The Endodontid Land Snail Genera *Pilsbrycharopa* and *Paryphantopsis*

(Mollusca : Pulmonata)

BY

ALAN SOLEM

Field Museum of Natural History, Chicago, Illinois 60605

(3 Text figures; 6 Tables)

Publication of a synoptic review of New Guinea and Indonesian endodontid land snails (Solem, 1958) was based upon limited material and use of only conchological characters. Several species names were left as "Problematica." Subsequently I have been able to study nearly all type specimens, located some previously unstudied conchological material, and obtained preserved material of two undescribed species, one belonging to *Pilsbrycharopa* and the other to *Paryphantopsis*. A review of these two genera is presented below in order to correct previous errors, distinguish these genera from the endodontid land snails of Micronesia and Polynesia, and to record anatomical data having critical importance in interpreting pulmonate phylogeny.

This study is a side project to monographic reviews of the Pacific Island endodontid land snails that are completed, but whose publication will be delayed. Establishment of which are systematically significant and which are trivial characters, definition of measurements, patterns of formal description, determination of normal variation, plus criteria for supraspecific classification are developed in the longer papers.

MATERIAL STUDIED

With two exceptions, specimens examined consist of type material or specimens previously recorded in the literature. Several extremely interesting unstudied sets collected by Lamberto Loria in Eastern Papua between 1890 and 1893 were located in the Museo Civico di Storia Naturale, "Giacomo Doria," Genova. Preserved specimens of two undescribed species collected in the Eastern Highlands of New Guinea by J. Linsley Gressitt in 1955 were found in the Bernice P. Bishop Museum. These sets have turned a routine conchological review of types into a study contributing data towards the problem of relating slugs to shelled snails.

For convenience, the following set of abbreviations is utilized throughout the text to indicate the source of specimens examined.

ANSP	Academy of Natural Sciences, Philadelphia
BMNH	British Museum (Natural History), London
BPBM	Bernice P. Bishop Museum, Honolulu
FMNH	Field Museum of Natural History, Chicago
MHNG	Museo Civico di Storia Naturale "Giacomo Doria," Genova
RNHL	Rijksmuseum van Natuurlijke Historie, Leiden
SMF	Natur-Museum Senckenberg, Frankfurt
UMMZ	University of Michigan Museum of Zoology, Ann Arbor
ZMA	Zoologisch Museum, Amsterdam
ZMB	Zoologisches Museum der Humboldt Universität, Berlin

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All measurements were taken by the author. Species less than 5 mm in diameter were measured with an ocular micrometer under 16× - 32× magnification. Larger species were measured to the nearest 0.1 mm with a dial vernier caliper. In Tables 2, 3, and 4, where more than single specimens were available, measurements are recorded as mean, standard error of the mean, and range of variation, for example, "6.76±0.145 (6.27-7.32)". Height, diameter, and umbilical width measurements are given in millimeters. Ribs are counted on the body whorl and ribs/mm is an index of rib spacing on the body whorl. Whorls are counted to the nearest eighth, "+" or "—" indicating slight differences. Unless specified, all measurements were made only on adult shells. Despite having nondeterminate growth, adult and gerontic specimens of endodontids can be recognized from the shell. Measurements of large samples collected on Pacific Islands have shown that adult size variation shows a normal distribution (unpublished data). Thus statistical comparisons of samples are meaningful and useful.

DISTRIBUTIONS AND LOCALITIES

Pilsbrycharopa, as here delimited, ranges from northern Borneo and Bali to New Britain in the Bismarck Archipelago. The few and scattered locality records probably indicate lack of collecting. Undoubtedly additional species will be discovered. *Paryphantopsis* is known from the eastern two-thirds of New Guinea and the Louisiade Archipelago. Data concerning the geographic position of type localities for the Indonesian and Bismarck Archipelago species are provided in the original descriptions or citations, but the New Guinea localities are extremely difficult to find on maps. Many species came from classic ornithological collecting camps, whose names are meaningless to malacologists or cartographers. Other shells were taken on expeditions whose itineraries would be familiar to botanists or entomologists, but are unknown to scientists in other disciplines. With the help of Dr. Austin L. Rand, Chief Curator of Zoology at Field Museum of Natural History and Mrs. van der Feen, I am able to provide at least approximate coordinates for the New Guinea localities. Accuracy of citations varies widely. Data on the Archbold localities (see ARCHBOLD, RAND & BRASS, 1942) and other West Irian localities are relatively precise. Data on the New Guinea and Papua stations sometimes are only area designations, since the original localities were not precisely defined or the collections were made long before accurate maps were available or in uncharted areas lacking convenient reference points.

Although coordinates are cited in the text, a brief indication of the more difficult and generalized localities seems desirable. They are presented in rough geographic order from west to east:

Cyclops Mountains, near the former Hollandia (= Kotabaru, Sukarnapura), West Irian at about 140°35′ E, 2°30′ S;

Maeanderberg, area past great bend of Upper Sepik River, Sepik District, New Guinea at about 141°25′ E, 4°10′ S, probably accurate to 40′;

Daulo Pass, near Chuave, Eastern Highlands, New Guinea at about 145°10′ E, 6°03′ S, accurate for general area only;

Constantinhafen, Astrolabe Bay, Madang District, New Guinea at about 145°45′ E, 5°20′ S, accurate to about 10′;

Vikaiku, village on Angabunga or St. Joseph River, inland from Hall Sound, Central District, Papua at about 146°55′ E, 8°45′ S, visited by Lamberto Loria in the 1890's, almost certainly no longer in use as a village name and thus unidentifiable;

Arva (= Aroa) River, northwest of Port Moresby, Central District, Papua at about 146°55′ E, 9°00′ S, exact locality along river unknown;

Moroka, near headwaters of Laloki River, east of Port Moresby, Central District, Papua at about 147°25′ E, 9°30′ S, also a probably vanished Loria station;

Bujakori, village along Kemp Welch River, northeast of Rigo, Central District, Papua at about 147°40′ E, 9°35′ S, another Loria station whose name may no longer be used;

Sattelberg, Huon Peninsula, near Finschhafen, Morobe District, New Guinea at about 147°40′ E, 6°30′ S.

Pilsbrycharopa SOLEM, 1958

Archiv für Molluskenkunde, **87** (1-2): 24

Very small to quite large Charopinae in which the apical sculpture consists of radial and spiral elements with varying dominance. Whorls loosely to very tightly coiled, generally about $3\frac{3}{4}$ to $4\frac{1}{2}$, more in tightly coiled species (*P. baliana, P. renschi*). Spire flat to strongly elevated, umbilicus widely open to closed. Radial sculpture normal in most, reduced in *P. gressitti* and *P. schneideri*. Secondary spiral cording present or absent. Whorl contour and shape

variable. Anatomy known only for one species. Pallial cavity typically charopinine except for partial downward rotation. Terminal genitalia distinguished by long penial retractor muscle, elongated penis with large stimulator but no vergic papilla, smooth and irregular pilasters, and short epiphallus with small diverticulum.

Type species: – *Pilsbrycharopa papuana* SOLEM, 1958 by OD.

Pilsbrycharopa is used in a greatly expanded sense as an "umbrella" for several species from Indonesia, New Guinea, and New Britain. Only one of the 9 species has been dissected. Most taxa are known only from single collections of a few empty shells. Possibly 5 groups of species should be recognized:

a) typically sculptured, flat spired or slightly elevated, reddish brown shells with moderately to widely open umbilici, variable in size, apical sculpture variable.

Pilsbrycharopa kobelti (BÖTTGER, 1908) from Indonesia and New Guinea

Pilsbrycharopa timorensis (B. RENSCH, 1935) from Timor

Pilsbrycharopa brunnescens (MÖLLENDORFF, 1892) from Timor Laut and Papua

Pilsbrycharopa nigrofusca (SMITH, 1896) from New Guinea (+*P. papuana* SOLEM, 1958)

b) typically sculptured, slightly elevated spire, thick body whorl with strong lateral flattening above periphery, reddish brown shell with narrow umbilicus, medium size, apical sculpture of fine radials and spirals.

Pilsbrycharopa densecostulata (THIELE, 1928) from New Guinea

c) reduced radial sculpture near aperture, very slightly elevated spire, rounded body whorl, large flammulated shell, umbilicus quite narrow, apical sculpture with narrow radials more prominent than spirals.

Pilsbrycharopa gressitti, new species from New Guinea

d) very fine radial sculpture, elevated spire of many whorls, tight coiling pattern, laterally compressed body whorl, reddish-yellow horn, closed umbilicus, apical sculpture of radials that are lower than the spirals.

Pilsbrycharopa baliana (B. RENSCH, 1930) from Bali

Pilsbrycharopa renschi (FRANC, 1952) from Flores and Sumbawa (= *Charopa vicina* B. RENSCH, 1930 not PRESTON, 1907)

e) low and broad radial sculpture with finer spirals, strongly elevated spire, rounded body whorl, flammulated, large shell, with umbilicus nearly closed by reflection and angulation of baso-columellar margin.

Pilsbrycharopa schneideri (I. RENSCH, 1937) from Papua and New Britain

The Charopinae are widely distributed in Melanesia, Micronesia and Polynesia as far east as the Society Islands. Some 86 species have been reviewed in a just completed monograph. They are highly conservative in shell form, basic sculptural pattern, umbilical size, whorl count and apical sculpture. What would seem to be relatively minor changes in the above shell features were found to be correlated with anatomical divergences and indicated generic separation. Besides the Pacific Islands, Charopinae or their derivatives are major constituents of the New Caledonian, Tasmanian and New Zealand endodontid faunas. In Indonesia and New Guinea this group seems to have been replaced by the various helicarionid taxa. I have no doubt that the species in *Pilsbrycharopa* are relicts. Quite possibly anatomical studies may demonstrate that the above species belong to 4 or 5 genera. Certainly the varying shell features listed above for groups **c**, **d** and **e** were found to indicate generic differences in the Pacific Island taxa. Since only one species could be dissected and only the most fragmentary material is known for almost all species, I prefer to define *Pilsbrycharopa* in a much broader sense than genera used in the Pacific Island monograph. The probabilities of obtaining preserved soft parts are remote. Division into several genera based upon analogous variation would not provide any phyletic insights.

Retention of a single generic name serves two practical purposes. The species, despite their variability, do have a basic similarity in form and sculpture that contrasts with the form and sculpture of the New Guinea endemic genus *Paryphantopsis*. The variation in apical sculpture seen in the species lumped as *Pilsbrycharopa* shows how the pitted apical sculpture of *Paryphantopsis* could evolve by a series of gradual changes from the primitive charopinine pattern of prominent spiral cords. This is discussed more fully later. Classification into the two genera is practical both from the standpoint of facilitating identification of the two general phenotypes and in leaving open the currently unanswerable question of which stock was the most probable ancestor of *Paryphantopsis*. While origin of the latter from some group of *Pilsbrycharopa* is reasonably certain, without anatomical data on more species in both genera, phyletic speculation would be of little value.

Determination of the relationships between the species groups outlined above must await dissection of the soft parts, but some statements can be made concerning their relative degree of specialization. Detailed study of the

many Polynesian-Melanesian Charopinae has included establishing the median condition for various characters whose states can be coded or measured. By comparing the character states in the species groups of *Pilsbrycharopa* with the median character states for the Polynesian-Melanesian taxa, degrees of departure from the typical condition become obvious. Those species showing more and greater departures from the norm are considered more specialized than those showing greater similarity to the median states. Such a crude comparison does not permit relating species groups to each other, but does permit ranking in terms of specialization.

Data on median states and quartile ranges for the toothless Charopinae of Polynesia and part of Melanesia are given in Table 1. This involves 50 species level taxa.

widely umbilicated, while *P. timorensis* differs mainly by its very wide umbilical opening. The above 3 species have typical apical sculpture with only slight radial elements. *Pilsbrycharopa nigrofusca* is greatly enlarged, slightly altered in proportions, and has stronger radial elements in the apical sculpture. Except for size alterations, the above species show few departures from the typical pattern. Group "a" is thus very generalized.

Pilsbrycharopa densecostulata shows several significant changes. The apical sculpture has narrow radial and spiral elements, the umbilicus is much narrower, the whorl count reduced, the H/D ratio and body whorl width noticeably increased without prominent spire elevation, there is strong lateral flattening of the body whorl and apparently the ribbing is very crowded. These specializations are not necessarily correlated with each other, although the whorl thickening and compression may be responsible for the umbilical narrowing. Hence the separation of *P. densecostulata* as a group "b." Its characters can be derived from those shown in group "a," but I am not claiming linear descent on the present limited evidence.

Pilsbrycharopa gressitti has a flat spire, radial apical sculpture much more prominent than the spiral, a quite narrow umbilicus, major radial sculpture becoming very crowded on the body whorl, retains a flammulated color pattern, is extremely large and has a very loose coiling pattern. Many of the same features are mentioned for *P. densecostulata,* but the degree of specialization is greater in *P. gressitti*, and the basic shape changes are quite dif-

Table 1

Mean Species Measurements
in Pacific Island Toothless Charopinae

	Minimum	First Quartile	Median	Third Quartile	Maximum
Shell height in mm	1.00	1.38	1.55	1.77	2.55
Shell diameter in mm	2.08	2.50	2.84	3.35	4.92
H/D ratio	0.463	0.505	0.538	0.573	0.625
Whorl count	$3\frac{1}{2}$	$3\frac{7}{8}+$	$4\frac{1}{8}-$	$4\frac{3}{8}-$	$6\frac{5}{8}$
Diameter/umbilical width ratio	2.73	3.69	4.29	4.99	closed
Ribs on body whorl[1]	38.0	77.1	92.5	112.2	225.8
Ribs/mm on body whorl[1]	3.35	8.04	10.8	12.2	21.0
Apical cords	8.60	9.40	10.2	11.8	18.5

[1] Four species have reduced ribbing and were omitted from this table

The entire 2nd and 3rd quartile ranges for characters are not very large, emphasizing the relatively conservative nature of this group. Apical sculpture in these species consists of prominent spiral cords, sometimes reduced, rarely with addition of secondary radial elements. Either closure or great widening of the umbilicus is rare. Reduction of the radial ribbing has occurred a few times and a change to widely spaced ribbing is more common. Comparative data on *Pilsbrycharopa* species are given in Tables 2 and 3.

Despite having a relatively large size, mean diameter of the types is 3.96 mm, *Pilsbrycharopa brunnescens* conforms most closely to the median image, agreeing in H/D ratio, whorls, D/U ratio, apertural inclination, and rib count. The lower Ribs/mm is probably a simple correlative of greater size. *Pilsbrycharopa kobelti* is small and rather

ferent in the two species. *Pilsbrycharopa gressitti,* the only member of group "c," shows more and stronger specializations than does either group "a" or "b."

Pilsbrycharopa renschi and *P. baliana* have great spire protrusion (about 0.40 body whorl width), very thick and laterally flattened body whorls, markedly increased whorl count, high H/D ratio, closed or nearly closed umbilicus, low apical radial ribs and more prominent spirals, and very crowded radial ribbing. The specializations are extreme in nature and group "d" is quite different from the preceding groups.

Pilsbrycharopa schneideri has achieved many of the group "d" changes, but in a different way. Its body whorl is rounded and the spire very strongly protruded, its radial apical sculpture is broadly rounded and much more prominent than the spiral, the broad major radial ribs are crowded and irregular on the body whorl, the umbilicus is closed by contraction and has a peculiar reflection and angling of the baso-columellar lip that is very different from the pattern seen in other *Pilsbrycharopa.* The shell is very thick. Although the effect of the changes plus the raw measurements and proportions suggest that groups "d" and "e" are quite similar, detailed comparison of the features shows that the same results have been arrived at by different methods. *Pilsbrycharopa renschi* and *P. schneideri* are specialized to a greater degree than other species, but their similarities seem to be convergent and there are major differences in whorl contour, sculpture and form.

The five groups of *Pilsbrycharopa* show successively greater departures from the median pattern seen in a related and generalized genus of wide distribution with 50 known species level taxa. Group "a" is still generalized and group "b" only moderately changed. Groups "c," "d," and "e" are much more specialized, but each in a different way or have achieved the same result by different means. I reject any implication of a linear phyletic relationship between groups "b - e." Probably each group was independently derived from ancestors sharing the characteristics of group "a."

In distribution, species are found as far west as Borneo (*Pilsbrycharopa kobelti*) and as far east as New Britain (*P. schneideri*), but most are from the Wallacea transition zone between the dominance of Oriental and Australian faunas (*P. kobelti, P. timorensis, P. brunnescens, P. baliana, P. renschi*) and New Guinea (*P. kobelti, P. brunnescens, P. nigrofusca, P. densecostulata, P. gressitti* and *P. schneideri*). It should be noted that even with very limited material, several species, *P. kobelti, P. brunnescens,* and *P. schneideri,* have wide distributions. Since land mollusks do not show an Oriental-Australian faunal division from Indonesia to New Guinea, this is not an important feature.

An artificial key to the species follows.

KEY TO THE SPECIES OF *Pilsbrycharopa*

1. Umbilicus contained more than 15 times in the diameter or closed 2
   Umbilicus widely open or contained less than 15 times in the diameter 4
2. Diameter less than 4.5 mm; apical sculpture fine; crowded, narrow radial ribs 3
   Diameter more than 5.0 mm; apical sculpture of wide radials; radial ribs irregular on the body whorl . . . *Pilsbrycharopa schneideri* (I. RENSCH, 1937)
3. Umbilicus closed; over 200 ribs on body whorl . . . . . *Pilsbrycharopa renschi* (FRANC, 1952)
   Umbilicus a narrow crack; about 150 ribs on the body whorl *Pilsbrycharopa baliana* (B. RENSCH, 1930)
4. Adult diameter over 6.0 mm 5
   Adult diameter less than 4.5 mm 6
5. Umbilicus very narrow, D/U ratio more than 8; radial ribbing crowded near aperture . . . . . *Pilsbrycharopa gressitti,* spec. nov.
   Umbilicus widely open, D/U ratio less than 4.50; radial ribs not crowded near aperture . . . . . *Pilsbrycharopa nigrofusca* (SMITH, 1896)
6. Whorls strongly flattened laterally; body whorl thick; umbilicus relatively narrow . . . . . *Pilsbrycharopa densecostulata* (THIELE, 1928)
   Whorls not strongly flattened laterally; body whorl narrower; umbilicus widely open 7
7. Diameter more than 3.0 mm 8
   Diameter less than 2.7 mm . . . . . *Pilsbrycharopa kobelti* (BÖTTGER, 1908)
8. Umbilicus very widely open, D/U ratio about 2.20 . . *Pilsbrycharopa timorensis* (B. RENSCH, 1935)
   Umbilicus narrower, D/U ratio about 4.00 . . . *Pilsbrycharopa brunnescens* (MÖLLENDORFF, 1892)

Pilsbrycharopa kobelti (BÖTTGER, 1908)

Charopa kobelti BÖTTGER, 1908, Nachr. Bl. dtsch. Malak. Gesell., 40 (4): 181-182; figs. 1-3 – Kap Tial, Hitu, North Ambon, Indonesia.

? *Charopa novoguineensis* SOÓS, 1911, Annales Musei Nat. Hungarici, 9: 352; fig. 7 – on trees under

moss, Sattelberg, German New Guinea at 800 m elevation.

Pilsbrycharopa kobelti (Böttger), Solem, 1964, Sabah Soc. Journ. 2 (1 - 2): 23; fig. III, 23 – Gomantong Hill, Sabah (= North Borneo).

Beilania kobelti (Böttger), van Benthem Jutting, 1964, Nova Guinea, Zool., 26: 13 – Waima, Misool.

Diagnosis: Shell very small, diameter 1.69 - 2.45 mm (mean 2.06 mm), with 3¼ to 4¼ normally coiled whorls. Apex and spire slightly to moderately and evenly elevated, body whorl descending at most slightly more rapidly, H/D ratio 0.442 - 0.549 (mean 0.490). Apical whorls 1¼, sculpture of 9 - 12 (mean 10.8) narrow spiral cords with an intrusion of radial swellings on last quarter to third. Postnuclear whorls with high, prominent, narrow, lamellar, protractively sinuated radial ribs, 57 - 94 (mean 74.0) on the body whorl, whose interstices are 2 to 5 times their width. Ribs/mm 9.60 - 14.53 (mean 11.71). Microsculpture of fine radial riblets, 5 to 9 between each pair of major ribs, crossed by much finer and more crowded spiral riblets, with relatively prominent, widely spaced secondary spiral cording. Sutures deep, whorls strongly rounded above, only slightly compressed laterally above periphery and on basal margin. Umbilicus open, "U"-shaped, slightly and regularly decoiling, contained 2.90 - 3.59 times (mean 3.17) in the diameter, margins rounded. Aperture subcircular, very slightly compressed laterally above periphery, inclined about 15° from shell axis.

Pilsbrycharopa kobelti is characterized by its very small size, nearly circular whorl contour, widely open umbilicus and dominant apical sculpture of spiral cords with secondary radial elements at anterior end. Other *Pilsbrycharopa* are much, much larger and have the apical sculpture composed of more nearly equal radial and spiral elements.

Description: Shell very small, with a little less than 4 normally coiled whorls. Apex and spire slightly and evenly elevated, body whorl not descending more rapidly, H/D ratio 0.500. Apical whorls 1¼, sculpture of 9 narrow, inconspicuous spiral ribs with a slight intrusion of broad radial swellings on last quarter whorl. Postnuclear whorls with narrow, lamellar, protractively sinuated radial ribs whose interstices are 3 to 4 times their width. Microsculpture of fine radial riblets crossed by much finer and more crowded spiral riblets with a secondary sculpture of moderately prominent spiral cords. Sutures deep, whorls strongly rounded above, not conspicuously flattened on the outer margins. Umbilicus moderately open, "U"-shaped, slightly and regularly decoiling, contained 3.05 times in the diameter. Color mainly leached from the shell. Lip and portions of body whorl badly broken. Height of holotype 0.95 mm, diameter 1.94 mm.

Holotype: Moluccas: Ambon, Kap Tial, Hitu. Natur-Museum Senckenberg, Frankfurt number 75499.

Range: Sabah (= North Borneo), Ambon, Misool and New Guinea.

Table 2

Variation in Group "A" Species of *Pilsbrycharopa*

	Number of Specimens Examined	Ribs	Ribs/mm	Height
P. kobelti (Böttger) Gomantong, Sabah (juvenile shell)	1	62.0	13.63	0.77
Ambon (holotype)	1	–	–	0.95
Ambon (ZMA)	8	80.8±2.65 (68-94)	12.10±0.472 (10.46-14.53)	1.02±0.047 (0.77-1.18)
Waima, Misool (ZMA)	4	63.3±5.01 (57-78)	10.46±0.390 (9.60-11.35)	1.00±0.048 (0.92-1.13)
P. timorensis (B. Rensch) holotype	1	not available	not available	2.01
P. brunnescens (Möllendorff) Tenimber, SMF 165692-4	4	89.3±3.45 (82-98)	7.19±0.577 (6.67-7.77)	2.21±0.034 (2.14-2.27)
Vikaiku, Papua	8	88.1±1.48 (82-94)	7.74±0.196 (6.90-8.42)	1.94±0.050 (1.74-2.17)
P. nigrofusca (Smith) Constantinhafen	7	124.3±2.81 (114-132)	6.16±0.168 (5.34-6.69)	2.97±0.045 (2.81-3.07)

Material: Sabah: Gomantong Hill (2 specimens, FMNH 118926). Ambon (8 specimens, ZMA collected October 11-13, 1949 by M. A. Lieftinck): Kap Tial, Hitu (1 specimen, SMF 75499). Misool: Waima (6 specimens, ZMA collected September 13-14, 1948 by M. A. Lieftinck).

Remarks: A complex of species may be lumped under this specific name, but available data are insufficient to justify any separation. The types and only known specimens of *Charopa novoguineensis* were destroyed in 1956. In size and general appearance this shell seems to fall within the range of variation cited above, although the brief description does not give sufficient details to enable placement. There are discrepancies between the description and figures, since the description cited 4½ whorls, but the figure shows 3¼ whorls. I prefer to consider this a probable synonym of *Pilsbrycharopa kobelti.*

Examples of *"Beilania" demani* (Tapparone-Canefri, 1883) have been collected on Ambon and Misool at the same localities, and the species have been confused in previous literature. These are easily separated by *B. demani* having 2 prominent parietal lamellae, stronger radial ribbing, a flat spire, usually wider umbilicus and the apical sculpture lacks the secondary radial elements.

Measurements of the several sets are given in Table 2. The Gomantong shell is juvenile and one subadult example is included in the measurements of the Ambon series. An accurate rib count on the holotype was not possible and this specimen was not directly compared with other specimens. Obviously it is within the range of variation shown by the other specimens in respect to measurable characters. The Misool shells are smaller, slightly higher, more narrowly umbilicated and with fewer, less crowded radial ribs than the Ambon population. Possibly the former are subadult, but characters indicating adulthood are poorly defined in this species. Their lower whorl count, mean 3½+ compared with 3⅞+, is suggestive of their not being adult. Without study of additional material and dissection of the soft anatomy, I prefer to leave these as a single rather broadly defined species.

Classification of *Charopa kobelti* in *Pilsbrycharopa* rather than one of the Melanesian-Polynesian genera is based upon the intrusion of radial elements into the apical sculpture, nearly circular aperture and lack of whorl flattening, low mean whorl count and coiling pattern. The primary alternative is an essentially Polynesian genus that extends westward into the New Hebrides, Bismarcks and Solomon Islands. Species of this as yet unpublished taxon from the Bismarcks and Solomon Islands have much tighter coiling patterns, marked lateral flattening of the body whorl above the periphery, and no trace of radial elements in the apical sculpture. Dissection of *P. kobelti* will be required in order to ascertain its generic position. *Pilsbrycharopa* and the other genus differ greatly in genitalia so that solution of the problem will be relatively simple. The conchological features listed above show greater similarity to *Pilsbrycharopa,* hence I have classi-

Table 2

Variation in Group "A" Species of *Pilsbrycharopa*

Diameter	H/D Ratio	Whorls	Umbilicus	D/U Ratio
1.45	0.534	3	0.43	3.38
1.91	0.500	4—	0.63	3.05
2.14±0.082 (1.71-2.43)	0.475±0.0071 (0.442-0.496)	3⅞+ (3½-4¼)	0.69±0.032 (0.51-0.79)	3.11±0.042 (2.95-3.35)
1.92±0.105 (1.68-2.19)	0.519±0.0110 (0.496-0.549)	3½+ (3¼-3¾)	0.58±0.058 (0.51-0.76)	3.33±0.160 (2.90-3.59)
3.7	0.541	4	1.71	2.16
3.96±0.058 (3.82-4.08)	0.559±0.0050 (0.546-0.568)	4¼ (4⅛-4¼)	0.92±0.040 (0.86-1.02)	4.31±0.130 (4.21-4.57)
3.63±0.056 (3.39-3.85)	0.534±0.0081 (0.500-0.578)	3¾ (3⅝-4)	0.89±0.021 (0.82-0.99)	4.08±0.096 (3.79-4.56)
6.43±0.112 (6.14-6.93)	0.462±0.0069 (0.439-0.489)	4⅜— (4⅛-4½)	1.87±0.051 (1.63-2.03)	3.45±0.059 (3.31-3.76)

fied it in that genus despite the very small size, which corresponds more with the Bismarck-Solomon species.

Pilsbrycharopa timorensis (B. Rensch, 1935)

Charopa brunnescens timorensis B. Rensch, 1935, Sitz.-Ber. Ges. naturf. Freunde, Berlin, **1934:** 323, fig. 7 – West Timor; Solem, 1958, Arch f. Mollusk. **87** (1-3): 25.

Description: Shell larger than average, with slightly less than 4 normally coiled whorls. Apex and spire slightly and evenly elevated, body whorl descending a little more rapidly, H/D ratio 0.541. Apical whorls 1½, early sculpture eroded, last one-third whorl with very low radial ribs. In umbilicus a faint trace of spiral cording visible on first nuclear whorl. Remaining whorls with irregular, low, protractive radial ribs whose interstices are less than twice their width. Microsculpture almost totally eroded, occasionally traces of fine microradials and even finer microspirals visible, 3 to 4 microradials between each pair of major ribs. No trace of secondary spiral cording. Sutures moderately impressed, whorls flattened laterally above evenly rounded periphery and on basal margin. Umbilicus widely open, cup-shaped, contained 2.16 times in the diameter, margins rounded. All color leached from shell. Aperture ovate, flattened basally and laterally above periphery, inclined about 30° from shell axis. Height of holotype 2.01 mm, diameter 3.7 mm.

Holotype: Timor: Nenas at 1000 m to 2000 m elevation. Zoologisches Museum der Humboldt Universität, Berlin.

Remarks: Unfortunately the holotype and only known specimen was damaged in an attempt at cleaning heavy incrustations. The shell is very worn and obviously collected dead. It differs from the type lot of *Pilsbrycharopa brunnescens* in having a much wider umbilicus and in lacking secondary spiral cording, although unquestionably it is closely related. The difference in umbilical size is large enough to warrant specific separation following the pattern in similar situations found among Pacific Island species.

Pilsbrycharopa brunnescens (Möllendorff, 1892)

Patula (Discus) brunnescens Möllendorff, 1892, Nachr.-Bl. dtsch. malak. Ges. **24:** 87 – Tenimber Islands; Solem, 1958, Arch. f. Mollusk. **87** (1-3): 25.

Diagnosis: Shell relatively large, diameter 3.82 - 4.08 mm (mean 3.95 mm), with 4⅛ to 4¼ normally coiled whorls. Apex barely emergent or slightly elevated, lower whorls descending slightly, body whorl more rapidly, H/D ratio 0.546-0.568 (mean 0.559). Apical whorls 1⅜ to 1½, sculpture on early portion of narrow, somewhat wavy spiral ribs, 15 or 16 in number, with faint radial ribs and a development of strong, broadly rounded radial ribs on the last quarter to half whorl. Postnuclear whorls with prominent, lamellar, protractively sinuated radial ribs, 82-98 (mean 89.2) on the body whorl, whose interstices are 2 to 4 times their width. Ribs/mm 6.77-7.77 (mean 7.19). Microsculpture of fine, regularly spaced radial riblets, crossed by much finer, more crowded spiral riblets with a secondary sculpture of moderately prominent spiral cords whose interstices are about 3 to 4 times their width. Sutures deep, whorls strongly rounded above, somewhat flattened laterally above periphery and on basal margin. Umbilicus relatively narrow, "V"-shaped, regularly decoiling, contained 4.00-4.57 times (mean 4.31) in the diameter, margins rounded. Color light reddish yellow horn without darker flammulations. Aperture sub-circular, slightly flattened laterally above periphery, on basal, and on columellar margin, inclined about 25° from the shell axis.

Pilsbrycharopa brunnescens is much smaller and has much less prominent radial elements in the apical sculpture than does *P. nigrofusca; P. kobelti* is much smaller and has a wider umbilicus; *P. timorensis* is much more widely umbilicated..

Description: Shell large, with slightly more than 4¼ normally coiled whorls. Apex and spire slightly and evenly elevated, body whorl descending more rapidly, H/D ratio 0.556. Apical whorls 1⅜, sculpture mainly eroded with prominent, broadly rounded radial ribs crossed by finer, more widely spaced spiral ribs visible on the last third. Postnuclear whorls with prominent, lamellar, narrow, protractively sinuated radial ribs, 86 on the body whorl, whose interstices are 2 to 4 times their width. Microsculpture mostly eroded, where visible consisting of regularly spaced radial riblets crossed by much finer and more crowded spiral riblets with a secondary sculpture of moderately prominent, fairly widely spaced spiral cords. Sutures deep, whorls strongly rounded above, slightly flattened laterally above periphery and on basal margin. Umbilicus relatively narrow, "V"-shaped, regularly decoiling, contained 4.00 times in the diameter. Color light reddish yellow horn. Aperture sub-circular, inclined about 25° from the shell axis. Height of lectotype 2.27 mm, diameter 4.08 mm.

Lectotype: Tenimber Islands. Natur-Museum Senckenberg, Frankfurt number 165692.

Range: Tenimber Islands and New Guinea.

Material: Tenimber Islands (4 specimens, SMF 165692-

4). Papua: Vikaiku, Angabunga River, inland of Hall Sound (30 specimens, MHNG, FMNH 159264).

Remarks: The type set from Timor Laut and the shells from Vikaiku agree very well in shape, color and major sculptural features. Both average between 15 and 16 spiral apical cords and their rib counts are essentially identical. The slightly smaller size and lower whorl count of the Vikaiku shells may reflect either bias for large size in the type set remnant studied or, more probably, fewer gerontic individuals in the former set. A possibly significant difference is the complete absence of secondary spiral cording in the Vikaiku shells, while it is very prominent in the Tenimber sample. I consider the available evidence too fragmentary to warrant separation, but on the basis of variation patterns seen in other taxa I suspect that the two are distinct.

Pilsbrycharopa brunnescens is intermediate between *P. kobelti* and *P. nigrofusca* in size and sculpture, but differs from both in its narrower umbilicus and higher spire. The radial apical sculpture is almost exactly intermediate in character.

Pilsbrycharopa nigrofusca (E. A. Smith, 1896)

Charopa nigrofusca E. A. Smith, 1896, Journ. of Malac. 5 (2): 18; plt. 2. figs. 10 - 12 – German New Guinea.

Pilsbrycharopa papuana Solem, 1958, Arch. f. Mollusk. **87** (1-3): 24 - 25; plt. 3, figs. 2 - 6 – Konstantinhafen, New Guinea.

Pilsbrycharopa nigrofusca (E. A. Smith), Solem, 1958, Arch. f. Mollusk. **87** (1-3): 25.

Diagnosis: Shell very large, diameter 6.14 - 6.93 mm (mean 6.43 mm), with $4\frac{1}{8}$ to $4\frac{1}{2}$ relatively loosely coiled whorls. Apex barely emergent, spire flat, body whorl descending slightly, spire protrusion about one tenth body whorl width, H/D ratio 0.439 - 0.489 (mean 0.462). Apical whorls $1\frac{3}{8}$, sculpture of fine, relatively crowded spiral ribs, crossing lower, quite broadly rounded, somewhat retractive radial ribs which are covered with very fine, closely spaced radial riblets occasionally visible on a well-preserved specimen. Postnuclear whorls with prominent, "V"-shaped, strongly protractively sinuated radial ribs, 114 - 132 (mean 124.3) on the body whorl, whose interstices are 2 to 5 times their width. Microsculpture a lattice of coequal radial and spiral riblets, equally spaced, 7 to 15 microradials between each pair of major ribs. Sutures moderately impressed, whorls strongly rounded above, greatly flattened laterally above periphery and slightly below with rounded periphery and basal margin. Umbilicus broadly "V"-shaped, regularly decoiling, contained 3.31 - 3.76 times (mean 3.45) in the diameter. Color reddish yellow brown without darker maculations, apex lighter in tone. Aperture sub-circular, strongly flattened above periphery with slightly deflected lip and slightly flattened lower lateral margin and umbilical edge, inclined almost 25° from the shell axis.

The flat spire, large size, wide umbilicus, loosely coiled whorls and microreticulated sculpture immediately separate *Pilsbrycharopa nigrofusca* from the other species of *Pilsbrycharopa*. Species of similar size, *P. gressitti* and *P. schneideri,* have very small umbilici and reduced radial sculpture.

Description: *(nigrofusca)* Shell very large, with slightly more than $4\frac{1}{8}$ relatively loosely coiled whorls. Apex and spire flat, last whorl descending slightly, H/D ratio 0.457. Apical whorls $1\frac{3}{8}$, sculpture of about 20 fine spiral ribs, crossing much lower, broadly rounded radial ribs with a fine secondary sculpture of radial riblets visible on lower portion. Postnuclear whorls with low but prominent, "U"-shaped, strongly protractively sinuated radial ribs, 114 on the body whorl, whose interstices are 2 to 5 times their width. Microsculpture a lattice of co-equal radial and spiral riblets. Sutures deep, whorls sharply rounded above, greatly flattened laterally above periphery and slightly flattened below. Color reddish yellow brown without darker maculations, apex lighter in color. Umbilicus broadly "V"-shaped, regularly decoiling, contained 3.36 times in the diameter. Aperture subcircular, strongly flattened laterally above periphery, slightly flattened laterally below periphery and on columellar margin, inclined about 25° from the shell axis. Height of lectotype 2.81 mm, diameter 6.15 mm.

(papuana) Shell very large, with $4\frac{3}{8}$ relatively loosely coiled whorls. Apex and spire flat, body whorl moderately descending, H/D ratio 0.443. Apical whorls $1\frac{1}{2}$, sculpture of fine spiral ribs, about 23 in number, reticulated by slightly finer radial ribs on the early portion with an intrusion of broadly rounded radial ribs on the last one-third whorl. Postnuclear whorls with rounded, prominent, protractively sinuated radial ribs, 116 on the body whorl, whose interstices are 2 to 3 times their width. Microsculpture a lattice of co-equal radial and spiral riblets in a somewhat waved pattern. Sutures deeply impressed, whorls evenly rounded at shoulder, strongly flattened laterally above periphery and on basal margin, with evenly rounded periphery. Color dark reddish yellow horn, apex somewhat lighter in tone. Umbilicus widely opened, "V"-shaped, regularly decoiling, contained 3.42 times in the diameter. Aperture large, ovate, flattened laterally above periphery and slightly on basal margin, inclined about 25° from the shell axis. Height of holotype 3.08 mm, diameter 6.93 mm.

Holotype of *papuana:* New Guinea: Constantinhaven. Natur-Museum Senckenberg, Frankfurt number 158151/1 ex-Möllendorff.

Lectotype of *nigrofusca:* New Guinea: Konstantinhaven. British Museum (Natural History) number 96.6.1.21.

Range: Known only from Konstantinhaven, New Guinea.

Paratypes: B. M. (N. H.) 96.6.1.22 (*nigrofusca*); SMF 158182/3, FMNH 63527, UMMZ 141799 (*papuana*).

Remarks: Inspection of the types of *Charopa nigrofusca* SMITH, 1896, showed that *Pilsbrycharopa papuana* SOLEM, 1958, is a synonym, probably based upon material from the type lot of the former. The original figures of *C. nigrofusca* are incorrect in proportions and led to the erroneous assumption that the two taxa were separable.

The large size and flattened form of *Pilsbrycharopa nigrofusca* are the obvious features separating it from *P. brunnescens*. This enlargement was not achieved by adding whorls, but simply through overall increase. Rib spacing is slightly wider, but only to the extent proportional to size change. In having a slightly lower spire and proportionately wider umbilicus, *P. nigrofusca* shows a characteristic linked change. In this instance, it is caused by depressing the plane of coiling and flattening of the whorls. *Pilsbrycharopa brunnescens* from Vikaiku has the spire protrusion/body whorl width index average 0.098, while in *P. nigrofusca* it is 0.105 (see Table 2). The spire of *P. brunnescens* appears much higher, but the measured protrusion is only slightly less. Body whorl width averages 1.18 mm in *P. brunnescens* and is 1.88 mm in *P. nigrofusca*. There is thus an increase of 77% in mean diameter between the species (3.63 in Vikaiku *P. brunnescens* to 6.43 in *P. nigrofusca*) but only a 59% increase in body whorl width. This is caused by more marked compression of the whorls in *P. nigrofusca*.

Much more significance can be attached to the greater radial element in the apical sculpture of *Pilsbrycharopa nigrofusca*.

Pilsbrycharopa densecostulata (THIELE, 1928)

Charopa densecostulata THIELE, 1928, Zool. Jahrb., Syst. **55:** 127; plt. 5, fig. 14 – 29 km unterhalb Maeanderberg (Upper Sepik River), New Guinea.
Pilsbrycharopa densecostulata (THIELE), SOLEM, 1958, Arch. f. Mollusk. **87** (1-3): 25.

Remarks: I have not seen the single known example of this species, but the original description and figures leave no doubt as to its affinities. The apical sculpture, shape, umbilical form and radial sculpture all appear to be intermediate between the features of species such as *Pilsbrycharopa brunnescens* and the very specialized *P. renschi* or *P. schneideri*.

Maeanderberg is a classic collecting area on the Upper Sepik River, Sepik District, New Guinea located past the great bend of the Sepik quite near the border of West Irian at about 4°10′ S, 141°25′ E.

Pilsbrycharopa gressitti SOLEM, spec. nov.

(Figures 1d to 1f; 2f to 2i)

Diagnosis: Shell very large, diameter 6.27 mm - 7.32 mm (mean 6.76 mm), with 3⅞ to 4¼ normally coiled whorls. Apex and spire slightly to moderately and evenly elevated, spire protrusion averaging one-ninth body whorl width, last whorl descending more rapidly, H/D ratio 0.559-0.642 (mean 0.585). Apical whorls slightly more than 1½, sculpture of about 15 - 18 fine and widely spaced spiral cords crossing much higher and more widely spaced radial ribs that become more crowded near end of apex. Postnuclear whorls with narrow, low rounded radial ribs, in fresh material with fine periostracal extensions, that become extremely crowded and indistinct by middle of body whorl. Microsculpture occasionally distinguishable as very fine and crowded radial riblets, much finer and more crowded spiral riblets, with a secondary sculpture of low, very broad spiral cords whose interstices are usually less than twice their width. Sutures moderately impressed, whorls strongly rounded above, compressed laterally above periphery and on basal margin, with evenly rounded periphery and columellar margins. Umbilicus very narrow, "V"-shaped, slightly decoiling, partly covered in adults by rolled reflection of columellar lip, contained 9.27 - 12.47 times (mean 10.74) in the diameter. Aperture ovate, compressed laterally above periphery and on basal margin, inclined about 25° from shell axis.

Pilsbrycharopa gressitti has only a slightly elevated spire, a narrow umbilicus, and is quite large. Species of similar size differ in having a minute or closed umbilicus and grossly elevated spire *(P. schneideri)* or a wide umbilicus and regular ribbing *(P. nigrofusca)*. None of the other *Pilsbrycharopa* exceed 4 mm in mean diameter.

Description: Shell very large, with 3⅞ normally coiled whorls. Apex and spire very slightly and evenly elevated, last whorl descending much more rapidly, H/D ratio 0.563. Apical whorls more than 1½, early portion worn, lower part with 16 narrow spiral cords, whose interstices are 5 to 6 times their width, with much higher, narrow, rounded, widely spaced radial ribs, whose interstices at first are 4 to 5 times their width, becoming more crowded near

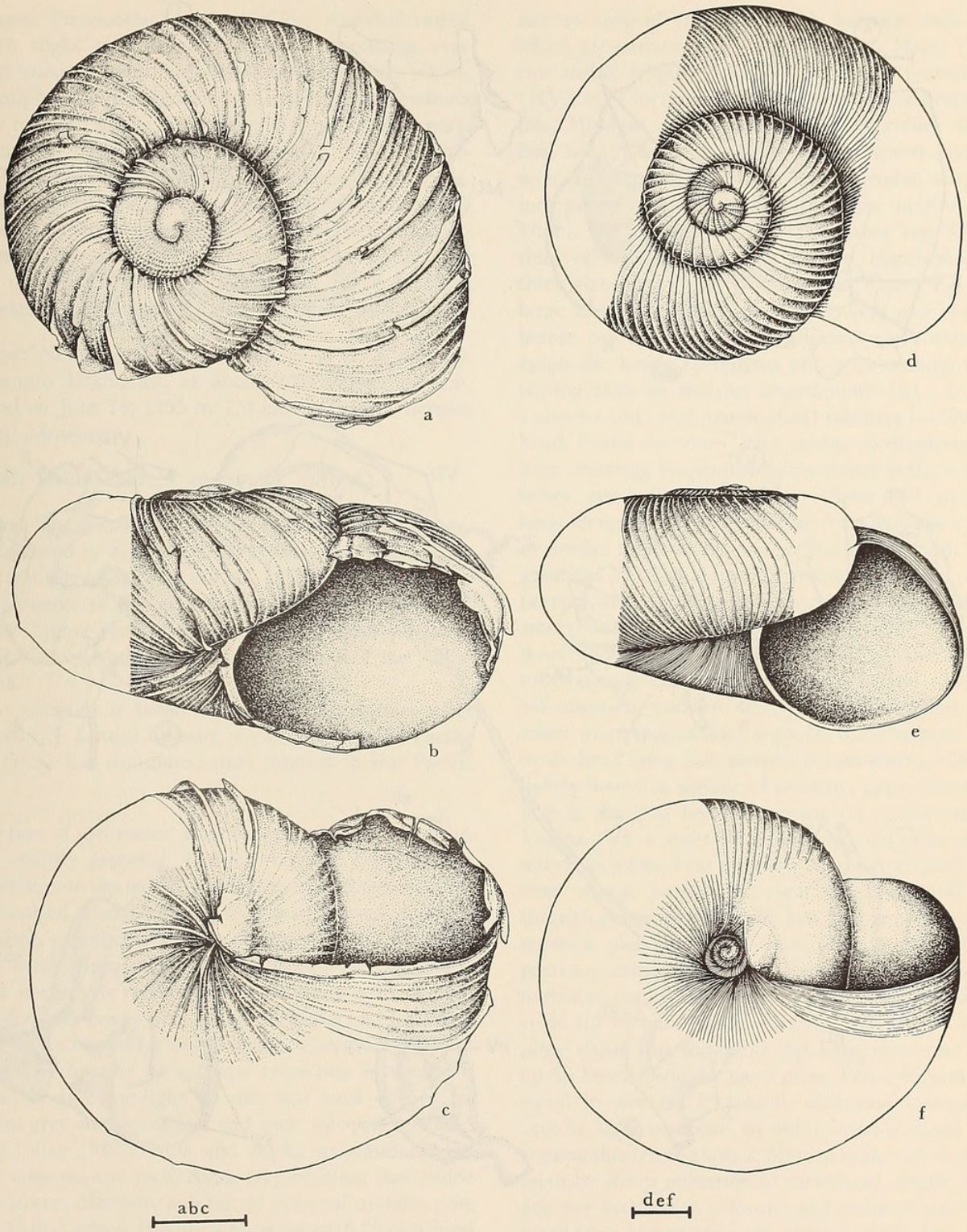

Figure 1

a - c: Holotype of *Paryphantopsis* ***dauloensis*** SOLEM, spec. nov. Daulo Pass, Eastern Highlands, New Guinea, Bernice P. Bishop Museum

d - f: Holotype of *Pilsbrycharopa* ***gressitti*** SOLEM, spec. nov. Daulo Pass, Eastern Highlands, New Guinea, Bernice P. Bishop Museum.

Scale lines equal 1 mm

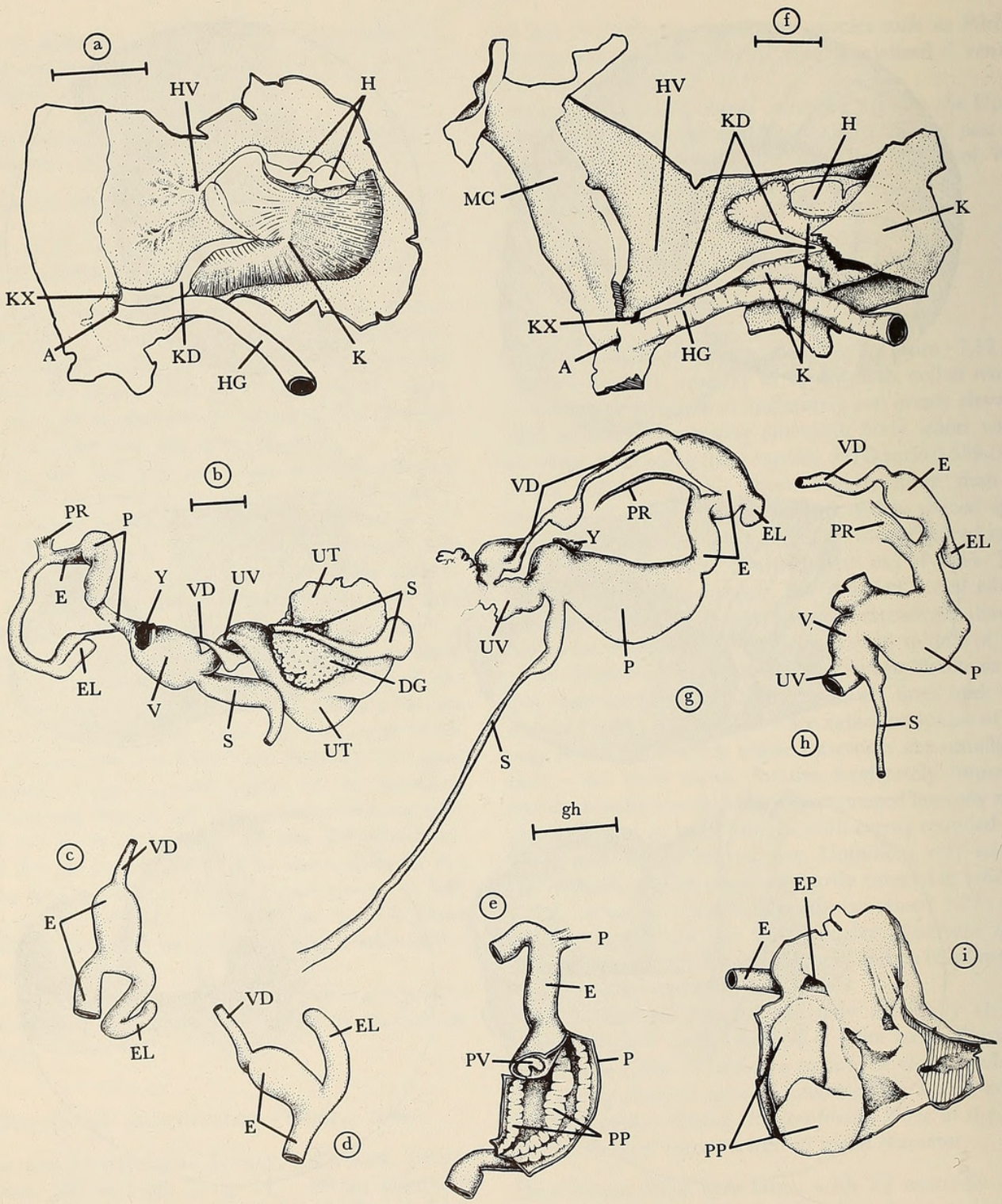

Figure 2

a - e: *Paryphantopsis* ***dauloensis*** Solem, spec. nov. Type lot. Daulo Pass, Eastern Highlands, New Guinea. a - pallial region; b - genitalia; c - d - detail of epiphallic diverticulum in two specimens; e - interior of penis

f - i: *Pilsbrycharopa* ***gressitti*** Solem, spec. nov. Type lot. Daulo Pass, Eastern Highlands, New Guinea. f - pallial region; g - h - terminal genitalia; i - interior of penis

Scale lines equal 1 mm

Dissections deposited in Bernice P. Bishop Museum

end of apex. Postnuclear sculpture of low, rounded, radial ribs with slight periostracal extensions, becoming very crowded lower on spire, indistinguishable on body whorl. Microsculpture as in diagnosis. Sutures impressed, whorls strongly rounded above, compressed laterally above periphery and on basal margin, with evenly rounded periphery. Umbilicus very narrow, "V"-shaped, slightly decoiling, contained 12.44 times in the diameter, partly narrowed at aperture by columellar lip reflection. Aperture ovate, compressed laterally above periphery and slightly on basal margin, inclined about 30° from shell axis. Height of holotype 4.12 mm, diameter 7.32 mm.

Holotype: New Guinea: Daulo Pass (ca. 6°03′S, 145°10′ W), Eastern Highlands, at about 8 200 feet elevation. Collected on June 14, 1955 by J. Linsley Gressitt. Bernice P. Bishop Museum.

Material: Daulo Pass (7 specimens, BPBM).

Remarks: The very characteristic apical sculpture is perfectly captured in Figure 1 d. In contrast to that of *Pilsbrycharopa nigrofusca* (see SOLEM, 1958, plt. 3, fig. 2) the radial elements of the apical sculpture are narrow and distinctly higher than the spiral cords. *Pilsbrycharopa schneideri* has slightly greater accentuation of the radial elements.

Great pleasure is taken in naming this species after its collector, J. Linsley Gressitt, whose work on the Pacific Island fauna has stimulated such interest in the Pacific biota.

Description of soft parts: Foot broad, truncated anteriorly, tail slightly tapering, bluntly rounded behind. Sole transversely corrugated in preservative, without longitudinal zonation. Pedal grooves deeply impressed, high on side of foot, suprapedal smaller than pedal, uniting above tail, no caudal horn or middorsal groove present. Slime network irregularly rectangular, units much smaller than lateral divisions below pedal grooves. Head and ommatophores without marked peculiarities. Gonopore position not observed because of extreme retraction in available material. Body color light on sole and back of tail, an iridescent grey on sides of foot and neck, sole yellow-white. Mantle collar (MC) wide and thick, no glandular extension onto mantle roof. Anus (A) opening just inside pneumostome, distinctly anterior of external ureteric pore (KX). Pallial region (Figure 2 f) measures 6.25 mm from edge of mantle collar to posterior end of kidney, distance from anterior edge of kidney to mantle collar about 2.6 mm. Lung roof clear of granulation. Kidney (K) bilobed, about 3.4 mm long, slanting downward from parietal-palatal margin after anterior third of rectal lobe, tapering posteriorly under intestinal loops. Ureter (KD) typical, narrow strip of lung roof visible between arms of ureter which are narrow at point of reflection. Heart (H) large, two thirds length of kidney. Principal pulmonary vein (HV) very inconspicuous, without major branching visible. Hindgut (HG) departing from kidney about 3.65 mm behind edge of mantle collar. Apical genitalia not seen. Prostate (DG) of numerous slender acini opening into groove on inner surface of upper uterine chamber. Uterus (UT) bipartite, upper chamber very slender and thin walled, lower chamber swollen, biscuit-shaped, with thick glandular walls. Vas deferens (Figure 2, g - h) very large and glandular at first, narrowing to a slender tube before penioviducal angle, reflexing up to enter bulbous epiphallic head. Epiphallus (E) with swollen head narrowing after an anterior diverticulum (EL) followed by a slender tube with longitudinal pilasters leading to penis head. Penial retractor (PR) arising on diaphragm, rather long, inserting longitudinally on coiled shaft of epiphallus below epiphallic diverticulum. Penis (P) about 2 mm long, elongately ovate, tapering from bulbous head down to slender atrium. Internally (Figure 2 i) with short longitudinal pilasters clustering around epiphallic pore, main portion with modified stimulatory pad and accessory pilasters, walls very dense and muscular. Atrium (Y) very short and slender. Free oviduct (UV) short, a narrow tube opening into very short vagina lateral to spermathecal insertion, without clearly defined internal structures other than longitudinal grooves. Spermatheca (S) with ovoid head lying just above prostate-uterus, slender shaft lightly bound to surface of prostate, approximately doubling in size just before inserting on penioviducal angle. Vagina (V) a short thick-walled, wide tube with heavy muscular walls. Free muscle system not studied, except to note typical passage of right ommatophoral retractor through penioviducal angle. Jaw fragmented in mounting, separate plates, about 3 times as long as wide on outer portions, central area fused. Radula with central about 1μ narrower than 1st lateral, mesocone extending slightly beyond tip of basal plate. Laterals 12 - 13, 1st with basal plate about 13μ wide and 16μ long, mesocone extending up 6μ beyond edge of basal plate. Ectocone and endocone equal in size on 1st lateral, endocone increasing more rapidly than ectocone on outer laterals, basal plate becoming shorter and wider. Shift to marginals in one or two teeth by sharp reduction in mesoconal length, less dramatic size increase in ectocone and endocone, shift in basal plate from almost square to shorter than wide. Marginals 9 to 10, outer with basal plate width twice length, cusps becoming shorter, ectocone split by 8th marginal, last marginals often only with mesoconal remnant. (Based on 3 fragmentary specimens from the type set. They had been extracted previously with the apical parts remaining in the shells.)

Pilsbrycharopa renschi (FRANC, 1952)

Charopa vicina B. RENSCH, 1930 (not PRESTON 1907), Zool. Anz. **89** (3-4): 87 – Batoe Doelang, Sumbawa and Rana Mêsé, Flores, Lesser Sunda Islands; B. RENSCH, 1932, Zool. Jahrb., Syst. **63:** 102; plt. 3, fig. 34; SOLEM, 1958, Arch. f. Mollusk., **87** (1-3): 25.

Charopa renschi FRANC, 1952, Bull. Soc. France **77** (1): 78 – New name for *Charopa vicina* RENSCH, 1930 not PRESTON, 1907.

Description: Shell larger than average, with slightly more than 5⅛ tightly coiled whorls. Apex and spire markedly and evenly elevated, spire protrusion about two fifths body whorl width, last whorl descending very slightly, H/D ratio 0.750. Entire shell encrusted and sculpture partly destroyed by fungal attack. Apex with both radial and spiral sculpture, details not detectable. Postnuclear whorls with fine, very crowded, vertical radial ribs, about 230 on the body whorl, that become retractive near umbilical closure. Microsculpture a lattice of radial and spiral elements, the latter weaker. All sculpture fainter below periphery of body whorl. Sutures not very deep, whorls strongly and evenly rounded above, becoming flatly rounded on outer margin. Umbilicus completely closed by reflection of lip. Color yellow horn with faint reddish tinge. Aperture crescentic, slightly more strongly rounded above and on umbilical margin. Columellar lip thickened and reflected. Height of holotype 2.86 mm, diameter 3.82 mm.

Holotype: Sumbawa, Batoe Doelang, west part of island, at 1 000 to 2 000 m elevation. Zoologisches Museum der Humboldt Universität, Berlin.

Paratype: Flores, Rana Mêsé at 1 200 - 1 300 m elevation (SMF 5733).

Additional Material: Sumbawa, Tamboka at 3 000 feet elevation (BMNH 98.10.25.184).

Remarks: The juvenile paratype is badly broken, has the apical whorls missing, and a narrowly open umbilicus. Although the juvenile (3¾ whorls) from Tamboka was somewhat worn, it showed that the apical sculpture consists of fine, very crowded spiral riblets with smaller, slightly lower radial riblets and an intrusion of low rounded radial ribs on the lower part of the apex. This serves to relate *P. renschi* to *Pilsbrycharopa* despite the quite different shape. Differences from *P. baliana* are given under that species.

Pilsbrycharopa baliana (B. RENSCH, 1930)

Charopa baliana B. RENSCH, 1930, Zool. Anz., **89** (3 - 4): 86; fig. 14 – Gitgit and Batoeriti, Bali, Lesser Sunda Islands; B. RENSCH, 1932, Zool. Jahrb., Syst. **63:** 102; SOLEM, 1958, Arch. f. Mollusk., **87** (1 - 3): 25.

Description: Shell larger than average, with 5¼ very tightly coiled whorls. Apex and spire markedly and evenly elevated, body whorl not descending more rapidly, spire protrusion a little less than two fifths body whorl width, H/D ratio 0.729. Apical and early postnuclear whorls with sculpture eroded. Lower whorls with thin, vertical, radial ribs, 151 on the body whorl, whose interstices are 3 to 5 times their width. Ribs become retractively sinuated upon basal umbilical area. Ribs/mm 12.39. Microsculpture a lattice of radial and spiral riblets, the latter distinctly finer. Both macro- and microsculpture weaker below periphery of body whorl. Sutures deep, whorls strongly rounded above slightly angled periphery, compressed laterally, flatly rounded to basal margin, which is strongly rounded. Umbilicus a narrow crack, contained about 20 times in the diameter. Color reddish-yellow horn without flammulations. Aperture crescentic, strongly rounded on umbilical and upper palatal margins, parallel to shell axis. Columellar margin thickened. Height of holotype 2.83 mm, diameter 3.88 mm.

Holotype: Bali, Gitgit at 500 - 600 m elevation. Zoologisches Museum der Humboldt Universität, Berlin.

Paratype: Bali, Batoeriti at 800 m elevation (SMF 5734).

Remarks: The paratype differed only in being slightly less elevated (H/D ratio 0.698) and a trifle smaller (diameter 3.82 mm). The whorl count was identical. Unfortunately, the apical sculpture was eroded.

The very similar *Pilsbrycharopa renschi* (FRANC, 1952) differs in having a closed umbilicus when adult, finer and more crowded radial sculpture (ca. 230 ribs on the body whorl), a slightly less obtuse spire angle, and shallower sutures.

Pilsbrycharopa schneideri (I. RENSCH, 1937)

Charopa schneideri I. RENSCH, 1937, Arch. f. Naturgesch., N. F., **6** (4): 587 - 588; figs. 29 - 31 (shell, genitalia, radula) – Malkong-Bach, Karlei, Matong, Lomal, Patagun, Ulamona and Insel Lolobau, New Britain, Bismarck Archipelago.

Table 3

Variation in Groups "B - E" Species of *Pilsbrycharopa*

	Number of Specimens Examined	Ribs	Ribs/mm	Height	Diameter	H/D Ratio	Whorls	Umbilicus	D/U Ratio
P. densecostulata (THIELE)	0	–	–	2.3	3.75	0.613	$3\frac{3}{4}$	0.67	5.60
P. gressitti SOLEM, spec. nov., Daulo Pass	6	–	–	3.95 ± 0.136 (3.53–4.44)	6.76 ± 0.147 (6.27–7.32)	0.585 ± 0.0131 (0.559–0.642)	4 + ($3\frac{7}{8}$–$4\frac{1}{4}$)	0.60 ± 0.030 (0.52–0.72)	10.74 ± 0.518 (9.27–12.47)
P. baliana (B. RENSCH) Bali	2	151	12.39	2.75	3.85	0.714	$5\frac{1}{4}$	0.16	24.4
P. renschi (FRANC) Sumbawa	1	230	19.17	2.86	3.82	0.750	$5\frac{1}{8}$	closed	–
P. schneideri (I. RENSCH) Malkong	22	–	–	3.99 ± 0.148 (3.01–5.82)	5.95 ± 0.151 (5.10–7.91)	0.669 ± 0.0113 (0.588–0.774)	$4\frac{7}{8}$ ($4\frac{3}{8}$–6)	crack to closed	over 20
Vikaiku	1	–	–	4.38	6.21	0.705	$4\frac{3}{4}$ +	crack	–
Buja Kori	4	–	–	3.36 ± 0.084 (3.20–3.60)	5.52 ± 0.108 (5.23–5.69)	0.608 ± 0.0161 (0.563–0.632)	$4\frac{3}{8}$ + ($4\frac{1}{4}$–$4\frac{1}{2}$)	crack	–

Diagnosis: Shell very large, diameter 5.10 to 7.91 mm (mean 5.95 mm), with $4\frac{3}{8}$ to 6 rather tightly coiled whorls. Apex and spire moderately to very strongly elevated, spire not rounded above, spire protrusion more than one third body whorl width, H/D ratio 0.588 - 0.774 (mean 0.669). Apical whorls $1\frac{5}{8}$ to $1\frac{3}{4}$, sculpture of curved, slightly retractive, close-set radial ribs, whose interstices are about equal to their width, plus distinctly smaller spiral ribs. In worn specimens this approximates a "pitted" sculpture. Postnuclear whorls with low, rather irregular, strongly protractively sinuated radial ribs, about 145 on the body whorl, whose interstices are 3 to 6 times their width. Microsculpture of rather coarse radial riblets with exceedingly fine spiral reticulation and a secondary sculpture of broad, widely spaced spiral cords. Where the spiral cords cross the radial ribs and riblets, a "beaded" effect results. Suture impressed, whorls slightly shouldered above, outer and basal margins evenly rounded. Umbilicus completely closed, a slight crack, or a very narrow opening contained more than 20 times in the diameter. Color light yellow-white with frequent radial reddish flammulations that coalesce over much of the shell spire. Aperture subcircular, slightly shouldered above, with evenly rounded outer margins, basal margin extended flatly to columella. Columellar lip thickened by white callus, reflected and twisted to close umbilicus, adults with a distinct columellar-basal angle. Aperture inclined about 15° from shell axis.

Table 4

Size and Shape Variation in *Paryphantopsis*

Name	Number of Specimens Examined	Height	Diameter	H/D Ratio	Whorls
P. platycephala	4	3.04 ± 0.042 (2.94–3.14)	4.93 ± 0.188 (4.71–5.49)	0.618 ± 0.0171 (0.571–0.653)	$2\frac{3}{4}$ + ($2\frac{3}{4}$–$2\frac{7}{8}$)
P. fultoni	10	3.41 ± 0.074 (3.01–3.79)	8.52 ± 0.127 (7.97–9.28)	0.401 ± 0.0098 (0.354–0.434)	$2\frac{3}{4}$ ($2\frac{5}{8}$–3)

Pilsbrycharopa schneideri is very large, with a nearly closed or closed umbilicus, protruding spire, and altered radial sculpture. *Pilsbrycharopa gressitti* and *P. nigrofusca* have much finer sculpture, open umbilici and much less elevated spires. Other *Pilsbrycharopa* are much, much smaller in size.

Paratypes: New Britain: Malkong (ZMB, FMNH 146031).

Material: New Britain: Malkong (30 specimens, ZMB, FMNH 146031). Vikaiku, village on Angabunga or St. Joseph River, inland from Hall Sound (2 specimens, MH NG collected by Lamberto Loria in July 1892); Bujakori, village along Kemp Welch River, northeast of Rigo (9 specimens, MHNG, FMNH 159264, collected by Lamberto Loria in August 1890).

Remarks: *Pilsbrycharopa schneideri* differs from the other New Guinea species in its very elevated spire, having the radial apical sculpture primary, the flared baso-columellar lip, closed or cracked umbilicus, irregular radial ribbing, and very strong secondary spiral cording. The Indonesian *P. renschi* and *P. baliana* are very similar in general appearance, but have typical endodontid radial ribs and a less specialized apical sculpture.

Paratypes from Malkong came from river drift piles and showed considerable variation in size and shape (Table 3). Both the Vikaiku adult and 4 Bujakori examples fall within the range of variation shown by this set. I can see no sculptural differences between the shells and do not hesitate to consider them conspecific. Adult shells can be recognized by the angled baso-columellar margin and generally closed umbilicus. Juveniles have a rounded margin and slightly open umbilicus.

I. Rensch (*loc. cit.*) gave outline figures of the terminal genitalia and radular teeth. Apparently there is no epiphallic diverticulum as in *Pilsbrycharopa gressitti,* and the illustrated vas-deferens-epiphallic union seems peculiar. Without study of the penis interior and verification of the epiphallic diverticulum absence, I would hesitate to separate this species from *Pilsbrycharopa.*

Paryphantopsis Thiele, 1928

Zool. Jahrb., Syst. 55: 125 - 126.

Medium sized to very large Charopinae in which the apical sculpture varies from a lattice of co-equal radial and spiral riblets to distinctly pitted surface. Whorls very loosely coiled, generally about 3, rarely more. Spire normally slightly raised, flat in many species. Umbilicus normally closed, narrowly open laterally only in *Paryphantopsis dauloensis* and *P. sculpturata.* Radial sculpture reduced to periostracal fringes in most taxa, remnants of major radials in *P. striata* and *P. louisiadarum.* Whorls keeled in *P. elegans* and *P. fultoni,* rounded in other species. Anatomy known only in one species. Pallial cavity shortened, hindgut and kidney separating early, arms of ureter widely spread, pulmonary vein markedly branched. Terminal genitalia with short penial retractor muscle, tapering short penis with vergic papilla and large corrugated pilasters, a long epiphallus and epiphallic diverticulum.

Type species: *Flammulina (Paryphantopsis) lamelligera* Thiele, 1928 by OD.

Except for the material of *Paryphantopsis fultoni* and *P. platycephala* reported on below, no species of this genus is known from more than 3 specimens. Variation in 4 adults of *P. platycephala* and 9 *P. fultoni* is summarized in Table 4.

Obviously we have only the most rudimentary knowledge of intra-populational variation. This makes it impossible to attempt a formal revision on the species level. I have examined the types of all but *Paryphantopsis similis* Thiele, 1928, *P. lamelligera* Thiele, 1928 and *P. globosa* (Hedley, 1890). Type specimen descriptions are presented for species described prior to the work of van Benthem Jutting (1964, pp. 13 - 17), but her species are well defined and easily identifiable.

Table 5 summarizes available data on species characters. The taxa show differing combinations of relatively few changes in character states. *Paryphantopsis fultoni* and *P. elegans* are immediately recognizable because of their sharp peripheral keels; *P. louisiadarum* and *P. striata* by the lack of periostracal fringing on the ribs. Otherwise the differences are in size, spire and apex elevation, body whorl descension and presence or absence of an umbilical chink. These are comparatively minor changes and the general appearance of *Paryphantopsis* species is very similar.

No specimens have been taken in the fairly well collected Vogelkop or Biak Island areas of Irian. All known species have been collected between about 139° E near the Idenburg River of Irian to Rossel Island, Louisiades, Papua. Specimens of *Paryphantopsis fultoni, P. platycephala* and a shell tentatively identified as *P. globosa* have been taken near Moroka on the Laloki River, Papua; *P. filosa* and *P. sculpturata* above the Idenburg River; *P. latior* and *P. arcuata* in the Star Mountains of Irian. Apparently there is some sympatry or near sympatry within the genus. Members of the last two species pairs were taken at different elevations, but within a few miles of each other. Judgment of distribution and speciation patterns must

Table 5

Type or Mean Adult Characters in *Paryphantopsis*

	Height in mm	Diameter in mm	H/D Ratio	Whorls	Peripheral Keel	Periostracal Fringes	Spire	Apex	Body Whorl Descension	Umbilicus
Paryphantopsis (P.) filosa	2.7	3.6	0.750	3	No	Yes (Weak)	Raised	Strongly Raised	Yes	Closed
pygmaea	3.3	4.6	0.717	2¾	No	Yes	Raised	Raised	Yes	Closed
arcuata	3.1	4.8	0.646	3	No	Yes	Raised	Raised	Rapid	Closed
sculpturata	3.3	4.75	0.705	3	No	Yes (Weak)	Raised	Slightly Raised	Rapid	Open
similis	3.5	5.0	0.700	3⅛	No	Yes	Raised	Raised	Yes	Closed
platycephala										
Type	2.7	5.1	0.529	3	No	Yes	Flat	Flat	Slight	Closed
Moroka	3.04	4.93	0.618	2¾+	No	Yes	Flat	Flat	Slight	Closed
dauloensis	3.26	5.48	0.595	3+	No	Yes (Weak)	Raised	Raised	Yes	Open
elegans	2.55	5.82	0.442	3	Yes	Yes	Raised	Raised	No	Closed
latior	4.0	6.45	0.620	3	No	Yes (Weak)	Flat	Flat	Rapid	Closed
lamelligera	5.0	7.5	0.667	3	Weak	Yes (Large)	Raised	Raised	Yes	Closed
striata	5.40	7.70	0.696	3⅛	No	No	Raised	Raised	Rapid	Closed
fultoni	3.40	8.65	0.431	2¾	Yes	Yes (Large)	Flat	Slightly Raised	No	Closed
louisiadarum	6.50	9.25	0.703	3–	No	No	Raised	Flat	Yes	Closed
P. (Gallodema) globosa	4.44	5.95	0.747	3⅜	No	No	Raised	Raised	Yes	Crack
(Moroka Juvenile)										
Original Description	10.0	12.0	0.588	4½	No	No	Raised	Raised	Yes	Open

await much larger and geographically more diverse samples.

Recognition of species group is equally premature, with only the single species, *Paryphantopsis dauloensis,* dissected. An exception concerns the position of the shell described as *Rhytida globosa* HEDLEY, 1899. IREDALE (1941, p. 92) proposed a generic name, *Gallodema,* and suggested it might be "an aberrant Zonitid" or a paryphantid. He also described the genus *Illonesta* for *Paryphanta louisiadarum* MÖLLENDORFF, 1899, having overlooked the description of *Paryphantopsis* THIELE, 1928. As can be seen from Table 5, HEDLEY's species differs greatly in size, whorl count and major sculpture from the typical *Paryphantopsis.* In apical sculpture, however, it is intermediate between *Paryphantopsis* and the more specialized *Pilsbrycharopa,* and the largest *Paryphantopsis* are nearer in size than the largest *Pilsbrycharopa.* Pending availability of further material for dissection, I prefer to classify HEDLEY's species as a *Paryphantopsis,* but use *Gallodema* as a subgeneric name.

No key to the species is attempted, since simple comparison of the measurements and variable shell features with the data in Table 5 will indicate which are the most similar morphotypes.

Species are listed in ascending order of size. Comments are restricted to addition of new or supplemental data. For most species I have included only references to previous literature.

Paryphantopsis (Paryphantopsis) filosa VAN BENTHEM JUTTING, 1964

Paryphantopsis filosa VAN BENTHEM JUTTING, 1964, Nova Guinea, Zool., 26: 14 - 15; figs.

16 - 19 – Araucariakamp at 800 m elevation, south of Idenburg River, near Vlakke Peak, north side Snow Mts., Irian (ca. 139°10′ E, 3°30′ S).

Paryphantopsis (Paryphantopsis) pygmaea (BAVAY, 1908)

Helicarion pygmaeus BAVAY, 1908, Nova Guinea, Zool., **5:** 286 - 287; plt. 14, figs. 14, a, b, c – Cyclopis montem Novae Guineae (= Cyclops Mts., near Hollandia, West Irian, ca. 140°35′ E, 2°30′ S).

Paryphantopsis pygmaea (BAVAY), VAN BENTHEM JUTTING, 1964, Nova Guinea, Zool., **26:** 13 - 14.

Paryphantopsis (Paryphantopsis) arcuata VAN BENTHEM JUTTING, 1964.

Paryphantopsis arcuata VAN BENTHEM JUTTING, 1964, Nova Guinea, Zool., **26:** 16; figs. 24 - 27 – Nimdol, bivak 36 at 1 220 m elevation, Star Mountains, Irian (ca. 140°48′ E, 4°54′ S).

Paryphantopsis (Paryphantopsis) sculpturata VAN BENTHEM JUTTING, 1964

Paryphantopsis sculpturata VAN BENTHEM JUTTING, 1964, Nova Guinea, Zool., **26:** 14; figs. 12 - 15 – Rotankamp and Tussenkamp at 1 100 - 1 200 m elevation, south of Idenburg River, near Vlakke Peak, north side Snow Mts., Irian (ca. 139°10′ E, 3°30′ S).

Paryphantopsis (Paryphantopsis) similis (THIELE, 1928)

Flammulina (Paryphantopsis) similis THIELE, 1928, Zool. Jahrb., Syst., **55:** 127; plt. 5, figs. 12, a – Maeanderberg, Upper Sepik River, Sepik District, New Guinea (ca. 147°40′ E, 6°30′ S).

Paryphantopsis (Paryphantopsis) platycephala VAN BENTHEM JUTTING, 1964

Paryphantopsis platycephala VAN BENTHEM JUTTING, 1964, Nova Guinea, Zool., **26:** 16-17; figs. 28-31 – Doormanpad bivak at 1 410 m elevation, above Doorman River, Upper Mamberamo drainage, West Irian (ca. 138°30′ E, 3°23′ S).

Material: Papua, Moroka, headwaters of Laloki River, east of Port Moresby, Central District (10 specimens, MH NG, FMNH 159262).

Remarks: Four adults and six juveniles from near Moroka, collected by Lamberto Loria in 1893, are tentatively referred to *Paryphantopsis platycephala.* They are nearest to this species, although showing some differences from the type in height and H/D ratio. Variation in the few adults is summarized in Table 4.

Paryphantopsis (Paryphantopsis) ***dauloensis,*** SOLEM spec. nov.

(Figures 1 a to 1 c; 2 a to 2 e)

Diagnosis: Shell slightly smaller than average, diameter 5.36 mm to 5.59 mm (mean 5.48 mm), with 3 to 3⅛ loosely coiled whorls. Apex and spire barely to moderately and evenly elevated, body whorl descending moderately to much more rapidly, H/D ratio 0.577-0.612 (mean 0.595). Apical whorls 1½, rounded, sculpture of rather vague radial and spiral riblets producing a weakly pitted appearance by partial fusion and wear. Postnuclear whorls with irregular growth wrinkles, many with prolonged periostracal extensions, frequency and prominence of extensions reduced on shell base. Microsculpture mostly absent, occasionally visible under 96× magnification as fine radial and slightly finer spiral riblets. Sutures deep, whorls strongly rounded above, compressed laterally above and below rounded periphery. Umbilicus narrowly and laterally open, rolled reflection of columellar lip partly constricting opening. Aperture very large, subcircular, compressed laterally above and below rounded periphery, inclined about 40° from shell axis.

The open umbilicus, absence of spiral pitting on the postnuclear whorls, reduced fringing and weak apical sculpture separate *Paryphantopsis* ***dauloensis*** from previously described species. *Paryphantopsis latior* VAN BENTHEM JUTTING has a flat apex and spire, closed umbilicus and is almost 1 mm larger in mean diameter; *P. similis* has a closed umbilicus, is smaller, much higher and has the periostracal fringes much more prominent; *P. sculpturata* has an open umbilicus, prominent spiral pitting on the lower whorls, and is almost 1 mm smaller in mean diameter.

Description: Shell smaller than average, with 3 loosely coiled whorls. Apex and spire slightly protruding, body whorl descending more rapidly, H/D ratio 0.577. Apical whorls 1½, evenly rounded, surface cracked and partially obscured by fungus, sculpture of low radial and spiral riblets of equal size, tending towards a pitted appearance. Postnuclear whorls with irregular radial growth wrinkles, many with prominent periostracal extensions. Microsculpture occasionally visible as fine radial and slightly finer spiral riblets, surface usually smooth. Sutures deep, whorls strongly rounded above, compressed laterally above and below rounded periphery. Color reddish-brown, becoming

yellow-brown near apex. Umbilicus narrowly and laterally open, periostracal reflection of columellar lip covering opening in direct bottom view. Aperture very large, inclined about 40° from shell axis, margin only weakly sinuated. Height of holotype 3.09 mm, diameter 5.36 mm.

Holotype: New Guinea: Daulo Pass, Eastern Highlands at about 8200 feet elevation. Collected by J. Linsley Gressitt on June 13, 1955. Bernice P. Bishop Museum.

Range: Known only from the type collection.

Material: Daulo Pass (2 specimens, BPBM).

Remarks: Of the previously described *Paryphantopsis,* only *P. sculpturata* VAN BENTHEM JUTTING has a partly open umbilicus. It is smaller, higher and has prominent spiral sculpture on the lower whorls.

Description of the soft parts: Foot and tail shorter than in *Pilsbrycharopa*. Sole broad and transversely corrugated. Pedal grooves high on foot, deeply impressed, suprapedal less conspicuous, both united over tail, no caudal horn or middorsal groove present. Slime network typical. Gonopore position not observed. Body color iridescent yellow-white with a very faint reddish tint (caused by preservative?). Mantle collar thick and with low lobes, but no glandular extension onto pallial roof. Pneumostome masked by swellings on mantle edge. Anus opening just inside pneumostome, external ureteric pore lying right beside anus. Pallial region (Figure 2 a) measures 2.96 mm from edge of mantle collar to peak of kidney, distance from anterior end of kidney to mantle collar about 1.50 mm. Lung roof clear of granulations. Kidney bilobed, lobes almost equal in length, high in center, slanting backwards under intestinal looping beyond end of pallial cavity. Posterior portion of kidney sharply angled down from hindgut and parietal-palatal margin. Ureter reflexed, complete, lung roof visible between arms of ureter, tube not tapering, compressed at point of reflection. Heart large, more than two thirds length of pericardial kidney arm, slightly hidden posteriorly by margin of kidney. Principal pulmonary vein very inconspicuous, without major branching after initial bifurcation. Hindgut departing from ureter 1.4 mm behind anus. Apical genitalia not seen. Prostate and uterus as in *Pilsbrycharopa*. Vas deferens (Figure 2 b, VD) large at first, becoming very slender, entering epiphallus at swollen head after being coiled once around penis at muscle sheath. Epiphallus (E) with swollen head, long lateral diverticulum (EL), and long, coiled tube leading to penis head. Diverticulum equal in length to epiphallic head (Figures 2 c, 2d). Penial retractor (PR) arising from diaphragm, very short, inserting on epiphallic tube near entrance to penis. Penis (P) about 1.9 mm long, club-shaped, gradually tapering, basal third a slender tube with muscular sheath. Internally (Figure 2 e) with short vergic papilla (PV) with central groove, sheath of verge attached to one wall of penis, other walls with corrugated longitudinal pilasters (PP) tapering into atrium. Atrium (Y) very short, rather broad. Free oviduct (UV) short, internally with longitudinal pilasters, opening into vagina. Spermatheca (S) with basal portion a muscular tube exceeding in diameter free oviduct, narrowing at base of prostate-uterus to slender tube passing up prostate surface, head club-shaped, gradually expanding, lying slightly above apex of prostate-uterus. Vagina (V) greatly expanded, with very thick glandular walls. Free muscle system without unusual features. Jaw of narrow plates, length 5 or 6 times width, fused centrally and tightly joined out to margins. Width about 0.10 mm to 0.11 mm, length not determined since jaw broken in mounting. Central slightly smaller than 1st lateral, mesocone cusp barely projecting beyond basal plate. Laterals 10 to 12, 1st about 10μ wide, 13 μ long, cusp projecting beyond end of basal plate. Ectocones and endocones all smaller than in *Pilsbrycharopa*. Marginals with square basal plates, 7 to 8 in number, single ectocone and endocone two thirds length of mesocone.
(Based on two broken specimens extracted from shell and broken off in process).

Paryphantopsis (Paryphantopsis) elegans (FULTON, 1902)

Paryphanta elegans FULTON, 1902, Ann. Mag. Nat. Hist., (7). **9:** 182 - 183 – Arva (=Aroa) River, New Guinea.
Illonesta elegans (FULTON), IREDALE, 1941, Austral. Zool., **10** (1): 93.
Paryphantopsis (Paryphantopsis) elegans (FULTON), SOLEM, 1958, Arch. f. Mollusk., **87** (1-3): 23; 1959, *loc. cit.*, **88** (4-6): 156.

Description: Shell of average size, with 3 very loosely coiled whorls. Apex and spire slightly and evenly elevated, last whorl not descending more rapidly, H/D ratio 0.438. Apical whorls 1$\frac{5}{8}$, sculpture of crowded, minute, oval to circular pits caused by fusion of radial and spiral riblets, with a nearly medial keeled ridge that fades out after nuclear whorls. Postnuclear whorls with low, irregular, protractively sinuated growth wrinkles, occasionally with lamellar periostracal extensions. Peripheral keel possessing a serrated periostracal fringe. Occasional traces of minute, vague pits arranged in spiral patterns. Microsculpture of fine, rather widely spaced radial riblets with faint traces of very fine and crowded spiral riblets. Sutures deep, channeled, whorls flatly rounded with stronger spiral

sculpturing visible, particularly strongly pitted within aperture. Color dark olive yellow brown with irregular lighter streaks. Apex light yellow orange in tone. Umbilicus closed by reflection of lip. Aperture very large, subtriangular, almost flat above periphery, gently and evenly rounded below, with very sinuated edge, inclined almost 50° from the shell axis. Height of holotype 2.55 mm, diameter 5.82 mm.

Holotype: Papua: Arva (=Aroa) River at 6 000 feet elevation. British Museum (Natural History) number 1907.5.28.11.

Range: Known only from the type collection.

Material: Arva River (3 specimens, BMNH 1907.5.28.11, SMF 161111, ANSP 109258).

Remarks: The much larger *Paryphantopsis fultoni* has a flat spire and lacks any trace of postapical spiral punctations. No other species have a sharp peripheral keel.

Paryphantopsis (Paryphantopsis) latior
VAN BENTHEM JUTTING, 1964

Paryphantopsis latior VAN BENTHEM JUTTING, 1964, Nova Guinea, Zool., **26:** 15 - 16; figs. 20 - 23 – Ok Minan, beyond bivak 39A at 1 450 to 1 500 m elevation, Star Mountains, Irian (ca. 140°48′43″ E, 4°54′32″ S).

Paryphantopsis (Paryphantopsis) lamelligera
(THIELE, 1928)

Flammulina (Paryphantopsis) lamelligera THIELE, 1928, Zool. Jahrb., Syst., **55:** 126; plt. 5, figs. 10, a – Maeanderberg, 670 m elevation, Upper Sepik River, Sepik District, New Guinea (ca. 147°40′ E, 6°30′ S).

Paryphantopsis (Paryphantopsis) striata (FULTON, 1902)

Paryphanta striata FULTON, 1902, Ann. Mag. Nat. Hist., (7), **9:** 182 – Arva (=Aroa) River, New Guinea.

Flammulina (Paryphantopsis) striata (FULTON), THIELE, 1928, Zool. Jahrb., Syst., **55:** 126; plt. 5, fig. 11.

Illonesta striata (FULTON), IREDALE, 1941, Austral. Zool., **10** (1): 93.

Paryphantopsis (Paryphantopsis) striata (FULTON), SOLEM, 1958, Arch. f. Mollusk., **87** (1-3): 23.

Description: Shell very large, with $3\frac{1}{4}$ loosely coiled, globosely swollen whorls. Apex and spire moderately and evenly elevated, body whorl descending only slightly more rapidly, H/D ratio 0.707. Apical whorls $1\frac{5}{8}$, sculpture of widely spaced, approximately equal radial and spiral riblets, forming a cross-hatch sculpture except in the sutural area where the spiral ribbing is absent. Secondary sculpture of very fine radial ribbing, barely visible. Postnuclear whorls with narrow to low, broadly rounded, vague growth wrinkles, occasionally prolonged into periostracal lamellae. Microsculpture of very fine, crowded, radial riblets crossed by slightly finer spiral riblets. Color reddish brown with irregular orange-yellow periostracal streaks, apex light yellow orange. Sutures deep, whorls strongly rounded above, flattened laterally above periphery, with flattened and elongated basal margin. Umbilicus closed. Aperture very large, somewhat flattened laterally above periphery and on basal margin, inclined about 30° from the shell axis, with very sinuate lip edge. Height of holotype 5.69 mm, diameter 8.04 mm.

Holotype: Papua: Arva (=Aroa) River at 6000 feet elevation. British Museum (Natural History) number 1902.5.28.10.

Range: Known only from the type collection.

Material: Arva River (2 specimens, BMNH 1902.5.28.10, SMF 161110).

Remarks: The apical sculpture of widely spaced radial and spiral ribs which form a cross-hatch pattern, is an obvious forerunner of the minutely pitted sculpture of *Paryphantopsis louisiadarum*. In the latter the pattern of pitting carries over onto the postnuclear whorls, but is totally absent in the few specimens known of *P. striata*. The lack of periostracal fringes is shared with *P. louisiadarum*, which differs in its larger size, pitted apical sculpture and less rapid body whorl descension.

Paryphantopsis (Paryphantopsis) fultoni (COEN, 1922)

Chronos fultoni COEN, 1922, Ann. Mus. Civico Stor. Natur. Giacomo Doria, (3), **9:** 361 - 363; figs. 3 - 4 – Moroka, New Guinea.

Diagnosis: Shell very large, diameter 7.97 mm to 9.28 mm (mean 8.52 mm), with $2\frac{5}{8}$ to 3 very loosely coiled whorls. Apex distinctly elevated, spire flat, body whorl not descending more rapidly, H/D ratio 0.354 to 0.434 (mean 0.401). Apical whorls $1\frac{1}{2}$, bi-keeled, flat above supraperipheral keel, a marked supraperipheral sulcus, followed by a rounded peripheral keel, sculpture of minute pits arranged in spiral rows. Postnuclear whorls macroscopically smooth above periphery except for irregular malleations, growth wrinkles, and occasional periostracal extensions. Periphery with very large and irregular periostracal fringe,

lower palatal wall with regularly spaced, crowded, narrow, prominent periostracal rib extensions. Under 96× magnification traces of micro-radial riblets and finer microspiral riblets are visible on upper surface, clearly defined on lower surface of shell. Sutures deep on apex, becoming very shallow on spire, apical whorls bikeeled, lower whorls becoming strongly flattened laterally above sharply keeled periphery, with evenly rounded lower palatal margin. Columellar lip recurved over and closing very narrow umbilical chink even in juveniles. Aperture very large, flattened laterally above periphery, inclined more than 50° from shell axis.

The keeled periphery, very prominent periostracal fringing, absence of spiral pitting below the apex, and large size identify *Paryphantopsis fultoni; P. elegans* (Fulton) has the keeled periphery and fringes, but is much smaller (diameter 5.82 mm), has spiral pitting on the lower whorls, and the sutures deep even to the aperture; *P. lamelligera* (Thiele) has only a very weak peripheral keel, much stronger spire and apical elevation with marked descension of the body whorl. All other *Paryphantopsis* have rounded peripheries.

Description: Shell very large, with $2\frac{7}{8}$ very loosely coiled whorls. Apex slightly protruding, spire flat, body whorl not descending, H/D ratio 0.424. Apical whorls slightly less than $1\frac{1}{2}$, flattened above mid-upper palatal keel, concave below to peripheral keel, sculpture of minute punctations formed by fusion of spiral and radial ribs. Postnuclear whorls with irregular growth wrinkles, sometimes bearing periostracal fringe extensions, surface somewhat malleated with remnants of apical keels and sulci, periphery with roughly triangular, quite large periostracal fringes, lower palatal wall with narrow, high, rather crowded, regularly spaced radial periostracal rib extensions. Microsculpture visible on lower surface as fine radials crossed by finer spirals, barely visible on upper surface. Sutures deep on apex, becoming quite shallow on lower spire, postnuclear whorls flattened laterally above sharply angled periphery, evenly rounded below. Color reddish brown near aperture, becoming greenish yellow on upper spire, apex yellow-white. Umbilical chink closed by reflection and periostracal extension of columellar lip. Aperture very large, flattened laterally above periphery, inclined about 50° from shell axis. Height of lectotype 3.46 mm, diameter 8.11 mm.

Lectotype: Moroka, Laloki River, headwaters, east of Port Moresby. Collected by Lamberto Loria in July 1893. Museo Civico di Storia Naturale "Giacomo Doria," Genova.

Material: Moroka (19 specimens, MHNG, FMNH 159265).

Remarks: Differences from *Paryphantopsis elegans* are covered in the diagnosis above. Probably the most significant are the absence of spiral sculpture on the lower whorls and regular fringed sculpture on the shell base seen in *P. fultoni*. Moroka is a classic ornithological collecting locality on the slopes of Mt. Wori-Wori about 25 miles inland of Tupuseleia and fairly near Port Moresby.

Paryphantopsis (Paryphantopsis) louisiadarum
(Möllendorff, 1899)

Paryphanta louisiadarum Möllendorff, 1899, Nachr.-Bl. dtsch. Malak. Gesell., **31**: 89 – Louisiade Islands, New Guinea; Möllendorff, 1902, Syst. Conch. Cab., I, **12**, B, p. 17; plt. 3 figs. 1-3; Solem, 1959, Arch. f. Mollusk., **88** (4-6): 156; plt. 12, figs. 10, 11; plt. 13, fig. 6.
Illonesta louisiadarum (Möllendorff), Iredale, 1941, Austral. Zool., **10** (1): 93.
Paryphantopsis (Paryphantopsis) louisiadarum (Möllendorff), Solem, 1958, Arch. f. Mollusk., **87** (1-3): 23 – Rossel Island, Louisiades.

Description: Shell very large, with $2\frac{7}{8}$ very loosely coiled, globosely swollen whorls. Apex nearly flat, lower whorls descending moderately, H/D ratio 0.704. Apical whorls $1\frac{3}{8}$, sculpture a network of spiral and radial ribs broadly joining each other, forming regular rows of small circular to oval pits, about 15 in number across the whorl. Pitted sculpture continuing on post nuclear whorls with radial ribbing gradually becoming more prominent and at the end of the second whorl a fine microsculpture of radial riblets crossed by much finer and more crowded spiral riblets becoming visible. On the body whorl the sculpture has become reduced to series of spiral grooves in which the small pits are visible with most of the surface showing irregular growth lines and microsculpture. Color olive yellow brown with occasional darker flammulations becoming very dark in the sutures. Umbilicus closed by reflection of lip. Aperture very large, somewhat flattened laterally above periphery and on basal margin, inclined about 35° from the shell axis. Height of lectotype 6.54 mm, diameter 9.28 mm.

Lectotype: New Guinea: Louisiade Islands. Natur-Museum Senckenberg, Frankfurt number 137274.

Range: Louisiade Islands.

Material: Rossell Island (1 specimen, ANSP 109257); Louisiades (2 specimens, SMF 137274, SMF 165564).

Remarks: Only the sharply keeled *Paryphantopsis fultoni* approaches the size of this species. No anatomical material

is available and apparently no specimens have been collected in this century.

Paryphantopsis (Gallodema) globosa (HEDLEY, 1890)

Rhytida globosa HEDLEY, 1890, Ann. Rep. British New Guinea, **1888 - 89:** 65 – Mt. Victoria, Owen Stanley Mts., Papua; HEDLEY, 1891, Proc. Linn. Soc. New South Wales, (2), **6:** 80; plt. 10, figs. 15, 16; SOLEM, 1959, Arch. f. Mollusk. **88** (4-6): 156 to 157.

Gallodema globosa (HEDLEY), IREDALE, 1941, Austral. Zool., **10** (1): 92.

Paryphantopsis (Gallodema) globosa (HEDLEY), SOLEM, 1958, Arch. f. Mollusk., **87** (1-3): 24

Remarks: I have not been able to examine the type of *Rhytida globosa*, which was deposited in the Queensland Museum, Brisbane. The original description mentioned the pitted apical sculpture and "bleached" early whorls. A single shell from Moroka (MHNG) collected by Lamberto Loria in July, 1893, is referred to this species, although much smaller in size. It is 4.44 mm high, 5.95 mm in diameter, H/D ratio 0.747, with $3\frac{3}{8}$ whorls. HEDLEY's original measurements of height 10 mm and diameter 17 mm give a calculated H/D ratio of 0.588, but the original figures give a height of 10.9 mm, diameter 15.9 mm for a calculated H/D ratio of 0.686. I consider that the Moroka shell is closely related to HEDLEY's species, if not merely a juvenile example.

Apical sculpture of the Moroka shell consists of coequal radial and spiral riblets that produce a lattice pattern with a few worn spots appearing "pitted" as in typical *Paryphantopsis*. IREDALE (*loc. cit.*) sketchily described a new genus, *Gallodema*, for this species. It is intermediate between *Pilsbrycharopa* and *Paryphantopsis* in shape and whorl count. The apical sculpture also appears transitional. I question the desirability of generic separation and prefer to use *Gallodema* as a subgenus of *Paryphantopsis*.

COMPARATIVE REMARKS

Despite knowing only part of the visceral hump anatomy for one species in each genus, a comparison between the two yields significant information on patterns of pulmonate evolution. *Pilsbrycharopa* and *Paryphantopsis* belong to the same subfamily. They have quite different average patterns of shell structure. The two dissected species, *Pilsbrycharopa gressitti* and *Paryphantopsis dauloensis*, are sympatric. Therefore existing genital differences may provide no information helpful in elucidating phylogeny. In the Pacific Island endodontid taxa, sympatric species in the same genus or closely related genera show marked character displacement in penial structures (unpublished data). One species of such a pair or group may be strikingly altered in penis structures, while the other(s) may be only very slightly modified, or they may diverge in different directions from the "average" structural pattern.

I cannot state whether the *Pilsbrycharopa* or the *Paryphantopsis* is greatly modified, since without dissection of many species, determination of the average pattern is not possible. *Pilsbrycharopa gressitti* has an oval penis, lacks a vergic papilla, has a large stimulatory pad and large smooth pilasters near the base, while *Paryphantopsis dauloensis* has a club-shaped penis with a vergic papilla, no stimulatory pad, and corrugated longitudinal pilasters. The existence of these differences may have phylogenetic significance or may reflect character displacement to enforce species isolation. A hint of possible ecological divergence is given by the body color, yellow-white in *Paryphantopsis*, greyish tones in *Pilsbrycharopa*. In the Pacific Island endodontids, yellow-white body color is associated with litter dwelling forms, greyish tones with semiarboreal taxa. No ecological data have been recorded concerning the habitat of either genus, but general affinities of both seem to be with the Pacific Island, rather than the New Zealand-Australian taxa. Correlation of ecological zonation and body color reasonably could be expected to hold for the New Guinea taxa. A combination of slight ecological divergence and exaggeration of species isolating mechanisms is the common pattern when closely related species become sympatric. A possible hint of dietary difference is given in the radular teeth. Those of *Paryphantopsis* have the basal plates of the laterals much narrower and the marginal basal plates are square rather than rectangular. Mesoconal cusps are shorter in *Paryphantopsis* and there is no evidence of ectoconal cusp splitting on the outermost marginals. This shift in radular tooth shape and cusp size may indicate a scraping feeding action rather than the normal slicing action in more typical endodontid radulae. Ecological and life history observations in the Daulo Pass area on the two genera could yield very important data on the origin and maintenance of mating barriers in pulmonates. Both genera also have been collected at Moroka.

While the above data concerning such factors of microevolution are interesting, differences between the two genera provide deeper insights into patterns of major change. A look at the shell illustrations of the two new species (Figure 1) and mean measurements (Tables 2, 3, 5) confirms the existence of several consistent differences in

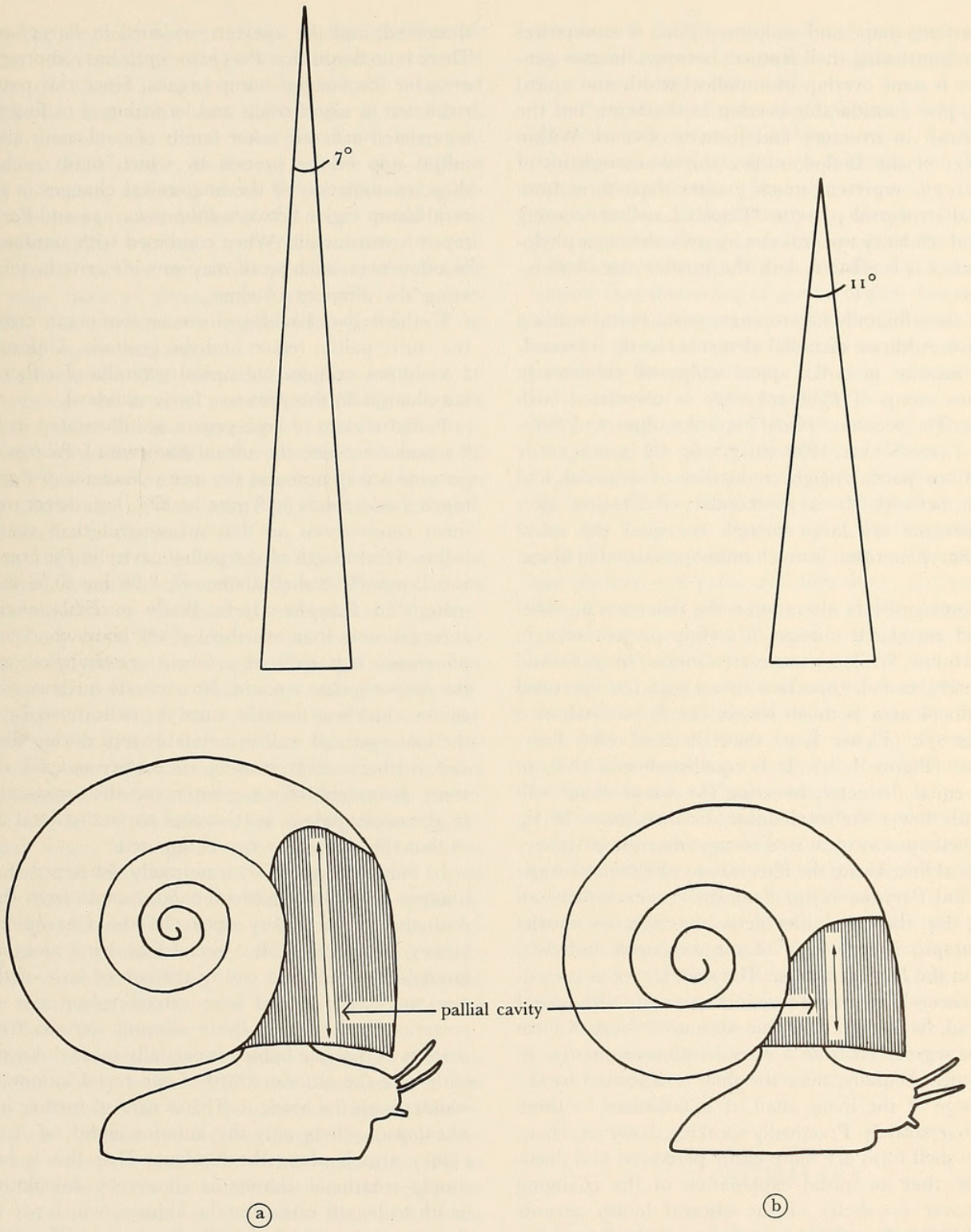

Figure 3

Visceral hump volume relationships and foot length-pallial cavity ratios in *Pilsbrycharopa* (a) and *Paryphantopsis* (b)

coiling pattern, shape and sculpture. Table 6 summarizes the major contrasting shell features between the two genera. There is some overlap in umbilical width and apical sculpture, plus considerable overlap in diameter, but the basic contrast in structure and form is obvious. Within the context of the Endodontidae, the characteristics of *Paryphantopsis* represent much greater departures from the typical structural pattern. "Cope's Law" concerning the general tendency towards size increase during a phylogenetic series is consistent with the greater size of *Paryphantopsis.*

Within the subfamily Charopinae, spiral apical cording is primitive. Addition of radial elements clearly is secondary. The increase in radial apical sculptural elements in the species group of *Pilsbrycharopa* is correlated with larger size. The peculiar "pitted" apical sculpture of *Paryphantopsis* (see SOLEM, 1959, plt. 13, fig. 6) is most easily derived from partial height reduction of a radial and spiral rib network. It is a secondary derivation after radial elements are large enough to equal the spiral cording. *Paryphantopsis* is much more specialized in apical sculpture.

The most significant alteration is the reduction in whorl count and correlated change in coiling pattern seen in *Paryphantopsis.* While accurate area measurements could not be made, casual inspection shows that the apertural cross-sectional area is much less in the 4- to 5-whorled *Pilsbrycharopa* (Figure 1, e) than the 3-whorled *Paryphantopsis* (Figure 1, b). It is equally obvious that, in shells of equal diameter, lowering the whorl count will significantly lower the total linear distance from the lip edge to shell apex as measured along either the periphery or midwhorl line. Using the illustrations of *Pilsbrycharopa gressitti* and *Paryphantopsis dauloensis* as examples and adjusting for the size differences, the distance in the *Paryphantopsis* is only 73% of the measured midwhorl distance in the *Pilsbrycharopa.* The shell serves to encompass the visceral hump and provides space for withdrawal of the head, foot and tail, so that alterations in shell form cannot be segregated from a consideration of changes in the anatomy. Actually, since the shell is deposited by the mantle edge of the living snail, it is fallacious to think of the two separately. Practically speaking, however, changes in the shell form are more easily perceived and documented so that an initial explanation of the changing surface cover (= shell) of the visceral hump permits better understanding changes in organs of the latter.

The net effect of a reduction in whorl count and loosening of the coiling patterns is shown in Figure 3. If the two visceral humps could be decoiled and distorted into simple cones, the volume would change only slightly, but the spire angle would be enlarged, the height of the cone shortened, and the aperture widened in *Paryphantopsis.* There is no doubt that *Paryphantopsis* has a shorter, wider area for the visceral hump organs. Since this pattern of reduction in whorl count and loosening of coiling pattern is repeated in family after family of land snails and is an initial step in the process by which snails evolve into slugs, examination of the anatomical changes in the visceral hump region between *Pilsbrycharopa* and *Paryphantopsis* is worthwhile. When combined with similar studies in other taxa, such work may provide criteria for evaluating the affinities of slugs.

In this report I wish to focus on two organ complexes, the entire pallial region and the genitalia. Unfortunately I could not examine the apical genitalia of either genus, but changes in this area are fairly standard.

Pallial regions of both genera are illustrated in Figures 2 a and 2 f. Since the mean diameter of *Pilsbrycharopa gressitti* is 6.76 mm and the mean diameter of *Paryphantopsis dauloensis* is 5.48 mm, or 19% less, direct measurement comparisons are less meaningful than the use of ratios. Total length of the pallial cavity in *Pilsbrycharopa* is 6.25 mm (0.92 shell diameter); 2.96 mm (0.54 shell diameter) in *Paryphantopsis.* While in *Pilsbrycharopa* it occupies more than one-third of the body whorl, in *Paryphantopsis* it is reduced to about one-sixth, or only half the proportionate amount. No accurate measure of pallial cavity width was possible, since the delicate roof tissue on the lower palatal wall is inevitably torn during dissection and further cut in pinning the cavity out for detailed study. It undoubtedly is greater, but the organs all occupy the upper palatal portion and parietal-palatal margin, so that this dimension can be ignored.

In most land snails with normally developed shells the hindgut follows the parietal-palatal angle from the anus past the pallial cavity apex. In the Charopinae, the kidney is bilobed, with a rectal lobe lying alongside the hindgut from anterior end to the curved base of the kidney and a pericardial lobe extending anterior of and posterior to the heart. *Pilsbrycharopa* departs from this pattern in that the kidney is partially rotated downwards, with only the anterior third of the rectal kidney arm in contact with the hindgut. This is carried further in *Paryphantopsis,* where only the anterior eighth of the rectal kidney arm is along the hindgut. That this is basically simple rotational change is shown by calculating the width to length ratios for the kidneys, which are 0.69 in *Paryphantopsis* and 0.65 in *Pilsbrycharopa.* The difference is within the probable range of measurement error and has no significance. *Pilsbrycharopa* represents an initial stage in pallial cavity shortening, which is carried further in *Paryphantopsis.* A more obvious change concerns the spatial relationships of the primary (ascending) and sec-

ondary (descending) ureters (KD). In typical Charopinae the two branches are either compacted together between the kidney lobes or a narrow strip of lung roof is visible between and a very slight angle is developed. In *Pilsbrycharopa* the ureter arms are clearly divergent with about a 28° angle. In *Paryphantopsis* the angle is greatly increased, reaching about 60° in dissected specimens. Obviously, continuation of this trend would result in development of a primary ureter transversely oriented in the pallial cavity, essentially paralleling the mantle collar edge. Such an arrangement is present in the Succineidae. The phylogenetic implications of this will be considered in another report.

Two additional pallial alterations require comment. In *Pilsbrycharopa* the external ureteric pore (KX) is located distinctly behind the anal opening (A); in *Paryphantopsis* the two open side by side at the posterior pneumostomal margin. *Pilsbrycharopa* has the principal pulmonary vein (HV) simple and unbranched; *Paryphantopsis* has multiple branches on the pallial roof.

From a pallial cavity extending one-half to five-eighths of a whorl apically in most Charopinae, *Pilsbrycharopa* shows a reduction to one-third of a whorl and *Paryphantopsis* to one-sixth. The proportionate shortening of the pallial cavity reduced the length of the pulmonary vein and hence the surface for both water and gas exchange. Branching of the vein restores balance to the system. Adjustment of the kidney and ureter to the "squeeze" was achieved by partial rotation of the kidney and opening of the angle between the primary and secondary ureter. This is only one of the many ways to compensate for the changed forms. The species described as *Flammulina nigrescens* von Möllendorff (1900, pp. 107-109) from Ponape, Caroline Islands has a shell form very similar to that of *Paryphantopsis,* but the pallial region is very different. In that species, the very elongated, bilobed kidney has become square in shape, very thick in the middle, the ureter arms right next to each, and the kidney does not deflect from the hindgut (unpublished data).

Genital structures of the two genera agree in essentials and differ widely in details. I have dissected over 100 species of endodontids from the Pacific Islands. *Pilsbrycharopa* and *Paryphantopsis* differ sharply from all of these in having a diverticulum (EL) on the epiphallus and in having the penial retractor muscle insert on the epiphallus rather than on the head of the penis. Structures of the prostate-uterus, spermatheca and vas deferens agree with the typical Charopinae. The penial differences were outlined above and are not discussed further. The most obvious difference in the two genera is the length of the penial retractor muscle (PR) – long in *Pilsbrycharopa,* very short in *Paryphantopsis.* Since the muscle arises from the diaphragm near the pallial cavity apex, shortening of the cavity shortens the muscle.

In *Paryphantopsis* the epiphallus and vagina are considerably longer than in *Pilsbrycharopa.* At first glance this appears anomalous, since shortening of the visceral hump in the former genus should tend to shorten the genital organs. Unfortunately the complete prostate-uterine areas of neither genus were available for study. From dissections of Pacific Island and Thailand taxa, I have learned that shortening of genital organs does not proceed uniformly, but is done on a zonal basis. Hence shortening may be restricted to the prostate-uterine section in this particular *Paryphantopsis,* but have proceeded in the lower area in the *Pilsbrycharopa.* The extent and variability of such zonal compaction can be appreciated by comparing the genital anatomy of *Durgella libas* and *Cryptaustenia gadinodromica* (see Solem, 1966, p. 54, fig. 9*a*; p. 62, fig. 12*b*). Both have shells of about 4 whorls and very large and elongated feet. In *Durgella* (*loc. cit.,* p. 54) the prostate-uterus is very long and the free oviduct, spermatheca and penis obviously short; in *Cryptaustenia,* the prostate and uterus are only slightly longer than the spermatheca and penial complex. *Megaustenia siamensis* (*Ibid.,* p. 83, fig. 19*a*) agrees more with *Durgella,* but has the penial complex convoluted and coiled. All three helicarionid genera represent about 1½ whorls reduction from the normal helicarionid pattern. Compaction of genital structures has occurred, but different zones have been affected to different extents.

This makes it exceedingly difficult to evaluate differences betwen the genitalia of two species that show partial visceral hump reduction, unless considerable data are available concerning the "normal" or "typical" structural pattern in species that do not show such shell reduction. Since *Pilsbrycharopa* and *Paryphantopsis* show major differences from Pacific Island genera, *i. e.,* possession of the epiphallic diverticulum, insertion of the penial retractor on the epiphallus, adjustment of the pallial cavity to compaction by kidney rotation, and internal penial configurations, we do not know what the typical pattern is in related genera.

SUMMARY

Pilsbrycharopa and *Paryphantopsis* present contrasting patterns of shell structure (Table 6), although they are very similar in anatomy. Changes from the normal charopinine pattern in the pallial complex of these genera indicate one method of coping with an early stage in visceral

Table 6

Shell Differences
Between *Pilsbrycharopa* and *Paryphantopsis*

Whorl count	*Pilsbrycharopa* 3¾ to 5+	*Paryphantopsis* 2¾ to 3⅛
Coiling pattern	tighter	much looser
Umbilicus	usually widely or moderately open	slight lateral crack or completely closed
Size of aperture	smaller	much larger
Radial sculpture	usually typical	reduced to periostracal fringes
Apical sculpture	spiral cords to equal radials and spirals	spiral and radial to pitted
Calcification	average to heavy	below average to slight
Diameter	1.9 - 7.3 mm median 3.88 mm	3.6 - 17.0 mm median 5.8 mm

hump reduction. If carried to a greater extent, evolution of slug-like forms becomes possible and interpretation of such patterns will aid in determining the affinities of slugs.

Pilsbrycharopa contains nine species. When more species can be dissected, it may be broken up into several genera, but in the absence of such data, I prefer to use a single broadly defined generic taxon. Several of the species may be compound taxa.

Paryphantopsis contains fourteen nominate units. They are known only from type material and the extent of intra- and inter-populational variation is unknown.

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