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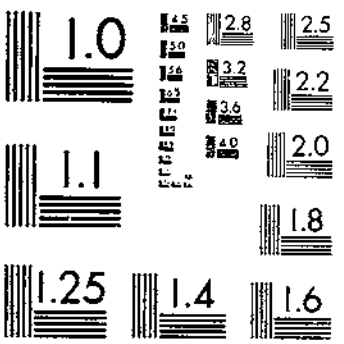

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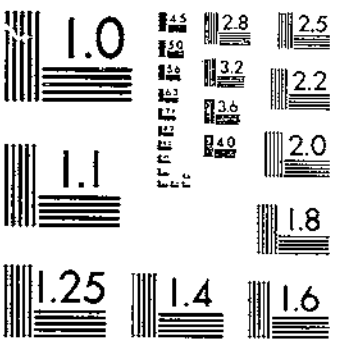

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A Review of LEAFHOPPERS of the GENUS DRAECULACEPHALA

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PREFACE

This review was undertaken in an effort to produce a practical classification for the species of the important and taxonomically difficult genus *Draeculacephala*. The basis of the work is primarily morphological, although the meager biological information available has been taken into account. There is a great need for additional biological work. The recent works of Müller (1954) and Frediani (1954) (see Literature Cited) emphasize the need for experimental evidence regarding the stability of often minor differences used by taxonomists for distinguishing species. The differences distinguishing species of *Draeculacephala* are admittedly slight, and it is frequently difficult to assign populations to logical positions in the species-subspecies-variety hierarchy. The same is true, of course, of many other leafhopper genera.

The taxonomist who is obliged to work with preserved material must evaluate categories to the best of his ability, and within the limitations of his material make the most practical classification possible. The final test of his conclusions rests with field and laboratory observations relating to the behavior of the living insects. Breeding experiments are most desirable to test the validity of synonymizing *D. californica* Davidson and Frazier with *portola* Ball, to test the accuracy of the separation of *producta* (Walker) from *portola*, and to check the authenticity of retaining a wide range of intergrading forms under the last name. Until the results of these and other tests are known, the classification proposed in this paper is intended to serve as an interim instrument for species identification.

All the specific names associated with *Draeculacephala* are accounted for in the checklist at the end of the paper. The head is missing from the type of Walker's specimen of the species *immolata*. Possibly, *immolata* does not belong to *Draeculacephala*, for we know of no species in the genus with pronotal markings like those mentioned in the original description. Until the type can be examined, Provancher's *viridis* must also remain an enigma. The original description is not diagnostic, no type locality was designated, and no species of *Draeculacephala* seems to conform to the color markings of the original description.

The U. S. National Museum has provided most of the specimens used in this study. Additional material was made available by P. J. Christian of the University of Louisville, H. E. Deay of Purdue University, D. M. DeLong of Ohio State University (specimens from his private collection), Henry Dietrich of Cornell University, N. W. Frazier of the University of California, J. N. Knull of Ohio State University, Frank W. Mead of the State Plant Board of Florida, and H. H. Ross of the Illinois State Natural History Survey. Davidson has also examined specimens from the collection of the University of Kansas, the University of Minnesota, and the Carnegie Museum. Sketches and observations of some of the Walker types were generously provided by W. E. China and R. J. Izzard of the British Museum.

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A Review of LEAFHOPPERS of the GENUS DRAECULACEPHALA[1]

By David A. Young, Jr.,[2] *Entomology Research Division, Agricultural Research Service, United States Department of Agriculture,* and Ralph H. Davidson, *Department of Zoology and Entomology, Ohio State University*

The genus *Draeculacephala*, in temperate North America, probably contains more commonly collected species than any other leafhopper genus. One of several species may occur in almost unbelievable numbers, especially in the midwestern United States. Young has seen specimens attracted to lights in the theater district of Louisville, Ky., in such numbers that people preferred to walk in the street rather than through the annoying myriads of leafhoppers. Davidson has seen similar numbers in the evening at a roadside market near Columbus, Ohio. Lawson (*1930*) reported *Draeculacephala mollipes* (Say) to be one of the two most common species of leafhoppers collected in a light trap in Kansas in 1928 and 1929. In 1929, more than 95,000 specimens were taken.

Economically, the genus *Draeculacephala* must be considered of much importance. The species feed primarily on the Gramineae, and huge populations are frequently encountered. Although quantitative studies have not been carried out, it seems reasonably certain that species of *Draeculacephala* cause losses amounting to thousands of dollars annually in the United States by their feeding on plants of the grass family. Osborn (*1912*) estimated that 25 to 50 percent of the growth of grass might be lost to leafhoppers. He considered *Draeculacephala* to be one of the important genera, and listed timothy, bromegrass, and bluegrass as host plants. Gibson (*1916, p. 177*) reported that during 1915 a species was injurious to young corn in Arkansas. In 1915 he had reported finding nymphs and adults in numbers on wheat, barley, oats, burclover, sourclover, Johnson grass, and Wall barley, and adults on several other economic plants. Specimens of *portola* Ball from rice in Cuba have been sent to Young in some numbers. Painter (*1955*) recorded *soluta* Gibson on corn and teosinte in Guatemala.

Some species of *Draeculacephala* are also vectors of plant diseases. Hewitt, Frazier, and Houston (*1942*); Hewitt, Frazier, Jacob, and Freitag (*1942*); and Freitag, Frazier, and Flock (*1952*) have demonstrated that *minerva* Ball, *portola* (as *californica* Davidson & Frazier), *noreboracensis* (Fitch), and *crassicornis* Van D. are able to transmit Pierce's disease virus. Abbott and Ingram (*1942*) have reported *portola* as a vector of chlorotic streak disease of sugarcane. Turner and Pollard (*1955*) reported an unknown species of *Draeculacephala* to be a vector of phony peach disease.

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[1] Homoptera, Cicadellidae.

[2] Resigned May 14, 1957 to become associated with the Department of Entomology, North Carolina State College, Raleigh, N. C.

LIFE HISTORY

Several life-history studies have been carried out, but the confused state of the taxonomy of the genus in the past makes it difficult to conjecture which species were involved. Gibson (*1915*) published a study of the life history of "*Draeculacephala mollipes*" in Arizona, but it seems probable that the species he worked with was *minerva* Ball. He reported overwintering in the adult stage. Osborn and Ball (*1897, p. 614*), also reporting on "*mollipes*", stated that in Iowa overwintering occurred chiefly in the egg stage, although adults and nymphs overwintered also. The real identity of the species involved in their observations is not known, but it was certainly not the one studied by Gibson. Osborn (*1912, p. 56*) reported two generations annually for *noveboracensis*.

PREPARATION OF SPECIMENS

Unfortunately, it is usually impossible to identify species in the genus *Draeculacephala* without making dissections. This has been recognized as true of the males for a number of years. The present study discloses that characters useful in species identification occur in the structure of the ovipositor. Here also the characters are observable only after dissection.

The following procedure has been used for dissection and examination of genital characters. First, the entire abdomen is broken off the specimen and soaked in aqueous potassium hydroxide solution until the abdomen is clear in the males, or until the abdominal contents are loosened in the females. The length of time the abdomen remains in the caustic solution will vary with the concentration of the solution and the temperature. Heating will hasten the maceration process. It is easy to overestimate the time required for maceration in this genus (and in many other genera of the Tettigellinae) because, in spite of their large size, they require less time for maceration than some smaller members of other subfamilies (the Deltocephalinae, for example). Soaking too long softens the genitalia to the degree that they become transparent and their microscopic details hard to observe. This caution applies especially to the females, because a treatment of sufficient duration to clear the abdominal contents will frequently make some details of the second valvulae of the ovipositor almost invisible.

The abdomen is next placed for a few minutes in mildly acidulated water, then moved to a drop of glycerine in the concavity of a hollow-ground slide for observation. The details of the aedeagus and the aedeagal paraphyses of the male can be observed sufficiently for identification without dissection. If dissection is desirable, the conjunctiva at the base of the anal tube is severed, and the anal tube, with the aedeagus and paraphyses attached, is removed as a unit.

The contents of the female abdomen are removed with a pair of minute needles. Next, the conjunctiva at the base of the seventh sternum and also the membrane on each side are severed. Then the dorsal conjunctiva at the base of the pygofer is severed. This frees as a unit the pygofer with the ovipositor and the seventh sternum attached. This unit is now oriented with its apex up, and the membrane of the genital vestibule is pressed against the surface of the

slide and severed, freeing the seventh sternum. The weak membrane connecting the first valvifers to the pygofer is broken next, then the tenuous connections which hold the third valvulae dorsally. The articulation of the second valvifer with the pygofer on each side is now broken. If a needle is thrust transversely between the bases of the second valvulae and the second valvifers, and a slight cephalad pulling force is exerted, the pair of second valvulae, their valvifers, and the attached third valvulae slide free.

In this work it was found that the male genitalia could be studied satisfactorily in the glycerine preparations described above. Both lateral and caudal aspects of the aedeagus must be observed in each specimen—an impossibility if the structures are flattened in a balsam preparation. In order to illustrate the male genitalia they were placed in glycerine in the concavity of a slide and immobilized by attaching them to a small amount of boric acid ointment placed on the slide before the concavity was filled with glycerine. The structure to be illustrated was properly oriented, then one edge of it pressed into the edge of the ointment. For storage, the dissected parts are thrust into the abdominal cavity which serves as a container large enough to be easily seen and manipulated. The abdomen is placed in a small drop of glycerine in the bottom of a small glass vial through the cork of which the pin that bears the specimen is thrust diagonally, so that gravity tends to keep the glycerine away from the cork.

The characters of the second valvulae of the female were observed and illustrated from balsam slide preparations. For identification purposes, however, glycerine preparations are sufficient. The dissections can be stored in the same manner as discussed for the males.

HISTORICAL REVIEW

The genus *Draeculacephala* is a member of the subfamily Tettigellinae, the generic taxonomy of which is in an extremely unsatisfactory state. Ball (*1901*) segregated *Draeculacephala* from the genus *Tettigonia*, which was then—as its substitute *Tettigella* is now—a cumbersome, heterogeneous category of convenience instead of naturally related forms.

Van Duzee (*1915*) revised the North American species of *Draeculacephala*. Ball (*1927*) again revised the genus and placed four of the previously included species in a new segregate, *Carneocephala*. Ball and China (*1933*) published a paper discussing several species of *Draeculacephala*, with notes on Walker's types. Lawson (*1920*), in his work on Kansas Cicadellidae, appears to have been the first to recognize the importance of the male genitalia as diagnostic characters in *Draeculacephala*.

Provancher (*1872, p. 352*) described the North American species *viridis* in the Amyot and Serville genus *Acopsis* (type *A. viridicans* A. & S. from Madagascar). The Provancher name was placed in *Draeculacephala* as early in 1901 by Ball, who cited it as a synonym of *Draeculacephala mollipes* (Say). It was perhaps these two events which led Evans (*1947, p. 161*) to cite *Draeculacephala* as a junior synonym of *Acopsis*, an action followed by Young (*1949, p. 55*) and a few others. Oman (*1949, p. 68*), however, reaffirmed the distinctness of *Draeculacephala* on the basis of an examination of the type of *Acopsis viridicans* A. & S. by Louise M. Russell.

De Long's (*1948*) treatment of the Illinois species is the most comprehensive recent effort to classify species with modern techniques.

GENERIC DESCRIPTION AND GENERIC RELATIONSHIPS

Tettigelline leafhoppers with dorsum not coarsely punctate; head well produced and triangular, antennal ledge[3] angular dorsally, face in profile flat or slightly convex; forewing reticulately veined apically; hind wing with submarginal vein evanescent anteapically; male with sternal basal abdominal apodemes weak, not traversing first conjunctiva behind their origin; male plates elongate-triangular, with macrosetae along lateral margins, apices lobate and weakly sclerotized; male pygofer with distinct setae; connective with apex exceeding style apices; aedeagus with a pair of symmetrical basal processes (*paraphyses*), usually bisinuate, attached to connective and to aedeagal shaft by membrane; aedeagal shaft short, gonopore dorsoapical. Female with second valvula of ovipositor having dorsal teeth almost throughout length, the more basal primary teeth triangular, the more apical ones quadrate, with secondary denticles on the primaries. Color usually pale green, occasionally tan; ground color of crown of head nearly always yellow.

Draeculacephala is closely related to *Carneocephala* Ball and *Helochara* Fitch. From *Carneocephala* it can be separated by the antennal ledge which is angular dorsally, the presence of macrosetae in an irregular longitudinal series along the lateral margin of each male plate, more conspicuous setae on the male pygofer, and the less convex face, in profile. *Carneocephala floridana* (Ball) is somewhat intermediate in the characters of the antennal ledge and the macrosetae. From *Helochara*, *Draeculacephala* can be distinguished by its lack of coarse punctures on the dorsum.

All three of these genera belong to a large complex of genera of Tettigellinae in which the styles, connective, and paraphyses of the male genitalia are as described above for *Draeculacephala*. The Old World *Tettigella viridis* (L.), which is the type of *Tettigella* China and Fennah, the type genus of the Tettigellini, has similar male genitalia, and appears to belong to the same complex of genera.

KEY TO SPECIES AND SUBSPECIES OF DRAECULACEPHALA

1. Males 2
   Females 18

2. (1) Aedeagus with very strong lateral expansions on shaft in ventral aspect (figs. 1*E*, 2*E*, 3*E*) 3
   Aedeagus with shaft oval or suboval in caudoventral aspect, occasionally emarginate apically 5

3. (2) Aedeagus with shaft strongly keeled ventrally (fig. 1*E*); crown of head with a conspicuous median anteapical black marking *angulifera* (Walker), p. 7
   Aedeagus with shaft not strongly keeled ventrally; crown of head with two pairs of lateral dark markings 4

[3] The term "antennal ledge" refers to the area between the eye and the lateral clypeal suture, immediately above the antenna. This ledge has a facial and a dorsal surface. The narrow transition area between these two surfaces may be angular, or rounded.

4. (3) Antennal seta flattened; aedeagal shaft very strongly expanded in caudoventral aspect (fig. 2*E*); antennal ledge with a dorsal black streak in lateral aspect (fig. 2*C*)_____*crassicornis* Van Duzee, p. 8
Antennal seta not flattened; aedeagal shaft much less expanded; antennal ledge in lateral aspect with a pair of dark markings
noveboracensis (Fitch), p. 9

5. (2) Aedeagus with a convex dorsal projection near base of shaft in lateral aspect (figs. 4*F*, *G*; 5*D–F*; 6*E*)_____ 6
Aedeagus with an acutely angular or a quadrate dorsal projection near base of shaft in lateral aspect_____ 10

6. (5) Aedeagal paraphyses straight or nearly so in lateral aspect, not bisinuate (fig. 4*E*)_____*antica* (Walker), p. 11
Aedeagal paraphyses bisinuate in lateral aspect_____ 7

7. (6) Aedeagal shaft narrowly oval in caudoventral aspect (fig. 5*G–J*)
mollipes (Say), p. 12
Aedeagal shaft broadly oval in caudoventral aspect (fig. 6*D*, *F*)_____ 8

8. (7) Scutellum with a pair of basal black spots, one on each side about midway between midline and lateral angles_____ 9
Scutellum without such markings_____ *bradleyi* Van Duzee, p. 16

9. (8) Color of forewings tan, pronotum with a pair of longitudinal dark markings, one behind each eye_____ *septemguttata* (Walker), p. 13
Color of forewings dull green, pronotum without such markings
balli Van Duzee, p. 15

10. (5) Aedeagus with a quadrate projection near base of shaft in lateral aspect (figs. 9*E*, 10*D*)_____ 11
Aedeagus with an angular projection near base of shaft in lateral aspect (fig. 12*D*)_____ 12

11. (10) Aedeagal shaft narrowly oval in caudoventral aspect (fig. 9*F*); crown of head with V-shaped dark markings at apex (fig. 9*A*) (distribution: Florida) _____*pagoda* Ball, p. 17
Aedeagal shaft more broadly oval in caudoventral aspect (figs. 10*E*, *F*), crown of head without V-shaped dark marking at apex (distribution: eastern, southeastern, and north-central United States)
delongi, n. sp., p. 18

12. (10) Head in dorsal aspect more slender and acute, its median length more than two-thirds its transocular width_____*producta* (Walker), p. 19
Head broader and blunter, its median length almost always less than two-thirds its transocular width_____ 13

13. (12) Thoracic pleura without a distinct dark longitudinal line_____ 14
Thoracic pleura with such a line_____ 15

14. (13) Crown of head heavily inscribed with black; scutellum with a pair of black dots on disc before transverse sulcus; aedeagus with apex strongly convex in lateral aspect (fig. 12*D*) (southern United States)
inscripta Van Duzee, p. 20
Crown of head very rarely heavily inscribed with black; scutellum without such dots; aedeagus with apex usually concave in lateral aspect (fig. 13*H*, *I*) (Central and South America)
clypeata Osborn, p. 21

15. (13) Aedeagus narrowly oval (fig. 14*D*); paraphyses in lateral aspect curved dorsad towards their own basal portions_____*soluta* Gibson, p. 23
Aedeagus broadly oval (figs. 15*E*, 16*K*); paraphyses in lateral aspect extending caudad, away from their own basal portions_____ 16

16. (15) Forewing with length of inner apical cell nearly always six-tenths or less the length of claval commissure measured from scutellar apex to claval apex (distribution: western United States, Mexico, and Hawaii)
minerva Ball, p. 24
Forewing with length of inner apical cell nearly always more than six-tenths length of claval commissure measured as above (distribution: most of the United States, Canada, Mexico, Central America, Cuba, and Hawaii)_____ *portola* Ball, p. 17

17. (16) Length usually less than 7.7 mm.; face with ground color suffused with brown or black, at least basally; line of face, in profile, less strongly divergent from line of crown ..... subsp. *portola* Ball, p. 26
Length 7.7 mm. or more; face with ground color pale, not suffused with brown; line of face, in profile, more strongly divergent from line of crown ..... subsp. *paludosa* Ball and China, p. 28

18. (1) Pleural portion of pronotum without dark markings, *or* if present, then not extending completely from anterior to posterior margin 19
Pleural portion of pronotum solid black *or* with a longitudinal dark marking extending from anterior to posterior margin 22

19. (18) Head heavily inscribed with heavy black lines ..... *inscripta* Van Duzee, p. 20
Head with paler markings or spots, not as above 20

20. (19) Clypeus pale with fuscous ares (Nearctic species) 21
Clypeus pale without such ares, *or* black or brown with irregular pale areas (Neotropical species) ..... *clypeata* Osborn, p. 21

21. (20) Seventh sternum with hind margin more strongly produced at middle (fig. 3*F*) ..... *noveboracensis* (Fitch), p. 9
Seventh sternum with hind margin weakly produced at middle (fig. 1*F*) ..... *angulifera* (Walker), p. 7
crassicornis Van Duzee, p. 8

22. (18) Median length of head eight-tenths or more its transocular width 23
Median length of head less than eight-tenths its transocular width 25

23. (22) Length 8.5–9.5 mm ..... *producta* (Walker), p. 19
Length 6.3–7.8 mm 24

24. (23) Scutellum with a pair of black spots 26
Scutellum without a pair of black spots ..... *bradleyi* Van Duzee, p. 16

25. (22) Scutellum with a pair of black spots 26
Scutellum without a pair of black spots 28

26. (24 or 25) Scutellar spots small, equidistant from lateral margins of scutellum and from each other ..... *pagoda* Ball, p. 17
Scutellar spots larger, much closer to lateral scutellar margins than to each other 27

27. (26) Color of forewings tan, pronotum with a pair of longitudinal dark markings, one behind each eye ..... *septemguttata* (Walker), p. 13
Color of forewings dull green; pronotum without such markings. ..... *balli* Van Duzee, p. 15

28. (25) Crown of head with a fuscous median apical suffusion (distribution: Mexico and Central America) ..... *soluta* Gibson, p. 23
Crown of head without a fuscous median apical suffusion, often with anteapical black markings along lateral margins (distribution varied, including Mexico and Central America) 29

29. (28) Ovipositor with length of second valvula usually 2.3 mm. or more 30
Ovipositor with length of second valvula usually less than 2.3 mm 31

30. (29) Size smaller, length usually less than 10.6 mm.; face with ground color suffused with brown or black, at least basally; line of face, in profile, less strongly divergent from line of crown (fig. 16*E*, *G*, *I*). ..... *portola* subsp. *portola* Ball, p. 26
Size larger, length usually 10.6 mm. or more; face with ground color pale, not suffused with brown; line of face, in profile, more strongly divergent from line of crown (fig. 17*D*) ..... *portola* subsp. *paludosa* Ball and China, p. 28

31. (29) Second valvula of ovipositor with ventral margin more convex anteapically, the apex appearing less acute (fig. 15*F*) ..... *minerva* Ball, p. 24
Second valvula of ovipositor with ventral margin concave anteapically, the apex appearing more acute as a result (fig. 10*G*) 32

32. (31) Flattened second valvula of ovipositor with its dorsal margin regularly convex (ignoring irregularities produced by teeth) (fig. 4*K*) *antica* (Walker), p. 11
Flattened second valvula of ovipositor rectilinear or slightly concave in middle half of dorsal margin (fig. 5*K*, *L*) 33

33. (32) Forewing with blue veins ..... *delongi*, n. sp., p. 18
Forewing without blue veins ..... *mollipes* (Say), p. 12

SPECIES DESCRIPTIONS

Draeculacephala angulifera (Walker)

Tettigonia angulifera Walker, List homopt. insects, Brit. Mus., Vol. 3, p. 771. 1851.
Draeculacephala manitobiana Ball, Iowa Acad. Sci. Proc. 8: 70. 1901.
Draeculacephala angulifera Distant, Ann. and Mag. Nat. Hist. (8) 2: 61. 1908.

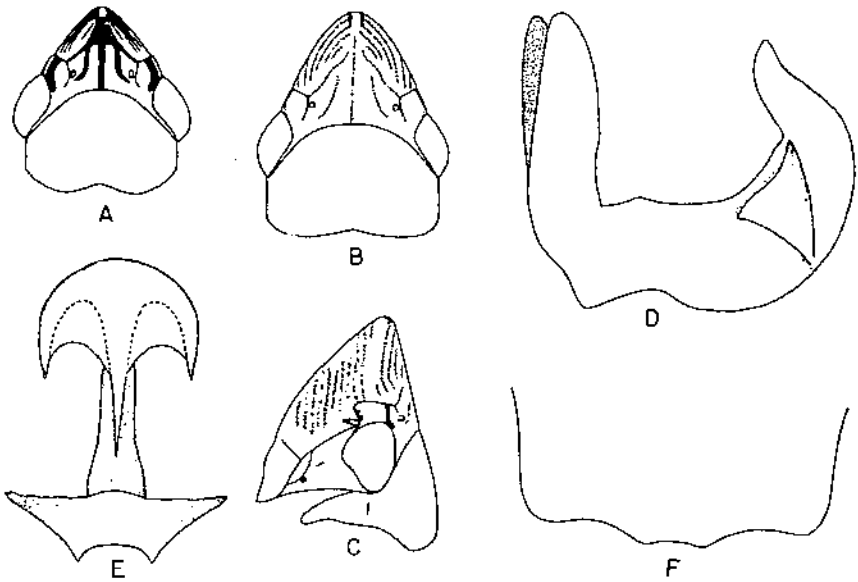

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FIGURE 1.—*Draeculacephala angulifera* (Walker): *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagus, lateral aspect; *E*, same, caudoventral aspect; *F*, seventh abdominal sternum of female.

Length of male 6.6–7.7 mm., of female 7.5–9.0 mm. Crown of head of male with median length from slightly less than three-fourths to eight-tenths interocular width; and one-half, or slightly less, transocular width. Crown of female with length from three-fourths to more than nine-tenths interocular width; and from slightly more than half to six-tenths transocular width. Clypeus regularly but slightly convex; clypellus strongly convex. Face yellow, with transverse brown arcs on clypeus in female. Crown of head with median line from base almost to apex, a pair of oblique lines on each side of disc, several lines along the dorsal portion of the muscle impressions, brown in female, black in male: a pair of small markings, one on each side of apex, and a line along dorsal margin of each antennal ledge dark

brown to black in both sexes. In the male the more median pair of oblique lines on the disc often coalesce anteriorly with the more lateral pair of oblique lines, which in turn coalesce anteriorly with the median dark line in a conspicuous triangular enlargement of the latter. Pronotum and scutellum without dark markings. Forewing dark green with paler green veins. Pleural region without a black line.

Male without a distinct dorsal protuberance on aedeagal shaft, shaft keeled ventrally proximad of a pair of lateral triangular projections, each of which is recurved. Female seventh sternum only slightly produced posteriorly.

Specimens of this species have been examined from areas from Newfoundland to Pennsylvania and westward to Colorado and British Columbia, and from Yukon Territory, and Alaska.

D. angulifera was described from a specimen or specimens from Newfoundland. The identity of this species as presently interpreted rests on the work of Ball and China (*1933, p. 1*). The type material is in the British Museum.

The female lectotype (Oman *1947, p. 179*) of *Draeculacephala manitobiana* Ball, in the U. S. National Museum, has been examined.

D. angulifera is closely related to *crassicornis* from which it can be readily distinguished, in the male, by the genitalia. No reliable characters have been found to separate females of the two species. Although the heads of *angulifera* females tend to be more elongate-triangular, the character is too inconstant to use in a key. Distinguishing characters for *noveboracensis* are discussed below. The only other species of *Draeculacephala* with a crown as heavily inscribed with black in the male is *inscripta*, from which *angulifera* is readily distinguished by its lack of black markings on the pronotum and scutellum. The ranges of the two species do not overlap, *inscripta* occurring in the southern United States.

Ball's 1901 illustrations of *angulifera* were in error, as pointed out by Ball and China in 1933. The species he illustrated is *portola* ssp. *paludosa* Ball and China.

Draeculacephala crassicornis Van Duzee

Draeculacephala crassicornis Van Duzee, Ent. News 26: 181. 1915.

Length of male 6.9–7.8 mm., of female 7.6–8.4 mm. Crown of head of male with proportions as described for *angulifera*. Crown of female with length from slightly less than seven-tenths to more than nine-tenths interocular width; and from slightly less than half to more than six-tenths transocular width. Face in profile not specifically distinct from *angulifera*. Face of both sexes yellow with transverse brown arcs on clypeus, without a ventral black spot on antennal ledge. Crown of male with dark markings as *angulifera*, but less distinct, and not coalescing anteapically as in *angulifera*. Crown of female marked as in *angulifera*. Pronotum and scutellum without dark markings. Forewing dark green to yellowish green with veins paler green to blue.

Male with a distinct dorsal triangular protuberance on shaft near base; apical portion of shaft very strongly expanded laterally on each side. Female seventh sternum not strongly produced posteriorly.

Specimens have been examined from Alaska, British Columbia, Alberta, Manitoba, Washington, Oregon, California, Idaho, Wyoming, Utah, Colorado, and Nebraska.

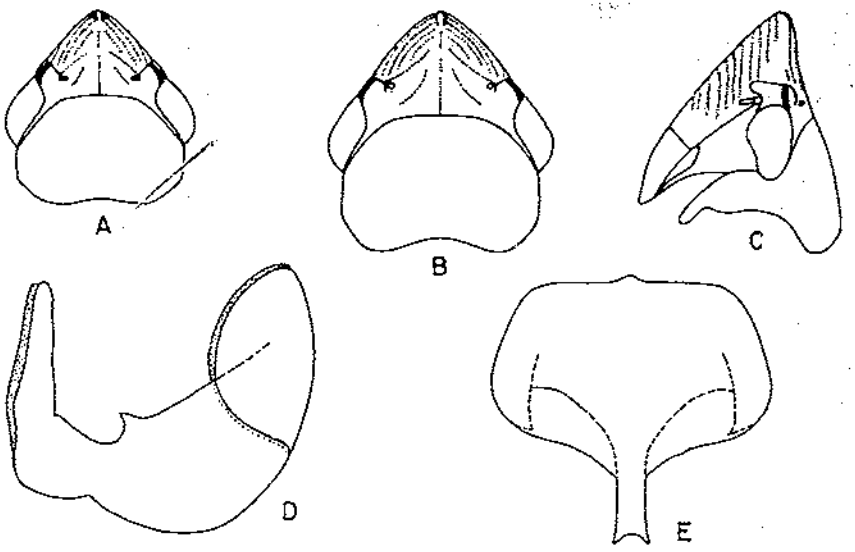

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FIGURE 2.—*Draeculacephala crassicornis* Van Duzee: *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagus, lateral aspect; *E*, aedeagal shaft, caudoventral aspect.

This species is similar in appearance to *noveboracensis* and *angulifera*. From *noveboracensis*, it differs in its lack of a ventral black spot on the antennal ledge in both sexes, in the shape of the aedeagus in the male, and in the less strongly produced hind margin of the seventh sternum in the female. Reliable characters to separate females of *crassicornis* from *angulifera* have not been found.

Draeculacephala noveboracensis (Fitch)

Aulacizes noveboracensis Fitch, N. Y. State Cabinet of Nat. Hist. Ann. Rpt. 4: 56. 1851 (Feb.).

Tettigonia prasina Walker, List. homopt. insects, Brit. Mus., Vol. 3, p. 768. 1851 (Oct.).

Diedrocephala novaeboracensis; Osborn and Ball, Iowa Agr. Expt. Sta. Bul. No. 34, p. 614. 1897.

Draeculacephala novaeboracensis; Ball, Iowa Acad. Sci. Proc. 8: 71. 1901.

Draeculacephala noveboracensis; Osborn, U. S. Dept. Agr., Bur. Ent. Bul. No. 108: 58. 1912.

Length of male 7.0–8.1 mm., of female 7.5–8.7 mm. Crown of head of male with median length from six-tenths to almost eight-tenths interocular width; and from slightly more than one-third to almost one-half transocular width. Crown of female with length from slightly more than two-thirds to almost nine-tenths interocular width; and from slightly more than four-tenths to less than six-tenths transocular width. Clypellus strongly convex in lateral aspect. Face yellow in male, suffused with fuscous and with fuscous transverse arcs on clypeus in female, in both sexes with a conspicuous dark marking on lower portion of antennal ledge, and a similar spot on the dorsal angle, the latter spot visible in dorsal aspect. Crown with a dark spot on each side of apex; markings on disc varied, at most with narrow median line on basal two-thirds and a pair of narrow oblique lines on each side black; usually with fuscous arcs on the dorsal

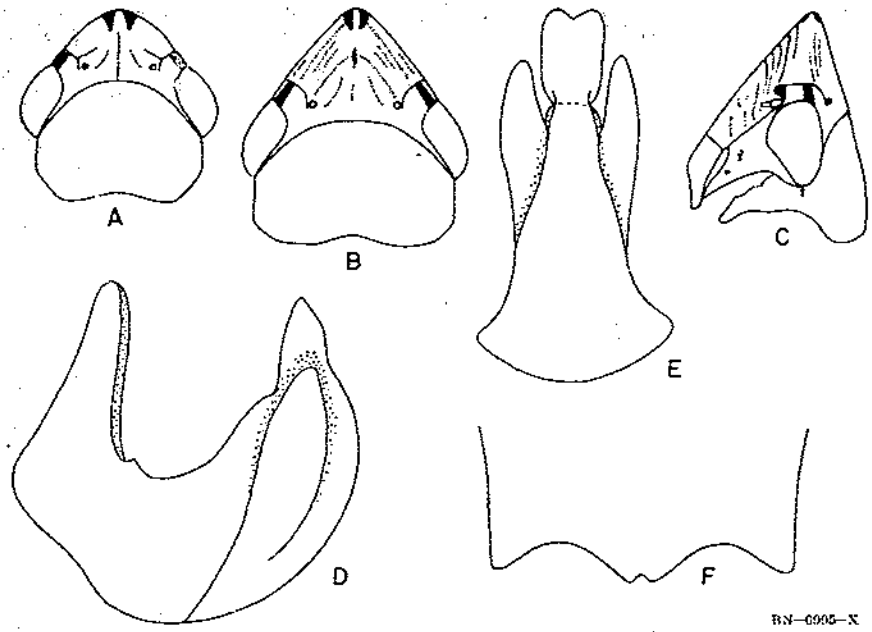

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FIGURE 3.—*Draeculacephala noveboracensis* (Fitch): *A*, Anterior dorsum, male; *B*, same, female: *C*, head and pronotum, female, lateral aspect; *D*, aedeagus, lateral aspect; *E*, same, caudoventral aspect; *F*, seventh abdominal sternum, female.

muscle impressions. Pronotum and scutellum without dark markings. Forewing dark green with paler green veins. Pleural region without a black line.

Male with a weak angular proturberance near base of aedeagal shaft in lateral aspect; shaft with a pair of lateral processes which are not strongly divergent in caudal aspect; apex of shaft slightly expanded.

Specimens have been examined from Maine, Vermont, New Hampshire, New York, Pennsylvania, Minnesota, Illinois, Wisconsin, Iowa, North Dakota, South Dakota, Nebraska, Colorado, Utah, Montana, Idaho, California, Washington, Oregon, Ontario, and British Columbia.

D. noveboracensis was described from a single female from New York. Walker described *prasina* from Hudson Bay. Ball (*1901, p. 71*) synonymized the two names, and Ball and China (*1933, p. 1*) reiterated the suppression of the Walker name, in a joint effort in which China had access to the Walker types. The location of the Fitch type is unknown, and in the opinion of the present writers the identity of the species was fixed by Ball's redescription and illustrations in 1901. There seems to be no likelihood of error in this, for the only other species similar in external appearance is *crassicornis* Van Duzee, which does not occur in eastern North America.

Draeculacephala noveboracensis is easily distinguished from *crassicornis* by the dark markings of the antennal ledges. The markings on each ledge are paired in *noveboracensis*, single in *crassicornis*. The seventh sternum of the female is more strongly produced posteriorly than in either *crassicornis* or *angulifera*.

Osborn and Ball (*1897, p. 614*) reported this species occurring only in sloughs in Iowa, especially on slough grass (*Spartina cynosuroides*). Osborn (*1912, p. 59*) reported two generations annually.

Draeculacephala antica (Walker)

Tettigonia antica Walker, List homopt. insects, Brit. Mus., Vol. 3, p. 771. 1851.
Dracculacephala mollipes; Ball (in part), Iowa Acad. Sci. Proc. 8: 67. 1901.
Dracculacephala mollipes var. *antica;* Ball and China, Kans. Ent. Soc. Jour. 6: 1. 1933.
Draeculacephala antica; DeLong and Caldwell, Check List of Cicadellidae of Amer. North of Mex., p. 10. Columbus, Ohio (State University). 1937.

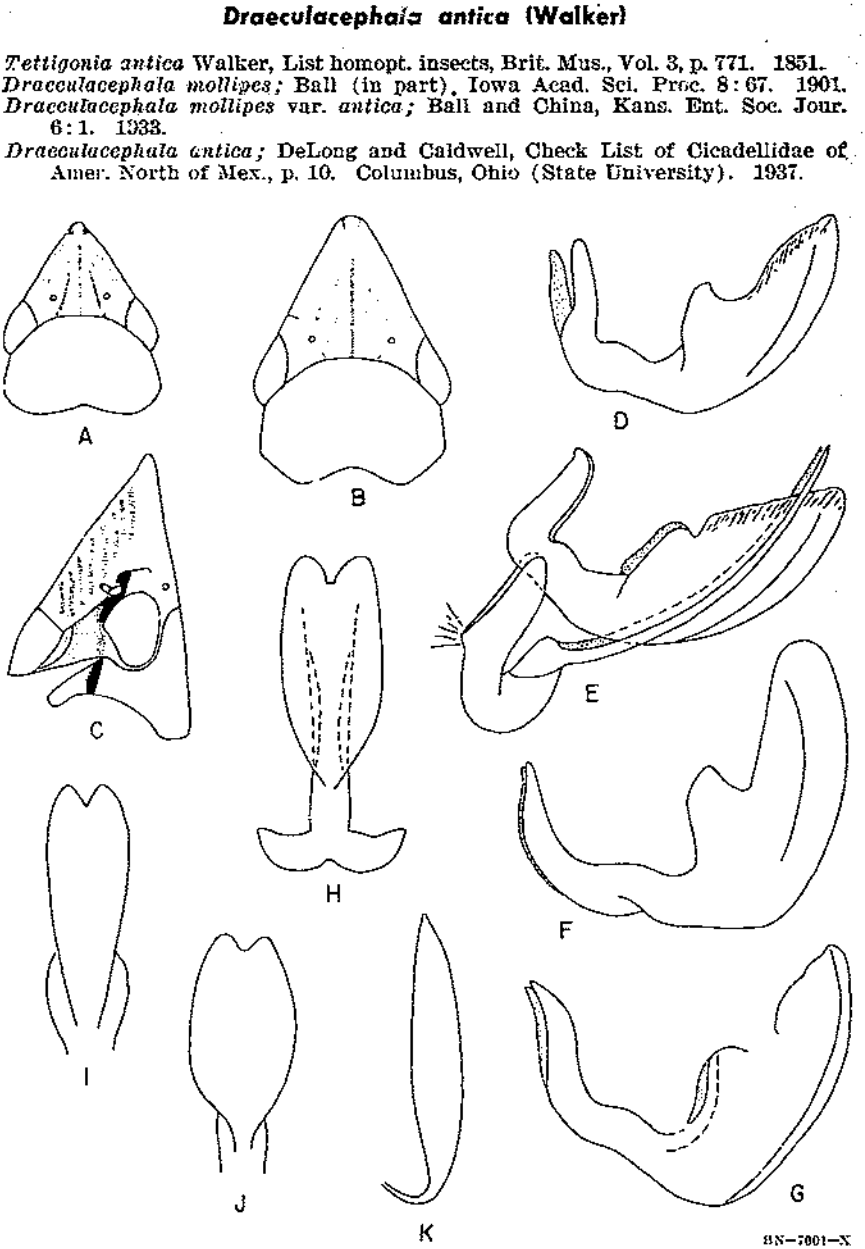

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FIGURE 4.—*Draeculacephala antica* (Walker): *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D* – *G*, aedeagus, lateral aspect, showing individual variations (*E* with paraphyses shown); *H*, aedeagus, caudoventral aspect; *I* – *J*, aedeagal shaft showing individual variation; *K*, outline of flattened second valvula of ovipositor.

Length of male 5.7–7.3 mm., of female 7.5–8.6 mm. Crown of head of male with median length usually slightly greater than interocular width, and one-half to two-thirds transocular width. Clypellus as in *mollipes* (see below). Color very similar to *mollipes;* forewing with veins nearly always yellowish green. Male with dorsal protuberance of aedeagal shaft convex at least dorsally, usually more pronounced than in *mollipes* and tending to be concave along its hind margin (fig. 4*D*, *F*); paraphyses curving gradually posterodorsad throughout length, not bisinuate.

Specimens have been examined from localities in the area from Quebec to Virginia, westward to Colorado, and from Texas and Arizona.

This species is often taken in company with *mollipes*, which it resembles closely in most characteristics. It is most readily distinguished from the latter species by its straight paraphyses, and the form of the convex protuberance of the aedeagal shaft, the protuberance usually appearing tilted caudad in lateral aspect, with its hind margin slightly concave.

The type locality is Trenton Falls, N. Y. Dr. W. E. China kindly compared a male specimen of this species with the male type in the British Museum. His sketch of the internal male genitalia leaves no doubt than *antica* was first correctly identified and illustrated satisfactorily by DeLong (*1948, p. 151*).

Draeculacephala mollipes (Say)

Tettigonia mollipes Say, Acad. Nat. Sci. Phila. Jour. 6 : 312. 1830.
Draeculacephala mollipes; Ball, Iowa Acad. Sci. Proc. 8 : 67. 1901.
Draeculacephala constricta Davidson and DeLong, Ohio Jour. Sci. 43 : 193. 1943, *new synonymy.*
Acopsis constricta; Young, Ky. Acad. Sci. Trans. 13 : 55. 1949.

Length of male 6.2–6.7 mm., of female 7.5–8.0 mm. Crown of head of male with median length subequal to interocular width, and five-eighths to five-ninths transocular width. Clypellus in profile weakly convex. Face slightly darkened near base, paler below; crown with markings weak, at most with median line, a pair of oblique linear markings on each side on disc, a dash on each side of apex, an obscure dark line on antennal ledge and some obscure submarginal markings on dorsal muscle impressions, fuscous. Forewing with veins yellowish green to bluish green; pleural region with a fuscous to black line produced anteriorly to anterior margin of antennal ledge.

Male with aedeagal shaft with dorsal protuberance smoothly convex; shaft narrowly oval in caudoventral aspect; paraphyses strongly bisinuate in lateral aspect.

Specimens of this species have been examined from Quebec to North Carolina westward to Kansas, and southwestward, along the Texas gulf region to Brownsville, Texas.

The Say type has been destroyed.

Say, in his original description, specified that the forewings were green with "nervures paler". Although the chances are excellent that he had a mixed series before him, the characterization of the veins in a description based almost entirely on color, excludes several species with conspicuously blue veins from consideration.

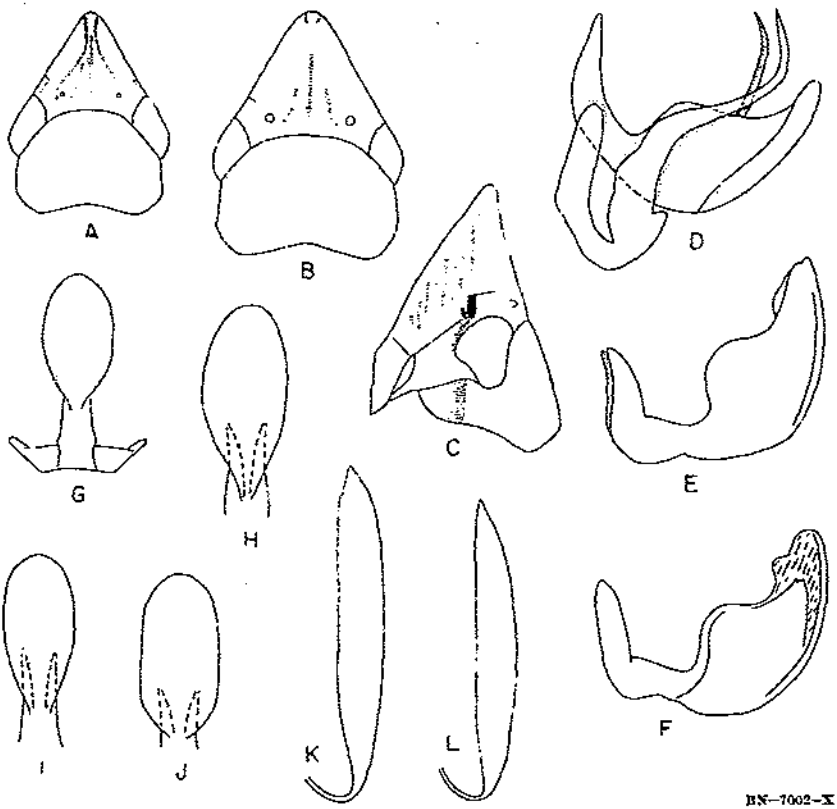

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FIGURE 5.—*Draeculacephala mollipes* (Say): *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagus and paraphyses, lateral aspect; *E* – *F*, aedeagi, lateral aspect, of two specimens showing individual variation; *G* – *J*, aedeagi, caudoventral aspect, showing individual variation; *K* – *L*, second valvula of ovipositor of two specimens.

Ball (*1901, p. 34*) further restricted the possible interpretations of this species in a redescription which conformed with the original description, and in illustrating the anterior dorsum of a male and a female. Lawson (*1920, p. 97*) interpreted the species in a sense compatible with that of Say's and Ball's descriptions, and illustrated the male genitalia in lateral aspect (*plate IX*). At this time, the identity of *mollipes* is considered to have been settled, and Davidson and DeLong's subsequent (*1943, p. 193*) designation of a neotype not in conformity with these older works should be considered invalid.

The holotype of *D. constricta* Davidson and DeLong has been examined.

In general appearance, specimens of *mollipes* resemble those of *antica* and *delongi*, both of which occur in the range of *mollipes*. The key should be consulted for distinguishing characters.

Draeculacephala septemguttata (Walker)

Tettigonia septemguttata Walker, List homopt. insects. Brit. Mus., Vol. 3, p. 773. 1851.

Draeculacephala mollipes var. *septemguttata*; Ball, Iowa Acad. Sci. Proc. 8:68. 1901.

Draeculacephala septemguttata; Distant, Ann. and Mag. Nat. Hist. (8) 2:61. 1908.

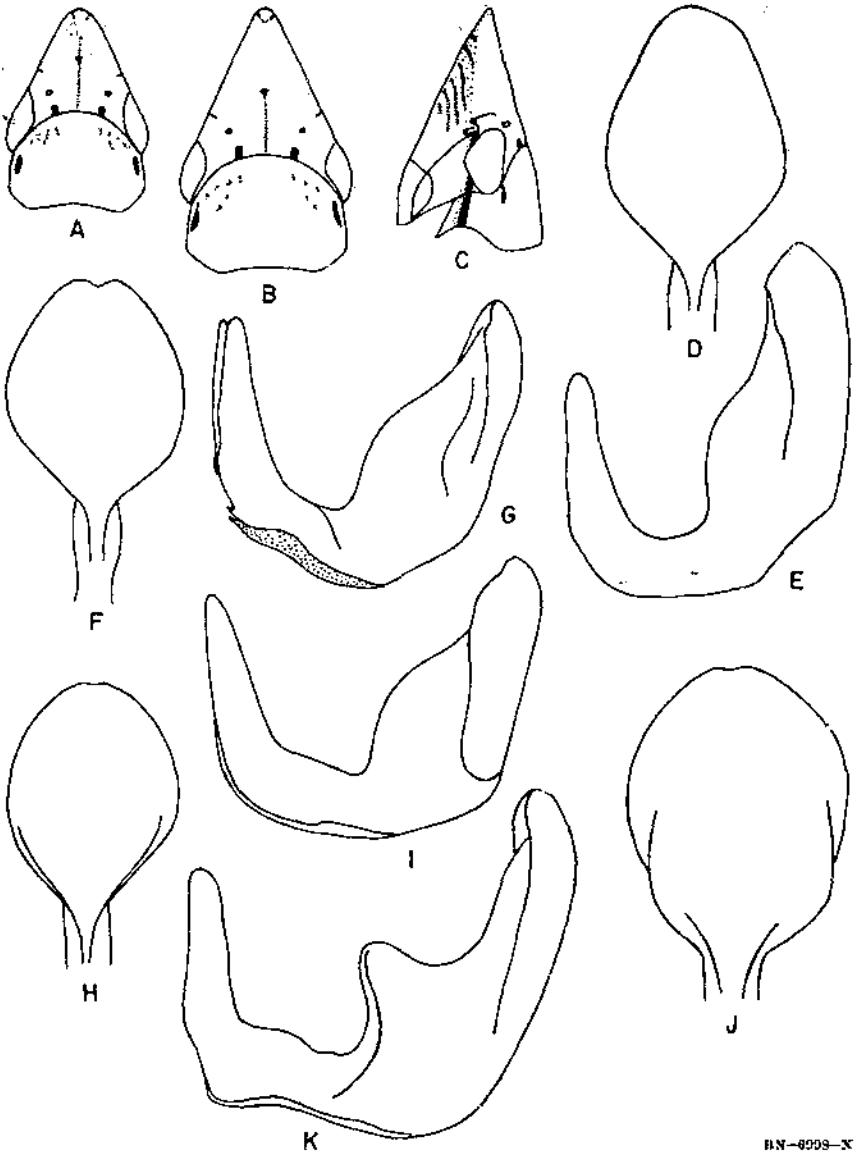

FIGURE 6.—*Draeculacephala septemguttata* (Walker): *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, lateral aspect (same specimen as *B*); *D*, aedeagal shaft, caudoventral aspect; *E*, aedeagus, lateral aspect; aedeagal shaft, caudoventral aspect, and aedeagus, lateral aspect, of specimens from *F* – *G*, Key Largo, Fla.; *H* – *I*, Plant City, Fla.; *J* – *K*, Hilliard, Fla. (*A* – *C* specimen from Key Largo, Fla.; *D* – *E* specimen from Hillsboro Co., Fla.)

Length of male 5.3–6.4 mm., of female 6.3–7.8 mm. Crown of male with length varying from equal to, to one-third greater than, interocular width, and from six-tenths to almost three-fourths transocular width. Crown of female with median length varying from one-fourth to four-tenths greater than interocular width, and from three-

fourths to almost nine-tenths transocular width. Clypellus weakly convex in profile. Color tan; face darker brown near base, paler below, with a few darker transverse arcs on upper portion of clypeus distinct or not; crown markings variable, at least with a median dark dot near middle of disc, a pair of similar dots on basal margin, and a pair of ferruginous-to-black, short marks, one on each side of apex; at most with the median line and suggestions of additional arcs and lines also black. Pronotum with a longitudinal submarginal dash behind each eye brown to black, and occasionally with additional brown or black vermiculations behind anterior margin. Scutellum with a pair of triangular black spots on base midway between median line and lateral basal angles. Forewing with veins dull white; pleural region with a fuscous-to-black line produced anteriorly to anterior margin of antennal ledge.

Male with aedeagal shaft varying from broadly oval to pyriform in ventral aspect; in lateral aspect with basal dorsal protuberance convex, the degree of convexity varying from slight to pronounced; paraphyses usually bisinuate, occasionally nearly straight.

The type is in the British Museum.

Specimens have been examined from southeastern North Carolina to Florida, and from Louisiana and Mississippi. This species is closely related to *balli* (below), and the characters separating the two are weak, except for the color characters mentioned in the key. In southeastern North Carolina at least, the two species occur in the same habitat, and there appears to be no intergradation. Specimens of *septemguttata* tend to be larger, with the crown more produced relative to both the interocular width and the transocular width than in *balli*, although there is some overlapping in each of these characteristics. The form of the aedeagus in lateral aspect is remarkably variable in both species, exhibiting almost every form found in the *mollipes* group. In one form most nearly similar to *antica* in this characteristic, the paraphyses are also almost straight, as in *antica*, but the markings and the form of the aedeagus in ventral aspect are similar to these characters in typical *septemguttata*.

Draeculacephala balli Van Duzee

Draeculacephala balli Van Duzee, Ent. News 26: 179. 1915.

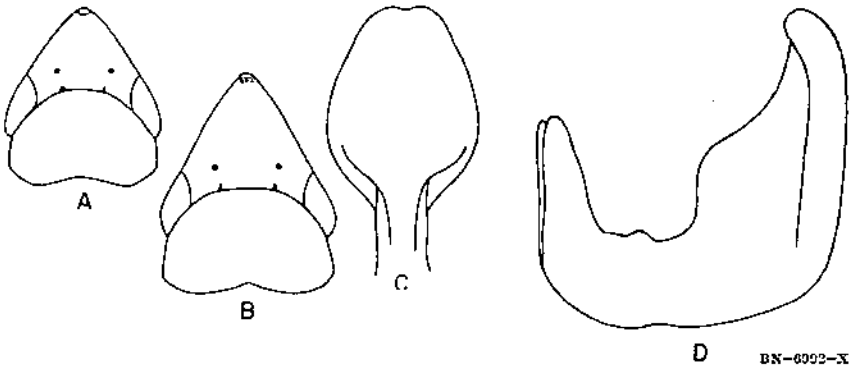

FIGURE 7.—*Draeculacephala balli* Van Duzee: *A*, Anterior dorsum, male; *B*, same, female; *C*, aedeagus, caudoventral aspect; *D*, same, lateral aspect (specimens from Opelousas, La.).

Length of male 4.8–5.5 mm., of female 6.0–6.7 mm. Crown of male with median length about equal to interocular width and from slightly more than half to more than six-tenths transocular width. Crown of female with median length varying from about equal to, to four-tenths greater than, interocular width and from six-tenths to nine-tenths (rarely more than three-fourths) transocular width. Face as in *septemguttata*. Crown dull greenish yellow with median discal and paired basal dark markings as in *septemguttata*. Pronotum without dark markings. Scutellum marked as in *septemguttata*. Forewing dull green with veins paler green; pleural region as in *septemguttata*.

Male genitalia within range of variation described above for *septemguttata*.

Specimens of this species have been examined from Virginia to Florida, westward along the Gulf States to Texas, and from Tennessee to Missouri.

The species is closely related to *septemguttata* in the treatment of which distinguishing characters have been discussed.

Draeculacephala bradleyi Van Duzee

Draeculacephala bradleyi Van Duzee, Ent. News 26: 180. 1915.

Draeculacephala mollipes var. *minor;* Osborn, Ent. Soc. Amer. Ann. 19: 341. 1926.

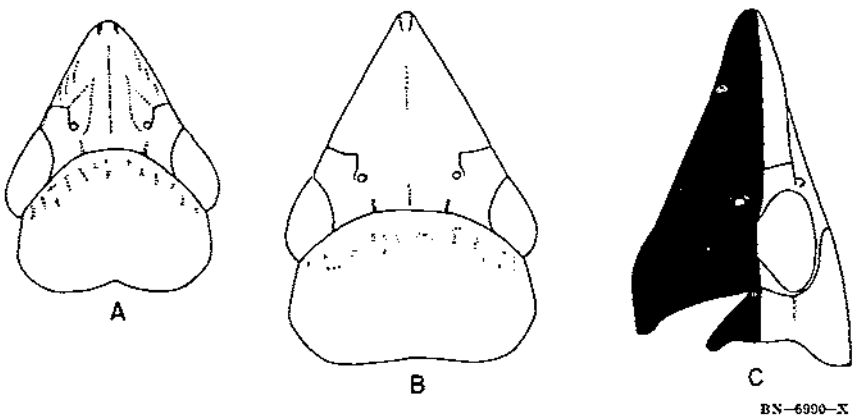

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FIGURE 8.—*Draeculacephala bradleyi* Van Duzee: *A*, Anterior dorsum, male paratype; *B*, same, female type; *C*, head and pronotum, lateral aspect, type.

Length of male 5.1–5.6 mm., of female 6.3–7.0 mm. Male with length of crown of head varying from subequal to, to one-fifth greater than, interocular width, and from six- to seven-tenths transocular width. Female with length of crown from one-fifth to four-tenths greater than interocular width, and from three-fourths to nine-tenths transocular width. Clypellus in profile only weakly convex. Face usually black, slightly paler below in male; crown with markings weak and variable, the midline narrowly, an oblique narrow dash on disc on each side, and a short marking on hind margin on each side, a dash on each side of apex, an obscure line on antennal ledge, often fuscous. Pronotum often with a submarginal row of fuscous vermiculations near anterior margin. Forewings with veins pale green.

Male genitalia within the range of variation illustrated for *septemguttata*.

The type, a female from Billy's Island, Okefenokee Swamp, Georgia, is in the Cornell University collection. It, the allotype, and a series of paratypes have been examined through the kindness of Dr. Henry Dietrich of that institution. Additional specimens have been examined from North Carolina, South Carolina, Georgia, Alabama, Mississippi, localities from northern to southern Florida, Cuba, and the Isle of Pines.

D. bradleyi is very closely related to *septemguttata* from which it can be readily separated by its lack of black spots on the scutellum. In specimens from continental United States, the very black face of females of *bradleyi* will aid in separating it from *septemguttata*.

Draeculacephala pagoda Ball

Draeculacephala pagoda Ball, Fla. Ent. 11 : 37. 1927.

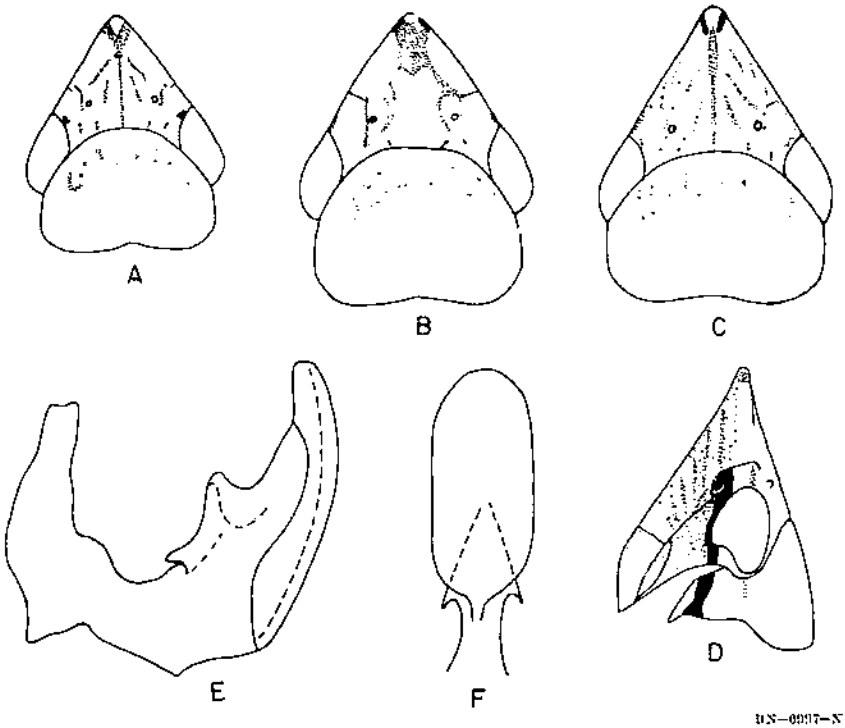

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FIGURE 9.—*Draeculacephala pagoda* Ball: *A*, Anterior dorsum, male; *B*, same, another specimen (slightly larger scale); *C*, same, female; *D*, head and pronotum, lateral aspect; *E*, aedeagus, lateral aspect; *F*, aedeagal shaft, caudoventral aspect.

Length of male 4.8–5.5 mm., of female 5.6–6.8 mm. Head variable in form; crown with median length from slightly less to slightly greater than interocular width, and from slightly more than one-half to six-tenths transocular width. Clypellus in lateral aspect strongly convex. Head with an apical pale spot surrounded with darker mark-

ings; face moderately darkened throughout, clypeus with an indistinct median longitudinal, and short transverse darker markings, the latter not attaining the median marking. Crown with markings variable in intensity, usually with a pronounced subapical median dark marking that gives off a pair of caudolateral arms, each of which branches before its respective ocellus forming an ocellar areole which is open behind; other crown markings variable. Pronotum with weak vermiculate markings in a submarginal band near anterior margin. Forewing greenish blue, sordid green or brown, veins paler but not blue; pleural region with black line as in *mollipes*.

Male aedeagal shaft with dorsal protuberance quadrate in lateral aspect; shaft narrowly oval in caudal aspect; paraphyses strongly bisinuate in lateral aspect.

Specimens of this species have been examined only from Oviedo, Sanford, Gainesville, and Silver Springs, Fla. The holotype male, from Sanford, is in the U. S. National Museum collection.

The form of the aedeagus in this species is close to that found in *delongi*, but *pagoda* can be distinguished from the latter by its darker markings on crown and pronotum, and its lack of blue veins on the forewing.

Draeculacephala delongi, new species

Draeculacephala mollipes; Davidson and DeLong, Ohio Jour. Sci. 43: 193. 1943 (not *mollipes* (Say)).

Length of male 5.5–6.6 mm., of female 6.9–7.9. Crown of head of male with ratio of median length to interocular width approximately as in *mollipes*, and with median length from slightly more than one-half to almost seven-tenths transocular width. Clypellus in lateral aspect strongly convex to slightly protuberant. Head with a pair of anteapical dark spots near apex. Face weakly embrowned dorsally, with dark brown clypeal arcs; clypellus paler; cheeks variously marked with dark brown. Crown with midline from base almost to apex and a pair of oblique lines on disc pale brown, occasionally with additional pale brown weak linear markings on coronal portions of lateral clypeal sulci, and more anteriorly along coronal portions of muscle impressions. Pronotum without vermiculate submarginal markings near anterior margin. Forewing deep green to pale green, almost always with veins contrastingly blue; pleural region with black line as in *mollipes*.

Male with aedeagus as in *pagoda*, but with shaft broader near midlength in caudoventral aspect.

Holotype male and a number of paratypes of both sexes, Washington, D. C., Oct. 2, 1933 (P. W. Oman) in the U. S. National Museum collection (cat. no. 64,086). Other specimens from Ontario and Maine to Florida and westward to Minnesota and Missouri have been examined.

This is the species Davidson and DeLong (*1943, p. 193*) interpreted as *mollipes*, a course not followed here for reasons brought out in the discussion of the latter species, but which has been followed by several authors, including Young (*1949, p. 55*). In the form of the male genitalia, *delongi* is very closely related to *pagoda*, from which it may be distinguished by its lack of a dark-bordered pale areole on the crown apex, its lack of dark submarginal markings on the pronotum, its blue veins in the forewing, and its larger size. Females of *delongi*

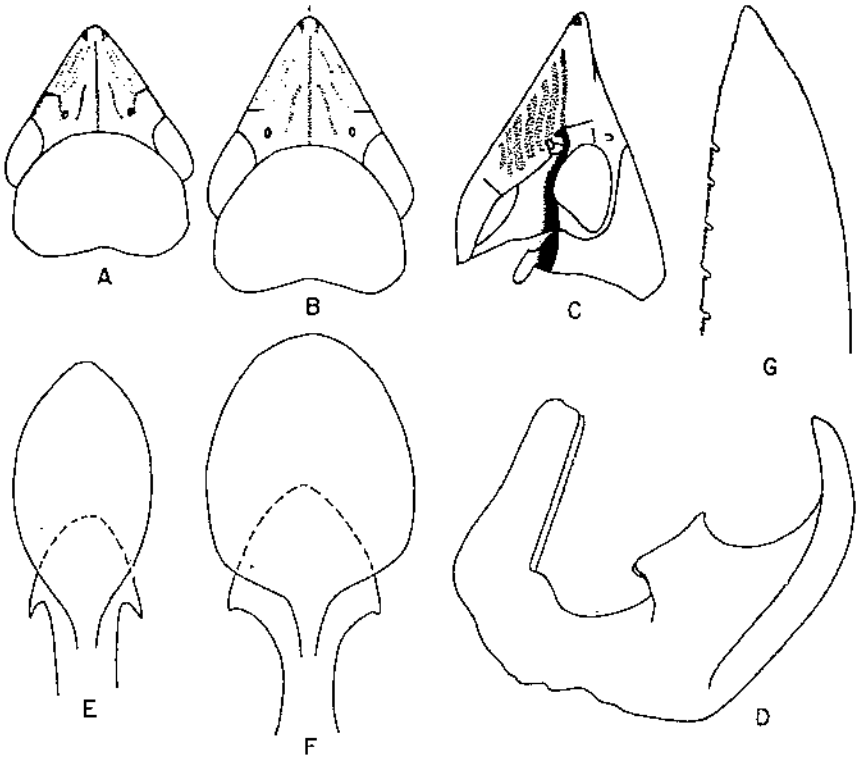

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FIGURE 10.—*Draeculacephala delongi*, new species: *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagus, lateral aspect; *E*, aedeagal shaft, caudoventral aspect (Washington, D. C.); *F*, same (Schuyler Lake, N. Y.); *G*, apex of second valvula, from balsam mount.

are similar in appearance to those of *antica* and *mollipes*, from the former of which they differ in the ovipositor characters set forth in the key. Good morphological characters have not been found to separate females of *delongi* from females of *mollipes*, but the blue of the veins in the forewing of *delongi* is an unusually constant color character.

Draeculacephala producta (Walker)

Tettigonia producta Walker, List homopt. insects, Brit. Mus., Vol. 3, p. 772. 1851.
Tettigonia minor Walker, List homopt. insects, Brit. Mus. Vol. 3, p. 772, 1851.
Tettigonia acuta Walker, List homopt. insects, Brit. Mus. Vol. 3, p. 773, 1851.
Draeculacephala producta; Ball, Iowa Acad. Sci. Proc. 8:68. 1901.

Length of male 6.0–7.1 mm.; female 8.5–9.5 mm. Crown of head of male with median length varying from one-eighth greater to more than one-fifth greater than interocular width, median length from slightly more than two-thirds to almost three-fourths transocular width; female crown with median length from slightly less than one-third to more than four-tenths interocular width, and more than eight-tenths transocular width. Clypellus in lateral aspect from

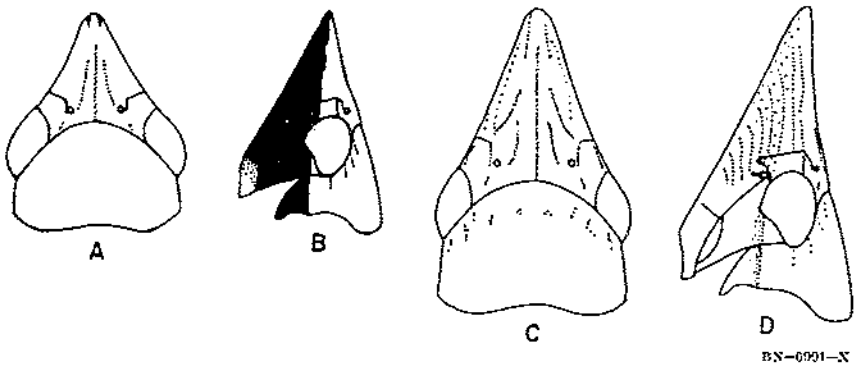

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FIGURE 11.—*Draeculacephala producta* (Walker): *A*, Anterior dorsum, male; *B*, head and pronotum, male, lateral aspect; *C*, anterior dorsum, female; *D*, head and pronotum, female, lateral aspect.

slightly to strongly convex. Forewing with base of clavus distinctly punctate; length of inner apical cell of male varying from 0.56–0.62 length of commissural margin from scutellar apex to claval apex, 0.53–0.59 in female. Face of male strongly darkened in its upper portion, brown or black with transverse arcs obscured; face of female from slightly to heavily darkened, with transverse arcs of clypeus distinct. Crown, pronotum, and forewings marked as in *portola* (see below). Pleural region of thorax black or pale with a brown or black stripe.

Male genitalia as in *portola*.

The type, from St. John's Bluff in Florida, is in the British Museum. A number of specimens, including *bradleyi*, *portola*, and the species under discussion, were compared with the Walker types of *producta*, *minor*, and *acuta*. The male of the present species agreed particularly well with the type of *minor*. A male compared with the type of *producta* and a female compared with the type of *acuta* yielded differences small enough to appear within the range of individual variation of the present species.

This species occurs from northern Florida to the Florida Keys. It is not readily confused with other species except *portola* to which it is very closely related and with which it is often found. There is a need for study of these two species in the field to establish whether or not they are reproductively distinct. The keys contain the best distinguishing characters found, but the characters are weak.

Draeculacephala inscripta Van Duzee

Draeculacephala inscripta Van Duzee, Ent. News 26:180. 1915.

Length of male 5.4–6.3 mm., of female 7.7–8.3 mm. Head with median length of crown from seven- to eight-tenths interocular width in both sexes, and from slightly more than four-tenths to slightly more than one-half transocular width. Clypellus of male slightly, of female strongly, convex. Forewing appearing granulose at base of clavus, with length of inner apical cell from six-tenths to slightly more than seven-tenths length of commissural margin from scutellar to claval apex. Face pale, clypeus with transverse arcs and a median line dark brown to black. Crown yellow with markings

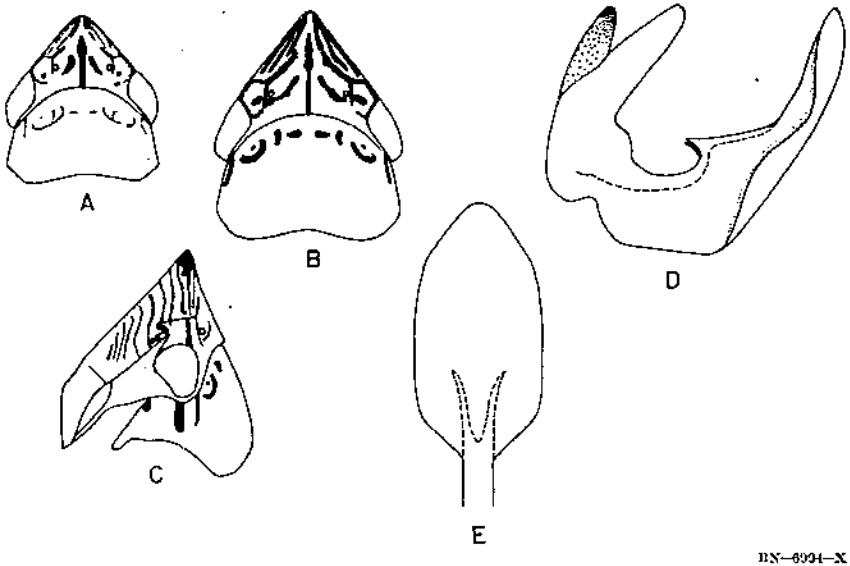

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FIGURE 12.—*Draeculacephala inscripta* Van Duzee: *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagus, lateral aspect; *E*, aedeagal shaft, caudoventral aspect.

pronounced, somewhat variable in male; female with median line almost to apex, a pair of oblique lines on each side on disc, a pair of spots one anteromesad of each eye, a line along edge of antennal ledge which curves caudomesad along inner eye margin on each side of crown, the coronal portion of the lateral clypeal sulci, and oblique lines on the crescentiform areas of muscle impressions, black, the last tending to converge anteriorly to form a black spot. Pronotum with irregular black markings in submarginal region near anterior margin. Forewing deep green to pale green with yellowish green veins; thoracic pleural region without a longitudinal black line.

Male aedeagal shaft with dorsal protuberance triangular in lateral aspect; shaft narrowly oval in caudal aspect, the sides parallel except at base and apex; paraphyses very weakly bisinuate in lateral aspect.

Specimens have been examined from Maryland, Virginia, Georgia, Florida, Ohio, Illinois, Tennessee, Mississippi, Arkansas, and Louisiana. The type locality is Okefenokee Swamp, Georgia.

The triangular protuberance on the aedeagal shaft in lateral aspect is similar to that of *minerva* and *portola*, from both of which *inscripta* can be easily separated by the lack of a dark pleural stripe, and by the shape of the aedeagal shaft in caudal aspect.

Draeculacephala clypeata Osborn

Tettigonia mollipes; Fowler (in part), Hemipt.-Homopt., Biol. Cent. Amer., Vol. 2, p. 273, pl. 18. 1900, (not *mollipes* (Say)).
Draeculacephala mollipes; Osborn, Ohio Nat. 9: 463. 1909.
Draeculacephala mollipes var. *minor;* Osborn, *loc. cit.*
Draeculacephala clypeata Osborn, Carnegie Museum Ann. 16: 236. 1926.
Draeculacephala lenticula Ball, Fla. Ent. 11: 38. 1927, *new synonymy.*

Length of male 4.8–7.0 mm., of female 6.8–8.5 mm. Head variable in form, especially in male; crown with median length from two-thirds

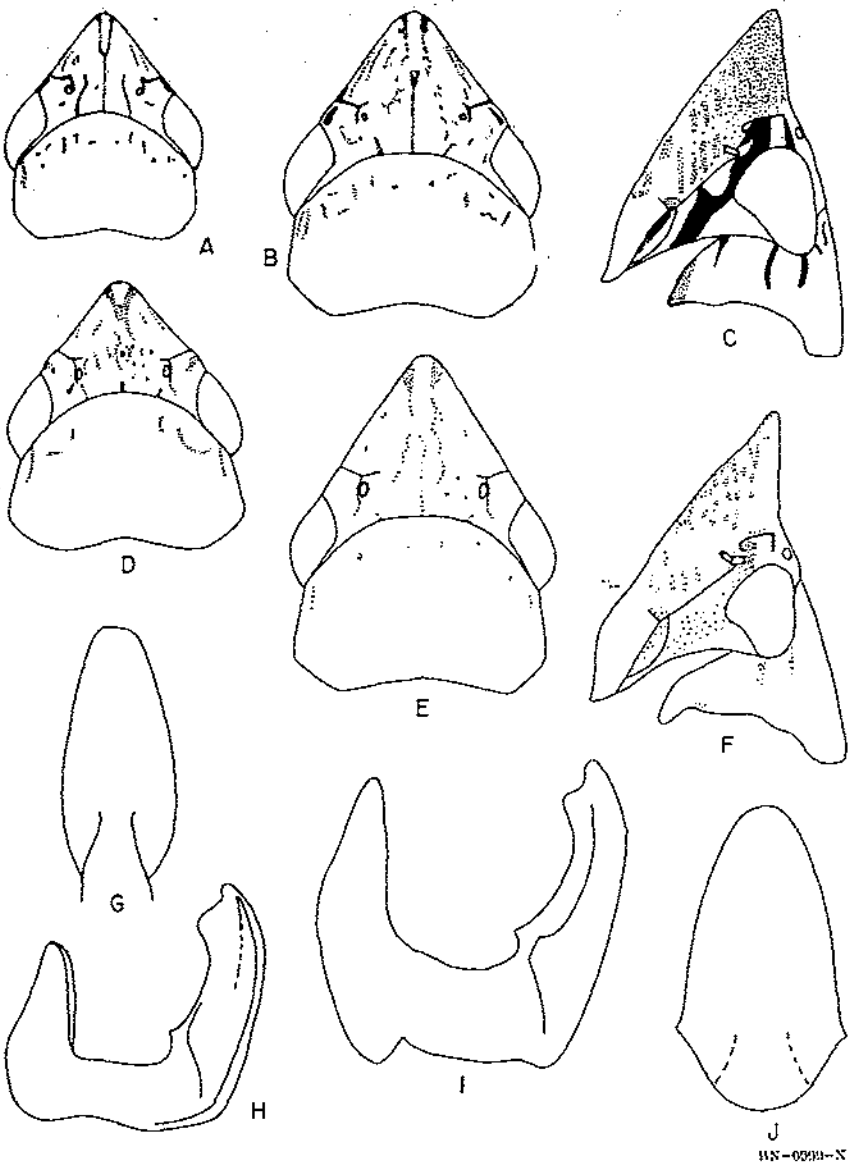

FIGURE 13.—*Draeculacephala clypeata* Osborn: *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, anterior dorsum, male; *E*, same, female; *F*, head and pronotum, lateral aspect, female; *G*, aedeagal shaft, caudoventral aspect (Alvarado, Mex.); *H*, aedeagus, lateral aspect, same specimen; *I*, aedeagus, lateral aspect (Volcan, Chiriqui, Panama); *J*, aedeagal shaft, caudoventral aspect, same specimen as *I*. (*A–C* from Alvarado, Mex.; *D* from Volcan, Chiriqui, Panama; *E–F* from Juan Diaz, Panama.)

to nine-tenths interocular width in male, usually almost equal to interocular width in female, median length from slightly less to slightly more than half transocular width in male, more than six-tenths transocular width in female. Clypellus in lateral aspect broadly

convex. Crown with an apical lenticular pale spot margined with brown or black; disc variously marked, usually irregularly marked with brown or black dots, male rarely marked as in *inscripta;* face with clypellus pale to sordid yellow, rarely darkened medially; clypeus varying from completely pale and concolorous with clypellus, to fairly heavily and irregularly marked with brown or black, and with irregular pale areas; genae with or without dark markings. Pronotum often with weak vermiculate markings in a submarginal band near anterior margin. Forewings variable, from tan to green, most often deep green, with veins paler but not blue; pleural region marked as in *inscripta.*

Aedeagal shaft with dorsal protuberance as in *inscripta;* shaft in caudal aspect narrowly oval to oval with base broadened and occasionally with a small angular projection on each side; apex usually concave in lateral aspect, but occasionally truncate, rarely convex.

Specimens have been examined from a number of localities, from central Mexico to Colombia and British Guiana. The identity of this species, as interpreted here, rests on specimens compared by Davidson with the holotype female in the Carnegie Museum. The type of *D. lenticula* Ball is in the U. S. National Museum collection.

This apparently is the commonest neotropical species. It is related to *inscripta* Ball, but is readily distinguished from the latter by its lack of black spots on the scutellum.

The specimens illustrated by Fowler (*1909, pl. 18*) as *Tettigonia mollipes* could be either *clypeata* or *soluta* Gibson.

Specimens reported from Guatemala as *mollipes* and *mollipes* var. *minor* by Osborn in 1909 have been examined through the kindness of Dr. J. N. Knull of Ohio State University.

Draeculacephala soluta Gibson

Tettigonia mollipes; Fowler (in part), Hemipt.-Homopt., Biol. Cent. Amer. Vol. 2, p. 273, pl. 18, 1900, (not *mollipes* (Say)).
Draeculacephala soluta Gibson, Biol. Soc. Wash. Proc. 32: 25. 1919.

Length of male 5.6–6.3 mm., of female 7.0–7.7 mm. Crown of head with median length approximately equal to interocular width in male; slightly greater than interocular width in female; median length from slightly more than half to almost two-thirds transocular width in male, from two-thirds to three-fourths transocular width in female. Clypellus in lateral aspect broadly and slightly convex. Head with an apical pale spot surrounded with darker markings; face with clypeus brown or black except near transclypeal suture, occasionally with paler ares; genae brown or black. Crown of head with an anteapical fuscous area along midline, usually divided at apex leaving pale areole described above; posterior margin of crown with a triangular brown spot on each side midway between midline and inner eye margin; midline infuscated in basal two-thirds in male, occasionally concolorous with remainder of disc in female. Pronotum occasionally with weak vermiculate markings in a submarginal band near anterior margin. Forewing usually deep green with paler greenish-yellow veins; pleural region with a black line as in *mollipes.*

Male with aedeagus much as *clypeata* Osborn; paraphyses in lateral aspect short, curved to a position such that their apices are not greatly separated from the dorsal portion of their basal arms (fig. 14, F).

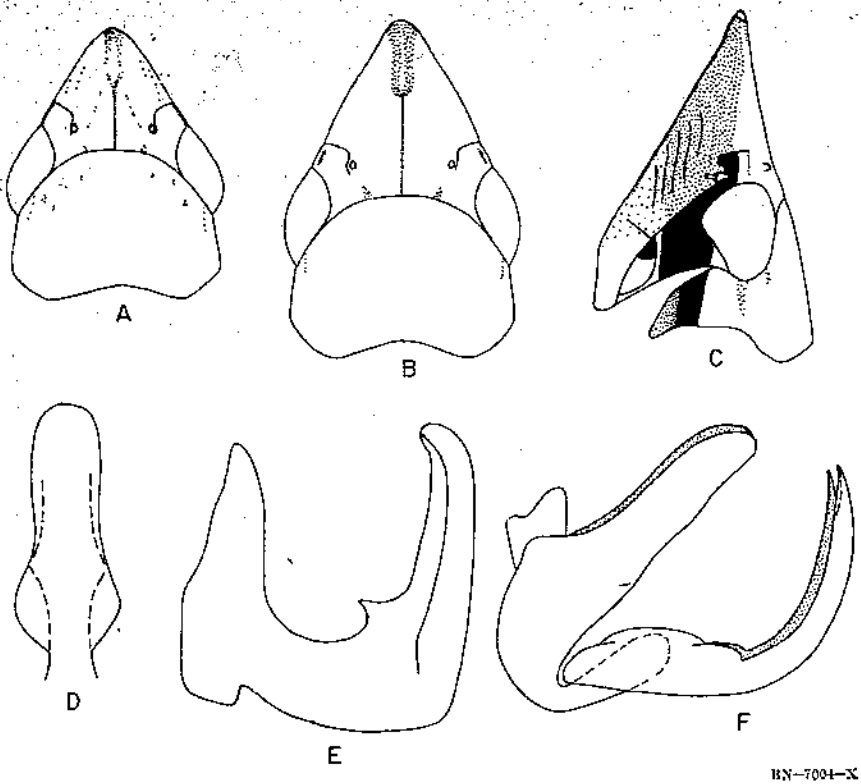

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FIGURE 14.—*Draeculacephala soluta* Gibson: *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagal shaft, caudoventral aspect; *E*, aedeagus, lateral aspect; *F*, paraphyses, lateral aspect. (*A* from the type.)

Specimens of this species have been examined from southern Mexico, Guatemala, Honduras, El Salvador, Costa Rica, and Panama. The holotype, a male from Tegucigalpa, Honduras, in the U. S. National Museum collection, has been examined. The specimen illustrated by Fowler (*1900, pl. 18*) as *mollipes* is probably either *soluta* or *clypeata* Osborn.

As pointed out in the introduction, Painter (*1955, p. 48*) reported this species from corn and teosinte in Guatemala.

Draeculacephala minerva Ball

Draeculacephala mollipes var. *minor;* Ball (in part), Iowa Acad. Sci. Proc. 8: 69. 1901.
Draeculacephala minerva Ball, Fla. Ent. 11: 36. 1927.
Draeculacephala mollipes; Gibson, U. S. Dept. Agr. Bul. No. 254: 1–16. 1915.

Length of male 5.2–6.5 mm., of female 6.0–7.8 mm. Head of male with median length of crown varying from equal to interocular width to three-fourths interocular width; median length less than two-thirds transocular width; female with median length of crown varying from slightly more than interocular width to eight-tenths interocular width, and nearly always less than two-thirds transocular width. Clypellus

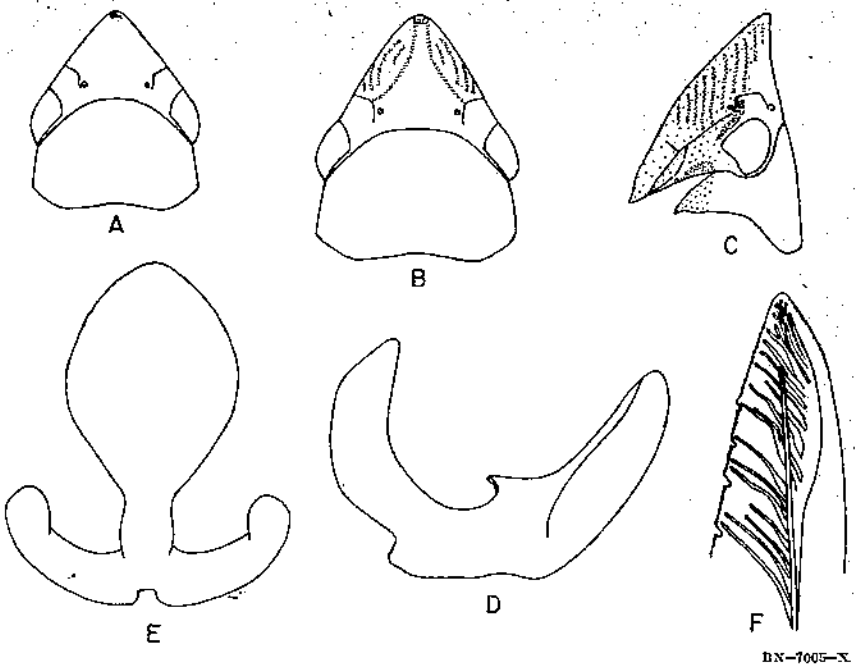

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FIGURE 15.—*Draeculacephala minerva* Ball: *A*, Anterior dorsum, male; *B*, same, female; *C*, head and pronotum, female, lateral aspect; *D*, aedeagus, lateral aspect; *E*, same, caudoventral aspect; *F*, apex of second valvula of ovipositor. (*A*, *D*, *E* from allotype; *B*, *C* from holotype.)

slightly convex in lateral aspect. Forewing of female with length of inner apical cell one-half or less length of claval commissure measured from scutellar apex to claval apex; in male nearly always six-tenths or less. Face of male in green-winged forms from almost completely jet-black to black with paler spots or areas in clypellar region; face of female and of tan-winged males pale brown with transverse arcs darker brown. Crown with ground color stramineous, dull yellow, yellow suffused with green, or tan, occasionally unmarked, usually faintly marked as in *portola*. Pronotum usually unmarked, occasionally with pale brown vermiculate submarginal markings near anterior margin. Forewing varying from deep green, with veins concolorous or paler yellowish green, to tan, with the veins concolorous; pleural region of thorax with a brown or black line always present.

Male aedeagal shaft with dorsal protuberance triangular in lateral aspect; shaft oval in caudal aspect; paraphyses bisinuate in lateral aspect.

Female seventh sternum with posterolateral lobes fairly strong, hind margin more nearly transverse than in *portola*.

Specimens have been examined from northern California, southern Utah, southern Nevada, and Brownsville, Tex., south to the Panama Canal Zone. There is a single specimen (possibly mislabeled) in the U. S. National Museum from Quincy, Fla. The holotype, a female from Stanford, Calif., is in the U. S. National Museum collection.

This species, like *portola*, appears to have been introduced and become established in Hawaii.

As pointed out in the introduction, there is a good possibility that Gibson's (*1915*) biological studies of "*Draeculacephala mollipes* (Say)" conducted in Arizona are referable to *D. minerva* Ball. He reported on the life history of the species in some detail. His remarks on the brown variety are the basis for this questionable synonymy, for brown specimens of *minerva* are common in collections. His habitus drawings of the adult (sex not stated), taken from one of Osborn's papers, probably apply to a species other than *minerva*.

Draeculacephala portola Ball

Tettigonia mollipes; Fowler (in part), Hemipt.-Homopt., Biol. Cent. Amer. Vol. 2, p. 273. 1900.
Draeculacephala angulifera: Ball (in part), Iowa Acad. Sci. Proc. 8: 69. 1901.
Draeculacephala mollipes; Osborn, Ent. Soc. Amer. Ann. 19: 341. 1926.
Draeculacephala portola Ball. Fla. Ent. 11: 35. 1927.
Draeculacephala paludosa Ball and China, Kans. Ent. Soc. Jour. 6: 3. 1933.
Draeculacephala cubana Metcalf and Bruner, Puerto Rico Univ. Jour. Agr. 20: 926. 1936 (*new synonymy*).
Draeculacephala producta; DeLong, Ill. Nat. Hist. Surv. Bul. 24 (2): 148. 1948.
Draeculacephala californica Davidson and Frazier, Ohio Jour. Sci. 49: 127. 1949 (*new synonymy*).
Acopsis producta; Young, Ky. Acad. Sci. Trans. 13: 55. 1949.
Draeculacephala producta: Beirne, Canad. Ent. 88 (sup. 2): 35. 1956.

Length of male 6.5–8.7 mm., of female 7.0–11.4 mm. Crown of head of male with median length varying from slightly greater than interocular width to eight-tenths interocular width; median length less than two-thirds transocular width; female with median length of crown varying from slightly less to slightly greater than interocular width, and less than eight-tenths transocular width. Clypellus in lateral aspect from slightly to strongly convex. Forewing appearing granulose at base of clavus, with length of inner apical cell nearly always two-thirds or more length of commissural margin measured from scutellar apex to claval apex. Face with darker transverse area on ground color varying from completely pale yellowish to heavily suffused with brown or black, with the clypellus paler. Crown with markings variable in intensity, with median line except at apex, a pair of convergent oblique lines on each side of disc, a pair of marks at apex, and lines along muscle impressions, dark. Pronotum nearly always without dark markings. Forewing varying from deep green to pale yellowish green, veins from green to pale blue. Pleural region of thorax with a black line always indicated, although not always distinct anteriorly.

Male with aedeagal shaft with dorsal protuberance triangular in lateral aspect; shaft pyriform in caudal aspect, the length of the broadened portion from eight-tenths to slightly greater than the width, occasionally nearly oval in form, but broadly so; paraphyses bisinuate in lateral aspect.

Female seventh abdominal sternum with posterolateral lobes weak, the hind margin more oblique on each side of the mesal lobe than in *minerva*.

Draeculacephala portola subspecies portola Ball

(See species heading for literature reference.)

Length of male 6.5–7.9 mm.; of female 7.0–10.8 (type) mm. Face with ground color of upper portion nearly always darkened at least

slightly, occasionally (allotype) almost black. Apex of head, in lateral aspect, sharper (fig. 16 *E*, *G*, *I*) than in ssp. *paludosa*.

D. portola, in a strict sense, is the commonest *Draeculacephala* in eastern and central United States, and the form most often collected.

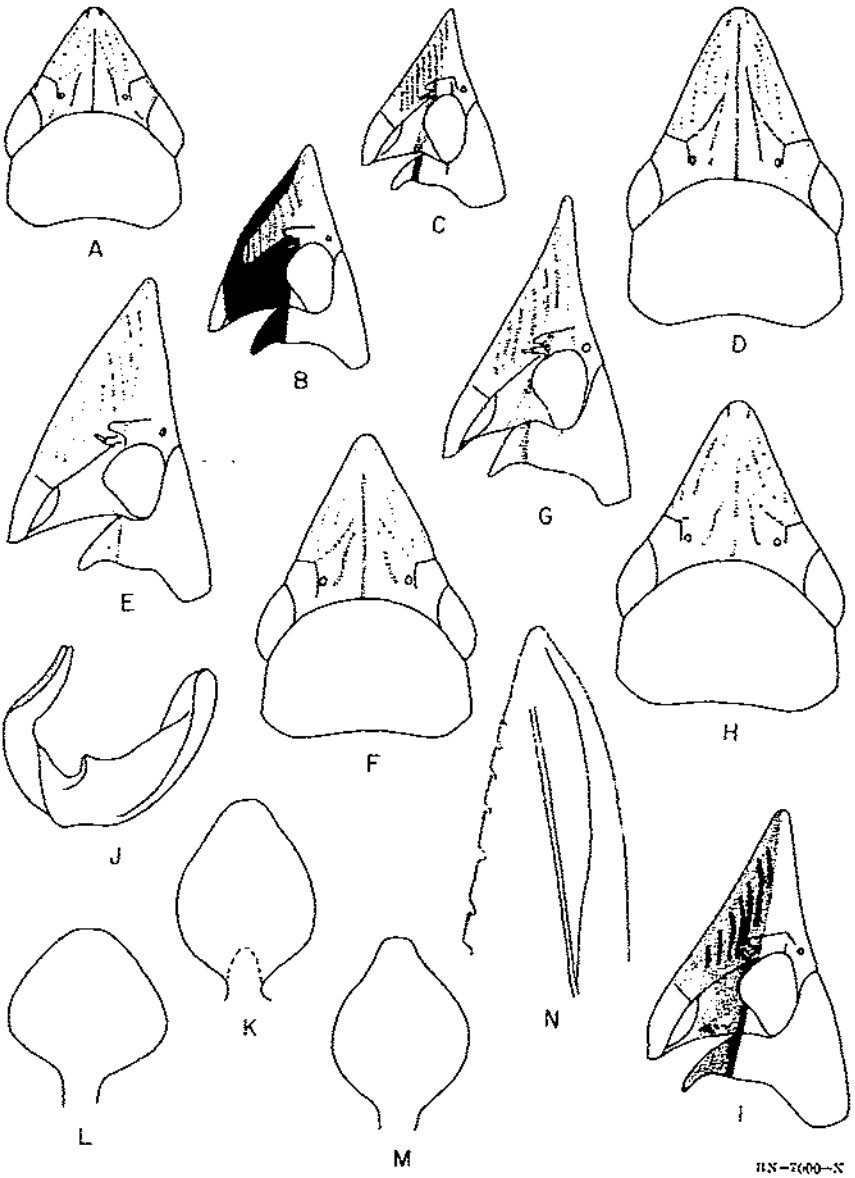

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FIGURE 16.—*Draeculacephala portola* Ball (s.s.); *A*, Anterior dorsum, male (allotype); *B*, head and pronotum, male, lateral aspect (allotype); *C*, same (Sebring, Fla.); *D*, anterior dorsum, female (holotype); *E*, head and pronotum, female, lateral aspect (holotype); *F*–*G*, female (Brownsville, Tex.); *H*–*I*, female (Pittsfield, Ill.); *J*, aedeagus, lateral aspect; *K*–*M*, aedeagal shaft, caudoventral aspect, showing individual variations; *N*, apex of second valvula of ovipositor, canals not shown. (*J*, *K* from allotype; *L* from Gainesville, Tex.; *M* from Riverton, N. J.; *N* from Sanford, Fla.)

Collections examined indicate that it has a continuous distribution from Ontario to southern Florida, westward to Texas. In addition, specimens have been examined from a few localities in California, from the Mexican States of Vera Cruz, Oaxaca, Guerrero, and Tamaulipas, from Honduras, and from Cuba. Several nymphal instars have been taken in early January in Sanford, Fla. The subspecies has also been introduced to Hawaii and has become established there.

The subspecies is very closely related to *minerva*, from which it can usually be separated by the ratio of the length of the inner apical cell of the forewing to the length of the claval commissure, measured from the scutellar apex to the claval apex of the forewings in repose, the character used in the key. The forewing character works satisfactorily in the greater part of the ranges of *portola* (*s.s.*) and *minerva*, but has been found weak in the case of some specimens from the Brownsville, Tex., region, and in some of the male paratypes of *californica* Davidson and Frazier. The close resemblance of "*californica*" to *minerva* led Frazier to attempt to breed the two. It would be extremely interesting to know whether or not the results of the breeding experiments would have been similar if specimens of *portola* from the North-Central States had been used to attempt a cross with the California specimens. But the failure of the breeding experiments presents the most important reason for retaining *minerva* as a separate species, instead of treating it as a subspecies of *portola*, a rational action in view of the character breakdown mentioned above, and the almost identical male genitalia in the two forms.

D. p. portola is greatly variable, and it seems very possible that biological work may eventually reveal that several entities are included under the taxon as we interpret it. The form Metcalf and Bruner described as *cubana* includes specimens with striking blue veins and a face as pale as in subspecies *paludosa*. Such specimens are found in Florida as well as in Cuba, but a number of intergrading forms have been found in Florida, and the Metcalf and Bruner name has been synonymized for that reason. In Cuba, this blue-veined form occurs in numbers in rice fields. The contour of the face in profile, and its color are quite variable.

Abbott and Ingram (*1942, pp. 99, 100*) have presented fairly convincing evidence that chlorotic streak, a disease of sugarcane, is transmitted by this subspecies.

The holotype, a female from Jacksonville, Fla., is the largest specimen examined, and the allotype is the darkest faced male. The holotype is in the U. S. National Museum.

Draeculacephala portola subspecies *paludosa* Ball and China

(See species headings for literature reference.)

Length of male 7.7–8.7 mm.; of female 10.6 (holotype)–11.4 mm. Face with ground color of upper portion not at all darkened. Apex of head blunter (fig. 17*D*) than in ssp. *portola*.

In the male allotype, from Ames, Iowa, and in one specimen from Iowa County, Iowa, the aedeagus in caudoventral aspect is more convex in its apical half, the whole shaft appearing more oval (fig. 17, *F*) than in typical *portola*, but this is a fine distinction and needs to be confirmed in additional series, not available at present.

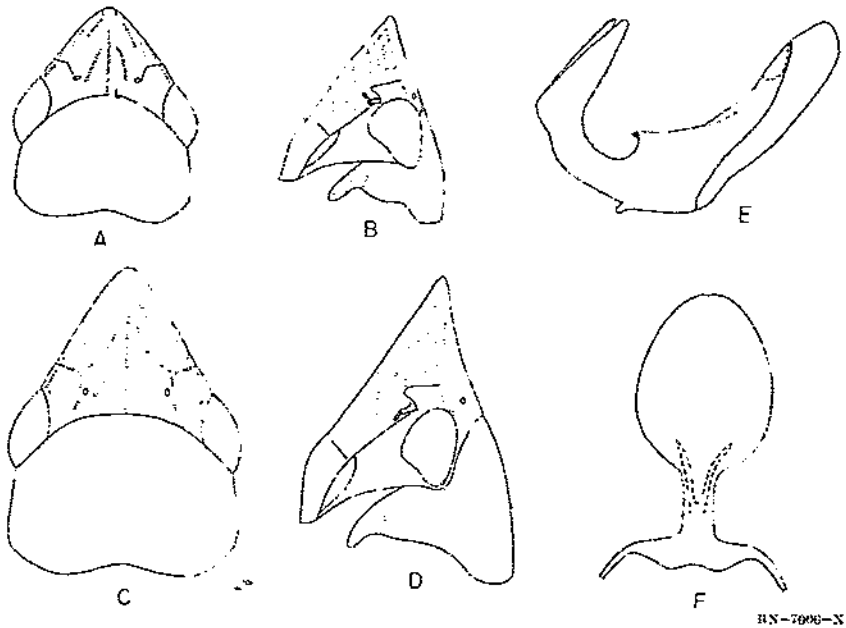

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FIGURE 17.—*Draeculacephala portola* ssp. *paludosa* Ball and China: *A*, Anterior dorsum, male allotype; *B*, same specimen, head and pronotum, lateral aspect; *C*, anterior dorsum, female type; *D*, same specimen, head and pronotum, lateral aspect; *E*, aedeagus, lateral aspect; *F*, same, caudoventral aspect.

Ball and China described this form from specimens collected from rushes at the edge of a swamp in Ames, Iowa. Specimens have been examined only from Iowa County, Iowa, three localities in Minnesota, and from Buda, Ill. DeLong (*1948, p. 149*) states that *paludosa*, which he treats as a variety of *portola*, is widely distributed from the east coast to the west coast on river bulrush. Yet, he lists only one record for Illinois. Judging from its scarcity in collections seen by the authors, the subspecies is fairly rare. It is given subspecific rank here because it is assumed that some degree of ecological isolation exists between it and the typical subspecies.

The type is in the U. S. National Museum, and was illustrated by Ball (as *angulifera*) in 1901.

CHECKLIST OF SPECIFIC NAMES OF DRAECULACEPHALA [4]

acuta (Walker), 1851: 773=producta
angulifera (Walker), 1851: 771
    manitobiana Ball
antica (Walker), 1851: 771
balli Van Duzee, 1915: 179
bradleyi Van Duzee, 1915: 180
californica Davidson and Frazier, 1949: 127=portola
clypeata Osborn, 1926: 236
    lenticula Ball

[4] We have included all of the specific names known to have been associated with the generic name in past publications.

constricta Davidson and DeLong, 1943: 193=mollipes
crassicornis Van Duzee, 1915: 181
cubana Metcalf and Bruner, 1927: 926=portola
delongi Young and Davidson
floridana Ball, 1901: 72 in *Carneocephala*
gillettei Ball, 1901: 72 in *Carneocephala*
innotata (Walker) [Tettigonia], 1851: 770 *species inquirenda*
inscripta Van Duzee, 1915: 180
lenticula Ball, 1927: 38=clypeata
manitobiana Ball, 1901: 70=angulifera
minerva Ball, 1927: 36
minor (Walker), 1851: 772=producta
mollipes (Say), 1830: 312
    constricta (Davidson and DeLong)
noveboracensis (Fitch), 1851: 56
    prasina (Walker)
pagoda Ball, 1927: 37
paludosa Ball and China, 1933: 3=portola
portola Ball, 1927: 35
    paludosa Ball and China
    cubana Metcalf and Bruner
    californica Davidson and Frazier
prasina (Walker), 1851: 768=noveboracensis
producta (Walker), 1851: 772
    minor (Walker)
    acuta (Walker)
reticulata (Signoret), 1854: 22 in *Carneocephala*
septemguttata (Walker), 1851: 773
soluta Gibson, 1919: 25
viridis (Provancher) [Acopsis], 1872: 352 *species inquirenda*

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