that of hind coxa; gaster as long as thorax; third and fourth gastral tergites sub-equal in length and each approximately as long as first and second tergites combined.

Male.—Unknown.

Type.—U.S.N.M. no. 62904.

Type locality.—Paradise Mt., Trinidad, B.W.I.

Described from 26 female specimens as follows: Holotype, Paradise Mt., Trinidad, B.W.I., March 1952, reared from *Bruchus* sp. in pigeon peas, no. 241, F. D. Bennett; 3 paratypes intercepted at the D. C. Inspection Station in seeds of *Rhynchosia* from Mexico, May 20, 1953, H. Y. Gouldman; 22 paratypes, Brownsville, Texas, March 1921, reared from seeds of *Havardia brevifolia* infested with *Merobruchus* sp., J. C. Bridwell.

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## GEOGRAPHIC VARIATION IN THE BLISTER BEETLE LYTTA BIGUTTATA (COLEOPTERA, MELOIDAE).[1]

By Richard B. Selander,[2] Urbana, Illinois

*Lytta biguttata* is one of the most abundant and widely distributed species of the genus *Lytta* in North America. As has been long recognized, the color pattern of the species is highly variable, but no comprehensive study of this variation has been made previously. When analyzed this variation is found to consist of a wide range of individual variation superimposed on an even wider range of geographic variation.

The present paper is being published prior to my revision of the North American species of *Lytta* in order that the included information as well as the name of one of the subspecies will be available to others now engaged in a project involving *biguttata*. A description of the structural features of the species, together with additional synonymy, host plant information, and more detailed locality data for the subspecies will appear in my revision.

### *Lytta biguttata* LeConte

In all races the ground color of the pronotum and elytra is yellow-orange, the elytra being paler; the tarsi are black or brown.

[1] Field work contributing to this study was supported by grants from the Sigma Xi-RESA Research Fund and the Penrose Fund of the American Philosophical Society.

[2] Illinois Natural History Survey.

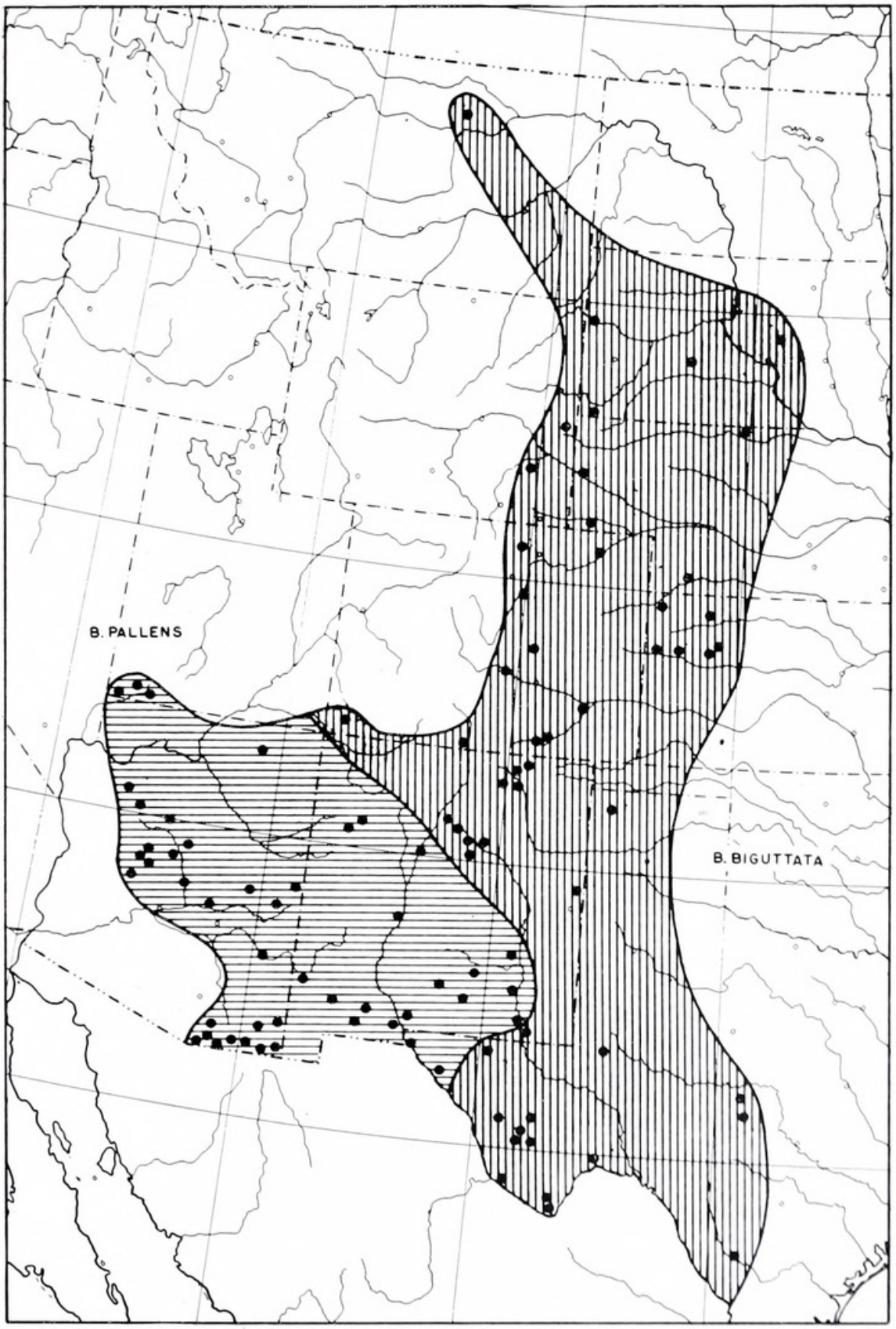


Fig. 1. Distribution of *Lytta biguttata* in the United States. Literature records are included.

Distribution: Northern Montana and central South Dakota to western Texas and eastern New Mexico; thence westward through southern Colorado and New Mexico to Arizona (exclusive of the Sonoran Desert) and southwestern Utah, extending southward on

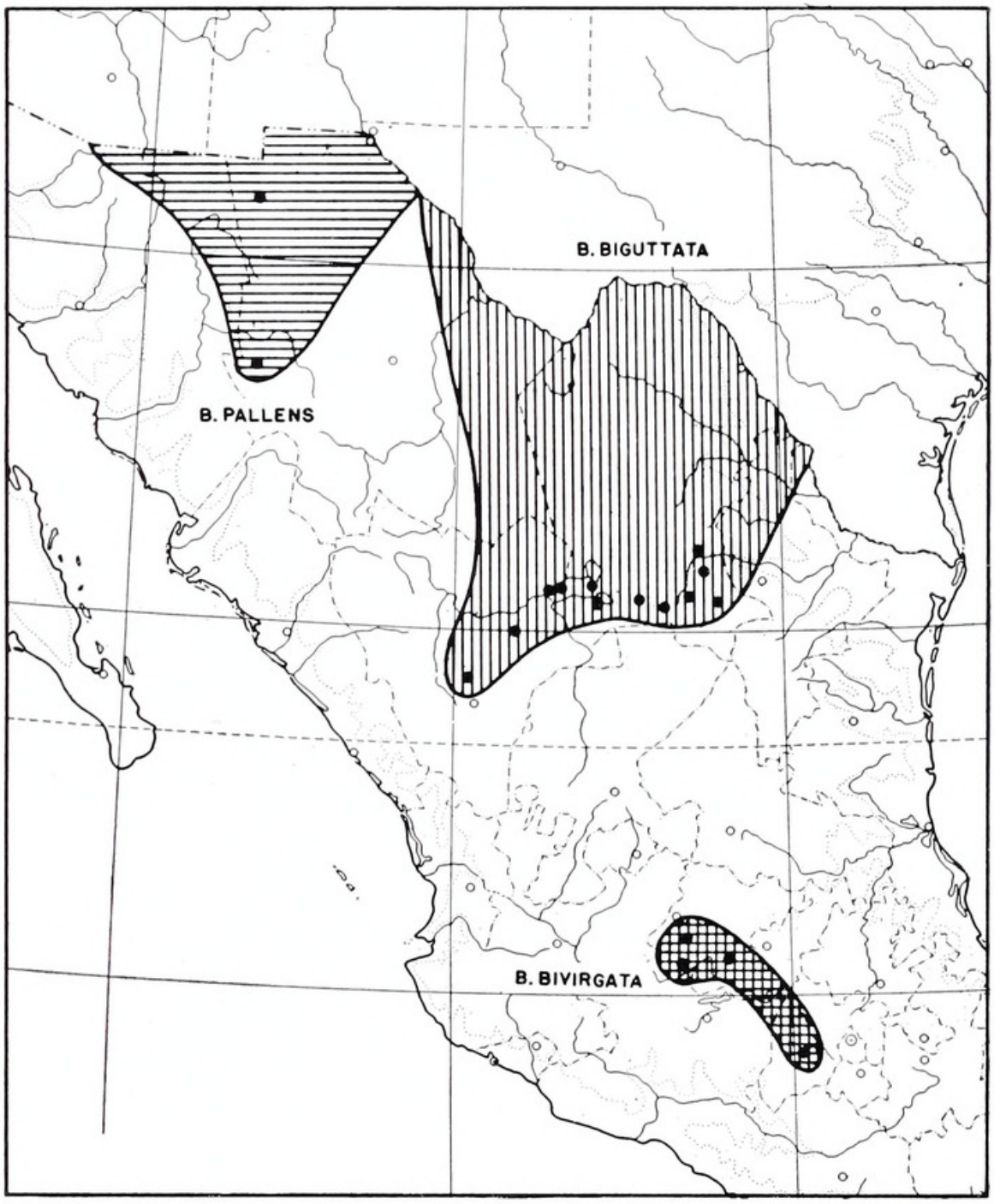


Fig. 2. Distribution of *Lytta biguttata* in México. Literature records are included.

the Mexican plateau to the state of México. See figures 1–2.

The species occurs commonly on Compositae and is probably a pollen feeder. Three well-marked subspecies may be recognized,

series of which are distinguishable by use of the following key:

Key to the Subspecies of *biguttata*

1. Head and under surface orange, or at least predominantly of this color ..... *b. pallens*
   Head and under surface black, or at least predominantly of this color ..... 2
2. Elytra each with a dark subapical spot or short vitta ..... *b. biguttata*
   Elytra each with a pair of submarginal dark vittae ..... *b. bivirgata*

*Lytta biguttata* **pallens** n. subsp.

Head, femora, and under surface, except frequently a part of the thorax, orange or yellow-orange. Upper surface immaculate or with a pair of black spots on the pronotum and/or a black or brown spot distally on each elytron (fig. 4A). Elytral suture entirely pale or finely bordered with black or brown for basal half or less. Tibiae in both sexes and basal antennal segments in male black or orange. Antennal segments less elongate than in *b. bivirgata*. Elytral pubescence moderately long, sufficiently dense to be conspicuous under magnification, as on head and pronotum.

Distribution: Valley of the Virgin River in southwestern Utah (Washington County) through Arizona, exclusive of the Sonoran Desert, to central western Chihuahua, extreme western Texas (Hudspeth County), and southeastern New Mexico. See figures 1–2.

Variation and Intergradation: The femora are sometimes finely tipped with black. Within the range of typical *b. pallens* the under surface of the thorax is entirely orange in approximately 61 per cent of the specimens examined, partially black in about 39 per cent. The area covered by the black thoracic markings varies from a fine margin of the side pieces to all but the middle of the metasternum. Five specimens with well-developed thoracic markings have some black on the first to first three visible abdominal sternites. In two of these (Senator Mine and Douglas, Arizona) and in one specimen with a typical abdomen (Douglas) the head is suffused with brown or black on the vertex. The pronotal and elytral markings are, on the average, less extensive in *b. pallens* than in *b. biguttata* and are more frequently absent. As in *b. biguttata* there is some correlation between the extent of the dark markings on the body and legs and the extent and intensity of those on the elytra.

Contact with *b. biguttata* results in increased variability in series of *b. pallens* from northwestern and southeastern New Mexico and extreme western Texas, with some influence of *b. biguttata* apparent in central eastern Arizona also. Although almost every conceivable transitional stage between *b. pallens* and *b. biguttata* coloration is represented among material from intergradational localities, it has been found convenient in analyzing variation within these races to assign specimens to one of three types, according to whether the color pattern is 1) typical or nearly typical of *b. pallens*, 2) typical or nearly typical of *b. biguttata*, or 3) more or less intermediate between the two.

Intergradation between *b. pallens* and *b. biguttata* is shown graphically in figure 3 by the use of pie graphs indicating the relative frequency of the three color pattern types in material from various localities. It should be noted that in order to minimize error associated with extremely small samples, most series consisting of less than three specimens have been lumped with adjacent series. All specimens from the range of *b. biguttata* outside the limits of the map shown in figure 3 are assignable to the *b. biguttata* type.

A specimen of *b. pallens* from the Santa Rita Mountains, Arizona, is indistinguishable from typical *b. biguttata*, but eight other specimens from the Nogales region are typical of *b. pallens*. Although the Santa Rita specimen may indicate that the influence of *b. biguttata* on *b. pallens* extends as far south as southern Arizona, it is perhaps equally likely that it represents an extreme expression of the range of individual variation of *b. pallens*. A series of eight specimens from the Sierra Ancha Mountains of eastern central Arizona includes two specimens of the intermediate type and one typical of *b. biguttata* and is clearly intergradational. To the east a specimen from Springerville, Arizona, is typical of *b. biguttata*. Two other samples from the general region consist of one specimen each of typical *b. pallens*. Northward *b. pallens* ranges into southwestern Utah and northeastern Arizona (northern Mojave County) in typical form.

In series of nine specimens from 18 miles east of Gallup, New Mexico, and three from Albuquerque, *b. pallens* and the intermediate type occur in the proportion of two to one. A decrease in the influence of *b. pallens* to the north is suggested by a series of specimens from Montezuma County, Colorado, consisting of two *b. biguttata*, two intermediate, and one *b. pallens* types and referable, therefore, to *b. biguttata*. An abrupt transition between *b. pallens* and *b. biguttata* in northern central New Mexico is

indicated by the fact that a series of 17 specimens from Santa Fe and San Miguel counties shows no influence of *b. pallens*.

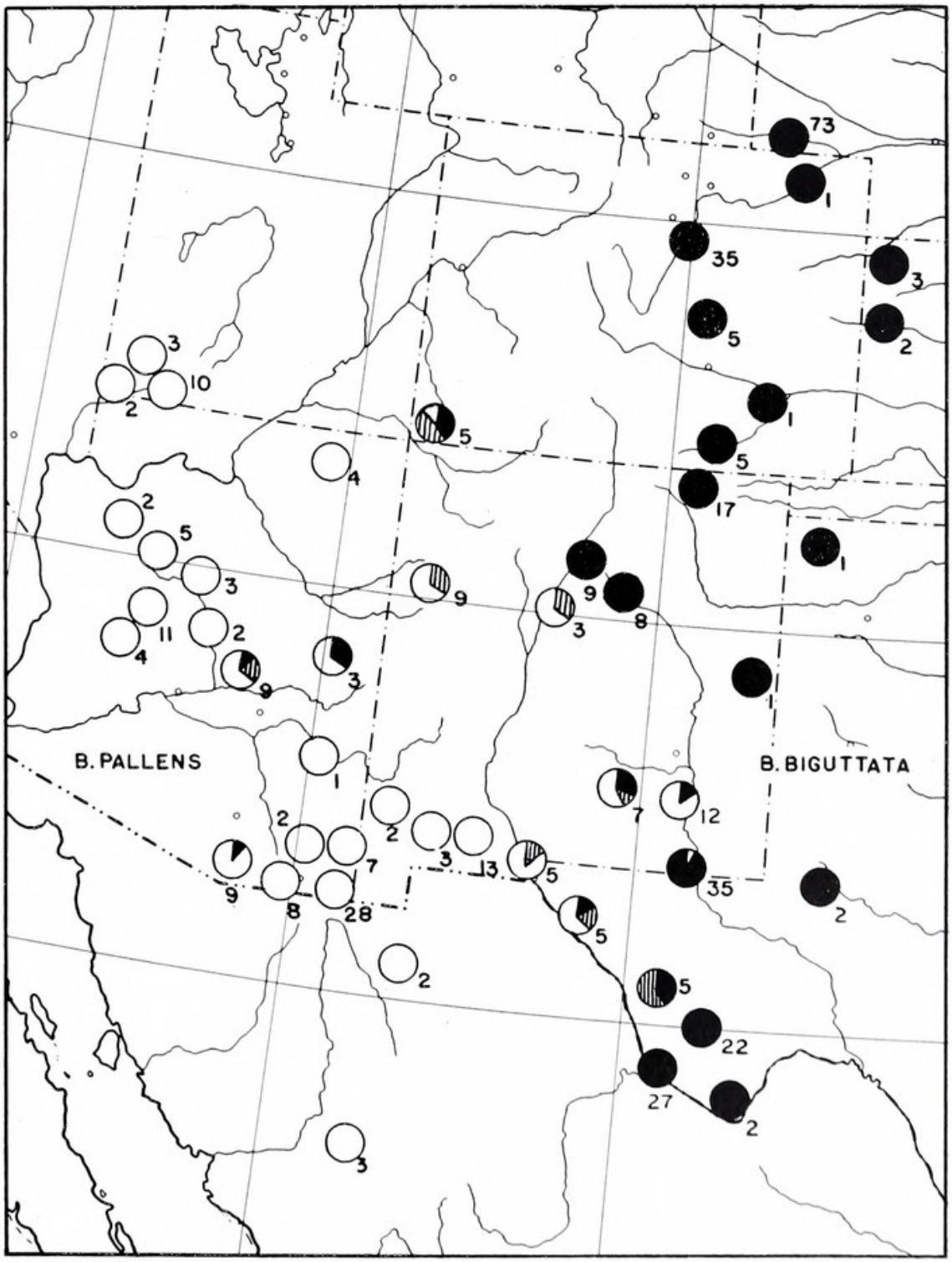


Fig. 3. Intergradation of *Lytta b. biguttata* and *b. pallens*. Relative frequency of the *b. biguttata*, *b. pallens*, and intermediate color pattern types in each sample is indicated by the size of the black, white, and lined sectors, respectively, of the pie graphs.

Variation of *b. pallens* toward *b. biguttata* is somewhat less abrupt in southeastern New Mexico. Seven specimens from

northern Otero County give the ratio of four *b. pallens,* one intermediate, and two *b. biguttata* types. Twelve specimens from Artesia, northern Eddy County, show even stronger influence of *b. pallens* than the Otero County material, consisting of 10 *b. pallens* and two *b. biguttata* individuals. One of two specimens from Carlsbad, central Eddy County, represents *b. pallens,* the other *b. biguttata.* Taken together this pair is perhaps closer to *b. pallens* than to *b. biguttata;* it has been assigned to *b. pallens* but has been lumped with the Loving series in figure 3. Sixteen miles to the southeast of Carlsbad the effect of *b. biguttata* is dominant, a series from Loving consisting of 30 *b. biguttata* and two *b. pallens* types.

A gradual cline of color variation is evident in central southern New Mexico and extreme southwestern Texas. Pure *b. pallens* extends into southern New Mexico as far east as western Dona Ana County. Three specimens from Las Cruces in central Dona Ana County are typical of *b. pallens,* as is a single specimen from adjacent El Paso County, Texas. A specimen from 10 miles east of Las Cruces is of the intermediate type, although closer to *b. pallens* than to *b. biguttata.* To the southeast, three specimens from McNary, Hudspeth County, Texas, represents *b. pallens,* one the intermediate type, and one *b. biguttata.* Finally, a series from 11 miles north of Valentine, Jeff Davis County, consists of three intermediate and two *b. biguttata* types and is assignable to *b. biguttata.*

The relationship of the two subspecies in central New Mexico is unknown. The high degree of variability in central eastern Arizona samples may indicate that the influence of *b. biguttata* is greater through central New Mexico than to the north and south. The species *biguttata* has been recorded from Socorro, New Mexico, but no information as to the character of the population there is available. Contact and intergradation of *b. pallens* and *b. biguttata* undoubtedly occur in northern México, but the range of the species in México is so poorly known that no information on this subject is available at the present time.

Remarks: Holotype male and allotype female from Douglas, Arizona, September 15, 1933, W. W. Jones, in the collection of the University of California at Berkeley. The majority of other specimens of *b. pallens* studied have been designated as paratypes. Speciments examined: 168.

### *Lytta biguttata biguttata* LeConte

*Lytta biguttata* LeConte, 1853, Proc. Acad. Nat. Sci. Philadel-

phia, 6: 332.

*Cantharis alemani* Dugès, 1889, An. Mus. Michoacano, 2: 106. *New synonymy.*

Head, antennae, tibiae, and under surface, except commonly the last two visible abdominal segments and a small patch at the sides of some of the preceding sternites, black. Femora black or, less commonly, orange broadly tipped with black. Pronotum usually with a pair of black discal spots, sometimes with a black dot on each side anterior to these. Elytra usually each with a black spot or elongate streak distally (fig. 4B), occasionally immaculate. Elytral

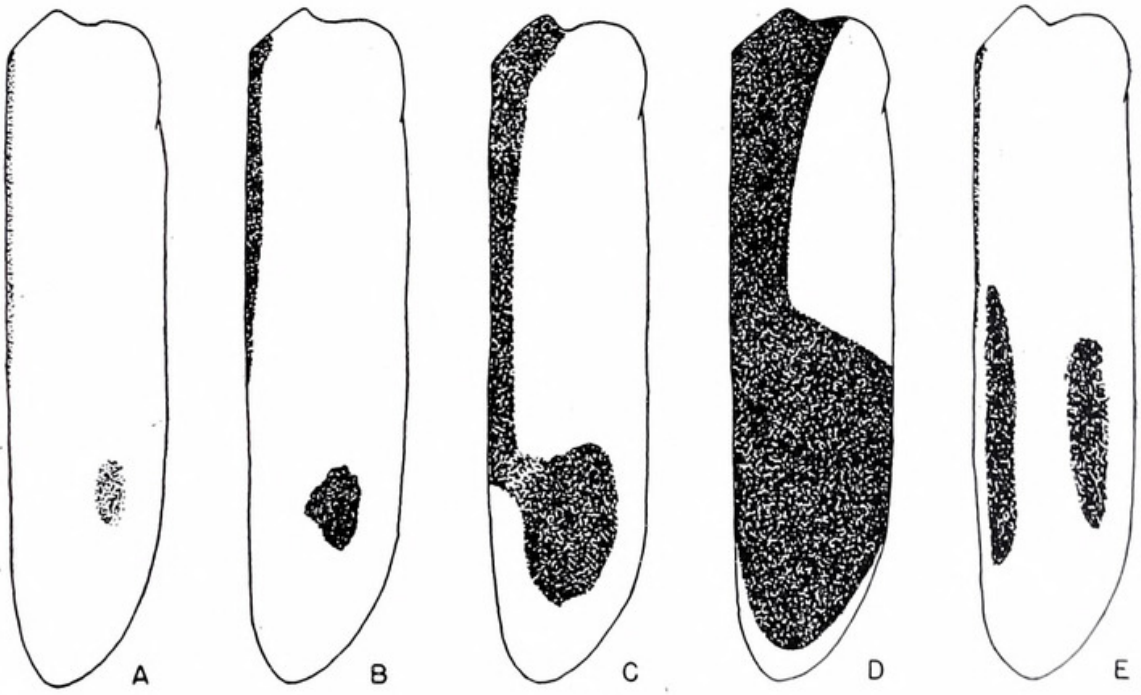


Fig. 4. Variation in the elytral color pattern of *Lytta biguttata*. A. *b. pallens,* Zion National Park, Utah; B. and C. *b. biguttata,* Santa Fe, New Mexico; D. *b. biguttata,* Ciudad Lerdo, Durango (after Champion, 1893, Biol. Centr.-Amer., Col. 4(2), pl. 21, fig. 23); E. *b. bivirgata,* 1 mile east of Villagrán, Guanajuato.

suture usually finely bordered with black for basal half. Antennae and elytral pubescence as in *b. pallens.*

Distribution: Northeastern Montana and central South Dakota through the Great Plains regions of Wyoming, Nebraska, Kansas, Colorado, and northern Texas to extreme southwestern Colorado (Montezuma County) and northern and eastern New Mexico; thence through southwestern Texas (east of Hudspeth County) to southeastern Coahuila and central Durango. See figures 1–2.

Variation and Intergradation: Except at intergradational localities (see below) the head, antennae, and under surface of the

thorax are consistently black in *b. biguttata.* The abdomen and legs show some variety with respect to the extent of dark markings but are more extensively marked than in *b. pallens.*

Variation in the extent and intensity of the elytral markings covers an unusually wide range. From the typical pattern (fig. 4B) the elytra vary imperceptibly to an entirely immaculate extreme which is represented sporadically and at low level throughout the range of the subspecies. In rare instances loss of the elytral spots is accompanied by absence of the sutural borders. Variation in the other direction is almost as continuous and sporadic. The elytral spots vary in form from nearly round to elongate-oval, in some cases becoming quite vittate in appearance. On the basis of a relatively small sample the tendency for elongation of the spots seems to be stronger in northern México than elsewhere within the range of the subspecies. Pronounced enlargement of the spots is accompanied by an increase in extent of the sutural borders of the elytra. In three especially well-marked specimens from Santa Fe, New Mexico, the borders extend to and narrowly fuse with the spots, as in figure 4C. The elytral color pattern of a specimen examined from Ciudad Lerdo, Durango, is similar, but the borders and spots are narrowly separated. The extreme of variation in this direction is represented by a female from Ciudad Lerdo figured by Champion (1893, Biol. Centr.-Amer., Col. 4(2), pl. 21, fig. 23) in which the spots cover all but the apical margin of the distal half of the elytra (fig. 4D).

One of four specimens from Cottonwood, South Dakota, has unicolorous, dark brown elytra. The other specimens are typically colored. It appears to me that the Cottonwood variant represents an anomaly rather than an extreme of normal color pattern variation.

Except possibly with respect to the shape of the elytral spots, color variation in non-intergradational populations of *b. biguttata* seems to show no significant correlation with geographic distribution. As might be expected, some correlation is evident between the extent of the markings on the body and legs and the extent and intensity of the markings on the elytra. This relationship can be expressed only on the basis of averages, however, as the elytral markings vary within wide limits among otherwise identically marked specimens; moreover, in some of the palest specimens the elytra are heavily marked, while in some of the darkest they are immaculate. In some of the more heavily marked specimens the pronotal spots may extend to the basal margin.

A specimen from the Chisos Mountains, Big Bend National

Park, Texas, is exceptional in that the abdomen is largely orange. Although this specimen possibly reflects the influence of intergradation between *b. biguttata* and *b. pallens* to the north, I am more inclined to believe that it represents an extreme of normal color variation. Series of specimens from Cortez, Colorado; Loving, New Mexico; and 11 miles north of Valentine, Texas, although assignable to *b. biguttata* show definite intergradation with *b. pallens* and have been discussed under that subspecies.

Remarks: The type locality of *biguttata* is Santa Fe, New Mexico. *Cantharis alemani* was described by Dugès on the basis of a single female specimen from Ciudad Lerda, Durango. Champion (1892, Biol. Centr.-Amer., Col. 4(2): 440) placed *alemani* as a questionable junior synonym of *quadrimaculata*, but it seems more likely that it was based on a specimen of *biguttata*. The type locality of *alemani* is within the range of the present subspecies. Several specimens of *b. biguttata* studied from the United States fit Dugès' description of *alemani* in all details. Specimens examined: 321.

*Lytta biguttata bivirgata* (Dugès), *new status*

*Cantharis bivirgata* Dugès, 1881, La Naturaleza, 5: 140, pl. 4, fig. 2.

*Cantharis alfredi* Dugès, 1889, An. Mus. Michoacano, 2: 98.

Head, antennae, and under surface, except the last two visible abdominal segments and a small patch at the sides of some of the preceding sternites, black. Femora and tibiae orange, finely tipped with black. Pronotum with a pair of black discal spots and a small black dot on each side anterior to these. Usual distal spot replaced on each elytron by a pair of black, submarginal vittae (fig. 4E). Elytral suture finely bordered with black for basal half. Antennal segments perceptibly more elongate in form than in *b. biguttata* and *b. pallens*. Elytral pubescence short, bristle-like, very sparse.

Distribution: Meseta Central of the states of Guanajuato and México. See figure 2. At present the known range of *b. bivirgata* is isolated from the main range of *biguttata* by a distance of more than 300 miles. Collecting in central México, however, has not been sufficiently intensive to establish if this hiatus in distribution is an actuality in nature. The subspecies *b. bivirgata* undoubtedly has a larger range than shown. Records obtained in 1955, the first in 67 years, more than doubled its known range.

The established southern limits of range of *b. biguttata* correspond roughly with the southern border of the Mapimí Province as defined by Smith (1949, Ann. Assoc. Amer. Geogr., 39: 231. fig. 1) but even more closely parallel Mexican highways 31 and 60 connecting Durango City and Monterrey.

Variation and Intergradation: The description of structural characters is drawn from three specimens which I examined. As far as color pattern is concerned, the description applies to the typical form as described by Dugès on the basis of material from southwestern Guanajuato. Dugès did not mention the lateral orange patches of the abdominal sternites, but these could have been easily overlooked by him. That the extent of color pattern variation in *b. bivirgata* is comparable to that of the other subspecies of *biguttata* is shown by the list of color varieties given by Dugès, but, unfortunately, the relative frequency of neither the typical form nor any of the color varieties was indicated by him.

In Dugès' variety A the vertex of the head, except for a stripe on the midline and a broad border around the eyes, is yellow. Varieties B through F are based on various degrees of development of the pronotal spots. In lightly marked specimens the discal pair, which are typically rather large, are reduced to dots and the antero-lateral dots are absent. In heavily marked individuals the discal spots extend to the posterior margin of the pronotum and exhibit a greater or lesser degree of fusion. All pronotal variation described for *b. bivirgata* is duplicated in *b. biguttata.*

Progressive steps in extension of the elytral markings form the basis for varieties G through J of Dugès. In variety G the vittae of each elytron are wider than in the typical form but still separate; in variety H they contact one another; in variety I they fuse to form a single large spot which reaches the sutural margin; and in variety J the sutural border of each elytron is broadened and fused with the spot. As Champion noted, this last elytral color pattern is the same as that in his heavily marked specimen of *b. biguttata* from Durango.

One of two specimens of *b. bivirgata* studied from 1 mile east of Villagrán, Guanajuato, is typical. In the other specimen the head has the color pattern of Dugès' variety A and there is, in addition, a large pale area on the under surface of the thorax. A single male from 14 miles west of Toluca, México, is typical except that the vittae of each elytron contact each other, corresponding to the condition in Dugès' variety H, and the first and fourth to sixth antennal segments are partially orange.

Although *b. bivirgata* appears to be geographically isolated from