PACIFIC INSECTS

Vol. 1, no. 4 December 25, 1959

Organ of the program "Zoogeography and Evolution of Pacific Insects," Published by Entomology Department, Bishop Museum, Honolulu, Hawaii, U.S.A. Editorial committee: J. L. Gressitt (editor), D. E. Hardy, M. A. Lieftinck, T. C. Maa, I. M. Mackerras, L. W. Quate, J. J. H. Szent-Ivany, R. L. Usinger and K. Yasumatsu.
Devoted to monographs and zoogeographical studies of insects and other terrestrial arthropods from the Pacific area, including eastern Asia, Australia and Antarctica. Normally to appear quarterly.

# THE BEMBIDION AND TRECHUS (Col.: Carabidae) OF THE MALAY ARCHIPELAGO[1, 2]

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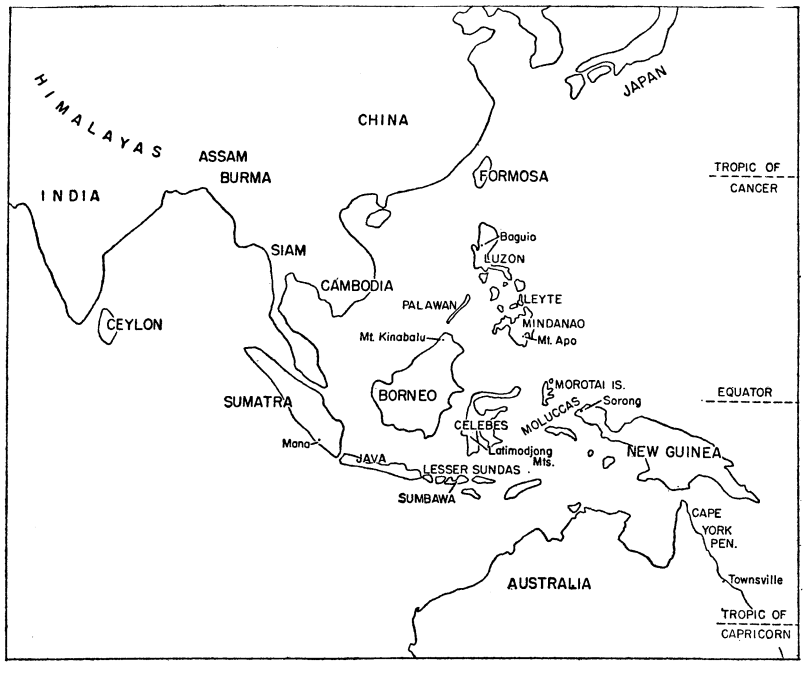
This is a zoogeographic study of how certain primarily northern genera of small, predaceous ground beetles extend into the tropical Malay Archipelago (see following map). The genera are the well known *Bembidion* and *Trechus*, both treated here in a very broad, old fashioned, but still useful sense.

This paper might be called a study in complexity of distribution. Of *Bembidion*, for example, it might be said simply that the genus in a very broad sense (including the coastal subgenus *Cillenus*) probably extends from Asia to Australia with no wide gap in distribution. Or it might be said that *Bembidion* without *Cillenus*, but still in a very broad sense, extends from Asia to Sumatra, Java, Borneo, Celebes, and the Philippines; is apparently absent on the Moluccas and New Guinea; and occurs again in Australia, especially in the south-temperate part of the continent; but this statement would still be much too simple. In fact, at least five different stocks of *Bembidion* have reached the western part of the Malay Archipelago from Asia. The different stocks all reach different limits or at least have different total distribution patterns. And one of the stocks has had a rather complex history on the islands, and has apparently made a double or triple invasion of northern Luzon.

This paper might also be called a study of transtropical dispersal, of how primarily north-temperate groups of Carabidae cross the tropics from Asia to Australia, or from

1. My work on Carabidae of the Malay Archipelago has been aided by a John Simon Guggenheim Memorial Foundation fellowship which enabled me to spend six months at the British Museum during the winter of 1947-48, studying especially the great collection of Oriental Carabidae of the late H. E. Andrewes.

2. A note on methods is necessary. Proportions given in my descriptions of species are based on actual measurements, made with a micro-ruler in the ocular of a stereoscopic microscope, of width of head, width of prothorax, etc. I usually measure and calculate the proportions of one pair of each species; to do it for all specimens would be impossibly time-consuming. The proportions are used to distinguish species only when differences are decisively great and are obvious to the eye. Width of head includes the eyes. Width of apex of prothorax is width between most advanced points of anterior angles; of base, between points of posterior angles if the latter are distinct, or otherwise between (and including) the punctures from which the posterior-lateral setae arise. Length of prothorax is always length at middle.




North to southern S. America, and reach the south-temperate zone. They do it in two ways. Some do it by "mountain hopping" (*cf.* Simpson's "island hopping"), by somehow jumping gaps from one mountain range to another or by following mountain systems that cross the tropics. Some *Bembidion* may have crossed the whole width of the tropics in this way in America. In the Malay Archipelago, however, although some Asiatic Carabidae, including some *Bembidion*, have apparently mountain hopped as far as Celebes and the Philippines, and possibly to New Guinea (some Harpalini?), none seems to have reached Australia in this way. Some other temperate groups of Carabidae cross the tropics at low altitudes but in special habitats: on or near the seashore (*Bembidion* of subgenus *Cillenus* in the Malay Archipelago, and *Bembidion* of the *constrictum-contractum* group in America), or beside flowing fresh water (certain Trechini in both Old and New Worlds), or beside standing water (*Bembidion sobrinum* perhaps in Africa as well as the Malay Archipelago). These special habitats all have in common the presence of water, which may give some protection against tropical climate. Cases that involve the Malay Archipelago are described in more detail in the following pages.

Both *Bembidion* and *Trechus* are primarily ground-living genera. Both include species that are hydrophiles (that live beside running or standing water) and other species that are mesophiles (that live on or in the ground away from open water). Both genera include winged, dimorphic, and flightless species. Most of the hydrophiles are winged and at least some of them fly. Many of the mesophiles have atrophied wings and are flightless.

## BEMBIDION

Hundreds of species of *Bembidion* (in the present broad sense) occur in Eurasia and

N. America above the tropics. They are numerous in temperate China and Japan and in the Himalayas. In the Himalayas they occur especially in mountain valleys from about 1,000–3,000 m altitude, and at least one reaches 5,000 m, but very few descend to the tropical plains of India (Andrewes, 1935: 94). Most *Bembidion* seem to be barred from the tropics, either by physical factors or perhaps by competition—a related genus, *Tachys*, swarms in the tropics and seems to replace both *Bembidion* and *Trechus* there. However a few *Bembidion* do occur on the tropical islands between Asia and Australia, as described in this paper. Several species of the genus occur in Australia (Sloane, 1921), especially temperate southern Australia and Tasmania, and some occur on New Zealand. The pattern of distribution of *Bembidion* in America parallels the pattern in the Old World. There are many species in N. America north of the tropics. A few occur on high mountains in tropical C. and S. America and at least one group is widely distributed in wet saline habitats in the lowland tropics too (Darlington, 1953: 13–14). And a few additional species occur in south-temperate S. America.

The six groups of *Bembidion* (*s. lat.*) in the Malay Archipelago are distinguished in the following key.

## Key to Groups of Bembidion (s. lat.) of the Malay Archipelago

1. Posterior transverse impression of pronotum deep, sharply defined, sulciform; head very large, with long mandibles (species found on or near the seashore)..... ..... I. Subgen. **Cillenus** *s. lat.*
   Posterior transverse impression of pronotum less deep, less sharply defined; head relatively smaller, with shorter mandibles ..... 2
2. Elytral margins almost rectangularly angulate at humeri (body fusiform; striae of elytra entire, coarsely punctate)..... II. Subgen. **Bracteon** *s. lat.*
   Elytral margins not strongly angulate at humeri..... 3
3. Both dorsal punctures of elytron attached to 3rd stria; elytra not spotted..... ..... III. **bryanti-pendleburyi** group
   One or both dorsal punctures of elytron on 3rd interval, not attached to stria; elytra with subapical spots ..... 4
4. Prothorax strongly cordate, base narrower than apex; entire upper surface with heavy, nearly isodiametric microsculpture ..... IV. **niloticum** group
   Prothorax less cordate, base wider than apex ..... 5
5. Pronotum less transverse, disc without microsculpture (in the insular species) ..... .....V. **varium** group
   Pronotum more transverse (fig. 5), disc microreticulate (in the insular species) ... ..... VI. Subgen. **Philochthus**

## I. Bembidion, subgenus Cillenus

The subgenus *Cillenus* (*s. lat.*) is widely distributed in the Old World but does not occur in America. Andrewes (1938) has revised the species known to him. Different species have been found in Europe, China, Japan, Formosa, Palawan in the Philippines, Morotai in the Moluccas, New Guinea, tropical and temperate eastern Australia, Fiji, and New

Zealand. These known localities suggest that further collecting will show *Cillenus* to be continuously distributed across the islands from north-temperate eastern Asia to south-temperate eastern Australia. Most of the species live on the seashore between tide lines, and some are flightless, but *C. alatum* of Morotai lives beside running fresh water near the shore and is winged and probably flies, and the two other species known from the Malay Archipelago may have the same habits. They may represent the ancestral winged stock from which different flightless *Cillenus* have been independently derived in different places (Darlington, 1953: 13).

KEY TO KNOWN SPECIES OF CILLENUS (S. LAT.) OF THE MALAY ARCHIPELAGO

1. Humeral margins rounded or at most weakly subangulate; posterior trochanters about 1/2 length of femora, bluntly pointed, not finely produced ..... **1. alatum**
   Humeral margins almost rectangularly angulate; posterior trochanters about 3/5 as long as femora, finely produced at apex ..... 2
2. Elytral margins at base reaching bases of 4th striae; femora and penultimate segments of maxillary palpi dark ..... **2. albertisi**
   Elytral margins reaching bases of 5th striae; femora and penultimate segments of maxillary palpi pale ..... **3. hoogstraali**

**1. Bembidion (Cillenus) alatum** Darlington, 1953: 15.

DISTRIBUTION: Moluccas; known only from the southern lowland of Morotai I.; 12 specimens taken by myself Sept. 1944 by throwing water over gravel bars of a clear, flowing stream, near the seashore.

**2. Bembidion (Cillenus) albertisi** Putzeys, 1875: 748.—Andrewes, 1938: 192.

DISTRIBUTION: New Guinea; Putzeys' single type was from Sorong, at the W. tip of New Guinea. Andrewes' redescription was based on the same specimen. No additional specimens are known.

**3. Bembidion (Cillenus) hoogstraali** Darlington, n. sp. Fig. 1.

Rather slender, subparallel, moderately convex; brown (testaceous when immature) with greenish reflexions, each elytron with a large post-humeral triangular testaceous spot extending from margin inward almost to 1st stria; appendages testaceous, tips of mandibles and outer parts of antennae darker; upper surface micro-reticulate but moderately shiny especially toward elytral apices. *Head* (in measured specimens) .90 & .90 width prothorax; eyes moderate; antennae slender, median segments about 3× long as wide; frontal furrows subparallel, extending onto clypeus. *Prothorax* cordate, 3/10 wider than long (W/L 1.30 & 1.30); apex wider than base (A/B 1.20 & 1.23); sides broadly rounded, moderately sinuate before right, sharply defined basal angles; anterior lateral setae less than 1/4 of prothoracic length from apex, posterior setae on posterior angles; apex subtruncate or slightly emarginate; base rounded-subtruncate except slightly emarginate each side near angles; disc with anterior transverse impression faint, median longitudinal line lightly impressed, sub-basal transverse line deep. *Elytra* about 1/4 wider than prothorax (E/P 1.26 & 1.22), rather long, subparallel; margins almost rectangularly angulate at humeri, extending inward to slightly inside ends of 5th striae but not reaching bases of 4th striae; subapical

emarginations small but abrupt in both sexes; striae entire (except 6 and 7 abbreviated apically), well impressed, not distinctly punctate; intervals slightly convex, 3rd with 2 dorsal punctures near outer edge before middle and behind apical 1/4. *Inner wings* fully developed. *Lower surface* rather lightly micro-reticulate, not punctate. *Legs*: ♂ with segments 1–2 each front tarsus slightly dilated, squamulose below; posterior trochanters about 3/5 lengh of femora and finely produced at apex in both sexes. *Length* 4.4–5.0; width 1.4–1.6 mm.

DISTRIBUTION: Palawan, Philippine Is.; known only from the type locality

Holotype ♀ (Chicago Natural History Museum) and 1 unpigmented (immature) ♂ paratype (MCZ. 30068) both from Puerto Princesa, sea level, Palawan, Philippine Is., 1 and 4 May 1947, H. Hoogstraal, second growth forest. The actual habitat is not given. The species may live on the beach, or by running water a little inland. The types may have been taken at light, although they are not so labelled.

This new species is probably related to *Cillenus albertisi* Putz. of w. New Guinea. I know *albertisi* only from description, but the new species evidently differs from it as indicated in the key, above. The new species differs from *C. alatum* of Morotai by having the elytral margins much more strongly angulate at humeri and the posterior trochanters longer and more acuminate. All these species resemble and are probably related to *C. yokohamae* Bates of Japan, which, however, combines angulate humeral margins with short posterior trochanters.

## II. Bembidion, subgenus Bracteon

The subgenus *Bracteon* (*s. lat.*) is primarily Holarctic, but (if *Microserrullula* is included) it extends into the tropics of Africa and India etc., and a species occurs on Formosa. The group is represented in the Malay Archipelago by a single, new species isolated on Luzon, where it occurs on river sand bars at low altitudes, in fully tropical climate.

**4. Bembidion (Bracteon) subfusum** Darlington, n. sp. Fig. 2.

Sub-fusiform, rather convex; greenish black, appendages reddish, outer antennal segments darker; moderately shining, microsculpture isodiametric, well impressed on head especially posteriorly, faint or absent on disc of pronotum, deep on base and sides of pronotum, distinct on elytra. *Head* .81 & .80 width prothorax; eyes large; antennae slender, median segments about 3× long as wide; frontal furrows rather narrow, subparallel, well impressed, extending onto clypeus. *Prothorax* subquadrate except narrowed anteriorly; width/length 1.23 & 1.26; base as wide as widest part; base/apex 1.35 & 1.36; sides broadly rounded at middle, broadly sinuate posteriorly and sometimes also anteriorly; apex convex, with anterior angles moderately advanced; base slightly lobed at middle, oblique at sides; basal angles obtuse (almost right), well defined; posterior lateral setae on angles, anterior lateral setae absent; disc convex, median longitudinal line distinct, anterior transverse line almost obsolete, posterior transverse impression present but not sharply defined. *Elytra* almost 1/2 wider than prothorax (E/P 1.46 & 1.48), widest just before basal 1/4; sides nearly straight (or sub-sinuate) and slightly converging posteriorly, then rounded to apices, with broad, slight subapical sinuations; margins not serrate, rectangular at humeri, reaching bases of 4th striae; striae formed by rows of close, coarse punctures anteriorly,

groove-like posteriorly; intervals slightly convex, 3rd without differentiated areas, with 2 dorsal punctures on outer side, before middle and about 1/4 from apex. *Inner wings* fully

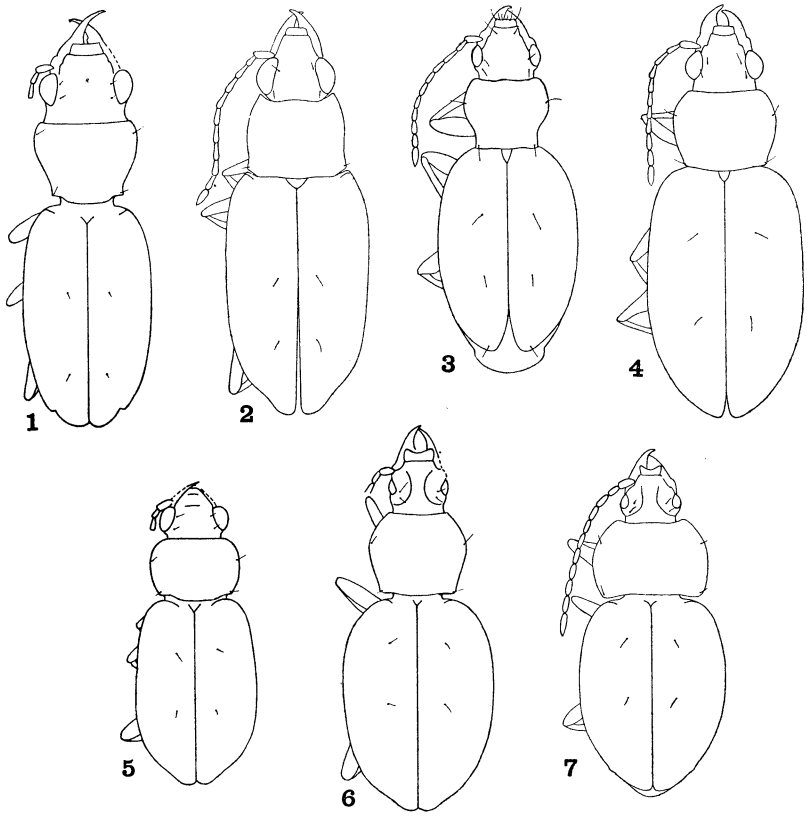



Fig. 1, *Bembidion* (*Cillenus*) *hoogstraali* n. sp., holotype ♀; 2, *B. subfusum* n. sp., paratype ♀; 3, *B. bryanti* Andr., Lake Linau, Mt. Apo, Mindanao, ♀; 4, *B. igorot* n. sp., paratype ♀; 5, *B. guttula* (F.), holotype of *sumatrensis* Louwerens, ♂; 6, *Trechus bontoc* n. sp., holotype ♂; 7, *T. latior* n. sp., paratype ♂.

developed. *Lower surface* shining, almost impunctate, with micro-reticulation present but for the most part lightly impressed. *Legs* normal. *Length* 4.3–5.1; width 1.6–2.0 mm.

DISTRIBUTION: Luzon, Philippine Is.; known only from the type locality.

Holotype ♂ (MCZ 30069) and 35 paratypes all from central plains of Luzon, Philippine Is., Feb.-Sept. 1945, taken by myself. The beetles were on sand bars of rivers and were active by day in sunlight, running and flying like tiny tiger beetles—this is the habit of some other *Bracteon.*

In Netolitzky's key (1942: 37/9ff.) this new species runs to "*Cylindrobracteon,*" the three previously known species of which occur in Japan and Formosa. As compared with *chloropus* Bates and *aeneipes* Bates of Japan, the Philippine species has the elytral striae much more coarsely punctate and differs in other details. It evidently differs from the Formosan *fusiforme* Netolitzky (which I know only from description) in having the ely-

tral striae entire at base, not obliterated anteriorly as in *fusiforme*.

## III. Bembidion, bryanti-pendleburyi Group

What, for convenience, I am calling the *bryanti-pendleburyi* group of *Bembidion* undoubtedly has Asiatic relationships, but the details of them are unknown. Andrewes has compared *Bembidion bryanti* with the European *nitidulum* Marsh; *bakeri* with the European *monticola* Sturm; and *pendleburyi* and *dammermani* with the mainly European subgenera *Synechostictus* and *Pseudolimnaeum*; but these are indications of the general nature of the species in question and not of direct relationships. In my opinion the four insular species here grouped together are probably derived from one temperate-Asiatic ancestor that has dispersed and diversified on the higher mountains of the western Malay Archipelago. Diversification may have followed the lines of the key (below). There may first have been separation of a stouter, duller species and a more slender, shining one. Both may then have dispersed extensively, both (for example) reaching Luzon. Both may then have differentiated geographically, on different mountains. And *bryanti* may then have redispersed, reinvading northern Luzon and forming a pattern of double invasion with its close relative, *bakeri*. Dispersal has probably been accomplished by winged individuals, which still occur in *bryanti*, *bakeri* and *pendleburyi*, although wing atrophy has occurred probably several times in the group.

### Key to Known Species of Bembidion of the bryanti-pendleburyi Group

1. Form stouter; less shining, most of upper surface with reticulate microsculpture in both sexes; base of pronotum rather vaguely punctate ..... 2
   Form more slender; more shining, most of upper surface without reticulate microsculpture at least in ♂ (elytra sometimes with microsculpture in ♀); base of pronotum coarsely punctate ..... 3
2. Antennae shorter (6th segment less than 3× long as wide); wings dimorphic, fully developed or reduced to vestiges 1/2 to 3/4 length of elytra (Java, Mindanao, Luzon) ..... **5. bryanti**
   Antennae longer (6th segment at least 3× long as wide); wings dimorphic, fully developed or reduced to vestiges shorter than in *bryanti*, about 1/4 or less length of elytra (N. Luzon) ..... **6. bakeri**
3. Eyes less prominent (about as in *bakeri*); elytral striae nearly entire (about as in *bakeri*); wings reduced in the unique type (but perhaps dimorphic) (Java)..... ..... **7. dammermani**
   Eyes more prominent; elytral striae more effaced apically; inner wings fully developed in specimens seen (but perhaps dimorphic) (N. Borneo, Celebes, Luzon) ..... **8. pendleburyi**

**5. Bembidion bryanti** Andrewes, 1921: 249. Fig. 3.

*salamander* Andrewes, 1933: 274. **New synonymy.**

DISTRIBUTION: Java; Mindanao and Luzon, Philippine Is.

JAVA: The unique type of *bryanti* is from Mt. Papandajan 2550 m, W. Java. The 14 original examples of *salamander* are from "W. Java: Mt. Gedeh Crater, 2600 m, and E. Java: Idjen, Ongop-Ongop, 1850 m."

MINDANAO: Mt. Apo (Davao Prov.): 2 from Baclayan 1950 m, E. slope of mountain; 369 from Lake Linau 2350 m, N. slope; 19 from near summit, 2900 m, and 1 from crater 2900 m, H. Hoogstraal and F. W. Werner, Oct.-Nov. 1946, Chicago Natural History Museum Philippine Expedition. One additional specimen from "Lino" Lake 2400 m, Mt. Apo, 19 Sept. 1930, C. F. Clagg, in Chicago Mus., and also 2 from E. slope Mt. McKinley 2350 m, Davao Prov., 21 Sept. 1946, Hoogstraal.

LUZON: 2 specimens from Irisan, Benguet [Mountain] Prov., June 1903, R. C. McGregor; and 2 from Anuling, Zambales Prov., McGregor (all in USNM).

Andrewes considered *bryanti* and *salamander* very closely allied, perhaps only local forms of one species, and in view of the variability of the species elsewhere I see no reason to keep them separate. I have seen the types of both at the British Museum and have two Idjen specimens of *salamander* before me now to compare with the Philippine series. The type of *bryanti* has fully developed, folded inner wings (I am indebted to Dr. E. B. Britton for determining this for me); the types of *salamander*, reduced wings; but, since the closely related *bakeri* is dimorphic, the state of the wings is not to be considered an important taxonomic character in this group.

The Mt. Apo specimens vary considerably in size and in exact form of prothorax. The inner wings are reduced in *all* these specimens to from 3/4 to 1/2 the length of the elytra but are never as short as in short-winged individuals of *bakeri*. I at first put the Luzon specimens of this species with *bakeri*, then noticed their much shorter antennal segments and found that their (reduced) wings too agreed with *bryanti* rather than *bakeri*. Irisan is near Baguio and is only about 9 km north of Mt. Santo Tomás (where *bakeri* occurs) but at a lower altitude, about 1200 m. I have not located Anuling but it is presumably in the mountains of W. Luzon north of Bataan.

**6. Bembidion bakeri** Andrewes, 1924: 197.

DISTRIBUTION: Luzon, Philippine Is. Andrewes' unique type was from Baguio, Benguet [Mountain] Prov., N. Luzon, collected by C. F. Baker. It is now in the British Museum, where I have examined it. I have seen additional specimens from near Baguio as follows: 2, Mt. Santo Tomàs 1800 m, Mountain Prov., 6 May 1931, F. C. Hadden (Calif. Ac. Sci.); 56, same locality, 2100 m, 1 May 1931, Hadden (Bishop Mus.); and 67, "Baguio & vic." (some or all actually taken on the north side of Mt. Santo Tomàs, about 5 km SE of Baguio), about 1500 m, June-Sept. 1945, taken by myself.

These specimens listed above are all plainly *bakeri*, with no intergradation with *bryanti*, although the latter occurs within a few miles at a slightly lower altitude. The state of the wings in the different collections of *bakeri* varies. In Hadden's series, all specimens are fully winged; in mine, only 8 are fully winged, and 59 have vestigal wings (the vestiges being not more than 1/4 as long as the elytra, much shorter than in *bryanti*, in all specimens). This may indicate a real change in state of wings between 1931 and 1945, or it may reflect a slight difference in locality: my specimens were taken at a somewhat lower altitude than Hadden's, and if I sampled a permanent population while he got individuals that had flown up the mountain slope, that would account for the difference in wings. My

specimens were collected among stones in wet places where water was seeping down the mountain slope; Hadden's, "under stones along the trail to the top of Mt. Santo Tomàs."

**7. Bembidion dammermani** Andrewes, 1933: 273.

DISTRIBUTION: Java; Andrewes' unique ♀ type was from Mt. Pangrango 2400 m, W. Java; I have seen no other specimens.

I examined the type at the British Museum in 1947 and noted that it is more slender, more parallel, and more shining than *bakeri*, with more punctate base of pronotum, but with eyes about the same (less prominent than in *pendleburyi*) and elytral striae about as in *bakeri* (less abbreviated than in *pendleburyi*). The inner wings of the type are reduced, but the species may be dimorphic.

**8. Bembidion pendleburyi** Andrewes, 1931: 442, fig. 3.

DISTRIBUTION: Borneo, Luzon, Celebes.

BORNEO: The type locality is Kamborangah, 2150 m, Mt. Kinabalu, N. Borneo. There were 5 specimens in the type series; I saw 3 of them at the British Museum in 1947.

LUZON: 1 ♂, Baguio & vic., 1200–2200 m, Mountain Prov., June-Sept. 1945, taken by myself [but just where in the vicinity of Baguio I do not know]; and 1 ♀, Haight's Place [NW of Baguio], 2400 m, Mt. Pauay, 1–8 Oct. 1931, Clagg and Rivera; received by Museum of Comparative Zoology with C. W. White Collection.

CELEBES: 1 ♀, Latimodjong Mts., 1200 m, Bontoe Batoe Dist., 14–25 May 1931, C. F. Clagg, in traplight; received by MCZ with C. W. White Collection.

This is the first *Bembidion* of any sort recorded from Celebes. Although I have not compared them directly with the types, both the Philippine and Celebes specimens agree in general with Andrewes' description and my notes on *pendleburyi*, except for one detail. In typical *pendleburyi* from Borneo the ♀ as well as the ♂ lacks elytral microsculpture; Dr. Britton has confirmed this for me. The Philippine ♂ is almost without elytral microsculpture, but both the Philippine and Celebes ♀♀ have the elytra, though still rather shining, almost covered with distinct microreticulation. More material is needed to show whether the Bornean, Philippine, and Celebes forms are distinguishable on this or perhaps other characters. All the specimens are fully winged.

## IV. Bembidion, niloticum group

The *niloticum* group of *Bembidion* is represented in the Malay Archipelago by only the following very widely distributed species.

**9. Bembidion sobrinum** Boheman, 1848: 232.—Andrewes, 1935: 201.—Sloane, 1921: 193.
*opulentum* Nietner, 1858: 420.

DISTRIBUTION: S. and E. Africa, tropical Asia, part (but not all) of the Malay Archipelago, parts of tropical and south-temperate E. Australia, and apparently also New Caledonia: the species exhibits some geographical variation, which I have not tried to assess. In Asia *sobrinum* occurs from Ceylon and the plains of India at least to Burma, Thailand, and Cambodia (and the closely related *niloticum* extends north to temperate Japan). On the Malay Archipelago *sobrinum* is apparently recorded only from Java, Leyte

and Luzon in the Philippines, and Sumbawa in the Lesser Sunda Islands. It has not been found on Celebes, the Moluccas, or New Guinea, and its absence at least on New Guinea is fairly well established by the large amount of collecting that has been done there in recent years. In Australia it apparently does not occur on the Cape York peninsula (I did not find it there during extensive collecting in 1958) but does occur in eastern Australia at least from the latitude of Townsville in tropical Queensland south to cool-temperate Tasmania. The species lives beside standing water in open, often muddy places. It is winged and active and probably flies well. It is the sort of carabid that might be dispersed by man. Numbers might be attracted onto a lighted boat at night, then carried long distances.

The history of this species is doubtful. It may have reached Australia by way of the Lesser Sunda Islands, and in that case it may still range more or less continuously from Asia across these islands to Australia, by passing Celebes, the Moluccas, and New Guinea. Or it may have reached Australia from Asia by way of Celebes, the Moluccas, and New Guinea, and disappeared on these islands. Or it may possibly have been carried to Australia by man. However, I doubt this. Some of the endemic species of *Bembidion* in Australia look as if they may have been derived from a *sobrinum*-like ancestor, and this suggests that the group to which *sobrinum* belongs reached Australia long before man did.

## V. Bembidion, varium group

Andrewes' (1935) *varium* group of *Bembidion* is admittedly artificial. The species in it are diverse and not necessarily closely related to each other, and they do not fall easily into Netolitzky's Palearctic subgenera. In treating the following new species from Luzon, therefore, I can say that it is geographically isolated, derived from Asia, and that it resembles a species from Assam, but I cannot generalize further about the distribution of its relatives.

**10. Bembidion igorot** Darlington, n. sp. Fig. 4.

Form average for *varium* group, rather convex; dark reddish piceous, appendages paler, each elytron with a small subapical testaceous spot near outer side; very shining, microsculpture faint or absent. *Head* .79 & .81 width prothorax; eyes rather large; antennae moderate, median segments a little less than 3× long as wide; frontal furrows well defined, subparallel anteriorly, curving outward posteriorly to bases of eyes. *Prothorax* somewhat transverse (width/length 1.32 & 1.29), a little narrower in front than behind (base/apex 1.16 & 1.19); sides broadly rounded, slightly sinuate very near basal angles, which are right-obtuse but slightly blunted; apex very broadly emarginate or subtruncate (depending on angle of view); base slightly lobed at middle, truncate at sides; lateral margins rather narrow anteriorly, much wider posteriorly, with lateral setae about 2/5 from apex and just before basal angles; latter carinate; disc with median line rather fine, anterior transverse line distinct at sides but interrupted or poorly defined at middle, posterior transverse impression poorly defined; baso-lateral impressions deep, base between them irregularly punctate. *Elytra* about 1/2 wider than prothorax (E/P 1.51 & 1.55); humeri prominent but rounded; sides subparallel at middle, curving to apex with very slight subapical sinuations; margins ending at humeri about opposite bases of 6th striae; striae moderately impressed on disc, very light laterally (reduced to lines of well spaced punctures), very

light or slightly abbreviated apically, distinctly punctate; intervals slightly convex at least on disc, 3rd with usual 2 dorsal punctures toward outer edge (but not attached to stria) about 1/4 from base and behind middle. *Inner wings* fully developed. *Lower surface* nearly impunctate, with microsculpture faint or absent. *Legs* normal. *Length* 3.6–4.2; width 1.4–1.7 mm.

DISTRIBUTION: Luzon, Philippine Is.; known only from the type locality.

Holotype ♂ (MCZ 30070) and 32 paratypes all from near Baguio, Mountain Province, N. Luzon, Philippine Is., June-Sept. 1945, taken by myself. They were taken by stamping down vegetation in a large grassy swamp near the village of Trinidad, north of Baguio, at about 1250 m elevation.

This species closely resembles *Bembidion cupido* Andrewes of Assam (type examined, in British Museum) in form of prothoracic margins and in most other ways but has the prothorax less narrowed anteriorly than in *cupido*, with more obtuse, less denticulate posterior angles, and with the anterior transverse line of the pronotum more widely interrupted at middle.

## VI. Bembidion, subgenus Philochthus

**11. Bembidion (Philochthus) guttula** (Fabricius), 1792: 166 (*Carabus*). Fig. 5.

*Bembidion new species* Andrewes, 1933: 320.—*Bembidion sumatrensis* Louwerens, 1953: 89. **New synonymy.**

DISTRIBUTION: W. Palearctic Region; ? introduced in Sumatra.

SUMATRA: 1, Manna (Mana), 1902, M. Knappert. I am indebted to Dr. A. Diakonoff for permitting me to examine the Sumatran specimen. It is labeled "*Bembidion* sp. nov., Det. H. E. Andrewes" and is the type of *sumatrensis* Louwerens. Louwerens correctly referred his species to the Palearctic subgenus *Philochthus*, but failed to notice that it is indistinguishable from the western Palearctic *guttula*. So far as I can determine, neither *guttula* nor any closely related form occurs in tropical Asia, and it is therefore probable that the species has been introduced into Sumatra or that the supposed Sumatran specimen is mislabeled.

## TRECHUS

The Trechini of the Malay Archipelago belong to three principal genera, all of which must be mentioned although I shall discuss only *Trechus* in detail. (1) *Perileptus*[1], which is widely distributed in the warmer part of the Old World (and which occurs only in the W. Indies in America), extends continuously (so far as the land is continuous) across the islands from temperate E. Asia and Japan to warm-temperate New South Wales in Australia, except that its place is taken in much of New Guinea by the related (derived?) *Perileptodes*. The species of *Perileptus* live in gravel banks and bars of brooks and rivers, and are winged and good fliers. (2) *Trechodes* occurs in Africa and Madagascar, is appar-

1. "*Neoblemus*" *bottcheri* Jedlicka (1935: 197) of Mindanao is a slightly aberrant *Perileptus*, as I know from examination of the type in the British Museum. It may be a synonym of *P. melas* Jeannel.

ently localized in tropical Asia (known only from Burma), is represented by another localized species on Luzon but is unknown elsewhere in the Malay Archipelago, and is widely distributed in tropical and south-temperate Australia from the Cape York Peninsula etc. to Victoria. The species of this genus too live by running water and are winged and fly well. (3) *Trechus* (*s. lat.*) is primarily Holarctic. It is especially well represented in Europe but is widely distributed also in Asia including the Himalayas and Japan, as well as in temperate N. America. One species is already known from the mountains of northern Luzon and 2 more from there are described below. The genus is otherwise unknown in the Malay Archipelago and unknown in the tropical part of Australia, but a number of species of it occur in south-temperate Australia, mostly in Tasmania and the mountains of Victoria, but two species extend north to northern New South Wales or the mountains on the Queensland border. In the northern hemisphere, *Trechus* includes winged brook-side hydrophiles as well as flightless mesophiles. At least one of the Australian *Trechus* is winged or dimorphic too (*T. diemensis* Bates, which lives in rotting logs rather than beside brooks), although most Australian species are flightless.

It will be seen that the Trechini, like *Bembidion*, suggest by their present distribution how a north-temperate group of small Carabidae may cross the tropics and reach the south-temperate zone of Australia by means of winged species associated with water, in this case running streams. *Perileptus* ranges almost continuously across the tropics now. *Trechodes* has probably done so in the past; *Perileptus* may have replaced it rather recently in stream-side habitats in most of the Malay Archipelago and tropical Asia. And, perhaps in the more distant past, a winged, brook-side *Trechus* may have crossed the tropics in the same way, then left the brooks and become flightless to produce the existing Australian species.

The 3 species of *Trechus* that I found in N. Luzon were all collected along the mountain road north of Baguio, toward Bontoc, but I do not know whether they occurred together or in slightly different localities. The highest point on this road is about 2200 m. There are still higher mountains in N. Luzon on which no collecting has been done, and it seems likely that additional species of *Trechus* will be found on them. Jeannel (1923) says *T. bakeri* is closely allied to Himalayan species, and my new Philippine species are evidently derived from the same stock as *bakeri*. Jeannel (1927: 157 & 165) later put *bakeri* in his *indicus* group, of which the type species is winged. This suggests that, although the Philippine species are "apterous", their ancestor dispersed by flight and lost its wings after it reached Luzon.

## Key to Species of Trechus of Northern Luzon

1. Prothorax relatively narrow (width/length 1.23 & 1.19 in measured specimens), with sides straight or subsinuate before base ..... **12. bontoc**
   Prothorax relatively wider, with sides rounded to base ..... 2
2. Prothorax moderately wide, width/length 1.32 & 1.35, base/apex 1.29 & 1.28... **13. bakeri**
   Prothorax still wider, with very wide base, width/length 1.47 & 1.44, base/apex 1.50 & 1.47 ..... **14. latior**

**12. Trechus bontoc** Darlington, n. sp. Fig. 6.

Form of average, convex, "apterous" species of genus; rufous; rather shining, micro-

sculpture lightly impressed, almost isodiametric on head especially posteriorly, transverse on pronotum, more transverse and very faint on elytra. *Head* narrow, .61 & .62 width prothorax; eyes small and almost flat, hardly as long as genae behind them; antennae rather long, median segments about 3× long as wide; frontal channels smoothly, almost evenly rounded except subsinuate anteriorly. *Prothorax* relatively small and narrow, width/length 1.23 & 1.19, narrowed posteriorly and still more so anteriorly (base/apex 1.30 & 1.28); sides rounded nearly to base, then almost straight and briefly or faintly sinuate before posterior angles; latter obtuse, slightly blunted; apex truncate or broadly emarginate (depending on angle of view), with anterior angles scarcely advanced; base subtruncate except slightly sinuate each side of median part; lateral margins rather narrow anteriorly, moderately wider posteriorly, each with usual 2 setae a little before middle and almost on posterior angle; median line well impressed, anterior and posterior transverse impression obsolete; baso-lateral impressions rather small, smooth. *Elytra* wide (elytra/prothorax 1.55 & 1.62), convex; humeri prominent but broadly rounded; sides round to apices, with slight subapical sinuations; striae entire; well impressed, not distinctly punctate except 3rd with usual dorsal punctures near basal 1/4 and middle; intervals slightly convex, impunctate. *Inner wings* vestigial. *Lower surface* virtually impunctate, rather shining, with lightly impressed microsculpture. *Legs* of normal length; ♂ with segments 1–2 each front tarsus dilated, squamulose below; and ♂ (but not ♀) also with front femora strongly angulate (almost dentate) below about 1/3 from base. *Length* 4.8; width 1.9 mm.

DISTRIBUTION: N. Luzon, Philippine Is.; known only from the type locality.

Holotype ♂ (MCZ 30071) and 1 ♀ paratype both from Baguio and vicinity, Mountain Prov., N. Luzon, Philippine Is., June-Sept. 1945, taken by myself. The specimens were actually taken along the Bontoc Road north or northwest of Baguio, probably at an altitude of about 2200 m under stones in damp places but not by running water.

**13. Trechus bakeri** Jeannel, 1923: 416, 426, fig. 16; 1926: 157, 165, figs. 545–548.

*arrowi* Jedlicka, 1935: 79. **New synonymy.**

DISTRIBUTION: N. Luzon, Philippine Is.; known only from the vicinity of Baguio.

The types of *bakeri* and *arrowi* are both in the British Museum, where I examined them in 1947 and established their specific identity. I collected 8 specimens of this species along the Baguio-Bontoc road, probably near 2200 m, June-Sept. 1945, under stones in damp places but not by running water. Proportions of a measured ♂ ♀ are head/prothorax .63 & .61, prothoracic width/length 1.32 & 1.35, base/apex 1.29 & 1.28, and width elytra/prothorax 1.49 & 1.44.

**14. Trechus latior** Darlington, n. sp. Fig. 7.

Form of stout, convex, "*apterous*" *Trechus*; piceous or reddish piceous, legs brown, antennae often darker; moderately shining, with microsculpture lightly impressed, nearly isodiametric on head especially posteriorly, transverse on pronotum, more transverse and faint on elytra. *Head* small, .56 & .58 width prothorax; eyes small but rather convex, longer and more prominent than genae; antennae rather slender, median segments about 3× long as wide; frontal furrows almost evenly rounded except subsinuate anteriorly. *Prothorax* large, wide posteriorly, width/length 1.47 & 1.44, base/apex 1.50 & 1.47; sides broadly, evenly rounded from apex to base; basal angles blunted-obtuse or narrowly rounded; apex sub-

truncate, with anterior angles rounded and scarcely advanced; base truncate at middle, slanting backward at sides; lateral margins narrow anteriorly, much wider posteriorly, each with usual two setae about 1/3 from apex and at (rounded) basal angle. Disc convex; median line well impressed; anterior and posterior transverse impressions vague; lateral margins extending inward as narrow basal margins on each side of base, then curving forward to make small, smooth baso-lateral impressions. *Elytra* about 1/3 wider than prothorax (E/P 1.32 & 1.32), convex, with humeri prominent but broadly rounded; sides subparallel to behind middle, then rounded to apices, with slight subapical sinuations; striae entire, moderately impressed, impunctate except for usual 2 dorsal punctures on 3rd stria less than 1/4 from base and near middle; intervals moderately convex, impunctate. *Inner wings* vestigial. *Lower surface* rather shining, virtually impunctate, with lightly impressed microsculpture. *Legs* of normal length; ♂ with segments 1–2 of each front tarsus dilated, squamulose below as usual; ♂ front femur not angulate or dentate below. *Length* 4.3–4.5; width 1.8–1.9 mm.

DISTRIBUTION: N. Luzon, Philippine Is.; known only from the type locality.

Holotype ♂ (MCZ 30072) and 5 paratypes all from Baguio and vicinity, Mountain Prov., N. Luzon, Philippine Is., June-Sept. 1945, taken by myself. These, like my other Luzon *Trechus*, were actually taken along the road north of Baguio toward Bontoc, probably near 2200 m. altitude, under stones in damp places but not by running water. Also one additional ♂ with the same data (but not necessarily from exactly the same locality) which I assign to this species but not as a type; it varies toward *bakeri*.

## REFERENCES

Andrewes, H. E. 1921. Notes on Oriental Carabidae.—II. Some new species of *Bembidium* from Java and Indo-China. Ent. Month. Mag. **57**: 248–252.

———— 1924. Some further species of *Bembidium* from North India, ...Ent. Month. Mag. **60**: 191–198.

———— 1931. On the Carabidae of Mount Kinabalu. Federated Malay Museums, Journ. **16**: 431–485, map.

———— 1933. On some new species of Carabidae, chiefly from Java. Treubia **14**: 273–286.

———— 1933. A catalogue of the Carabidae of Sumatra. Tijdschr. v. Ent. **76**: 319–382.

———— 1935. Fauna of British India, including Ceylon and Burma. Coleop., Carabidae 2, Harpalinae 1.

———— 1938. On *Cillenus* Samouelle. Royal Ent. Soc. London, Proc. (B) **7**: 190–196.

Boheman, C. H. 1848. Insecta Caffraria **1**.

Darlington, P. J. Jr. 1953. A new *Bembidion* of zoogeographic importance from the Southwest Pacific. Coleopterists' Bull. **7**: 12–16.

Fabricius, J. C. 1792. Entomologica Systematica 1, Part 1.

Jeannel, R. 1923. Les Trechinae de la Region Orientale. Ann. Mag. Nat. Hist. ser. 9, **12**: 393–435.

———— 1927. Monographie des Trechinae (2e livraison). L'Abeille **33**: 1–592.

Jedlicka, A. 1935. Neue Carabiden. Soc. Ent. Czechoslovakia, Acta **32**: 79.

———— 1935. Eine neue philippinische Neoblemusart. Soc. Ent. Czechoslovakia, Acta **32**: 197.

Louwerens, C. J. 1953. New Carabidae from the Malay Archipelago. Zoologische Mededelingen **32**: 87–95.

Nietner, J. 1858. Descriptions of new Ceylon Coleoptera. Ann. Mag. Nat. Hist. ser. 3, **2**: 418–431.

Putzeys, M. J. 1875. Descriptions de carabiques nouveaux ou peu connus. Mus. Civ. Genova (Genoa), Ann. **7**: 721–748.

Sloane, T. G. 1920. [Australian *Trechus.*] Linnean Soc. New South Wales, Proc. **45**: 143–150.

———— 1921. [Australian *Bembidion.*] Linnean Soc. New South Wales, Proc. **46**: 192–194.

NOTE: Reference should be made to Jeannel's monograph of Trechini (Trechinae), in L'Abeille, 1926–1928, in which "*Trechus*" is divided into many genera assigned to two tribes. It is an outstanding work, but to attempt to follow it in the present paper would complicate the situation and the terminology without changing the essential fact that *Trechus* in the oldfashioned sense occurs mainly in the north- and south-temperate zones and has somehow crossed the tropics. In fact, according to Jeannel's classification, it has done so twice!

## FIELD WORK ACCOMPLISHED

Considerable field work has been accomplished under the program "Zoogeography and evolution of Pacific insects." This program is an attempt to coordinate certain phases of systematic and zoogeographic work on terrestrial arthropods of Pacific islands, eastern Asia and Antarctica, while building up collections from certain parts of these areas at Bishop Museum. Primary concentration is on the oceanic islands and the Papuan Subregion. During the past five years, participants in the program have collected in various areas as follows: Japan, 2 entomologists; Ryukyu Is., 2; Taiwan, 5; Thailand, 3; India, 1; Ceylon, 1; Malaya, 5; Indonesia, 1; Australia, 2; Borneo, 3; Philippines, 4; New Guinea and Bismarcks, 10; Solomon Is., 2; New Hebrides, 3; New Caledonia, 3; Micronesia, 4; Fiji, 3; Samoa, 2; New Zealand, 3; Antarctica, 3. In terms of man-months of field work by these participants in the various areas, the figures are: Japan, 1 month; Ryukyu Is., 1; Taiwan, 4; Thailand, 3; India, Ceylon, Indonesia, Australia and New Zealand, together, 2; Malaya, 4; Borneo, 11; Philippines, 12; New Guinea and Bismarcks, 53; Solomons, 4; New Hebrides, 2; New Caledonia, 3; Micronesia, 7; Fiji, 2; Tonga, 1; Samoa, 6; Tahiti, 1; Antarctica, 5 (total, 122 months collecting, 1955–59). The participants in the program are mostly listed on pages 58 and 323 of this volume. Additional collections were taken by W. W. Cantelo, E. L. Cassidy, J. Healy, J. R. Hendrickson, S. M. K. Hu, the late Steven Kirner, K. S. Lin, and C. Nibley, Jr., besides several entomologists in Hawaii, and others.

During 1959, W. W. Brandt collected in NE New Guinea and New Ireland; J. L. Gressitt in Netherlands New Guinea, NE New Guinea, Manus, New Ireland, New Britain, New Georgia (Solomons) and Antarctica; N. L. H. Krauss in Fiji, New Caledonia and New Hebrides; R. E. Leech in New Zealand and Antarctica; T. C. Maa in N. Borneo,

Taiwan, Netherlands New Guinea, Papua, NE New Guinea and the Bismarcks; Borys Malkin in Subantarctic South America; C. D. Michener in Papua and NE New Guinea; C. W. O'Brien in Antarctica; L. W. Quate in the Philippines; and C. M. Yoshimoto in the Philippines. Probably nearly one million specimens were taken during 1959.

## NOTE ON FORMAT OF "PACIFIC INSECTS"

A detailed outline for article format for this journal has not yet been prepared. For the time being it is not planned to make strict rules on all points, and some variation in methods of treatment and citation may be used. It is felt that different types of articles may vary in requirements. In general, for the principal sort of articles anticipated, the style used in the first article (Wirth & Hubert) is recommended (but ♂ and ♀ signs to be used except for paragraph headings). In brief, the following points are recommended (in addition to those mentioned on inside front cover): Use metric system; use numerals, fractions (in figures), decimals, and signs such as ♂, ♀, ×, +, =, whenever possible, in order to save space; use "segment 3, 4," etc. instead of "third, fourth"; use appropriate abbreviations, such as N, E, S, W; NE, SE, SW, NW; km, m, mm, mostly without periods except at end of sentence, or as "N. Luzon." Dates are cited thus: "20 Oct. 1955." In citations, Ann., Bull., Mem., Proc., Verh., etc. follow title of institution or society, as "1957, R. Ent. Soc. Lond., Proc. (B) **26** (11–12): 197, fig. 1." Where it will save space, one may use the system adopted in Darlington's article in this issue, or that in Gressitt's and Tokunaga's articles in preceding issues (citation immediately following species-heading where generic combination unchanged). Do not mark mss. for type, such as for bold-face, except in light pencil in margin, and except for straight underlining of scientific names for italics in text only. Illustrations, if mounted, should be attached only with rubber cement.

## RECENT LITERATURE ON PACIFIC INSECTS

Benson, R. B. 1959. Further studies on the Fenusini (Hymenoptera: Tenthredinidae). R. Ent. Soc. Lond., Proc. (B) **28** (5-6): 90–92, 4 figs.

Brass, L. J. 1959. Summary of the fifth Archbold expedition to New Guinea (1956–1957). Results of the Archbold expeditions No. 79. Amer. Mus. Nat. Hist., Bull. **118** (1): 1–69, map, 8 pls.

Britton, E. B. 1958. Insect distribution and the theory of continental drift. 8th Pac. Sci. Congr., Proc. **3A**: 1383–92, 3 figs.

Bryant, G. E. and J. L. Gressitt. 1957. Chrysomelidae of Fiji (Coleoptera). Pacific Science **11** (1): 2–91, 47 figs.

Carne, P. B. 1957. A revision of the ruteline genus *Anoplognathus* Leach (Coleoptera: Scarabaeidae). Austral. Jour. Zool. **5**: 88–143, 1 pl., 85 figs.

China, W. E. 1957. The marine Hemiptera of the Monte Bello Islands, with descriptions of some allied species. Linn. Soc. Lond. (Zool.), Jour. **43**: 342–57, 6 figs.

Cohic, F. 1957. Rapport sur une mission effectuée aux îles Chesterfield. Inst. Franç. d'-Oceanie. Off. Rech. Sci. Tech. Outre-Mer, Paris. 20 pp.

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