A. Adams, 1863, and *T. teramachii* Keen & Campbell, 1964, but the shell differs from both by the presence of a broad, fluted spine on the siphonal canal and by the angle of the anal tube. The present material represents a wide geographical range extension for this apparently rare species, previously known only from the type locality.

Typhis (Typhina) virginiae Houart, 1986

Figs 12, 41, 62

Typhis (Typhina) virginiae Houart, 1986 : 440, pl. 2, fig. 7.

MATERIAL EXAMINED. — **New Caledonia.** "Vauban" 1978-79 : stn 2, 22°17' S, 167°14' E, 425-430 m, type locality.

BIOCAL : stn DW 77, 22°15' S, 167°15' E, 440 m, 5 September 1985 : 9 spms.

MUSORSTOM 4 : stn DW 226, 22°47' S, 167°22' E, 390 m, 30 September 1985 : 1 sh. — Stn CC 246, 22°08' S, 167°11' E, 410-420 m, 3 October 1985 : 5 shs. — Stn CC 247, 22°09' S, 167°13' E, 435-460 m, 4 October 1985 : 2 shs.

TYPE LOCALITY. — South of New Caledonia, 22°17' S, 167°14' E, 425-430 m.

DESCRIPTION. — Shell small, delicate, triangular, up to 7.8 mm (holotype). Spire moderately high, consisting of 1.25 protoconch whorls and 4 angulate teleoconch whorls. Suture of whorls slightly appressed. Protoconch smooth and rounded, glossy. Last whorl bearing 4 thin, sharp varices, ending in an acute and curved open spine. Apertural varix bearing a winglike flange, extending from the shoulder spine to approxima-

tely the 3/4 of the siphonal canal. Spiral sculpture obsolete. A moderately long anal tube originates between each pair of varices, situated slightly nearer to succeeding varix and forming an angle of approximately 25° with the axis of the shell. Other axial sculpture obsolete except fine growth striae.

Aperture small and ovate, edge forming an entire, erect peristome. Siphonal canal moderately long, sealed and smooth, tapering at the end, slightly bent to the right. Colour of the shell creamy white, siphonal canal and upper whorls pale brown ; a pale brown band also sometimes apparent at the base and the anterior part of the anal tubes.

MEASUREMENTS (holotype). — A-B : 7.8 × 4.1 mm. — C : 1.4 × 1.1 mm. — D : 2.8 mm. — E-F : 2.9 × 0.6 mm. — G : 25°.

DISCUSSION. — The species was originally compared with *Typhis (Typhina) pauperis* Mes-tayer, 1916, and *Typhis (Typhina) bivaricata* Verco, 1909. From *T. pauperis* the shell differs by its lower spire, its lower and more globose protoconch, the position of the anal tubes and the smooth and sharp varices. It differs from *T. bivaricata* by its larger size, its longer siphonal canal and its smooth and sharp varices. Both *T. pauperis* and *T. bivaricata* differ by having curving crenulations on the varices, mostly on the outer apertural lip.

Typhis (Typhina) carolinae Houart, 1987

Figs 3-4, 11, 42, 61

Typhis (Typhina) carolinae Houart, 1987 : 204, figs 2-4, 12, 13.

MATERIAL EXAMINED. — **New Caledonia.** LAGON : stn 120, 22°28' S, 166°44' E, 46 m, 23 August 1984 : 1 spm. — Stn 296, 22°41' S, 166°44' E, 26 m, 26 November 1984 : 1 spm. — Stn 326, 22°26' S, 167°02' E, 67 m, 28 November 1984 : 1 spm (AMS C 153702). — Stn 354, 22°32' S, 167°00' E, 78 m, 29 November 1984 : 1 spm, holotype. — Stn 382, 22°33' S, 167°14' E, 57 m, 22 January 1985 : 1 spm. — Stn 383, 22°32' S, 167°13' E, 62 m, 22 January 1985 : 1 spm. — Stn 403, 22°35' S, 167°18' E, 45 m, 23 January 1985 : 1 spm. — Stn 405, 22°38' S, 167°20' E, 27 m, 23 January 1985 : 1 spm. (NMNZ MF 47730). — Stn 562, 22°44' S, 166°59' E, 48 m, 16 July 1985 : 1 spm. — Stn 572, 22°52' S, 167°00' E, 65 m, 17 July 1985 : 1 spm. (R. HOUART coll.). — Stn 598, 22°19' S, 167°06' E, 73-75 m, 5 August 1986 : 1 spm. — Stn 603, 22°16' S,

167°05' E, 78-80 m, 5 August 1986 : 1 spm. — Stn 632, 21°57' S, 166°50' E, 44-45 m, 6 August 1986 : 1 spm.

TYPE LOCALITY. — New Caledonia, Grand Récif Sud, Lagon, 22°32' S, 167°02' E, 78 m.

DESCRIPTION. — Shell large and spinose, up to 20.5 mm (holotype). Spire moderately high, consisting of 1.5 protoconch whorls and 5 shouldered, spinose, teleoconch whorls. Suture of whorls impressed. Protoconch rounded, smooth and glossy. Last whorl bearing 4 spinose and ventrally squamous varices, ornamented with small, backwardly curved, open spinelets. Shoulder spine long and strongly upwards curved. Spiral sculpture consisting of 3 to 4 very shallow, sometimes squamous, low cords on the posterior part of last whorl. Axial sculpture of fine growth striae. A rounded anal tube originates about midway between each pair of varices, slightly nearer preceding varix, forming an angle of 60 to 90° with the axis of the shell. Last tube long to very long and hollow, others gradually shorter and closed.

Aperture roundly-ovate to rounded, edge erect and smooth, forming an entire peristome. Siphonal canal sealed, long to very long, posteriorly flat and broad with spinelike projections posteriorly. Colour creamy-white to light brown, shoulder darker. Operculum with apical nucleus. Radula : rachidian bearing 3 cusps and 2 lateral denticles. Central and lateral cusps of approximately the same size ; lateral denticles slightly shorter and narrower ; 1 or 2 small outer denticles may erratically be present on the base of central cusp.

MEASUREMENTS (holotype). — A-B : 20.5 × 11.2 mm. — C : 4 × 3.5 mm. — D : 10.5 mm. — E-F : 13.3 × 1.5 mm. — G : 90°.

DISCUSSION. — This species was originally compared with *Typhis* (*Typhina*) *montforti* A. Adams,

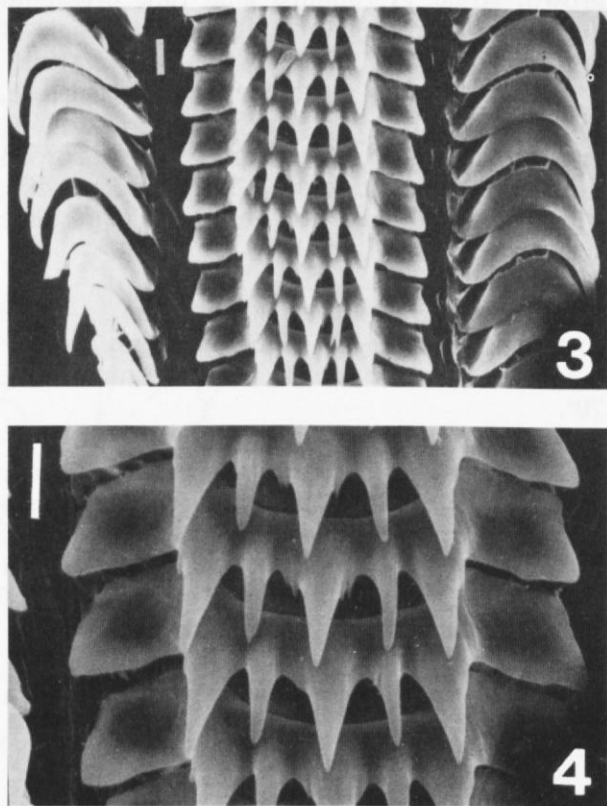
Subgenus *TALITYPHIS* Jousseau, 1882

Type-species by original designation : *Typhis expansus* Sowerby, 1874.

Typhis (*Talityphis*) *neocaledonicus* Houart, 1987

Figs 13, 44, 66

Typhis (*Talityphis*) *neocaledonicus* Houart, 1987 : 208, figs 8, 9, 16.



FIGS 3-4. — Radula of *T. carolinae* Houart, 1987 (scale lines 10 μ m).

1863, *T. (T.) yatesi* Crosse & Fischer, 1865, *T. (T.) imperialis* Keen & Campbell, 1964 and *T. (T.) teramachii* Keen & Campbell, 1964. The shell differs from these four species in having more spinose varices ; the varical ornamentation being dorsally bent, while the other species show ventrally bent crenulations. Other differences with related species are the position and angle of anal tubes ; ornamentation of the siphonal canal ; form of the protoconch and sculpture of the shell.

MATERIAL EXAMINED. — New Caledonia. LAGON : stn 416, 22°38' S, 167°14' E, 40-50 m : 1 spm, holotype.

TYPE LOCALITY. — New Caledonia, Grand Récif Sud, Lagon, 22°38' S, 167°14' E, 40-50 m.

DESCRIPTION. — Shell relatively small for the subgenus and broadly fusiform, up to 18 mm. Spire moderately high, consisting of 1.5 protoconch whorls and 5 shouldered and angulate teleoconch whorls. Suture of whorls impressed. Protoconch rounded, somewhat flattened and smooth. Last whorl bearing 4 laminate and sharp varices. Last varix broad and expanded, extending from the uppermost part of the shoulder spine to almost the tip of the siphonal canal. The partition is well developed. Varices ending in a sharp open shoulder spine. No apparent spiral sculpture but very shallow, low cords on posterior side of varices. A rounded anal tube originates at the shoulder margin, just in front of preceding varix, forming an angle of 70° with the axis of the shell. Last tube hollow and long, others short and closed.

Aperture rounded, edge erect and smooth, forming an entire peristome. Siphonal canal moderately long, broad and sealed, strongly bent

backwards on its tip. Shell colour pale brownish with some brown spots on the edge of the aperture and on the siphonal canal.

MEASUREMENTS (holotype). — A-B : 18 × 13 mm. — C : 3.5 × 2.9 mm. — D : 6.5 mm. — E-F : 9.4 × 1.9. — G : 70°.

DISCUSSION. — *T. neocaledonicus* may be compared with *Typhis (Talityphis) bengalensis* (Radwin & d'Attilio, 1976) from the Bay of Bengal, but that species has a much smaller shell (7.6 to 9.5 mm), with no spiral sculpture, a larger aperture and a different arrangement of the anal tubes, situated approximately medially between each pair of varices. *T. (T.) campbelli* (Radwin & d'Attilio, 1976), has a more slender and higher protoconch; the shoulder spines are not recurved and the position of the anal tubes is different, also situated medially between each pair of varices.

Genus *SIPHONOCHELUS* Jousseau, 1880

Subgenus *SIPHONOCHELUS* Jousseau, 1880

Type-species by original designation : *Typhis arcuatus* Hinds, 1843.

TYPE LOCALITY. — Australia, east of Sydney, 200 m.

Siphonochelus (Siphonochelus) pavlova
(Iredale, 1936)

Figs 14, 35, 45, 56, 63

Typhina pavlova Iredale, 1936 : 324, pl. 24, fig. 12. — RADWIN & D'ATTILIO, 1976 : 205, pl. 31, fig. 6. — KAICHER, 1978 : 1563. — HOUART, 1986 : 435, pl. 3, figs 8, 8A.

MATERIAL EXAMINED. — **New Caledonia.** "Vauban" 1978-79 : stn 40, 22°30' S, 166°24' E, 250-350 m, 7 June 1979 : 10 shs.

BIOCAL : stn DW 77, 22°15' S, 167°15' E, 440 m, 5 September 1985 : 1 spm.

MUSORSTOM 4 : stn CC 246, 22°08' S, 167°11' E, 410-420 m, 3 October 1985 : 1 sh. — Stn CC 247, 22°09' S, 167°13' E, 435-460 m, 4 October 1985 : 1 spm.

Chesterfield Islands. MUSORSTOM 5 : stn DW 301, 22°07' S, 159°25' E, 487-610 m : 1 spm.

Australia. Trawled off Cape Moreton, South Queensland : 2 spms (R. HOUART coll.).

DESCRIPTION. — Shell small, biconic, up to 10 mm (MNHN, MUSORSTOM 4, stn CC 247), but larger (up to 16 mm) in Australian specimens. Spire high, consisting of 1.5 to 1.6 protoconch whorls and 5 somewhat shouldered teleoconch whorls. Suture of whorls impressed. Protoconch rounded, elongate and smooth. Last whorl bearing 4 rounded varices, joined to varix of preceding whorl by a buttress. No spiral sculpture. Axial sculpture consisting of a very shallow axial ridge and fine growth striae. A long, somewhat curved, tubular anal tube originates from the succeeding varix, forming an angle of approximately 40 to 45° with the axis of the shell. Tube of apertural varix long and hollow, others short (broken) and closed.

Aperture roundly-ovate, edge erect and smooth, forming an entire peristome. Siphonal canal long, sealed and smooth, slightly bent to the

right and tapering on its tip. Shell whitish to light brown with brown maculations on the base of the siphonal canal and on the buttresses on the suture.

MEASUREMENTS (illustrated specimen, MNHN). — A-B : 10×4.9 mm. — C : 1.7×1.4 mm. — D : 3.5 mm. — E-F : 2.9×9 mm. — G : 40 to 45°.

DISCUSSION. — For the differences with *Siphonochelus (S.) saltantis* sp. nov. see that species. There are no noticeable differences with the Australian shells, except these are somewhat more globose with slightly more rounded varices.

Known in Australia from the coast of New South Wales (IREDALE, 1936) and from Cape Moreton, South Queensland (RADWIN & D'ATTILIO, 1976 : Pl. 31, Fig. 6 and R. HOUART coll.).

Siphonochelus (Siphonochelus) angustus sp. nov.

Figs 15-16, 43, 65

MATERIAL EXAMINED. — **Chesterfield Islands.** MUSORSTOM 5, stn DW 304, 22°10' S, 159°26' E, 385-420 m : 2 shs.

TYPE MATERIAL. — Holotype MNHN, MUSORSTOM 5, stn DW 304 (6.7×3.4 mm); 1 paratype MNHN, same station (6.3×3.3 mm).

TYPE LOCALITY. — Coral Sea, Nova Seamount, MUSORSTOM 5, 22°10' S, 159°26' E, 385-420 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 6.7 mm (holotype). Spire high, consisting of 1.5 protoconch whorls and 4 convex teleoconch whorls. Suture of whorls impressed when visible. Protoconch broad, rounded, slightly flattened and glossy. Last whorl bearing 4 rounded varices. No spiral sculpture. Axial sculpture consisting of one, sometimes shallow or obsolete, axial ridge, situated midway between each pair of varices. Shell slightly excavated between axial ridge and succeeding varix. A flattened and broad anal tube originates from succeeding varix, forming an angle of approximately 10 to 15° with the axis of the shell; its broad and flattened base masks the suture of whorls. Other axial sculpture of fine growth striae.

Aperture ovate and smooth, partially broken.

Siphonal canal short, broad at the base and narrower at its tip, smooth, tubular and sealed. Shell ivory white and glossy.

MEASUREMENTS (paratype). — A-B : 6.3×3.3 mm. — C : 1.4×1.0 mm. — D : 1.7 mm. — E : tube broken. — F : 1.2 mm. — G : 10 to 15°.

DISCUSSION. — The shell of *Siphonochelus japonicus* (A. Adams, 1863) is brown coloured, has more pronounced axial ribs and is deeply excavated between each varix and axial rib; the suture is deeper and the anal tubes are more detached from the whorls; the varices are weaker and the protoconch is higher and more rounded.

? *Siphonochelus syringianus* (Hedley, 1903) from shallower water has a brown coloured shell, it is barely half the size for the same number of teleoconch whorls; its protoconch is slightly smaller and non acute; its intervarical costae are more apparent; the teleoconch whorls are more detached from each other and the shoulder is stronger and broader. The varices and anal tubes are more numerous for *S. syringianus* : 6 on first teleoconch whorl and 5 from second teleoconch whorl onwards, including the last whorl while *S. angustus* has 4 varices and 4 anal tubes on each whorl.

Siphonochelus boucheti sp. nov. has a comparatively larger shell, with a more rounded protoconch, smaller anal tubes and broader shell. It has more pronounced and erect axial ridges and varices.

ETYMOLOGY. — Named *angustus* due to its relatively narrow shell.

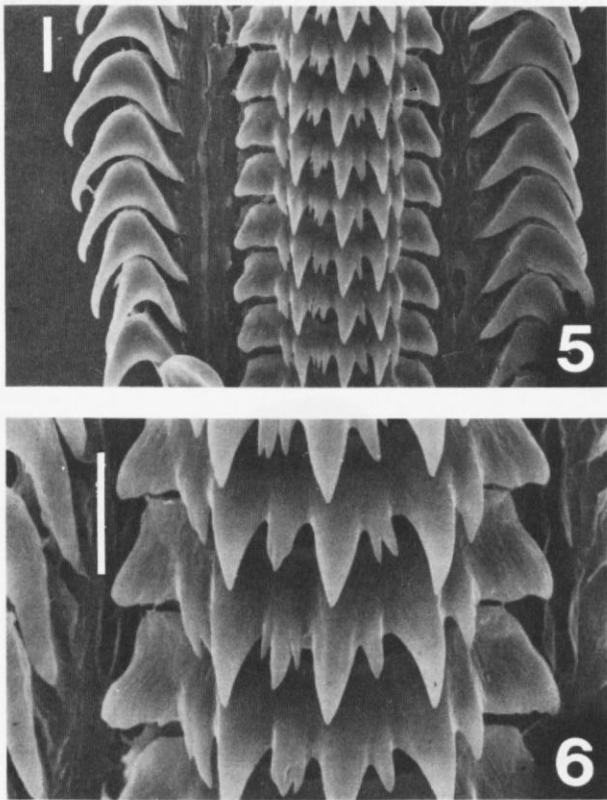
Siphonochelus (Siphonochelus) boucheti sp. nov.

Figs 5-6, 17-18, 47, 68

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 46, 22°53' S, 167°17' E, 570-610 m, 30 August 1985 : 2 spms. — Stn DW 51, 23°05' S, 167°45' E, 680-700 m, 31 August 1985 : 6 spms. — Stn CP 57, 23°44' S, 166°58' E, 1 490-1 620 m, 1 September 1985 : 1 sh. — Stn DW 66, 24°55' S, 168°22' E, 505-515 m, 3 September 1985 : 20 spms. — Stn DW 70, 23°25' S, 167°53' E, 965 m, 4 September 1985 : 1 sh.

CHALCAL 2 : stn DW 72, 24°55' S, 168°22' E, 527 m, 28 October 1986 : 21 spms.

Chesterfield Islands. MUSORSTOM 5 : stn DC 358, 19°39' S, 158°47' E, 680-700 m, 18 October 1986 : 1 spm.



FIGS 5-6. — Radula of *S. boucheti* sp. nov. (scale lines 10 μ m).

TYPE MATERIAL. — Holotype MNHN, CHALCAL 2, stn DW 72, 10.1 \times 5 mm; 20 paratypes, same station (MNHN, NMNZ, AMS, USNM, NSMT, Natal Mus., R. HOUART coll.).

TYPE LOCALITY. — South of New Caledonia, CHALCAL 2, stn DW 72, 24°55' S, 168°22' E, 527 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 10.5 mm (specimen from BIOCAL, stn DW 66). Spire high, consisting of 1.6 protoconch whorls and 5 shouldered teleoconch whorls. Suture of whorls impressed. Protoconch rounded, smooth and glossy. Last whorl bearing 4 rounded varices, angulate at the shoulder. No spiral sculpture. Intervarical axial sculpture consisting of a strong rounded ridge, situated about midway between each pair of varices, slightly nearer to succeeding varix. Shell excavated between axial ridge and succeeding varix. A flattened and arched anal tube originates from the

succeeding varix; broad at the base and gradually narrower at its tip, strongly upward bent, forming an angle of approximately 20 to 25° with the axis of the shell. Other axial sculpture of fine growth striae.

Aperture ovate, edge erect and smooth, forming an entire peristome. Siphonal canal short, broad at the base and narrower at its tip, smooth, tubular and sealed. Shell ivory white and glossy.

Radula: rachidian bearing 5 cusps and 2 lateral denticles. Laterals cusps rarely bearing outer denticles. Lateral denticles erratically divided into 2 or 3 smaller denticles.

MEASUREMENTS (holotype): A-B: 10.1 \times 5 mm. — C: 2.5 \times 1.7 mm. — D: 2.6 mm. — E-F: 2.5 \times 1.2 mm. — G: 20 to 25°.

DISCUSSION. — *S. boucheti* is related to *Siphonochelus nipponensis* Keen & Campbell, 1964 but the shell has more upward vertically bent anal tubes which are flatter on the base; they originate immediately from the varix in *S. nipponensis* while they are somewhat separated in *S. boucheti*. The varices are more strongly shouldered than in *S. nipponensis*; the protoconch of *S. boucheti* is approximately 50% larger, and the aperture is narrower.

Siphonochelus japonicus (A. Adams, 1863), a smaller related species, has been compared with adult specimens of *S. boucheti* and also with an approximately equal-sized juvenile. *S. boucheti* has a translucent white shell while *S. japonicus* has a brownish to dark brown shell, but other differences are the more shouldered whorls in *S. boucheti*, which also has a more globose and almost twice larger protoconch; the varices are strongly shouldered and the anal tubes are slightly joined to them while these of *S. japonicus* are rounded with the anal tubes distinctly joined; these anal tubes being flatter in *S. japonicus*.

Siphonochelus generosus Iredale, 1936, a South-eastern Australian species is also similar to the new species but *S. boucheti* has a twice larger and more globose protoconch, more fusiform whorls, more erect apertural lip and slightly more upwardly bent anal tubes.

Siphonochelus solus Vella, 1961, is a more fusiform species with smaller protoconch and

weaker axial costae. The new species also has slightly more upwardly bent anal tubes and the axial costae are more separated from the anal tubes.

S. tillierae Houart, 1986, is a narrower and comparatively smaller shell. The anal tubes do not originate from the varices and are rounded and straight, while flattened and arched for the new species. The axial ridge is also stronger and more evident in *S. boucheti*.

ETYMOLOGY. — Named in honour of Dr P. BOUCHET (MNHN), who shared in most of the recent French expeditions in New Caledonia.

***Siphonochelus (Siphonochelus) saltantis* sp. nov.**

Figs 7-8, 9, 19-20, 46, 70

MATERIAL EXAMINED. — **New Caledonia.** BIOCAL : stn DW 64, 24°48' S, 168°09' E, 250 m, 3 September 1985 : 5 spms.

Chesterfield Islands. MUSORSTOM 5 : stn DW 263, 25°21' S, 159°46' E, 150-225 m, 8 October 1986 : 9 spms. — Stn DW 274, 24°45' S, 159°41' E, 285 m, 9 October 1986 : 1 spm. — Stn DW 303, 22°12' S, 159°23' E, 332 m, 12 October 1986 : 1 spm. — Stn DW 304, 22°10' S, 159°26' E, 385-420 m, 12 October 1986 : 1 sh.

TYPE MATERIAL. — Holotype MNHN, MUSORSTOM 5, stn 303, 9.2 × 4.1 ; 1 paratype MNHN, MUSORSTOM 5, stn 304.

TYPE LOCALITY. — Coral Sea, Nova Seamount, MUSORSTOM 5, stn DW 303, 22°12' S, 159°23' E, 332 m.

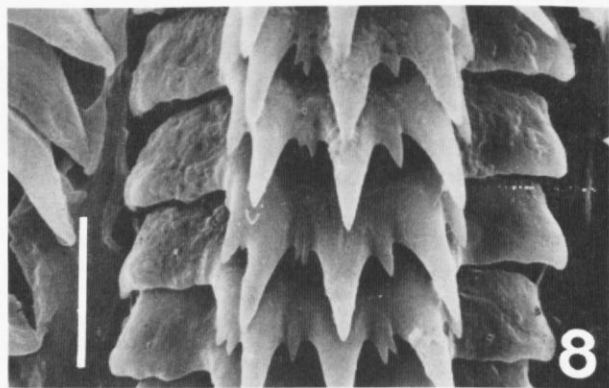
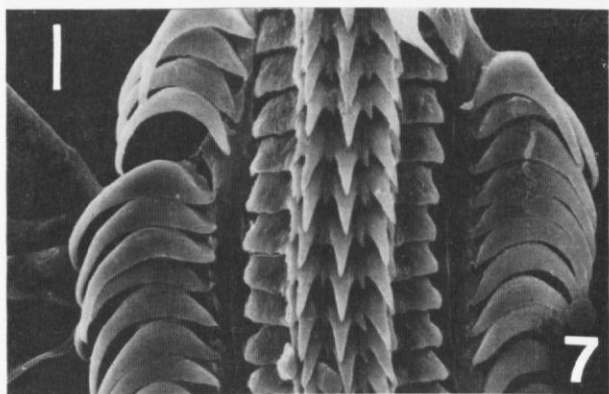
DESCRIPTION. — Shell small and fusiform, biconic, up to 9.2 mm (holotype). Spire high, consisting of 1.5 to 1.75 protoconch whorls and 4 slightly angulate and shouldered teleoconch whorls. Suture of whorls impressed. Protoconch small, rounded and glossy. No spiral sculpture. Axial sculpture consisting of 4 sharp varices and fine growth striae. A long, fused, slightly angulate and slender anal tube originates from the varices, forming an angle of approximately 25 to 30° with the axis of the shell. Tube of apertural varix very long and hollow, others broken and closed.

Aperture rounded and very small, edge erect and smooth, forming an entire peristome. Siphonal canal long and fused, broad at the base,

gradually narrower and tapering at its tip, bent to the right. Shell glossy white, often with more or less visible brown maculations at the base of the anal tubes, siphonal canal and remnants of previous siphonal canals.

Radula : rachidian bearing 3 cusps, 2 small lateral denticles and 2 small marginal denticles. Lateral denticles erratically divided into 2 smaller denticles.

MEASUREMENTS (holotype). — A-B : 9.2 × 4.1 mm. — C : 1.4 × 1.0 mm. — D : 3.6 mm. — E-F : 3.8 × 0.7 mm. — G : 25 to 30°.



FIGS 7-8. — Radula of *S. saltantis* sp. nov. (scale lines 10 μm).

DISCUSSION. — Compared with *S. pavlova* (Iredale, 1936), the shell is twice smaller for the same number of teleoconch whorls ; the aperture is also smaller. The protoconch is comparatively smaller, more rounded while that of *S. pavlova* is large and elongate. *S. pavlova* has a more globose shell with more rounded varices and more apparent buttresses where the varices join

the preceding whorl, and with a shallow axial ridge.

Typhis (Typhina) virginiae Houart, 1986, another recently named species from New Caledonia has a more angulate shell with a larger aperture; the axial lamellae are separated from the anal tubes and are sharper while the anal tubes are less backwards bent and more horizontal. The suture is more impressed in *T. virginiae* and the buttresses formed where the varices or axial lamellae join the preceding whorl are shallow while they are large and very apparent in *S. saltantis*.



FIG. 9. — Operculum of *S. saltantis* sp. nov. (scale line 0.5 mm).

ETYMOLOGY. — *Saltantis* = dancer. Named for its similarity with *Siphonochelus pavlova* (Iredale, 1936).

***Siphonochelus (Siphonochelus) unicornis* sp. nov.**

Figs 21-23, 48, 67

MATERIAL EXAMINED. — New Caledonia. BIOCAL : stn DW 44, 22°47' S, 167°14' E, 440-450 m, 30 August 1985 : 1 spm. — Stn DW 46, 22°53' S, 167°17' E, 570-610 m, 30 August 1985 : 3 spms.

MUSORSTOM 4 : stn DW 226, 22°47' S, 167°22' E, 390 m, 30 September 1985 : 1 sh.

TYPE MATERIAL. — Holotype MNHN, MUSORSTOM 4, stn DW 226, 12 × 5.5 mm; 1 paratype MNHN, BIOCAL, stn DW 44; 3 paratypes, BIOCAL, stn DW 46 (MNHN, NMNZ, R. HOUART coll.).

TYPE LOCALITY. — New Caledonia, MUSORSTOM 4, stn DW 226, 22°47' S, 167°22' E, 390 m.

DESCRIPTION. — Shell small and fusiform, biconic, up to 12 mm (holotype). Spire high, consisting of 1.5 to 1.75 protoconch whorls and 5 fusiform and slightly shouldered teleoconch whorls. Suture of whorls impressed. Protoconch large, rounded and glossy. No spiral sculpture. Axial sculpture consisting of 4 more or less sharp varices and a very shallow axial ridge, situated nearer to preceding varix. No other axial sculpture. A long, fragile and almost horizontal anal tube originates from the apertural varix, forming an angle of 70 to 75° with the axis of the shell (paratype MNHN, stn DW 46). Other tubes broken.

Edge of aperture slightly erect, ovate, forming an entire peristome. Siphonal canal moderate in length, broad at the base and narrow at its tip, smooth. Colour white, with a shallow pale brown band at the base of the siphonal canal.

MEASUREMENTS (paratype MNHN). — A-B : 9.7 × 4.7 mm. — C : 1.8 × 1.3 mm. — D : 3.3 mm. — E-F : 4.5 × 0.8 mm. — G : 75°.

DISCUSSION. — Compared with *Siphonochelus boucheti*, *S. unicornis* has a larger and more elongate protoconch and a larger aperture. The axial ribs are weaker and the anal tubes more backwards bent, being almost horizontal. *Siphonochelus (Siphonochelus) erythro stigma* Keen & Campbell, 1964, has a more rounded and smaller protoconch, rounded and spirally sculptured varices, globose and upwardly bent anal tubes.

No other related species is known.

ETYMOLOGY. — Named *unicornis* for its long apertural anal tube.

***Siphonochelus (? Siphonochelus) undulatus* sp. nov.**

Figs 24-25, 49, 69

MATERIAL EXAMINED. — New Caledonia. MUSORSTOM 4 : stn DW 203, 22°36' S, 167°05' E, 105-110 m, 27 September 1985 : 1 sh.

TYPE MATERIAL. — Only known from the holotype, MNHN.

TYPE LOCALITY. — New Caledonia, MUSORSTOM 4, stn DW 203, 22°36' S, 167°05' E, 105-110 m.

DESCRIPTION. — Shell very small, fusiform and biconic. Spire high, consisting of 1.75 protoconch whorls and 4 teleoconch whorls. Suture of whorls slightly appressed. Protoconch slightly elongate, convex and smooth. Last whorl bearing 4 rounded varices, extended on previous whorl by a small buttress. Other axial sculpture consisting of one elongate ridge, situated nearest to preceding varix; shell excavated between axial ridge and succeeding varix. Spiral sculpture consisting of 5 cords, most evident on the varices and axial ridges. A short, rounded anal tube originates from succeeding varix, forming an angle of approximately 20 to 25° with the axis of the shell.

Aperture roundly-ovate, forming an entire peristome, smooth and slightly erect. Siphonal canal short, smooth and fused, sealed and tapering on its tip. Colour ivory-white with traces of pale brown on the anterior part of last whorl.

MEASUREMENTS (holotype). — A-B : 5.9 × 3.0 mm. — C : 1 × 0.8 mm. — D : 1.4 mm. — E : tube broken. — F : 0.6 mm. — G : 20 to 25°.

DISCUSSION. — *S. undulatus* is here tentatively included in *S. (Siphonochelus)*, its shell sculpture being somewhat unexpected in the nominal subgenus. *S. (Pilsbrytyphis)* Woodring, 1959, confined to the middle Miocene of Panama (GERTMAN, 1969) also has strange sculpture, consisting of a wrinkled shell surface. No other species of *Siphonochelus* is related, but the species may be compared with *Typhis (Typhina) bivaricata* Verco, 1909. In *T. bivaricata* the anal tubes are separated from the varices, which are foliated and sharp, while rounded and tuberculate for the new species; it has also longer and more horizontal anal tubes.

Although probably subadult with its 4 teleoconch whorls, *S. undulatus* is definitely distinct from other Recent and fossil species.

ETYMOLOGY. — Named *undulatus* for its undulating spiral sculpture.

Subgenus **LAEVITYPHIS** Cossmann, 1903

Type-species by original designation : *Typhis muticus* J. Sowerby, 1834.

Siphonochelus (Laevityphis) tillierae

Houart, 1986

Figs 26, 27, 50, 64

Siphonochelus (Laevityphis) tillierae Houart, 1986 : 442, pl. 2, fig. 6.

MATERIAL EXAMINED. — New Caledonia. "Vauban" 1978-79 : stn 40, 22°30' S, 166°24' E, 250-350 m, 7 June 1979 : 2 shs. (type material).

BIOCAL : stn CP 75, 22°19' S, 167°23' E, 825-860 m, 4 September 1985 : 9 shs. — Stn DW 79, 20°40' S, 166°52' E, 1 320-1 380 m, 5 September 1985 : 1 sh. — Stn DW 80, 20°32' S, 166°48' E, 900-980 m, 5 September 1985 : 1 sh.

MUSORSTOM 4 : stn DW 161, 18°39' S, 163°11' E, 550 m, 15 September 1985 : 1 sh. — Stn DC 168, 18°48' S, 163°11' E, 720 m, 16 September 1985 : 1 sh.

TYPE LOCALITY. — New Caledonia, stn 40, 22°30' S, 166°24' E, 250-350 m ("Vauban" 1978-79).

MEASUREMENTS (holotype). — A-B : 5.9 × 2.8 mm. — C : 1.3 × 0.8 mm. — D : 1.3. — E-F : 1.1 × 0.5 mm. — G : 70 to 75°.

DESCRIPTION. — Shell small and fusiform, elongate, up to 9.9 mm (MUSORSTOM 4, stn DW 161). Spire high, consisting of 1.25 to 1.75 protoconch whorls and 4 to 5 rounded teleoconch whorls. Suture of whorls impressed. Protoconch rounded and smooth, glossy. Last whorl bearing 4 strong and somewhat rounded and shouldered varices. No spiral sculpture. Axial sculpture consisting of a shallow intervarical low ridge, slightly nearer to preceding varix. A rounded and short anal tube originates near preceding varix, forming an angle of approximately 70 to 75° with the axis of the shell. Other axial sculpture of fine growth striae.

Aperture ovate, columellar lip adherent posteriorly, otherwise erect. Outer apertural lip erect and smooth. Siphonal canal short, tubular and sealed, very slightly bent to the right. Shell entirely white.

DISCUSSION. — *S. tillierae* was originally compared with *Siphonochelus (S.) solus* Vella, 1961, *S. (S.) generosus* Iredale, 1936, *S. (Laevityphis) transcurrens* (von Martens, 1902) and *S. (Siphonochelus) tubuliger* (Thiele, 1925). The shell of *S. tillierae* differs from that of *S. solus*,

S. generosus and *S. transcurrens* by its smaller size, form of whorls and form and position of the anal tubes. From *S. tubuliger* it differs by its more elongate form, its shorter anal tubes and

the angle of these. The aperture of *S. tubuliger* is rounded, but ovate in *S. tillierae*, and the varices are shorter and much finer.

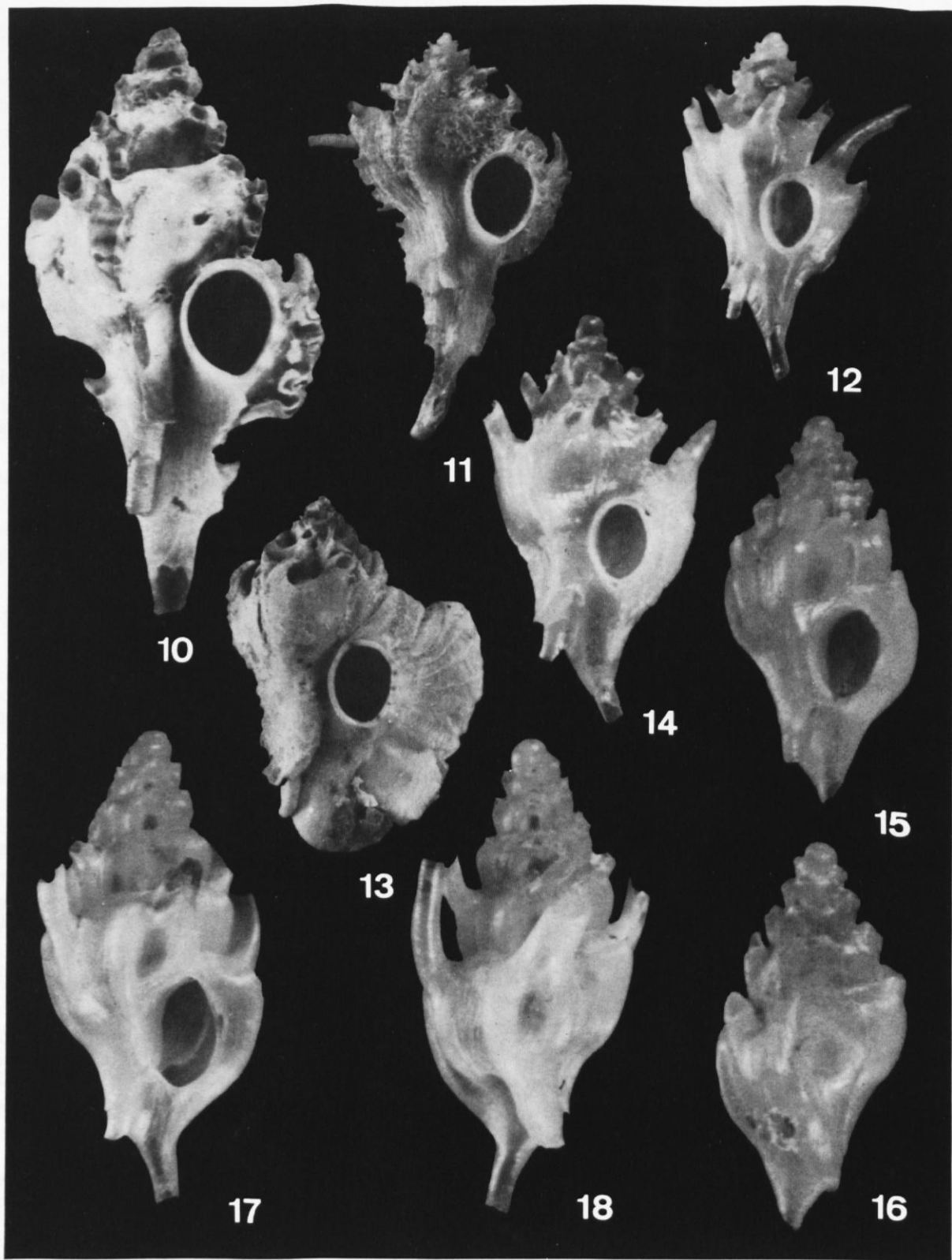
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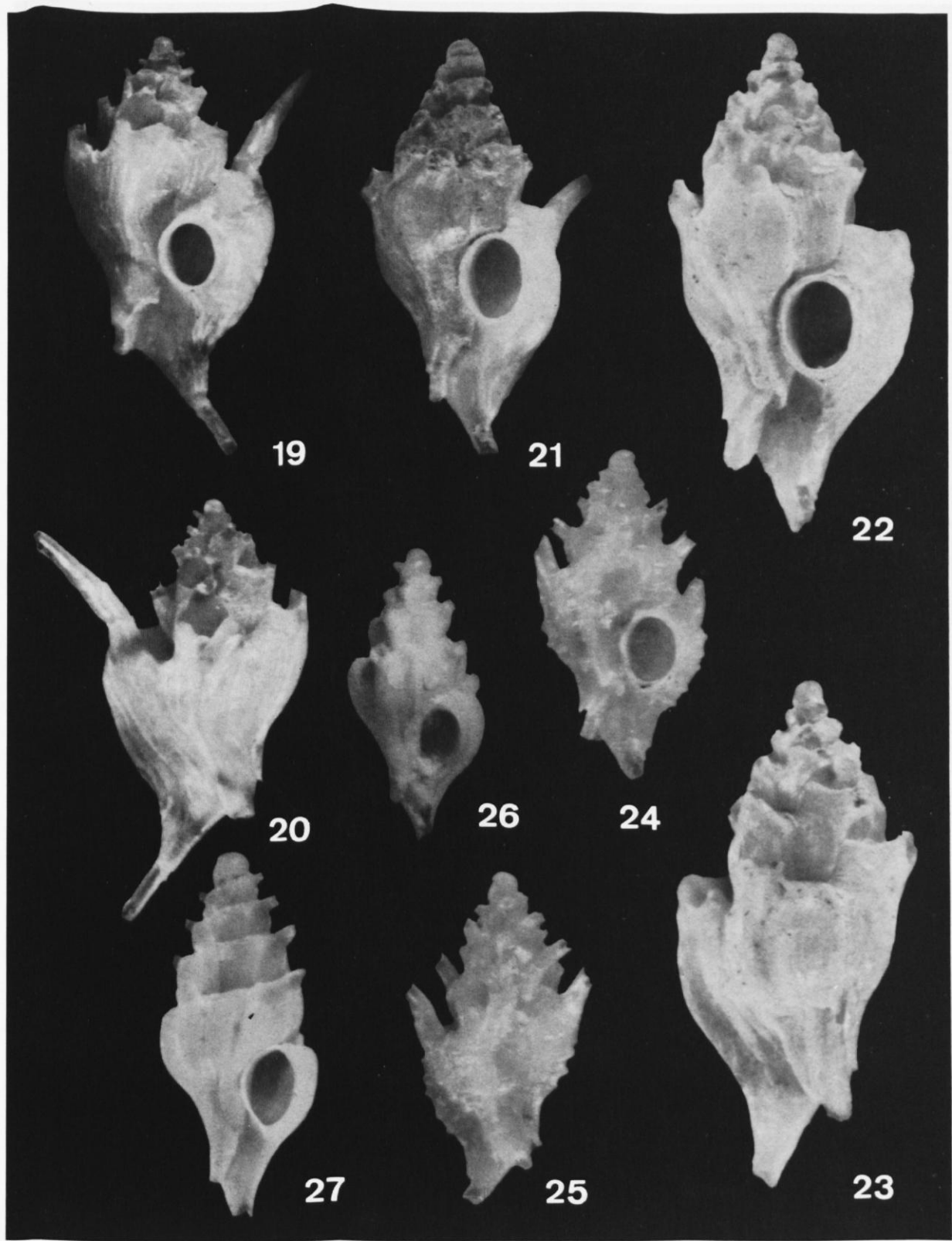
Australian Museum); Mr B. MARSHALL (Natl Mus. New Zealand) and Dr A. MATSUKUMA (National Science Mus., Tokyo). I am also most indebted to Dr P. BOUCHET and Prof. E. H. VOKES (Tulane University) for reading the manuscript and for their remarks and suggestions.

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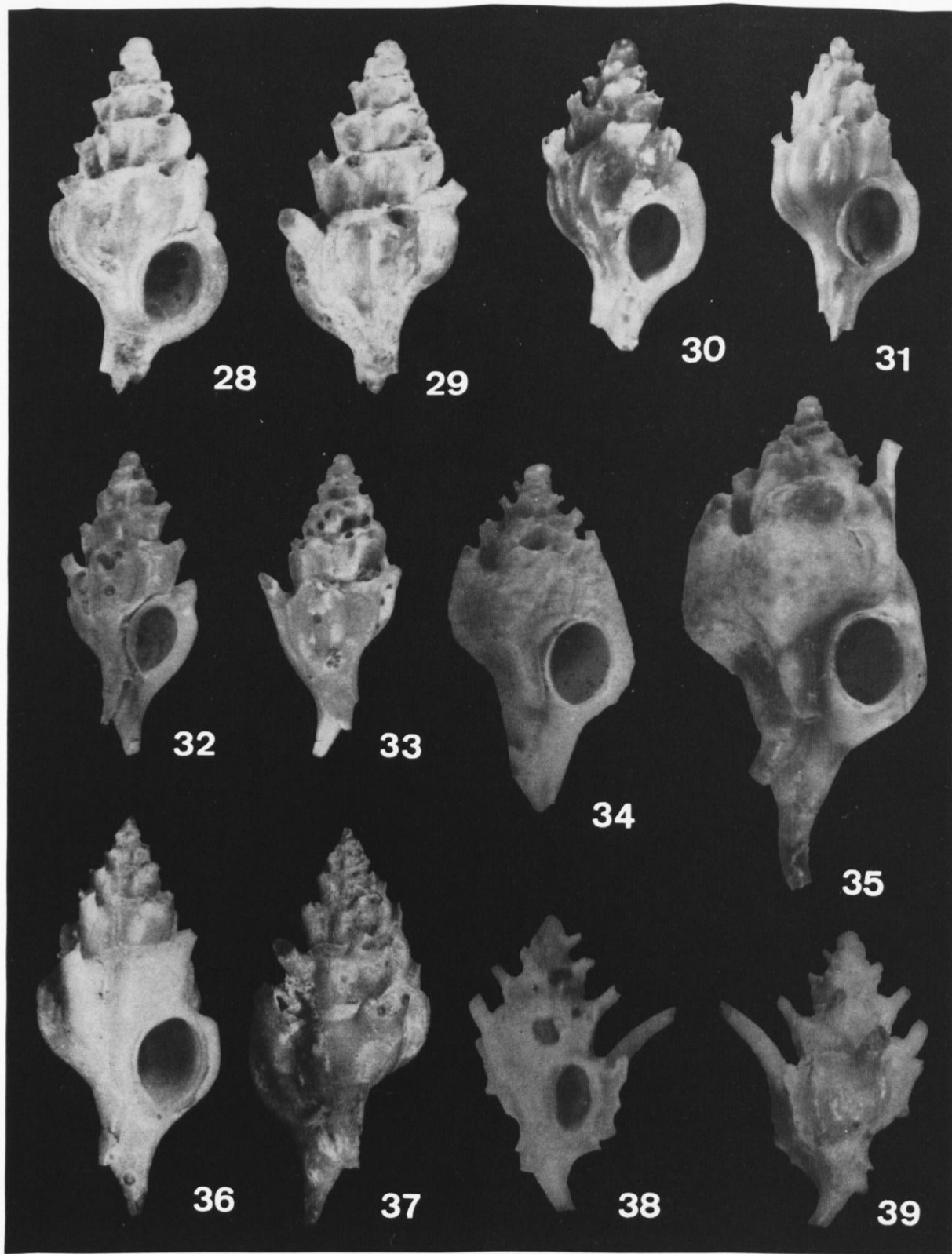
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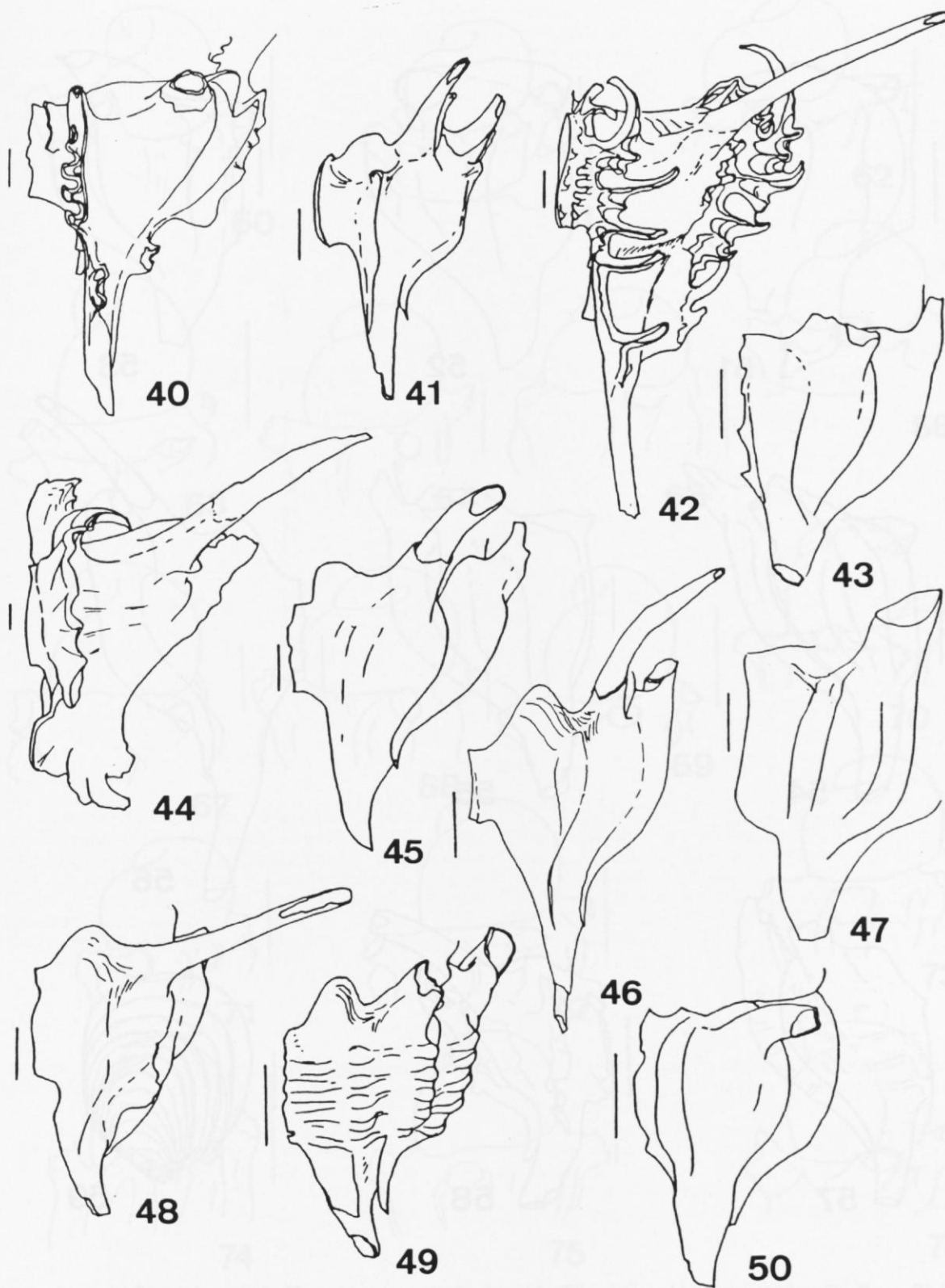
FIGS 10-18. — **10.** *Typhis (Typhina) imperialis* Keen & Campbell, 1964, New Caledonia, MUSORSTOM 4 : stn DW 222, MNHN, 13.5 mm. — **11.** *Typhis (Typhina) carolinae* Houart, 1987, New Caledonia, holotype MNHN, 20.5 mm. — **12.** *Typhis (Typhina) virginiae* Houart, 1986, New Caledonia, holotype MNHN, 7.8 mm. — **13.** *Typhis (Talityphis) neocaledonicus* Houart, 1987, New Caledonia, holotype MNHN, 18 mm. — **14.** *Siphonochelus (S.) pavlova* (Iredale, 1936), New Caledonia, MUSORSTOM 4 : stn CC 247, MNHN, 10 mm. — **15-16.** *Siphonochelus (S.) angustus* sp. nov., holotype MNHN, 6.7 mm. — **17-18.** *Siphonochelus (S.) boucheti* sp. nov., holotype MNHN, 10.1 mm.



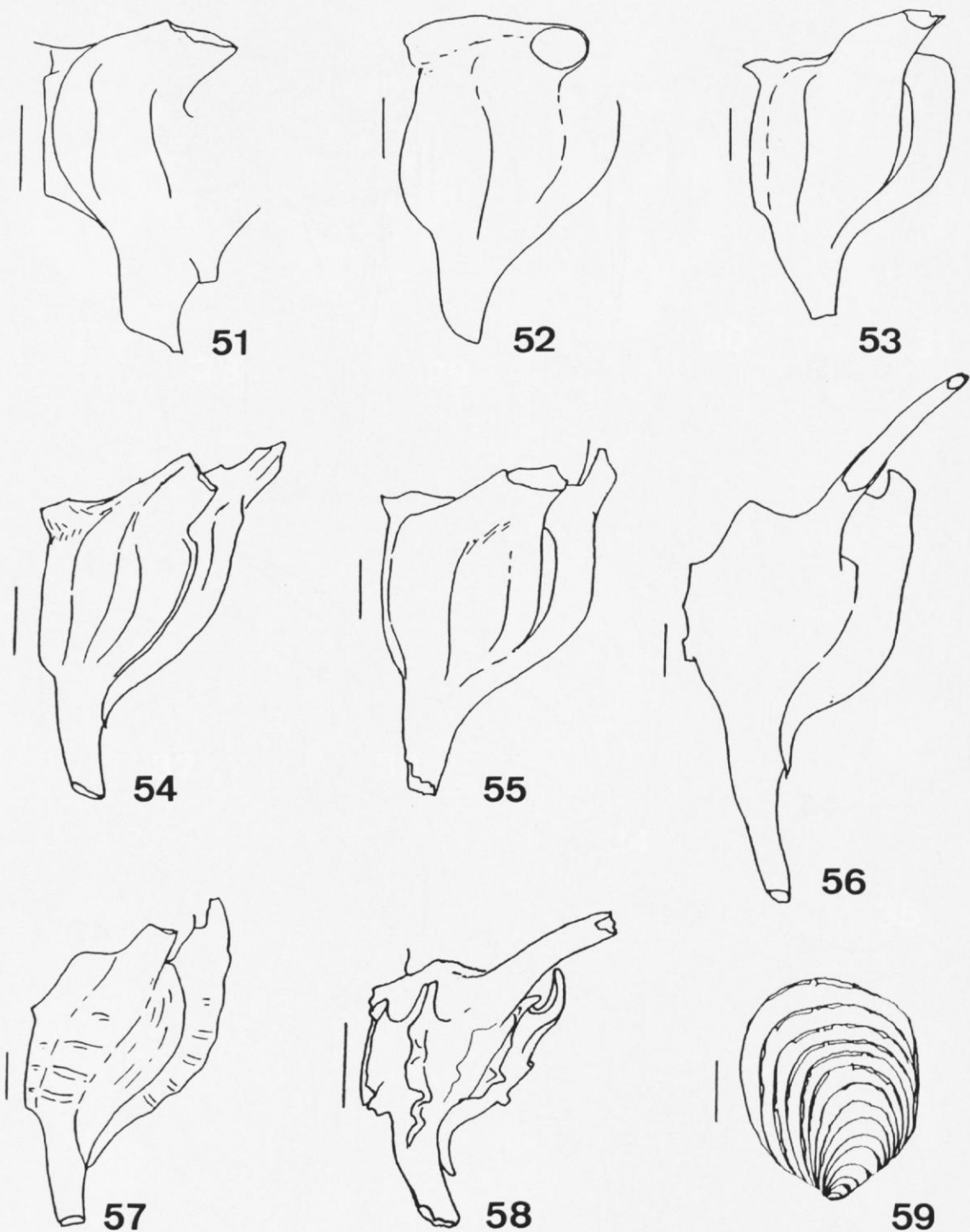
FIGS 19-27. — 19-20. *Siphonochelus (S.) saltantis* sp. nov., holotype MNHN, 9.2 mm. — 21-23. *Siphonochelus (S.) unicornis* sp. nov. : 21. New Caledonia, BIOCAL : stn DW 46, paratype MNHN, 9.1 mm. ; 22-23. Holotype MNHN, 12 mm. — 24-25. *Siphonochelus* (? *Siphonochelus*) *undulatus* sp. nov., holotype MNHN, 5.9 mm. — 26-27. *Siphonochelus (Laevityphis) tillierae* Houart, 1986. : 26. Holotype MNHN, 5.9 mm. ; 27. New Caledonia, BIOCAL : stn DW 80, MNHN, 8 mm.



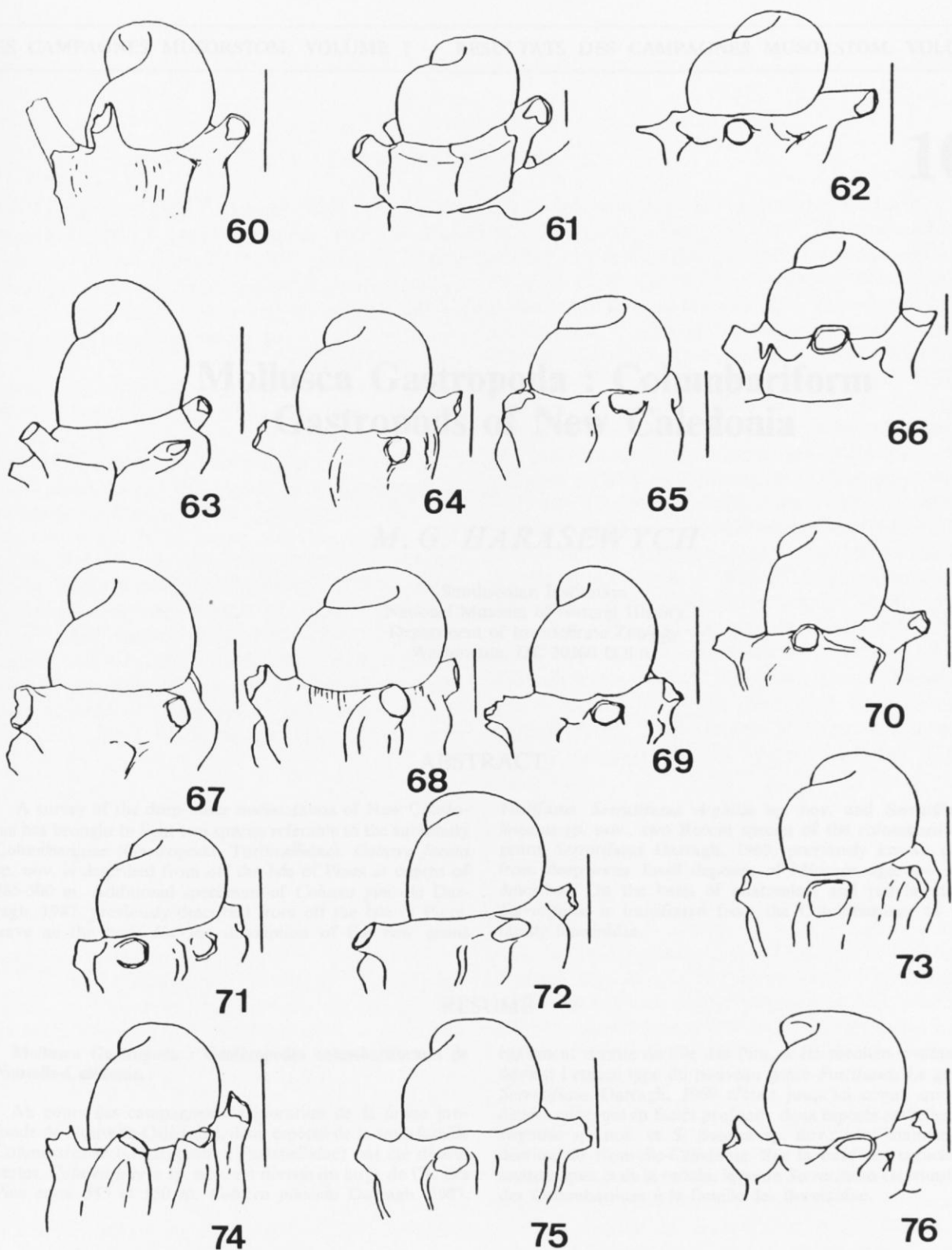
FIGS 28-39. — 28-29. *Siphonochelus* (*S.*) *nipponensis* Keen & Campbell, 1964, Japan, NSMT 44065, 7.5 mm. — 30. *Siphonochelus* (*S.*) *japonicus* (A. Adams, 1863), Japan, NSMT 44066, 6.6 mm. — 31. *Siphonochelus* (? *Siphonochelus*) *syringianus* (Hedley, 1903), South Queensland, Australia, R. HOUART coll., 8.8 mm. — 32-33. *Siphonochelus* (*S.*) *solus* Vella, 1961, New Zealand, NMNZ 66725, 9 mm. — 34. *Siphonochelus* (*S.*) *erythrostigma* Keen & Campbell, 1964, South Queensland, Australia, R. HOUART coll., 10 mm. — 35. *Siphonochelus* (*S.*) *pavlova* (Iredale, 1936), South Queensland, Australia, R. HOUART coll., 15.2 mm. — 36-37. *Siphonochelus* (*S.*) *generosus* Iredale, 1936, syntype AMS C60688, 11.8 mm. — 38-39. *Typhis* (*Typhina*) *bivaricata* Verco, 1909, holotype SAM D13481, 6 mm.



FIGS 40-50. — Profiles of aperture and last varix of Typhinae (scale lines : 1 mm). — 40. *Typhis (Typhina) imperialis*, MUSORSTOM 4 : stn DW 222, MNHN. — 41. *Typhis (Typhina) virginiae*, holotype MNHN. — 42. *Typhis (Typhina) carolinae*, LAGON : stn 603, MNHN. — 43. *Siphonochelus (S.) angustus*, holotype MNHN. — 44. *Typhis (Talityphis) neocaledonicus*, holotype MNHN. — 45. *Siphonochelus (S.) pavlova*, MUSORSTOM 4 : stn CC 247, MNHN. — 46. *Siphonochelus (S.) saltantis*, holotype MNHN. — 47. *Siphonochelus (S.) bouchetti*, paratype MNHN. — 48. *Siphonochelus (S.) unicornis*, BIOCAL : stn DW 46, paratype MNHN. — 49. *Siphonochelus* (? *Siphonochelus*) *undulatus*, holotype MNHN. — 50. *Siphonochelus (Laevityphis) tillierae*, holotype MNHN.



FIGS 51-59. — Profiles of aperture and last varix of Typhinae (scale lines : 1 mm). — 51. *Siphonochelus* (*S.*) *japonicus*, NSMT 44066. — 52. *Siphonochelus* (*S.*) *nipponensis*, NSMT 44067. — 53. *Siphonochelus* (*S.*) *generosus*, syntype AMS C 60688. — 54. *Siphonochelus* (*S.*) *solus*, NMNZ M 66725. — 55. *Siphonochelus* (? *Siphonochelus*) *syringianus*, R. HOUART coll. — 56. *Siphonochelus* (*S.*) *pavlova*, R. HOUART coll. — 57. *Siphonochelus* (*S.*) *erythro stigma*, R. HOUART coll. — 58. *Typhis* (*Typhina*) *bivariata*, holotype SAM D 13481. — 59. Operculum of *Typhis* (*Typhina*) *carolinae*, paratype MNHN.



FIGS 60-76. — Protoconchs (scale lines : 0.5 mm). — 60. *Typhis (Typhina) imperialis*, BIOCAL : stn DW 64, MNHN. — 61. *Typhis (Typhina) carolinae*, paratype MNHN. — 62. *Typhis (Typhina) virginiae*, holotype MNHN. — 63. *Siphonochelus (S.) pavlova*, "Vauban" : stn 40, MNHN. — 64. *Siphonochelus (Laevityphis) tillierae*, holotype MNHN. — 65. *Siphonochelus (S.) angustus*, holotype MNHN. — 66. *Typhis (Talityphis) neocaledonicus*, holotype MNHN. — 67. *Siphonochelus (Siphonochelus) unicornis*, MUSORSTOM 4 : stn CC 246, MNHN. — 68. *Siphonochelus (S.) boucheti*, paratype MNHN. — 69. *Siphonochelus (? Siphonochelus) undulatus*, holotype MNHN. — 70. *Siphonochelus (S.) saltantis*, holotype MNHN. — 71. *Siphonochelus (S.) nipponensis*, NSMT 44065. — 72. *Siphonochelus (S.) generosus*, syntype AMS C 60688. — 73. *Siphonochelus (S.) japonicus*, NSMT 44066. — 74. *Siphonochelus (? Siphonochelus) syringianus*, R. HOUART coll. — 75. *Siphonochelus (S.) solus*, NMNZ M 66725. — 76. *Siphonochelus (S.) erythro stigma*, R. HOUART coll.

