

SMITHSONIAN MISCELLANEOUS COLLECTIONS

VOLUME 95 NUMBER 7

THE GOLD-BANDED SKIPPER (RHABDOIDES CELLUS)

(WITH EIGHT PLATES)

BY

AUSTIN H. CLARK

U. S. National Museum

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CITY OF WASHINGTON
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EARLY STAGES OF RHABDOIDES CELLUS

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PREFACE

Early in the spring of 1934 while walking through the woods east of Great Falls, Md., Mrs. Leila F. Clark and I came upon a small glade at the base of a rather steep hill where a small stream broadened into a marshy spot. The abundance here of trailing arbutus (*Epigaea*

repens) and of hepatica (*Hepatica americana*) indicated that this region had, at least for the most part, escaped the numerous fires that have ravaged these woods in the past, and suggested that it might offer something of interest in its fauna and flora.

Revisiting the locality on May 30, we were somewhat surprised to find a gold-banded skipper (*Rhabdoides cellus*), a rare butterfly in this region. On June 3 we caught seven. Evidently the butterfly was common enough here to make the working out of its life history a comparatively simple task. So we undertook an intensive study of the insect and were fortunate enough to secure abundant material of all stages.

As no general account of this interesting butterfly has heretofore been published, it has seemed to us worth while to preface the record of our personal observations with the references to previous notices of the species, a list of the localities from which it is known, and a brief history. This appeared to us especially desirable for the reason that the gold-banded skipper is an excellent example of a butterfly with its normal habitat in the highlands of Mexico and Southern Arizona and a secondary habitat, in which it appears to have an uncertain and precarious foothold, in the more or less mountainous country near the eastern seaboard from southern New York to Florida.

In our study of this species we have been greatly aided by Capt. N. D. Riley, Keeper of Entomology in the British Museum (Natural History), who was so very kind as to send us a list of all the specimens from north of Mexico in the collections under his care; by Dr. William J. Gerhard, who generously sent us a list of the specimens in the Strecker and Snyder collections in the Field Museum of Natural History, Chicago; by Ernest L. Bell, of Flushing, Long Island, N. Y., who was so good as to supply us with a list of the specimens in his collection, and also of those that he had given to the American Museum of Natural History, New York; by Edward S. Thomas of the Ohio State Museum, at Columbus, who most courteously sent us the records (hitherto unpublished) from Ohio; by Prof. Franklin Sherman, Head of the Department of Entomology and Zoology at the Clemson Agricultural College, who kindly sent us the records (unpublished) from South Carolina; by Dr. Hugo Kahl, of the Carnegie Museum, at Pittsburgh, Pa., who courteously permitted us to examine the specimens in the William H. Edwards collection; and by Prof. Ellison A. Smyth, Jr., formerly Head of the Department of Biology at the Virginia Polytechnic Institute at Blacksburg, Va. (now retired and living at Salem, Va.), who was so very good as to send us his notes on this species.

We are under special obligations to the late Foster H. Benjamin and to Dr. William Schaus, of the Bureau of Entomology and Plant Quarantine, who permitted us to study the material under their care, and in addition aided us in every possible way.

To Dr. John A. Comstock, Associate Director of the Los Angeles Museum, and to Commander Charles M. Dammers, of Riverside, Calif., we are indebted for their courtesy in answering our inquiries regarding the possible occurrence of this butterfly in California.

During a visit to St. Louis Dr. Edwin P. Meiners told us of a specimen that had been captured in that State, and later was so very kind as to send us complete information in regard to it.

RHABDOIDES CELLUS (Boisduval and Le Conte)

Plates 1-3, figs. 1-16

Eudamus cellus BOISDUVAL and LE CONTE, Histoire générale et iconographie des lépidoptères et des chenilles de l'Amérique septentrionale, pl. 73. Paris, 1833 (colored figures of both surfaces of imago, pupa, and larva on leaf of *Breweria aquatica*).—HERRICH-SCHÄFFER, Corresp.-Blatt zool.-mineralog. Ver. Regensburg, 19 Jahrg., no. 12, p. 180, no. 73, 1865 (diagnosis).—SCUDDER, A systematic revision of some of the American butterflies, with brief notes on those known to occur in Essex County, Mass., p. 62, 1872 (has not been able to examine or determine this species); also in Rep. Peabody Acad. Sci., 1871, p. 83, 1872 (same).—W. H. EDWARDS, Report upon geographical and geological explorations and surveys west of the One Hundredth Meridian, in charge of First Lt. Geo. M. Wheeler, vol. 5, Zoology, chap. 8, p. 794, 1875 (in list of Lepidoptera collected in 1871-1874 in Calif., Nev., Utah, Colo., N. Mex., and Ariz.).—W. H. EDWARDS, Catalogue of the diurnal Lepidoptera of America north of Mexico, Trans. Amer. Ent. Soc., vol. 6, p. 58, no. 495, 1877 (Southern States; W. Va., Ky.; Ariz.).—SPEYER, in Lintner, Systematic arrangement of the European and some American Hesperidae, Ent. Contr., no. 4, 12, p. 72, 1878 (listed).—STRECKER, Butterflies and moths of North America, p. 162, no. 341, Reading, Pa., 1878 (Va. southward to the Gulf of Mexico).—GLOVER, in unpublished notes, pl. B, fig. 25 (larva and pupa; from Boisduval and Le Conte); pl. F, fig. 13 (imago, both surfaces; from the same).—PUBLICATION COMMITTEE, Brooklyn Entomological Society, Check list of North American Macro-Lepidoptera, p. 5, no. 566, Brooklyn, N. Y., 1881; also published in Bull. Brooklyn Ent. Soc., vol. 4, p. 5, no. 566, October 1881 (listed).—PLÖTZ, Ent. Zeit., Stettin, Jahrg. 43, nos. 1-3, p. 95, Januar-März 1882 (synonym of *festus* Hübner).—W. H. EDWARDS, Papilio, vol. 3, no. 1, p. 10, January 1883 (Ariz.; vicinity of Fort Grant, Cochise Co., or on Graham Mountain).—W. H. EDWARDS, Revised catalogue of the diurnal Lepidoptera of America north of Mexico, 1884; also published in Trans. Amer. Ent. Soc., vol. 11, p. 320, November 1884 (listed; *festus* Hübner a synonym; W. Va. to Gulf of Mexico; Tex.; Ariz.).—W. H. EDWARDS, List of species of the diurnal Lepidoptera of America north of Mexico, Butterflies of North America,

vol. 2, no. 596, 1884 (listed).—FRENCH, Butterflies of the eastern United States, pp. 371-372, no. 194, 1886 (description; W. Va. to the Gulf of Mexico; Tex.; Ariz.).—W. H. EDWARDS, Butterflies of North America, 3d ser., pt. 5, *Debis* 1, 5th page of text, 1888 (occurrence near Coalburgh, W. Va.).—HENRY EDWARDS, U. S. Nat. Mus. Bull. 35, p. 37, 1889 (early stages; from Boisduval and Le Conte).—SMITH, Catalogue of insects found in New Jersey, in Cook, Final Rep. State Geologist, Geol. Surv. New Jersey, vol. 2, pt. 2, p. 279, 1890 (taken rarely by the Newark collectors).—SKINNER, Ent. News, vol. 2, no. 1, suppl. p. iv, January 1891 (listed in exchange list of butterflies of America north of Mexico).—SKINNER, in Smith, List of Lepidoptera of Boreal America, p. 17, no. 624, Philadelphia, 1891 (listed).—MAYNARD, Manual of North American Butterflies, p. 209, no. 596, Boston, 1891 ("yellow-banded brown-wing"; description; W. Va. to the Gulf of Mexico; Tex.; Ariz.).—BEUTENMÜLLER, Bull. Amer. Mus. Nat. Hist., vol. 5, p. 304, 1893 (description; description of larva and pupa, abridged from Scudder, after Abbot's figures; food plants Convolvulaceae; vicinity of Newark, N. J., after Smith); pl. 5, fig. 18.—WHITE, Ent. News, vol. 5, no. 6, p. 175, June 1894 (Prospect Park, Brooklyn, N. Y.; 1893).—SMYTH, Ent. News, vol. 6, no. 8, p. 244, October 1895 (Montgomery Co., Va.).—OSBURN, Ent. News, vol. 6, no. 9, p. 283, November 1895 (Nashville, Tenn.; rare; one specimen, August; food plant unknown).—FRENCH, Butterflies of the eastern United States, p. 371, no. 194, 1896 (from 1886 edition).—SKINNER, A synonymic catalogue of the North American Rhopalocera, p. 97, no. 629, Philadelphia, Dec. 15, 1898 (W. Va. to Gulf of Mexico; Tex.; Ariz.; Mexico).—SMITH, Insects of New Jersey; suppl. 27th Ann. Rep. State Board of Agriculture, 1899, p. 383, 1900 (taken rarely near Newark; larvae on Convolvulaceae).—BARNES, Ent. News, vol. 11, no. 1, p. 332, 1900 (very common in the Huachuca Mountains, Ariz.); the same paper reset and repaged, entitled Notes on North American diurnals with some additions and corrections to Dr. Skinner's catalogue, p. 5, 1900 (very common in the Huachuca Mountains, Ariz.).—BEUTENMÜLLER, The butterflies of the vicinity of New York City; Guide Leaflet No. 7, Suppl. Amer. Mus. Journ., vol. 2, no. 5, p. 50, no. 91, May 1902 (gold-banded hesperid; exceedingly rare in this neighborhood, but more common in the Southern States and Mexico); figure, p. 50.—SMITH, Check list of the Lepidoptera of Boreal America, p. 13, no. 672, June 1903 (listed).—KUNZE, Ent. News, vol. 15, p. 240, 1904 (Huachuca Mountains; on flowers of *Rudbeckia*).—SKINNER, Synonymic catalogue of the North American Rhopalocera, suppl. no. 1, p. 33, 1905 (listed).—WRIGHT, Butterflies of the West Coast of the United States, p. 68, San Francisco, 1905 (South Atlantic States).—BEUTENMÜLLER, A manual of American and European butterflies and moths, reproduced in natural colors, with their common and scientific names, pl. 7, nos. 47, 47a, New York and London, 1906.—BRIMLEY and SHERMAN, Ent. News, vol. 18, no. 3, p. 100, March 1907 (Tryon, N. C., May, June, July).—LINDSEY, Ann. Ent. Soc. Amer., vol. 18, no. 1, p. 100, March 1925 (haplotype of *Rhabdoides*).—SMITH, Report on the insects of New Jersey, Ann. Rep. New Jersey State Mus., p. 424, Trenton, 1910 (taken rarely at Newark; larva on *Convolvulus*).—FRENCH, Butterflies of the eastern United States, 4th ed., p. 371, no. 194, 1914 (from previous editions).

- (*Papilio gentilis*, *Astycus celebris*) *Cecrops festus* GEYER, in Hübner, Beiträge zur Sammlung exotischer Schmetterlinge, Fünftes Hundert, p. 27, figs. 907, 908, 1837 (description; no locality).
- Hesperia cellus* DOUBLEDAY and WESTWOOD, Genera of diurnal Lepidoptera, vol. 2, p. 526, no. 9, 1852 (United States).—MORRIS, Smithsonian Misc. Coll., vol. 3, p. 14, May 1860 (listed); vol. 4, p. 105, February 1862 (description; United States).
- Hesperia festus* DOUBLEDAY and WESTWOOD, Genera of diurnal Lepidoptera, vol. 2, p. 526, no. 10, 1852 (? locality).
- Goniloba cellus* WEIDEMEYER, Catalogue of North American butterflies, p. 38, Philadelphia, 1864 (United States); reprinted in Proc. Ent. Soc. Philadelphia, vol. 2, p. 538, March 1864 (references; United States).
- Eudamus festus* HERRICH-SCHÄFFER, Corresp.-Blatt zool.-mineralog. Ver. Regensburg, 23 Jahrg., no. 12, p. 186, no. 3, 1869 (in key).—PLÖTZ, Ent. Zeit., Stettin, Jahrg. 43, nos. 1-3, p. 95, no. 62, Januar-März, 1882 (references; short description; *cellus* included as a synonym).
- Spathilepia cellus* BUTLER, Entomologist's Monthly Mag., vol. 7, p. 57, 1870 (listed as belonging to the new genus *Spathilepia*).—KIRBY, Synonymic catalogue of diurnal Lepidoptera, p. 578, no. 5, London, 1871 (listed).—W. H. EDWARDS, Synopsis of North American butterflies, in Butterflies of North America, vol. 1, p. 39, 1872 (Southern States; W. Va.).—GERHARD, Systematische Verzeichniss der Macro-Lepidopteren von Nord-America, p. 27, no. 468, Leipzig, 1878 (listed; Union).
- Thymele festus* KIRBY, Synonymic catalogue of diurnal Lepidoptera, p. 571, no. 35, London, 1871 (listed).
- Rhabdoides cellus* SCUDDER, Butterflies of the eastern United States and Canada, vol. 3, p. 1855, 1889 (detailed description of the imago; descriptions of the larva and pupa from Abbot's figures; Ga. to Ariz., and as far north as W. Va. and Ky.; Mexico; Putta, about 150 miles from Oaxaca, on the Pacific slope; Tallahassee, Fla., Apr. 17; notes).—E. Y. WATSON, Proc. Zool. Soc. London, p. 34, January 17, 1893 (listed).—SCUDDER, Brief guide to the commoner butterflies of the northern United States and Canada, p. 166, New York, 1893 (a southern type found at least as far north as W. Va. and Ky.).—GODMAN and SALVIN, Biologia centrali-Americana, Insecta, Lepidoptera-Rhopalocera, vol. 2 (text), p. 331, 1894 (North America; Southern States; Ariz.; Mexico; Milpas, in Durango; Cuernavaca, June; Xucumanatlan; Omilteme; Mexico City; Pinal, near Puebla; Oaxaca; Putla; notes); vol. 3 (plates), pl. 80, fig. 8, 1894 (male genitalia).—DYAR, U. S. Nat. Mus. Bull. 52, p. 57, no. 586, 1902 (South Atlantic States; Ariz.; Mex.).—MABILLE, Genera Insectorum, publiés par P. Wytsman, 17^a fasc., Lepidoptera Rhopalocera, Fam. Hesperidae, p. 29, Bruxelles, 1903 (listed; North America).—J. H. and A. B. COMSTOCK, How to know the butterflies, p. 294, New York, May 1904 (short description; W. Va. to the Gulf of Mexico); pl. 44, fig. 2 (colored).—DYAR, Journ. New York Ent. Soc., vol. 13, p. 114, September 1905 (occurs in Arizona).—FORBES, Field tables of Lepidoptera, 1906, p. 16, Worcester, Mass. (markings and size).—MABILLE and BOULLET, Ann. Sci. Nat., Zool., 87^e ann., 9^e sér., vol. 16, nos. 1-4, p. 128, 1912 (description); p. 129 (synonymy; record of specimens examined).—BARNES and McDUNNOUGH, Check list of the Lepidoptera of Boreal America, p. 18, Decatur, Ill., February 1917 (listed).—GROSSBECK,

- Bull. Amer. Mus. Nat. Hist., vol. 37, art. 1, p. 27, 1917 (Tallahassee, Fla., Apr. 17; Biscayne Bay, Fla.).—DRAUDT, in Seitz, Macrolepidoptera of the world, vol. 5, p. 871, 1922 (diagnosis; widely distributed in North and Central America); p. 1048 (*pseudocellus*, treated on p. 871 as a form of *cellus*, separated as a distinct species); pl. 169, rows a and b.—FORBES, in Leonard, List of the insects of New York, Mem. 101, Cornell Univ., Agr. Exp. Stat., p. 670, August 1926, issued January 1928 (Brooklyn, N. Y.; presumably a stray).—HOLLAND, Butterfly book, revised ed., p. 338, pl. 45, fig. 12, 1931 (the Virginias southward and westward to Ariz. and Mexico; common in the Carolinas; Mexican specimens are larger and the light band is narrower).—A. H. CLARK, Science, n. s., vol. 80, no. 2068, pp. 163-164, Aug. 17, 1934 (brief account of the life history).
- Achalarus cellus* HOLLAND, Butterfly book, p. 326 (the Virginias southward and westward to Ariz. and Mexico; common in the Carolinas); pl. 45, fig. 12; reprinted, 1910.—COOLIDGE and CLEMENCE, Ent. News, vol. 22, no. 1, p. 4, January 1911 (compared with *A. pseudocellus*, spec. nov.).—HOLLAND, The butterfly guide, p. 202, New York, 1915 (Virginias southward to Ariz. and Mexico); pl. 132, p. 202, fig. 2 (colored); reprinted, 1923.
- Achalarus cellus* GIRALTY, Ent. News, vol. 11, p. 439, 1900 (abundant in Anne Arundel Co., Md.).
- Cecrops festus* KIRBY, Zuträge zur Sammlung exotischer Schmetterlinge . . . von Jacob Hübner und Carl Geyer, new English facsimile edition, p. 24, Brussels, 1908-1912 (Mexico; figure is of a female); p. 92 (distribution, North America).
- Eudamus (Rhabdoides) cellus* SKINNER, Trans. Amer. Ent. Soc., vol. 37, p. 189, 1911 (description of imago, larva, and pupa, the first from French, 1886, the last two from Scudder, 1889; W. Va. to the Gulf of Mexico; Tex.; Ariz.; Mexico; Putta; Colima; Milpos; Cuernavaca; Xucumanatlan; Omilteme; Pinal; Mexico City; Oaxaca; Nashville, Tenn., Aug. 19 (Osborn); Tallahassee, Fla., Apr. 17 (Maynard); Ga., Apr. 25 (Abbot); food plant *Breweria aquatica*; apparently two broods).
- Cecropterus cellus*, LINDSEY, Univ. Iowa Studies, Studies in Nat. Hist., vol. 9, no. 2 (in reality no. 4), 1st ser., no. 43, p. 31, Feb. 15, 1921 (synonymy; Pa., July; Va. and W. Va., May and June; Tex. and Ariz., April and August); fig. 9, a (club of antenna), b (detail of neuration of anal area of secondary), p. 30.—SKINNER and WILLIAMS, Trans. Amer. Ent. Soc., vol. 48, no. 2, p. 120, June 1922 (description of male genitalia); fig. 19, p. 119 (male genitalia; Mount Graham, Ariz.).—BARNES and BENJAMIN, Check list of the diurnal Lepidoptera of Boreal America, San Diego, California, p. 21, 1926 (listed; *festus* Geyer included as a synonym, and *aereofuscus* Gunder as an aberration); republished a few days later in Bull. Southern California Acad. Sci., vol. 25, part 1, p. 21, January-April, 1926 (same).—HARRIS, A list of the butterflies of Georgia, Trans. Georgia Naturalists Club, vol. 1, no. 1, p. 21, January 1931 (Macon, Ga.).—LINDSEY, BELL, and WILLIAMS, Denison Univ. Bull., Journ. Sci. Lab., vol. 26, p. 31, April 1931 (Pa., July; Va. and W. Va., May-August; Tex. and Ariz., April, July-September; synonymy); pl. 1, fig. 10, a, b (from Lindsey, 1922); pl. 5, fig. 2 (male genitalia).—A. H. CLARK, U. S. Nat. Mus. Bull. 157, p. 204, 1932 (D. C., June 25, 1889; Difficult Run, Va., June 23, 1920; Collington, Md., July 30, 1930); pl. 50, figs. 3, 4 (specimen without data).—RICHARDS, Bull.

Brooklyn Ent. Soc., n. s., vol. 26, no. 5, p. 250, December 1931 (River Falls, S. C., August; Calahan Mountain, S. C., June; Macon, Ga.).

Aucthon cellus H. H. SHEPARD, Lepidopterorum Catalogus editus ab Embrik Strand, pars 47, Hesperidae, Subfamilia Pyrginae I., p. 83, Dec. 4, 1931 (very detailed references; U. S.; Mexico).

Rhabdoites cellus A. H. and L. F. CLARK, The Auk, new series, vol. 51, no. 4, October 1934, p. 528 (near Great Falls, Md.; early stages).

Type locality.—Jacksonborough, county seat of Scriven County, Ga.

Type.—Raised from a full-grown caterpillar found on a leaf of *Breweria aquatica*. The adult emerged on April 25, the caterpillar having pupated 3 weeks previously.

LOCALITY RECORDS

NEW YORK: Prospect Park, Brooklyn, Long Island, 1893 (H. G. White, 1894; W. T. M. Forbes, 1928, as Brooklyn, L. I.).

NEW JERSEY: Newark (J. B. Smith, 1890; Beutenmüller, 1893).

PENNSYLVANIA: July; no further data (Lindsey, Bell, and Williams, 1931); Lititz, near Lancaster, June 25, July 14, 16, 1892; J. J. Heiserman (3, U.S.N.M.).

MARYLAND: Collington, July 30, 1930 (A. H. Clark, 1932). Opposite Widenwater, 1.1 miles southeast of Great Falls (A. H. Clark, 1934, as vicinity of Washington). Anne Arundel County (Girault, 1900).

DISTRICT OF COLUMBIA: Washington, June 25, 1889, Ernest Shoemaker (A. H. Clark, 1932).

VIRGINIA: May-August; no further data (Lindsey, Bell, and Williams, 1931). Great Falls, Fairfax County, June 4 (E. L. Bell collection). Difficult Run, Fairfax County, June 23, 1920, Ernest Shoemaker (A. H. Clark, 1932). Fairfax County, June 24, 1925, F. M. Schott (1, U.S.N.M.). Fairfax County, June 23 (E. L. Bell collection). Buckingham, Buckingham County, June (Amer. Mus. Nat. Hist., from the E. L. Bell collection). Buckingham County, Aug. 16 (E. L. Bell collection). Wingina, Nelson County (Amer. Mus. Nat. Hist., from the E. L. Bell collection). Montgomery County (Smyth, 1895; Skinner, 1911).

WEST VIRGINIA: No further data (W. H. Edwards, 1872; French, 1886; Scudder, 1889). Same (1, Strecker coll., Field Mus.). May-August; no further data (Lindsey, Bell, and Williams, 1931). Charleston, May 18, 22, 30, 1900 (4, U.S.N.M.). Kanawha County (5, W. H. Edwards coll., Carnegie Mus.). Coalburgh, W. H. Edwards, July 25, 1886 (1, W. H. Edwards coll., Carnegie Mus.).

OHIO: Hocking and Jackson Counties, in the southeastern part of the State, 1934 (Edward S. Thomas, *in litt.*).

KENTUCKY: No further data (W. H. Edwards, 1877; Scudder, 1889).

TENNESSEE: Nashville, August (Osburn, 1895; Skinner, 1911, with the date Aug. 19).

NORTH CAROLINA: No further data; H. K. Morrison (1 male, British Mus.). Tryon, Polk County, in the southwestern part of the State, May, June, July (Brimley and Sherman, 1907).

SOUTH CAROLINA: River Falls, in the mountains in the western part of the State, 1,500 to 2,700 feet; Henry K. Townes, Jr., August (Richards, 1931). Calahan Mountain; Henry K. Townes, Jr., June (Richards, 1931). Greenville

County, in mountains, June to August; Henry K. Townes, Jr. (Franklin Sherman, *in litt.*). Rocky Bottom, Pickens County, June 1, 1933, June 21, 1932, Aug. 9-12, 1927, Aug. 31, 1930; Franklin Sherman (Franklin Sherman, *in litt.*).

GEORGIA: No further data; Henry Edwards (1 male, British Mus.). Near Jacksonborough, a town formerly existing about 8 miles north of Sylvania, Screven County; John Abbot, Apr. 25 (Boisduval and Le Conte, without locality, 1833; Scudder, as Georgia, 1889; Skinner, as Georgia, 1911). Macon, Bibb County, in the central part of the State; Strohecker (Harris, 1931; Richards, 1931).

FLORIDA: No further data (3 males, of which 2 are from H. Strecker, British Mus.). Same (2, Strecker coll., Field Mus.). Same (1, W. H. Edwards coll., Carnegie Mus.). Tallahassee, April 17, C. J. Maynard (Scudder, 1889; Skinner, 1911). Tallahassee; Albert Koebele (1, U.S.N.M.). Biscayne Bay; Annie Trumbull Slosson (Grossbeck, 1917).

MISSOURI: Seventy-six, Perry County; Herman Schwarz, July 20, 1919 (Edwin P. Meiners, *in litt.*).

TEXAS: No further data (French, 1886; Skinner, 1911). Same (1 female, British Mus.). April, July-September; no further data (Lindsey, Bell, and Williams, 1931). Kerrville, Kerr County; H. Lacy (9, U.S.N.M., one dated May 1901). Kerrville, Apr. 10 (E. L. Bell coll.).

ARIZONA: No further data (French, 1886; Scudder, 1889; Godman and Salvin, 1894; Dyar, 1905; Skinner, 1911). Same (3, U.S.N.M.). Same (7 males, 2 females, British Mus.; 4 males, 2 females, H. K. Morrison; 2 males from W. H. Edwards coll.). April, July-September; no further data (Lindsey, Bell, and Williams, 1931). Southern Arizona; Poling (10, 2 dated September 1900; Snyder coll., Field Mus.). Same (5, U.S.N.M., 2 dated September 1900). White Mountains, in the central eastern part of the State (1, U.S.N.M.). Santa Catalina Mountains (1, U.S.N.M.). Palmerlee, Cochise County (9, U.S.N.M.). Same (Amer. Mus., New York, from the E. L. Bell coll.). Chiricahua Mountains, Cochise County; V. L. Clemence (3 males, British Mus.). Vicinity of Fort Grant, Cochise County, or on Graham Mountain; H. K. Morrison, 1882 (W. H. Edwards, 1883). Mount Graham (Skinner and Williams, 1922). Fort Grant; H. K. Morrison (5 males, 2 females, British Mus.). Cochise County (5 males, British Mus.). Paradise, July (Amer. Mus., New York, from the E. L. Bell coll.). Ramsey Cañon, Huachuca Mountains, Cochise County; 5,000 to 7,000 feet; June-July (Coolidge and Clemence, 1911). Huachuca Mountains, July 16-23, 24-30, Aug. 16-23, 24-30 (Barnes, 1900; 7, U.S.N.M.). Huachuca Mountains (Kunze, 1904). Tucson, Pima County, July 1-15 (E. L. Bell coll.). Baboquivari Mountains, Pima County, July 15, 1924 (Gunder, 1925). Same locality, August (2, U.S.N.M.). Arizona mountains (4, W. H. Edwards coll., Carnegie Mus.).

NORTH AMERICA: No further data (1 female, Boisduval coll., British Mus.). Same (Mabille and Boulet, 1912; they record 1 male in the Paris Mus. from the Boisduval collection; 2 females in the Mabille collection; and in addition 2 males and females—6 in all).

MEXICO: No further data (Geyer, 1837, according to Kirby, 1908-1912). Same (Scudder, 1889; Skinner, 1911). Milpas, State of Durango, Forrer (Godman and Salvin, 1894; Skinner, 1911). Guadalajara, State of Jalisco (1, U.S.N.M.). Jalisco, July 15 (E. L. Bell coll.). Xucumánatlan, H. H. Smith (Godman and Salvin, 1894; Skinner, 1911). Omilteme, H. H. Smith (Godman and Salvin,

1894; Skinner, 1911). Colima, State of Colima (Skinner, 1911). Ciudad Mexico, Distrito Federal, Schumann (Godman and Salvin, 1894; Skinner, 1911). Same locality, August, R. Müller (1, U.S.N.M.). Mount Popocatepetl, 8,000 feet, June 1906 (1, U.S.N.M.). Cuernavaca, State of Morelos, June, H. H. Smith (Godman and Salvin, 1894; Skinner, 1911). Same locality, June 1906 (2, U.S.N.M.). Same locality, July 1906 (1, U.S.N.M.). Pinal, near Puebla, State of Puebla, F. D. Godman (Godman and Salvin, 1894; Skinner, 1911). Jalapa, State of Vera Cruz (2, U.S.N.M.; 2 Strecker coll., Field Mus.). Orizaba, State of Vera Cruz (Draudt, 1922). Balsas, northwestern Guerrero (E. L. Bell coll.). Oaxaca, State of Oaxaca, Fenochio (Godman and Salvin, 1894; Skinner, 1911). Same locality (1, U.S.N.M.). Putta, or Putla, about 150 miles from Oaxaca, on the Pacific slope (Scudder, 1889; Godman and Salvin, 1894; Skinner, 1911).

GUATEMALA: Volcan Santa Maria, William Schaus and John Barnes, June (1, U.S.N.M.).

No LOCALITY: Sept. 16, 1923 (1, U.S.N.M.). Collection of C. V. Riley (2, U.S.N.M.). Collection of Charles Oberthur (1, U.S.N.M.). Collection of Kate B. Preston (1, U.S.N.M.). Collection of W. H. Edwards (2, one of which is the original of the colored figures published by Holland; Carnegie Mus.). No data (5, U.S.N.M.).

The records from Anne Arundel County, Md., and Biscayne Bay, Fla., are interesting in being from regions of a type not usually inhabited by this butterfly, and we would like to see them confirmed. We confess to a certain amount of doubt in regard to them.

Capt. N. D. Riley wrote us that there is in the British Museum a specimen from Lord Walsingham's collection labeled "California." Lord Walsingham himself collected only in northern California, mainly in Colusa, Shasta, and Siskiyou Counties in July and August, 1871. He was always exceedingly careful regarding the labeling of his material. The specimen was presumably acquired by purchase or otherwise, and was mislabeled before coming into his possession. Dr. John A. Comstock, whose word regarding the occurrence of butterflies in California we consider as final, writes us that this species does not occur in California, and Commander Charles M. Dammers, whose knowledge of Californian butterflies is exhaustive, is equally positive on this point.

RANGE AND DISTRIBUTION

According to Forbes, the specimen recorded from Brooklyn by White was presumably a stray individual. In New Jersey it is said to be taken rarely by the Newark collectors, and in Pennsylvania we know it only from Lititz, where it appears to be rare. It has not been found in Delaware, and in Maryland it is known only from Anne Arundel County, where in 1900 it was said to be common; from a single individual recorded from Collington; and from near Great

Falls, where in 1934 and 1935 it was fairly common, though by no means abundant. There is a single record for the District of Columbia.

From Virginia it is known for the most part only through the capture of individuals from a number of widely scattered localities; but Smyth in 1895 said that it is occasionally taken in Montgomery County. The only localities we know in West Virginia are Charleston and Coalburg, in Kanawha County, where it is not common.

In Ohio it was taken for the first time in 1934, in two of the southeastern counties, as Edward S. Thomas has been so kind as to inform us by letter. William H. Edwards gave Kentucky among the localities for this species, but did not say on what grounds, and Osburn speaks of it as rare at Nashville, Tenn., where he took a single specimen.

In North Carolina it is known only from Tryon, and in South Carolina only from Greenville and Pickens Counties in the western part of the State, so we do not understand Dr. W. J. Holland's statement that "It is common in the Carolinas."

In his manuscript notes, quoted by Scudder, Abbot expressly calls it rare in the vicinity of Jacksonborough, Ga., and Harris, who recorded it from Macon, spoke of it as rare. From Florida it is recorded only from Tallahassee and Biscayne Bay. In Missouri a single specimen, almost fresh, was captured at Seventysix.

There are no records of this species from Alabama, Mississippi, or Louisiana, and in Texas it is only known from Kerrville, where it seems to be fairly common.

It is locally common in southern Arizona, and Barnes wrote that it is very common in the Huachuca Mountains near the Mexican border.

It is not known from New Mexico or from California.

In Mexico, according to Godman, it has a wide range in the highlands, occurring at an elevation of 6,000 feet in the Sierra Madre of Durango, as high as 8,000 feet in the Sierra Madre del Sur, and at similar altitudes in other parts of Mexico. It also occurs at Cuernavaca, where H. H. Smith found it in July.

The southernmost locality from which it is known is the Volcan Santa Maria in Guatemala, where a specimen now in the United States National Museum was captured by William Schaus and John Barnes in June.

The known range of this butterfly—from New York to Florida, about Kerrville, Tex., and from southern Arizona southward to Guatemala—is curiously discontinuous.

Furthermore, though it is generally common in Mexico and in the mountains of southern Arizona, in the eastern States, though widely distributed, it is very local, occurring at widely separated stations almost exclusively in hilly or mountainous regions where it is found in small numbers—indeed from many localities there is only a single record. It is true that its habits are such as to cause it easily to be overlooked, yet if it were anywhere really numerous in the eastern States, or if it were generally distributed, this certainly would be reflected in the records.

Most of the specimens in collections are from Arizona or Mexico. No collection contains a long series of eastern specimens, nor more than a very few eastern examples from any one locality.

The explanation of the distribution of the gold-banded skipper would seem to be that its true habitat is in Mexico and the mountains of southern Arizona, where it is locally a common permanent resident. In the eastern States it is a casual resident of erratic and fortuitous occurrence, maintaining its foothold by virtue of constant new arrivals from the southwest coupled with redistribution from local more or less permanent centers; though constantly present, it cannot properly be regarded as an endemic species in this area.

We believe its status to be parallel to that of *Strymon ontario ontario*, which appears to be frequent about St. Louis, Mo., but farther east and northeast merely an erratic casual visitor.

THE NAMED VARIETIES OF RHABDOIDES CELLUS

Var. **AEREOFUSCUS** Gunder

Rhabdoides cellus ab. ♂ *aereofuscus* GUNDER, Ent. News, vol. 36, p. 196, pl. 5 (facing p. 193), fig. 6, 1925 (diagnosis; Baboquivari Mountains, Pima Co., Ariz.; July 15, 1924).

Cecropterus cellus ab. *aereofuscus* BARNES and BENJAMIN, Check list of the diurnal Lepidoptera of Boreal America, p. 21, 1926; reprinted in Bull. Southern California Acad. Sci., vol. 25, pt. 1, p. 21, January-April, 1926 (listed).

Autochton cellus ab. *aereofuscus* H. H. SHEPARD, Lepidopterorum Catalogus editus ab Embrik Strand, pars 47, Hesperidae, Subfamilia Pyrginae I, p. 84, Dec. 4, 1931 (listed).

Diagnosis.—"Normal specimens of *cellus* and *pseudocellus* are black, or nearly black. The black on this specimen, including the antennae and body parts, is replaced by bronze-brown. The band of gold across the primaries, costal white marks and fringes remain normal. Expanse 46 mm."

Type locality.—Baboquivari Mountains, Pima County, Ariz.

Type.—A male in the collection of Jean D. Gunder taken on July 15, 1924.

Var. MEXICANA Draudt

Rhabdoides cellus form *mexicana* DRAUDT, in Seitz, *Macrolepidoptera* of the world, vol. 5, p. 871, 1922 (diagnosis; Orizaba); pl. 169, row a.

Autochton cellus var. *mexicana* H. H. SHEPARD, *Lepidopterorum Catalogus editus ab Embrik Strand, pars 47, Hesperidae, Subfamilia Pyrginae I*, p. 84, Dec. 4, 1931 (listed).

Rhabdoides cellus mexicana HOFFMANN, *Anal. Inst. Biol., Univ. Nac. Mexico*, vol. 3, no. 2, June 1932, p. 139 (Orizaba, Vera Cruz; type collected by Toro II).

Diagnosis.—In both sexes with the band across the fore wings almost twice as broad as in the typical form, deep orange yellow, terminating roundedly below, the small apical spots still smaller, reduced to two, the yellow fringes on the hind wings narrower.

Type locality.—Orizaba, Vera Cruz, Mexico.

Type.—Collected by Cayetano del Toro and sent to Dr. Draudt by Roberto Müller.

Var. LEILAE A. H. Clark

Plate 2, figs. 1, 2

Rhabdoides cellus var. *leilae* A. H. CLARK, *Science*, n. s., vol. 80, no. 2068, p. 164, Aug. 17, 1934.

Diagnosis.—Very dark, blackish; the usual gold band across the fore wings is replaced by a series of four spots, the first, adjoining the costal border, small, the second, crossing the cell, about half as broad as the usual band in the same place and much lighter in color than the first, the third, very small and bright golden, in the middle of the interspace between veins M_2 and M_1 , and the fourth, nearly as large as the second, in the interspace below near its outer end.

Type locality.—Maryland, woods just north of the unpaved portion of the Conduit Road 1.1 miles southeast of Great Falls, or just over one-half mile west of the point where the paved road from Washington turns north up the hill, leaving the conduit.

Type.—U.S.N.M. no. 51415; emerged July 20, 1934, from a pupa formed on July 4 and kept under natural conditions. Other specimens emerging later from the same lot were normal.

Additional specimen.—W. Herbert Wagner raised a similar individual, but it failed to spread properly and was not preserved.

KEY TO THE NAMED VARIETIES OF RHABDOIDES CELLUS

- a*¹. Band across the fore wings broad and continuous.
*b*¹. Ground color black or blackish brown (when fresh).
*c*¹. Band on fore wings normal, golden yellow, pointed below. *cellus*.
*c*². Band on fore wings almost twice as broad as normal, rounded below,
mexicana.
*b*². Ground color bronze-brown. *aercofuscus*.
*a*². Band on fore wings represented by four well-separated spots. *leilac*.

VARIATION

This butterfly appears to be unusually uniform in its characters, both locally and throughout its range.

The specimens at hand from Maryland (pl. 2, figs. 3-6), all taken during the past summer, are very dark, blackish, and small. Gunder, speaking presumably of this species as it occurs in Arizona, said that "Normal specimens of *cellus* and *pseudocellus* are black or nearly black." In Maryland a few much lighter badly broken specimens were caught but were not preserved.

The specimens at hand from West Virginia (pl. 1, figs. 7, 8) are as small as those from Maryland, but are lighter in color. They were caught, however, 34 years ago and presumably have faded.

Those from Pennsylvania (pl. 3, figs. 13, 14) are as large as those from Arizona (pl. 3, figs. 11, 12), with which they agree in their ground color as well as in all other details.

At first sight the fringe on the hind wings of the Maryland individuals appears clearer white than it is on the western specimens, but closer examination shows that this is on account of the greater contrast with the darker ground color.

The band on the fore wing varies very little. It is narrowest in two specimens from Kerrville, Tex., but it is almost equally narrow in two from Pennsylvania and in one from Maryland. It is broadest in a specimen from Maryland, though almost equally broad in some from Arizona.

There are no differences that can be detected between specimens from Mexico and others from Arizona. Two from Cuernavaca have the band slightly narrower than the others, and the one from Guatemala (pl. 4, figs. 15, 16) has it slightly broader, though not so uniformly broad as it is in the one from Maryland.

Dr. W. J. Holland said that Mexican specimens are larger and the light band is narrower, and Dr. M. Draudt described a form (*mexicana*) from Orizaba with the band almost twice as broad as usual. It is quite likely that more or fewer of the individuals in certain

localized communities may possess certain minor features by which they may be distinguished; nevertheless, this insect in Mexico as a whole is singularly uniform.

So far as we have been able to determine there are no variations of geographical significance in this butterfly, and the named varieties are therefore to be regarded as individual variants or "aberrations."

HISTORY

The first notice of this species was the publication by Dr. Jean Alphonse Boisduval and Maj. John E. Le Conte in 1833 of an excellent colored plate showing the imago, a caterpillar on one of the leaves of a sprig of *Breweria aquatica*, and a pupa. No text was published in connection with the plate, which bore at the bottom the name *Eudamus cellus*.

The plate was a reproduction of a painting by John Abbot, who lived for nearly 20 years—from about 1790 to about 1810—at Jacksonborough, Ga. Jacksonborough no longer exists, but in Abbot's time it was an important town. It was confirmed as the county seat of Scriven (now Screven) County on February 15, 1799, and for more than 40 years the business of the county was mainly transacted there. But in 1847 the public buildings were removed to Sylvania, the present county seat. This robbed Jacksonborough of all importance, and it was soon abandoned.

Jacksonborough was situated on Beaver Dam Creek near its junction with Brier Creek in the north-central part of Screven County, roughly 7 miles north of Sylvania. Presumably Abbot's specimen came from this locality, or its more or less immediate vicinity. The butterfly has not since been reported from Screven County, and until this year the caterpillar that he found has remained the only one known.

In 1837 Carl Geyer published a brief description of this species under the name of *Cecrops festus* (*Papilio gentilis*, *Astycus celebris*), which was illustrated by figures in colors of the upper and under sides.

In the second volume of their "Genera of Diurnal Lepidoptera" published in 1850-1852, Edward Doubleday and John Obadiah Westwood listed this species under the name of *Hesperia cellus*, with the habitat United States.

The Rev. Dr. John Gottlieb Morris, in his "Catalogue of the Described Lepidoptera of North America" prepared for the Smithsonian Institution and published in May 1860, listed *Hesperia cellus*, taking

the name from Doubleday and Hewitson. In his "Synopsis of the described Lepidoptera of North America" published by the Smithsonian Institution in February 1862 Doctor Morris, under *Hesperia cellus*, gave a brief diagnosis of this species, with the habitat United States.

In 1870 Arthur Gardiner Butler proposed the new genus *Spathilepia* in which he included *cellus* as the last of several species listed.

In his "Synonymic Catalogue of Diurnal Lepidoptera" published in 1871 William Forsell Kirby listed both *Spathilepia cellus* and *Thymele festus*.

William Henry Edwards in his "Synopsis of North American Butterflies" published in 1872 included *Spathilepia cellus*, giving as the habitat the Southern States and West Virginia.

One of the unpublished plates of butterflies and moths prepared by Townend Glover shows colored figures of the larva and pupa of this species, and another shows both surfaces of the wings of the imago. They are identified as *Eudamus cellus*, and were copied from the figures of Abbot reproduced by Boisduval and Le Conte.

In the list of the Lepidoptera collected in 1871-1874 in California, Nevada, Utah, Colorado, New Mexico, and Arizona, published by W. H. Edwards in 1875 in the "Report upon Geographical and Geological Surveys West of the One Hundredth Meridian in Charge of First Lieut. George M. Wheeler," *Eudamus cellus* is included, but there is no indication of the locality where it was taken.

In his "Butterflies and Moths of North America" published in 1878 Ferdinand Heinrich Herman Strecker included *Eudamus cellus*, and gave a short synonymy; the range he gave as from Virginia southward to the Gulf of Mexico.

Eudamus cellus is included in the "List of North American Macrolpidoptera" prepared by the Publication Committee of the Brooklyn Entomological Society and published by the Society in 1881.

In a revision of the genus *Eudamus* published in 1882 Carl Plötz listed *Eudamus festus*, crediting the species to Hübner instead of to Geyer and placing *E. cellus* as a synonym under it.

Edwards in 1883 recorded *Eudamus cellus* from Arizona, where it had been taken in 1882 by H. K. Morrison either in the vicinity of Fort Grant, Cochise County, or on Graham Mountain.

In his "Revised Catalogue of the Diurnal Lepidoptera of America North of Mexico" published in November 1884 Edwards included *festus* Hübner as a synonym of *Eudamus cellus*, the range of which he gave as West Virginia to the Gulf of Mexico, Texas, and Arizona.

George Hazen French in his "Butterflies of the Eastern United States" published in 1886 gave an excellent description of *Eudamus cellus*, which he said ranges from West Virginia to the Gulf of Mexico, and also occurs in Texas and Arizona.

Regarding the occurrence of this butterfly near Coalburgh, W. Va., W. H. Edwards wrote in 1888:

On one occasion, in June, I visited an unopened coal seam at least a mile from any clearing, and at five hundred feet elevation above the creek, where the coal was exposed to view, owing to its being between two ledges of rock, a little sulphur-tinctured water trickled upon the base rock, and here were several [*Debis*] *Portlandia* and that rare butterfly *Eudamus Cellus*, in a cluster, eagerly sucking.

Samuel Hubbard Scudder in 1889 created the new genus *Rhabdoides* for this species and a few others that he did not name. He gave an exhaustive description of the imago but did not figure it. His descriptions of the last stage larva and of the pupa are taken from Abbot's colored figures. He said that it ranges from Georgia to Arizona, and as far north as West Virginia and Kentucky; he also listed a specimen from Tallahassee, Fla., taken by Charles Johnson Maynard on April 17, and another from Putta on the Pacific slope of Mexico about 150 miles from Oaxaca. Scudder said that this species does not seem to be so common as the other larger skippers of the same region and notes that Abbot expressly called it rare. He said that Abbot bred the butterfly on April 25 from a caterpillar that shut itself up in its cocoon 3 weeks previously. He remarked that Abbot said it frequents the sides of swamps, and that in his various manuscripts *Breweria aquatica* is given as the food plant, and upon this it is figured by Boisduval and Le Conte.

Dr. John Bernhard Smith in his "Catalogue of the Insects found in New Jersey" published in the Final Report of the State Geologist of New Jersey in 1890 said that *Eudamus cellus* is taken rarely by the Newark collectors.

Eudamus cellus was listed by Dr. Henry Skinner in his "List of the Lepidoptera of Boreal America" published in 1891.

William Beutenmüller in his list of the butterflies of the vicinity of New York published in 1893 gave a brief description of *Eudamus cellus* and figured it; he also gave a description of the caterpillar and of the chrysalis, abridged from Scudder. He said that the food plants are Convolvulaceae and cited Smith's record from Newark, N. J.

Lt. Edward Yerbury Watson listed *Rhabdoides cellus* in his revision of the Hesperiidæ published in 1893.

In their "Biologia Centrali-Americana" published in 1894 Frederick Ducane Godman and Osbert Salvin gave the habitat of *Rhabdoides cellus* as the Southern States, Arizona, and the highlands of Mexico. The Mexican localities given are: Milpas, in Durango (collected by Forrer); Cuernavaca, in June; Xucumanatlan; Omilteme (collected by H. H. Smith); Mexico City (collected by Schumann); Pinal, near Puebla (collected by F. D. Godman); Oaxaca (collected by Fenochoio); and Putla (quoting Scudder, who gave it as Putta). They published a figure of the male genitalia.

Eudamus cellus was recorded by H. G. White in June 1894 as having been taken in Prospect Park, Brooklyn, N. Y., in 1893, and in November 1895 William Osburn recorded it as rare at Nashville, Tenn., where a single specimen had been taken in August; he said that the food plant is unknown.

Ellison Adger Smyth, Jr., in October 1895 said that *Eudamus cellus* is occasionally taken in the watered ravines in Montgomery County, Va., where the wild catnip covers the ground.

Dr. William Jacob Holland in the "Butterfly Book" published in 1898 gave a brief account of this species under the name of *Achalarus cellus*. He said that what little we know of the early stages is based mainly upon the observations of Abbot, and there is an opportunity here for some young naturalist to render a good service to science by rearing the insect through all stages from the egg. The habits of the larva are not greatly different from those of allied species. He said that *A. cellus* is found in the Virginias and thence southward and westward to Arizona and Mexico, adding that it is common in the Carolinas. He gave an excellent colored figure of the upper surface of a male.

In 1900 Alex. A. Girault wrote that *Achalarus cellus* is abundant in Anne Arundel County, Md.

William Barnes in 1900 said that *Eudamus cellus* is very common in the Huachuca Mountains in Arizona.

Beutenmüller in his account of the butterflies of the vicinity of New York City published in 1902 said that *Eudamus cellus* is exceedingly rare in that region but more common in the Southern States and Mexico.

Harrison Gray Dyar listed *Rhabdoides cellus* in 1902, giving as the habitat the South Atlantic States, Arizona, and Mexico. In a paper published in 1905 he said that it occurs in Arizona.

Speaking of protective coloration of insects in southern Arizona, R. E. Kunze said in 1904 that *Amblyscirtes (Pamphila) bellus* is usually seen feeding on the prominent yellowish cones of *Rudbeckia*

laciniata, and is not often observed on any other but this cone-flower. In the Huachuca mountains *Eudamus cellus* is its companion in rifling the yellow flowers of *Rudbeckia*. On these flowers, according to Kunze, *bellus* seems to be less protected than *cellus*.

In their list of the butterflies of North Carolina published in March 1907 Clement Samuel Brimley and Franklin Sherman, Jr., recorded *Eudamus cellus* from Tryon in the extreme southwestern part of the State, where it flies in May, June, and July.

Karl R. Coolidge and Victor L. Clemence wrote in 1911 that in Ramsey Cañon, in the Huachuca Mountains, Cochise County, Ariz., at an altitude of 5,000 to 7,000 feet, *cellus* first appeared about the middle of June but was not plentiful until July. In the same article Dr. J. H. McDunnough said that the collection of Dr. William Barnes contained a specimen of *Achalarus pseudocellus* bearing the label "W. Va." We have examined this specimen and agree with Dr. McDunnough that it is an example of *Rhabdoides pseudocellus*. The label is in the handwriting of W. H. Edwards. Mr. Edwards was not aware that together with *cellus* in Arizona there lives a second smaller species of the same size as *cellus* as it occurs in West Virginia. It is possible that in looking over his collection he saw among the larger Arizona specimens a small individual apparently agreeing with those from West Virginia and, thinking a mistake had been made, changed the label on the latter.

Dr. Henry Skinner in 1911, under *Eudamus (Rhabdoides) cellus*, republished French's description of the imago, and Scudder's descriptions of the last-stage caterpillar and pupa. He gave the range as from West Virginia to the Gulf of Mexico, Texas, Arizona, and Mexico. He repeated the localities given by Scudder, omitting Kentucky, and those given by Godman and Salvin. He added Colima, Mexico, and Nashville, Tenn., August 19 (Osburn). The food plant, he said, is *Breveria aquatica*. He remarked that from the dates of capture it would seem that there are two broods of this species. He quoted Smyth's account of its occurrence in Montgomery County, Va.

In his reprint of Jacob Hübner and Carl Geyer's *Zuträge* published in 1908-1912 Kirby listed *Cecrops festus*, adding the information that the figure represents a female and indicating that the specimen came from Mexico. The distribution of the species is given as North America. Foster H. Benjamin called our attention to the fact that very few of Hübner's species came from Mexico and suggested that the original of *Cecrops festus* was more likely to have come from the eastern United States. We find that Kirby listed only 14 of Hübner's species from Mexico, whereas 117 were listed as from the eastern

United States, 74 of these from Georgia. Though there is no real evidence, we are inclined to believe that the type specimen of *Cecrops festus* came from Georgia and that it was sent to Hübner by John Abbot.

In his list of the Lepidoptera of Florida published in 1917 John A. Grossbeck cited Maynard's record from Tallahassee, originally published by Scudder, and added a new record from Biscayne Bay, where the species had been obtained by Mrs. Annie Trumbull Slosson.

In their "Check List of the Lepidoptera of Boreal America" published in 1917 Drs. William Barnes and James Halliday McDunnough listed this species as *Rhabdoides cellus*.

In 1921 Prof. Arthur Ward Lindsey listed this species as *Cecropterus cellus*, giving a synonymy and saying that it is found in Pennsylvania in July, in Virginia and West Virginia in May and June, and in Texas and Arizona in April and August.

In Dr. Adelbert Seitz' "Macrolepidoptera of the World" Dr. M. Draudt in 1922 gave a short diagnosis and colored figures of *Rhabdoides cellus*, which he said is widely distributed in North and Central America, and described and figured a new variety under the name of *Rhabdoides cellus* form *mexicana*.

In 1925 Jean Daniel Gunder described and figured in colors *Rhabdoides cellus* ab. ♂ *acreofuscus*.

Professor Lindsey in 1925 gave *Eudamus cellus* as the haplotype of the genus *Rhabdoides*.

William Barnes and Foster H. Benjamin in their "Check List of the Diurnal Lepidoptera of Boreal America" published in 1926 included *Cecropterus cellus*, with *festus* Geyer as a synonym and *acreofuscus* Gunder as an aberration.

Dr. William Trowbridge Merrifield Forbes in 1928 listed White's specimen of *Rhabdoides cellus* from Brooklyn, N. Y., saying that it was presumably a stray.

In their revision of the HesperIIDae of North America published in 1931 A. W. Lindsey, Ernest L. Bell, and Roswell Carter Williams, Jr., gave a synonymy of *Cecropterus cellus* and figured the male genitalia. The localities and dates they gave as Pennsylvania, July; Virginia and West Virginia, May to August; Texas and Arizona, April, July-September. They mentioned Gunder's ab. ♂ *acreofuscus*.

In the revised edition of the "Butterfly Book" published in 1931 Holland, under *Rhabdoides cellus*, repeated the information given in the earlier edition, and added that Mexican specimens differ from those from the United States in being larger with the light band narrower.

Lucien Harris, Jr., in 1931 said of *Cecropterus cellus* that this rare butterfly has been taken at Macon, Ga.

In 1932 Carlos C. Hoffmann said that the type specimen of *Rhabdoides cellus mexicana*, described by Draudt in 1922, had been sent the latter by Roberto Müller; it came from Orizaba, Vera Cruz, where it had been collected by Cayetano del Toro.

In his "Butterflies of the District of Columbia and Vicinity" published in 1932 the author recorded *Cecropterus cellus* from the District of Columbia, June 25, 1889 (Ernest Shoemaker); from Difficult Run, Fairfax County, Va., June 23, 1920 (Ernest Shoemaker); and from Collington, Md., July 30, 1930. He said that this species has a wide range throughout the South, but is nowhere very common. It is to be sought for along the sides of streams and in the immediate vicinity of swamps. The species was illustrated by photographs of the upper and under surfaces of a specimen without data.

In August 1934 the author published a brief notice of the discovery of *Rhabdoides cellus* in some numbers in the vicinity of Washington and gave a short account of the eggs and early stages. The eggs and larvae were found in numbers on the hog-peanut (*Falcata pitcheri*). A new form, *Rhabdoides cellus* var. *leilae*, was described. In a note published in October 1934 the locality was given more specifically as near Great Falls, Md.

FIELD NOTES

Our observations on this butterfly were made in the woods just north of the unpaved portion of the Conduit Road, 1.1 miles southeast of Great Falls, Md., and slightly more than half a mile west of the point where the paved road leaves the Conduit Road and turns north up the hill. Here a small stream from the woods passes under the conduit. A few hundred feet up this stream north of the conduit there is a cleared spot a hundred feet or so in diameter, along the west side of which, at the base of a steep hillside, the stream broadens into a little marsh perhaps 20 feet across. It was along the edges of this little marsh and in the marsh itself that the great majority of the butterflies were found.

We first met with this butterfly on May 30, when we saw and captured a single individual. On June 3 we caught seven, on June 10 eight, on June 17 ten, and on June 24, when we were accompanied by Dr. George W. Rawson, of Detroit, Mich., we met with no less than twenty. On July 1 we found only four, all of them battered. Two of these were taken home alive, the last dying on July 3.

Previous records for the District of Columbia and its immediate vicinity are: June 23, 1920 (Ernest Shoemaker); June 24, 1925 (F. M. Schott); and June 25, 1889 (E. Shoemaker). These records, combined with our experience, seem to warrant the statement that the maximum abundance is reached about June 24.

We noticed that this skipper is very seldom seen in the morning, appearing only after midday and flying until almost dusk. This habit of appearing in wet hollows near water in the afternoon suggested that the true habitat of the butterfly was somewhere else. Presumably it is active in its home territory during the morning, but in the heat of the afternoon seeks out the wettest places it can find. If it were a swamp or a bog butterfly, as has been supposed, it would certainly be present in wet localities in the morning. All of our swamp and bog butterflies, and all of its relatives in this region, are active in the morning.

Another thing we noticed was that the females soon get the hind wings badly frayed, and old females commonly have the posterior half of the hind wings completely worn away. The prompt fraying of the hind wings of the females appeared to be good evidence that they were engaged in depositing their eggs on some plant, the leaves of which are exceedingly rough on the under side. They were not depositing their eggs on any minutely soft downy plant, such as *Breweria aquatica*, on which the caterpillar was figured by John Abbot, or on any of its local relatives.

In walking through the woods near the marshy expansion of the little stream where we had seen the insect most frequently, we noted a certain spot high up on the hillside where we always saw one or two in passing. Dr. Rawson also found several feeding on *Hydrangea* on the hillside immediately above the stream. Both of these spots are abundantly overgrown with the hog-peanut, *Falcata* (or *Amphicarpa*) *pitcheri*, the leaves of which are extremely rough on the under side, bearing very numerous strong hooked hairs.

On July 1 one of these plants, growing high up on the hillside at the place where in passing we had frequently seen individual examples of the butterfly, was found to be much eaten, and on its larger leaflets we found a score or more of little shelters differing from the shelters described for any of our skippers. In these shelters eight skipper caterpillars were found, in the third, fourth, and fifth stages, differing from any described caterpillars, and we also found the empty shell of an undescribed egg.

On July 4 we collected 167 caterpillars in all stages, 46 empty egg shells, and 6 eggs, all of which hatched a day or two later. Of the

caterpillars brought home, one (collected July 1) pupated on July 4, three on July 8, and two on July 11. We found no butterflies on this date.

On July 15, accompanied by W. Herbert Wagner, we collected 89 caterpillars, all in the fourth or fifth stages, most of them in the latter. As we found a considerable number of large shelters unoccupied, we assume that the usual habit of these caterpillars is when fully grown to leave these shelters and pupate among the dead leaves and rubbish on the ground. We saw no butterflies.

On July 20 a butterfly emerged from the pupa formed on July 4, and on July 25 another emerged from a pupa formed on July 11. The duration of the pupal stage in the summer is therefore 14-16 days.

On August 5, revisiting the locality in company with Dr. and Mrs. William M. Mann and Robert L. Duffus, of New York, we found six butterflies, caterpillars in all stages, and very many abandoned large shelters.

On August 19, in company with Dr. Herbert Friedmann and Hugh Upham Clark, we made a rather intensive search for material, but we found the insect by no means so common as previously. Only 3 butterflies were met with, and we could discover only 39 caterpillars, mostly in the second and third stages with 4 in the first stage and about half a dozen in the fourth; there were no caterpillars in the last stage, but about half a dozen recently abandoned full-sized shelters were found. The numbers of adults and caterpillars of *Epargyreus tityrus* had similarly decreased markedly, and *Achalarus lyciades* was not found in any stage.

On August 26 we were accompanied by Mrs. Frederick V. Coville, Ellsworth P. Killip, and Dr. George S. Myers. We found no butterflies, and only nine caterpillars, two in the first stage, four in the last stage, and three in the fourth stage. About half a dozen recently abandoned full-sized shelters were discovered. A single full grown and very large caterpillar of *Epargyreus tityrus* was found on *Meibomia paniculata*.

On September 1, in company with Dr. and Mrs. William R. Maxon and Miss Alice C. Atwood, we again visited the locality. No butterflies were found, and only 12 caterpillars, 2 in the second stage, 7 in the third stage, and 3 in the fourth stage. A few recently abandoned full-sized shelters were found. It was curious that of the 12 caterpillars found 8 were preparing to molt. One additional caterpillar, in the fifth stage, was discovered with the posterior third of the body blackened by bacterial rot. We had previously found a number of fully grown caterpillars of *Epargyreus tityrus* dead in their shelters

and discolored dark brown, but we had never previously found any evidence that the caterpillars of *Rhabdoides cellus* were attacked by this disease.

In the area in which we found it the butterfly was probably at approximately its maximum abundance, for in midsummer every hog-peanut plant on each of its long trailing shoots harbored at least one group of caterpillars, and usually two or more. On many of the more isolated and peripheral plants and shoots, and on such shoots as climbed high above the general mass, all the leaflets except a few of the largest near the base were entirely destroyed.

On June 1, 1935, W. Herbert Wagner found that the butterflies had reappeared, having survived an unusually severe winter.

The following account of the gold-banded skipper and its early stages is based upon observations on 61 living butterflies, the majority of which were caught, nearly 400 larvae representing all stages collected and brought home, and about 200 eggs and empty egg shells.

SEASON

In the vicinity of Washington this butterfly first appears late in May, flies through June, attaining its maximum shortly after the end of the third week, and disappears soon after the first of July. The second brood appears at the end of the third week in July, and the butterfly continues on the wing uninterruptedly, though in constantly diminishing numbers, until about the end of August.

The eggs are deposited over a long period, so that at the time of the disappearance of the first brood unhatched eggs, larvae in all stages, and pupae are to be found.

In July the butterfly is markedly less numerous than in June. Of the six pupae raised in the house three produced butterflies in 14-16 days, and three others remained as pupae until the end of the season. In view of the diminishing numbers of all stages of this butterfly with advancing summer in the field there can be no doubt that in nature, as well as under more or less artificial conditions, a very large percentage of the pupae from caterpillars of the second and succeeding broods last over until the following spring, just as is the case with *Epargyreus tityrus* and *Achalarus lyciades*, and with the local species of *Thorybes* and of *Thanaos* that have a second brood.

The period of emergence of the second brood is very much longer than that of the first brood. But the effect of this on the number of butterflies on the wing at any one time is undoubtedly more than offset by the relatively slight mortality in the younger stages as compared with the heavy mortality among hibernating pupae.

At the end of the season—toward the end of August—most of the very few butterflies still on the wing represent a second brood, while a few represent a third brood.

In Pennsylvania the gold-banded skipper first appears in June, in Maryland and Virginia toward the end of May, in southern West Virginia shortly after the middle of May, and in Georgia, Florida, Texas, and Arizona in April. There are numerous records throughout its range for July, but fewer for August; and only in Texas, Arizona, and southward has it been found in September. Skinner in 1911 noted that from the dates of capture it would appear that there are two broods.

HABITS OF THE BUTTERFLY

The gold-banded skipper most frequently is seen in wet grassy areas along the sides of streams or ponds in or near woods. It is seldom to be found in the immediate vicinity of the food plant, though it sometimes feeds on flowers growing near the hog-peanut patches.

Wet open spots in woods seem to form its favorite playgrounds, where the males congregate and engage in combat. This is in interesting contrast to the habit of the males of the local species of the related genus *Thorybes* (*Th. bathyllus*, *Th. pylades*, and *Th. confusus*) which choose as their playgrounds low, bare, and more or less barren hilltops frequently some distance from the nearest food plants, where they are often to be seen playing about in numbers.

We found the gold-banded skipper extremely local. One individual was met with near a temporary pond about 400 yards east of the stream, and another in a marshy spot along another stream about a quarter of a mile west, but these were the only strays we saw.

The flight of this butterfly is low, a foot or so above the ground, or just above the top of the long grass. It is slow and irregular in rounded zigzags with rapid wing beats and occasional short glides (most unusual in a skipper) and is easily followed with the eye, assisted by the bright golden band on the fore wings. Though somewhat jerky, the flight usually lacks the skipping motion characteristic of most skippers; but occasional males when coursing about over the grass tops may exhibit more or less of this. As a rule the flight is short, and the butterfly soon comes to rest, usually on a leaf near the ground or on a level with the grass tops, on a log, or on the ground itself. Rarely it chooses a leaf as much as a yard above the ground. It always rests with the wings fully expanded.

In the woods this butterfly is most inconspicuous, zigzagging about through the undergrowth, always keeping within a foot or so of the ground, occasionally alighting on a fallen dry leaf or on the ground.

It is unsuspecting and not easily frightened. If missed by the net it flies away, but sooner or later returns to the same place, just as the species of *Thorybes* do when on their playgrounds.

It feeds most commonly on the flowers of *Hydrangea arborescens*, which is common on the lower slopes of the hillsides where its food plant grows, but is sometimes seen on the flowers of the button-bush (*Cephalanthus occidentalis*) in bogs near the woods, and on the flowers of the iron weed (*Vernonia glauca*) along woodland paths.

It is the most sluggish, the least suspicious, and the easiest to catch of all our skippers. Even two males engaged in combat seem to take only a half-hearted interest in the proceeding and seldom rise more than a foot or so above the normal flight plane. Their movements as a rule entirely lack the dashing energy of those of the males of other skippers under similar conditions. But on occasion they will develop unsuspected vigor.

In its habits the gold-banded skipper resembles the species of *Thorybes* more closely than it does any other of our larger skippers, but is somewhat less energetic and more retiring, keeping mainly in and near undergrowth. It is at once distinguishable on the wing from *Epargyreus tityrus* and *Achalarus lyciades* by its slower and much less irregular flight, as well as by its habit of keeping always near the ground and dodging through the undergrowth.

But *Achalarus lyciades* is a less energetic flier than *Epargyreus tityrus* and does not fly so high, its flight being intermediate between that of the latter and that of the gold-banded skipper. Indeed, once or twice I have found that what I thought were two belligerent males of *Achalarus lyciades* were in reality males of *Rhabdoides cellus*.

EGGS

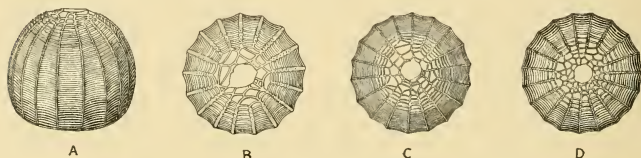
Plate 4, fig. 17; plate 6, figs. 28, 29; text figs. A-D, p. 26

The eggs are fastened on the under side of the leaflet in its outer half. They are usually nearer the midrib than the edge, and are always placed in the intervals between the veins, where they are pressed down upon and glued firmly to the short hooked bristles. Although most of the eggs are found in the middle third of the leaflet, longitudinally, a few are nearer the edge. But they are always in the outer half of the leaflet, and between the veins.

The eggs are laid almost invariably on the large leaflets toward the base of the plant and are only exceptionally found on the small leaflets near the summit. More or less isolated plants, and especially those growing along paths or open spots, are preferred to those growing in

dense masses, and on these the earliest caterpillars of the season are to be found. As the season progresses and the caterpillars become more numerous, the butterflies work inward from the periphery toward the center of the masses of hog-peanut until every plant bears its quota of caterpillars.

Though single eggs are commonly found, most of the eggs are deposited in groups of two or three. Strings of four are frequent and strings of five (pl. 4, fig. 17) occasional. One string of six was found. Sometimes two eggs are found side by side and unattached, presumably laid by different females. One leaflet was discovered which bore seven eggs in one group of three and two groups of two each.



Eggs of *Rhabdoides cellus*.

FIGS. A-D.—A, egg with 17 ribs, lateral view. B, egg with 17 ribs, apical view. C, egg with 18 ribs. D, egg with 19 ribs. All the eggs have the micropylar portion chipped away. See also plate 3, fig. 17, and plate 5, figs. 28, 29.

When the eggs are deposited in strings, the second egg is placed between the equator and the pole of the first so that the vertical axes of the two eggs make an angle of roughly 120° with each other, and the third is placed on the second in the same way. The little egg strings are thus very irregular, but only the first egg is fastened to, or touches, the leaf.

The eggs (pl. 4, fig. 17; pl. 6, figs. 28, 29; text fig. A, p. 26) are subglobular, 1 mm in diameter, very nearly as high as broad, broadest shortly above the base, with the upper portion very regularly and broadly rounded and the broad flattened base slightly concave in the center and rounded at the borders.

The sides are marked with prominent vertical ribs (figs. A-D, p. 26) that vary from 15 to 21, but are usually 17 and commonly 18, in number. In 152 eggs the number of ribs was as follows: 15 (4); 16 (33); 17 (56); 18 (45); 19 (12); 20 (1); 21 (1). Expressed in percentages the figures are approximately as follows: 15 (2.6 percent); 16 (22 percent); 17 (37 percent); 18 (29 percent); 19 (7.8 percent); 20 (0.6 percent); 21 (0.6 percent).

Irregularities in the ribs are infrequent, only three cases having been found. One egg with 19 ribs has an additional incomplete rib extending from the apex to a short distance beneath the shoulder. Another egg with 19 ribs has an incomplete rib that extends upward from the base to a short distance beneath the shoulder. A third egg with 16 ribs has an incomplete rib that extends from the base half way up to the shoulder. The ribs on either side of this incomplete rib bend toward each other beyond it so that at the shoulder they are the same distance apart as any two of the other ribs. The second rib to the left of the incomplete rib forks just beneath the shoulder, the right branch joining the rib to the right at the shoulder.

The ribs run from the upper portion of the curved border of the flattened base upward to the summit. In the lower half of the egg they are low, narrow, and inconspicuous, but they increase in height, width, and prominence above the equator. In fresh eggs the ribs above the equator may bear long irregular glassy hairs that soon wear off.

The ribs are connected by very fine transverse lines placed very close together, the oblong interstices between them over most of the surface being roughly 8 to 10 times as long (transversely) as broad, but becoming shorter toward the summit. In the lower half of the egg these transverse lines are so faint as to be obsolescent; in the upper half they become more definite, higher, and somewhat more widely spaced. Above the equator where the transverse lines join the vertical ribs they become suddenly and greatly expanded so that the ribs appear to be prominently and evenly beaded.

The apical portion of the egg for an area about 0.5 mm in diameter, or about half the diameter of the egg itself, is occupied by a conspicuous irregular reticulation. Alternate ribs are continued to the micropylar basin at the summit of the egg. Between these are usually three stout and widely spaced transverse bars as high and conspicuous as the ribs themselves. Some of the ribs here commonly fork, so that the reticulation is composed of quadrate, triangular, rhombic, and five-sided figures usually of more or less equal area. The ridges of this reticulation, including the continuation of the ribs within this area, are narrower and lower than the ribs beyond, smooth, high, abruptly differentiated from the smooth surface of the egg, and very conspicuous. The apex of the egg is occupied by a small flat circular micropylar basin.

The eggs are yellow, becoming brownish yellow before hatching. They are translucent, so that the head of the caterpillar is easily seen through the thin shell. The empty egg shells are translucent white with more or less of a pearly luster.

FIRST-STAGE CATERPILLAR

Plate 6, fig. 30; plate 8, figs. 43, 49, 50

On issuing from the egg the caterpillar of *Rhabdoides cellus* is 2 mm long and has a disproportionately large head 0.7 mm in width.

The head is finely and evenly rugose and bears a few widely scattered long bristles. The ocelli are six in number, four of them equally spaced in a curved line, one directly back of this line on the same level as the space between the second and third in the line counting from the top and distant from the line about half its length, and the sixth behind and below the others, "southwest" of the lower end of the line on the right side and "southeast" on the left, and distant about the length of the line from the its lower end.

The dorsal shield on the first thoracic segment is large and conspicuous with broadly rounded ends that reach about half way down the side of the segment. Its longitudinal length in the middorsal line is equal to about half the length of the head at the same level. It bears a bristle near the anterior edge half way between the middorsal line and the end, and another half way between this and the end near the posterior edge.

The first thoracic segment bears on either side a single very long hair curving anteriorly.

The legs of the first thoracic segment are darker and more corneous than the others.

Each segment behind the first thoracic bears two long hairs near the ventrolateral margin and one above the spiracle, or, if a spiracle is not present, in the corresponding position.

Dorsally each segment bears four well-separated minute papillae each supporting a short, straight, blackish, apically enlarged bristle, there being four rows of these down the back, the two inner rows very regular, the two outer more or less irregular.

The terminal segment bears on each side of the median line two long hairs near the distal border of the dorsal surface, and two below.

The prolegs have two long hairs on the outer side.

The spiracle of the eighth abdominal segment is very much larger than the minute spiracles on the other abdominal segments, and is situated about twice as far above the ventrolateral border.

The anal aperture has below it a conspicuous long wedge-shaped fan terminating in a comb of long, dark, tapering, stiff bristles.

The head is light yellow brown, the mouth parts margined with narrow lines of darker, and the bases of the ocelli darker. The dorsal shield is deep maroon, the rest of the first thoracic segment pink. The body is chrome yellow.

SECOND-STAGE CATERPILLAR

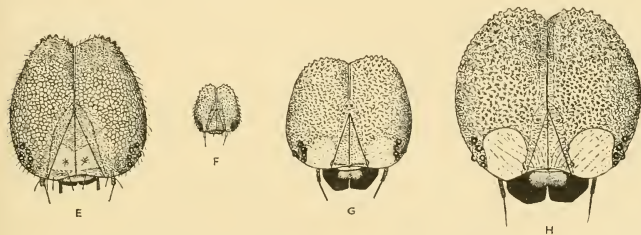
Plate 6, figs. 31, 32; text fig. E, p. 29

The head capsule is 1.1 mm wide at the widest part.

The head is more coarsely rugose than in the first stage. On the summit of the lobes are several well-separated, scalelike, more or less thin, sharply pointed triangular processes standing directly upward or leaning slightly forward. The hairs are much more numerous than in the stage preceding, but shorter. They are longest about the mouth parts.

The short, blackish, apically enlarged bristles with flaring ends standing on conical papillae are much more numerous on the dorsal surface than in the first stage, and more irregularly scattered.

The lower portions of the sides of the segments below the stigmata bear numerous short hairs.



Heads of second- to fifth-stage caterpillars of *Rhabdoides cellus*.

FIGS. E-H.—E, second stage. F, third stage. G, fourth stage. H, fifth stage. Figs. F-H are all on the same scale, much less magnified than fig. E. The head of the first stage is shown on plate 7, figs. 49, 50.

The sides of the prolegs bear numerous short hairs.

The end of the body bears numerous hairs of various lengths, though none of them are very long.

The head is deep maroon, almost black, without markings. The first pair of thoracic legs is dark, almost as dark as the head, but the others are of the same color as the body.

The maximum size for this stage is 8 mm in length.

THIRD-STAGE CATERPILLAR

Plate 6, fig. 33; text fig. F, p. 29

The head capsule is 2 mm wide at its widest part.

The scalelike prominences on the summit of the head lobes are more numerous than in the preceding stage, and the hairs are also more numerous.

On the dorsal surface the short bristles with enlarged ends are more numerous, and lighter in color. These also extend down the sides to below the spiracles. Below these along the inferolateral border of the segments are numerous hairs of moderate length.

The prolegs bear numerous hairs of moderate length.

The head is almost black, and is unmarked. The first pair of true legs is darker than the others.

The maximum size for this stage is 12 to 13 mm in length by 2.7 mm in width.

FOURTH-STAGE CATERPILLAR

Plate 6, fig. 34; text fig. G, p. 29

The head capsule is 3 mm wide at its widest part.

The total length of freshly molted caterpillars just entering this stage is 12 to 13 mm.

The head is as in the stage preceding, but more densely hairy, the hairs curving downward and being longest in the vicinity of the mouth parts.

The thoracic shield bears numerous scattered hairs.

Beyond the abruptly truncated end of the thoracic shield, extending downward to in front of the upper portion of the large oval spiracle, is a triangular plate, more or less definite, with the downward pointing apex very broadly rounded, representing the detached end of the shield, from which it is separated by a rather broad channel.

The dorsal surface is thickly beset with short, fine hairs, more or less of the ordinary form, which become longer and finer along the lower lateral margins of the segments, and longer and stouter at the end of the body.

The prolegs bear numerous fine hairs which become thickly crowded and curved downward toward the foot.

All of the circular indurated spots described for the last (fifth) stage are present.

The color is as in the following stage, except that the head is somewhat darker and the large spots, now appearing for the first time, are vague and ill-defined and shade imperceptibly into the surrounding color.

When the first thoracic segment is swollen preparatory to molting, a broad, elongated deep chrome spot appears extending backward and diagonally outward from under the necklike posterior extension of the head capsule on either side at the dorsolateral margin.

The maximum size of this stage is about 22 mm long by 4.5 mm wide.

FIFTH-STAGE CATERPILLAR

Plate 6, figs. 35, 36; plate 8, figs. 44-48, 51, 52; text fig. H, p. 29

The head capsule is from 4.3 to 4.8 mm wide at the widest part, slightly below the middle, and 4.8 mm high from the tip of the mandible to the summit of the lobe on the same side.

The total length of freshly molted caterpillars just entering this stage is about 23 mm. They will pupate when 24 to 25 mm long and 5 mm broad. Fully fed caterpillars are 32 to 35 mm long and unusually slender for caterpillars of this group, being only 5 to 6 mm broad. The largest one found was, when resting, 30 mm long and 6.7 mm broad.

The head at the summit of the lobes is minutely roughened with fine, more or less irregular vermiculations. Among these are numerous well-separated, abruptly elevated mesa-like elevations with the flattish top sloping upward and forward, or on the upper part of the front of the head outward and downward. From the edge of the top of these mesa-like elevations 6 to 8 or more fine but prominent ridges run downward and, turning outward, join the general fine vermiculation of the surface. These abrupt elevations, finally becoming irregular rugose tubercles, run down the sides of the head to the mouth parts. The front of the head below the upper portions of the lobes is closely vermiculated with very fine ridges which at first are here and there gathered into knots, but lower down become evenly disposed over a minutely rugose surface. Above the large yellow spots in the vicinity of the frontal triangle and also over the spots themselves the ridges become parallel and well spaced and run downward and inward toward the frontal triangle, making with it an angle of about 60°. Just above the apex of the frontal triangle and on each side of the median groove there is an irregular shield-shaped area with a small circular elevation in the center. There are two more similar circular elevations lower down, one on either side of the frontal triangle. On the frontal triangle there is a fine but prominent median ridge which in its upper quarter is somewhat sinuous with side branches running off from it, but in its lower three-quarters is straight and regular with a broad bare space on either side. Two or three of the lines over the yellow spot run into the frontal triangle, here bending downward and running parallel with the median carination to the lower edge. The head is thickly beset with slender hairs curving downward. These become erect on the frontal triangle, and over the yellow spots project downward and inward toward the mouth parts. The ocelli are arranged in a curved line of four along the outer concave edge of the yellow spot, with a fifth opposite the middle of the row forming with the first and third

in the curved row, counting from either end, approximately an equilateral triangle.

The shield on the first thoracic segment bears numerous short hairs. The detached ends of the thoracic shield are enclosed with the rest of the shield in a thick pad of skin and are not readily identifiable.

Above the anterior to the large prothoracic spiracle, in the center of the detached end of the thoracic shield, is a small, smooth, circular indurated spot surrounded by a circle of well-spaced hairs which are distant from it somewhat more than its own diameter. This spot is directly "northeast" of the spiracle on the right side, and "northwest" on the left. It is distant from the spiracle nearly the longer (vertical) diameter of the latter and lies in a vertical plane about its shorter diameter in advance of it.

There is another similar but less conspicuous spot below this, directly in front of the middle of the spiracle.

Directly beneath this, near the ventrolateral border of the segment and over the base of the first pair of thoracic legs, are two similar but larger spots with a diameter nearly twice as great. These are distant from the spiracle nearly twice its greater diameter and are about half their own diameter apart. One of them is higher than, and in advance of, the other.

Below and anterior to the first abdominal spiracle—"southeast" on the right side and "southwest" on the left—and distant from it about its shorter diameter is a similar spot of the same size as the two last mentioned. On the segments following, this spot is considerably lower, being distant from the spiracle about twice its longer diameter, the distance slowly increasing as the spiracles gradually decrease in size posteriorly. On the eighth abdominal segment the spot is directly beneath the enlarged spiracle, which is situated at a higher level than the spiracles preceding, and is distant from it nearly twice its longer diameter.

In the middle of the outer side of the large middle segment of each of the prolegs is a similar, but smaller, spot, that on the terminal prolegs being larger than the others.

On the ventral surface there are two similar spots on each of the two first abdominal segments situated one on either side on a line between the middle of the bases of the last thoracic legs and the first prolegs, and there are two similarly situated on the segment between those bearing the fourth pair and the terminal prolegs. There are also two on the dorsal side of the last segment.

The body is clothed with very numerous but well-spaced short, fine, pointed hairs, among which are numerous much longer, scattered,

slender, and pointed transparent hairs that become somewhat more numerous on the lower lateral borders of the segments, and much more numerous and darker on the dorsal surface of the last segment. The prolegs bear numerous down-curved hairs about the foot, and many on the basal portion.

The ventral surface has rather numerous scattered hairs.

The anal fan (pl. 8, fig. 52) is long wedge-shaped, ventrally gently convex, with 18 long, tapering, blunt teeth about the rounded distal edge. From the base of each of these teeth a rounded ridge runs to the narrow base.

The head in this stage resembles very closely the head of *Epargyreus tityrus*, differing chiefly in its smaller size, in the longer and more numerous hairs with which it is clothed, in its darker color, and in its yellow instead of orange spots.

The head is claret brown with a large deep chrome spot between the frontal triangle and the ocelli on either side. The border of the chrome-yellow spot adjoining the ocelli is gently concave, following the curved line along which the ocelli are placed, the inner border is evenly rounded, and the upper and lower borders are flattened. The mandibles and antennae are shining black.

The first thoracic segment bears a smooth clay-colored dorsal shield narrowly bordered in the middle third of the anterior margin with olive buff. A fine line of olive buff runs across it in the middorsal line of the caterpillar. A narrow groove near the posterior margin of the shield running not quite to the ends on either side is darker in color than the rest of the shield. The remainder of the first thoracic segment is bright rose red, or rose red below and straw yellow above, the two colors being divided by a line running from the lower portion of the sides of the neck just behind the head backward and upward to a point on the second thoracic segment at the level of the end of the thoracic shield.

The dorsal portion of the body is apple green with numerous evenly distributed small sulphur-yellow dots which are darkest in the anterior third, gradually becoming paler posteriorly.

The dorsal surface is delimited by a conspicuous broad lateral line of clear sulphur yellow. In the middle of the body this line is somewhat wider than the height of the deep chrome spots on the head, but it tapers to less than half this width at either end. The line is in reality interrupted, being composed on each segment of an irregularly bounded, but more or less squarish, mark followed by a broad vertical dash of the same height or slightly higher, which in turn is followed by three narrower vertical lines of the same length or slightly longer.

The sides of the body below the sulphur-yellow lateral line are apple green, somewhat lighter than the dorsal surface except in an indefinite band just below the lateral line and of about the same width. They bear numerous evenly distributed small sulphur-yellow dots.

The under surface, including the prolegs, is apple green, but paler, clearer, and more translucent than the upper surface, and without any yellow dots. The posterior end of the body and a narrow and ill-defined line just above the prolegs are pale, like the under side.

The thoracic legs, which at this stage are all alike, are straw yellow, becoming faintly brownish at the tip.

DURATION OF THE EARLY STAGES

We regret that it was not possible to determine the length of time spent by the larvae in each stage or the length of time spent in the egg, but the food plant is not one that lends itself to transplantation to or cultivation in a city house or garden.

The elapsed time between the appearance of the first brood (May 30, or perhaps a few days earlier) and the first appearance of the second brood (July 20) is 50 days, or slightly over 7 weeks. Two weeks are spent in the pupa, so that the period from the laying of the eggs to the formation of the pupa is 5 weeks, or a few days more.

MOLTING

The molting from the fourth to the last stage may be described as follows. Caterpillars preparing to molt are easily distinguishable by their swollen first thoracic segment. This becomes more and more distended until the skin tears apart just back of the thoracic shield. The lobes of the new head emerge from the rapidly widening slit, and in a few minutes the old head capsule with the thoracic shield attached drops off.

The new head is at first very pale dull greenish yellow against which the large chrome yellow spots, much darker, stand out prominently. The head very soon begins to darken, and within two hours has become a rather deep reddish flesh color.

After a resting period of considerable duration the caterpillar crawls out of the old skin, which is left extended at full length on the floor of the shelter.

The other molts do not seem to differ from this, except that in the molt from the first to the second stage the head capsule breaks away from the skin of the body along its posterior border, leaving the thoracic shield attached to the body skin.

An interesting feature of the molts is the striking uniformity in the sizes at which the various molts take place in different caterpillars. Fifty or more molting caterpillars were measured, and the difference between any two at the same stage was found to be negligible.

HABITS OF THE CATERPILLAR

The caterpillars of this species, like the adults, are more sluggish than the corresponding stage of *Epargyreus tityrus* or of *Achalarus lyciades*. If caterpillars of these three species are placed together, those of the last two will be the first to escape. They are also much less excitable, and although they will sometimes on being disturbed spit out a copious green liquid, or turn suddenly and attempt to bite, such actions are very exceptional. Indeed, the placidity of these caterpillars stands in strong contrast to the irritability of the caterpillars of *Epargyreus tityrus*.

The caterpillars remain concealed within their shelters during the day, those in the first three stages clinging to the roof with their head in the apex, those in the last two stages resting on the floor. In the first two stages, especially in the first, they are more or less restless, sometimes wandering about within their shelters and occasionally protruding the head from under its edge for a second or so, but the larger caterpillars remain quite inert.

At or just before dusk the caterpillars begin to leave their shelters to feed. Those in the first two stages may be seen crossing to the opposite side of the leaflet, and those in the third stage traveling to another leaflet. The caterpillars in the last two stages appear to be more cautious and to commence feeding later, as none of them were seen in the field outside their shelters. In the house, however, they fed voraciously after dark, consuming wilted and even dry leaves if no fresh leaves were available.

The caterpillars will live together in harmony under the most crowded and adverse conditions, displaying no tendency toward cannibalism.

SHELTERS

Plate 7, figs. 37-42

On escaping from the egg, the caterpillar eats away the central portion to within a short distance of the profile of the egg as seen from above. It then protrudes its head, directly upward, for a distance of about 0.5 mm and remains in this position for a few hours without moving. Then somewhat suddenly it crawls from the egg, travels to the edge of the leaf, and begins to construct its first shelter.

The shelters made by the young caterpillars (pl. 7, figs. 41, 42) are very characteristic. In the leaflet a cut is made running diagonally in from the edge, the inner end of the cut being nearer the base of the leaflet than the outer. Then nearer the base of the leaf a second cut is made, much shorter than the first, running inward at right angles to the edge of the leaflet to a point near the inner end of the first cut. The wedge-shaped flap thus formed is then turned inward over the upper surface of the leaflet (see pl. 7, fig. 40). The caterpillar now draws the two ends of the short edge of the flap toward each other and fastens the free angle to the surface of the leaflet near the inner end of the cut so that this border, originally the shorter edge of the flap, forms a high narrow arch. Beginning at the top of the arch the caterpillar fastens the sides of the highly arched opening tightly together, working downward as far as possible toward the bottom, but always leaving a low-triangular opening at the bottom (pl. 7, fig. 39). The acute angle formed by the edge of the leaflet and the longer cut is now fastened down to the surface of the leaflet as far away as possible from the edge of the leaflet, so that the edge of the longer cut and that edge of the flap that was originally the edge of the leaflet lie close down upon the upper surface of the leaflet. The only portions of the flap that are fastened to the surface of the leaflet are the angles between the original outer edge of the leaflet and the two cuts.

The result of this operation is a shelter that in shape resembles a limpet with the apex of its shell near one end, or a broad cone cut very diagonally. The apex of this structure was originally the middle of the shorter cut in the leaflet, now folded together.

The apex or peak of the shelter is secured by a broad and very dense mass of silk, and a very dense band closes the opening in front. At each end of the line forming the hinge where the bending of the flap over the upper surface of the leaf takes place there is a large amount of silk in a dense band forming a sort of bracket that holds the flap in the proper position over the upper surface of the leaflet. These two brackets are commonly connected by a close network of silk running from one to the other—that is, along the line of folding. A broad and rather dense network of silk is run down the middle of the roof of the shelter to furnish a footing for the caterpillar when resting during the day. The whole floor of the shelter is covered with a fairly close network, the caterpillar working inward from the edges, where the silk is laid down most thickly. This last network has the effect of making the floor of the shelter concave, thus giving more room within it.

The entire roof of the shelter is sometimes lined with silk, but in this case the band down the middle is always much more dense than the rest.

To recapitulate, the densest bands of silk are spun (1) in the peak of the shelter, (2) down the anterior part of the shelter, and (3) at the ends of the line of folding. All these bands are so strong that if the shelter is pulled apart the leaflet will tear around their ends. They are responsible for the form and for the security of the shelter. They are so very much stronger than the few threads used to fasten the angles of the flap down upon the surface of the leaflet that when these are cut after the abandonment of the shelter, the latter retains its form and is quite indistinguishable, unless touched, from an inhabited shelter. The broad network down the middle of the top of the shelter is considerably more dense than the relatively open, though complete, network that covers the floor of the shelter and makes it concave; this last is more dense peripherally than in the central portion.

The caterpillar enters and leaves the shelter under the inner edge—that is, the edge toward the middle of the leaflet. Within the shelter it always rests on the under side of the roof extended at full length with its head in the apex of the cone.

The path of the caterpillar from the shelter to the feeding area on the opposite border of the leaflet or in the later stages on another leaflet is marked by a runway of irregularly zigzag silk threads.

The original shelter is occupied for only a short time. It is then abandoned, first being rendered useless by the cutting of the threads that hold the flap down upon the upper surface of the leaflet. A second shelter is made which is abandoned and rendered useless in the same way, and others follow suit.

The first two shelters are usually made on the same side of the same leaflet, the second nearer the base than the first. The third is either on the other side of the same leaflet, or upon an adjoining leaflet. The large shelters of the third-stage caterpillars are always solitary, each on a leaflet by itself.

A single leaflet will commonly have three or four shelters along the margin of its outer half, but sometimes more are found, and on one leaflet we found no less than eight.

As the eggs are deposited usually two or three to a leaflet, the shelters nearest the base of the leaflet on each side are commonly occupied, the others empty. Sometimes three caterpillars are found on a single leaflet, though this is unusual. As a rule only two caterpillars will be found on a single leaflet, the others, if there are more than two eggs in the string, going to the adjacent leaflets.

The small caterpillars build their shelters progressively basalward from the apex of the leaflet, though never in its basal half. As they become larger they descend to the larger leaflets lower down.

As a result of the habit of the caterpillars of partially destroying abandoned shelters, occupied shelters are easily distinguished from unoccupied ones, a slight touch sufficing to raise the latter from the surface of the leaflet.

On a single occasion we found a second-stage caterpillar in a shelter made by fastening together two small overlapping leaflets after the fashion of the caterpillars in the last stage.

After entering the fourth stage the caterpillar constructs a shelter of a different type. Sometimes two long cuts are made running directly inward from the edge of the leaflet about an inch apart, and the outer edge of the flap so formed is simply folded inward over the upper surface of the leaflet and fastened down along the inner edge forming a cylindrical shelter more or less broadened in the middle. More commonly, perhaps, the margin of the leaflet is simply folded inward without any cuts being made. Whereas the shelters described previously are always in the outer half of the leaflet, these shelters are always in the broadest portion.

This type of shelter is soon abandoned, and the now large caterpillar binds two superposed leaflets together by a series of stout silk bands having the form of an elongate oval from 1 to 2 inches in its longer diameter. Within this oval both leaflets are lined with a sparse silk network, most dense about the periphery, that pulls their surfaces into a rather strongly concave form resulting in a well-concealed and commodious home.

Occasionally any convenient leaf may be fastened to the upper surface of a hog-peanut leaflet, or the shelter may be made of the leaves of the plant about which the hog-peanut is twining. Thus we have twice found large caterpillars in a shelter made by fastening a golden-rod (*Solidago*) leaf securely down upon a hog-peanut leaflet, and we have found others in shelters made of a hog-peanut leaflet and an oak leaf, two hickory leaflets, two sassafras leaves, and two grape leaves.

SHELTERS MADE BY RELATED SPECIES

On July 4 we found, together with the caterpillars of this species, a number of the caterpillars of *Epargyreus tityrus* on the larger leaflets of *Meibomia* (or *Desmodium*) *paniculata*, and on the leaflets of *M. dillenii* and the much less common *M. michauxii*. They were especially common on the first named. They were also abundant on the

leaflets of *Robinia pseudacacia*. With these on *Meibomia paniculata* and on *M. dillenii* we also found, in much smaller numbers, the caterpillars of *Achalarus lyciades*.

The caterpillars of both these species were in all stages, from those just hatched to the fully grown. The caterpillar of *Rhabdoides cellus* is easily distinguished from that of the other two species by its apple-green color and especially by the broad bright yellow lateral line.

The shelters made by the small caterpillars of *Epargyreus tityrus* and of *Achalarus lyciades* are alike, but they differ from the shelters made by the small caterpillars of *Rhabdoides cellus*. A long slit is made in a leaflet running inward at an angle more or less approximating 45° with the edge for a distance of about 6 mm. Then about 8 mm nearer the base of the leaflet another cut is made more or less at right angles to the edge of the leaflet to a depth of about 5 mm. The inner ends of these two cuts are 2 or 3 mm apart. The flap formed by these cuts is now bent inward over the upper surface of the leaflet and fastened down at the angles formed by the cuts and the outer margin of the leaflet. The two cut edges are left unfastened. The caterpillars of *Epargyreus tityrus* and of *Achalarus lyciades* enter and leave the shelters through the lenticular openings at the ends, whereas those of *Rhabdoides cellus* enter and leave the shelters under the long inner edge.

The shelters of the small caterpillars of *Rhabdoides cellus*, looking like little green limpets along the edge of the hog-peanut leaflet on the upper side, are at once distinguishable from the slightly and evenly convex shelters of the similarly small caterpillars of *Epargyreus tityrus* and *Achalarus lyciades*.

In the last stage the caterpillars of both *Epargyreus tityrus* and *Achalarus lyciades* make their shelters quite after the fashion of those of *Rhabdoides cellus*, at first folding inward a portion of the leaflet between two well-spaced cuts and fastening it down, and later, when they have become large and heavy, fastening two leaflets together. On *Robinia pseudacacia* the larger caterpillars of *Epargyreus tityrus* fasten together from two to eight, usually four or six, of the small leaflets.

We have never found the caterpillars of *Rhabdoides cellus* on any plant other than the hog-peanut. Though we have found hundreds of the caterpillars of *Epargyreus tityrus*, we have never found but one on the hog-peanut in this region. This was a fully grown one in a shelter formed of two leaflets, and it may possibly have strayed to the hog-peanut from some other plant.

However, on Apple Orchard Mountain in Bedford County, Va., we have found the caterpillars of *Epargyreus tityrus* frequently on the small-leaved hog-peanut (*Falcata comosa*), and they have been reported by others as found on the same plant.

POSSIBLE CORRELATION BETWEEN THE TYPE OF SHELTER AND THE TEXTURE OF THE LEAVES

It is possible that the very delicate texture of the hog-peanut leaflets, rather than any inherent peculiarity of the young caterpillars of the gold-banded skipper, is responsible for the construction of the peaked shelters. Some insect larvae show great ingenuity in adapting themselves to changed conditions.

The leaflets of the hog-peanut are less firm than are those of the species of *Meibomia*, *Robinia*, etc., upon which the caterpillars of *Epargyreus tityrus* and of *Achalarus lyciades* usually are found. Indeed, they are so delicate that unless the little shelters were braced in some way they would scarcely support the weight of a caterpillar clinging to the roof.

If the peaked shelters are simply due to the delicate texture of the hog-peanut leaflets, then the caterpillars of *Rhabdoides cellus* when on plants with firmer leaves would construct shelters of the same type as those of *Epargyreus tityrus* and of *Achalarus lyciades*, and these species on the hog-peanut would make their shelters after the fashion of those of *Rhabdoides cellus*.

On examining our series of second stage caterpillars after preservation in alcohol, two or three caterpillars of *Epargyreus tityrus* were found among them. Now if these had been in the type of shelter usually made by this species this would certainly have been noticed in the field. But they were not recognized until after preservation. The inference is that they were found on the hog-peanut living in peaked shelters of the type formed by the caterpillars of *Rhabdoides cellus*. But actual proof is lacking.

Elsewhere we have found the young caterpillars of *Epargyreus tityrus* on the small-leaved hog-peanut, always in its usual type of shelter. The leaflets of this plant, however, are of a firmer texture than the large leaflets of *F. pitcheri*.

COCOON

The fact that we have found a large number of abandoned shelters made by fully grown caterpillars, but have never found a pupa in a shelter, leads us to believe that the caterpillars leave the shelters and pupate among the dead leaves on the ground.

We have found the pupae of *Epargyreus tityrus* in the last stage shelter, but never the pupae of this species.

In forming their shelters the largest caterpillars fasten one leaflet down upon the upper surface of another in such a way as to leave an oval cavity about an inch long and of considerable depth between them. The leaflets are fastened together by strong bands of silk 2 to 6, usually 3 or 4, mm apart. These shelters are not destroyed when they are abandoned, and therefore are frequently appropriated by spiders or serve as more or less temporary abiding places for various types of insects.

In captivity the cocoon is formed after the fashion of the shelter of the fully grown caterpillar but is much more elaborate. Two suitable dry leaves are fastened together in such a way as to leave between them an oval cavity nearly or quite an inch long and of considerable depth. The stout bands of silk by which the leaves are fastened together are usually 3 or 4 mm apart, though sometimes closer together and sometimes more distant. They are stouter than the bands used in fastening the leaves together for the last shelter.

If the leaves are broken so that an aperture of appreciable size is left this aperture is closed by long bands of silk (pl. 4, fig. 18) usually 3 to 4 mm apart, though sometimes closer and sometimes distant as much as 6 mm, between which are run more or less regular cross bands approximately the same distance apart, forming an irregular network. The caterpillar then broadens the bands and cross bands until some of the interstices are wholly closed and most of them are reduced to a rough circle of varying dimensions.

This broadening of the bands and cross bands is simply a part of the process of lining the whole interior of the cocoon with a fairly uniform irregularly crisscross loose web of silk that scarcely conceals the underlying leaf and becomes dense only about the spot where, when it finally comes to rest, the caterpillar attaches the terminal pair of prolegs.

If the caterpillars are too crowded one may drive out another from a partially completed cocoon and appropriate it for itself, or part of a cocoon may be eaten away by caterpillars not yet fully fed. But these caterpillars are never cannibalistic.

PUPATION

Just before pupation the largest larvae shorten to a length of about 24 mm. The body becomes swollen to a maximum width of about 7 mm, the skin becoming very taut so that the plications on the

segments disappear. The second thoracic segment, which ordinarily is of about the same size as the third, becomes enormously swollen so that it is larger, though not broader, than the last thoracic and first abdominal segments together, and the skin covering it becomes exceedingly taut.

The color changes to a fairly uniform apple green, somewhat deeper green on the second thoracic and last three abdominal segments and slightly more yellowish elsewhere. The conspicuous yellow lateral stripe and the yellow spots completely disappear. The bright pink of the first thoracic segment fades to a light putty color with scarcely a trace of pink, and the brilliant chrome spots on the head fade to a dull deep putty color and become inconspicuous.

After a quiescent period of about 2 days the head splits along the median groove between the epicrania and down the suture between one of the epicrania and the adjoining adfrontal. The dorsal thoracic shield splits across in the middorsal line, and the skin of the dorsal surface splits down the median line as far as the fourth abdominal segment, or just above the second pair of prolegs. By intermittent wriggling the larval skin is shoved backward and compressed into a small bundle at the end of the body, drying out with extraordinary rapidity during this process. By further wriggling the cremaster is freed from the larval skin and entangled in the button of silk on which the posterior prolegs of the caterpillar previously rested.

PUPA

Plate 5, figs. 19-25

Immediately after its formation the pupa is a brilliant transparent green on the wing covers and thorax, with the abdomen a very light yellow clay color, almost straw yellow, becoming greenish at the tip. The eye is bordered posteriorly with a curved row of small bright red spots. Between the prothoracic spiracles are two fine transverse lines of bright red, one on either side of the median line. The anterior border of the thorax is pinkish. The prothoracic spiracles and the cremaster are dark brown, the former soon becoming blackish.

Within an hour the pupa begins to darken, the abdomen and head becoming gradually yellow brown and the wing covers and thorax olive green, darkest on the dorsal portion of the thorax and the anterior half of the wing covers below. In about 4 hours the abdomen has become orange brown, darkest posteriorly, the head orange brown with a tinge of olive green, and the thorax and wing covers bright olive green, lightest on the posterior half of the wing covers ventrally.

Continuing to darken, the head, thorax, and wing covers become dark coffee brown with a tinge of green, darkest on the outer portion of the wing covers, lighter and slightly reddish dorsally. The abdomen is bright burnt sienna above, later changing to bright mahogany brown, with the posterior half of each segment darker than the anterior, and the cremaster much darker.

The darkening continues slowly through pupal life, the pupa becoming entirely blackish 2 or 3 days before the butterfly emerges.

For 2 or 3 days after the formation of the pupa the abdomen remains very flexible, and the pupa somewhat irritable. The abdomen then gradually shortens and toward the end of the pupal stage has become immobile.

When first formed the pupa is very shiny and has a wet appearance. With the darkening in color the appearance of wetness disappears, and a thin, even, finely granular lavender-gray bloom or pruinosity gradually begins to manifest itself. During the next 20 hours the bloom increases in density and extends itself all over the pupa, except for the narrow rings between the abdominal segments and the deepest portions of the sutures, appearing last on the wing covers, over which it spreads from the base to the tip. The outer portions of the wing covers are the last areas to be covered. Meanwhile all trace of green has disappeared from the pupa. The bloom now begins to lighten in color and to change from a granular to a flocculent appearance, transforming into a flocculent and rather thick covering, looking when magnified somewhat like light, flocculent lavender-tinted snow. It is absent from the soft bands between the abdominal segments and from the beveled edges of the latter, from the glazed eye, from the circular patches on the ventral side of the abdomen, from the deepest portions of the sutural lines, from the prothoracic and other spiracles, and from the cremaster, except the sunken ventral portion; but eventually it may spread over some or all of these, although the prothoracic spiracles and the cremaster are rarely more than lightly covered.

The bloom is of a soft waxy texture and forms a very efficient protection against water. It is only very slightly, if at all, soluble in alcohol.

In general form the pupa is most like that of *Achalarus lyciades*, with the abdomen plump and the anterior portion rather slender.

As viewed dorsally the head and prothorax form a subquadangular mass slightly broader in front than behind, nearly twice as broad as long, with very broadly rounded outer angles passing over into a rather strongly convex front of which the middle third has a convexity of its own that brings it very slightly in advance of the arc formed by

the two lateral thirds. The head is separated from the thorax by a narrow but rather deep suture. Toward the head and prothorax the sides of the mesothorax converge from the well-rounded basal wing tubercles at an angle of about 30° with the middorsal line, the straight converging portions of the sides of the mesothorax being about twice as long as the outer profile of the prothoracic spiracle.

When viewed from in front the head curiously suggests the head of a manatee.

The mesothorax is slightly broader than long, rather strongly and evenly convex, and very slightly broader posteriorly than anteriorly. The basal wing tubercles are low and broadly rounded.

As viewed dorsally, the body increases in width from the posterior end of the mesothorax to the third abdominal segment, then tapers at about the same rate gradually and evenly to the base of the cremaster.

The dorsal profile rises in a broad ellipse from the middle of the anterior end to the row of tubercles between the prothorax and mesothorax, then rises slowly in a broad curve to the end of the anterior third of the mesothorax, whence it runs in an almost straight line very slightly downward, descending somewhat abruptly near the end of the mesothorax, which rises in a slight convexity. From the end of the mesothorax the profile rises evenly and very slowly to the third abdominal segment, and the fourth which is nearly as high, then curves with increasing rapidity downward to the base of the cremaster.

From the middle of the anterior end the ventral profile curves in an ellipse to the basal portion of the antennae, then runs in an almost straight line to above the first abdominal segment, where it curves broadly and, reaching the maximum height above the third abdominal segment, descends in a more or less straight line to the base of the cremaster.

The prothoracic spiracles are large, auriculate with a protuberant flaring posterior lip, and are directed forward and very slightly outward. The outer side of the raised lip bears 12 to 14 broad, well-spaced rounded ridges that run from the base to the swollen and somewhat tubercular rim. Within the lip is a broad, dense band of short dark brown hairs attached to a curved semicircular shelf of nearly uniform width that leaves a large semicircular opening with a radius nearly or quite equal to twice the width of the band of hairs.

The position of the mandibles is indicated by a broad, low, rugose, hairless hump.

The maxillae reach very nearly to the tip of the wing covers.

The tip of the antennae is 3 mm from the end of the wing covers.

The posterior legs terminate 1 mm before the tip of the antennae, or at about the middle of the second abdominal segment.

The fore legs end 3 mm in advance of the hind legs.

The moveable abdominal segments are encircled just within the anterior end by a low, narrow, inconspicuous elevated band.

The cremaster is 2 mm long, slender and recurved, and bears on the truncate tip numerous slender light brown spines with the tips curved in varying degrees, sometimes in a spiral.

Except on the third and following abdominal segments, on the glazed eye, and sometimes on the antennae, the pupa is rather conspicuously sculptured.

On the mesothorax the sculpture is relatively inconspicuous, consisting of numerous more or less regular, fine transverse grooves and a fine median line.

On the outer thirds of the metathorax the sculpture consists of fine irregular diagonal grooves; the middle third is more coarsely sculptured.

On the first two abdominal segments the sculpture consists of fine, irregular transverse lines.

The prothorax is rather deeply sculptured with irregular deep transverse grooves in the two central quarters and laterally directed chevron-shaped grooves in the lateral quarters. Along the posterior border of the prothorax between the prothoracic spiracles there is a sharp tubercle about midway between the spiracle and the median line with usually one smaller one between it and the median line and two smaller ones between it and the spiracle.

The portion of the head between the epicranial suture and the prothorax is marked by a low triangle with its base on the epicranial suture, behind which are two wedges with their small ends joined in the median line. These latter bear fine longitudinal lines that toward the broader outer ends become chevron-shaped, with the angles directed inward; the outermost chevron has a few short transverse lines between it and the outer end of the segment. The rest of the head, except for the smooth glazed eye, is finely rugose with more or less wavy lines.

The ventral surface, except for the abdominal segments, is finely sculptured with mostly transverse lines. The antennae may be finely sculptured with irregular transverse lines, or may be quite smooth, showing only the segmentation.

The pupa is studded with long curved hairs which are most numerous about the head and on the dorsal portion of the thorax, becoming shorter, finer, and more scattered on the abdomen. On the head the

hairs are segregated into definite patches. There is a large patch on the front, a smaller patch on either side behind and outside of this, just within the anterior portion of the base of the antennae, a large patch on the sculptured portion of the eye, a smaller patch beyond this and separated from it by the glazed eye, and a small but conspicuous patch on either side of the labrum.

There are no hairs on the wing covers or elsewhere on the ventral surface, except as follows. The first abdominal segment beyond the wing covers ventrally bears on either side of the median line a row of three hairs, the outermost the longest, at some distance beyond this a single hair, almost as far again beyond this single hair a group of three hairs arranged in a triangle, and beyond these seven widely scattered hairs. The next segment has the hairs similarly arranged. The segment following has the innermost group reduced to two hairs, and three hairs arranged in an equilateral triangle in place of the single hair on the segments preceding. The next segment has one hair anteriorly and near the median line, another slightly behind and outside this, two more beneath the middle of the space between the inner two hairs and the group of three on the preceding segment, and several more near the outer border. The segment preceding the cremaster has two hairs, one in front of the other, beneath the two innermost hairs on the preceding segment, and several more hairs in the outer portion of the posterior half.

The cremaster is provided with numerous long, stout hooks with the tips recurved spirally so that the point is on one side of and some distance from the shaft.

Eight pupae give the following dimensions:

Length mm	Maximum width mm	Minimum width mm	Width of head mm
20.5	6.2	5.5	4.5
17.3	6.4	5.0	4.3
17.5	6.3	4.8	4.0
18.2	6.2	4.8	4.0
17.7	6.4	5.0	4.0
16.8	6.0	4.7	4.1
17.7	6.4	5.2	4.0
18.0	6.8	5.7	4.2
—	—	—	—
Average 17.9	6.3	5.1	4.1

These measurements were made from pupae formed by caterpillars in captivity. As the caterpillars were not fed it is possible that the pupae are slightly below the average size. However, normal-sized butterflies emerged from others of the same lot.

When the butterfly emerges, the pupa splits first along the suture running between the posterior ends of the bases of the antennal sheaths, then along the inner edge of the antennal sheaths, and finally down the middle of the thorax dorsally. Three pupae were broken open in the same way.

In *Epargyreus tityrus* the escape of the butterfly is made after the same fashion, except that the second rupture is down the outer side of the antennal sheath instead of down the inner side. Thus in empty pupal cases of *Rhabdoides cellus* the antennal sheaths remain attached to the inner edges of the wing cases, whereas in empty pupal cases of *Epargyreus tityrus* they remain attached to the midtibial sheaths.

PARASITE

From one of the caterpillars a tachinid larva emerged and immediately pupated. In a few days the adult emerged from the pupa. Charles T. Greene was so kind as to identify this for us. It proved to be an example of *Achaetoneura aletiae* (Riley).

KEY TO THE EGGS OF RHABDOIDES AND RELATED GENERA

- a*¹. Egg regularly domed above, with no portion truncate; vertical ribs at least 15 (15 to 21) in number.
- b*¹. Vertical ribs very fine and low, becoming higher and conspicuously beaded above the middle of the egg; a broad area about the micropylar basin occupied by a large meshed and conspicuous reticulation in which the ribs and the widely spaced cross lines are smooth and of the same height and character.
- c*¹. With 15 to 21 (usually 17 or 18) vertical ribs; egg nearly as high as broad *Rhabdoides*.
- c*². With about 15 vertical ribs; egg a fourth broader than high.
Thorybes.
- b*². Vertical ribs high and conspicuous, not increasing in height above the middle of the egg; alternate ribs run to the micropylar basin; no conspicuous reticulation about the micropylar basin, the ribs and fine cross lines continuing directly to it..... *Epargyreus*.
- a*². Egg broadly truncate above over an area about equal in diameter to half the width of the egg; vertical ribs not over 15 in number.
- b*¹. With at most 12 vertical ribs; egg one-eighth again as broad as high.
Goniurus.
- b*². With more than 12 vertical ribs; egg one-fourth again as broad as high *Achalarus*.

KEY TO THE CATERPILLAR AT BIRTH IN RHABDOIDES AND
RELATED GENERA

- a*¹. Head excessively large; dorsal shield of first thoracic segment conspicuous; first pair of thoracic legs conspicuously more corneous than the others; head orbicular.
- b*¹. First thoracic segment with only the dorsal shield corneous.
- c*¹. Dorsal shield of first thoracic segment not nearly reaching the spiracles on either side.
- d*¹. Head light brownish yellow; dorsal shield of first thoracic segment much darker; body chrome yellow.....*Rhabdoides*.
- d*². Head black, sometimes blackish brown; dorsal shield of first thoracic segment of the same color as the head; body uniform pale yellow.....*Goniurus*.
- c*². Dorsal shield of first thoracic segment reaching and including the spiracles on the side.....*Achalarus*.
- b*². First thoracic segment entirely corneous.....*Thorybes*.
- a*². Head only moderately large; dorsal shield of first thoracic segment inconspicuous; all the thoracic legs alike in texture; head subpyramidal, much narrower above than below.....*Epargyreus*.

KEY TO THE MATURE CATERPILLAR IN RHABDOIDES AND RELATED
GENERA

- a*¹. Papillae of body inconspicuous, except by their color.
- b*¹. With a conspicuous bright-colored lateral stripe, the transverse markings in dots only.
- c*¹. Prolegs and end of body of the same color as the rest of the body, but paler; first thoracic segment as far as the dorsal shield bright rose pink.....*Rhabdoides*.
- c*². Prolegs orange, with blackish fuscous claws; end of body orange; first thoracic segment as far as the dorsal shield reddish.....*Goniurus*.
- b*². Markings wholly transverse and in broken lines, the longitudinal markings being wholly interrupted.....*Epargyreus*.
- a*². Papillae of body conspicuous, giving it a granulated appearance.
- b*³. Collar half as broad as the head.....*Achalarus*.
- b*³. Collar distinctly less than half as broad as the head.....*Thorybes*.

EXPLANATION OF PLATES

PLATE I (FRONTISPIECE)

Early stages of *Rhabdoides cellus* (inset, right center). *Left*: Full-grown caterpillar removed from its shelter. *Left center*: Fourth-stage caterpillar. *Just beneath the preceding*: A shelter or tent made by a third-stage caterpillar. *Upper, left side*: A leaf with three tents made by a first-stage caterpillar about one-twelfth of an inch long. *Lower right, beneath the petiole of the leaf*: The very inconspicuous shelter made by a full-grown caterpillar. *Upper right*: A string of five eggs attached to the under surface of a leaf. *Inset, lower left*: A pupa, removed from the cocoon. Painting by Hashime Murayama. The caterpillars are from color sketches of living specimens by Dr. Doris M. Cochran. Reproduced by courtesy of the National Geographic Magazine.

PLATE 2

- FIGS. 1, 2. Variety *leilae*, type specimen, raised from a caterpillar from near Great Falls, Md., emerged July 20, 1934, upper (1) and under (2) sides. U.S.N.M. no. 51415.
- FIGS. 3, 4. A specimen from near Great Falls, Md., June 3, 1934, upper (3) and under (4) sides.
- FIGS. 5, 6. A specimen from near Great Falls, Md., June 10, 1934, upper (5) and under (6) sides.
- FIGS. 7, 8. A specimen from Charleston, W. Va., May 22, 1900, upper (7) and under (8) sides.

PLATE 3

- FIGS. 9, 10. A specimen from Tallahassee, Fla., collected by Albert Koebele, upper (9) and under (10) sides.
- FIGS. 11, 12. A specimen from Palmerlee, Ariz., upper (11) and (12) under sides.
- FIGS. 13, 14. A specimen from Lititz, Pa., collected by J. J. Heiserman, July 16, upper (13) and under (14) sides.

PLATE 4

- FIGS. 15, 16. A specimen from Volcan Santa Maria, Guatemala, collected by William Schaus and John Barnes in June, upper (15) and under (16) sides.
- FIG. 17. A string of five eggs, of which the first and fourth are slightly chipped and contain dead larvae. $\times 5$.
- FIG. 18. A rent in a leaf forming one side of a cocoon which has been repaired by the caterpillar.

PLATE 5

Pupae of *Rhabdoides cellus* and *Epargyreus tityrus*.

All figures $\times 2$.

- FIG. 19. *Rhabdoides cellus*, living pupa, lateral view.
- FIG. 20. The same pupa, ventral view.
- FIG. 21. Another living pupa, dorsal view.
- FIG. 22. The same pupa, lateral view.
- FIG. 23. *Rhabdoides cellus*, a pupa with the wax removed, lateral view.
- FIG. 24. The same pupa, ventral view.
- FIG. 25. Another pupa, dorsal view.
- FIG. 26. *Epargyreus tityrus*, a small pupa, lateral view.
- FIG. 27. The same pupa, ventral view.

PLATE 6

- FIG. 28. An egg, slightly chipped about the apex and containing a dead larva. $\times 17$.
- FIG. 29. Three empty egg shells. $\times 17$.
- FIG. 30. Two caterpillars just from the egg. $\times 12$.

- FIG. 31. Two caterpillars in the second stage. $\times 12$.
 FIG. 32. Three caterpillars in the second stage. $\times 2.5$.
 FIG. 33. A caterpillar in the third stage. $\times 2.5$.
 FIG. 34. Four caterpillars in the fourth stage. $\times 2.5$.
 FIG. 35. Three caterpillars in the fifth (last) stage. $\times 2.5$.
 FIG. 36. Head of full-grown caterpillar. $\times 2.5$.

Note.—The photographs of caterpillars are from specimens in alcohol that have lost their markings; but the uppermost last stage caterpillar shows the light dorsolateral line fairly well.

PLATE 7

(All figures natural size.)

- FIG. 37. Shelter of a third-stage caterpillar.
 FIG. 38. The same, in side view.
 FIG. 39. The same, in end view.
 FIG. 40. Diagram illustrating the construction of the shelter; the portion of the leaf between the cuts is bent inward over the upper surface, the angles following the direction of the dotted lines to the arrow points; in this case the vein of the leaf forms a sort of ridge pole for the shelter.
 FIG. 41. Two first-stage shelters.
 FIG. 42. The same leaf in edge view, showing the elevation of the shelters.

PLATE 8

- FIG. 43. Caterpillar at birth.
 FIG. 44. A circlet of crochet tips on the proleg of a full-grown caterpillar.
 FIG. 45. A section of the band of crochets, viewed exteriorly; the recurved tips are shown in black.
 FIG. 46. Crochets of the three series, in side view.
 FIG. 47. First thoracic segment of a full-grown caterpillar.
 FIG. 48. Head and first thoracic segment of a full-grown caterpillar, dorsal view.
 FIG. 49. Head capsule of a first-stage caterpillar, front view.
 FIG. 50. The same, rear view.
 FIG. 51. Jaw of a full-grown caterpillar.
 FIG. 52. Anal structures of a full-grown caterpillar.



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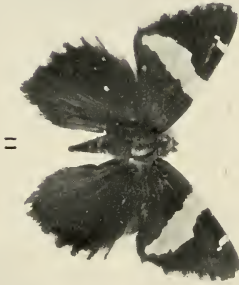
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RHABDOIDES CELLUS FROM VARIOUS LOCALITIES

(For explanation, see p. 49.)



RHABDOIDES CELLUS FROM VARIOUS LOCALITIES

(For explanation, see p. 49.)

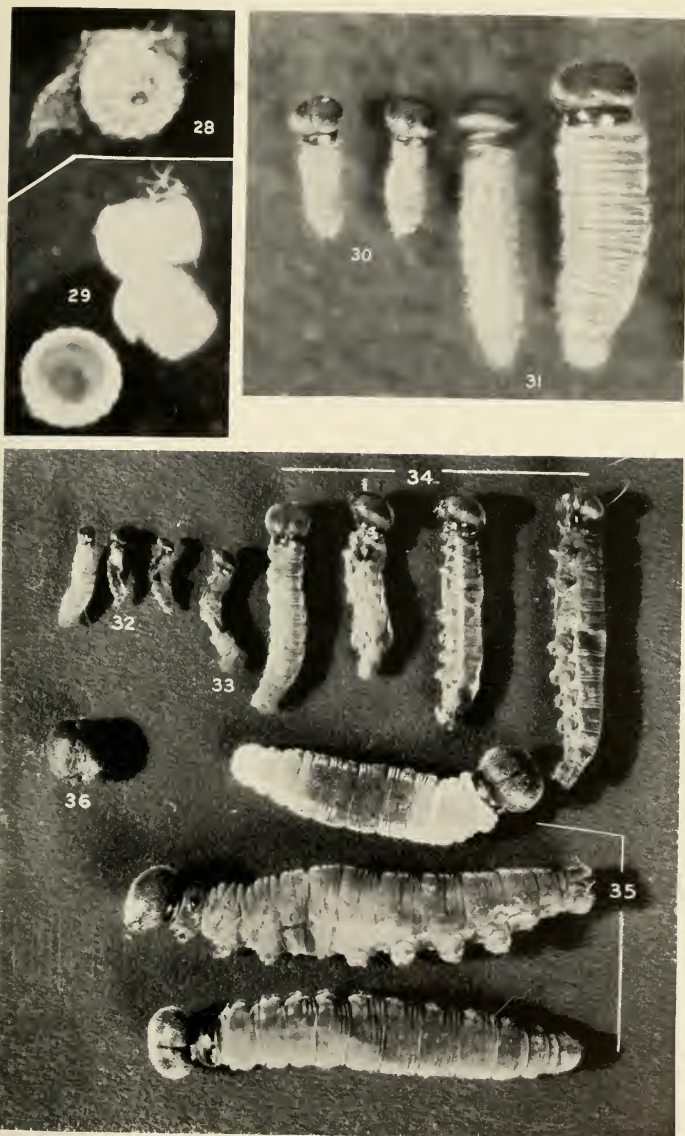


RHABDOIDES CELLUS (GUATEMALA), EGG STRING, AND PATCHED LEAF
(For explanation, see p. 49.)



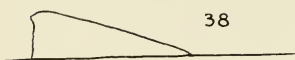
PUPAE OF RHABDOIDES CELLUS AND EPARGYREUS TITYRUS

(For explanation, see p. 49.)



EGGS AND LARVAE OF RHABDOIDES CELLUS

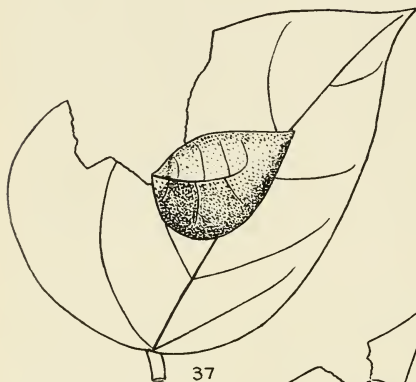
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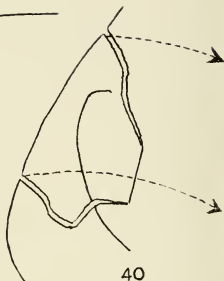
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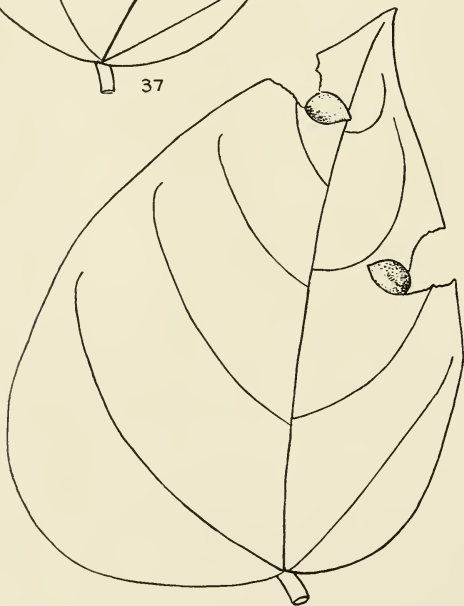
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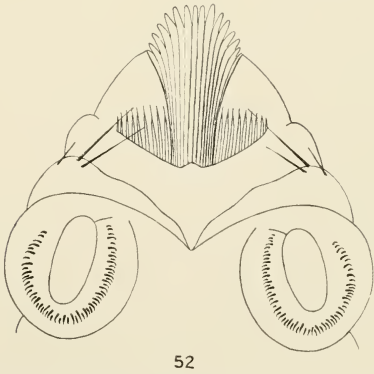
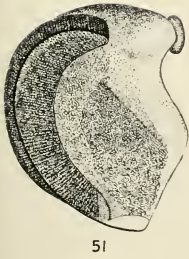
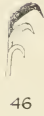
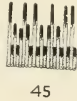
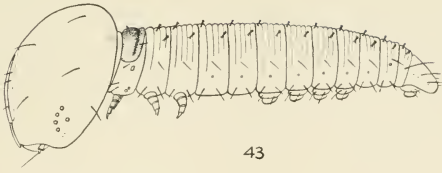


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SHELTERS MADE BY LARVAE OF RHABDOIDES CELLUS
(For explanation, see p. 50.)



DETAILS OF LARVAE OF RHABDOIDES CELLUS

(For explanation, see p. 50.)