

THE LAND MOLLUSCA OF THE KERMADEC ISLANDS.

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PLATE XVIII.

I PROPOSE to deal with the Land Molluscs collected on Sunday Island, Kermadec Group, under four headings, viz., Historical Notes, Ecological Notes, Systematic Account, and General Conclusions.

1. HISTORICAL NOTES.

In 1854 H.M.S. *Herald* surveyed Sunday Island, and although Macgillivray collected five species of land shells which were presented to the British Museum, they were never reported upon. In 1856 Pfeiffer described two species collected by Lieutenant Chimmo: I presume Lieutenant Chimmo was one of the officers of the *Herald*.

Nothing more was heard from the Kermadecs until 1873, when Mousson recorded one of Pfeiffer's species, and added three new ones from a collection made by Dr. Graeffe. The same year E. A. Smith described a *Vitrina* received from Sunday Island via Auckland: this was one of Mousson's new species, and Smith's name has priority by a few days.

In 1892, when Hedley and Suter made up the Reference List of the Land and Freshwater Mollusca of New Zealand, they included four species only from the Kermadecs, one of Pfeiffer's species being omitted. Mr. Hedley has since pointed out to me that Pfeiffer had recorded in 1863 *Tornatellina Novoseelandica*, Pfr., from Sunday Island.

The Land Molluscan fauna of Sunday Island therefore stood at the end of 1907 thus—

Helicarion Kermadecensis (Smith) = *ultima*, Mousson.

Medyla exposita (Mousson).

Macrochlamys Kermadeci (Pfeiffer).

Endodonta modicella vicinialis (Mousson).

Helix Chimmoi, Pfeiffer.

Tornatellina Novoseelandica, Pfeiffer.

2. ECOLOGICAL NOTES.

Sunday Island is the summit of an immense volcano, the crater being about one mile and a quarter in diameter. To the north-west and south-west run two long spurs which are cut into innumerable deep short gullies. The crater ridge averages about 1,000 feet, the highest point being over 1,700 feet, the lowest about 200 feet. The two spurs are each over 1,000 feet practically their whole length. The only flat land on the island was a small piece on the west coast and another on the east coast, though on the north coast a series of terraces about 80 feet above sea-level existed. The crater was similarly provided with minor ridges, the level being calculated as 40 feet above sea-level. From a theoretical point of view the island seemed favourable for the finding of localized races due to isolation. It is densely bush-covered, has a heavy rainfall, 70 inches

being registered in ten months, and an equable climate, the minimum thermometric record being 50° F., the maximum just under 90° F. in the shade. Such conditions would suggest a veritable paradise for land molluscs, especially as there seems to be little bird life to molest them. However, all the animals found were very minute, and well distributed. Before proceeding to the island I looked up the literature regarding New Zealand Land Molluscs, but found little was recorded of the habitats of the species published. I therefore made a simple rule of "search everywhere". One result was the finding of some snails in most unlikely places, and as I have always been interested in the habits of the animals as well as in the shells I now offer my observations.

The bush consisted of various kinds of trees, nikau palms, and tree-ferns; the undergrowth was chiefly fern. The most abundant tree, the poutukava of Polynesia, was disliked by all molluscs, only very rarely the commonest species being found thereon. On account of the pumiceous nature of the soil it did not hold water, and therefore the wet quickly disappeared after rain. In the crater there were three lakes, two of large size; these were, however, of a mineral character; the third, of very small size, was fresh. In the west bay was a large freshwater swamp, and there were besides two very small permanent springs. I did not, however, find any freshwater molluscs, though I constantly searched for them. I also noticed that the wettest portions of the bush did not yield anything out of the common, but rather that molluscs generally were scarcer in such places. Immediately upon landing a snail was found, which is the one recorded by Pfeiffer as *Tornatellina Novoseelandica*. This lived on the flat under pumice-stones and rotten logs; I was much surprised to find a snail under dry pumice-stones, yet this species was there commonly living and with it a mollusc which I have called *Paralaoma Raoulensis*. It was noted in the case of the latter that the pumice-stones which harboured it were generally moss-covered on the top, and in wet weather it was observed near or among the wet moss. When the rain stopped it retreated, and was then only discovered very snugly hidden away in the crevices, whereas the former was not so particular. *P. Raoulensis* was later found throughout the island under rotten wood and stones and decaying leaves. It was collected all over the heights as well as on the level, though it was more common on the latter. My next find, also on the flat, was a few specimens of *Kieconcha Kermadeci* (Pfr.). These were taken on the underside of a piece of rotten wood, and diligent search in the locality revealed no more. It was later sparingly found distributed all over the island, the favourite location being under well-decayed nikau leaves on the ground, but it was a solitary creature, rarely more than one or two being sheltered by the same leaf, and many leaves would be turned without disclosing any.

Trochonanina exposita, Mousson, was next collected, and its habits were, to me, very curious. It was never met with on the level, but only on the crater ridge. It would there be noted very numerous for a short distance, and then absolutely none could be found, the patch

being exactly limited. No reason whatever could be discovered for this extreme localization, only about half a dozen patches being observed, though every effort was made to find more. The species had gregarious habits, living under rotten nikau leaves on the ground, and hundreds could be collected from one of these patches in a few hours. Neither height nor dampness was accountable for the patches, one of the most vigorous patches being in a relatively dry position on the sides of the cliffs only about 500–600 feet high. Upon the highest point, over 1,700 feet, a few were obtained. These lived principally under rotten logs and were of a grey colour, whereas all the rest were uniformly brown. Little variability in size, shape, or colour was apparent, though thousands were critically examined. This is more remarkable in view of the extreme variability of the close ally of the species, the Norfolk Island *T. insculpta* (Pfeiffer).

On the sides of the cliff, while cutting a path, I obtained a few specimens of another Charopoid shell from under a wet moss-covered stone. Upon examination it showed a fully armoured mouth, and was consequently classed under *Ptychodon*. It was afterwards commonly obtained all over the cliffs, and also rarely on the level, its most frequent habitat being under dead nikau leaves, but it did not despise rotten wood, and also sometimes hid itself under wet stones. It was never found under dry stones like the first two species mentioned. This shell I call *Ptychodon pseutes*. The preceding five were the only snails found during the first eighteen weeks, whilst our time was engaged fixing up living places, making food arrangements, etc., so that it will be understood that the snails were not obtrusive.

Having cleared up the aforesaid matters vigorous search was prosecuted throughout the island, with most delightful results. The only way to establish the presence or absence of molluscs was to thoroughly search the island section by section. It had been proved to me by this time that the only feasible method was to search while it was raining, when the snails were moving. After a couple of days' search on the flat at one end, with no result, the other and untouched bush-covered end was investigated. The bush, however, was so dense that it was quite impossible to see these minute molluscs, and my only chance was when a break came, which was rarely. However, a piece of black bark was turned over whereon glistened two minute cream Charopoids, which I feel justified in naming *Charopa exquisita*. This species was afterwards found on the undersides of moss-covered stones deeply embedded in earth on the side of the cliff. A few were found under dead nikau leaves on the ridge, and some more were discovered under loose dry pumice-stones in the crater. Only two or three were found at a time, and it is the scarcest shell I obtained, the majority of the specimens being not fully grown. The next day in the same place, searching among dead leaves, I came across a dead shell which I call *Pronesopupa senex*. Search as I would I could gather no more specimens that day, the minute size and dark coloration effectually prohibiting its discovery in the darkness of the dense bush.

At the same time a new shell was brought to me that had been obtained on the cliffs. It was a very close ally of *Ptychodon pseutes*, and I have called it *P. amanda* on account of its beauty. This discovery made me forsake the flat and commence the investigation of the heights at once. I had noted in literature that snails from different altitudes differed specifically, and sometimes generically, from those living on the low level. The first day revealed a new shell in numbers under stones, dead nikau leaves, and rotten wood, well stowed away at about 1,200 feet. It was a cream Charopoid, which was at first thought to be the same as the one found on the level, but comparison showed them to be absolutely different. I have named this *Charopa Macgillivrayana* in honour of the first naturalist to exploit Sunday Island, and whose collections received no recognition. I find, in the British Museum, that he obtained all the species known at the end of 1907, though none were described from his collection. This shell was well distributed, in some places being almost numerous, but the small size prevented rapid collecting, each specimen having to be taken from its hiding-place by means of a pen nib reversed in a pen-holder. I offer this suggestion to collectors who have to get minute shells out of crevices of wood. Associated with it, under nikau leaves, were found *Ptychodon pseutes* and *amanda*, the latter rarely occurring. The last named was later found all over the heights, but it was a somewhat solitary animal, usually confining itself to its favourite rotten nikau leaves. This successful foray encouraged to further search, and as it rained all the night I set out for the same place the next morning to collect more specimens and perhaps add another new species. A great surprise was, however, in store, as approaching the hunting-ground my friend Mr. Roy Bell, one of the settlers of the island and who generally accompanied me on my excursions after these minute animals, noted a new larger snail climbing on a moss-covered tree-trunk. Immediately every idea was given up to the very careful inspection of all the tree-trunks in the immediate vicinity, with the result that they were found to have a peculiar and interesting snail fauna of their own. Previously tree-trunks had been casually examined, but with no result save rarely a *Tornatellina*, which I confused with the ground-living *T. Novoseelandica*. Furthermore, it had been mainly dry weather when such searching had been undertaken. I might point out that hunting for these tree-living minute snails was not a delightful occupation, as they only fed while it was raining or immediately afterwards. It needed all the zeal of the enthusiast to walk out in the pouring rain, climb 1,000 feet cliffs up slippery and dangerous goat-tracks, becoming wet and bedraggled at every footstep, wade through dripping ferns knee-deep, all to be done before the happy hunting-ground was reached, then to stoop low down round tree-trunks while the rain trickled down the neck, only stopping to wipe the wet out of one's eyes, already strained to a hurtful point to distinguish these dark-coloured atoms from the deep-green background. Two or three hours was quite sufficient at a time, as no rest could be taken owing to the dripping state of everything, including ourselves. It was not the

least use looking for these snails in the dry weather, as they hid themselves away in the moss, and were quite erratic in their choice of trees. From one tree-trunk a dozen might be procured, while careful examination of the adjoining half a dozen trees might not disclose an additional specimen. Further, this discrimination referred even to individuals as well as species. It was early observed that particular kinds of trees were never frequented by snails, but it was later absolutely proved that, even among the favoured species of trees, a further particularization was carried out to individuals, sometimes even to parts of one tree. I well remember one tree consisting of four separate limbs; from the first I obtained twenty odd specimens, and anticipating a fine haul commenced on the other three, with a total result of *one* specimen. Yet an investigation carefully carried out provided no solution. In addition localities differed; no place afterwards gave such results either as to species or individuals as the occasion now referred to, yet these tree-dwellers were afterwards recognized all over the island on the highlands. A few were obtained as stragglers on the flat, and it may be they were as common on the level, but the bush was there so dense that it was difficult to see even in dry weather, and an absolute impossibility in dull wet weather. However, to particularize the tree snails found on this eventful field-day. Four species were obtained associated together; the first one found and the largest of the four as well as the largest Charopoid was a *Ptychodon*, with which I have associated the name of Mr. Roy Bell, as an appreciation of his help and comradeship in the discovery of these forms. The specific name *Royanus* will always distinguish this. The next largest was a most beautiful shell which I refer to *Calymna*, and specifically call *arboricola*. It was much scarcer than the preceding. The third was a delightful *Charopa* with a resemblance to Reeve's *anguicula*, so I have termed it *pseudanguicula*. A very minute brownish shell completed that day's surprise list, and I propose to designate it *Flammulina miserabilis*. It is a wretched-looking little shell, and it was a miserable job keeping the eyes focussed to pounce upon it.

Such a fine haul urged to further efforts, and despite the continued and uninviting rain, a day later the trees in the same neighbourhood were again undergoing critical investigation with interesting results. On the cliffs, almost at the top, the *Pronesopupa*, previously represented by one dead shell from the level, was found numerously on tree-trunks, which were not moss-covered and unassociated with any of the previous day's finds. It appeared to have hidden away in crevices in the bark, and only came out after a deal of rain. Higher up, just on the ridge, an entirely different *Tornatellina* was noted on the moss-covered tree-trunks along with the *Tornatellina* I had confused with *T. Novoseelandica*, Pfr. In this case again the Charopoid forms were not found living with these, and this *Tornatellina* was always a very scarce shell. Considered criticism of the preceding results induced the idea of new forms, perhaps existing due to localization. Excursions to different parts of the island destroyed this, no new forms being obtained, but the known ones were proved to be well

distributed. However, on the flat a new *Tornatellina* was found upon a patch of Kawa Kawa or Pepper plant. When raining it was seen crawling up the stems and under the leaves in fair numbers. Nowhere else was it found save on this one small plot; I could not discover where it hid itself in the dry weather, though every wet day it was noted. It appeared quite an aberrant style of *Tornatellina*, the animal being quite unlike those previously examined, so that it was quite a pleasure to find that Pilsbry had created a new genus for either it or a very close ally. This species was immediately recognized as *T. inconspicua*, Brazier, from Lord Howe Island, when I showed it to Mr. Hedley at Sydney. I concluded that many prior names have been bestowed upon it, but I will note these in the systematic portion later. Upon the other side of the island another species of *Tornatellina* was observed. It was, however, noted all over the higher portions of the island under dead leaves, stones, rotten wood, etc.

By this time it seemed that the snail fauna must be pretty well known, yet the largest and most noticeable species had escaped our search. I allude to *Helicarion Kermadecensis* (Smith), which was simultaneously described by Mousson, who received it from Dr. Graeffe, who had stated it to be "numerous". Such was certainly not the case at this time, and therefore it was thought advisable to investigate the problem. It was considered probable that, as it was undoubtedly not "numerous" anywhere we had searched, its last refuge might be the highest point of the island, known as Moumoukai. It was therefore at once decided to be necessary to thoroughly search that locality as a forlorn hope. Much to my delight the first excursion provided one specimen living under a fallen nikau leaf, and among dead fern-leaves a couple of broken dead shells were noted. My second and third trips were unsuccessful, but on the fourth a second live specimen was obtained from under a fallen nikau palm leaf. It was now concluded that a beautiful clean animal like this *Helicarion* would not live among dirty leaves, but should be a tree-liver. Following up this line of investigation did not solve the problem. Two other members of our party, however, proved this theory correct, and to them belong the credit of the rediscovery of this beautiful animal. Messrs. W. R. Brook Oliver, now a member of this Society, and W. L. Wallace, while making a trip over Moumoukai, camped overnight on the top, and in the dew of the early morning a *Helicarion* was observed crawling on the bulbous head of the nikau palm. Upon climbing up the palm the underside of the leaves was found to be the station of the missing *Helicarion*. Hearing this, Mr. Roy Bell and I immediately visited the place, and, camping there, were well rewarded. It was found that only a very small colony existed, that its limits could be exactly defined, and that only a few trees were selected. Having fixed their station, search was renewed all over the island, but without success. No other colony was discovered at any altitude, so that it seems that this species has become almost exterminated in a space of forty years without visible enemies. If this colony be the only existing remnant

of this species, to what can it owe its extinction? As before quoted, Dr. Graeffe termed it "numerous", and I find Macgillivray collected it. There is not the least probability that either of these obtained it from the colony I have denoted, which was the south-west aspect of the highest peak of the island.

In the spring of the year, under stones on the level, another *Para-laoma* was obtained, to which I attach the designation *ambigua*. Fair numbers were collected, and it gave rise to much disquietude on my part. After nine months searching, to note a new shell on the well-looked over level was unexpected, while the discovery that *Helicarion Kermadecensis* was confined to a very small patch, and *Tornatellina inconspicua* to an even more restricted area, caused me much misgiving. I had anticipated I should be able to confidently state I had collected all the land molluscs of Sunday Island, but such facts as these destroyed my complacency. Renewed efforts were made, and other parts of the island explored, with no further results. Consequently, though I hope I have made known the whole of the non-marine molluscan fauna, I feel I can make no justifiable claim to have done so. A strange mollusc must here be dealt with. Shells were dredged in various depths, up to 25 fathoms, which I immediately recognized as non-marine though of Rissoid appearance. Later, Mr. W. L. Wallace discovered them alive crawling over wet moss on the sea-cliff of Dayrell Island, one of the outlying islets. Then Mr. W. R. Brook Oliver discovered them on the mainland in a similar situation. I searched very closely, but only found a few well hidden in crevices where water trickled down after heavy rain. From their occurrence in dredgings they would have been collected numerous had their station been discovered. From shell characters they would be referable to *Assimineia*, but they are inoperculate. Upon examining the Lifu marine Mollusca in the Manchester Museum, I recognized my puzzling shell in the type of *Barleeia chrysomela*, Melv. & Standen. This species was described from dead specimens found among shells and collected at Lifu, and the type has the mouth badly broken. I cannot discern the least difference between the Lifu shells and my own, but *Barleeia* is a very bad selection for generic location.

It seems of interest to note the great distinction between the tree-dwelling species and those found upon the ground. Owing to falling leaves, some of the former were occasionally noted on the ground, but none of the ground-livers were ever noticed to occur on trees.

The tree-dwelling molluscs were—

- Helicarion Kermadecensis* (Smith).
- Ptychodon Royanus*, Iredale.
- Calymna arboricola*, Iredale.
- Flammulina miserabilis*, Iredale.
- Charopa pseudanguicula*, Iredale.
- Pronesopupa senex*, Iredale.
- Tornatellina* sp., a slender form.
- T.* sp., near *bilamellata*, Anton.
- Elasmias inconspicua* (Brazier).

To the ground were confined—

- Fanulum expositum* (Mousson).
Kieconcha Kermadeci (Pfeiffer).
Ptychodon pseutes, Iredale.
P. amandus, Iredale.
Charopa Macgillivrayana, Iredale.
C. exquisita, Iredale.
Paralaoma Raoulensis, Iredale.
P. ambigua, Iredale.
Tornatellina Novoseelandica (Pfeiffer).
T. sp., conoid form.

3. SYSTEMATIC ACCOUNT.

The account herewith given is purely conchological. I am incompetent to deal with the anatomy of the snails obtained, though I have ample material in spirit which will be placed at the disposal of any anatomist willing to study and report upon them. It must be understood that the notes given here are mainly critical and are based upon shell features alone, and I would point out that I must conclude that even in the study of land Mollusca a fair consideration should be given to shell characters when attempts at classification are made. I find that Mollusca with heterogeneous shell characteristics are lumped together because some small anatomical feature is found constant, while shells, conchologically similar, are placed far apart on account of anatomical differences. There seems to be more reason in the latter procedure than in the former, but the anatomist seems to have outdone his brother conchologist in confusing material with immaterial differences. It is also imperative that for the study of zoogeography the exact generic location should be ascertained if possible, since the more restricted the genus the more accurate will be the conclusions drawn. The placing of a shell in any genus does not help much, and the consequent differentiation in the ensuing part is due to an attempt to observe the relationships of the molluscs collected. I shall have further to say on this subject under the generic names utilized.

GENUS HELICARION.

Helicarion, Férussac, Tabl. Syst. Moll., 1821, p. 24. Copy in Brit. Mus. (Nat. Hist.).

Type (by subsequent designation), *H. Cuvieri*, Férussac.

HELICARION KERMADECENSIS (Smith).

Vitrina Kermadecensis, E. A. Smith, Ann. Mag. Nat. Hist., ser. IV, vol. xi, p. 288, 1873.

Vitrina ultima, Mousson, Journ. de Conch., vol. xxi, p. 110, pl. vii, fig. 1, 1873.

Hab.—Sunday Island, Kermadec Group. Living upon the under-side of the leaves of the nikau palm on the highest point of the island only.

The generic reference would seem in this case to be easy, as Smith compared it with *Strangei*, Pfr., an Australian species, which should

certainly be congeneric with the Australian *H. Cuvieri*, the type of the genus. It has been shown that the glassy shells commonly referred to *Helicarion* cover very differently constituted animals. I note that the coiling of the Indian shells, for instance, is quite regular, and quite unlike the rapidly increasing, somewhat excentric coiling of the present species, which agrees with Australian shells.

In the *Trans. New Zeal. Inst.*, vol. xvi, 1883, p. 204 (1884), "*Vitrina Kermadecensis*, Pfr." is included in the New Zealand List as occurring at "Hobson's Glen, Auckland (T. W. Kirk)". This record is quite untrustworthy, as no other worker has found it in this locality; secondly, on the same authority European shells such as *Neritina fluviatilis* were recorded from the Wanganui River; and thirdly the specimens described by Smith were forwarded to him by a close relative of T. W. Kirk, so that an erroneous locality might have been easily added.

Genus FANULUM, nov. gen.

This name is proposed for the small group of molluses typified by *Trochonanina exposita*, Mousson, and which includes *Helix insculpta*, Pfr., and *Medyla imitatrix*, Sykes. They have obviously little relationship with *Trochonanina*, and cannot remain in *Medyla*. My friend Mr. G. K. Gude has pointed out to me that the genus *Medyla* was proposed by Albers (*Die Heliceen*, 2nd ed., 1860, p. 47) to replace *Vitrinella*, Gray, which was preoccupied by C. B. Adams, and as type was designated *Nanina viridis* (Quoy). In the *Gen. Rec. Moll.*, vol. ii, app., p. 642, 1858, Albers, however, was anticipated by H. and A. Adams, who had provided *Otesia* for exactly the same group. Consequently *Medyla* is quite unavailable. In the *Proc. Malac. Soc.*, vol. iii, pp. 330-3, 1899, Suter gave some anatomical notes upon *H. insculpta*, Pfr., and referred it to *Medyla* (*Euplecta*), and wrote that, on account of anatomical similarities, *Kaliella*, *Sitala*, *Coneuplecta*, and *Euplecta* would probably be best regarded as sections of one genus. The same writer later, in the *Index Faunæ Novæ Zealandiæ*, 1904, p. 63, referred to the Kermadec species as *Medyla* (*Coneuplecta*). Under such conditions, and inasmuch as I do not advocate the lumping of such diverse groups as regards shell characters, I am putting forward the above new name.

FANULUM EXPOSITUM (Mousson).

Trochonanina exposita, Mousson, *Journ. de Conch.*, vol. xxi, p. 111, pl. vii, fig. 2, 1873.

Hab.—Sunday Island, Kermadec Group. Living on the ground in local scattered colonies on the underside of rotten nikau palm leaves, only on the higher ground.

This species, as previously stated, was characterized by its occurrence gregariously in a few widely separated colonies. It was found on the highest point of the island, occurring as an aberration of a white colour, the regular colour being brown, and living under rotten logs in a solitary manner. The few specimens collected seemed somewhat more flattened, but some more conical ones were included, so that the only appreciable difference to grasp is the coloration. Yet the

animals had somewhat different habits, as above noted. On account of these differences I carefully preserved some animals for investigation, and would refer to them as var. *Moumoukai*, nov. var. By this means it may be able to fix this variation. This shell is practically smooth. The two described Norfolk Island forms which I would refer here, *insculptum* and *imitatrix*, are both heavily sculptured on the adult whorls, but the initial ones are smooth. On Norfolk Island also occurs a smooth race with a tendency to form sculpture, from which I should deduce that the unsculptured form is the oldest. Not much variation is shown in shape in the Kermadec shells, but the Norfolk Island *insculptum* seems to have a tremendous range, from a flattened conical shape to a high turreted one, which latter has become fixed in the species *imitatrix*. A still undescribed Norfolk Island smooth form is somewhat flattened, resembling the Kermadec species.

Genus KIECONCHA, nov. gen.

This generic name is proposed for the shell called *Helix Kermadeci*, Pfr. Mousson included it in the genus *Microcystis* in the Journ. de Conch., vol. xxi, p. 111, 1873. Hedley and Suter allowed it to remain in the same genus in the Reference List of the New Zealand Mollusca, but later Suter transferred it to *Macrochlamys*.

The following notes regarding the generic name *Microcystis* may be of interest. In the Index Moll. Beck introduced on p. 2 as a sub-genus of *Nanina*, Gray,

“MICROCYSTIS, Beck.

1. *M. pellicula*, Beck. F.H. ix, A 5-7 (?). Antill (?). An *H. Helicolimax pellicula*, F. (?).
2. *M. trifasciella*, Beck. I. Jamaica. An *H. trifasciata*, Stentz (?).
3. *M. pictella*, Beck. I. Jamaica.
4. *M. ornatella*, Beck. I. Opara.
5. *M. filiceti*, Beck. I. Pitcairn.
6. *M. amænula*, Beck. I. Opara.”

Sherborn gives a note to the following effect: “This appeared in 2 pts.; I, pp. 1-100, 1837; II, pp. 101-124, perhaps first in 1838. This was a preliminary issue. The final issue of pp. 1-124 and pp. 1-8 (the n.spp.) was issued in 1838.”

From this the above is absolutely the earliest introduction of *Microcystis*, and unless the first species can be considered as equalling “*pellicula* Férussac” it must be regarded as a *nomen nudum*. The pp. 1-8 (the n.spp.) mentioned by Sherborn, which were issued in 1838, contain descriptions of the five succeeding species mentioned after *M. pellicula*, and these are all described as “*Nanina (Microcystis)*”, and from this introduction it would appear that *Microcystis* must be quoted. The following is the order:—

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|-------|--|--------------|---------------|---------------|
| p. 2. | <i>Nanina (Microcystis) trifasciella</i> , | p. 2, No. 2. | <i>Hab.</i> , | Insulam Cuba. |
| p. 3. | „ | „ | „ | Ins. Jamaica. |
| „ | „ | „ | „ | Opara. |
| „ | „ | „ | „ | Pitcairn. |
| „ | „ | „ | „ | Opara. |

What should be considered the type of this heterogeneous mixture requires a little consideration. In the Proc. Zool. Soc. Lond., 1847, p. 170, Gray, being in a quandary, wrote: "(?) *Microcystis*, Beck. ? *Helicolimax*, sp. Férus. *M. pellicula*." It would seem, in face of the data given, that this type-designation can be ignored.

In 1860, in *Die Heliceen*, 2nd ed., p. 49, *Microcystis*, Beck, is included, and "Typus: *H. ornatella*, Beck" definitely stated. I should therefore conclude that this might be accepted, and *Microcystis* thus retained in the conventional usage. Accepting *ornatella* as the type of *Microcystis*, I would not recognize *Kermadeci* as congeneric unless that generic name was used with a very wide significance. For the purposes of zoogeographical study genera of wide limits are valueless, and I therefore do not adopt them. The transference of the species to *Macrochlamys* cannot be defended, as Godwin-Austen has shown that the only species really referable to *Macrochlamys* (save a Mauritian form, probably introduced) are confined to India. The only other generic name suggested in connexion with this species was *Microcystina*, Mörch, which, however, was founded on a Nicobar species, and is quite unsuitable for the Kermadec shell. Granting that *Kermadeci* might prove from animal characters to be referable to *Microcystis*, *sensu lato*, the shell characters deserve recognition by some other name, especially as typical *Microcystis* occur on Norfolk Island. I have therefore introduced the new name given above, and have assigned to it full generic rank until such time as the animals are dissected and compared with the type of *Microcystis*.

KIECONCHA KERMADECI (Pfeiffer).

Helix Kermadeci, Pfeiffer, Proc. Zool. Soc. Lond., 1856, p. 326.

Hab.—Sunday Island, Kermadec Group. Living under rotten nikau leaves and rotten wood on the ground.

Pfeiffer's description reads "*turbinata*", and the measurements are given as diam. maj. $3\frac{2}{3}$, min. $3\frac{1}{3}$ mm.; alt. $2\frac{1}{2}$ mm. This suggests an immature specimen, and the type, still preserved in the British Museum, though in imperfect condition, confirms that suggestion. The adult is conical, recalling *Trochonanina*, but the last whorl is not keeled and the base is rounded. I counted six whorls regularly increasing and descending; the aperture not oblique, almost regularly broadly sublunate; columella nearly vertical, somewhat expanded; no umbilicus.

Genus PTYCHODON, Ancey.

Ptychodon, Ancey, Bull. Soc. Mal. France, vol. v, p. 372, 1889.

Type (by original designation), *Helix leioda*, Hutton.

The correct attachment of the Polynesian, Neozelanic, and Australian 'Endodonts' is difficult. It is somewhat strange that much of the confusion seems due to the action of the maker of modern terrestrial malacology. Thus Pilsbry, when he evolved order out of chaos in his monumental *Guide to the Helices*, wrought some little confusion in this group by lumping all the Polynesian 'Endodonts' in *Endodonta*. He has been somewhat slavishly followed by later writers who have

overlooked the fact that he subsequently corrected his own erroneous conclusions.

Whilst collecting I separated my shells into their apparent genera. Unfamiliar with land molluscs, I was unaware of the subtleties constituting the different groupings, and simply knew at sight a '*Flammulina*' by shell characters from a Charopoid, and knew a Charopoid with an armed mouth was a *Ptychodon*. Attempting to gain information I consulted the unquestioned authority, Pilsbry's *Guide to the Helices*. I there found the family Endodontidæ comprising *Endodonta* and *Flammulina*, and that *Endodonta* covered *Ptychodon*, *Charopa*, *Phenacharopa*, etc., these 'genera' being regarded as sections only. The typical *Endodonta* seemed to show little relationship as regarded shell characters with my 'Endodontoid' forms, and I also observed that Pilsbry himself seemed to have had no little trouble in attempting to produce a satisfactory classification of these minute forms. His final diagnosis of the genus *Endodonta* reads: "Animal having distinct grooves above the margins of the foot, but no caudal mucous gland."

One of the few criticisms of this classification is that by Moellendorff, who, writing upon the Land Shells of the Caroline Islands (Journ. Malac., vol. vii, p. 107, 1900), recorded the genus *Flammulina*. The animal was dissected by Suter, who observed: "the presence of a peripodial groove, a caudal pore, the plaited jaw, and the radula clearly indicate that it must be classed under *Flammulina*." Moellendorff therefore wrote: "As I have said elsewhere, I consider Pilsbry's arrangement of including the well-defined family of Phenacohelicidæ, Suter (= *Charopidæ*, Hutton) within his Endodontidæ as a regrettable step backwards. The two families are not only conchologically well distinguished, but have different types of jaw and radula, and the Phenacohelicidæ possess a mucous pore . . . This (Suter's above quoted) confirmation of my classification is interesting for two reasons. Firstly, it proves that shell characters are not by any means so unimportant as modern malacology tends to consider them, and secondly that the Phenacohelicidæ extend much more to the North than hitherto known, the most northern habitat observed being New Caledonia." It will be noted that both Moellendorff and Pilsbry agree in accepting as a differential feature the absence of a caudal mucous pore.

I would now suggest that careful criticism of shell characters will prove as beneficial to malacology as the premature grasping of misunderstood animal characters. Thus, much as it displeases me, I must call for reconsideration the presence or absence of a caudal mucous gland as being of primary or even secondary importance. The shell I hereafter name *Ptychodon Royanus* is a typical Polynesian 'Endodontoid' in shell characters, and it covers an animal possessing a well-developed caudal mucous gland in life. It is a tree-dweller, and it should be noted that of the four discoidal forms living on tree-trunks, from shell characters two are easily referable to *Flammulina*, the third is the above-noted *Ptychodon*, and the fourth is a typical *Charopa*. I would suggest that all four possess a caudal

mucous pore, whilst I should not be surprised to find that no ground-living Endodont was possessed of such a feature. It should be remarked that no *Flammulina* was found permanently ground-dwelling, and my explanation of the presence of a caudal mucous pore was quite simple! To the snails which had taken up a tree-life a mucous gland was a necessity, whilst to those ground-dwelling it would be a luxury. Whether in these latter it had become aborted through disuse, or in the former it had been developed through necessity, and also the exact relationship of *Flammulina* and 'Endodonta', I must leave to the anatomist to puzzle out. My own conclusions as to the classification put forward by Pilsbry is that it was based upon too little material, and too much value was given to a really insignificant feature. Had more material been handled it is probable that a tree-living Endodont might have been included. As a matter of fact little damage has been done, as, after a very few animals were dissected, the molluscs were almost entirely grouped by means of shell characters. Having thus mentioned the general classification I would deal with the generic names *Ptychodon* and *Thaumatodon*.

Ptychodon was proposed for the Neozelanic *leioda*, Hutton. In the Man. Conch., ser. II, vol. ix, p. 25, Pilsbry introduced *Thaumatodon* as a section of *Endodonta*. Under this a large number of Polynesian and New Zealand snails are classed. No type is named, but as *multilamellata*, Garrett, is selected for illustrative purposes, I would designate that as type. Now from the diagnosis of *Ptychodon* and *Thaumatodon* given by Pilsbry, no differences can be observed, and the two seem absolutely synonymous. If they can be maintained from shell characters alone, a multitude of sections can be introduced. But my criticism of Pilsbry's figures and description of *multilamellata* (I have seen many specimens from Garrett's own collection, but none agreeing with Pilsbry's account) leads me to recognize in it a close relation, judging from shell characters, of my caudal mucous pore-bearing *Ptychodon*, so that it is quite possible that *Thaumatodon* may come into use for such forms. In the meanwhile it would be much better to drop *Thaumatodon* and refer to these armoured Charopas as *Ptychodon* only.

As I have noted, Pilsbry called all the Polynesian Endodonts *Endodonta*, whatever their shell characters might be, and in this he has been followed by most Australian and New Zealand writers. But in 1906 he and Ferris introduced the genus *Radiodiscus* (Proc. Acad. Nat. Sci. Phil., 1906, p. 154) for a shell from Arizona, and wrote: "In the Endodontidæ, where small differences in the shell characterize extensive series of species, it seems desirable to recognize as generic such readily definable groups as *Radiodiscus*." Later, writing on the Non-marine Mollusca of Patagonia in the Reports Princeton Univ. Exped. Patag., 1896-9, vol. iii, p. 516, 1910, this was reprinted, and then was added—"Some Tasmanian snails have a great resemblance to *Radiodiscus* in size, form, and sculpture, a resemblance possibly due to convergence, but perhaps indicating affinity. I have not been able to actually compare specimens. On account of their spirally sculptured embryonic shells Hedley has referred them to

the sub-genus *Allodiscus* of the genus *Flammulina*." The species indicated by Pilsbry are figured by Petterd & Hedley (Rec. Aust. Mus., vol. vii, p. 288, 1909), and the shells called *Fl. Roblini*, Petterd (pl. lxxxiv, figs. 19-21), and *Fl. curacoæ*, Brazier (pl. lxxxiii, figs. 14-16), have certainly an unfamiliar appearance when contrasted with typical *Flammulina*. It might be noted that Hutton considered *Helix ide*, Gray, such a typical *Charopa* that he cited it as the type, whereas on account of anatomical features, including the possession of a caudal mucous gland, it is included in *Flammulina* by Pilsbry, though a new sectional name was bestowed upon it, viz. *Suteria*, to replace *Patulopsis*, Suter, preoccupied.

I would endorse Pilsbry's dictum, above quoted, on the introduction of *Radiodiscus*, and advocate the introduction of many new names to be used generically in the family Endodontidæ. Through the kindness of Mr. J. H. Ponsonby I have been enabled to examine many Australian Endodontids, and I note many of the forms of shell differ: and it would seem that examination of the apical features might lead to a better understanding, since so far I have observed that similar shell characters are subsequent to similarly constituted protoconchs. I hope to have further to say on this subject later.

PTYCHODON ROYANUS, n.sp. Pl. XVIII, Fig. 10.

Shell discoidal, spire not sunken, last whorl scarcely descending, widely umbilicate. Whorls 4, in very old shells 5. Colour red-brown, sometimes unicolor, sometimes flammulate with darker. Protoconch consisting of one whorl finely sculptured with closely set slanting radial threads, over sixty being easily counted; adult whorls with a sculpture of straight erect sharp lamellæ, regular and equidistant, between which are clearly marked minor threads. On the first adult whorl there are about fifty regular lamellæ with a couple of minor threads between each; the next has sixty lamellæ, more widely spaced, with generally three minor threads intervening, and so on. Umbilicus deep and wide, almost one-third the diameter of the shell, sides steep, exposing previous whorls. Aperture lunate, lip thin. Apertural armour: on the parietal wall are three long prominent slender lamellæ, two of which project so as to be observed when the shell is viewed sideways and displacing five of the lamellæ of the previous whorl; sometimes the third and lowest also is thus observed, but generally it does not pass the outer lip. On the outer lip are five lamellæ; two strongest agreeing in position with the two major ones on the parietal wall, a third weaker agreeing with the weaker parietal lamella, and two still smaller situated on the basal curve; they can scarcely be said to be placed on the columella. This description is drawn up from an old specimen with a max. diam. of 4 mm. The teeth vary somewhat with age, as a young shell shows four well-defined parietal lamellæ, a thin slender one occurring between the two prominent ones above noted. Diam. max. 3.4, min. 3 mm.; alt. 1.5 mm.

Hab.—Sunday Island, Kermadec Group. Living on the moss-covered trunks of trees.

PTYCHODON PSEUTES, n.sp. Pl. XVIII, Fig. 12.

Shell sub-discoidal, spire slightly raised, narrowly umbilicate, sutures deeply impressed, last whorl descending to about half-way down the penultimate whorl. Colour pale reddish brown with darker flammulate markings. Whorls $4\frac{1}{2}$, well rounded; first whorl and a half, constituting the protoconch, radially sculptured with fine slanting threads, abruptly ceasing when the adult sculpture of straight, even-spaced lamellæ commence, about sixty being counted on the first adult whorl; the lamellæ regularly increase in number, but the spaces widen a little with age, and minute threads occur betwixt. Umbilicus narrow and deep, exposing the previous whorls, about one-fourth the diameter of the shell. Aperture lunate, lip thin. Apertural armour: well inside on the centre of the parietal wall is situated a long bifurcate lamella; on the columella are two separate, somewhat crass, conical teeth, the basal one the larger; on the inside of the outer lip, situated far back, are six lamellæ, one in the upper bend of the whorl almost unnoticeable and five even-spaced ones lower. Diam. max. 1.75, min. 1.6 mm.; alt. 9 mm.

Hab.—Sunday Island, Kermadec Group. Living under stones, rotten wood, and dead nikau leaves.

PTYCHODON AMANDUS, n.sp. Pl. XVIII, Fig. 11.

Shell sub-discoidal, spire slightly elevated, narrowly umbilicate, last whorl descending to about one-third the depth of the penultimate whorl. Colour white. Whorls and sculpture as in preceding. Aperture regularly lunate, outer lip thin, sharp. Apertural armour: much as in preceding; on the top of the outer lip inside is a very small thin lamella which is almost unnoticeable; four equal-placed lamellæ can be seen situated well back on the inside of the outer lip. Diam. max. 1.75, min. 1.5 mm.; alt. 1 mm.

Hab.—Sunday Island, Kermadec Group. Living under stones, rotten wood, and dead nikau leaves.

This is one of the quaint puzzles which occur to the thinking collector. To the systematist handling the shells it would only appeal as a well-marked colour variety, yet I am quite satisfied it is a well-differentiated species. I studied it on the island for nine months, and though the only appreciable difference was the colour, it occurred separately from *P. pseutes* and was always recognizable; it occurred all over the island, yet no intergradation as regards colour was met with. I have described a typical shell, but as regards the apertural characters some *P. pseutes*, Pfeiffer, seem to show exactly the same.

I note that of a Tasmanian shell Petterd & Hedley (Rec. Austr. Mus., vol. vii, p. 288, 1909) write: "*Endodonta antialba*, Beddome. Noted for the fact that half the specimens are milkwhite, and the balance brown colour." I do not know whether the conditions under which this shell lives have been reported upon, and therefore cannot be sure whether it provides a parallel case to the pair I have separated. In view of my experience, field observations of *antialba*, Beddome, might prove interesting.

Genus CHAROPA, Albers.

Charopa, Albers, *Die Heliceen*, 2nd ed., 1860, p. 87.

Type (by original designation), *Helix coma*, Gray.

(Not *Charopus*, Erichson, *Entomogr.* 1840, p. 119.)

This genus name provided for the toothless 'Endodonta' *Helix coma*, Gray, has been used to cover many different styles of toothless 'Endodonta'. It seems certain that instead of lumping, if splitting were indulged in we should have a better chance of gauging the immediate relationships of the species described. It would be easy to form sections of *Ptychodon* where teeth in varying numbers and shapes are present, but it is not so easy in *Charopa*, yet my Charopoid forms are certainly of diverse origin. I am of the opinion that my tree-living *Charopa* has a caudal mucous gland, and its shell characters certainly differ from those of the ground species. As noted previously, Pilsbry has recently advocated the splitting of the genus *Endodonta*, though it was due to his influence that these well-marked genera were merged into *Endodonta*. Australasian workers have not yet accepted his retraction, and most recently described species of *Charopa* have been placed in *Endodonta*.

CHAROPA MACGILLIVRAYANA, n.sp. Pl. XVIII, Fig. 6.

Shell sub-discoidal, whorls regularly coiled, spire not sunken, last whorl scarcely descending, widely umbilicate. Colour cream. Whorls $3\frac{1}{2}$; first whorl and a half, constituting the protoconch, smooth; adult sculpture consisting of straight, evenly spaced, erect lamellæ, about sixty on the first adult whorl and 80 to 90 on the next, becoming uneven and more widely spaced towards completion of whorl; interstices with minor threads. Aperture regularly lunate, outer lip thin, sharp. Mouth unarmed. Umbilicus deep, about one-fourth the diameter of the shell, exposing all the previous whorls. Diam. max. 2, min. 1.75 mm.; alt. 1 mm.

Hab.—Sunday Island, Kermadec Group. Living under stones, rotten logs, etc., on high land only.

CHAROPA (DISCOCHAROPA, n.subgen.) EXQUISITA, n.sp. Pl. XVIII, Fig. 8.

Shell minute, discoidal, thin, spire slightly sunken, widely umbilicate. Colour cream. Whorls 3, well rounded, last whorl scarcely descending. Sculpture: apical quarter whorl unsculptured; the remainder of the first whorl sculptured with very fine radial lamellæ, 40 in number; succeeding whorl with straight, even-spaced very closely set radial lamellæ, about 100 in number, increasing on last whorl to about 120, only due to rather wider spacing. Aperture lunate, lip thin, mouth unarmed. Umbilicus deep and very wide, exposing all previous whorls and more than one-half the breadth of the shell. Diam. max. 1.25, min. 1 mm.; alt. 5 mm.

Hab.—Sunday Island, Kermadec Group. Living under rotten wood, stones, etc.

Mr. J. H. Ponsonby has generously allowed me to examine his fine collection of Australian Endodonts, and among them I noted a series

bearing the data "Bassi, Brazier, 6 miles S. of Hobart. Under rocks 3 or 4 feet deep. Beddome". Under the microscope these were seen to be, comparatively speaking, gigantic facsimiles of the shell above described in form and sculpture, even to the apical characters. The coincidence of habitat must certainly indicate relationship, and I note that Suter (Ann. Mag. Nat. Hist., ser. vi, vol. xiii, p. 64, 1894) refers 'bassi' to the section *Gerontia* of *Flammulina*. Such a location is conchologically impossible, so that if Suter's shells were similar to the ones I have examined the species cannot be correctly placed in *Charopa*. As the apical features differ from those of *Charopa* and are constant in such distant localities as the Kermadecs and Bass's Straits, I propose the new sub-generic name DISCOCHAROPA with *Charopa exquisita* as type.

CHAROPA PSEUDANGUICULA, n.sp. Pl. XVIII, Fig. 9.

Shell discoidal, whorls loosely coiled, spire slightly elevated, last half whorl somewhat descending, widely umbilicated. Colour buff, regularly flammulate with rich red brown. Whorls $3\frac{1}{2}$; first whorl and a half unsculptured, including a bulbous first whorl a little tilted; the succeeding sculpture consists of very slender straight distant lamellæ, becoming more separate on last whorl; the interstices are finely threaded, and about fifty lamellæ occur on the first adult whorl. Aperture regularly lunate, lip thin, mouth unarmed. Umbilicus wide, cavernous, exposing all previous whorls. Diam. max. 1.9, min. 1.6 mm.; alt. .9 mm.

Hab.—Sunday Island, Kermadec Group. Living upon moss-covered trunks of trees.

Genus PARALAOMA, nov. gen.

The first turbinate land shell I noted on Sunday Island was that which I call *Paralaoma Raoulensis*. I was quite unable to generically locate it, and provisionally called it "*Charopa*", but the shape and sculpture seemed to effectually remove it from that genus. I knew of no New Zealand shell which remotely suggested this, and I felt convinced it should not be placed in *Endodonta*, *sensu lato*. Recently Mr. J. H. Ponsonby loaned me a large number of Australian Endodonts to look over, and almost at once I noted a shell from New South Wales which was apparently congeneric. This was labelled "*Morti*". In the Mem. Nat. Mus. Melb., No. 4, p. 7, 1912, Cox and Hedley place this species in *Laoma* and synonymize with it a shell Tate called *Flammulina retinodes*. In the same place figures are given (pl. ii, figs. 9-12) of *Laoma mucoides*, considered closely related. This was a generic location that had never suggested itself to me, and as my shells do not seem to have the least resemblance to typical *Laoma*, I am proposing the above generic name.

Laoma was thus introduced: In the Proc. Zool. Soc. Lond., 1849, p. 167 (1850), Gray described a new species of shell from New Zealand under the name "*Bulimus?* (*Laoma*) *Leimonias*", writing, "I am inclined to regard this shell as the type of a particular sub-genus of shell which may be characterized by the simple peristome,

the perforated axis, the square mouth, and the spiral ridges in the throat. If it prove distinct, it may be called *Laoma*."

Pilsbry in the *Guide to the Study of the Helices* lumped all the species assigned to *Phrixgnathus* under the genus *Laoma*, but later, in the *Index Faunæ Novæ Zealandiæ* (1904), Suter admitted a family Laomidæ (p. 62), comprising the two genera *Laoma* and *Phrixgnathus*. No conchologist could possibly place the shells here discussed in *Laoma* from a study of the shell characters of the type of *Laoma*. As Australian conchologists have variously chosen *Flammulina*, *Endodonta*, and now *Laoma*, I consider the introduction of a new generic name necessary, granted even that the animal may possess the structural characteristics of *Laoma*, *sensu lato*, which I have not yet seen proved.

In the Rep. Horn Sci. Exped., vol. ii, Zool., p. 188, 1890, Tate referred his *Charopa retinodes* to *Flammulina*, and wrote: "This species resembles *Helix paradoxa*, Cox, but is more depressed, the spiral sculpture more distant, and the umbilicus wider. The animal was not studied, but by shell characters it should be conspecific with the fore-named species, which Suter (Ann. Mag. Nat. Hist., Jan. 1894, p. 64) refers to *Laoma*, section *Phrixgnathus*. On the other hand, it is also comparable with an undescribed species of *Flammulina*, inhabiting South Australia, which possesses the caudal gland, pedal suture, jaw and dentition proper to that genus, whilst the form of the shell is more consonant with *Flammulina* than with *Laoma*."

In the Rec. Austr. Mus., vol. vii, p. 294, 1909, Petterd and Hedley synonymized *paradoxa*, Cox, with *Morti*, Cox, and in the Mem. Nat. Mus. Melb., No. 4, p. 11, 1912, Cox and Hedley added *Flammulina retinodes*, Tate, as another synonym, whilst in the former place they recorded as habits, "always in dry positions nestling under stones." Here, again, we have a coincidence of form, sculpture, and habits in such distant localities as the Kermadecs and Eastern, Southern, and Central Australia, which seems most suggestive of generic affinity.

PARALAOMA RAOULENSIS, n.sp. Pl. XVIII, Fig. 7.

Shell small, sub-conical, spire elevated, thin, translucent, last whorl descending, somewhat flattened, but periphery rounded, umbilicus wide; whorls $3\frac{1}{2}$; colour uniform brown. Sculpture: first whorl and a half smooth; the succeeding whorls sculptured with slanting, distant lamellæ, between which are minor threads crossed by minute scratches; on the penultimate whorl the major lamellæ number over thirty, and on the last whorl exceed forty. Aperture almost circular, columella slightly reflected, lip thin, sharp, mouth unarmed. Umbilicus wide and deep, exposing previous whorls, and about one-third diameter of shell. Diam. max. 2.0, min. 1.8 mm.; alt. 1.5 mm.

Hab.—Sunday Island, Kermadec Group. Living under stones, wood, and dead leaves on the ground.

PARALAOMA AMBIGUA, n.sp. Pl. XVIII, Fig. 5.

Shell small, sub-discoidal, spire little elevated, thin, translucent, last whorl descending, flattened above and periphery semi-keeled;

umbilicus wide; whorls $3\frac{1}{2}$; colour, uniform rich pale brown. Sculpture as in preceding species, but the lamellæ more distant and sharply defined with clearly marked minor threads, four to six between, and cross scratches obsolete; the lamellæ number less than twenty-five on the penultimate, and less than thirty on the last whorl. The aperture somewhat more quadrate than in the preceding species, whilst the umbilicus is slightly narrower; compared with the above it is flatter, paler, and more sharply sculptured. Diam. max. 2.1, min. 1.9 mm.; alt. 1.1 mm.

Hab.—Sunday Island, Kermadec Group. Living under stones, wood, and dead leaves on the ground.

Genus FLAMMULINA, Martens.

Flammulina, Martens, Critical List, New Zealand Mollusca, 1873, p. 12.

Type (by subsequent designation by Suter), *Helix compressivoluta*, Reeve.

Pilsbry divided his family Endodontidæ into two genera, *Endodonta* and *Flammulina*, the former being possessed of no caudal mucous pore, such being present in the latter. Mr. Suter, to whom Pilsbry was most indebted for his knowledge of the New Zealand molluscan fauna, had, however, issued the warning (Ann. Mag. Nat. Hist., vol. xiii, p. 64, 1894): "I do not attach very great importance to the presence or absence of the caudal gland, as we really do not know its true significance."

Subsequently Suter, in the *Index Faunæ Novæ Zealandiæ*, 1904, p. 62, retained his own family Phenacohelicidæ, including as genera (?) *Flammulina*, *Suteria*, *Phenacohelix*, *Therasia*, *Pyrrha*, *Allodiscus*, *Gerontia*, *Carthæa*, *Thalassohelix*, and *Phacussa*.

Hedley in recent papers seems to have utilized *Flammulina* in the Pilsbryan sense, but there seems to be ample room for subdivision from a criticism of the species he has allotted to *Allodiscus*, for instance, in the Tasmanian fauna.

The type of *Flammulina* is characterized by few whorls, somewhat rapidly increasing, and an oblique mouth, whose breadth is greater than its depth. Whatever sculpture is present is fine, and the costulæ are more or less evanescent in similarly shaped shells. According to Suter the jaw is characteristic.

A more scientific treatment would be the recognition of a family Flammulinidæ, and then the sections would be raised to the rank of genera and the relationships of the species denoted by means of these generic names. Thus Hedley in his recent *Index to the Land Shells of Victoria*—written in conjunction with Cox, but the classification would seem to be referable to Hedley—has included species of *Flammulina*, but the figures of *F. Fordeï*, Brazier (Mem. Nat. Mus. Melb., No. 4, pl. ii, figs. 13–15, 1912), *F. elenescens*, Cox & Hedley (ibid., pl. iii, figs. 16–18), and *F. meraca*, Cox & Hedley (ibid., pl. iii, figs. 19–21), portray shells having very different shell characters. If these had been placed in different genera we might have had a clue to their relationship other than that afforded in the description, without the examination of all recorded species

of *Flammulina* and *Endodonta*, for the latter is also necessary through the acceptance of the spirally striated nuclear whorls as characteristic of *Allodiscus*, considered as a sub-genus of *Flammulina*. In the following cases I refer one species to *Calymna* on account of its costulate appearance, whilst the other I simply call *Flammulina*, *sensu lato*, as my studies have not yet enabled me to place it. When Suter (loc. cit.) gave his experience with regard to the examination of Tasmanian molluscs, he concluded that the majority of Tasmanian '*Flammulinae*' belonged to *Gerontia*, but I note that Cox and Hedley have replaced some of these in *Endodonta*, where, judging from shell characters, they seem more happily located. *Endodonta*, however, seems, as regards species with armed aperture, very rare in Australia, whilst it also appears doubtful whether typical *Charopa* has yet been recorded. The delimitation of genera would certainly make these points more obvious.

FLAMMULINA MISERABILIS, n.sp. Pl. XVIII, Fig. 4.

Shell minute, thin, sub-conical, spire slightly elevated, sutures deep, umbilicus narrow. Colour uniformly pale-brownish fawn. Whorls $3\frac{1}{2}$; first whorl and a half finely spirally striated; succeeding whorls sculptured with fine radial striæ, and between the striæ closely set spiral scratchings. Aperture obliquely lunate, lip thin, sharp. Umbilicus deep and narrow, about one-fifth the diameter of the shell. Diam. max. 1.5, min. 1.25 mm.; alt. .8 mm.

Hab.—Sunday Island, Kermadec Group. Living on the moss-covered trunks of trees.

CALYMNA ARBORICOLA, n.sp. Pl. XVIII, Fig. 3.

Shell small, sub-discoidal, thin, fragile, umbilicus narrow. Whorls $3\frac{3}{4}$, somewhat rapidly increasing, sutures well marked. Colour pale fawn with darker red-brown flammulate markings. Sculpture: first whorl and a half, constituting the protoconch, finely spirally striated; the succeeding $2\frac{1}{4}$ whorls radially sculptured with closely set, low, evenly spaced riblets, about eighty being counted on the first adult whorl, minute threads intervening between each; on the following whorl the riblets and threads become almost inseparable, and about one hundred major riblets can be noted in most specimens, with two or three minor ones clearly marked between and almost as prominent; in some shells the major ones disappear on the last quarter whorl, and this consequently appears smoother in comparison. Aperture oblique, somewhat lunate ovate, columella reflected. Base rounded, umbilicus deep and narrow, about one-sixth the diameter of the shell. Diam. max. 2.6, min. 2.2 mm.; alt. 1.25 mm.

Hab.—Sunday Island, Kermadec Group. Living on the moss-covered trunks of trees.

HELIX CHIMMOI, Pfeiffer.

In the Proc. Zool. Soc. Lond., 1856, Pfeiffer described two shells supposed to have come from Sunday Island, Kermadec [*sic*] Group. The first (p. 326) was called *Helix Kermadeci*, and has since been recognized from Sunday Island. The other was called *H. Chimmoi*,

and both were received from Lieutenant Chimmo, whom I have suggested may have been one of the officers of the H.M.S. *Herald*.

I took with me to Sunday Island copies of all the descriptions of the known Kermadec shells, and I could find nothing on the island answering at all to the description of *H. Chimmoi*. In the British Museum I found specimens of the shell I have called *Ptychodon pseutes* so labelled, and concluded they must be the original specimens, though they disagreed with the original description as to size. I have, however, now found specimens which bear the label *H. Chimmoi*, and which someone has marked 'Type', and which agree with the Pfeifferian description. I have carefully examined them and would now suggest that the locality is quite erroneous. They are quite unlike anything I have collected, and though I do not claim to have absolutely obtained every mollusc, I cannot think that such a large and conspicuous form should have escaped me. My suspicions seem further confirmed in that two species about the same size were contained in this typical lot, and the other one is also quite unrepresented in my collection and is quite as unfamiliar as the typical *H. Chimmoi*.

PATULA MODICELLA, Férussac, var. *vicinalis*, Mousson.

In the Journ. de Conch., vol. xxi, p. 112, 1873, Mousson described as from Sunday Island, Kermadec Group, a shell he compared with *P. modicella*, Férussac, and only gave it varietal rank, but doubted that it might be regarded as specifically distinct. He wrote: "Ces différences consistent avec une forme générale assez analogue, en des tours un peu plus arrondis," and his measurement read "diam. 3; alt. 1.2 mm."

Here, again, nothing agreeing with this description was found, though the shell I have called *Ptychodon Royanus* suggested itself by its size. Comparison with *Patula modicella* showed that this had no relationship and could never be contrasted, and no other shell measuring anything like 3 mm. was found.

What can be the solution of these extraordinary puzzles? I have recorded our search for *Helicarion Kermadecensis*. Can it be that both *Helix Chimmoi*, Pfr., and *Patula modicella vicinalis*, Mousson, have been exterminated or likewise driven to some last undiscovered stronghold? The suggestion seems preposterous, so that I simply record here the facts that shells supposed to have been collected by Macgillivray and Graeffe were not found by me, though I should think I made much more extended and diligent search than either of my predecessors. Can it be that either of these shells were collected on one of the outside islands and characterize the former molluscan faunula of the group?

GENUS PRONESOPUPA, nov. gen.

The small shell for which I propose the above name has greatly perplexed me. It can be shortly characterized as a *Nesopupa* without any apertural armour. When Pilsbry wrote upon the Pacific Pupoid Shells (Proc. Acad. Nat. Sci. Philad., 1900, pp. 431-3) he introduced

Nesopupa (p. 432) for the shells previously named *Pagodella*, H. and A. Adams, and *Ptychochilus*, Boettger, both these names being pre-occupied. Pilsbry's diagnosis reads—

“Small, dark brown, opaque and lustreless; ribbed, costulate or striate, the aperture armed . . . , lip expanded.

“Type, *N. tantilla*, Gld. This is *par excellence* the Polynesian type of *Pupa*. A number of sections may perhaps eventually be distinguished, but only one seems to have any foundation in nature. This may be defined thus:

“*Nesopupa*, s.s. Peristome discontinuous above; palatal folds of moderate length.

“*Lyropupa*, n.sect. Peristome continuous; upper palatal fold very long; shell strongly costate.

“Type, *N. lyrata*, Gould.”

The species here described resembles *Nesopupa* in shell characters, but the unarmed mouth easily separates it. Moreover, it is not “opaque and lustreless” as I understand those words. I would rather describe some specimens as “semitransparent and somewhat glossy”. I have little doubt, however, that my genus will be later degraded, as some specimens of *Nesopupa* I have examined show that the teeth grow with age and are absent in the juvenile stage. These species, however, differ somewhat from the type of *Nesopupa*, and the series may not be congeneric, whilst they cannot be allotted to *Lyropupa*.

PRONESOPUPA SENEX, n.sp. Pl. XVIII, Figs. 1, 2.

Shell minute, pupoid, dextral, few whorls. Colour brown. Whorls 4; the first whorl and a half smooth; the succeeding whorls have a sculpture of distant sharp lamellæ, the intervening spaces threaded with striæ; in some shells the lamellæ are obsolete, or only occur on the last half whorl, whilst in others they regularly appear on each whorl; on the last whorl about a dozen can be counted, either indistinct or very prominent. A narrow deep umbilicus is present. The columella is straight and reflected; aperture discontinuous, almost circular, with the outer lip reflected and expanded. In general shape the specimens vary, some being more loosely coiled than others which have a humped-up appearance. Height 2, breadth 1.25 mm.

Hab.—Sunday Island, Kermadec Group. Living on tree-trunks, not moss-covered, and hiding in the crevices of bark in dry weather.

No species, in any way allied to this, has yet been recorded from New Zealand, though I have seen very similar shells with the mouth fully armed from Fiji. Nothing of this nature has yet been found on Lord Howe Island, but the species named *Vertigo norfolcensis* by Sykes, from Norfolk Island, is referable to *Nesopupa*; it is, however, very much larger and sinistral.

Family TORNATELLINIDÆ.

My systematic notes on the molluscs referred to this family are brief, for the following reason: When I had got together a few notes regarding the synonymy and forms, Pilsbry published in the *Nautilus*

(vol. xxiii, p. 122, 1910) a synopsis of the classification of this group as adopted in the *Manual of Conchology*, shortly to be issued. I at once forwarded specimens and notes to Dr. Pilsbry, asking him to make use of them. In the paper quoted, Pilsbry recognized three genera of Tornatellinids: *Elasmias*, nov., with *Tornatellina aperta*, Pease, as type; *Tornatellina*, Pfeiffer, 1842, with *T. clausa* = *bilamellata* (Anton) as type; and *Tornatellides*, nov., with *T. simplex*, Pease, as type.

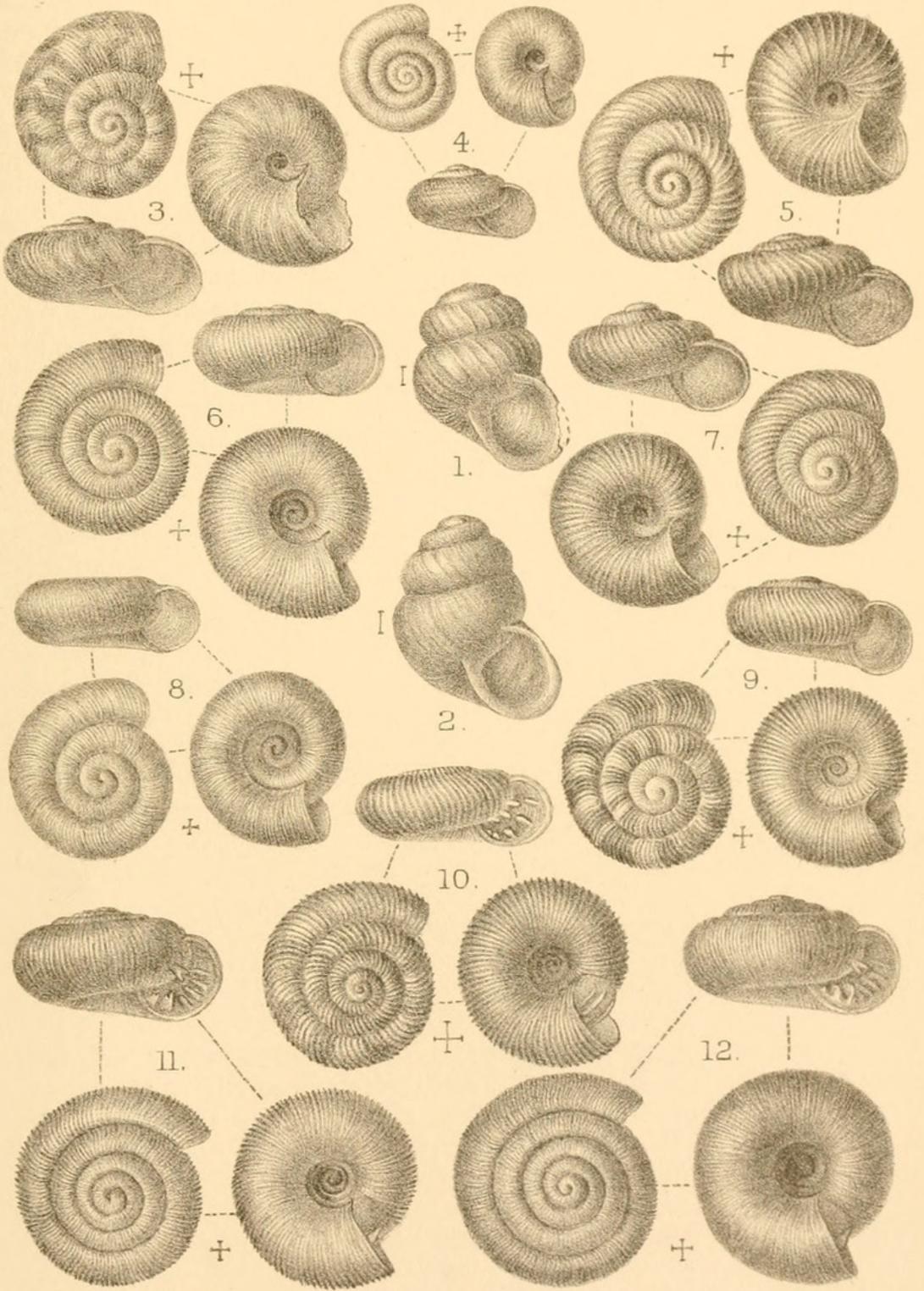
The introduction of the first-named genus seemed necessary to me from a study of the animal and shell characters of the mollusc mentioned as *T. inconspicua*, Brazier, in the earlier part of this paper. The fact that this mollusc was only found in one place on the low-lying part of the island nearest the present and former dwelling-places of the few settlers, led me to suggest its recent introduction to this faunula. Its recognition as identical with a Lord Howe mollusc, rare or apparently of restricted habitat under similar conditions, seems to confirm my conclusion, whilst, as pointed out to me by Mr. Hedley, the figures of *T. eucharis*, Brazier, and *T. Wakefieldæ*, Cox, approach this and may refer to the same species. I have recognized five species, two of which are ground-dwellers and three tree-dwellers.

The *Elasmias* would appear to be constantly a plant-living genus, as I note that when Benson described his *T. cernica* (certainly referable to this group) he noted (Ann. Mag. Nat. Hist., ser. II, vol. vi, p. 254) "creeping in showery weather on the leaves of Niccioli hedges". One of the tree-living species has the armature of the mouth closely agreeing with that of *T. bilamellata*, Anton, whilst in the other it is very slender. The two ground-dwelling forms are very different, one being a conical straight-sided form, the other being probably the one recorded as *T. novoseelandica*, Pfeiffer. In these Proceedings, vol. viii, p. 263, pl. xi, fig. 30, 1909, Suter described *T. subperforata* and observed: "The inflated body whorl, the straight, not tortuous, columella, and the narrow perforation separate it at once from *T. novoseelandica*, Pfeiffer."

When Pilsbry's monograph of these molluscs appears, we shall learn all about these.

4. GENERAL CONCLUSIONS.

It was anticipated that the collection of Land Mollusca would give some clue as to the relationship of the group, but I do not think any considerable deductions can be drawn from them. As a whole, their affinity is undoubtedly with the forms of the North and not with those of New Zealand. It must never be forgotten that New Zealand has been well searched for minute land molluscs, and has a great area with variable climatic conditions, as well as being most favourably disposed for the rapid differentiation of these minute forms through isolation. The northern islets have still innumerable minute forms to be brought to light, and not until much more is known can anything very definite be decided. The negative evidence afforded by this collection is, however, of much interest, and may be briefly glanced at. The faunulas and flora of the Kermadec Group has been



A.H. Searle del. et lith.

Huth imp.

LAND SHELLS FROM THE KERMADEC ISLANDS.

generally compared and contrasted with those of Norfolk Island, Lord Howe Island, and New Zealand, whilst recent evidence points to its great distinction. It is unfortunate that the land molluscs of Lord Howe Island are unknown as regards the minute forms, and although a fairly representative collection was obtained by Macgillivray at Norfolk Island, it remained unexamined until quite recently. It was, however, then studied by Sykes (Proc. Malac. Soc., vol. iv, p. 139 seq., 1900), who observes: "As pointed out by Professor Tate and others, the faunal relationship of Norfolk Island lies rather with New Zealand and Lord Howe Island than with the Australian Continent." This conclusion is so contrary to the nature of the molluscs recorded by Sykes, that it is quite impossible to explain it. To take Sykes' own generic dispositions, he admitted fourteen genera, including twenty-six species, and of these fourteen only five have been recorded from New Zealand. Of these five one is the Polynesian *Endodonta*; the second is *Charopa*, to which the Norfolk Island species are questionably referred and which is also Polynesian; the third and fourth, *Omphalotropis* and *Diplommantina*, which are typically Polynesian, have only one representative each in the north of New Zealand, the latter a very doubtful record; this leaves the fifth, *Carthæa*, which is an endemic New Zealand genus, but here the Norfolk Island shell does not seem correctly placed. What a hindrance to the zoogeographer must prove such an erroneous statement as that put forward by Sykes is only known to those interested! It would be quoted by many not conversant with molluscs, and who would depend upon Sykes' reputation as a conchologist for the correctness of his conclusions.

I have fortunately been able to examine a large quantity of material from Norfolk Island, and its extraordinary distinction from New Zealand forms is so markedly noticeable as to cause much wonderment as to its origin. Its distinction from that of the Kermadec Island is only emphasized by the finding of a species on each group closely allied. The genus *Fanulum*, which I have introduced for *Trochonanina exposita*, Mousson, apparently includes *Medyla insculpta*, Mousson, and *M. imitatrix*, Sykes, as well as a third undescribed species, all from Norfolk Island. Mr. Gude, however, who suggested the name and pointed out the differences between this genus and *Medyla* would include in its limits *Thais*, Homb. & Jacq., from the Solomon Islands and *rectangula* from the Marquesas. This at once discounts the affinity of the Kermadec with the Norfolk Island forms of the genus. As noted above, no minute forms are yet known from Lord Howe Island, but the general aspect of that molluscan faunula is just as distinct from that of Norfolk Island as the New Zealand one has been shown to be. As Hedley pointed out, the Lord Howe land Mollusca show most affinity with those of New Caledonia, the presence of *Placostylus* being most suggestive.

Now, the Kermadec faunula is characterized by the entire lack of any molluscs of appreciable size, whereas such do commonly occur in New Zealand (as *Placostylus*, *Paryphanta*, *Rhytida*, etc.), Lord Howe Island (as *Nanina*, *Placostylus*, etc.), and Norfolk Island (as *Fretum*, *Rotula*, etc.). It is conceded that Lord Howe Island has a relationship

with New Caledonia in the same manner as New Zealand has through *Placostylus*. It is obvious that Norfolk Island, from the absence of *Placostylus*, does not enter into the same chain, whilst the predominance of the *Fretum* group points to a relationship of Norfolk Island with the Solomons and the Fiji Islands. There is nothing in the Kermadec Mollusca that is distinctive in the same manner as the *Placostylus* and *Fretum* are. The general character of the minute species of the Kermadecs differs from that of most northern groups in the absence of *Omphalotropis* and *Diplommatina*, which both occur on Lord Howe and Norfolk Islands, and seem to just reach New Zealand. It would follow, then, that these genera did not arrive at New Zealand via the Kermadecs. The presence of Tornatellinids on the Kermadecs points to their easy colonization of the Pacific groups by means of drift or other conveyance. I feel certain that *Elasmias* has very recently settled on the Kermadecs, and also on Lord Howe Island. The Endodontoid shells show as much relationship with those of Polynesia as they do with New Zealand forms, whilst the Pupoid shell I have called *Pronesopupa* is Polynesian, no such form having yet been found in New Zealand. The species for which I have proposed the genus *Paralaoma* does not seem as yet to have relations recorded from New Zealand, though I consider the Australian *morti*, Cox, to be absolutely congeneric. This species has apparently a wide range in Australia, being recorded from Tasmania, Victoria, New South Wales, and South Australia. The *Helicarion* certainly came from the North, since no representative of this genus occurs in New Zealand, nor does it occur on Lord Howe or Norfolk Islands.

In view of the known molluscan faunulæ of New Zealand, Fiji, New Caledonia, Lord Howe, and Norfolk Islands, the whole facies of the Kermadec land Mollusca suggests the entire extinction of the faunula comparative with those named, and the re-peopling of the group by means of drift, and that the drift has been from the North. When the Northern groups have been thoroughly searched a more accurate comparison will be able to be made.

EXPLANATION OF PLATE XVIII.

- FIGS. 1, 2. *Pronesopupa senex*, n.sp.
 ,, 3. *Calymna arboricola*, n.sp.
 ,, 4. *Flammulina miserabilis*, n.sp.
 ,, 5. *Paralaoma ambigua*, n.sp.
 ,, 6. *Charopa Macgillivrayana*, n.sp.
 ,, 7. *Paralaoma Raoulensis*, n.sp.
 ,, 8. *Charopa exquisita*, n.sp.
 ,, 9. ,, *pseudanguicula*, n.sp.
 ,, 10. *Ptychodon Royanus*, n.sp.
 ,, 11. ,, *amandus*, n.sp.
 ,, 12. ,, *pseutes*, n.sp.
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Iredale, Tom. 1913. "The land Mollusca of the Kermadec Islands." *Proceedings of the Malacological Society of London* 10, 364–388.

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