

THE *EPILACHNA VIGINTIOCTOPUNCTATA* COMPLEX (COLEOPTERA: COCCINELLIDAE)

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Abstract. Three different Australian species of *Epilachna* (Epilachninae: Coccinellidae) have each been incorrectly named *E. vigintioctopunctata*. Through this study their true identities have been determined as *E. vigintioctopunctata pardalis*, *E. vigintisexpunctata vigintisexpunctata*, and *E. cucurbitae*, n. sp. All 3 are described here. Distribution maps and a key for separating them are presented. All are important pests of agricultural crops. Both subspecies of *E. vigintioctopunctata*—*vigintioctopunctata* and *pardalis*—and all 3 subspecies of *E. vigintisexpunctata*—*vigintisexpunctata*, *doryca* and *philippinensis*—have been studied. A number of lectotypes are designated. New synonymies are established as follows: *E. territa* and *E. territa* var. *indocilis* as synonyms of *E. vigintioctopunctata vigintioctopunctata*; *E. sparsa* var. *nigrescens* as synonym of *E. vigintioctopunctata pardalis*; *E. philippinensis australica* as synonym of *E. vigintisexpunctata vigintisexpunctata*; and *E. philippinensis remota* as synonym of *E. vigintisexpunctata philippinensis*. *E. doryca* is reduced to a subspecies of *E. vigintisexpunctata*, and *E. doryca philippinensis* becomes a subspecies of *E. vigintisexpunctata*. Intra-specific variations in maculation are presented in detail, as they have been responsible for previous misidentifications of the species. *E. vigintisexpunctata doryca* is recorded from Australia for the first time. *Henosepilachna* is synonymized with *Epilachna*.

The Epilachninae are a primarily phytophagous subfamily of Coccinellidae which occur mainly in tropical and semitropical parts of the world. Their southernmost distribution is in eastern Australia close to the New South Wales and Victoria border. Nine species have been recorded from Australia, but this study is concerned with only 3. However, these 3 are by far the most widespread Australian epilachnines and are important pests of many agricultural crops, particularly in eastern Australia. Records of their damage can be found in many articles in the *Agricultural Gazette of N.S.W.* from 1890 onwards. In addition, they are also major pests of agricultural crops outside Australia, including bringal (*Solanum melongena*) and bitter gourd (*Momordica charantia*). Their range extends throughout India, Pakistan, China, Japan, SE Asia and Oceania. Because of their similarity in size and appearance, their overlapping distribution, and their similar food habits, they have been confused both in the literature and in museum collections, and all 3 have been incorrectly referred to as the “28-spotted ladybird beetle [*Epilachna vigintioctopunctata* (Fabricius)].” As such they, and more particularly their larvae, have been recorded as pests of pumpkin, potato, tomato and related plants (Olliff 1890), tobacco, nightshades, trumpet flower weed (*Datura stramonium*), cucumber, melon, and cotton (Froggatt 1923). Although

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in recent times their taxonomy has been studied by Dieke (1947), Li & Cook (1961) and Bielawski (1963), these authors' failure to study the original type series has led to incorrect identification of all 3 species. Through this study the true identities and distribution of these species and their subspecies have been discovered, and by examination of the relevant type series it has been possible to designate a number of lectotypes and establish new synonymies. Intraspecific variations in maculation have been studied in detail, as they have been responsible for previous misidentifications of the species.

The various developmental stages of "*E. vigintioctopunctata*" were first described and illustrated by Olliff (1890). From his figure of the adult beetle with 28 spots on the elytra and a pronotum with a large black disc, it is possible to identify the species he studied as *E. vigintisexpunctata vigintisexpunctata* (Boisduval). Temperley (1928) made a more detailed study of the biology of "*E. vigintioctopunctata*." Her illustration of the adult beetle shows that she was actually studying *E. vigintioctopunctata pardalis* (Boisduval). In 1960, Stride & Warwick examined the larvae and food preferences of "*E. sparsa vigintisexpunctata*" and "*E. vigintioctopunctata*," basing their nomenclature on Dieke's (1947) monograph. They showed that the former fed primarily on solanaceous plants, while the latter fed almost exclusively on cucurbitaceous plants. From their descriptions and figures the 2 species can be identified as *E. vigintioctopunctata pardalis* and *E. cucurbitae*, n. sp., respectively. Thus, in the papers referred to above, the 3 species treated in this paper have each been called *E. vigintioctopunctata* (Fabricius). It is hoped that the data presented here will correct nomenclatural errors and prevent future ones by facilitating identifications of the adult beetles and delimiting the distribution of each of the species. Their biology has also been studied, and it will form the basis of a separate paper.

All type specimens listed as examined in the synonymies in this paper have been seen by me, with the exception of those in the Dejean Collection at the Museum Guimet, Lyon, France, due to that museum's policy of not loaning material. However, I am indebted to R.D. Pope, London, who very kindly agreed, when on a visit to Lyon in 1980, to examine and photograph the Museum's specimens of *Epilachna territa* Mulsant and *Coccinella vigintisexpunctata* Boisduval so that I could compare them with the rest of the type material. Pope selected and labelled the lectotype and paralectotype of *C. vigintisexpunctata* and the paralectotype of *E. territa*, and they are all designated here.

The different handwritings on labels of specimens from the various European museums have been compared with authenticated labels in Horn & Kahle (1935–1937) for verification of the authors. All label information is presented exactly as data appear on the labels. Added information is bracketed; repositories for specimens appear in parentheses.

The following abbreviations of museums and collections are used: AM, Australian Museum, Sydney; AMNH, American Museum of Natural History, New York; ANIC,

Australian National Insect Collection, CSIRO, Canberra; ANS, Academy of Natural Sciences of Philadelphia, Philadelphia; BMNH, British Museum (Natural History), London; BPBM, Bernice P. Bishop Museum, Honolulu; MCZ, Museum of Comparative Zoology, Harvard University, Cambridge; MNHN, Muséum National d'Histoire Naturelle, Paris; MNHU, Museum für Naturkunde der Humboldt-Universität, Berlin; SAM, South Australian Museum, Adelaide; TM, Természettudományi Múzeum, Budapest; USNM, U.S. National Museum, Washington; ZM, Zoologisk Museum, Copenhagen.

Genus *Epilachna* Dejean

Epilachna Dejean, 1837: 460. Type-species: *Coccinella borealis* Fabricius, by subsequent designation (Hope, 1840: 157).

Henosepilachna Li, 1961: 35. Type-species: *Henosepilachna sparsa* (Herbst), by original designation. **New synonymy.**

The name *Epilachna* was first published by Dejean (1837), defining the genus by listing a series of included species, some of which were already described. Heading the list was *Coccinella borealis* Fabricius, and in 1840 Hope designated it as the type-species. Three years later, Redtenbacher (1843) gave a brief description of the generic characters and for the next 100 years he was regarded as the author of *Epilachna*. In more recent times (Dieke 1947; Kapur 1950, 1967; Li & Cook 1961; Bielawski 1963; Sasaji 1971; Gordon 1975) Chevrolat has been acknowledged as the author based on page 460 in the 3rd edition of Dejean's (1837) *Catalogue des Coléoptères*. This interpretation is not quite correct. Because Dejean was the first person to publish and use the name *Epilachna* in print, although he attributed it to Chevrolat, he must be regarded as the true author.

Epilachna was defined as having tarsal claws with a basal tooth, but *E. borealis* lacks this tooth. As those Eurasian and Australian species with a basal tooth also have the 6th abdominal sternite of the female divided longitudinally in common with *borealis*, Dieke (1947) adopted this latter character as the more important diagnostic character for the genus, and so was able to include them in the genus *Epilachna*.

In 1961, Li (vide Li & Cook 1961) erected a new genus, *Henosepilachna*, with *E. sparsa* (Herbst) as its type-species. It was distinguished from *Epilachna* by having a basal tooth on each claw, a divided 6th abdominal sternite in the female, and male genitalia with an apical thorn on the parameres and a basal knife-edge and setae on the median lobe. Bielawski (1965a) and Sasaji (1971) accepted this new genus.

Kapur's (1966) reexamination of *E. borealis* females together with those of certain Asian species of *Epilachna* showed that the split in the 6th abdominal sternite was a variable character. He rejected *Henosepilachna* and regarded *Epilachna* as a valid genus for many Asian and Australian species. When Gordon (1975) redefined *Epilachna*, he ignored the controversial claws and female 6th abdominal sternite. An unpub-

lished study I have made of the Epilachninae of Asia, Australia and Oceania supports Kapur (1967) and has shown that other characters on which *Henosepilachna* is based are also variable. *Henosepilachna* Li is regarded here as a synonym of *Epilachna* Dejean.

The 3 species studied in this paper had all been placed in *Henosepilachna* (Li & Cook 1961, Bielawski 1965a) and one of these species, *vigintioctopunctata vigintioctopunctata* (Fabricius) [= *E. sparsa* (Herbst)] is the type-species. *E. vigintisexpunctata* (Boisduval) [= *E. philippinensis australica* Dieke] is closely related to *E. vigintioctopunctata vigintioctopunctata*, even though the basal knife-edge of the male median lobe is very reduced in size (Fig. 10). However, *E. cucurbitae*, n. sp. [= *E. vigintioctopunctata* sensu Dieke 1947, nec Fabricius 1775] is quite different, but is closely related to several other species, which include *E. solomonensis* Dieke, *E. signatipennis* (Boisduval), *E. dentulata* Dieke, *E. reducta* Dieke and *E. emarginata* Dieke (Dieke 1947, Bielawski 1963). Consequently, I am proposing that these 3 species be regarded as members of 2 different species groups. They may readily be separated by the possession of a quadratic basal tooth on the claw (Fig. 23a–d) versus a triangular basal tooth (Fig. 23e–f); mandibles with a rounded apex and few serrations (Fig. 22a–b) versus a pointed apex and many serrations (Fig. 22c); a dorsal knife-edge on the male median lobe (Fig. 4, 10) versus its absence (Fig. 16); a siphon with a pointed apex (Fig. 7, 13) versus a deep median notch (Fig. 19) and female genital plates each with a shallow notch on the inner margin near the base (Fig. 8, 14) versus a deep notch (Fig. 20). Other species groups have already been established within *Epilachna* (Dieke 1947, Gordon 1975).

Members of the genus *Epilachna* always have the surface of the elytra punctured. Dieke (1947) regarded this punctation as double, large numbers of very fine punctures being interspersed between fewer irregularly spaced coarser punctures. Occasionally they might be almost absent. This interpretation was accepted by Li & Cook (1961) for *Henosepilachna*, and by Gordon (1975) for most Western Hemisphere species of *Epilachna*. Stereoscan electron micrographs of the 3 species included in this paper have shown the elytral punctures to be single and irregularly spaced (Fig. 22g). What look like fine punctures under the light microscope appear to be setal sockets.

The maculation of the 28-spotted species of *Epilachna* is regarded as derived from a basic pattern (Dieke 1947). The basic pronotal pattern consists of 7 separate spots numbered as in Fig. 1. It may be modified by increase or decrease in melanization, causing fusion or loss of various spots, and may lead to an immaculate pronotum or a large black disc formed by melanization of ground pigment surrounding the spots. The basic elytral pattern consists of 6 black *persistent* spots on each elytron. The position, shape and size of each spot is variable, but it is rare for any to be absent. The spots were numbered 1 to 6 by Mulsant (1850). They are usually arranged as in Fig. 1. This pattern may be modified by the addition of from 1 to 8 *nonpersistent* spots on each elytron. The nonpersistent spots are identified by the letters a to h and their positions on each elytron are fairly constant (Fig. 1). They may always be absent,

but usually the number, size, and degree of melanization of nonpersistent spots are so variable that they can never be reliably used as a species character. However, a species may be divided into a number of subspecies on the basis of spot pattern. A second modification is by enlargement and confluence of spots. Horns may extend into the ground color until coalescence with 1 or more spots occurs, leading to different patterns. This linkage may occur between persistent spots, nonpersistent spots, or both types. Both single and multiple linkage may occur, and this may lead to total fusion of spots. A third modification is by melanization of ground color surrounding the spots, spreading from the apex anteriorly, and sometimes leading to total melanization of the elytron. All aspects of spot variation occur in the *E. vigintioctopunctata* complex in Australia.

KEY TO SPECIES OF *Epilachna* IN THE *vigintioctopunctata*
COMPLEX IN AUSTRALIA

1. Apical angle of elytron distinct; claws with basal tooth quadratic (Fig. 23a, c); median lobe of ♂ with basal knife-edge (Fig. 4, 10); ♀ genital plates with shallow notch (Fig. 8, 14) 2
 Apical angle of elytron rounded; claws with triangular basal tooth (Fig. 23e); median lobe of ♂ without basal knife-edge (Fig. 16); ♀ genital plates with deep notch (Fig. 20) **cucurbitae, n. sp.**
2. Postcoxal line complete (Fig. 22e); claw without process on basal tooth (Fig. 23d); basal knife-edge on ♂ median lobe weakly developed (Fig. 10); pronotum with large black disc and no spots **vigintisexpunctata vigintisexpunctata** (Boisduval)
 Postcoxal line incomplete (Fig. 22d); claw with small process on inner apical corner of basal tooth (Fig. 23b); basal knife-edge on ♂ median lobe well developed (Fig. 4); pronotum with spots **vigintioctopunctata pardalis** (Boisduval)

The subspecies of *Epilachna vigintioctopunctata* (Fabricius)

A badly damaged ♀ syntype of *Coccinella 28-punctata* Fabricius from Kiel and now in ZM, has been examined. It is here designated lectotype. All that remains are the right elytron, the abdomen, and the genital plates mounted on a microslide. The elytron (Fig. 2) appears to have 16 spots, but 2 are artifacts. The genital plates (Fig. 3) are as illustrated for *E. sparsa* (Herbst) by Dieke (1947), Li & Cook (1961) and Bielawski (1963).

Two other specimens of *C. 28-punctata* are associated with the lectotype in ZM. No. 480115, a female, bears a label "*C. 28-punctata* e Tranquebar" in what is probably Koenig's hand. Although topotypic, it is impossible to know if Fabricius examined it. The pronotum has 2 faint spots and the elytra 28 spots. Its abdomen was dissected by G.H. Dieke about 1947 (Ole Martin, pers. commun., 1978), and the genital plates were mounted on a microslide. They also are as illustrated by Dieke (1947) for *E.*

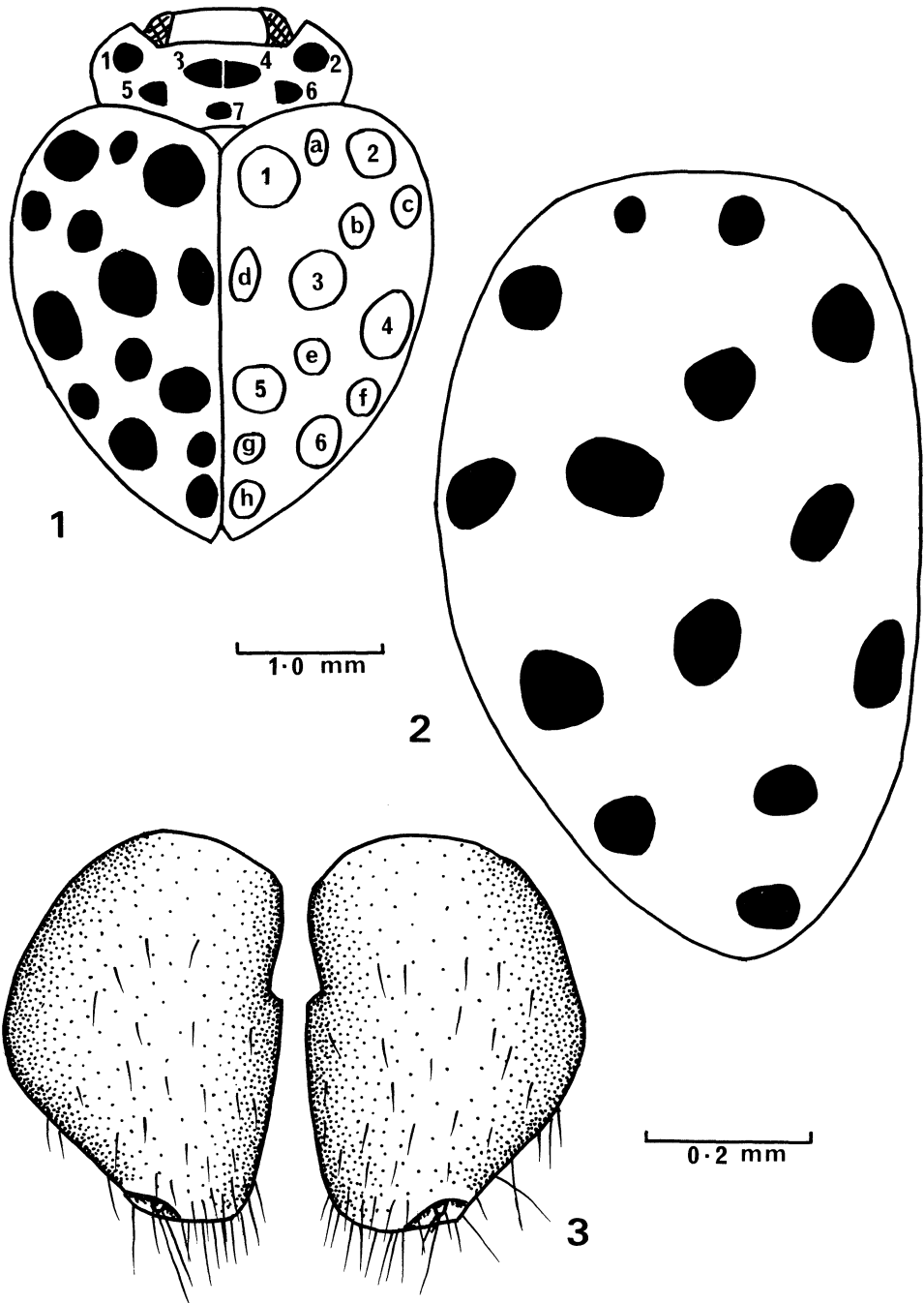


FIG. 1-3. 1, Sketch showing positions of pronotal and elytral spots. 2-3, *Coccinella 28-punctata* lectotype: 2, right elytron; 3, ♀ genital plates.

sparsa. On the slide label Dieke designated this specimen neotype. Dieke published nothing on *Epilachna* after his 1947 monograph (published 20.I.1947) and so the neotype has no type status. The other specimen is of doubtful provenance, as it has no data attached to it.

Although the type of *C. sparsa* Herbst has not been examined, its illustration (Herbst 1786) indicates that it is a synonym of *E. vigintioctopunctata*. It is regarded as such here.

C. 28-punctata was described by Fabricius (1775) from specimens collected by Koenig at Tranquebar, southern India (Zimsen 1964). It was not figured. Herbst's (1786) description and illustration of *C. sparsa* from the East Indies resembles *C. 28-punctata*, except the pronotum has 4 and not 7 spots, and the elytra 24 instead of 28 spots. Mulsant (1850) synonymized *sparsa* with *28-punctata* and transferred it to *Epilachna* Dejean. This synonymy was accepted until Dieke (1947) restored *E. sparsa* to the status of a separate species. He believed the type of *C. 28-punctata* had been lost and he applied the name *vigintioctopunctata* to material from Ceylon, Ceram Is, New Guinea, Australia, Solomon Is and Samoa (see below). Dieke's views were accepted by Miyatake (1959), Li & Cook (1961), Stride & Warwick (1960) and Bielawski (1963, 1965a). However, Kapur (1967) continued to follow Mulsant (1850) after examination of topotypic material of *E. vigintioctopunctata*. Sasaji (1971) believed Kapur's interpretation was more acceptable.

From the 4 subspecies of *E. sparsa* separated by Dieke (1947) on the grounds of geographic distribution and later sunk back into *E. sparsa* by Li & Cook (1961), I propose to restore 2: *E. sparsa sparsa* (Herbst) and *E. sparsa vigintisexpunctata* (Boisduval), treated here as *E. vigintioctopunctata vigintioctopunctata* (Fabricius) and *E. vigintioctopunctata pardalis* (Boisduval), respectively (see below). The 2 subspecies may be separated as follows.

vigintioctopunctata: 1) number of elytral spots variable from 12 to 28, with tendency to loss of nonpersistent spots; 2) spots *d* and 2 not susceptible to linkage (Table 2); 3) no melanization of elytral ground color.

pardalis: 1) number of elytral spots very constant at 26 with loss of spot *a*; 2) spot 6 not susceptible to linkage (Table 2); 3) linkage and multiple linkage more common than in *vigintioctopunctata*; 4) melanization of elytral ground color may occur.

The variable maculation of *vigintioctopunctata* has led to its misidentification from Herbst (1786) onwards.

***Epilachna vigintioctopunctata vigintioctopunctata* (Fabricius)**

Fig. 2-3

Coccinella 28-punctata Fabricius, 1775: 84. Lectotype ♀, India: (ZM), here designated [examined].

Coccinella sparsa Herbst, 1786: 160. Syntype(s). East Indies (MNHU) [not examined]. [Syn. by Mulsant, 1850: 837.]

Epilachna vigintiocto-punctata (Fabricius): Mulsant, 1850: 834.—Kapur, 1967: 152.

Epilachna sparsa (Herbst): Dieke, 1947: 29-32. [Valid species; syn. by Kapur, 1967: 152.]

Epilachna territa Mulsant, 1850: 787. Lectotype ♂, Maluku (MNHN), here designated [examined]. **New synonymy.**

Epilachna territa var. *indocilis* Mulsant, 1850: 788. Lectotype ♀, Maluku (MNHN), here designated [examined]. **New synonymy.**

Epilachna gradaria Mulsant, 1850: 789–791. Lectotype ♂, India (MNHN), here designated [examined]. [Syn. with *sparsa sparsa* by Dieke, 1947: 32.]

Epilachna gradaria var. *addita* Mulsant, 1850: 791. Lectotype ♂, India (MNHN), here designated [examined]. [Syn. with *sparsa sparsa* by Dieke, 1947: 32.]

Epilachna gradaria var. *vieta* Mulsant, 1850: 791. Syntype(s), India (location unknown) [not examined]. [Syn. with *sparsa sparsa* by Dieke, 1947: 32.]

Epilachna gradaria var. *socors* Mulsant, 1850: 791. Syntype(s), India (location unknown) [not examined]. [Syn. with *sparsa sparsa* by Dieke, 1947: 32.]

Epilachna gradaria var. *congressa* Mulsant, 1850: 791. Syntype(s), India (location unknown) [not examined]. [Syn. with *sparsa sparsa* by Dieke, 1947: 32.]

Epilachna gradaria var. *stolida* Mulsant, 1850: 791. Syntype(s), India (location unknown) [not examined]. [Syn. with *sparsa* by Dieke, 1947: 31.]

Epilachna sparsa sparsa (Herbst): Dieke, 1947: 32.

Epilachna sparsa var. *gradaria* Mulsant: Dieke, 1947: 32. [Syn. with *sparsa sparsa* by Li & Cook, 1961: 40.]

Epilachna sparsa orientalis Dieke, 1947: 34. Neotype ♂, China (USNM), here designated [examined]. [Syn. with *sparsa sparsa* by Li & Cook, 1961: 40.]

Epilachna sparsa var. *cinerea* Dieke, 1947: 35. Holotype ♂, China (USNM), [examined]. [Syn. with *sparsa sparsa* by Li & Cook, 1961: 40.]

Epilachna sparsa territa Mulsant: Dieke, 1947: 35. [Syn. with *sparsa sparsa* by Li & Cook, 1961: 40.]

Henosepilachna sparsa (Herbst): Li & Cook, 1961: 40 (partim). [Syn. by Kapur, 1967: 152.]

Henosepilachna vigintioctopunctata (Fabricius): Sasaji, 1971: 309.

This subspecies has been fully described by Dieke (1947) and Li & Cook (1961) as *E. sparsa*.

Variation. Pronotum usually with 6 or 7 spots. In 120 (51.3%) of the 234 specimens examined all 7 spots are present and free, spot 7 has been lost in 84 (35.9%), and 21 (9.0%) are immaculate. Spot linkage and fusion are common, particularly between spots 3 and 4 (31.6%). Occasionally 3, 4 and 7 may be joined (0.9%) or all spots may be joined (2.1%). Elytral spots are very variable in size, number and degree of melanization. All 28 spots are present in 198 (84.6%), 26 in 18 (7.7%), 24 in 4 (1.7%), 22 in 4 (1.7%), 20 in 3 (1.3%) and 12 in 7 (3.0%). In many specimens spots are very small and faint. Spot *a* has been lost in 28 specimens (12%), *b* lost in 2 (0.9%) *c* lost in 2 (0.9%), *e* lost in 5 (2.1%) and almost lost in 2, *f* lost in 3 (1.3%) and almost lost in 5, *g* lost in 5 (2.1%) and almost lost in 3, *h* lost in 5 (2.1%) and almost lost in 4, and *l* lost in 1 (0.4%). Spots *d*, 2, 3, 4, 5, and 6 are present in all specimens examined. In specimens from China and Japan 28 spots are usually present, but in specimens from India, Pakistan and Indonesia there is a tendency for reduction in number of spots, sometimes with loss of all nonpersistent spots. Spot linkage has occurred in 26 (19.4%) (Table 1). Most common linkage is between *g* and *h*. Multiple linkage on a single elytron has occurred in 11.5% of the 26 specimens. Apart from spots *a*, *d*, and 2, all spots are susceptible to linkage (Table 2), and incipient linkage is common.

Distribution. India, Pakistan, Nepal, China, Taiwan, Macau, Hong Kong, Japan, N Vietnam, Malaysia, Indonesia.

Specimens examined. TYPE MATERIAL. *C. 28-punctata* lectotype ♀, *28-punctata* [Fabricius' hand], No. 580512 (ZM). *E. territa* lectotype ♂, 206, 1967/41, Museum Paris, Ternate, Hombron, 1841, *Epilachna territa* Muls. auct. det. [unknown hand] (General Coll. Mulsant Types, MNHN); *E. territa* paralectotype ♀, Java, *chryso-*

TABLE 1. Elytral spot linkage in 2 subspecies of *Epilachna vigintioctopunctata*.

<i>vigintioctopunctata</i>				<i>pardalis</i>			
SINGLE GROUP LINKAGE	% LINKAGE (n = 26)	MULTIPLE GROUP LINKAGE	% LINKAGE (n = 26)	SINGLE GROUP LINKAGE	% LINKAGE (n = 93)	MULTIPLE GROUP LINKAGE	% LINKAGE (n = 93)
<i>g-h</i>	30.8	<i>b-c; g-f</i>	3.8	<i>g-h</i>	35.5	<i>b-c; e-g</i>	4.3
<i>b-c</i>	19.2	<i>b-c; 3-g-f; 6-h</i>	3.8	<i>b-c</i>	28.0	<i>b-d; e-g</i>	3.2
<i>3-5</i>	11.5	<i>b-c; e-f; g-h</i>	3.8	<i>e-g</i>	19.4	<i>b-c; e-g-f</i>	3.2
<i>1-3</i>	3.8			<i>b-d</i>	7.5	<i>b-c; e-g-h</i>	2.2
<i>e-g</i>	7.7			<i>e-g-h</i>	6.5	<i>1-2; e-g</i>	2.2
<i>e-f</i>	3.8			<i>1-2</i>	5.4	<i>b-c; g-h</i>	1.1
<i>6-h</i>	3.8			<i>d-b-c</i>	5.4	<i>b-c; f-e-g-h</i>	1.1
<i>3-g-f</i>	3.8			<i>e-g-f</i>	4.3	<i>e-f; c-b-d</i>	1.1
<i>4-3-5</i>	3.8			<i>e-f</i>	2.2	<i>f-e-g; c-b-d</i>	1.1
				<i>f-e-g-h</i>	2.2	<i>b-d; f-e-g-h</i>	1.1
				<i>3-4</i>	1.1	<i>3-b; g-5-e</i>	1.1
				<i>3-b</i>	1.1	<i>b-c; g-h</i>	1.1
				<i>g-5-e</i>	1.1		

melina var. and *terrata* [unknown hand] (Dejean Coll., Museum Guimet, Lyon). *E. terrata* var. *indocilis* lectotype ♀, 207, 1967/41, Museum Paris, Ternate, Hombron, 1841, *Epilachna terrata* var. *indocilis* Muls. auct. det. [same unknown hand as *terrata* lectotype labels] (General Coll. Mulsant Types, MNHN). *E. gradaria* lectotype ♂, 991 *Epilachna gradaria* Muls. Calcutta [Perroud's hand] (Perroud Coll., MNHN); *E. gradaria* paralectotype ♂ [without labels] (Perroud Coll., MNHN). *E. gradaria* var. *addicta* lectotype ♂, *addicta* [Perroud's hand] (Perroud Coll., MNHN). *E. sparsa orientalis* neotype ♂, USNM paratype 57106, *Epilachna sparsa orientalis* Dieke det. Dieke 1943, Ming Chiang Fuchow China, F.R. Metcalf VI [19]26 (USNM); *E. sparsa orientalis* paratypes: 4♀, same data as neotype; 2♀, C.F. Wu No. 37, Soochow China [19]38; 1♀, Nanking Kiangsu Prov. China, H.F. Loomis, Aug. 1916, det. Dieke; 1♀, same data but Aug. [19]14; 1♀, Shao-Wu China [19]39, T.H. Cheng No. 01917, Aug. 30 [19]39; 1♀, S of Suifu Hunnan Border, Apr. 15–Jun. 10 1929, Szechuen China, D.C. Graham; 1♀, Suifu China, D.C. Graham coll., Oct. 1930; 1♀, same data but 1–5 IX 1930; 4♀, Japan, Mitsukuri, 24 8 [19]10; 1♀, China, Koebele; 1♂, Chin-ling Mtns Shensi E.B. Apr.–May 1904; 1♀, Japan 24721; 1♀, Japan 24810 11 [19]38; 1♂, Kobe Japan, Baker; 1♀, Kiushu Japan. 1♂, China, H.F. Loomis, Aug. 29 [19]19, Shanghai Kiangsu Province. [Each specimen also carries] USNM paratype 57106 [and] *Epilachna sparsa orientalis* Dieke det. Dieke 1943 [printed] (USNM). *E. sparsa* var. *cinerea* holotype ♂, Type No. 57107 USNM, *Epilachna sparsa cinerea* Dieke holotype, Szechwan China, D.C. Graham, nr Kuanshien Aug. 1933, 2000–4000 ft [printed] (USNM). *E. sparsa* var. *cinerea* paratypes: 1♂, Szechuen China, D.C. Graham, Ningyuenfu, 6000 ft alt., Aug. 1 [19]28; 2♂, 2♀, [same data except] Aug. 4–5 [19]28; 2♀, 1 unknown sex, [same except] 6200 ft alt., Jul. 31 [19]28; 1♂, Szechuen China, D.C. Graham, Kuanshien, 2000–3000 ft alt. 1930; 1♀, Szechuen China, D.C. Graham, 1928; 1♀, Szechuen China, D.C. Graham, nr Suifu, 1200 ft, Sep. 25 [19]23; 1♂, China, H.F. Loomis, Aug. 1919, Nanking Kiangsu Province; 1♀, Suifu Szechuen China, Jun. 6 [19]29. [Each specimen also carries] USNM paratype 57107 [and] *Epilachna sparsa cinerea* Dieke paratype [printed] (USNM). 1♂, Szechwan China, D.C. Graham, nr Kuanshien, Aug. 1933, 2000–4000 ft; 4♂, 1♀, Szechwan China, D.C. Graham, Ningyuenfu, alt. 6000 ft, Aug. 4 [19]28; 1♀, 1 unknown sex, [same except] 6200 alt., July 31 [19]28; 1♀, Szechwan China, D.C. Graham, near Suifu, Jun. 1–5 [19]29. [Each specimen also carries] *Epilachna sparsa cinerea* Dieke paratype G.H. Dieke Coll. [printed] (USNM). OTHER MATERIAL. Total of 269 specimens from India (10); Pakistan (21); China (23); Macau (9); Hong Kong (4); Japan (7); Taiwan (33); N Vietnam (1); Malaysia (10); Indonesia [Amboina (1), Java (144)].

Remarks. The lectotype of *E. gradaria* Mulsant has spots 1 and 2 just recognizable on the pronotum and 12 small persistent spots of equal size on the elytra. The para-

TABLE 2. Linkage susceptibility of elytral spots in 2 subspecies of *Epilachna vigintioctopunctata*.

SPOT	% LINKAGE <i>vigintioctopunctata</i> (n = 26)	% LINKAGE <i>pardalis</i> (n = 93)
a	—	—
b	30.7	41.9
c	30.7	33.3
d	—	12.9
e	15.4	35.5
f	19.2	8.6
g	53.8	68.8
h	42.3	44.0
1	3.8	5.4
2	—	5.4
3	23.1	2.2
4	3.8	1.1
5	15.4	1.1
6	7.7	—

lectotype of *E. gradaria* has an immaculate pronotum, but the elytral maculation is identical with that of the lectotype. The genitalia protruding from its abdomen are identical with those of *E. vigintioctopunctata vigintioctopunctata*. *E. gradaria* is morphologically identical with *E. vigintioctopunctata* and must be regarded as a synonym. A third specimen labelled *addicta* corresponds with Mulsant's (1850: 791) description of *E. gradaria* var. *addita* except for the addition of spot *d*. Its pronotum has 7 spots. It is here designated lectotype of *addita*. It is morphologically identical with the lectotype of *E. gradaria*, and so is a synonym of both *E. gradaria* and *E. vigintioctopunctata vigintioctopunctata*. This confirms Dieke's (1947) assumption of synonymy based on Mulsant's (1850) original descriptions of *gradaria* and *addita*.

The lectotype of *E. territa* Mulsant has an immaculate pronotum and elytra with 12 persistent spots of irregular size, 1 and 2 being smaller than the others. Spot 1 lies very close to the suture, 4 extends to the margin, and 3 and 5 on the left elytron are very weakly linked. The genitalia, dissected out by the author, are identical with those of *E. vigintioctopunctata vigintioctopunctata*. A photo of the paralectotype of *E. territa* shows its pronotum bears spots 1 and 2, and its elytral spots 4, 3 and 5 are strongly united. *E. territa* is morphologically identical with *E. vigintioctopunctata vigintioctopunctata* and so must be regarded as a synonym. The lectotype of *E. territa* var. *indocilis* Mulsant differs from the lectotype of *E. territa* in having pronotal spots 1, 3, 4 and 2, and 12 elytral spots free and of equal size. It is morphologically identical with the lectotype of *E. territa* and is synonymized with it here, thus also becoming a synonym of *E. vigintioctopunctata vigintioctopunctata*.

The "holotype" of *E. sparsa orientalis* carries a red label Type No. 57106 USNM and *Epilachna sparsa orientalis* Dieke det. Dieke 1943, China, H.F. Loomis, Aug. 29 [19]19, Shanghai, Kiangsu Province. Uncharacteristically, the Dieke determination

label omits holotype. In his original description (Dieke 1947: 34), the type-locality is given as China, Fukien Prov, Fuchow-Ming Chiang. A specimen from Shanghai with the same data as on the type labels is called a paratype. This suggests that the red type label has been placed on the wrong specimen. Dieke lists 8 paratypes from Fuchow, Ming Chiang and all 9 specimens form a topotypic series. Five of these specimens (1♂, 4♀), labelled paratypes, are in USNM. Three further specimens, non-paratypes, are in the G.H. Dieke Collection. The 9th specimen is missing. It is not in BPBM, MCZ, AMNH, or ANS. It is possible Dieke never designated a holotype. His (1947) claim that 3 paratypes had been deposited in BPBM and a further 23 paratypes deposited in MCZ cannot be substantiated. As the holotype and almost ½ of the 55 paratypes cannot be located, it is proposed to designate as neotype the male from the 5 topotypic paratypes. Morphological similarities, identical genitalia, and overlapping distribution confirm that *E. sparsa orientalis* is a synonym of *E. vigintioctopunctata vigintioctopunctata*.

The holotype and paratypes of *E. sparsa* var. *cinerea* Dieke show that var. *cinerea* is a synonym of *orientalis* based on identical morphology and genitalia and overlapping geographic distribution, and confirm that var. *cinerea* is also a synonym of *E. vigintioctopunctata vigintioctopunctata*.

Neither Dieke (1947) nor Li & Cook (1961) examined the types of *E. gradaria* and their variations or those of *E. territa* and their variation. Dieke based his identifications on Mulsant's (1850) original descriptions and Li & Cook followed Dieke's interpretation, except for sinking Dieke's *sparsa territa* back into *sparsa sparsa*. Dieke (1947, Fig. 13–14) figured 2 variations of *E. sparsa territa*, but not the typical 12-spotted form. As so few specimens of *territa* have been examined here (including a specimen from BPBM with immaculate pronotum and 12 elytral spots) variation in maculation cannot be assessed, so it is not possible to confirm if Dieke's variations of *sparsa territa* are variations of *territa* or *vigintioctopunctata pardalis*, or if Li & Cook's (1961) interpretation of *sparsa territa* as a synonym of *sparsa sparsa* includes the real *territa*.

Dieke (1947, Plate 1, Fig. 17–18) also figured 2 further variations of *E. sparsa*: var. *bijuncta* and var. *trijuncta*. Neither of these variations were described or named (except in the figure captions) by Dieke, so they have no validity. Thus, in their synonymy of *Henosepilachna sparsa*, Li & Cook (1961) incorrectly listed *bijuncta* and *trijuncta* as synonyms of *H. sparsa*. Dieke's figure of var. *trijuncta* closely resembles the paralectotype of *E. territa*.

***Epilachna vigintioctopunctata pardalis* (Boisduval)**

Fig. 4–9; 22a, d; 23a–b

Coccinella pardalis Boisduval, 1835: 596. Lectotype ♂, Santa Cruz Is: Vanikoro (MNHN), here designated [examined].

Epilachna pardalis (Boisduval): Mulsant, 1850: 840.

Epilachna vigintisexpunctata (Boisduval): Mulsant, 1850: 838 [misident.].

Epilachna vigintioctopunctata (Fabricius): Temperley, 1928: 11 [misident.].

Epilachna vigintioctopunctata ab. *pardalis* (Boisduval): Korschefsky, 1931: 26.

Epilachna vigintioctopunctata ab. *vigintisexpunctata* (Boisduval): Korschefsky, 1931: 27.

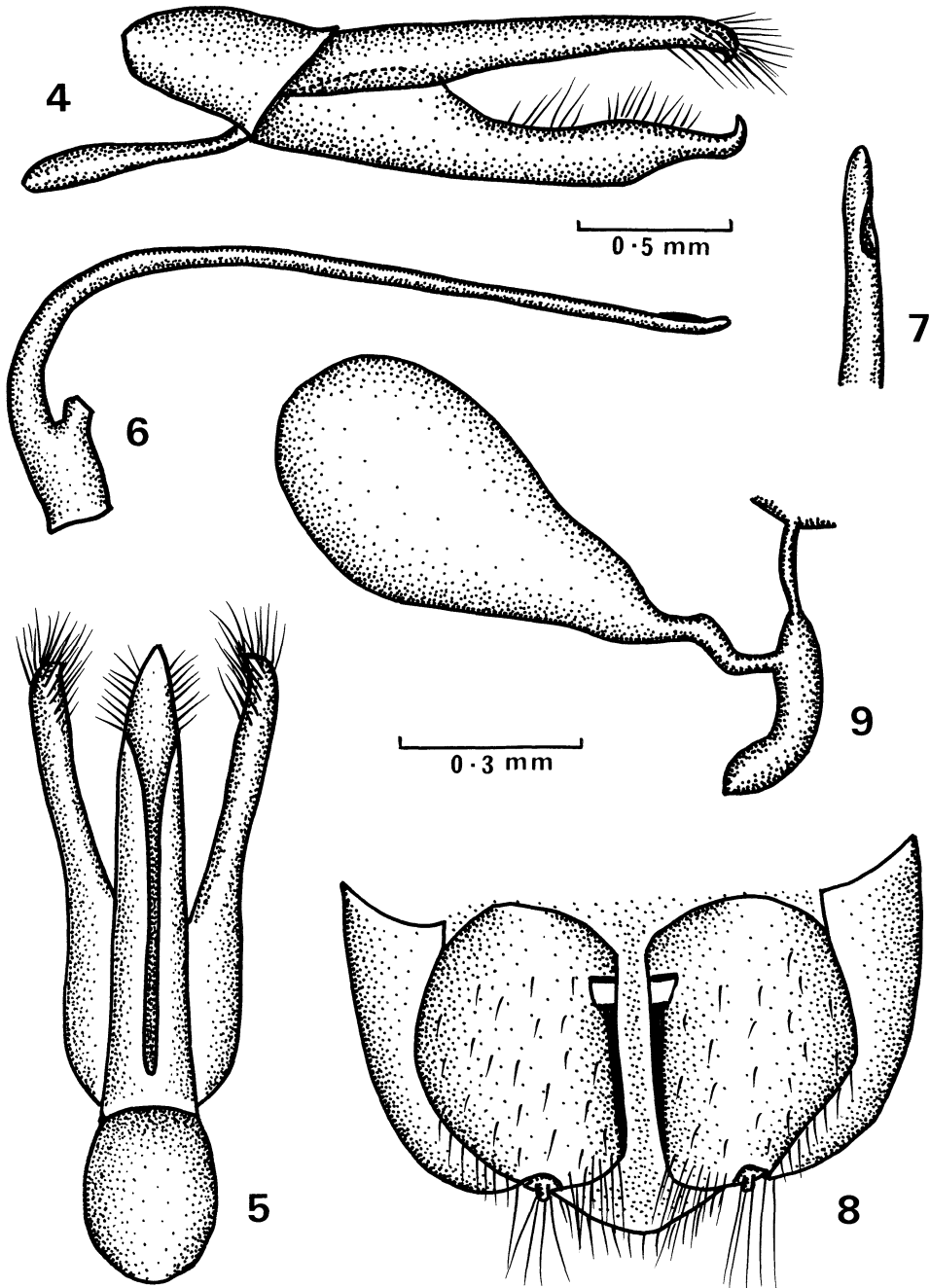


FIG. 4-9. *Epilachna vigintioctopunctata pardalis*. 4-7, ♂ genitalia: 4, lateral view median lobe, paramere and trapes; 5, dorsal view median lobe and parameres; 6, siphus; 7, apex of siphus. 8, ♀ genital plates. 9, spermatheca and accessory gland. Fig. 4, 5, 6 to scale 0.5 mm; Fig. 7, 8, 9 to scale 0.3 mm.

Epilachna sparsa vigintisexpunctata (Boisduval): Dieke, 1947: 36. [Syn. with *sparsa sparsa* by Li & Cook, 1961: 40.] [misident.]

Epilachna sparsa vigintisexpunctata (Boisduval): Bielawski, 1963: 321.

Henosepilachna sparsa (Herbst): Li & Cook, 1961: 40 (partim).

Henosepilachna sparsa vigintisexpunctata (Boisduval): Bielawski, 1965b: 211.

Epilachna sparsa var. *nigrescens* Dieke, 1947: 37. Lectotype ♀, Fiji: Ndavingale, Kodavu (USNM), here designated [examined]. [Syn. with *sparsa sparsa* by Li & Cook, 1961: 40.] **New synonymy.**

Epilachna sparsa vigintisexpunctata var. *nigrescens* Dieke: Bielawski, 1963: 332.

♂. Length 6.2 mm, width 5.3 mm, broadly oval, convex, broadest anterior to middle of elytron; lateral margin of elytron rounded from humeral angle to apex. Color orange-brown, pronotum with 2 black spots 5, 6; elytra with 26 black spots, *d* and *g* touching suture line, and *c*, *4*, *f*, *h*, extending to lateral margin. Antennae 11-segmented, light brown with 3 last segments medium brown; mouthparts and legs light brown; prosternum light brown; metasternum black; first 5 abdominal sternites black with posterior border light brown, 6th abdominal sternite light brown; pubescence thick, golden. Mandible (Fig. 22a) with rounded apex, apical tooth trifid, curved, 2nd and 3rd teeth large, simple, of approximately equal size, with minor teeth (dentules) on lower margin of all 3 teeth and inner margin of mandible below 3rd tooth, the latter usually with 5–6 dentules, a double row of serrations extending from base of 2nd tooth to just beyond base of 3rd tooth, without basal tooth. Pronotum 0.5 as long as broad, anterior margin slightly rounded with anterolateral angles rounded and strongly projecting anteriorly; posterior margin obtusely angled and rounded at apex; disc of pronotum shallowly convex; pubescence short, thick, golden, slightly appressed. Scutellum small, equilaterally triangular, dark brown, thickly covered with golden setae. Elytra 2× as long as broad, broadest anterior to middle of elytron, narrowed anteriorly, but broader at base than posterior border of pronotum; lateral margin rounded; apical angle distinct; humeral callus prominent; punctuation single, variable in size, scattered over disc and margins, usually separated by greater than their diameter; pubescence short, thick, golden, dark over elytral spots, slightly appressed. Prosternum short, with narrow intercoxal protuberance bluntly rounded at apex. Postcoxal line behind metacoxa on 1st abdominal sternite triangular, incomplete, distinct, subterminal, reaching 0.8 distance to posterior margin (Fig. 22d); posterior margin of 5th abdominal sternite subconcave; 6th abdominal sternite entire, distal margin emarginate with small median notch. Tarsal claws bifid, inner claw wider than outer claw, basal tooth quadratic with small process on inner apical corner; 2 basal teeth on each claw almost touching (Fig. 23a–b). Genitalia. Siphon slender, 1.8× as long as median lobe and parameres, gently curved near base then straight, with sharply pointed apex without setae or appendages (Fig. 6); orifice subterminal (Fig. 7); trabes elongate with distal portion dilated 0.43 of total length; parameres elongate, dorsal margin straight, ventral margin straight 0.4 of length, then concave gradually decreasing in width towards apex, armed with apical thorn, with 2 thick rows of setae around apex shorter in length than those on median lobe; median lobe with ventral margin straight 0.72 total length, then sharply curved upwards to apical hook, dorsal margin with strongly developed basal knife-edge 0.36 total length, then 0.25 of margin straight, changing to gently undulating and curving up to apical hook, long setae numerous on dorsal margin between 0.1–0.5 from apex (Fig. 4–5).

♀. Length 7.0 mm, width 5.8 mm. Similar to ♂ except posterior margin of 5th abdominal sternite truncate; 6th abdominal sternite arcuate, with median longitudinal split to base; posterior margin of 10th tergite rounded. Genital plates kidney-shaped, 1.4× longer than broad, with shallow notch on inner margin 0.25 from base, small stylus on apical margin with long setae (Fig. 8). Spermatheca (Fig. 9) very lightly chitinized, with large pearshaped accessory gland.

Variation. Length 5.3–7.1 mm; width 4.5–5.8 mm; ♀ usually larger than ♂. Pronotum

usually with 7 spots. In the 263 specimens examined, spot 7 has been lost in 25 (9.5%), 6 lost in 14 (5.3%), 5 lost in 15 (5.7%), 4 lost in 1 (0.4%), and 3 lost in 1 (0.4%). Spots 5, 6 and 7 have been jointly lost in 13 (4.9%), and almost lost in 4 (1.5%). Spot linkage and fusion are very common (97.7%), particularly between spots 3 and 4 (73%), but all spots may form various combinations, and sometimes all may be linked. A few specimens have a large black disc identical with that in *E. vigintisexpunctata* *vigintisexpunctata*. Elytral spots tend to enlarge in size due to increased melanization. Spot *a* has been lost in all but 1 specimen examined, and with very few exceptions, the number of spots has remained remarkably constant at 26. In only 1 Australian locality, Kalamunda in Western Australia, has there been additional loss of spots *b* and *c*. On the islands to the north of Australia there is a tendency for loss of spots. In 10 specimens from Timor all nonpersistent spots have been involved: *b* has been lost in 4 specimens and reduced in size in 3; *c* lost in 2 and reduced in size in 3; *d* lost in 1; *e* lost in 2; *f* lost in 3; *g* lost in 1 and reduced in size in 3; and *h* lost in 1 and reduced in size in 1. As a result, 50% of the 10 beetles have 26 spots, 30% have 24 spots, 10% have 18 spots, and 10% have 12 spots. In specimens from Java, out of 143 offspring from 26-spotted parents, 14% show variation in the number of spots; 1 (0.7%) has 28 spots, 12 (8.4%) have 24 spots, 4 (2.8%) have 22 spots, and 3 (2.1%) have 20 spots. Another variation occurs in specimens from Fiji, where increased melanization of the orange-brown ground color surrounding the black spots has occurred rather than coalescence or loss of spots, so that the greater part of each elytron is black, leaving only spots 1 and 2, or just 2 free. In some specimens the original black spots may still be recognizable. In specimens from Samoa, increased melanization has led to enlargement of spots, but the full 26 spots have been retained. In specimens from Australia, spot linkage has occurred in 93 (35%) of the specimens (Table 1). Most common linkage is between *g* and *h*. In 22.6% of the 93 specimens, multiple linkage may occur on a single elytron. Apart from spot 6, all spots are susceptible to linkage, but some more so than others (Table 2), and incipient linkage is common with production of long horns.

Distribution (Fig. 24). Australia (Northern Territory, Queensland, New South Wales, Western Australia); Indonesia (Timor, Lombok, Java); Santa Cruz Is; New Hebrides; New Caledonia; Fiji Is; Samoa; Society Is.

Specimens examined. TYPE MATERIAL. *C. pardalis* lectotype ♂, Muse, 222, *Epilachna pardalis* Boisd. Mulsant det., Vanikoro d'urville, Museum Paris Vanikoro d'Urville, nov. sp. *C. vigintisexpunctata* Dej. affinisimum [and] 26. *cocc. pardalis* B. [last 2 labels in Boisduval's hand] (MNHM). *E. sparsa* var. *nigrescens* lectotype ♀, Ndavingale, Kodavu, Fiji, N.L.H. Krauss 27.4.[19]41. G.H. Dieke Collection, *Epilachna sparsa 26-punctata* Boisd. [all printed] (USNM). *E. sparsa* var. *nigrescens* paralectotypes: 2♂, 1♀, Viti Levu, Fiji I. 1♂, 1♀, [same data plus] June 1924, E.H. Bryan Jr Collector [all printed] (BPBM). OTHER MATERIAL. Total of 953 specimens from Australia [Northern Territory (2), Queensland (176), New South Wales (328), Western Australia (127), state unknown (10)]; Indonesia [Timor (7), Lombok (1), Java (145), Tanimbar Is (1)]; New Hebrides (12); New Caledonia (1); Polynesia (1); Fiji Is (129); Samoa (11); Society Is (2).

Affinities. *E. vigintioctopunctata* is closely related to *E. vigintisexpunctata* by the possession of a quadratic basal tooth on the claw, mandibles with a rounded apex and few serrations, and by the shape of both ♂ and ♀ genitalia; however, *E. vigintioctopunctata* has a well-developed basal knife-edge on the ♂ median lobe.

Remarks. The lectotype of *C. pardalis* has 26 elytral spots with spot *a* missing. Spots 1, 5 and *g* extend to the suture line. Spot *b* though very faint, is present on the left elytron, but on the right elytron a pin has been stuck through the specimen, ob-

scuring spot *b*. The pronotum has 2 spots close together on the median posterior border. *C. pardalis* must now be regarded as a subspecies of *E. vigintioctopunctata*, based on similarities in genitalia, variation in maculation, and disjunct distribution.

C. pardalis was among the insects collected between 1826–1829 during the voyage of the *Astrolabe*. Boisduval (1835) described it, but it had already been illustrated and named *Coccinelle panthère* Boisd. (Vanikoro) on Plate 8, Fig. 26 in the plates illustrating the entomological part of the voyage of the *Astrolabe* (Boisduval 1832). According to Boisduval (1835), the elytra had 23 black spots of unequal size, 1 being fused along the suture line. However, Fig. 26 (1832) shows 25 spots, 12 on each elytron plus 1 fused spot. The pronotum is shown as immaculate. Boisduval regarded *pardalis* as near to *C. vigintisexpunctata* Boisduval. In 1850, Mulsant redescribed it and transferred it to *Epilachna*. Korschefsky (1931) reduced it to an aberration of *E. vigintioctopunctata*, where it remained until Bielawski (1963) misidentified it as a synonym of *E. vigintioctopunctata* sensu Dieke (1947).

Comparison of the lectotypes of *C. pardalis* and *C. vigintisexpunctata* (see below) has shown them to be different species. Mulsant's (1850) interpretation of *E. vigintisexpunctata* has proved to be *C. pardalis*. As *vigintisexpunctata* it was reduced to an aberration of *E. vigintioctopunctata* (Korschefsky 1931), raised to a subspecies of *E. sparsa* (Dieke 1947), reduced to a full synonym of *E. sparsa* (Li & Cook 1961) and reinstated as a subspecies of *sparsa* (Bielawski 1963, 1965a). None of the authors mentioned here examined the type of *C. pardalis*.

Dieke appears not to have designated a holotype for his *E. sparsa* var. *nigrescens*. He stated (1947) that the type was a ♀ from Fiji deposited in BPBM, but that museum has no record of it. Dieke based var. *nigrescens* on 2♂ and 2♀. A ♀ in the G.H. Dieke Collection (USNM) labelled *Epilachna sparsa 26-punctata* Boisd. closely resembles Dieke's (1947) Fig. 16 of *nigrescens*, except that the pronotum is not immaculate. Instead it has 7 spots with 3 and 4 united. It is regarded as one of the missing syntypes and is here designated lectotype. Five specimens from Fiji in BPBM also fit the description of *nigrescens*. Of these, 2♂ and 1♀ each carry *Epilachna sparsa 26-punctata* Boisd. det. G.H. Dieke. They also are regarded as syntypes and are here designated paralectotypes. The ♀ paralectotype has only elytral spot 2 free, so is a more extreme form of the variation. Identical morphology and genitalia and overlapping geographic distribution show that var. *nigrescens* is a synonym of *E. vigintioctopunctata pardalis*. Li & Cook (1961) reduced *E. sparsa* var. *nigrescens* to a full synonym of *E. sparsa*.

The subspecies of ***Epilachna vigintisexpunctata*** (Boisduval)

Examination by me of the lectotype of *Coccinella vigintisexpunctata* Boisduval, the lectotype of *Coccinella doryca* Boisduval, and the holotype of *E. philippinensis* Dieke has shown the 3 species to be so closely related that they must be regarded as subspecies. *E. philippinensis* is the most junior of the 3, having been described over 100

years after the other 2. Due to page priority, *vigintisexpunctata* must be regarded as the nominate subspecies, with *doryca* and *philippinensis* becoming separate subspecies within *vigintisexpunctata*.

The 3 subspecies may be separated as follows.

vigintisexpunctata: 1) 28 elytral spots almost invariably constant; 2) linkage and multiple linkage common between both persistent and nonpersistent elytral spots, especially the latter; 3) pronotum with large black disc formed from fusion of all 7 spots and melanization of ground color.

doryca: 1) elytra with 12 persistent spots; nonpersistent spots lacking; 2) linkage and multiple linkage very common between all persistent spots; 3) number of pronotal spots variable and often lacking, all 7 spots present very rare; spots may be linked to form a black disc; 4) total melanization of elytra may occur.

philippinensis: 1) number of elytral spots variable from 12–28, with tendency to loss of nonpersistent spots; 2) linkage of elytral spots very rare, with no linkage between nonpersistent spots; no multiple linkage; 3) weak melanization of spots, and no melanization of ground color; 4) pronotum usually immaculate, but occasionally spots may occur; all 7 spots present very rare.

Shared characters: vigintisexpunctata and philippinensis: 1) similarity of genitalia, 2) elytra with nonpersistent spots, 3) linkage of persistent spots, although very rare in *philippinensis* (Table 3); *vigintisexpunctata* and *doryca*: 1) similarity of genitalia, 2) linkage and multiple linkage of persistent elytral spots (Table 3), 3) strong melanization of spots and melanization of ground color; *doryca* and *philippinensis*: 1) similarity of genitalia, 2) pronotal spots when present variable in number, 3) spot linkage between persistent spots, but usually different spots in each subspecies and very rare in *philippinensis* (Table 4). The 3 subspecies may be further separated by their disjunct distribution.

***Epilachna vigintisexpunctata vigintisexpunctata* (Boisduval) Fig. 10–15; 22b, e;
23c–d**

Coccinella vigintisexpunctata Boisduval, 1835: 590. Lectotype ♂, Australia (Museum Guimet), here designated [examined by R.D. Pope, London].

Epilachna philippinensis australica Dieke, 1947: 42. Holotype ♂, Australia (USNM) [examined]. [Syn. with *doryca* as *doryca australica* by Bielawski, 1963: 330.] **New synonymy.**

Epilachna doryca australica Dieke: Bielawski, 1963: 330.

♂. Length 6.8 mm, width 5.5 mm, broadly oval, convex, broadest anterior to middle of elytra; lateral margin of elytron rounded from humeral angle to apex. Color orange-brown; pronotum with large black disc formed through fusion of all 7 spots together with melanization of most of the ochreous ground color, disc extending to posterior margin, anterior margin very narrow and ochreous, lateral margins wider and also ochreous; elytra with 28 black spots, *d* and *g* touching suture line, and *c*, *4*, *f* and *h* extending to lateral margin. Antennae 11-segmented, light brown with last 3 segments fuscous; mouthparts and prosternum light brown, legs and metasternum fuscous; abdominal sternites fuscous with posterior borders light brown, pubescence thick and golden. Mandible (Fig. 22b) with rounded apex, apical tooth trifold, curved, 2nd and 3rd teeth large, simple, of approximately equal size, with minor teeth (dentules) on lower margin of apical and 2nd tooth and inner margin of mandible below 3rd tooth, the latter usually with 4–6 dentules; a single row of serrations extends from base of 2nd tooth to just below 3rd tooth; without basal tooth. Pronotum 0.5 as long as broad, broadest halfway up lateral margin, anterior margin truncate with anterolateral angles rounded and strongly projecting anteriorly, posterior margin obtusely angled and rounded at apex; disc of pronotum shallowly convex; pubescence short, thick, golden. Scutellum small, equilaterally triangular. Elytron 2× as long as broad, broadest anterior to middle of elytron, narrowed anteriorly to be slightly broader at base than posterior border of pronotum; lateral margin rounded; apical angle distinct; humeral callus strongly raised; punctuation single, variable in size, scattered over

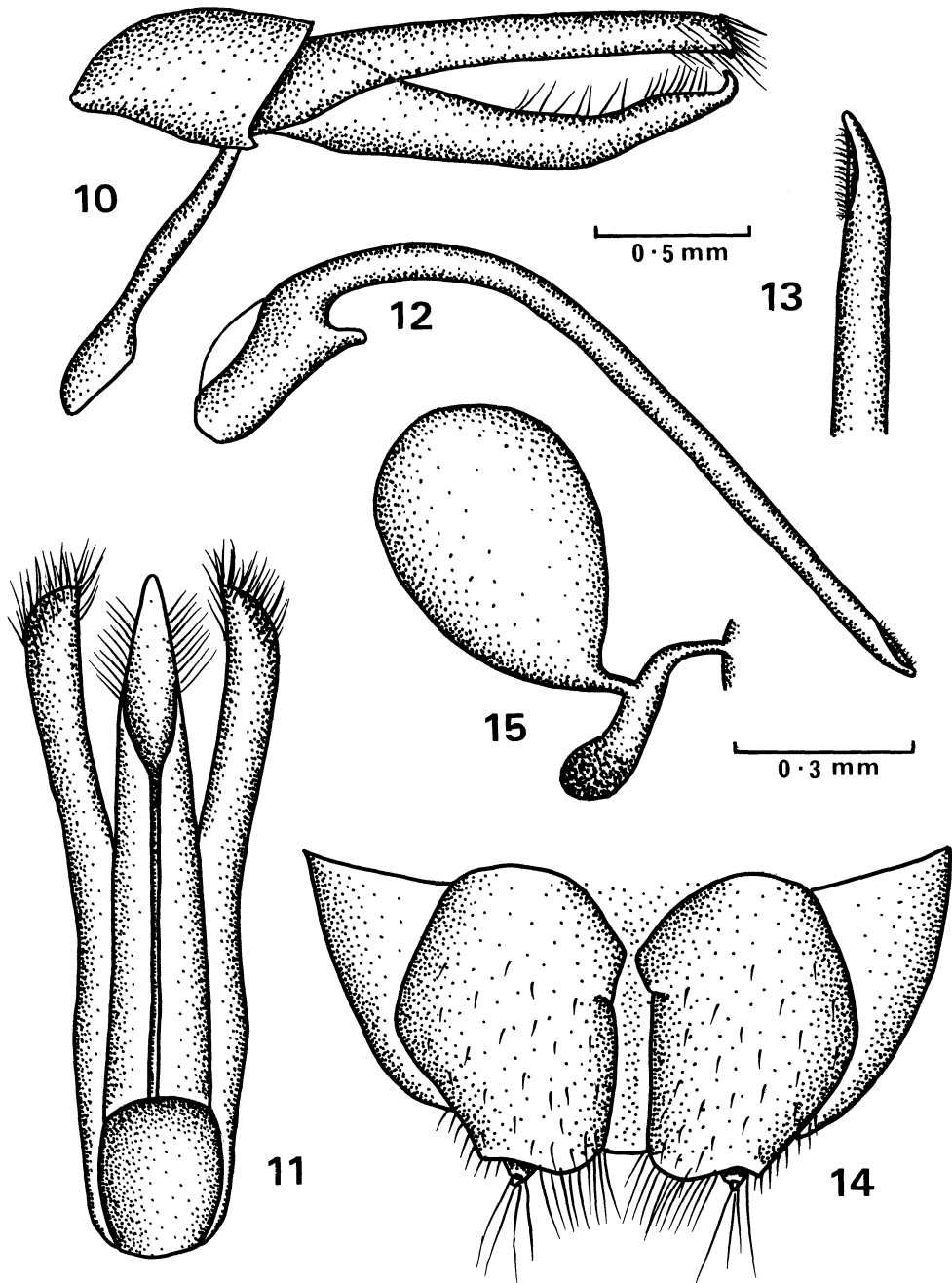


FIG. 10-15. *Epilachna vigintisexpunctata vigintisexpunctata*. 10-13, ♂ genitalia: 10, lateral view median lobe, paramere and trapes; 11, dorsal view median lobe and parameres; 12, siphon; 13, apex of siphon. 14, ♀ genital plates. 15, spermatheca and accessory gland. Fig. 10, 11, 12 to scale 0.5 mm; Fig. 13, 14, 15 to scale 0.3 mm.

TABLE 3. Elytral spot linkage in 2 subspecies of *Epilachna vigintiseppunctata*.

<i>vigintiseppunctata</i>				<i>doryca</i>	
SINGLE GROUP LINKAGE	% LINKAGE (n = 44)	MULTIPLE GROUP LINKAGE	% LINKAGE (n = 44)	SINGLE GROUP LINKAGE	% LINKAGE (n = 27)
<i>a-b</i>	43.1	<i>a-b</i> ; 2- <i>c</i>	13.6	1-3-4	29.6
2- <i>c</i>	34.0	<i>a-b</i> ; 3-5	6.8	1-3	11.1
<i>e-g</i>	25.0	<i>a-b</i> ; <i>e-f</i>	6.8	2-1-3-5	11.1
				4-6	
3-5	25.0	<i>e-g</i> ; 2- <i>c</i>	4.5	1-2-4-6	7.4
2- <i>c</i> -4- <i>f</i>	20.5	2- <i>c</i> -4- <i>f</i> ; <i>a-b</i>	4.5	2-1-3-5-6	7.4
				4	
<i>e-f</i>	6.8	2- <i>c</i> -4- <i>f</i> ; 3-5	4.5	BLACK	7.4
<i>b-c</i>	2.3	2- <i>c</i> -4- <i>f</i> ; <i>e-g</i>	4.5	2-4-6	3.7
		<i>e-g</i> ; <i>b-c</i>	2.3	2-4-6	3.7
				^	
				3 5	
		<i>e-g</i> ; 2- <i>c</i>	2.3	3-4; 5-6	3.7
		<i>a-b</i> ; <i>e-g</i>	2.3	1-3-4-5	3.7
		2- <i>c</i> ; <i>a-b</i> ; <i>e-f</i>	2.3	1-3-5-6	3.7
				4	
				1-3-5	3.7
				4-6	
				2-1-3-4	3.7
				5-6	
				1-3-4-5-6(R*)	3.7
				1-3-4(L**)	

* Right elytron.

** Left elytron.

disc and margins, usually separated by greater than their diameter; pubescence short, thick, golden, covering black spots as well as ground color, slightly appressed. Prosternum short, with narrow intercoxal protuberance truncate at apex. Postcoxal line behind metacoxa on 1st abdominal sternite complete, distinct (Fig. 22e), reaching 0.74 distance to posterior margin; posterior margin of 5th abdominal sternite subconcave; 6th abdominal sternite entire, posterior margin rounded, shallowly emarginate at apex. Tarsal claws bifid, inner claw wider than outer claw, basal tooth quadratic with incipient process on inner apical corner; 2 basal teeth of each claw almost touching (Fig. 23c-d). Genitalia. Siphon slender, 1.6× longer than median lobe and parameres, gently curved near base then straight, with sharply pointed apex without setae or appendages (Fig. 12); orifice oval, subterminal, surrounded by short setae (Fig. 13); trabes elongate with distal ½ dilated; parameres flattened, elongate, parallel-sided, subequal in length with median lobe, with 2 thick rows of setae around apex, armed with apical thorn; median lobe with ventral margin straight or slightly curved 0.75 total length, then sharply curved upwards to apex, dorsal margin with small basal knife-edge 0.3 total length, then slightly curved for 0.4 of length, apical 0.3 slightly convex and strongly curved upwards to apical hook, setae

TABLE 4. Linkage susceptibility of elytral spots in 3 subspecies of *Epilachna vigintisexpunctata*.

SPOT	% LINKAGE <i>vigintisexpunctata</i> (n = 44)	% LINKAGE <i>doryca</i> (n = 27)	% LINKAGE <i>philippinensis</i> (n = 5)
<i>a</i>	43.1	—	—
<i>b</i>	45.5	—	—
<i>c</i>	56.8	—	—
<i>d</i>	—	—	—
<i>e</i>	31.8	—	—
<i>f</i>	27.3	—	—
<i>g</i>	25.0	—	—
<i>h</i>	—	—	—
1	—	88.8	—
2	54.5	37.0	—
3	22.7	88.8	100.0
4	20.5	85.2	80.0
5	22.7	48.1	20.0
6	—	51.9	—

numerous on dorsal margin close to apex, a few longer setae often on dorsal margin between 0.25–0.50 from apex (Fig. 10, 11).

♀. Length 7.2 mm, width 5.9 mm. Similar to ♂, except posterior margin of 5th abdominal sternite subconcave tapering to short pointed apex; 6th abdominal sternite arcuate, with median longitudinal split to base; posterior margin of 10th tergite rounded. Genital plates kidney-shaped, 1.5× longer than broad, with shallow notch on inner margin 0.3 from base, small stylus on apical margin with long setae (Fig. 14). Spermatheca (Fig. 15) very lightly chitinized, more so towards apex, with almost spherical accessory gland.

Variation. Length 5.3–7.4 mm; width 4.2–5.9 mm; ♀ usually larger than ♂. Pronotum usually with large black disc, but very occasionally with spots as well as or instead of disc. In the lectotype and 1 other specimen there is a small spot on either side of disc; in 1 paralectotype there are 3 fused groups of spots: 3, 4, 7; 5, 1; and 6, 2. In another specimen spots 1, 2, 5, 6 are free, and 3, 4, 7 fused. In yet another all 7 spots are linked, but do not form a disc. The latter specimen and the paralectotype have 26 elytral spots having lost *a*. Elytral spots tend to enlarge due to increase in melanization. The number of spots is relatively constant at 28. Spot *a* has been lost in only 3 (0.7%) specimens examined. Instead it often increases in size. In one specimen *d* has been lost. Increased melanization has led to spot linkage in 44 (7.6%) of the specimens examined (Table 3). Most common linkage is between *a* and *b*, and the link may be so thick that the identity of the spots is lost. In over 50% of the 44 specimens, more than 1 group of spots may be linked on a single elytron. Most spots are susceptible to linkage, some more so than others (Table 4), and incipient linkage is common with the production of long horns, but it has not been observed with *d*, *h*, 1 or 6. Linkage patterns do not seem to be ecophenotypically controlled, nor are they induced by laboratory culturing.

Distribution (Fig. 25). Australia (Queensland, New South Wales, Australian Capital Territory).

Specimens examined. TYPE MATERIAL. *C. vigintisexpunctata* lectotype ♂, [with pink label] *Goccinella* [crossed off label] *Epilachna 26-punctata*. mihi. h in Nova Hollandia (Dejean's hand) (Dejean Coll. Museum Guimet,

Lyon). *C. vigintisexpunctata* paralectotypes, 2♀ [with same label as lectotype] (Dejean Coll. Museum Guimet, Lyon). *E. philippinensis australica* holotype ♂, Type No. 57110 USNM, *Epilachna philippinensis australica* Dieke holotype, Australia Richmond River N.S.W. [printed]. *E. philippinensis australica* paratypes: 1♂, USNM paratype 57110, *Epilachna philippinensis australica* Dieke paratype, Richmond River Australia Koebele; 1♀, USNM paratype 57110, *Epilachna philippinensis australica* Dieke det. Dieke 1943, Australia Koebele; 1 sex unknown *Epilachna australica* Dieke see Type Coll. USNM paratype 57110, *Epilachna philippinensis australica* Dieke det. Dieke 1943, Australia Richmond R. N.S.W. [all printed] (USNM). OTHER MATERIAL. Total of 574 specimens from Australia [Queensland (45), New South Wales (529), Australian Capital Territory (1)].

Affinities. Closely related to *E. vigintioctopunctata* by having a quadratic basal tooth on the claw, mandibles with a rounded apex and few serrations, and by the shape of both ♂ and ♀ genitalia; however, the basal knife-edge of the ♂ median lobe is very reduced in size in *E. vigintisexpunctata*.

Remarks. The lectotype ♂ of *C. vigintisexpunctata* has elytra with 28 not 26 spots, and with spots *d* and *g* extending to the suture line. Apart from this, it agrees with Boisduval's (1835) description. One ♀ paralectotype of *C. vigintisexpunctata* is identical with the lectotype. The other ♀ paralectotype has 26 elytral spots with *a* absent, and the pronotum has 3 fused groups of spots. Two further females each carry an additional label, one Latreille and the other D'Urville. As neither name appears in either Boisduval (1835) or Mulsant (1850), these 2 specimens are not regarded as part of the type series.

C. vigintisexpunctata was among the insects collected between 1826–1829 during the voyage of the *Astrolabe*. Although Boisduval regarded the species as Dejean's, it is listed in the Dejean Catalogue as *Epilachna vigintisexpunctata*. Boisduval (1835) was the first person to publish its description, but it was not figured. In 1850, Mulsant redescribed it and transferred it to *Epilachna*. The lectotype of *C. vigintisexpunctata* is a different species from that described by Mulsant, but from then until now Mulsant's interpretation has been accepted and it has been regarded as the 26-spotted form of *E. vigintioctopunctata* or *E. sparsa*.

Apart from Nouvelle Hollande (Boisduval 1835), the type-locality of *C. vigintisexpunctata* is not given. However, comparison of the route taken by the *Astrolabe* in the *Atlas* of the voyage (1833) with the known distribution of the species (Fig. 25) strongly suggests that the type-locality is Sydney, New South Wales.

The holotype and 3 paratypes of *E. philippinensis australica* Dieke agree well with Dieke's (1947) description. Comparison of the type material of *australica* with that of *C. vigintisexpunctata* has shown the subspecies to be conspecific.

***Epilachna vigintisexpunctata doryca* (Boisduval), new status**

Coccinella doryca Boisduval, 1835: 597. Lectotype ♂, New Guinea [Irian Jaya] (MNHN), here designated [examined]. **New status.**

Epilachna doryca (Boisduval): Mulsant, 1850: 761 (printer's error) (partim).

Epilachna doryca (Boisduval): Crotch, 1874: 86.—Dieke, 1947: 69.

Epilachna doryca var. *erimensis* Weise, 1902: 493. Syntypes, New Guinea (TM) [not examined].—Dieke, 1947: 70. [Syn. with *doryca doryca* by Bielawski, 1963: 326.]

Epilachna doryca ab. *nigripennis* Korschefsky, 1934: 268. Holotype ♀, New Guinea (MNHU) [not examined]. [Syn. with *doryca doryca* by Bielawski, 1963: 326.]

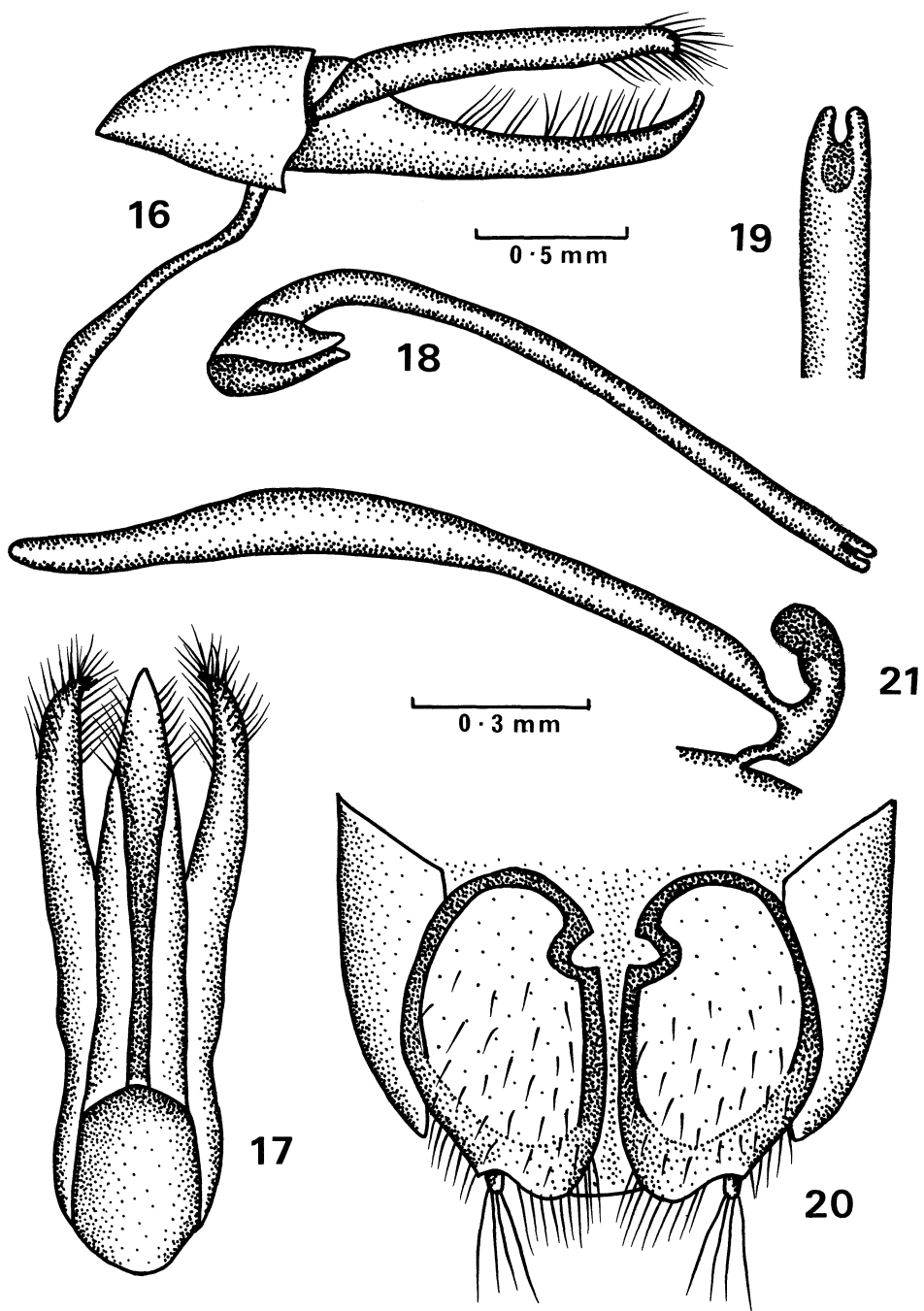


FIG. 16-21. *Epilachna cucurbitae*. 16-19, ♂ genitalia: 16, lateral view median lobe, paramere and trapes; 17, dorsal view median lobe and parameres; 18, siphon; 19, apex of siphon. 20, ♀ genital plates. 21, spermatheca and accessory gland. Fig. 16, 17, 18 to scale 0.5 mm; Fig. 19, 20, 21 to scale 0.3 mm.

Epilachna doryca doryca (Boisduval): Bielawski, 1963: 326.

Hemosepilachna doryca doryca (Boisduval): Bielawski, 1965a: 536.

This subspecies has been fully described by Dieke (1947) and Bielawski (1963).

Variation. Pronotum subject to loss of spots and spot linkage. In 5 (17.2%) of the 29 specimens examined, spots 1, 3, 4 and 2 are free; 5 more (17.2%) have 1, 3, 4, 7 and 2 fused into a disc; 1 (3.5%) has 1, 2 free, 3, 4 linked; 1 (3.5%) has 5, 1, 2 and 6 free and 3, 4 linked; 1 (3.5%) has all 7 spots free, and 16 (55%) have immaculate pronota. Spot linkage is present in 24% of the specimens, with the black disc formed through fusion of 5 spots approaching the 7-spot fused disc of *vigintisexpunctata*. Only persistent spots occur on the elytra, and they tend to enlarge due to increased melanization. They vary from all free (2 = 7%), to weakly linked (16 = 55%), to strongly linked (10 = 34.5%), to the elytra being almost totally black (1 = 3.5%) (Table 3). Multiple linkage is very common (93.1%). All spots are susceptible to linkage, but some more so than others (Table 4). Incipient linkage with the production of long horns is common. In *vigintisexpunctata* 20.5% of the specimens examined have linkage of spots 2, c, 4 and f along the lateral margin of each elytron. In *doryca* 31% have this lateral linkage extended anteriorly across the base of the elytron and posteriorly to its apex, and it may incorporate 1, 2, 4 and 6. Of 4 specimens from Coen River, Queensland, 2 have spots 2, 4, and 6 linked and 2 1, 2, 4 and 6 linked, in all cases with the band extending beyond 6 to the apex. This lateral linkage also occurs in 5 of the New Guinea specimens, but here general melanization has increased with separate linkage of other spots occurring leading to the formation of different patterns of linkage (Table 3). The extreme form has total melanization of the elytra.

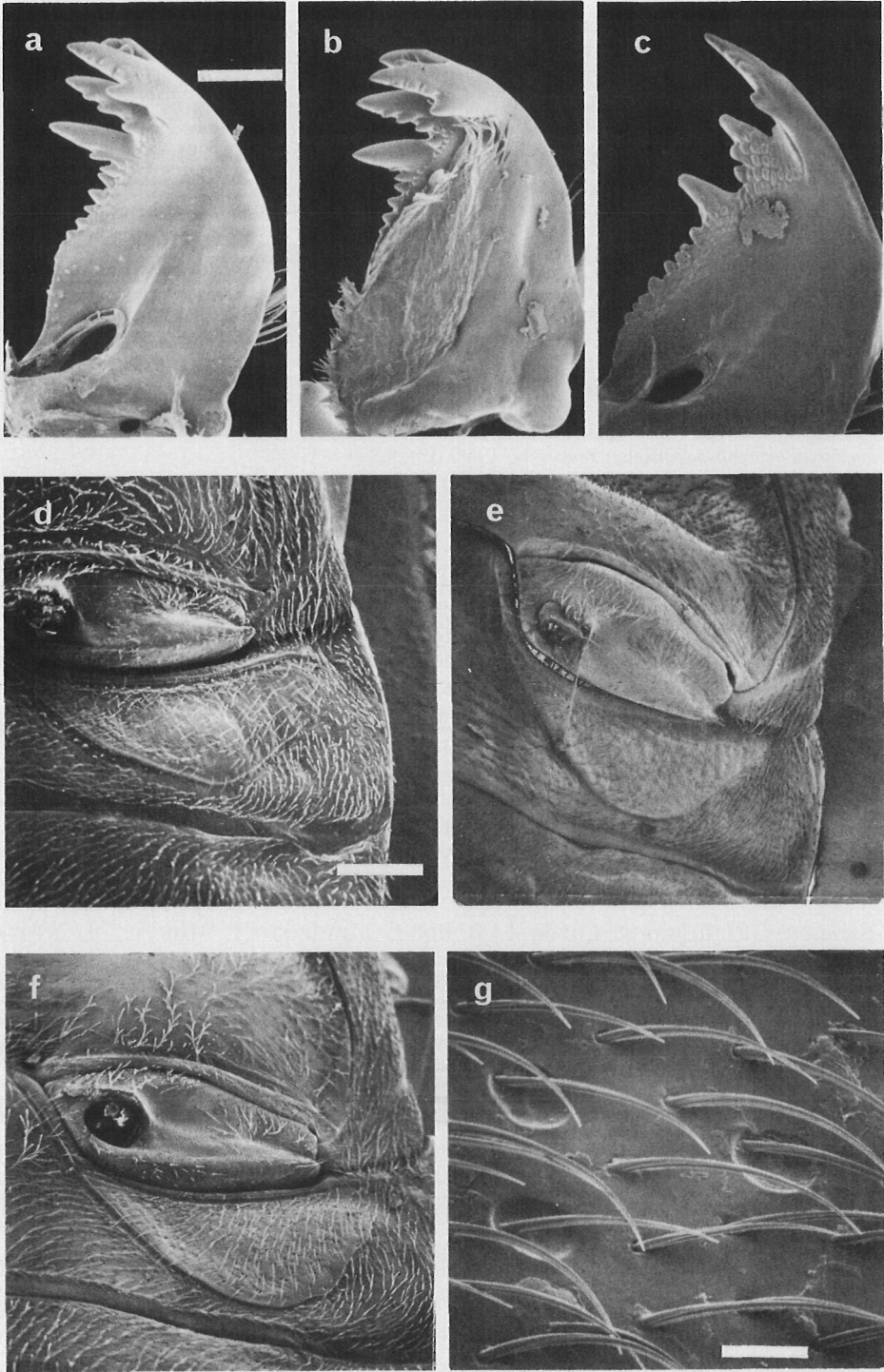
Distribution (Fig. 25). Java, Waigeo I, Biak I, Aru I, Irian Jaya, New Guinea, New Britain, New Ireland, Bougainville I, Woodlark I, Solomon Is, Australia.

Specimens examined. TYPE MATERIAL. *C. doryca* lectotype ♂, Museum Paris Dorey d'Urville, 196, *Epilachna doryca* Boisd. Mulsant det., dorey d'Urville, 21. *c. doryca* B. [the latter probably in Boisduval's hand] (MNHN). OTHER MATERIAL. Total of 76 specimens from Indonesia [Java (1), Waigeo I (1), Aru I (1), Biak I (3), Irian Jaya (14)]; New Guinea (28); New Britain (12); New Ireland (5); Bougainville (1); Woodlark I (2); Solomon Is (4); Australia [Queensland (4)].

Remarks. The lectotype of *C. doryca* has a pronotum with 2 black spots, not 4 as described by Boisduval (1835). No pronotal spots are shown in its illustration (Boisduval 1932, Fig. 21). This suggests that the lectotype may have been part of a syntype series. Apart from this, it agrees with Boisduval's description and figure.

C. doryca was collected between 1826–1829 during the voyage of the *Astrolabe*. It was described by Boisduval (1835), but the species had already been illustrated and named *Coccinelle de Dorei* Boisd. on Plate 8, Fig. 21 in the plates illustrating the entomological part of the voyage of the *Astrolabe* (Boisduval 1932). The type-locality, Dorei dans la Nouvelle-Guinee is now known as Manokwari. Mulsant (1850) trans-

FIG. 22. **a**, mandible of *E. vigintioctopunctata pardalis* (100 µm). **b**, mandible of *E. vigintisexpunctata vigintisexpunctata* (100 µm). **c**, mandible of *E. cucurbitae* (100 µm). **d**, postcoxal line on 1st abdominal sternite of *E. vigintioctopunctata pardalis* (400 µm). **e**, postcoxal line on 1st abdominal sternite of *E. vigintisexpunctata vigintisexpunctata* (400 µm). **f**, postcoxal line on 1st abdominal sternite of *E. cucurbitae* (400 µm). **g**, single punctation on elytron of *E. cucurbitae* (400 µm).



ferred *C. doryca* to *Epilachna* and redescribed it, basing his description on material from New Guinea (possibly the type material) and the East Indies. He considered the typical form to have all spots separate, and that the uniting of spots on the type was atypical. Weise (1902) named the typical form var. *erimensis* and Korschefsky (1934) named the form with black elytra ab. *nigripennis*. Both Dieke (1947) and Bielawski (1963) redescribed and illustrated *E. doryca*, but neither examined the type material.

The distribution of *doryca* is extended here to Australia.

***Epilachna vigintisexpunctata philippinensis* Dieke, new status**

Epilachna philippinensis Dieke, 1947: 40. Holotype ♂, Philippine Is (USNM) [examined]. [Syn. with *doryca* as *doryca philippinensis* by Bielawski, 1963: 324.]

Epilachna philippinensis remota Dieke, 1947: 41. Holotype ♂, Philippine Is (USNM) [examined]. [Synonymized with *doryca doryca* by Bielawski, 1963: 326.] **New synonymy.**

Epilachna doryca philippinensis Dieke: Bielawski, 1963: 324.

Henosepilachna doryca philippinensis (Dieke): Bielawski, 1965a: 536.

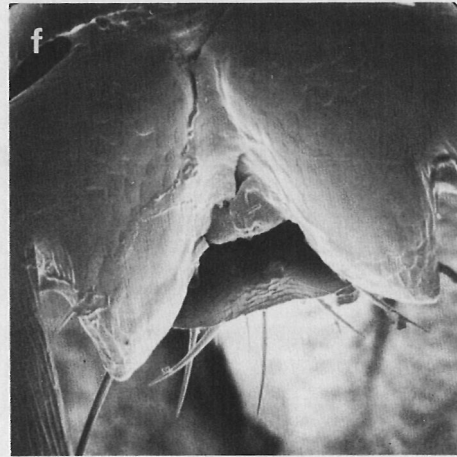
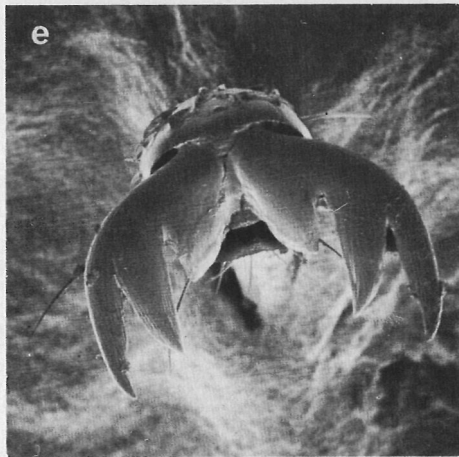
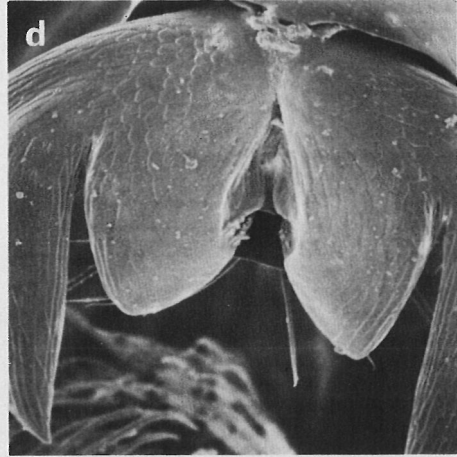
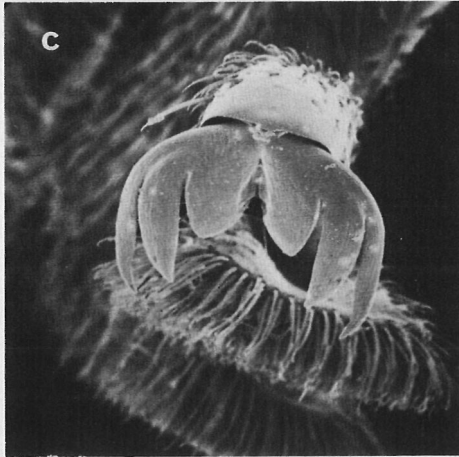
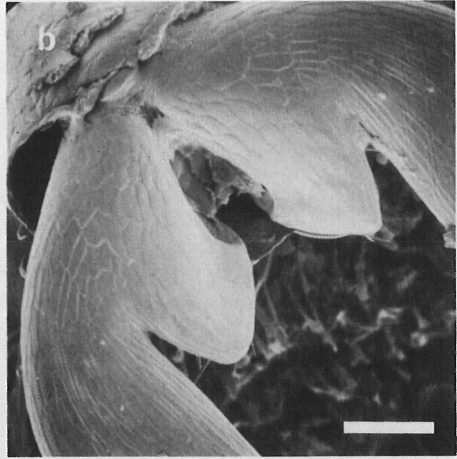
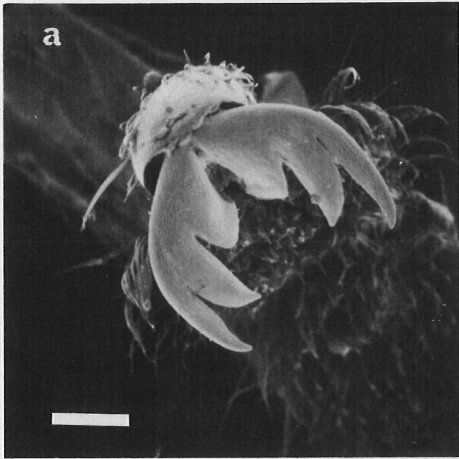
E. philippinensis was fully described and illustrated by Dieke (1947, Plate 1, Fig. 19; Plate 10, Fig. 118).

Variation. Pronotum immaculate in 83 (78.3%) of the 106 specimens examined; spots 1 and 2 present in 14 (13.2%); spots 1, 2, 3, 4 in 7 (6.6%); spots 2, 4, 5, 6 in 1 (0.9%) and all 7 spots present in 1 (0.9%). Spot linkage is absent. Elytral spots are very variable in size and number, and most are lightly pigmented. All 28 spots are present in 34 (32.1%) specimens, 26 in 14 (13.2%), 24 in 6 (5.7%), 21 in 1 (0.9%), 20 in 3 (2.8%), 14 in 1 (0.9%) and 12 in 47 (44.3%). Spot *a* has been lost in 72 (67.9%) specimens and almost lost in 3, *b* lost in 48 (45.3%) and almost lost in 6, *c* lost in 52 (49.1%) and almost lost in 2, *d* lost in 48 (45.3%) and almost lost in 2, *e* lost in 50 (47.2%) and almost lost in 6, *f* lost in 52 (49.1%) and almost lost in 5, *g* lost in 50 (47.2%) and almost lost in 9, *h* lost in 55 (51.9%) and almost lost in 5. Spot *a* is the first to disappear, with *b*, *c* and *d* the last, and also the last to be reduced in size. In 1 specimen, spot 6 is very small and 5 has almost completely disappeared. Spot linkage has occurred in only 5 (4.7%) specimens. Four (3.8%) have spots 3 and 4 united, and 1 (0.9%) has 3 and 5 united (Table 4). There is no linkage between nonpersistent spots and no multiple linkage.

Distribution. Philippines: Luzón I, Bohol I, Mindanao I, Mindoro I, Negros I, Palawan I, Samar I, Sulu Is.

Specimens examined. TYPE MATERIAL. *E. philippinensis* holotype ♂, Type No. 57108 USNM, *Epilachna philippinensis* Dieke holotype, Imugan, Luzón, Nueva Vizcaya Prov. McGregor [printed] (USNM). *E. philippinensis* paratypes: 5♀ [same data as holotype]; 10♀, 2♂, Nueva Viscaya Prov. Balite Pass McGregor; 9♀, 1♂, Limay Bataan Prov. Luzón PI. colln. R.C. McGregor; 1♂, 1♀, Ilocos sur Luzón McGregor; 1♀, Bay Laguna Prov. PI P.L. Strong Collector; 1♀, Manilla 1911 PI. C.V. Piper; 1♀, Manilla PI. W.A. Stanton; 1♀, Mt. Makiline, Luzón Baker; 1♂, Mt. Banahao PI. Baker; 1♀, Los Banos PI. Baker; 1♀, Luzón Laguna Prov. McGregor; 2♀ [no locality data]. [Each specimen also carries] paratype No. 57108 USNM [and] *Epilachna philippinensis*

FIG. 23. **a**, claw of *E. vigintioctopunctata pardalis* (100 μm). **b**, enlargement of basal tooth of claw of *E. vigintioctopunctata pardalis* (40 μm). **c**, claw of *E. vigintisexpunctata vigintisexpunctata* (100 μm). **d**, enlargement of basal tooth of claw of *E. vigintisexpunctata vigintisexpunctata* (40 μm). **e**, claw of *E. cucurbitae* (100 μm). **f**, enlargement of basal tooth of claw of *E. cucurbitae* (40 μm).



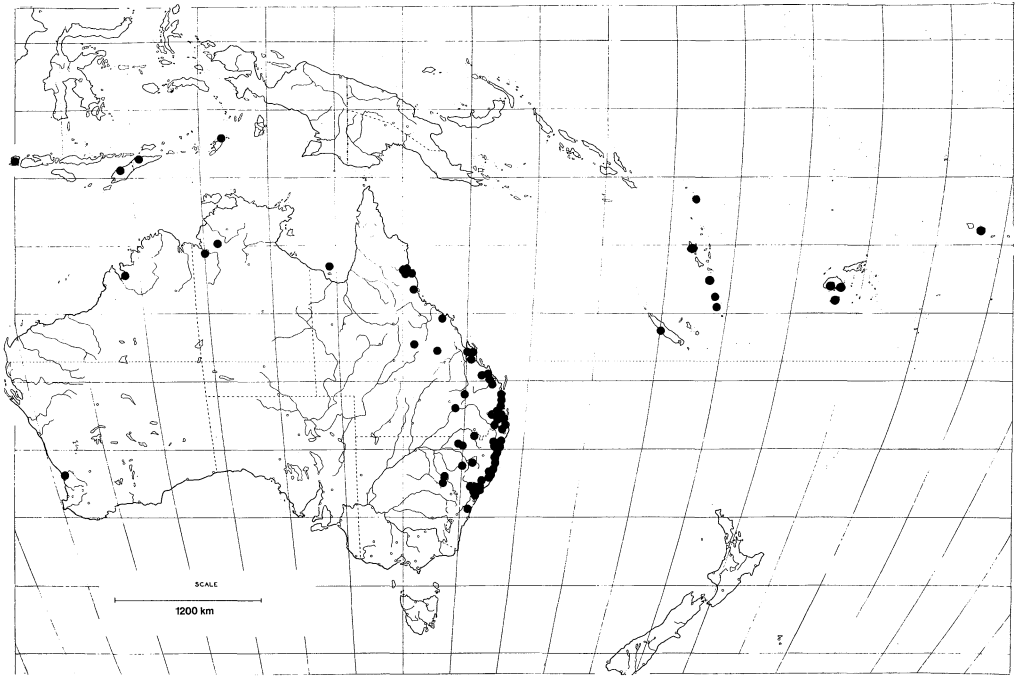


FIG. 24. Distribution of *Epilachna vigintioctopunctata pardalis*, excluding Java and the Society Is.

Dieke paratype [all printed] (USNM). *E. philippinensis remota* holotype ♂, Type No. 57109 USNM, *Epilachna philippinensis remota* Dieke holotype [Dieke's spelling], Mindanao, Mati Davao Pr. R.C. McGregor Jun 1927 [printed] (USNM). *E. philippinensis remota* paratypes: 1♀, Mindanao, Mati Davao Pr. R.C. McGregor Apr. 1927; 3♀, [same data except] Jun. 1927; 1♀, Davao Mindanao Baker; 2♀, Tomato TI X-[19]27 Victorias Occ. Negros W.D. Pierce; 1♀, Sulu Ids PI. Jolo July [19]24 A. Duyag coll. R.C. McGregor; 1♀, Los Banos PI. Baker; 1♀, cc 491 *Datura alba* Cadiz Viego Negros; 1♀, P. Princesa Palawan Baker; 1♀, Manila PI. 1911 C.V. Piper collection; 1♀, Bohol PI. Bilar Sep. [19]23 McGregor; 1♀, Mindanao May 1911 C.V. Piper Coll. [Each specimen also carries] paratype No. 57109 USNM [and] *Epilachna philippinensis remota* Dieke paratype [all printed] (USNM). 1♂, 4♀, Victorias Occ. Negros W.D. Pierce Tomato TI X-[19]27; 1♂, P. Princesa Palawan Is Baker; 1♀, Bohol PI Bilar Sep. [19]23 McGregor; 1♀, Mar 1927 Mindanao Mati Davao Pr. R.C. McGregor; 1♂, Negros PI. V-1911 C.V. Piper Coll.; 1♂, Bongao, Sulu Is PI. Jul. [19]24 A. Duyag. coll. R.C. McGregor. [Each specimen also carries] *Epilachna philippinensis remota* Dieke paratype G.H. Dieke Coll. 1965 [all printed] (USNM). OTHER MATERIAL. Total of 40 specimens from Philippines [Luzón I (18), Bohol I (1), Mindanao I (10), Mindoro I (2), Negros I (4), Palawan I (4), Samar I (1)].

Remarks. The holotype of *E. philippinensis* agrees with Dieke's (1947) description except that the pronotum is immaculate and the median lobe has more setae than shown in his Fig. 118. Bielawski's (1963) interpretation of *philippinensis* as a subspecies of *E. doryca* is incorrect (see above), and it is now transferred to *E. vigintisexpunctata* as *E. vigintisexpunctata philippinensis*. The holotype of *E. philippinensis remota* agrees with Dieke's (1947) description and Fig. 20, except that the pronotum bears spots 2, 4, 5, 6. The wide variation in nonpersistent spots suggests that the common 28-spotted

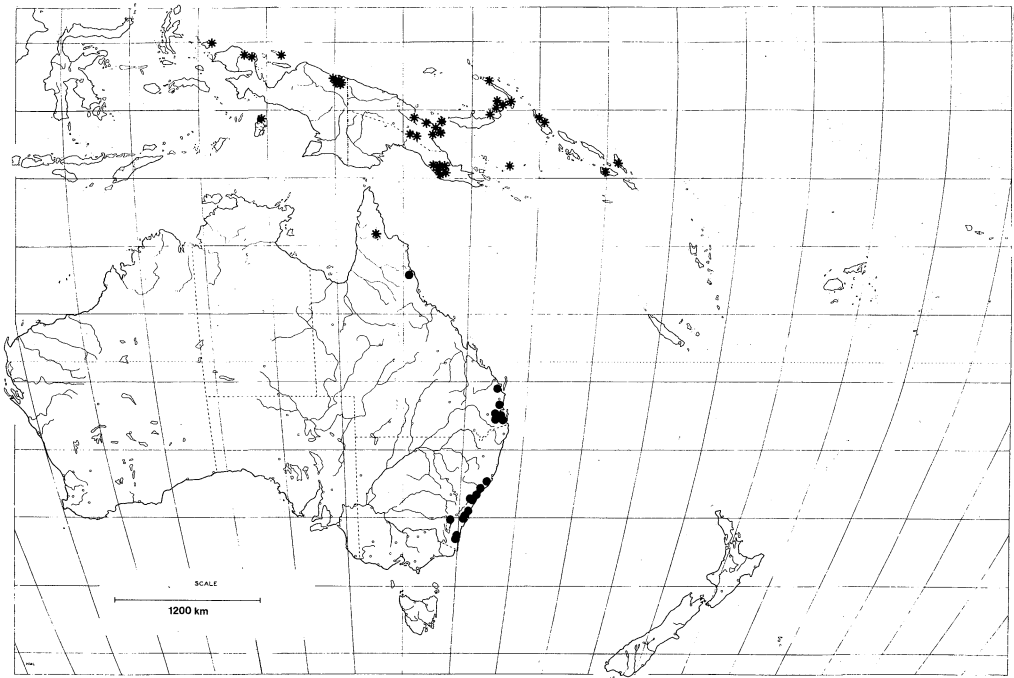


FIG. 25. Distribution of *Epilachna vigintiseppunctata* (black spots) and *E. vigintiseppunctata doryca* (black stars), excluding Java.

form of *philippinensis* and the common 12-spotted form of *remota* are extreme forms of a single variable species, and not subspecies as interpreted by Dieke (1947). Their overlap in the vicinity of Manila supports this. Their pronotal maculation is very similar, and their genitalia and morphology are identical. In both forms there is almost no spot linkage. Consequently, *remota* is removed from synonymy with *E. doryca doryca* (Bielawski 1963) and synonymized with *philippinensis*.

***Epilachna cucurbitae* Richards, new species**

Fig. 16–21; 22c, f–g; 23e–f

Epilachna vigintioctopunctata (Fabricius) Dieke: 1947: 42 [misident.].—Stride & Warwick, 1960: 208.

Henosepilachna vigintioctopunctata (Fabricius) sensu Dieke: Li & Cook, 1961: 89.

Epilachna pardalis (Boisduval) sensu Mulsant: Bielawski, 1963: 335 [misident.].

♂. Length 6.7 mm, width 5.8 mm, broadly oval, convex, broadest anterior to middle of elytron, lateral margin of elytron rounded from humeral angle to apex. Color orange-brown; pronotum with 7 black spots, 1, 2, 5, 6, 7 free, with 3 and 4 fused; elytra with 28 black spots, c, 4, f touching lateral margin, no spots touching suture. Antennae orange-brown, 11-segmented with last 3 segments fuscous; mouthparts and legs orange-brown; metasternum orange-brown with 2 large fuscous areas posterolateral on each side; abdominal sternites 1–6 light brown, each with a small fuscous spot on either side close to lateral margin. Mandible

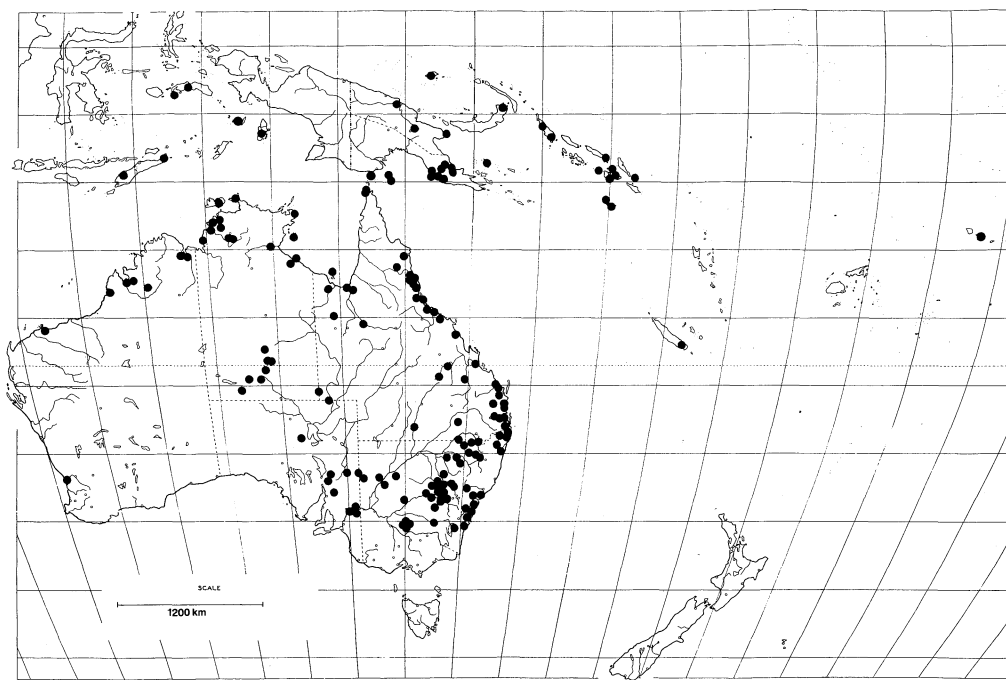


FIG. 26. Distribution of *Epilachna cucurbitae*, excluding Java, Maluku and the Philippines.

(Fig. 22c) with pointed apex, apical tooth trifid, pointed, 2nd tooth longer than 3rd tooth, with dentules on lower margin of apical and 2nd tooth and inner margin of mandible below 3rd tooth, the latter usually with 8 dentules; surface of 2nd tooth, basal portion of 3rd tooth and area at base of dentules below 3rd tooth heavily serrated; without basal tooth. Pronotum $0.27\times$ as long as broad, broadest at hind angles, anterior border shallowly emarginate with anterolateral angles rounded and strongly projecting anteriorly, posterior margin evenly rounded except for a slight emargination near the posterolateral angle on each side; disc of pronotum shallowly convex, without sculpture; pubescence golden, but black over spots, short, slightly appressed. Scutellum small, triangular. Elytron $1.5\times$ as long as broad, broadest anterior to middle of elytron, narrowed anteriorly to be slightly broader at base than posterior border of pronotum; lateral and apical margins with an entire narrowly grooved border, apical angle rounded; humeral callus strongly raised; punctation single, variable in size, irregularly scattered over disc and margins, usually separated by greater than their diameter (Fig. 22g); pubescence short, thick, golden, dark over elytral spots, slightly appressed. Prosternum short, with narrow intercoxal protuberance bluntly rounded at apex. Postcoxal line behind metacoxa on 1st abdominal sternite rounded, subcomplete, distinct, subterminal, reaching 0.86 distance to posterior margin (Fig. 22f); posterior margin of 5th abdominal sternite subconcave; 6th abdominal sternite entire, shallowly emarginate at apex. Tarsal claws bifid with basal tooth triangular, inner claw wider than outer claw, 2 basal teeth on each tarsus widely separated (Fig. 23e-f). Genitalia. Siphon slender, 1.65 longer than median lobe and parameres, gently curved near base then straight, rounded at apex with deep median notch (Fig. 18), apex without

setae or appendages (Fig. 19); trabes elongate with distal portion dilated; parameres flattened, elongate, parallel-sided, subequal in length with median lobe with 2 rows of setae around apex, armed with apical thorn; median lobe with ventral margin straight 0.75 total length then curved upwards to apex, dorsal margin gently curved upwards to apex, without basal knife-edge or apical hook, setae numerous on dorsal margin (Fig. 16–17).

♀. Length 7.1 mm, width 5.7 mm. Similar to ♂ except posterior margin of 5th abdominal sternite truncate; 6th abdominal sternite arcuate with median longitudinal split to base; posterior margin of 10th tergite rounded. Genital plates 1.6× longer than broad, with deep notch on inner margin 0.25 from base, small stylus on apical margin with long setae (Fig. 20). Spermatheca (Fig. 21) with apical ½ lightly chitinized, more so towards apex; with very long, narrow accessory gland.

Variation. Length 5.5–7.5 mm; width 4.7–6.1 mm; ♀ usually larger than ♂. Two fuscous spots sometimes absent from 1st abdominal sternite. In the 168 specimens examined, spots 5 and 6 have been lost in 61 (36.3%), 1 and 2 lost in 11 (6.5%), 7 lost in 6 (3.6%), and 3 and 4 lost in 1 (0.6%). Spots 5 and 6 have been jointly lost in 59 (35.1%). Spot linkage and fusion are very common (98.2%), particularly between 3 and 4 in 132 (78.6%), but also between 3, 4, 7 in 29 (17.3%), and 1, 3, 4, 2 in 2 (1.2%). Linkage between more than 4 spots has not been observed. Although size, shape and degree of melanization of elytral spots may be ecophenotypically controlled (they are much smaller in specimens from arid areas and northern Australia), the number of spots appears remarkably constant at 28. Only in specimens from 3 Australian localities has it been reduced. In specimens from Derby, Western Australia and Kensington, New South Wales *h* has been lost, and in 1 specimen from Gulargambone, New South Wales both *g* and *h* have been lost. In specimens from the north of Australia there is a tendency for loss of spots, but *a* has been retained in all but 1 specimen (from Moa I in Torres Strait). Other specimens from Moa I have lost *f*, with *b*, *d*, *g* very small and faint. One specimen from Bougainville I has 13 spots on the left elytron with *e*, *g* very small and *f* missing, and 12 spots on the right elytron with *e* reduced in size and *f*, *g* missing. In some specimens from Amboina and Maluku *d* is lost, in others the number of spots may be reduced to 22 or 20 with *a*, *c*, *f*, *h* reduced in size and *b*, *d*, *e*, *g* lost. Some specimens have lost all nonpersistent spots. Yet another variation occurs in the vicinity of Mt Lamington, Northern Province of Papua New Guinea, where melanization of the orange-brown ground color surrounding the black spots has occurred rather than coalescence or loss of spots, so that the greater part of each elytron is black, leaving only 1, 2 and *a* free. In specimens from Samoa, although all 28 spots are retained, there is increased melanization and enlargement of spots. In a few specimens spot linkage has occurred between *e*, *f*; *e*, *g*; and 3, 5. Other variations are *e*, *f*, *g*; and *e*, *f*, 5. Multiple linkage has not been observed.

Distribution (Fig. 26). Australia (Northern Territory, Queensland, New South Wales, Australian Capital Territory, Victoria, South Australia, Western Australia), Samoa, New Caledonia, Solomon Is, Bougainville I, New Britain, Manus I, New Guinea, Timor, Ceram I, Kai I, Aru I, Maluku, Amboina, Philippines.

Type data. Holotype ♂, allotype ♀, 12 paratype ♂, 6 paratype ♀, AUSTRALIA: New South Wales, Kensington, XI–XII-1977, ex zucchini (A.M. Richards). Holotype ♂, allotype ♀, 2♂ in ANIC; 2♂, 2♀ in BMNH; 3♂, 1♀ in BPBM; 1♂, 1♀ in USNM; 2♂, 1♀ in AM; 1♂, 1♀ in SAM.

Other material examined. Total of 2135 specimens from Australia [Northern Territory (75), Queensland (161), New South Wales (1699), Australian Capital Territory (2), Victoria (5), South Australia (19), Western

Australia (11), state unknown (10)]; Samoa [Upolu I (30)]; New Caledonia (2); Solomon Is [Santa Isobel I (3), Alu I (1), Bellona I (4), Guadalcanal I (11), Isle of Savo (1), Olevaga I (1), Ulawa I (2), Rennell I (14)]; Bougainville I (8); New Guinea [New Guinea (52), New Britain (2), Manus I (1), Trobriand Is (1), Yule I (1)]; Indonesia [Aru I (1), Timor (1), Maluku (1), Kai I (1), Amboina (4)]; Philippines [Dammai I (1)].

Affinities. Closely related to *E. signatipennis* (Boisd.), *E. solomonensis* Dieke, *E. dentulata* Dieke, *E. emarginata* Dieke, and *E. reducta* Dieke. In all species the shape of both ♂ and ♀ genitalia are very similar. The geographic distribution of each of these 5 species overlaps with that of *E. cucurbitae*, n. sp.

Remarks. Since Fabricius (1775) described *C. 28-punctata*, the name *vigintioctopunctata* has been used for at least 5 different species of *Epilachna*. Mulsant (1850) started the confusion by regarding *E. vigintioctopunctata* and *E. vigintisexpunctata* (Boisduval) sensu Mulsant as distinct species, and omitting India, the type-locality for *E. vigintioctopunctata*, from that species' distribution. In contrast, Korschefsky (1931) reduced *E. vigintisexpunctata* to an aberration of *E. vigintioctopunctata* and included India in its distribution. Dieke (1947) regarded *E. vigintisexpunctata* sensu Mulsant as a subspecies of *E. sparsa*, and considered *E. vigintisexpunctata* and *E. vigintioctopunctata* sensu Dieke distinct species. Dieke accepted Weise's (1900) description of a Ceylonese species as *E. vigintioctopunctata* and believed it was identical with specimens he had examined from Australia and the Pacific islands. Both Stride & Warwick (1960) and Bielawski (1963) accepted this and it has remained unchallenged until now. Examination of the lectotype of *C. 28-punctata* Fabricius (see above) has shown that it is a different species from the one which occurs in Australia, New Guinea, Solomon Is, New Caledonia and Samoa (currently known as *E. vigintioctopunctata* sensu Dieke). Therefore the latter species must be renamed. Because it can be separated from *E. vigintioctopunctata pardalis* and *E. vigintisexpunctata vigintisexpunctata* on biological as well as morphological characters (it feeds exclusively on Cucurbitaceae while the other 2 feed on Solanaceae) it is here named *E. cucurbitae*, n. sp.

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