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SOME NOTES ON THE OCCURRENCE OF PHASMATODEA IN OCEANIA

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Commonly known as the walkingsticks, or stick or leaf insects, because of their remarkable adaptation and resemblance to their immediate environment, the Phasmatodea are among the most striking and largest of all insects. They are of particular interest and significance to zoogeography in the Pacific.

In the following discussion, which is basically a review of the distribution of phasmatids of Oceania with some preliminary notes on their faunal relationships and dispersal, much information has been obtained from papers by K. Günther who has studied and published extensively on the taxonomy and zoogeography of Phasmatodea of most regions of the world during the past 35 years. His last comprehensive treatment of the Oceania phasmatids appeared in 1932. Undoubtedly, additional collections during the past 29 years should add considerable knowledge to the understanding of phasmatid distribution and origin, but are still largely unstudied.

Because of the inaccessibility of some of the pertinent literature concerning this group, the notes presented are from available sources only, and thus some of the records may be incomplete. Hence, the generalizations are not considered conclusive.

The system of classification of the Phasmatodea followed herein is based on Günther (1953) who included keys and discussed distribution and relationships and partly revised the only monograph of the group by Brunner and Redtenbacher (1907–1908). Though considered a monumental work, the monograph has been adversely criticized (Karny 1923). Günther stated that the criteria of classification of the phasmatids are perplexing, and implied the serious need for revision suggesting the application of the phylogenetic method as discussed by Hennig (1950) in his comprehensive paper on characteristic features on the theory of phylogenetic systematics. Nevertheless, Günther has incorporated Karny's corrections to the Brunner and Redtenbacher monograph, and in 1957 Beier recognized his classification and made a few changes, such as the correct use of Phasmatidae rather than the better known Phasmidae (Roberts 1941).

The Phasmatodea, with more than 2,000 species belonging to about 300 genera through-

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out the world, includes two families, the Phylliidae and the Phasmatidae. The Phylliidae is poorly represented in the Pacific oceanic islands with only two (Phylliinae and Heteropteryginae) of the eight recognized subfamilies in the world fauna present. Comparatively, the Phasmatidae is fairly well represented possessing seven (Podacanthinae, Phasmatinae, Eurycanthinae, Xeroderinae, Platycraninae, Necrosciinae, Pachymorphinae) of the 11 recognized subfamilies.

In the following analysis of Phasmatodea in Oceania[1], 61 species and two subspecies belonging to 30 genera are distributed sparsely in the oceanic islands.[2] Sixteen genera, 46 species and two subspecies are endemic. There are only one or two species per island in all genera except three. These are *Hermarchus* in Fiji, and *Canachus* and *Asprenas* in New Caledonia which are represented by four to seven species in those islands. Fiji and New Caledonia have the most species. Beyond Fiji only one to three widely distributed species occur as far east as Marquesas and Mangareva. New Zealand has a distinctive and highly endemic fauna much like that of New Caledonia. The representation of phasmatids in the oceanic islands is disharmonic which indicates that they are limited in their power of dispersal from the continental source areas.

NEW GUINEA, BISMARCK ARCHIPELAGO, SOLOMON ISLANDS, LOUISIADE ARCHIPELAGO

New Guinea has nearly 200 known species of phasmatids belonging to 63 genera. It possesses only two more subfamilies than are found on oceanic islands (Lonchodinae and and Aschiphasmatinae) but many more tribes, genera and species. Some genera absent in the oceanic fauna possess numerous species in New Guinea. For example, the genus *Neopromachus* has 48 species, *Dimorphodes* contains 18 species and *Sipyloidea* possesses 10 species. There are nine species in the genus *Eurycantha* which is primarily restricted to New Guinea, Bismarck Arch. and Solomon Is., but a few species occur in Australia and one is known from New Caledonia.

The Bismarck Archipelago has 18 species belonging to 13 genera, two of which are endemic. At least six of those species are also known from Solomon Is. and one each from Micronesia, New Hebrides and New Caledonia. Two species are common to Fiji, while three others are known from Sunda Is. to New Guinea.

Thirteen species of eight genera have been recorded from the Solomon Is. A number of species are shared with Bismarck Arch. and New Guinea. Three endemic species, two belonging to the genus *Ophicrania* and one to *Phasmotaenionema*, occur here.

The Louisiade Archipelago, located south of the Bismarcks, has at least three species, one of which is an endemic *Eurycantha*.

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1. Oceania includes Micronesia, Melanesia, Polynesia and Lord Howe I., Chatham I. and New Zealand.
2. Micronesia, E. Melanesia, New Caledonia, Polynesia and Lord Howe I. (according to Fig. 1, Gressitt 1956) are referred as oceanic islands in the Pacific.

SOUTHEASTERN AND CENTRAL POLYNESIA

The distribution of the Phasmatodea is limited in the Pacific oceanic islands. They are absent from the Hawaiian Islands, Easter, Australs, Phoenix and Fanning, and only a single widespread species, *Graeffea crouanii* (Le Guillou) (=*G. coccophaga* Newp.), occurs in Marquesas and Mangareva (the easternmost record for phasmatids), Tuamotus, Society Is. (Tahiti) and Cook Is. Another species, *Hermarchus pythonius* Westw., also occurs on Society Is. and extends west to Fiji, New Caledonia and New Hebrides.

Phasmatids are poorly represented in Tonga where only three species have been recorded, one of which is an endemic *Cotylosoma*, a genus restricted to Fiji, Tonga, Tongatabu and New Hebrides.

SAMOA AND FIJI

Samoa is inhabited by only two widely distributed species of *Graeffea*, but Fiji has a comparatively rich representation of 21 species, eight of which are endemic, belonging to 11 genera. Among the endemic species is *Cotylosoma dipneusticum* W.-M. For many years it was supposed to be aquatic; however, investigations have failed to prove its adaptation to an aquatic habitat. In addition, Fiji possesses two species belonging to *Cotylosoma*, one of which is common to New Hebrides, and the other is also known from both New Hebrides and Tonga. *Pterobrimus*, a monotypic genus, is endemic to Fiji and belongs to the tribe Obrimini which is primarily limited to the Philippine Archipelago. [The placement of this genus in Obrimini seems to be questionable, and it may belong to another subfamily according to Rehn and Rehn (1939).] Strangely enough Fiji possesses a large phasmatid, *Podacanthus typhon* Gray, of the primitive subfamily Podacanthinae which is chiefly restricted to Australia though known to occur in New Guinea. In addition, two wingless Australian species, *Pachymorpha simplicipes* Serv. (Pachymorphinae) and *Arphax australis* Charp (Phasmatinae, tribe Macracanthini), are present. *Pachymorpha* has several endemic species in New Zealand. Though *Arphax* is not in New Zealand, four other genera of the same tribe are well developed there with endemic species.

Most of the phasmatids occurring in Fiji are moderately large, ranging from five to seven inches in body length, particularly those of the genus *Hermarchus* in which three of the six species are endemic. Much of the Fijian fauna exhibits similarity to that of the nearby islands with four species shared with New Hebrides, three with New Caledonia, two each with Samoa and Bismarcks, and one each with Solomon Is., Lord Howe, Tasmania and New Zealand.

Though Fiji has comparatively more species than most of the islands except New Caledonia, its fauna is disharmonic for it lacks 18 of the 27 genera in the Phasmatidae occurring in oceanic islands. One of the three genera in the Phylliidae is also absent. Moreover, in comparison with New Guinea, it has a poor representation of tribes, genera and species, and is notably lacking in some genera of the Lonchodinae, Xeroderinae and Necrosciinae. The genera *Phyllium* and *Eurycantha* have a number of species in New Guinea, but they are absent in Fiji.

NEW CALEDONIA

New Caledonia has the richest phasmatid fauna of all islands with 24 known species belonging to 12 genera in five subfamilies with Eurycanthinae predominating. Of the 24 species, 16 belong to Eurycanthinae which is lacking in Fiji and Micronesia and all islands east of and including Tonga. Fourteen species and three of the six genera are endemic and belong exclusively to Eurycanthinae. Particularly striking is the considerable degree of development in the genus *Asprenas* confined to New Caledonia, New Hebrides and Loyalty Is. with seven endemic species. Two other endemic species belong to the genera *Clitarchus* (Phasmatinae) and *Brachyrhamphus* (Platycraninae). The high endemicity in New Caledonia of one subfamily suggests isolation and great age. The two nonendemic species of Eurycanthinae are *Canachus tyrrhoeus* Westw. which is also known from New Hebrides and Loyalty Is., and *Eurycantha calcarata* Lucas, a species fairly common in New Guinea and the Bismarck Archipelago. Although New Caledonia has only three more species than Fiji, its fauna is different. Only two genera, *Chitoniscus* and *Hermarchus*, are common to the two areas, but they are represented by entirely different species. A species of *Clitarchus* known to New Zealand is also present here.

LOYALTY ISLANDS

In spite of their proximity to New Caledonia, the Loyalty Islands have a distinctive fauna of eight species belonging to eight genera. Two genera, *Cladomimus* and *Gigantophasma*, and five species are endemic. Of the nonendemic species, three are also on New Caledonia, and one each on New Hebrides and Palau Is.

NEW HEBRIDES

Of the seven species and two subspecies belonging to five genera present in New Hebrides, four are also on Fiji, two on New Caledonia and one each on the Society Is. and New Britain. A subspecies of *Megacrania batesi* Kirby (Bismarck Arch., Micronesia) and *Hermarchus inermis* Redt. (Fiji) are endemic. Only one species, *Asprenas crassipes* Br. v. W., is endemic. The tribe Macracanthini, Phasmatinae, and the family Phylliidae, both represented in Fiji and New Caledonia, are absent in New Hebrides.

LORD HOWE ISLAND

Lord Howe Island possesses five species of phasmatids, two of which are endemic. They are *Dryococelus australe* (Montr.) of the subfamily Eurycanthinae [believed to be extinct; Gurney (1947) cites the uncertainty of its present status] and *Parasosibia australica* Redt. which belongs to the Southeast Asian subfamily, Necrosciinae, otherwise absent from oceanic islands. Three Australian species also inhabit this tiny island.

CHATHAM ISLAND AND NEW ZEALAND

A single species, *Argosarchus schauinslandi* Br. v. W., also known from New Zealand, inhabits Chatham Island.

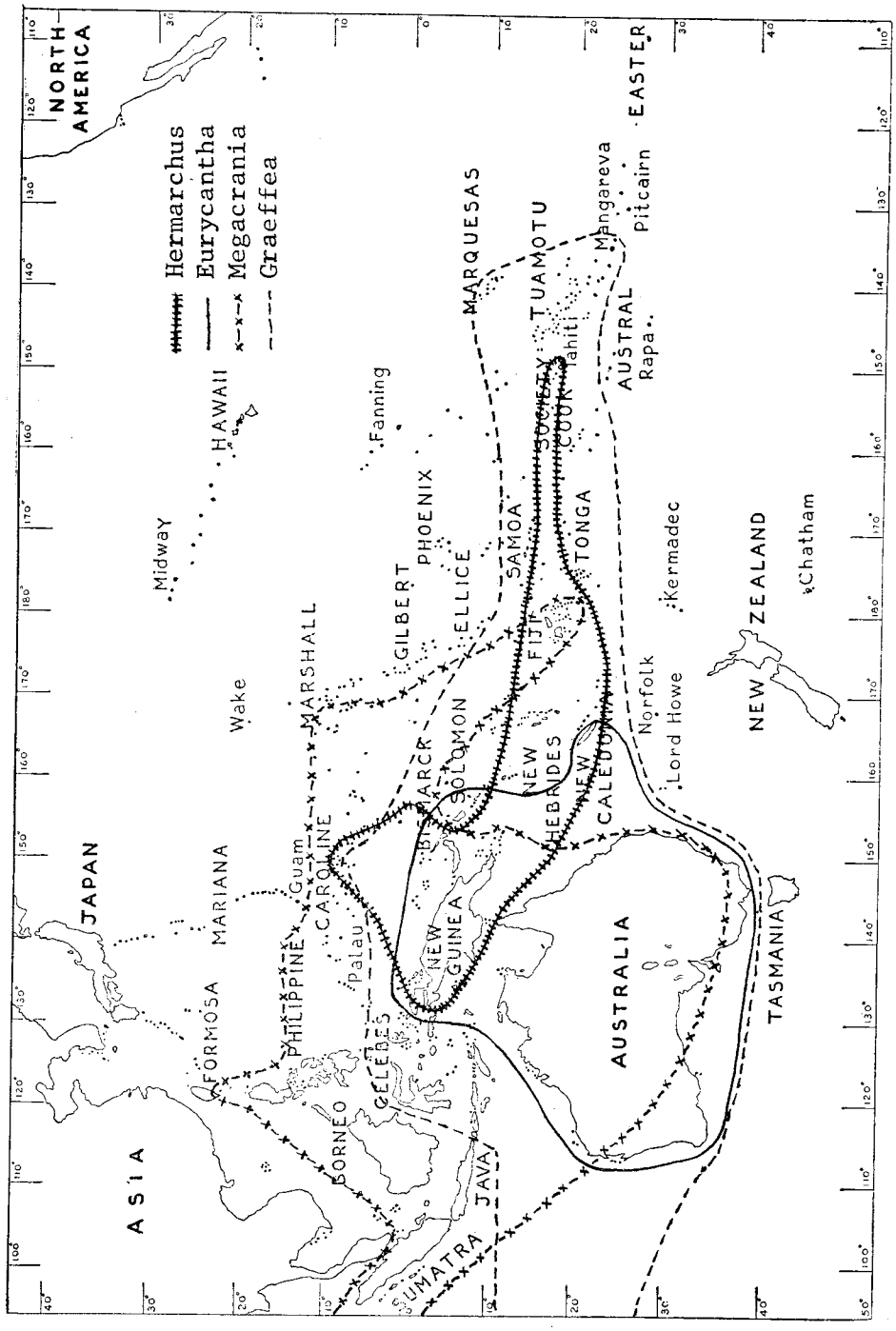

Fig. 1. The distributional ranges in the Pacific of four widespread phasmatid genera.

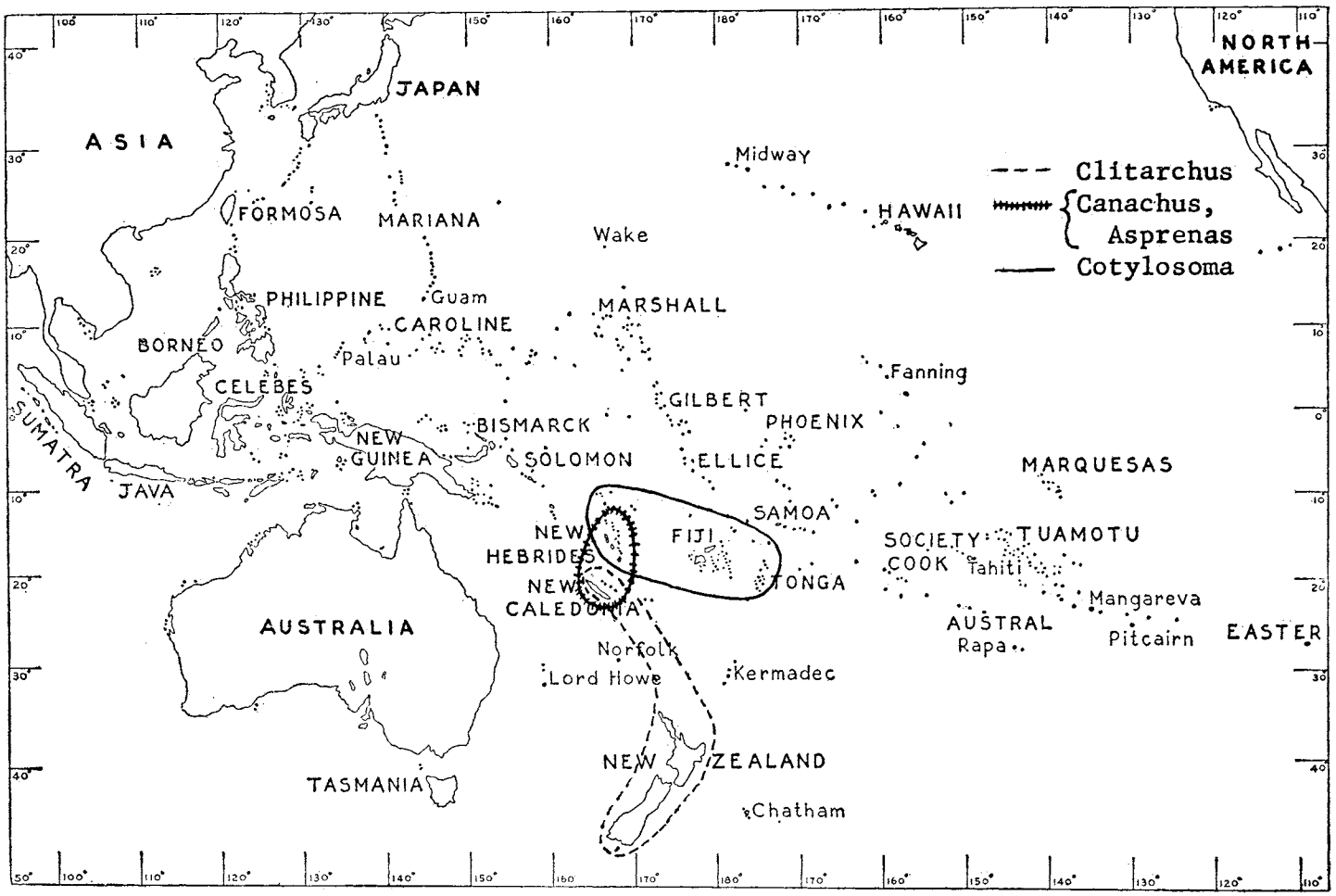

Fig. 2. The distributional ranges of four restricted Pacific genera.

New Zealand has a comparatively interesting and distinctive, though disharmonic, fauna with 26 species belonging to a genus of Phylliinae, four genera in the tribe Macracanthini, Phasmatinae, and three genera in the tribe Pachymorphini, Pachymorphinae. Sixteen of 17 species in Macracanthini, and all eight species in Pachymorphini are endemic. Its high endemicity in two tribes exclusively suggests long isolation which has resulted in the evolution of 24 endemic species.

Of the four endemic genera in New Zealand, the genus *Acanthoxyla* shows the greatest achievement in the development of eight species, one of which *A. senta* Sal. is restricted to the Three Kings Islands (this is the only species of *Acanthoxyla* known as both males and females. All others may reproduce parthenogenetically). A species of *Chitoniscus* known from Fiji and Bismarcks and recorded from New Zealand is questionable. New Zealand possesses three species of *Clitarchus*, two of which are endemic and one is found in New Caledonia.

MICRONESIA

The meager records for walkingsticks in Micronesia indicate sporadic occurrences with seven species having been recorded from Caroline Is. (four from Ponape, one from Truk, four from Palau), one from the Mariana Is. (Pagan, Saipan, Rota and Guam) and one from Marshall Is. The five endemic species in Micronesia are distributed as follows: *Diagoras ephialtes* Stål in Palau, *Acanthograeffea denticulata* Redt. in Mariana Is., *Acanthograeffea modesta* Günther in Truk, Ponape, *Hermarchus godeffroyi* Redt. in Ponape and *Heterocopus leprosus* Redt. restricted to Palau Is. and Ponape. *H. leprosus* Redt. is a small wingless stick insect belonging to the tribe Obrimini (Heteropteryginae) which is predominantly known from the Philippines. Widely distributed species of *Megacrania* and *Graeffea* are found in Caroline Is. Only one species, *Megacrania batesi* Kirby, has been recorded from Ebon Atoll, Marshall Is. (Gressitt 1954) and Angaur, Palau Is. (Esaki 1940). A species of *Chitoniscus* is shared with Loyalty Is. The genus *Diagoras* of the tribe Pharnaciini (Phasmatinae) is endemic to Palau Is.

Large walkingsticks have been collected from Palau Is. and Kusaie, but they are still unidentified. T. Esaki cited the discontinuous distribution of *A. denticulata* Redt. between Pagan and Saipan, and reported the probability of its occurrence in the intervening islands.

It is evident that there are many artificial gaps in the distribution of the phasmatids, and the completion of the Micronesian study now pending will undoubtedly result in additional records or other species so an adequate analysis cannot be made at this time.

DISTRIBUTION PATTERNS

The analysis of the distribution of phasmatids in Oceania shows certain patterns for several genera present in the oceanic fauna. The distribution of 30 genera (three, Phylliidae; 27, Phasmatidae) represented in the oceanic islands and eight genera in New Zealand is shown in Table 1.

Table 1A. Distribution of genera represented in oceanic islands.

GENERA	*DISTRIBUTION*
FAMILY PHYLLIIDAE	
Subfamily Phylliinae	
1. Chitoniscus	Palau, New Guinea, New Britain, Fiji, New Caledonia, Loyalty Is., New Zealand
Subfamily Heteropteryginae	
Tribe Obrimini	
2. **Heterocopus**	Palau, Ponape, New Guinea
3. **Pterobrimus**	Fiji
FAMILY PHASMATIDAE	
Subfamily Podacanthinae	
Tribe Podacanthini	
1. Extatosoma	New Guinea, Lord Howe I., Australia, Tasmania
2. Didymuria	Lord Howe I., Australia, Tasmania
3. Podacanthus	Fiji, Lord Howe I., Australia
Subfamily Phasmatinae	
Tribe Phasmatini	
4. Ctenomorpha	Fiji, Australia, Tasmania
Tribe Pharnaciini	
5. **Gigantophasma**	Loyalty Is.
6. **Diagoras**	Palau Is.
7. Hermarchus	Ponape, New Guinea, New Britain, Fiji, New Caledonia, New Hebrides, Society Is.
8. **Cladomimus**	Loyalty Is.
Tribe Macracanthini	
9. Arphax	Fiji, E. Australia
10. **Clitarchus**	New Caledonia, New Zealand
11. **Argosarchus**	Chatham I., New Zealand
Subfamily Eurycanthinae	
12. **Dryococelus**	Lord Howe I.
13. Eurycantha	Australia, New Guinea, Bismarcks, Solomons, New Caledonia
14. **Canachus**	New Caledonia, New Hebrides, Loyalty Is.
15. **Paracanachus**	New Caledonia
16. **Asprenas**	New Caledonia, New Hebrides, Loyalty Is.
17. **Labidiophasma**	New Caledonia
18. **Cnipsus**	New Caledonia
Subfamily Xeroderinae	
19. **Nisyrus**	Fiji
20. **Cotylosoma**	Fiji, New Hebrides, Tonga, Tongatabu
21. Leosthenes	New Caledonia, New Guinea
Subfamily Platycraninae	
22. Megacrania	Ceylon, Sumatra, Borneo, Philippines, Palau Is., Ponape, New Guinea, Admiralty Is., Bismarcks, New Hebrides, Fiji
23. **Acanthograeffea**	Mariana Is., Truk, Ponape
24. Graeffea	Seychelles to New Guinea, Ponape, Australia to Marquesas and Mangareva
25. **Brachyrhamphus**	New Caledonia, Loyalty Is.
Subfamily Necrosciinae	
26. Parasosibia	Lord Howe I., East India, Ceylon
Subfamily Pachymorphinae	
Tribe Pachymorphini	
27. Pachymorpha	Fiji, New Zealand, East Australia

Table 1B. Distribution of New Zealand genera.

GENERA	*DISTRIBUTION*
FAMILY PHYLLIIDAE	
Subfamily Phylliinae	
1. Chitoniscus	Palau Is., New Guinea, New Britain, Fiji, New Caledonia, Loyalty Is., New Zealand
FAMILY PHASMATIDAE	
Subfamily Phasmatinae	
Tribe Macracanthini	
1. **Clitarchus**	New Caledonia, New Zealand
2. **Tectarchus**	New Zealand
3. **Acanthoxyla**	New Zealand
4. **Argosarchus**	Chatham I., New Zealand
Subfamily Pachymorphinae	
Tribe Pachymorphini	
5. **Mimarchus**	New Zealand
6. **Micrarchus**	New Zealand
7. Pachymorpha	Fiji, New Zealand, E. Australia

Bold Face indicates genera endemic to the Pacific.

Of the 27 genera of Phasmatidae in the oceanic islands, 19 are represented by species of sporadic occurrence. The limits of distribution of four of the more widely distributed genera are illustrated in Fig. 1. The restricted distribution of four genera are outlined in Fig. 2. The distributional list of species belonging to the eight genera treated in Figs. 1 and 2 is shown in Table 2.

DISPERSAL AND ESTABLISHMENT

The Phasmatodea are limited in their power of dispersal as indicated by the sparse representation in the oceanic islands east of Fiji. This is largely attributed to the fact that phasmatids are sluggish and inactive insects. Their highly specialized mode of life requires an appropriate environment in which to live. Being strictly herbivorous, their survival and establishment are dependent upon the availability of food plants.

Studies on host specificity for walkingsticks have hardly been investigated. On Kusaie and Marshall Is., *M. batesi* Kirby has been observed feeding extensively on *Pandanus*. Two widespread species in Oceania are coconut feeders. Several species in Australia are injurious to *Eucalyptus* trees. The New Zealand *Tectarchus* species have been recorded from *Astelia*, *Rubus* and *manuka*. *A. prasina* (Westw.) lives on roses, loganberry and brambles.

A number of the walkingsticks are moderately large, possessing heavy and compact bodies resulting in high specific gravity. They are probably incapable of being dispersed by air currents, a method through which it is thought most small insects have been carried to the oceanic islands. Some of the phasmatids possess well developed wings, but they are usually not active flyers, and flying is generally confined to short distances between the leaves and branches of trees or bushes among which they conceal themselves during the day. They become active at night when they feed on the foliage.

Table 2. Distribution of species belonging to eight genera treated in figs. 1 and 2.

	Islands															Other localities
	New Zealand	Solomon Is.	Bismarck Arch.	Louisiade Arch.	Mariana Is.	Marshall Is.	Caroline Is.	Lord Howe I.	New Caledonia	Loyalty Is.	New Hebrides	Fiji	Tonga	Samoa	Cook Is.	Society Is.	Tuamotu Arch.	Mangareva	Marquesas	
SUBFAMILY PHASMATINAE																				
Tribe Pharnaciini																				
Genus Hermarchus																				
differens												×								
apollonius									×			×								
pythonius									×		××					×				
virga												×								
novae britanniae			×								××									
godeffroyi							×													
inermis inermis												×								
inermis speiseri											×									
Tribe Macracanthini																				
Genus Clitarchus																				
laeviusculus	×								×											
interrupte-lineatus	×																			
hookeri	×																			
multidentatus									×											
SUBFAMILY EURYCANTHINAE																				
Genus Eurycantha																				
horrida		×××																		New Guinea, Australia
calcarata		××							×											New Guinea, Australia
portentosa			×																	
insularis		×	×																	New Guinea
Genus Canachus																				
tyrrhoeus									×××											
harpya									×											
crocodilis									×											
salamandra									×											
alligator									×											
Genus Asprenas																				
gracilipes									×											
femoratus									×											
brunneri									×											
dubius									×											
impennis									×											
sarasini									×											
effeminatus									×											
spiniventris										×										
crassipes											×									

Table 2. (Continued)

	Islands																		Other localities
	New Zealand	Solomon Is.	Bismarck Arch.	Louisiade Arch.	Mariana Is.	Marshall Is.	Caroline Is.	Lord Howe I.	New Caledonia	Loyalty Is.	New Hebrides	Fiji	Tonga	Samoa	Cook Is.	Society Is.	Tuamotu Arch.	Mangareva	Marquesas	
SUBFAMILY XERODERINAE																			
Genus Cotylosoma																			
godeffroyi													×						
dipneusticum												×							
amphibius											×	×	×						
carlottae											×	×							
SUBFAMILY PLATYCRANINAE																			
Genus Megacrania																			
batesi batesi		×				×	×												Admiralty Is., Key I., Goram, Dschilolo, New Guinea, Australia, Sumatra Borneo, Luzon
batesi speiseri											×								
alpheus			×																Ceylon, Philippines, Aru I., Formosa
phelaus												×							
Genus Graeffea																			
crouanii		×					×		×			×	×	×	×	×	×	×	Australia
lifuensis										×									
minor												×	×						

Phasmatids are probably dispersed as eggs rather than adults. Just as adults are specialized for their highly protective mimicry, their eggs are remarkably striking, with an exceedingly hard, well protected shell which bears a close resemblance to seeds. They are very resistant to adverse weather conditions unlike the adults which usually perish during the winter in temperate climate. The lengthy period of development, sometimes taking one to three years for eggs to hatch, allows ample time and more chances for possible dispersal through human agency or rafting, and their ultimate establishment if conditions permit.

A probable means of dispersal of these eggs could be through rafting. T. C. Maa observed eggs, laid by at least one species of phasmatids, glued to branches of bamboo (personal communication). If this is often the case, eggs glued to trunks, logs or coconuts could have floated to the islands. On the other hand, eggs wedged in the leaf sheath of a coconut palm also could have floated to the islands with the nut. The hard-shelled eggs might survive long immersion in salt water.

A widely distributed species, *Graeffea crouanii* (Le Guillou), feeds extensively on coconut palms and occurs in Australia, Solomon Is., Caroline Is., New Caledonia, Fiji, Samoa, Tonga, Society Is., Marquesas and Mangareva. This species seems to have been easily

dispersed in the Polynesian islands where coconut palms occupy the coastal areas. With a suitable niche readily available, establishment would not be difficult once the walking-sticks reached an island. Another coconut feeder, *Hermarchus pythonius* Westw. inhabits Society Is., Fiji, New Caledonia and New Hebrides and may also have been dispersed on floating coconuts or coconut palms. There is no evidence to rule out dispersal by man, but the limited distribution of *H. pythonius* at least suggests natural dispersal.

Some phasmatids inhabit dead trees or logs. Gurney (1947) noted specimens of *Eurycantha calcarata* Lucas collected during the day in rotten stumps which suggests that, like cerambycids which bore into dead wood, they may have been dispersed on floating dead logs. Perhaps other species were distributed in this manner also.

It is possible that some species of phasmatids have been transported on live plants by man. In 1944 Uvarov reported that *Acanthoxyla prasina* (Westw.), the oldest known species in New Zealand, has been accidentally introduced and become established in the British Isles showing that the species was transported through importation of live plants from New Zealand. Another New Zealand species, *Clitarchus laeviusculus* Stål, is also established in British Isles.

FAUNAL RELATIONSHIPS

The fauna of Phasmatodea in Oceania seems to have been considerably influenced by the New Guinea fauna, which derived its fauna predominantly from the Indo-Malayan Subregion. The data in Table 3 were taken from Günther (1932) with a few additional records from Salmon (1948, 1954–55) and show the predominant New Guinea relationships of the Oceania fauna as compared to the lesser Australian relationships.

It appears evident that much of New Guinea's diversified fauna has relationships predominantly from the Indo-Malayan Subregion of the Oriental Region. Members of *Phyllium* (Phylliinae), a genus ranging from Seychelles, Mauritius over to Ceylon, India, Indo-China, East Indies, Borneo to Philippines and New Guinea, are primarily inhabitants of the humid jungles of the Malayan region. A closely related genus, *Chitoniscus*, is perhaps a locally developed offshoot of *Phyllium* and is distributed in Palau Is., New Britain, Fiji, New Caledonia, Loyalty Is., New Zealand (?) and New Guinea. The tribe Heteropterygini, which occurs in Malaya, East Indies, is represented in New Guinea by the genus *Haaniella*. The tribe Datamini, abundant in Moluccas, East Indies and Indo-China, possesses two genera, *Pylaemenes* and *Dares*, in New Guinea. The subfamily Aschiphasmatinae belongs predominantly to the Oriental Region and extends to New Guinea.

The subfamily Phasmatinae, containing the largest and more striking phasmatids, possesses the genera *Anchiale* and *Phasma* which occur from Sumatra and Java to New Guinea. *Dimorphodes* of the subfamily Xeroderinae which has several genera restricted to Melanesia and Polynesia has abundant species both in Celebes and New Guinea. Above all the recognized subfamilies in the world fauna, Necrosciinae has the largest generic representation with more than 50 genera included. Though it is absent from the oceanic islands, many genera and species are known from New Guinea, Solomon Is., and Bismarcks. This subfamily is largely limited to the Oriental Region and it is especially rich in the Greater Sunda Is., northward to China and Japan and southward to New Guinea. Some isolated forms have been found in Solomon Is. and Australia according to Günther. The Lonchodinae with ten genera in New Guinea (particularly in *Neopromachus* with 48 species)

Table 3. Faunal relationships of Oceania phasmatids according to Günther, 1932

Islands	Number of genera and species probably belonging to early Tertiary fauna		Number of genera and species probably belonging to late Tertiary or recent fauna, all with New Guinea relationships
	Related to:		
	New Guinea	Australia	
New Zealand		7: 25	1: 1
Chatham I.		1: 1	
Solomon Is.			8: 13
Bismarck Arch.			12: 18
Louisiade Arch.			3: 4
Mariana Is.			1: 1
Caroline Is.	1: 1 (?)		7: 7 (1?)
Marshall Is.			1: 1
Lord Howe I.	1: 1	4: 4 (1?)	
New Caledonia	7: 17	1: 2	4: 5
Loyalty Is.	5: 5		3: 3
New Hebrides	3: 4		2: 5
Fiji	3: 5 (1?)	4: 4 (1?)	6: 14 (2?)
Tonga	1: 2		1: 1
Samoa			1: 2
Cook Is.			1: 1
Society Is.			2: 2
Tuamotus			1: 1
Mangareva			1: 1
Marquesas			1: 1

has a wide range from Ceylon, India, Indo-China, northward to China and Japan, and from the Greater Sunda Is. to Celebes, Moluccas and Philippines. However, one species of *Carausius* is known to occur only from Seychelles and New Guinea.

Australia has had but little influence on the fauna of the oceanic islands and New Guinea, except on Fiji which possess several species occurring in Eastern Australia. However, these are probably accidental introductions. *Acanthomimus*, *Echetlus* and *Anophelepis* are among several genera present in Australia, but absent from New Guinea. Only one species each of *Podacanthus* and *Didymuria* of the subfamily Podacanthinae, well developed in Australia, is known in New Guinea. The genus *Extatosoma*, several species of which are large and striking in Australia, is represented in New Guinea at least by one unusual species. The genus *Stephanacris* in New Guinea is not known from Australia.

Günther (1953) cited the absence in Australia of Phylliidae which contains two subfamilies in oceanic islands and three in New Guinea. It is further believed to be of old Holarctic origin.

The Philippine influence, though weak, is indicated by the occurrence of two genera, *Heterocopus* in Micronesia (Palau Is. and Ponape) and New Guinea, and *Pterobrimus* (?) in Fiji. Both of these genera belong to the tribe Obrimini, a group of wingless, areolate phasmatids primarily confined to the Philippine Archipelago, but a few species occur in

North Borneo and Tulur Islands. The Datamini, on the other hand, represented in New Guinea and most of the Indo-Malayan Subregion, is absent from the Philippines. The *Phasmotaenionema* of the tribe Pharnaciini, also found in the Philippines, is known to extend to the Solomon Is.

SUMMARY

In the Pacific oceanic islands there are 61 species and two subspecies belonging to 30 genera. Sixteen genera, 46 species and two subspecies are endemic. In general, there are only one or two species per island in any one genus except *Hermarchus* in Fiji, and *Canachus* and *Asprenas* in New Caledonia which have four to seven species occurring on those islands. There is a general reduction in the numbers of species from west to east. New Caledonia and Fiji have the richest phasmatid fauna, while the poorest is on the easternmost islands in Polynesia, Marquesas and Mangareva, with a single widespread species. The oceanic phasmatid fauna is highly disharmonic, lacking many subfamilies, tribes, genera and species occurring in New Guinea and Australia.

New Zealand's fauna is very distinctive, possessing 26 species of eight genera, 24 of which are endemic species belonging exclusively to two tribes, Macracanthini and Pachymorphini.

Phasmatids are among the largest of all insects and are limited in their power of dispersal not only because they are sluggish and inactive, but because they are strictly herbivorous, and their highly specialized mode of life requires an appropriate environment in which to live. Some species may be host specific. In the oceanic islands one species seems to have dispersed easily and widely because of its subsistence on coconut palms. Probable means of dispersal may have been through rafting or human agency.

On the basis of the available data on the distribution of the Phasmatodea in Oceania, it appears that much of its fauna was derived from New Guinea where relationships are predominantly with the Indo-Malayan Subregion of the Oriental Region rather than with the Australian Region. The Philippine influence is weak, extending to Micronesia and New Guinea, and questionably to Fiji. New Caledonia indicates some relationships with New Zealand. There do not seem to be any close relationships between New Zealand and Australia.

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