

SMITHSONIAN

MISCELLANEOUS COLLECTIONS

VOL. 17

The Lord Baltimore Press  
BALTIMORE, MD., U. S. A.



PUBLISHED BY THE SMITHSONIAN INSTITUTION  
CITY OF WASHINGTON

V. 117  
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LEONARD CARMICHAEL,  
*Secretary, Smithsonian Institution.*



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VOLUME 117, NUMBER 1

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Thomas Lincoln Casey Fund

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NORTH AMERICAN FIREFLIES OF THE  
GENUS PHOTURIS

BY

HERBERT SPENCER BARBER

WITH PREFACE AND NOTES BY FRANK A. McDERMOTT



(PUBLICATION 4051)

CITY OF WASHINGTON

PUBLISHED BY THE SMITHSONIAN INSTITUTION

NOVEMBER 27, 1951



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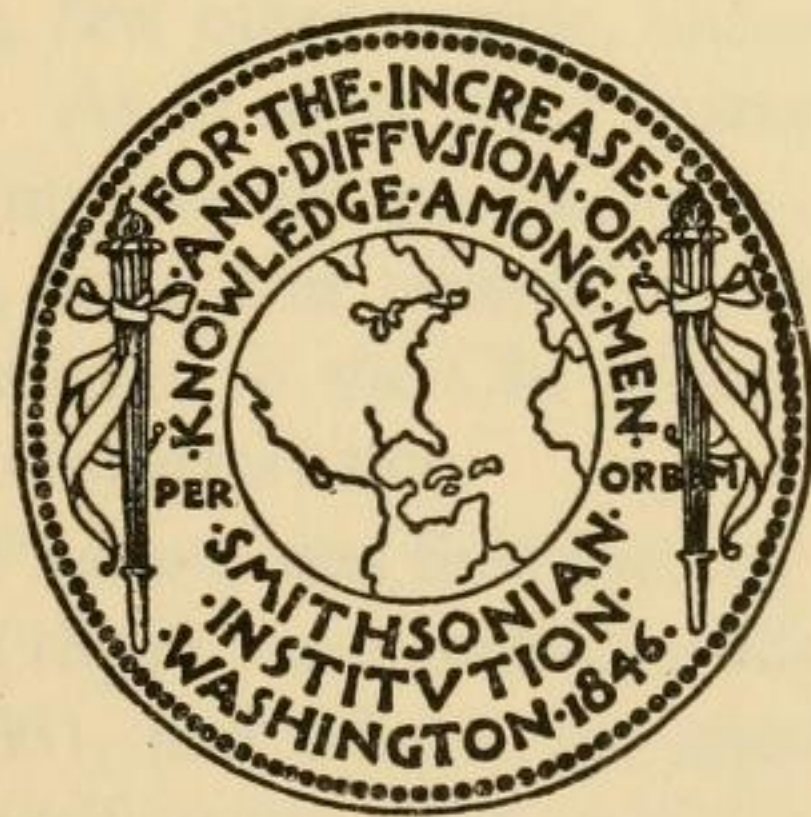
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## PREFACE

At the time of his death, on June 1, 1950, Herbert Barber had nearly completed the manuscript of a monograph on the North American fireflies of the genus *Photuris*. Subsequently, I was requested by Dr. E. A. Chapin, curator of the division of insects, U. S. National Museum, to review the manuscript with a view toward putting it in shape for publication. I have done this with mixed feelings of wonder at the amount of field work involved (not always in the easiest places for such studies), of admiration for Barber's persistent checking and rechecking of observations, and the logical deductions he has drawn, and of regret that he was not able to complete the work to his own satisfaction. Actually, the monograph as he wrote it is so nearly complete that little more than the correction of a few obvious typographical errors and the change of an occasional word or punctuation mark has been made in the text. His pencil sketch diagramming the flashes of the males of the various species of *Photuris* has been redrawn for reproduction, with the addition of those species he describes but did not include in his sketch.

The beetles of the family Lampyridae are almost unique among insects because of the ability of most species to produce light, a function limited to only a few other insects, although widely distributed among marine forms. As in most other insects, the family has been divided into a large number of genera, one of the most distinctive of which is *Photuris*, limited at present to New World species, and being more or less replaced in the Old World by the genus *Luciola*, of somewhat similar characteristics.

The generic name *Photuris* was first used by Dejean (1833), established by LeConte (1852), and subsequently used by Lacordaire (1857), Olivier (1886), and others, for species presumably falling naturally into this classification. The vagaries introduced by several authors have been sifted by Mr. Barber, and the details are given in the text of this monograph. Barber has done a beautiful piece of work in unraveling the tangled skein of nearly a score of morphologically very similar species, many with adjacent but overlapping habitats, and with distinct mating habits. He says, "All structures, even those of the male genitalia, appear identical in our numerous species." His manuscript refers to sketches of the aedeagus of *Photuris frontalis*, which he uses as typical, but his sketches have not



been found, and I have substituted for them sketches of this structure from *Photuris lucicrescens* from Delaware. In Barber's segregated set of 19 species and varieties, 10 show the aedeagus extruded, and except for size there is no observable difference in the different species; the aedeagus of *Photuris jamaicensis*, sketches of which have been kindly lent me by Dr. John B. Buck, is also apparently identical with that of Barber's species.

That Barber was able to recognize his species in dried specimens, when he had not seen the flashing conduct, was demonstrated to me when I submitted to him a series of five vials containing specimens collected around Wilmington, Del., each vial representing a different flash; for four of the vials he told me correctly the type of flash after a few minutes examination with a lens; the fifth contained specimens having a flash with which he was not familiar, and which were probably abnormal.

This work of Mr. Barber may stem ultimately—aside from his general interest in the Lampyridae—from a conversation between him, Dr. E. A. Schwarz, and myself in 1910, when I was studying the relation between light emission and mating habits of the fireflies. *Photuris pensylvanica* was mentioned, and Dr. Schwarz remarked on the enormous numbers in which it occurred in Panama. I asked if it were the same species, and he replied something to the effect that it was the same species from Massachusetts to Panama, and then added that "some day somebody is going to split that thing up." This Mr. Barber has done with infinite care and persistent checking. That portions of the picture are still confusing cannot be denied, but it is very evident that what was long considered to be a single species is undoubtedly a complex of many morphologically closely similar species with quite distinct habits, habitats, and mating behavior. If these have to be considered "physiological species," so be it.

That this condition is not peculiar to *Photuris* is indicated by another case among the Lampyridae described to me by Mr. Barber in June 1947. While collecting specimens of the supposed *Lecontea (Pyractomena) lucifera* (Melsheimer), near Washington, he encountered a species giving a single bluish flash instead of the twinkling 5-component flash previously ascribed to *lucifera*, but upon inspection of his vials the next day he concluded he had mixed his specimens, as all those he had taken were apparently identical. On his next trip he very carefully segregated the 1-flashers from the 5-flashers, but upon inspection he was again unable to tell one from the other by general appearance. In this case the aedeagi proved to be different,



but the question still remains as to which of the two is the one originally called *lucifera* by Melsheimer.

While the original manuscript of this monograph was apparently prepared by Mr. Barber about 1929, his interest in the problem continued unabated, and at least two species were defined after that time. His letters to me from 1926 to 1929 indicate the development of the ideas given in the monograph, and later correspondence gave evidence of the confirmation and extension of his observations, and also recorded his difficulties with cabinet specimens. Mr. Barber had started, about 5 years ago, an extensive review of the taxonomy of the Lampyridae, which work was most regrettably interrupted by his death. His notes show a complete grasp of the difficulties involved, an accurate and broad knowledge of the literature, and the modern concept of a species as a dynamic unit, a breeding population. Perhaps some quotations from his notes made in the course of his work on this revision may not be amiss:

Dated February 14, 1945:

The writer's belief that each species is an isolated self-perpetuating population, limitless in individuals by past and future generations, and that our taxonomy must correctly interpret these natural species which contrast so hopelessly with the customary "taxonomic" species, has combined with his inability to apply the available names to his samples of "natural" species, to discourage completion of manuscripts.

Undated, probably 1944:

If, however, a collector seeks the luminous species when they are active, distinguishes the signals of the several species which may be in their nuptial flight, and the peculiar flashes emitted by the opposite sexes of each, and collects individuals which emit a particular type of flash, his samples thus assembled and segregated will more correctly represent the unit species he has observed. If, also, the observer selects convenient undisturbed localities, such as upland fields, woods, river banks, marshes, etc., in which he can repeat his observations in successive seasons and years, he may find that each peculiar habitat has its sequence of species peculiar to it, their larvae present most of the year, the adults active for only a few days at the correct season, except the unpredictable abnormal individuals who leave no progeny. Repeated verification of observations is essential.

As late as September 1949 he wrote to me—

This problem (the species of *Photuris*) is far more complicated than you think, and we are still far from the truth. Taxonomy from old mummies which fill collections is a misguided concept. It leads to the misidentification of rotten old samples in collections. How these poor fireflies would resent being placed in such diverse company—among specimens of enemy species—if they were alive and intelligent! What contempt they would feel for the "damned taxonomist."



Barber's own field observations covered, for the most part, a rather limited geographical range, roughly within a radius of about 100 miles from Washington, D. C., and to judge from the species from Wisconsin, Cape Breton, and elsewhere it is quite possible that a number of other types of flashing conduct may be found in areas outside of those he covered. Only future work can show how general the distribution of his species may be and how much overlap in range may occur.

The practical mind may ask, "Of what use is such a study?" To which we may reply with Faraday's famous retort to Gladstone: "Of what use is a newborn babe?" Aside from the basic "increase and diffusion of knowledge among men," we can never tell when, where, and how a given observation may be of practical importance. The chance observation of a bacteriologist a quarter of a century ago, that bacteria did not grow in the presence of a mold, is the basis of the multimillion-dollar antibiotics industry of today. The possible importance of the Lampyridae as predators against agricultural pests has barely been touched upon (see p. 2 of this monograph, and the writer's "Common Fireflies of Delaware," Wilmington, 1948). In any event, such a study as this of Mr. Barber's on *Photuris* is, as Emerson says of beauty, "its own excuse for being."

FRANK A. McDERMOTT.

Wilmington, Del.

December 4, 1950.



Thomas Lincoln Casey Fund

NORTH AMERICAN FIREFLIES OF THE  
GENUS PHOTURIS

By HERBERT SPENCER BARBER<sup>1</sup>

*Division of Insect Identification  
Bureau of Entomology and Plant Quarantine  
United States Department of Agriculture*

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INTRODUCTION

Although it has been argued that so-called "physiological species" should not be given distinctive names, inasmuch as they cannot be identified from average cabinet specimens, this attitude is opposed to the objectives of the study of natural history. The demand for visible external characters by which species may be "identified" and the exaltation of this principle as a standard of specific value have already, within the memory of most of us, broken down before the newer standard (useful in many groups but not universally so) based upon internal or reproductive organs. Species being biological units composed of populations reproducing their kind and supposedly isolated from other species by barriers of some kind, it behooves the student to find the characters by which they may be recognized. If these characters are external and "structural" in the old sense, the investigator

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<sup>1</sup> For a biographical sketch of Mr. Barber, see Proc. Ent. Soc. Washington, vol. 52, pp. 259-269, 1950.—EDITOR.



is lucky. But if all the customarily used structural characters of shapes, sizes, and colors are variable within all of several allied species which are distinct in ecological habitat, time of maturity, habits, and courtship behavior, the student must find new standards or abandon his study. In the face of general opinion among systematists, which opinion has itself become standardized, the temptation is to take the latter course. But it is a pity that so few systematists realize that the only fundamental object of naming species is, in the ideal, to produce a system by which records of observed facts about species may be indexed so that the students of insect economy, behavior, anatomy, genetics, etc., as well as the systematist, may assemble and sort the desired data. Surely the confusion will be inextricable if only those species that chance to display some "structural" character receive distinctive names.<sup>2</sup>

In some groups specialization in structure seems to have occurred without apparent specialization in habits; in other groups structures remain practically identical but habits have become distinct; and in still others the exoskeletal variation within members of a brood may render ordinarily used characters useless, or plasticity of habits may, by accident, accompany temporary development of a differential habitus. Hybridization may be so common as to unite similar species into a variable or even homogeneous population, or may be so rare that fertile offspring, fit for reabsorption into either of the self-perpetuating species, are as infrequent as in mules.

In the genus *Photuris* individual variation is so common that the following studies have yielded few characters besides certain generalized differences of color, size, and, in a few cases, proportion; but since these are connected with habitat and habit distinctions, they must serve until better diagnostic characters are found. All structures, even those of the male genitalia, appear identical in our numerous species.

Although *Photuris* larvae are general predators on snails and soft-bodied insects and may be of some economic value as enemies of cutworms (Hess, 1920),<sup>3</sup> the specialization of different but hitherto confused species to different and particular types of breeding ground indicates diversity in the preferred prey. Records of observations on

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<sup>2</sup> Dr. Ferris has published similar views (Ferris, G. F., *The principles of systematic entomology*, p. 48, Stanford, Calif., 1928). For a further discussion see Mayr, Ernst, *Systematics and the origin of species*, New York, 1942 (1949), particularly p. 20, "What is a taxonomic character?"—McD.

<sup>3</sup> Names and years in parentheses refer to the Literature Cited at the end of the monograph.—McD.



feeding habits are fragmentary and cannot now be associated with particular species, but it should be obvious that marsh-inhabiting species could have little influence on a cutworm infestation in an adjoining field, whereas an abundant upland form, such as *pyralomimus*, described below, might be an important enemy.

#### OBSERVATIONS ON ADULT BEHAVIOR

Since the writer's interpretation of our *Photuris* fauna as he has observed it differs from that of students of fireflies who rely upon dried specimens and upon the standards of the older taxonomists, he begs for a moment that readers imagine themselves sharing with him a few selected experiences that have forced great changes in his belief as to what constitutes a species.

1. A hilltop field of grass bordered by woods in Rock Creek Park, D. C., early in June.—*Photuris* have just appeared here in the past few days, and on this evening they are flying in numbers over the field but not in the woods. Many are flashing in the gathering dusk as they fly a few feet above the grass, and only two types of flash are apparent in the air, the commonest being a series of about six very quick flashes in less than a half second, of not great brilliance. These are all males flashing their signals, hoping for answering flashes from prospective mates. Rarely one may see such a response in the short grass—a brief, less brilliant, single glow of about a third of a second duration—and observe the quickened repetition of the male's signals as he approaches in a long oblique descent. This female flash appears seldom in the air. Green leaves and the fingers are held over the bulb of a small flashlamp by the observer, concealed among foliage, and an attempt to mimic the female flash is made immediately following the flash of a nearby male. He comes rapidly to the hand and is caught; other males have seen the mimic of the female's flash and are coming also, so that the collector may catch half a dozen with the hand without moving from the edge of a concealing bush. A steady light does not attract, but frightens the males away. Another type of flash is occasionally seen as we ramble about, but it is the short, frequent, but very irregular flash of disturbed individuals, usually females, whose agitation is visible in abnormal functioning of the light organ.

This species the writer identifies doubtfully as *versicolor* Fabricius, which was described in 1798, without more definite locality than North America, from a specimen received from Mr. Hirschell and has since been incorrectly suppressed as a synonym of an earlier given specific name.



2. A rocky, heavily wooded island in the gorge of the Potomac late in June.—At the downstream end an alluvial deposit subject to freshets supports a dense growth of maples bound together by a canopy of wild grapevines, hiding the stars; underneath, a few sandy freshet channels can serve as paths. The great wood interior is filled with innumerable flashes of greenish-white light, and at first there seems no variation in the flashes. Each firefly appears to give a single short, very bright flash for each second that it flies, and all those flashing are males. An occasional slightly different flash on foliage or ground is investigated and discloses the presence of females, which have presumably mated and are not at all interested in the self-assertive males.

Two or three times during the preceding winter and spring the floods have swept for days, roaring between the trees and among the sandbars, bringing logs and smaller driftwood, which lie in masses where the trees chance to hold them. Other species of fireflies appear discouraged by such abuse of their breeding ground, but before the firefly season comes, the glowworms of this form are abundant in and about these masses of river drift, above and in the immediate vicinity of which the males later fly in numbers. Occasional individual adults are to be seen in every few hundred feet of river forest in June, but these are supposedly strays maturing where they were left as larvae by the water. The spring freshet of 1928 washed out the glade in which the species was watched the two preceding years, but it left an accumulation of drift on some logs 50 feet to one side. Few of this species were seen where formerly abundant, but they later became numerous about the driftwood. This species is herein named *potomaca*, p. 28.

3. Crossing the current to the Virginia shore, we see the same species in fewer numbers in the fringe of trees on the bank, but in the field behind are a few belated males of the flicker-flash species above described (*versicolor* Fabricius?). The path crosses the small neglected field and dips into a damp hollow carrying the drainage from Black Pond and bordered with scattered willows, beyond which the ground rises a few feet to a terrace upon which low alders grow. Then there is another narrow grassy strip and the wooded rocky hillside rises abruptly. The willows and low vegetation along the sluggish stream are glittering with myriads of flashes, of almost the same short duration and interval as the greenish lights we have just left in the river forest, but these are faintly orange instead of greenish, and slightly slower, about three flashes in 4 seconds. The samples caught are all males, but are smaller in size, differently colored, and



have slightly more elongate antennae. This species is herein named *hebes*, p. 34.

4. A few steps farther, the path enters the alders and immediately a very different type of flash confronts us. Poising almost motionless in the air, its light begins dim, grows steadily to great brilliance and dies abruptly, to reappear a quarter or half minute later as the firefly poises a few feet distant and again remains illuminated for from 1 to  $2\frac{1}{2}$  seconds. All these are, as before, males, but they are larger, broader, and much paler in color. Their females are found demurely about their business of seeking food, for the female *Photuris* eats other fireflies; but since no courtship is observable they are supposed to be already mated individuals no longer interested in the surrounding lights. This species is herein named *lucicrescens*, p. 33.

5. Drive 15 miles to the tide marsh of the Anacostia River, and even though the hour is midnight *Photuris* of several species are still flashing. The long crescendo flash just described is conspicuous in the bushes bordering the marsh, and in the treetops is a very short, bright flash, almost an explosion of light, at 4- or 5-second intervals. Samples of this species we cannot reach in its normal flight. But over the level tops of the tall, rank grass of the marsh another very different flash greets us—an instantaneous explosion of light followed immediately after an extremely short, dark interruption by a protracted brilliant light lasting 1 to 2 seconds, with the end perceptibly diminished in intensity. We wade into the deep grass and ooze and catch samples. They are not half so large as the crescendo-flash species on shore, and some have wing covers pale except basal remnants of the brown vittae. Certainly it is the only species seen tonight to which the original habit notes and description of *pensylvanica* (original spelling of specific name), published by De Geer more than a century and a half ago, can be applied. While emitting this double flash the male (for no females are visible to us) poises in his flight over the grass tops, dips slightly and rises, describing little U-shaped curves of light, the finish a little higher than the first flash. He must watch for his bride's answer straight beneath, since marsh grass stands vertical at this season and cannot be seen through obliquely. But his behavior is the result of instinct instead of reason and reflects an immensely old specific adaptation to this particular ecologic environment. No females can be found while we walk forward, but if we turn and force our way backward through the grass their annoyed flashes deep in the disturbed grass or on the surface of the ooze permit their capture in numbers. In the vial used to preserve these females I find



a minute fish (*Umbra*). Was a female eating a fish when caught? No other debris is in the vial.

6. Dense *Baccharis* bushes on a sand spit joining a wave-eroded bluff surmounted by oaks and pines, overlooking the brackish water of an arm of the Chesapeake early in July.—A warm evening breeze sways the bushes and low among them, or rising in their lee, fly moderate numbers of a small firefly emitting short, abrupt, faintly orange flashes at intervals of about 3 seconds. Specimens caught resemble the small, willow-swamp form (*hebes*, above), and the long double-flash species of the fresh-water tide marsh (*pensylvanica*), but they seem to have larger eyes and shorter antennae than these others.

Again, a small salt meadow near the mouth of the Potomac estuary, in front of pines, hollies, oaks, *Myrica*, *Baccharis*, and *Iva* bushes, in successively more frequently inundated tidal shore line than the wetter salt marsh.—Among these bushes and straying among the nearby grass tops appear short, slightly orange flashes at 2- to 3-second intervals, but the insects keep well down where the shore breezes do not blow them away from their native habitat, thus contrasting strongly with the other species visible in the woods.

The small size of the firefly and its feeble flash resemble those of *hebes*, but the preserved samples differ in that this salt-marsh species shows larger eyes, shorter and stouter antennae, a black labrum, and a broad, black, midpronotal vitta. The ancestors of this species having for ages past held their place among the shore bushes against breezes, the generation now under observation flies low among the sheltering bushes undisturbed by a mild wind which scatters and forces down the flight of *hebes*. We shall later (p. 35) name this new form *Photuris salinus*.

7. Varying from year to year with the earliness or lateness of the season, the flicker-flash species (*versicolor*) appears in the above-described field at Black Pond about the middle of May and has become relatively scarce by the second week of June, when it is replaced by a slightly smaller form whose males, when not disturbed, appear to have two distinct types of light signals. This form seems to originate from the swampy ground among the willow and alder clumps some two weeks before the larger species, *lucicrescens*, and the smaller one, *hebes*, above discussed, begin to be seen. The behavior of this intermediate species (if it be but one form with two habits) will be variously interpreted according to preconceived notions, but requires record here.



As the sky colors fade to gray, the first sharp, greenish-white flashes appear in the clumps of bushes and on their darker eastern sides, contrasting strongly with the feebler orange flashes of the few early males of *Photinus scintillans*, which almost immediately cease their activity. As dusk deepens, the *Photuris* become numerous, the very short, sharp flashes being emitted at intervals of from 3 seconds, on a pleasant evening, to perhaps 10 seconds, if it is cool and there is heavy dew. In the latter case they soon cease to fly and their slower flashes emanate from males resting on foliage in slightly more sheltered situations. But from time to time there appear among them males flying slowly over grass or bushes, or even resting on foliage if it has become cool, and emitting long, tremulous flashes, less intense than the commoner sharp flash, consisting of perhaps 10 to 20 pulsations, and lasting about a second. Within a quadrant of perhaps 50 yards' radius from the same point of observation, these long tremulous flashes may appear, followed by others, becoming more and more numerous, the shorter flashes disappearing until for a few minutes the long flashes dominate. This phenomenon suggests either that another species has temporarily become active, as the writer has often observed with certain species of *Photinus*, or that a contagious emotional exuberance has changed the behavior of those males formerly emitting the short flashes. Samples of the producers of each type of flash are not distinguishable, as in the case of *Photinus* above alluded to, and are hereinafter (p. 31) described as but one species, *tremulans*.

8. Late in July the swampy forest bordering the Patuxent River at Priest's Bridge, Md., is visited. As on previous visits during the preceding three weeks, only one species of *Photuris* (*lucicrescens*) seems to be active, displaying its long, crescendo flashes, but the numbers are now much reduced, and the flash appears shorter compared with our half-second pendulum, used for estimating duration of flash and of dark interval. The light appears to last from three-fourths second to about one and one-half seconds. The treetops are watched for the very short flashes seen elsewhere, but none are seen there now, nor were they seen on previous visits. We return along the road to the Capital, stopping when colonies of fireflies are seen. *Photinus pyralis* having ceased its activity at an earlier hour, no flashes are seen except about trees bordering wet spots in the hollows, usually swampy courses of small streams. Two such places show only the crescendo flashes, but about 6 miles west of Priest's Bridge we first see numbers of the very short explosions of light in the air about the tree tops. A gust of wind disturbs the fireflies, and one comes down among the lower branches flashing at about 5-second intervals,



very bright and short, about like the one-tenth-second camera shutter held against a light. When almost within reach the strong spotlight beam is abruptly thrown on him, and the net brings him to hand. No chance this time to have netted the wrong firefly, but he looks no different from those taken in their long crescendo flash. No more come down, and we must give up and go home.

Why were none of these flashes seen at Priest's Bridge or at two other stations? Why do both types of flash occur here and at some other places?

Various answers will satisfy various persons, but no one knows. Envy the bats their wings? With them we might follow single specimens through their evening's activities and see if they change their flashes.

By the first week in August the firefly population of the wooded island, the alluvial field, the willow-lined marshy stream, and the alder bushes near Black Pond has changed. A few belated females and an occasional male of the large crescendo-flash species (*lucicrescens*) are mixed with larger numbers of the short-flashing, smaller form (*hebes*) but are no longer confined to the restricted areas as observed in June. Abnormals appear in all populations, and these late-issuing individuals may have been lacking in some of the factors inducing early transformation or fertilization, and the resulting restless dispersal flights may have carried them far beyond the preferred breeding ground. The whole impression is that of meaningless variation, and doubts of specific significance are inevitable under such conditions. In the tidal marshes the little double-flash species (*pensylvanica*) has vanished, and from the shore forests strays of other species, most of them females, have wandered out over the marsh where they mingle with surviving individuals of a small *Pyractomena* and several small species of *Photinus*. Here again one can see only chaos in their behavior, but next year at the proper time and place the new generations will court their mates in a similar manner. Specific flashes will win specific answers, leading to reproduction. Perhaps we may learn that the manner of flashing is a barrier to possible intermixing of species. Perhaps the late-season abnormals are mixtures. Must we then ignore the differences in the early-season broods?

9. Through the kind interest of friends, observations and well-preserved samples of *Photuris* are available from the vicinity of Winona, Minn., where three apparently distinct species were encoun-



tered on the evenings of July 6 and 8, 1926, by Miss E. Myers and B. Boland. Two localities were examined: The first, which was rather dry land, 10 miles west of Winona on the road to Stockton, yielded 13 males of a form (*versicolor* var.?) whose males emitted five short, greenish flashes as fast as one could count, at perhaps half-minute intervals, while flying 2 or 3 feet above the tips of the tall weeds, and four males (*caerulucens*) that emitted a slow, blue-green flash of about 1 second's duration, whose light was dimly visible after the end of the flash. Flashes of the latter species were seen in much greater numbers in more open pastureland nearby and over trees. This latter species was taken in series (30 specimens) at the second locality in Wisconsin between Dodge and Bluff Siding, 10 miles northeast of Winona, producing the bluish-green, 1-second flashes over damp ground near a tamarack swamp. With it in almost equal numbers (24 specimens preserved) flew a slightly smaller but otherwise similar species (*aureolucens*) that emitted single, short, orange-colored flashes indistinguishable from the flashes of *Photinus castus* (?), which had been abundant at the first locality. Neither the latter species nor the 5-flash species was observed at this second locality.

Thus in one evening in June at Washington one may encounter pure colonies of five or more species of *Photuris*, and the vicinity of Winona yields three species which occur at the same time but are biologically very distinct, although, considered taxonomically, they offer few reliable characters for recognition of cabinet specimens. All these species have been until now commonly identified as *pennsylvanica*. If, however, the observer finds localities in which several of these species are mixed, and their several females contribute to the confusion of flashes, and if the observer collects but few samples without noting their flashes, he is readily convinced that it is only variation, and that there is no law of uniformity in the genus *Photuris*.

Variation in motive for flash, in the flash itself, as well as in size and in pigmentation of body, must be admitted, and the writer is far from satisfied on a great many points in this complex problem. The female flash serving as a sex signal in response to a male flash for the same purpose must be rarely visible to us. The flashes we see from females must often be warnings or nervous responses to irritation, but another suggestive phenomenon has been observed too often to be ignored: Sometimes the familiar flashes of a small species of *Photinus* male are observed excitedly courting a female, supposedly of the same species, whose response flashes appear normal to its kind, but when the electric light is thrown upon them one is startled to



find the intended bride of the *Photinus* is a large and very alert female *Photuris* facing him with great interest. Does she lure him to serve as her repast? Very often a dim steady light near the ground proves under the flashlamp to be a small, recently killed male *Photinus* being devoured by a nonluminous female *Photuris*, and females of the largest form of *Photuris* (*versicolor*) have been found quietly feeding on dimly glowing males of *Photinus pyralis* that had been wrapped in silk in an orb web from which the spider had departed, the *Photuris* female crawling on the web apparently in no danger of becoming entangled. Cannibalism has often been observed in captivity, male *Photuris* being devoured by their supposed females; but the writer's observations and those of McDermott (1917), as well as those of Williams (1917) and Hess (1920, p. 52), were made when all our familiar *Photuris* were called by one name, and the sexes may not have been conspecific. The accounts of *Photuris pensylvanica* by all three of these writers seem to have been based upon two or more species whose differences were interpreted merely as variation, but as series of rapid flashes are referred to in each it appears that some forms of the possibly composite species here called *versicolor* Fabricius were included in the material for each of these studies.

Mistakes will be made by the most careful observer in his attempt to record what he sees in connection with definite samples for subsequent comparative study. Minor variations occur in the population of a single species. Pure colonies are not often found. No satisfactory timing device has been available. A watch producing half-second ticks worn at the ear might offer sufficiently definite time rhythm for more accurate estimates of flash duration and interval.<sup>4</sup> The half-second swing of a short pendulum on a stick held in the hand is sufficiently accurate in spite of variation due to one's irregular movements. Its beat can be felt without looking away from the observed firefly, and luminous paint on the apparatus has been found unnecessary. After striking at a particular individual, two fireflies, perhaps of different forms, may be found in the net, an unnoticed individual having happened to be within the sweep of the net. Perhaps the desired specimen is missed and an imposter receives the label of careful observation, false when thus attached. But more often the trouble of writing labels for single individuals in separate vials tempts one to trust memory too far and vials become confused.

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<sup>4</sup> Some cheap watches tick four times to the second and if alternate ticks are of different tone are very useful as a standard rhythm by which flash duration and intervals can be estimated.



Certain typical observations have been contrasted in the above account, and a short statement regarding measurement and interpretation must be made.

It should be obvious that since these phenomena are visible only in the natural environment and represent the normal ways in which undisturbed males seek to satisfy their mating instinct, laboratory methods of exact measurement or controlled experiment are of no use. It is difficult for one observer to contrast, verify, record, and reconstruct all the factors of all the forms in this intricate problem, even in the limited environment of Washington. Imagining the ideal opportunity for observation, we might wish for two adjacent pure colonies which could be observed and contrasted at leisure. In any pure colony we must expect to observe (1) some variation in the normal behavior of the seeking males, and (2) very irregular behavior on the part of the females that have mated.

The courtship flashes of *Photuris* males appear to have become specialized in certain species from the normal short, single flash emitted at rather regular intervals of 5 to 10 seconds, by increased frequency in *hebes* (which flashes at 1- to 3-second intervals according to the warmth or coolness of the evening), and in *potomaca* (which, on a warm evening, may attain a rate of nearly two flashes per second), or the duration of the light emission may be lengthened and interruptions introduced as in the flicker-flash species *versicolor*, the protracted tremulous flash of *tremulans*, the interrupted protracted coruscation of the small marsh-inhabiting species *pennsylvanica*, or the long crescendo flash of *lucicrescens*.

The first-mentioned simple flash is given in such diverse colonies, varying so in size, color, localities, and dates of appearance, that no well-defined single species is discernible at this time, and no specific name is here attached to samples. The frequency, pattern, and intensity of the characteristic flashes of the males of several of the species of *Photuris* described herein are diagrammed in figure 1.

#### NOMENCLATURE

Fears have been entertained that an unfamiliar name must be adopted to replace *Photuris*. This name first appears in the 1833 edition of the Dejean Catalogue (p. 103), where 34 American species are included, all but a few of which (perhaps all but three species) are nomina nuda. *Photuris versicolor* Fabricius and *hectica* Fabricius are valid species therein contained, and were it not for the query after the latter name the designation of this species (*hectica* Fabri-



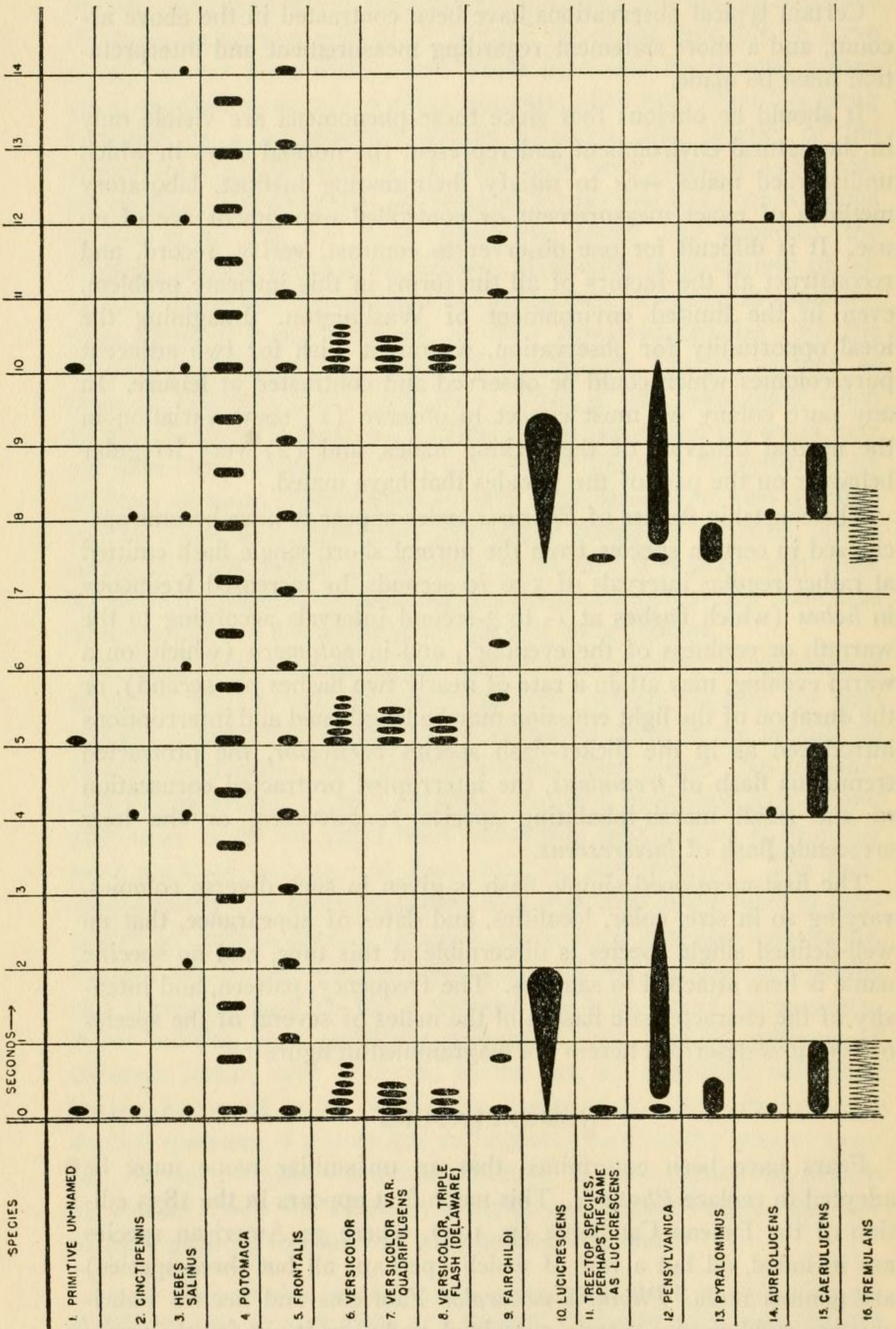


FIG. 1.—Diagram of flashing conduct of males of *Photuris* species. The time scale gives the usual frequency and duration of the flashes; the height and length of the marks indicate the intensity and pattern of the flashes. For further explanation see opposite page.



## EXPLANATION OF FIGURE I

No.	Species	Key No.	Duration and intensity of single flash	Frequency of flash	Color of light
1	Primitive un-named	..	Short; single Moderate	1 each 5 secs.	Yellowish?
2	<i>cinctipennis</i>	17	Short; single Weak	1 in 4 secs.	Yellowish?
3	<i>hebes</i>	15	Short; single	At 1 to 3 secs.	Almost orange
	<i>salinus</i>	16	Weak		
4	<i>potomaca</i>	7	Short; single Bright	Rapid, up to 2 per sec.	Greenish
5	<i>frontalis</i>	5	Short; single Moderate	At 1-sec. or less intervals	Greenish
6	<i>versicolor</i>	8	Composite of 3 to 5 or 6 very short, bright coruscations	At about 5 secs.	Greenish
7	<i>versicolor</i> var. <i>quadrifulgens</i>	9	Composite of 4 very short, bright corusca- tions	do.	do.
8	<i>versicolor</i> , triple flash (Delaware)	..	Composite of 3 very short, bright, rapid coruscations	do.	do.
9	<i>fairchildi</i>	11	2 short corusca- tions separated by an interval Moderate	At 5 to 6 secs.	?
10	<i>lucicrescens</i>	14	$\frac{3}{4}$ to $2\frac{1}{2}$ secs. Very bright	At 5 to 10 secs.	Greenish
11	Tree-top spe- cies, perhaps the same as <i>lucicrescens</i>	..	Very short and bright	do.	do.
12	<i>pensylvanica</i>	6	Long; double Moderate	do.	do.
13	<i>pyralomimus</i>	10	$\frac{1}{2}$ sec. Moderate	do.	Yellowish?
14	<i>aureolucens</i>	13	Short Weak	1 in 4 secs.	Yellow
15	<i>caerulucens</i>	12	1 sec. Moderate	1 in 4 secs.	Bluish green
16	<i>tremulans</i>	11a	1 sec. Bright	1 in 5 to 10 secs.	Greenish



cius) as genotype by Motschulsky (1853) would demand recognition. But Laporte's revision (1833) of the genus *Lampyrus* proposes a different name, *Telephoroides*, for six valid species, including *pennsylvanica*, and LeConte's 1852 rejection of "this uncouth name" claiming that it was printed "as a French word" appears to be an unwarranted action. LeConte's apparent belief that a generic name is invalid unless accompanied by diagnoses also led him to refer to *Photuris* as "the hitherto unpublished name of Dejean." In further subdivision of the group, Motschulsky (1853) adopted both of the above generic names and proposed seven new ones, designating genotypes for all. Lacordaire (1857, p. 338, footnote 1) supports LeConte's attitude and rejects Motschulsky's work, but in spite of the latter's designation of *occidentalis* Olivier as genotype of *Telephoroides* Laporte he credits this genus to Motschulsky and (p. 339, footnote 5) designates *pennsylvanica* DeGeer, with *versicolor* Fabricius mentioned as synonym, as genotype. Gorham (1880) follows Lacordaire but designates *pennsylvanica* as the type of *Photuris* LeConte. E. Olivier (1886) also ignores Motschulsky's genotype designations but rejects only five of his genera. In his 1907 work E. Olivier does not allude to genotype and suppresses all nine genonyms (credited to Motschulsky) under *Photuris* LeConte, but in 1910 the same author recognizes three genera, again ignores genotype designation, and arbitrarily lists the generic synonyms.

A future study must extricate the tangled nomenclature, but for the present it is enough to claim that Motschulsky's designation of *hectica* Fabricius as type of *Photuris* Dejean is invalid under the second paragraph of Article 30e of the International Code, and since no other genotype designation is known the writer hereby designates *Lampyrus versicolor* Fabricius type of *Photuris* Dejean.

The genotype of *Telephoroides*, *Lampyrus occidentalis* Olivier, 1790, designated by Motschulsky (1853), is unknown to me, and Lacordaire's designation of *pennsylvanica* is invalid; but since the former is cataloged in the genus *Photinus* by E. Olivier, 1910, our continued use of the name *Photuris* for our North American species may be justified even though the actual publication of the Dejean Catalogue dated 1833 may be subsequent to the Laporte revision, which appeared the same year.

A still more exasperating case is that of *Pyraetomena*, in which varied applications and spellings of the name have been incompletely cataloged without application of the genotype principle. Revision of all usages of the name is required, and we may even be forced to sup-



press its earliest valid form as a synonym of *Photuris*, but the proposal of substitute names is unwise until more complete bibliographical research is done and a better consideration of systematic relationships is possible. It now appears that *Lecontea* E. Olivier, 1899, is the proper genonym for the North American forms, although it differs in only one letter from the pythid genus *Lecontia* Champion, 1889.

Those seeking to apply the law of priority and the genotype principle to lampyrid genera may find the following chronological outline suggestive:

1833. Dejean (p. 102) groups 11 species into a genus that first carries the name "*Pyractomena* Dejean," but, although specific names are listed from Klug, Mannerheim, Latreille, and Dejean, no description of any of these species by these authors has been found. Since all appear to be nomina nuda the writer believes *Pyractomena* must be considered a nomen nudum of this date, although he also believes that the citation of Dejean by authors subsequently adopting his proposed genonym demands (article 19) that evident lapsus calami or typographical errors be corrected. One of the included species, *marginata* Latreille, may be found to be valid if a mention of *marginata* Linnaeus or Fabricius or Olivier can be found in Latreille's publication, but his only mention of this species that the writer has found (Humboldt and Bonpland, vol. 1, p. 348, 1811) is casual. He uses the French spelling without citation of author, and in the abbreviated German translation of this paper (Germar Mag., vol. 1, part 2, p. 122) the Latin name replaces the French form but without citation of Linnaeus.
1837. Dejean (p. 115) same as in 1833.
1843. Sturm (p. 76) in cataloging his collection adopts "*Pyractomena* Dej.," listing eight forms, all apparently nomina nuda, except the third species, *marginata*, which is accompanied by citations to Linnaeus, Fabricius, and Olivier. The generic name is therefore valid, with *marginata* Linnaeus, 1767, as its type, but this species is cataloged by E. Olivier, 1910, as a Brazilian species of *Photinus* with only two references, the original description and the redescription with figure by Olivier, 1790. This latter figure looks so much like a *Photuris* that *Pyractomena* Sturm may be one of its synonyms or subgenera, but until Linnaeus' and Olivier's types can be identified with adequate modern specimens no certainty can be felt that the figure represents the Linnaeus species.
1845. Melsheimer (Proc. Acad. Nat. Sci. Philadelphia, vol. 2, p. 304) described two Pennsylvanian species using the genonym *Pyratomena* (*c* omitted), but since he cites "Dej. Catal." for the name, "a lapsus calami or a typographical error is evident," and the generic name must be considered a homonym of that used by Sturm, but with *lucifera* Melsheimer, 1845, as its type.
1847. Erichson (Wiegemann's Archiv für Naturg.) adopted *Pyractomena*, citing Dejean, for a new Peruvian species, *interrupta*, which became his monobasic type and is cataloged by E. Olivier, 1910, in *Photinus*, although its bifid claws are more suggestive of certain groups of *Photuris*.



1849. Solier (*in* Gay, *Hist. Chile*, vol. 4, p. 445) cites Dejean and thought he adopted his invalid generic name, but spelled it *Pyractonema* (transposing the *n* and *m*), for nine new Chilean species which have since stood as a distinct genus under this name. His first species, *compressicorne*, is figured and is here designated genotype, but, as above argued, correction of spelling is required and the name becomes a homonym. The proposal of a new name is postponed pending a better knowledge of the limits of the genus *Lucidota*, of which *Pyractonema* Solier appears to be a part.
1849. LeConte (*in* White's *Statistics of Georgia*, p. 31, supplement) includes no valid species.
1850. LeConte (*in* Agassiz, *Lake Superior*, p. 228) lists *Lampyris borealis* Randall under *Pyractomena* Dejean, this being the basis of the below-cited remarks by McDermott, 1917.
1852. LeConte (*Proc. Acad. Nat. Sci. Philadelphia*, vol. 5, p. 336) includes five species under *Pyractomena* Dejean, *borealis* Randall being the fifth species. A generic diagnosis being given, many authors have held this as the first valid publication of the name.
1853. Motschulsky (*Etud. Ent.*, 1852, p. 37) uses an *e* instead of an *a* in "*Pyrectomena* Dejean" for which he designates "*Pyrectomena vitticollis* Mannerheim" of Santo Domingo as genotype, but since this species appears previously undescribed, although originally included (*nomen nudum*) by Dejean, the generic description is held to be the first validation of the specific name.
1857. Lacordaire (*Gen. Coleopt.*, vol. 4, p. 321) suppresses *Pyrectomena* (Dejean) LeConte as synonym of *Photinus* but later (p. 324, footnote 5) applies it to one of the subgeneric groups, containing six species.
1880. Gorham (*Trans. Ent. Soc. London*, 1880, p. 32) treats *Pyrectomena* (Dejean) Motschulsky, LeConte, citing *vitticollis* as type and recognizing six species.
1899. E. Olivier (*Bull. Mus. Hist. Nat. Paris*, vol. 5, p. 371), not knowing of the use of *Lecontia* Champion, 1889, for a genus of Pythidae, proposed *Lecontea* as a new name for *Pyractomena* LeConte, 1851 (1852) (into which he merged *Pyrectomena* Motschulsky, 1852) on the ground that *Pyractonema* Solier, 1849, has priority. *Lecontea* E. Olivier is therefore isogenotypic with LeConte's genus.
1917. McDermott (*Can. Ent.*, vol. 49, p. 53) adopted the present writer's opinion (now reversed) and, holding the Solier and LeConte genonyms not homonyms, designates *Lampyris borealis* Randall type of the latter.

From these facts it appears necessary to regard *Pyractomena* Sturm as a possible subgenus or relative of *Photuris* and to discontinue the use of the former name in the sense so long accepted.

A much more perplexing case also demands consideration but seems to affect only the indexing of synonyms. To state that *Pyrectosoma* Motschulsky, 1854 (p. 39) is an isogenotypic synonym of *Photuris* Dejean when its description was apparently drawn from a species of *Lecontea* (*Pyractomena*) cannot but offend those who regard genera as groups of species displaying the diagnosed character-



istics; yet the fact remains that *versicolor* Fabricius was originally designated as its genotype, and Motschulsky's subsequent "corrections" (1855, p. 72) after seeing Fabricius' type of *versicolor* cannot change its generic nomenclatorial status. But to catalog his taxonomic opinions it is still necessary to list *Pyrectosoma versicolor* Motschulsky, 1853, 1854, and 1855 [not Fabricius] in the synonymy of *Lecontea*, indicating that it is a pure primary homonym of the synonym of *Photuris* and nomenclatorially not available for use as the name of any species. In Opinion 14, the International Commission on Zoological Nomenclature, 1910, has considered most of the principles involved in this case, and in Opinion 65, 1914, a hypothetical case almost identical in principle is treated, but these deal only with the question of availability of the names.

These genonyms and genotypes, excluding the *Pyractomena* series already discussed, may be listed:

*Photuris* Dejean, 1833, p. 103.

*hectica* Fabricius, genotype designated by Motschulsky, 1853, is not available because doubtfully included by Dejean (Article 30e of International Code).

*versicolor* Fabricius, type by present designation. (This species is also the originally designated genotype of *Pyrectosoma* Motschulsky, 1853.)

*Photuris* LeConte, 1852, p. 337.

*pennsylvanica* DeGeer, designated by Gorham, 1880 (species not originally included in Dejean).

*Telephoroides* Laporte, 1833, pp. 127 and 144.

*occidentalis* Olivier designated genotype by Motschulsky, 1853, p. 55 (cataloged in *Photinus* by E. Olivier, 1910).

*pennsylvanica* DeGeer (*versicolor* Fabricius), genotype designation by Lacordaire, 1857, p. 339, footnote 5, is invalid because subsequent to that by Motschulsky.

*Pyrectosoma* Motschulsky, 1853, p. 38.

*versicolor* Fabricius, genotype by original designation (therefore isogenotypic with *Photuris* Dejean, but characterization was drawn from mis-determined specimens supposed to belong in *Pyractomena* of LeConte, *Lecontea* Olivier).

Generic characters of *Photuris* are amply diagnosed by LeConte, 1852, but our more recent papers on fireflies appear to have considered the lunate last joint of the labial palpi and the cleft external claw of all tarsi as unworthy of notice. In habitus all *Photuris* in our fauna differ from other genera of fireflies in their more oval and much less depressed form, which permits their sturdy, agile movements to be so characteristically distinct. Supporting these peculiarities in adults, their larvae are of such distinctive form and are so adapted to free movement upon the surface of the soil that E. Olivier's



1907 and 1910 elevation of the group to subfamily rank distinct from the Luciolinae is readily acceptable.

#### SPECIES OF PHOTURIS

The easy taxonomy of previous studies is reflected by Leng (1920) in cataloging only three species of North American *Photuris* and listing five supposed synonyms. Only two mild protests against this simple concept of our forms are known to me, Wenzel (1896) having remarked on "two forms of *Photuris frontalis*" taken by him at Anglesea, N. J., and Blatchley (1924) having sought to recognize *lineaticollis* LeConte, 1852 (name omitted in LeConte, 1881), as a distinguishable variety. Whether the better-described *Telephoroides lineaticollis* Motschulsky, 1854, is identical with the form to which LeConte had previously applied the name is immaterial at present, and since the writer does not know the LeConte type of this species the name is tentatively applied in the following table to a conspicuous southern form displaying the character originally stated.

Two of the other species named by LeConte, 1852, *congener* and *frontalis*, were confused by that author prior to his 1881 revision and have ever since been misdetermined in all collections, the latter name always being applied to the former species, and *frontalis* proper being unrepresented by specimens. But in the Leng list *congener* appears erroneously placed as synonym of *divisa*.

Of the four much older names hitherto considered conspecific with *pensylvanica*, *marginata* Panzer, 1789, type locality "America meridionale," may be deleted from our lists since it is almost certainly a South American species of *Photuris* not identical with any form in our fauna, but since Panzer's name is preoccupied by *Lampyrus marginata* Linnaeus, 1767,<sup>5</sup> some other name must be used for his species when it is reidentified. *Photuris versicolor* Fabricius, 1798, is not a synonym of *pensylvanica* and must be recognized as one of our species, but the writer's observations would indicate a need of much more critical study than has here been possible since his notes record different behavior at different stations. The brief description of *vittigera* by Motschulsky, 1854, appears applicable to the majority of

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<sup>5</sup> The source of Professor Brunniche's sample which Linnaeus described cannot be known and the type locality is America. This habitat was restated as southern America by G. A. Olivier, 1790, whose figure shows long legs and antennae suggesting *Photuris*, and was further restricted to Brazil by E. Olivier, 1910, who listed the species in *Photinus*. But as stated elsewhere in this paper (see p. 15) *marginata* Linnaeus is genotype of *Pyrractomena* Sturm.



individuals inhabiting local fresh-water tide marshes, but this little species is believed to be the original *pensylvanica* DeGeer, 1774, and seems not to be elsewhere treated in literature unless it is one of the two forms mentioned by Wenzel (1896) as *frontalis*.

#### SPECIES HERE DISTINGUISHED

Unsatisfactory as are many of the distinctions used in the accompanying table and in the appended comments, it is believed best thus to emphasize the inadequacy of preserved specimens for specific identification. The variation of characters customarily used for taxonomic distinction is so obvious in the large series before me that, had the specimens not been carefully collected to represent species distinguishable on behavioristic peculiarities, no attempt at division would have been made. Failure of such species to exhibit sufficiently well-marked differential characters is probably not an uncommon phenomenon, but owing to the existing dominance of taxonomy over biology such species are too frequently ignored. A number of other species of *Photuris*, believed to be new, are before me, but the formality of naming them without the support of a definite knowledge of their habits would be objectionable. It is believed that many more biological units must be recognized and that many observers must contribute opposing opinions before an agreement as to method of taxonomic treatment is possible; but the long-accepted simplicity of this genus is an example of our ignorance of one of the commonest, most conspicuous, and supposedly best-known groups of insects.

#### PHOTURIS MALE GENITALIA

Since no specific distinctions in the male genital structures have been observed, although abundant prepared material has been examined, we must give added emphasis to the supposed specific barriers indicated in the courtship behavior, the ecological adaptations, and the nuptial seasons of the different forms.

The male genitalia are unlike those of other lampyrids I have examined, as well as the four genera considered by Sharp and Muir, 1912, in that the sides of the "basal piece" are produced into long, slender, clubbed, lateral processes extending beyond the apex of a slender median lobe. A well-developed but very slender flagellum or internal sac, often 4 mm. in length, armed with minute, flattened, spinelike scales, is invaginated from the median orifice through the median foramen and extends well into the coiled tube (*stenazygos*), which passes through the basal orifice of the aedeagus and attaches



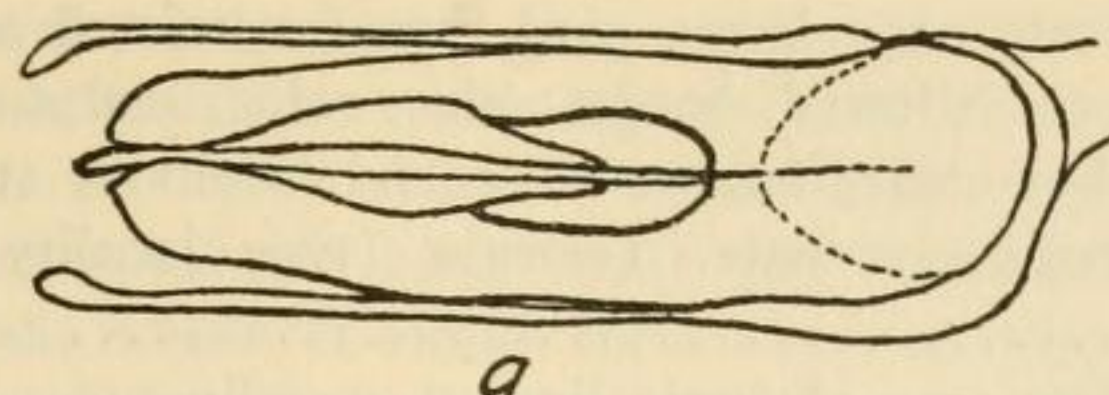
to the base of the median lobe. This flagellum appears capable of being evaginated and probably is inserted to the spermatheca during copulation; but except in length no distinctions were observed in the different forms of which preparations were made. In no prepared material has this flagellum been evaginated, and no duct attached to its apex (probably the functional orifice) has been seen.

[The sketches (figs. 2, 3) are of the aedeagus of *Photuris lucicrescens* from specimens taken in Delaware, Mr. Barber's drawings from *Photuris frontalis* not having been found. Figure 2 shows dorsal, ventral, and lateral views of a cleared specimen, indicating some of the internal structure, and figure 3 the dorsal and lateral views on a larger scale of another specimen with the lateral processes spread. The lateral lobes fuse with the dorsal surface of the median lobe at about basal third, and are armed internally opposite this point with a strong transverse ridge, which is sharply angulate at inner third.—McD.]

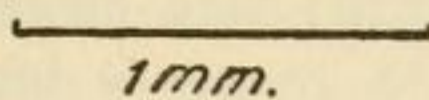
#### TABLE OF SPECIES OF PHOTURIS

- |  |   |
|--|---|
| 1. Pronotum with or without infusate area but always without a pair of oval, red discal spots.....   | 2   |
| Infusate median vitta of pronotum narrowed (sometimes interrupted) in middle third by two conspicuous oval red or orange spots ( <i>pennsylvanica</i> group comprising numerous similar species, of vaguely dissimilar habitus but distinctive habits and habitats).....   | 6   |
| 2. Pronotum entirely pale yellow.....  | 3   |
| Pronotum with discal infuscation.....  | 4   |
| 3. Elytra entirely black; metasternum concolorous with the yellow head and thoracic sclerites above and below; fourth visible sternite with apical margin pale, the lutescent area broad at middle, narrower toward but not reaching the sides; apical infuscation of femora gradual and hardly noticeable, but knees, including base of tibiae, pale; length 8.4-11.5 mm. Type locality, Alpine, Tex. ( <i>flavicollis</i> Fall, 1927, not E. Olivier, 1886)..... | 1. <i>brunnipennis</i> var. <i>falli</i> , new name     |
| Elytra black with narrow sutural and broader lateral yellow margins which are not continuous around apex; head, prothorax and mesothorax yellow above and below; the metasternum piceus; coxae and basal five-sixths of femora yellow, the knees, tibiae, tarsi, antennae, and four abdominal sternites black; length 11 mm. Type locality, Paradise Key, Fla.....   | 2. <i>brunnipennis</i> var. <i>floridana</i> , new var. |
| 4. Pronotal infusate area median; front flavous.....   | 5   |
| Pronotal infuscation longitudinally divided by narrow median pale line; front infusate; emargination of penultimate sternite, size, sculpture, etc., as in <i>floridana</i> except front broader in male, more than twice as wide as one eye in same aspect. Type locality, "Missouri Territory."  |   |
|  | 3. <i>divisa</i> LeConte                                |

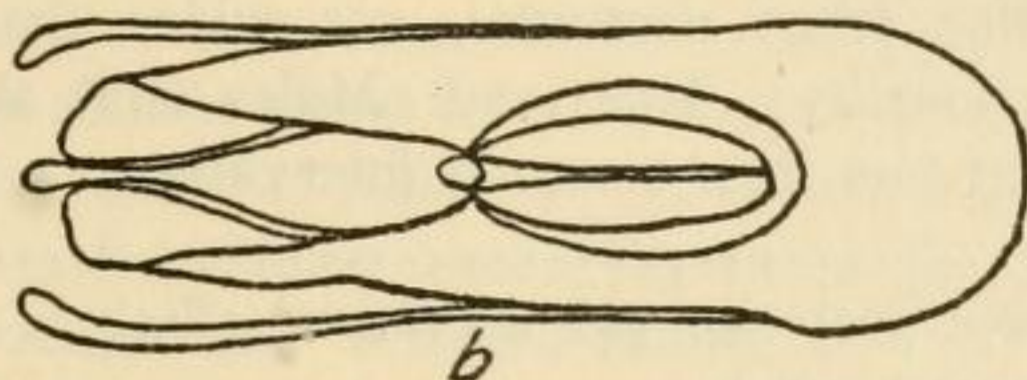




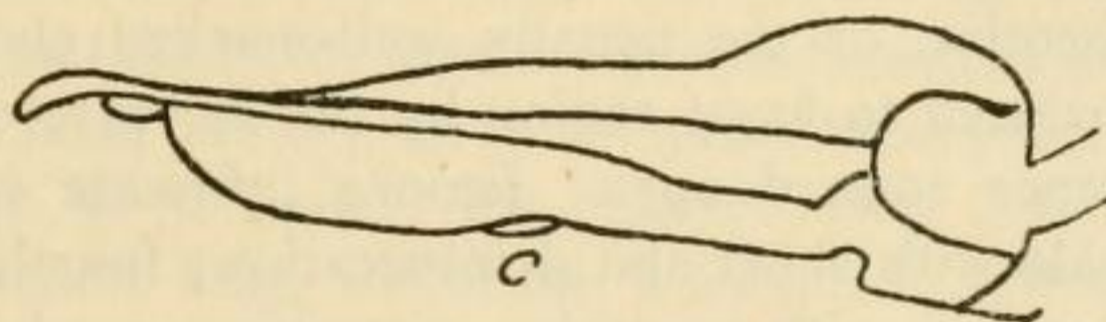
a



1mm.

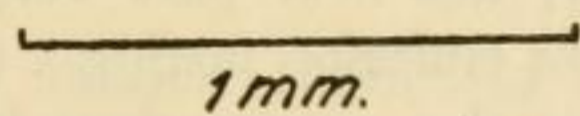


b

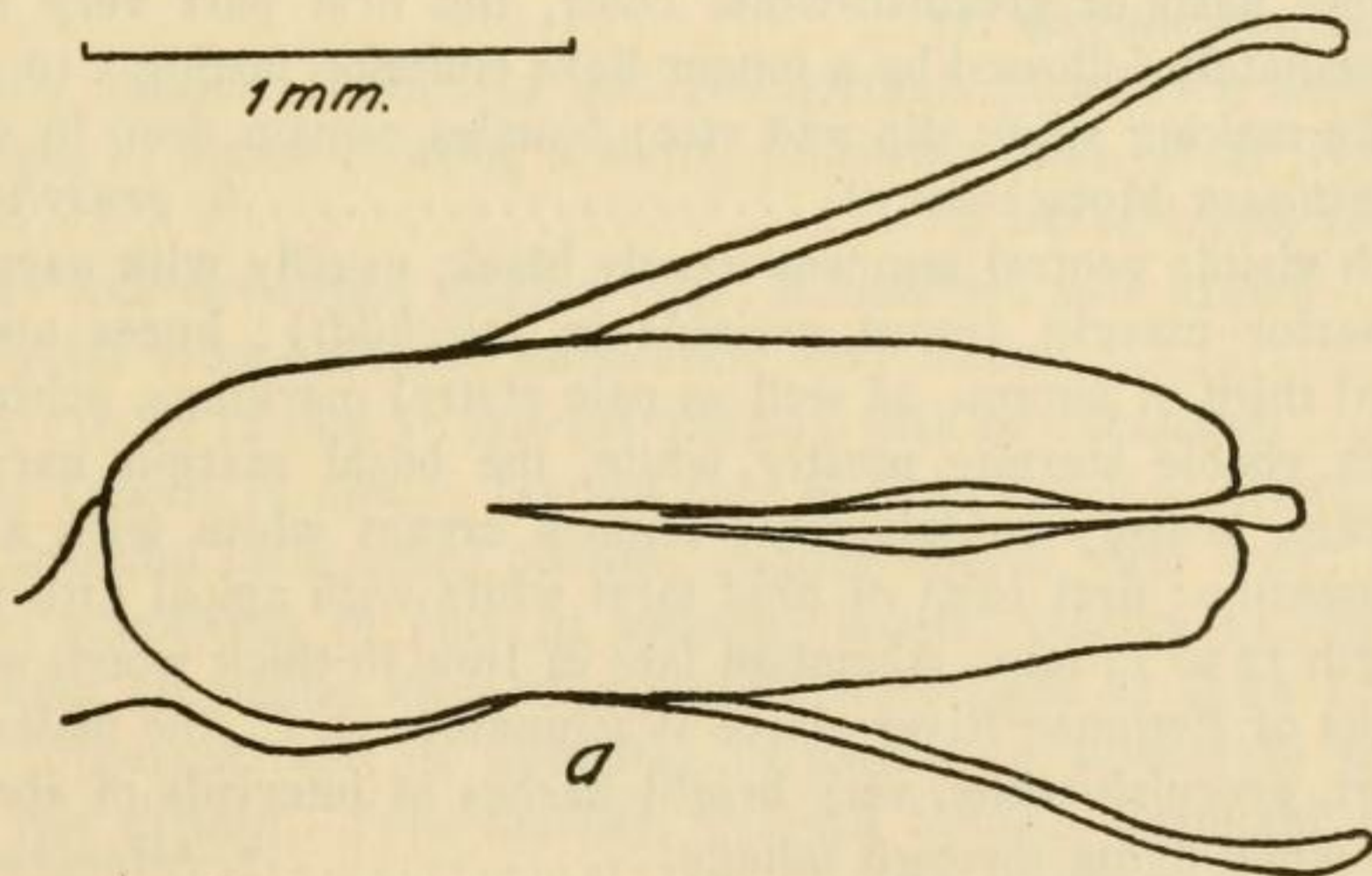


c

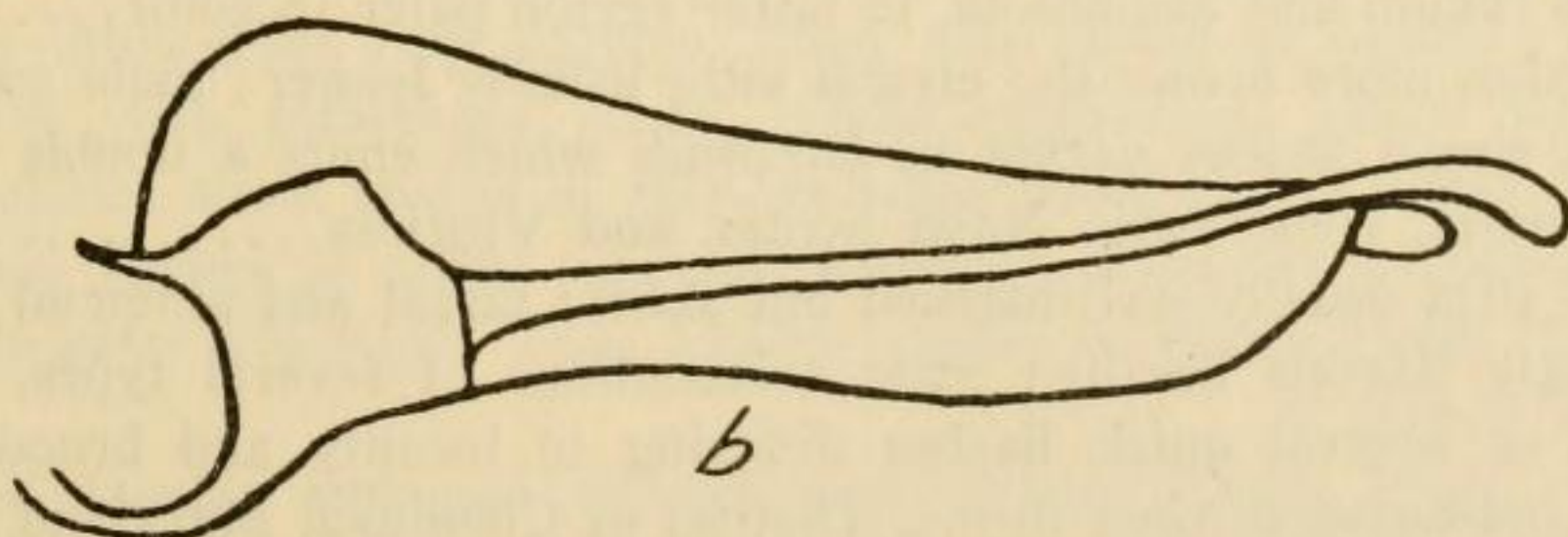
FIG. 2.—Aedeagus of *Photuris lucicrescens* Barber. Cleared specimen showing part of the internal structure. *a*, dorsal view; *b*, ventral; *c*, lateral.



1mm.



a



b

FIG. 3.—Aedeagus of *Photuris lucicrescens* Barber. Specimen showing lateral processes spread. *a*, dorsal view; *b*, lateral.



5. Pronotal infusate area large, oval, not constricted and shading imperceptibly into yellowish border; size, color, sculpture, and front as in *floridana* but emargination of second luminous sternite less deep and more broadly arcuate. Georgia (type locality), Florida, and Texas .....4. *congener* LeConte
- Pronotal infusate area abruptly limited, usually twice as long as wide and constricted at basal third; size larger (12 to 14 mm.), more robust; coloration similar to *congener* but infuscation darker, pale elytral margins continuous around apex, and femoral infuscation reaching middle; front narrower, not wider than radius of eye. Georgia (type locality), Maryland. Males emit short, slightly yellowish flashes at less than 1-second intervals.....5. *frontalis* LeConte
6. Coxae infusate ..... 7  
Coxae pale (except posterior pair in *lineaticollis*)..... 14
7. Size larger (10 to 17 mm.)..... 8  
Size small (8 to 10 mm.), pronotal infuscation usually broad with smaller pair of reddish spots; color variable, the elytra usually with short or moderate oblique pale vittae which are sometimes absent, sometimes subentire, or the usually well-marked elytral infuscation occasionally reduced to basal region by the increase of marginal and sutural lutescence toward apex; femora infusate in apical third; tarsal joints pale with short apical infuscation; fourth visible sternite infusate, sometimes with posterior margin narrowly pale. Inhabits fresh-water tidal marshes of Chesapeake estuaries, June and July; males fly at top of marsh vegetation, poising to emit a protracted double flash of greenish-white color, the first part very short and immediately followed by a longer light emission lasting 1 to 2 seconds, while making slight dip and rise; females remain deep in vegetation (*?vittigera* Motschulsky).....6. *pennsylvanica* DeGeer
8. Fourth visible ventral segment mostly black, usually with narrow white posterior margin (more variable in *fairchildi*); knees and usually basal third of femora, as well as pale elytral markings, ochreous..... 9  
Fourth visible sternite mostly white, the basal margin narrowly infusate, broadly so laterally; femora cream white with ante-apical infuscation; first joint of hind tarsi white with apical fifth infusate; length 12 to 14 mm. Abundant late in June in thick woods on alluvial banks of Potomac River above Washington, D. C., the males emitting short, greenish-white, very bright flashes at intervals of about 1 second while flying through foliage.....7. *potomaca*, new species
9. Infuscation darker; oblique elytral vitta usually shorter; male coruscations flickering or composed of three or more quick flashes. Chesapeake region and Minnesota, in latter region paler in color..... 10  
Infuscation more brownish; elytral vitta usually longer; male coruscations, single flashes except in *fairchildi* which emits a double flash; Minnesota, New York, Nova Scotia, and Virginia..... 11
10. Elytral vitta usually well-marked but short; tarsal and antennal joints strongly flavous basally; male coruscations of several types, three, four, or several quick flashes differing in locality and brood, perhaps indicating distinct forms. District of Columbia, Maryland, Delaware, and Minnesota.....8. *?versicolor* Fabricius



- Elytral vitta obsolescent; tarsal and antennal joints almost wholly black; male coruscations consisting of four slow flashes. Cape Henry, Va. ....9. (*versicolor?*) *quadrifulgens*, new var.
11. Form slightly more robust; hind tarsal and antennal joints a little more slender, the fourth to eighth inclusive measuring  $4\frac{1}{2}$  mm.; sub-humeral pale band usually broader than epipleural infuscation; length 12 to 13 mm.; males flying slowly at top of tall grass and over lawns, dipping and flashing at about 5-second intervals, much like *Photinus pyralis* but beginning its flash on downward flight. Selkirk, N. Y., July 3, 1924.....10. *pyralomimus*, new species  
Form slightly more slender; hind tarsal joints a little broader; antennal joints shorter, the fourth to eighth inclusive measuring  $3\frac{1}{2}$  or 3 mm... 12
12. Antennal joints 4 to 8 inclusive measuring about  $3\frac{1}{2}$  mm.; male coruscations single; habitat near Winona, Minn..... 13  
Antennal joints 4 to 8 inclusive measuring about 3 mm.; male coruscations double; habitat Cape Breton Island.....11. *fairchildi*, new species  
Generally similar in appearance to *fairchildi*, differing chiefly in having shorter and narrower elytral vittae and somewhat darker coloration. The antennae and posterior legs are proportionately somewhat longer, the elytra a little wider, and the pronotum longer relatively to the width than in *fairchildi*; the characteristic flash of the male is unique, a 1-second long, vibrating, tremulous coruscation. Habitat, low land below Black Pond, Va.....11a. *tremulans*, new species
13. Size of *pyralomimus* (about 13 mm.); males emitting a slow, bluish-green flash of about 1-second duration. Winona, Minn.  
12. *caerulucens*, new species  
Size slightly smaller (about 12 mm.; abnormals measuring 10.5 mm. and 13 mm.); males emitting a short, yellowish flash. Near Winona, Minn.....13. *aureolucens*, new species
14. Elytra with well-developed oblique vitta; infuscation pale brown..... 15  
Oblique elytral vitta obsolete, infuscation very dark..... 17
15. Size small (10 to 12 mm.); labrum entirely pale or infuscate..... 16  
Size larger (about 15 mm.); labrum pale at base, black at apex; more robust, pronotal infuscation normal, oblique elytral vitta long; males flying in abundance in July in swampy woods, poising in flight to emit a long crescendo flash of greenish-white light of from 1 to  $2\frac{1}{2}$  seconds' duration, and of sufficient brilliance to illuminate foliage several feet distant. Type locality, Priest's Bridge, Patuxent River, Md.....14. *lucicrescens*, new species
16. Labrum wholly pale (rarely slightly clouded); antennae long (7 to 8 mm.), slender; eyes smaller (2.0 to 2.2 mm. across); median pronotal infuscation very narrow, often interrupted at middle; oblique elytral vitta sometimes short, rarely evanescent; males flying in abundance about bushes in July, emitting short, rather feeble, slightly orange flashes at about 1-second intervals. Inhabits willow-covered fresh-water lowlands. Type locality, outlet of Black Pond, Va.  
15. *hebes*, new species  
Labrum black; antennae shorter and stouter; eyes larger (about 2.5 mm. across); median pronotal black area broad; male flash



- much like that of *hebes* (*supra*); inhabits salt-water marshes along Chesapeake Bay. Type locality, a *Baccharis* thicket on sand spit at Sherwood Forest, 7 miles northwest of Annapolis, Md. (July 7 and 9, 1928.).....16. *salinus*, new species
17. Size small (11 to 12 mm.), pronotal vitta normal, coxae and legs white except ante-apical infuscate cloud on inner edge of front femora and often some apical infuscation on tibiae and tarsal joints; pale margin of elytra continuous around apices; first four visible sternites with pale hind margins. Type locality, Sherwood Forest, near Annapolis, Md.....17. *cinctipennis*, new species
- Size large (15 to 17 mm.); pronotal vitta usually interrupted; basal half of femora and the coxae, except posterior pair, ochreous, the latter partly or wholly infuscate; 4 black sternites without pale border. Habits unknown. Florida and Louisiana.....18. *?lineaticollis* LeConte?

#### 1. PHOTURIS BRUNNIPENNIS var. FALLI, new name

*Photuris flavicollis* FALL, 1927, not Olivier, 1886.

This conspicuous form was named after the present paper was virtually complete, and its practical identity with *brunnipennis* was not suspected until a specimen from Alpine, Tex., the type locality, was obtained from Mr. Schaeffer and compared (January 1927) with the Cuban specimens mentioned under the following variety. Such close relationship between two striking forms, one inhabiting a tropical swampy region, and the other almost the summit of the Continental Divide in western Texas, should be supported by intermediate colonies. Fall's original description mentions the triangulate labial margin, which is obscured by regurgitated material in my unique specimen, but the divergence in this structure between Cuban specimens of *brunnipennis* and the type set of *floridana*, mentioned below, is noteworthy.

#### 2. PHOTURIS BRUNNIPENNIS FLORIDANA, new variety

Eleven males taken by the writer on February 19 and 23, 1919, at Paradise Key (Royal Palm State Park) about 40 miles southwest of Miami, and four specimens (two males, two females) labeled Miami, Fla., March 1920, P. Laurent, received from George M. Greene, differ from the Cuban form, *brunnipennis* J. DuVal, in that the yellow margins of the elytra are much broader, the metasternum is wholly piceous, and the fourth visible sternite of abdomen is piceous, except, rarely, faintly paler at middle, but never with the broad white posterior margin as in the Cuban samples. The latter consist of a male and female from Cayamas and Habana, determined by E. Olivier in 1911, and by Leng and Mutchler in 1922, sup-



ported by a series of 4 males and 12 females from Sanitago de las Vegas, Cuba. A better knowledge of peculiarities of different colonies of *brunnipennis* in Cuba may show these differences to be insignificant. The writer failed to make notes on the behavior of the specimens he collected but believes they were flying low in the dense "hammock" forest at dusk and emitting short single flashes. The type locality is Paradise Key.

Type and 14 paratypes, U.S.N.M. No. 61001.

In *floridana* the labium is small, oval, slightly infusate, and rarely shows more than a feeble median tooth, while in Cuban *brunnipennis* the infuscation is darker, the integument stronger, and the anterior margin prominently tridentate, the teeth being formed by four equal emarginations.

### 3. PHOTURIS DIVISA LeConte, 1852

Twelve specimens in National collection, with data as follows: Topeka, Kans. (Popenoe), four specimens, one of them dated July 19; Riley County, Kans. (Popenoe), four specimens, June 1, 4, and 19; Kansas (Snow), two specimens; Baldwin, Kans. (Bridwell), one specimen, and Lincoln, Nebr., July, collected at electric light, one specimen. The type locality is "Missouri Territory," and there are three specimens in the LeConte collection bearing green discs, which, according to that author's labeling system, indicate "Nebraska, etc." All specimens have the third antennal joint longer than the second, as noted by LeConte, and all are males. The manner of flashing appears to be unrecorded.

### 4. PHOTURIS CONGENER LeConte, 1852

The type stands as the seventh specimen of the series labeled *frontalis* LeConte in the LeConte collection, apparently where that author placed it when preparing his 1881 synopsis. Type locality is Georgia. Nineteen specimens in National collection from Florida (Daytona, March 1907, P. Laurent, one specimen received from George M. Greene; Haulover (near Allenhurst), March 10 and 14; Crescent City, May 25, and Lake Harney, Hubbard and Schwarz, thirteen examples) and Texas (Columbus, July 3, Schwarz, one example, and, without definite locality, from Belfrage collection, four examples). One female from Texas shows no pronotal infuscation and one each from Crescent City and Lake Harney have this infuscation broken into a narrow prescutellar spot and a broader spot over the head, but in the other specimens it is a large, ill-defined, elongate, discal infuscation. Habits unrecorded. Length 9 to 11 mm.



## 5. PHOTURIS FRONTALIS LeConte, 1852

This species appears not to have been recognized since its description more than 75 years ago, all students having followed LeConte, 1881, in applying the name to another species, *congener*, from which it differs conspicuously in its larger size and more robust form. It occurs in abundance in ravines and along the foot of a wooded bluff facing Breton Bay, 2 miles from Leonardtown, Md., in July, the males flying rapidly through the foliage but not going high among the branches. They emit very regular, quick, bright flashes of yellowish color at intervals of about three-fourths of a second, abruptly discontinuing the flashes when they alight on foliage. Only two females have been seen in several evenings spent in watching this species, one, which was glowing faintly, in the grasp of a large phalangid on the ground and more than half eaten, July 8, 1923, and one which produced a fine streak of light as it descended to alight upon a leaf some 8 feet above the ground, July 4, 1927.

The species was observed abundantly in the locality on July 13, 1923, June 19, 1925, and July 4, 1927; but was sought vainly on June 18, 1926, and June 7, 1927. One male was caught at Sherwood Forest, near Annapolis, Md., July 13, 1927 (P. G. Russell), and another on St. George Creek, in St. Marys County, Md., July 1, 1931.

## 6. PHOTURIS PENNSYLVANICA (DeGeer, 1774)

?*Telephoroides vittigera* MOTSCHULSKY, 1854, p. 60.

If the original types can be studied the above synonymy may need revision, but of the species observed and collected by the present writer only one appears referable to either of the descriptions originally accompanying the above specific names. This is the diminutive species appearing in great abundance over the tall grass of the Potomac and Patuxent tide marshes. The majority of the specimens fit Motschulsky's description, but only a few have the brown tint of the elytra confined to the base as described by DeGeer, who records the size as equivalent to 10 mm. His figure (pl. 17, fig. 8) is 14 mm. in length but other familiar species are equally enlarged. His indirect quotation from Acrelius informs us that they particularly inhabit the prairies of Pennsylvania all summer, flying and shining like thousands of sparks. Information about Acrelius has since come to notice in the very interesting comment by Jones (Ent. News, vol. 41, p. 305, 1930), and it appears most likely that the type locality is within the present city of Wilmington, Del., the southern part of which was



until a few years ago a fresh-water marsh and might then have been called prairie. Ecologically it must have been practically identical with the marshes near Washington, over which vast numbers of this little firefly may be observed. Samples studied consist of about 90 specimens preserved by the writer on numerous visits to their restricted habitat, and supported by two specimens from the collection of George M. Greene, labeled Riverton, N. J., June 17 and July 3, 1899, which may be regarded as practically topotypes.

In many of them the oblique, pale elytral vitta is obsolete or evanescent and in some the confluent infusate area is narrowed by widening of the lateral and sutural pale borders. In mid-April, 1927, larvae were found by means of their lights to be very abundant in the drier part of the marsh near the Shaw Lily Ponds, Kenilworth, D. C., and when taken indoors they prepared their cells, pupated, and issued as adults within a few days. Six weeks later (June 1) the first adults were seen in the same locality, and 10 days later they had become very numerous. By mid-July the numbers were considerably reduced.

This species first attracted my attention on June 24, 1924, in the Patuxent River marsh at Hills Bridge, Md., 20 miles east of Washington, and since it occurs in pure colony unmixed with other species of *Photuris*, and flies at about the height of one's head as he wades in the marsh grass, it offers a very convenient contrast with the treetop-frequenting forms that have hitherto been identified as *pensylvanica*. Its very distinct behavior is so striking that it is strange no observers have described it. Its habits have been noted often by the writer, both in the Patuxent and Potomac marshes, and the following composite account may better represent the species than scattered detailed records.

One arrives after sunset, intending to watch. The dusk is settling down over the marsh, and no firefly lights have yet been seen. Then, in the darker, eastern side of an isolated alder bush comes the first flash. Inspection discloses a male of this species rapidly ascending a stem from the now very dark interior of the bush. Numbers of others are thus appearing, but as yet they do not take flight, colors of foliage being still visible. They flash at intervals in the darker places, each flash being a very short, bright explosion of light succeeded by an equally short and abrupt interruption, followed immediately by the protracted second flash, the whole lasting 1 to some 3 seconds. When dusk has sufficiently advanced they fly, and others appear all over the marsh. While producing the light they poise in one place, with only a slight fall and rise in height, or perhaps while



ascending they make a slight spiral movement. No females can be found, except by accident, until their presence near the roots of the grass is understood, when the explanation of the peculiar stationary coruscation of the male manifests itself. The grass standing vertical, the response flash of the female could not be seen by the male unless he poised directly over her and waited long enough for her to answer his signal. Can such a high degree of adaptation of courtship behavior to the peculiar structure of marsh plant growth be other than an indication of long-established specific distinction? As one cannot thus imitate the male and cannot expect the female to respond after the rude commotion made by one's close approach, flashlight mimics are abandoned. Females confined in a screen-covered pan on the bow of the skiff, which has been placed in the stream, partly concealed in the wildrice, apparently answer flashes of males, but the latter are too distant and the cloud of mosquitoes, as well as the belief that males recognize and avoid abnormal environment, discourages perseverance.

#### 7. *PHOTURIS POTOMACA*, new species

No other characters than those given in the key have been noticed, and variation is found even in these. Five of the 24 males show greater extent of the basal infuscation of the fourth visible sternite, approaching the condition in *versicolor*. In two of the same series the apical infuscation of the tarsal joint is diffused basally and in the eight females taken with these males the fourth sternite is black or only narrowly bordered with white. Abundant and conspicuous as this species is in the shore woods of the Potomac above Washington, the writer has failed to preserve an adequate series, as only two lots are available: 19 males and 4 females from Offutt Island (type locality) in the Potomac, 2½ miles below Great Falls, Md., June 23 and 24, 1926, and 9 specimens, 3 of them females, taken June 30, 1926, on the Virginia shore at Stubblefield Falls, near Plummers Island, Md. Another male was taken July 1, 1926, by the river near Black Pond, Va. As already stated, the males emit very short, greenish flashes at regular intervals of about 1 second, while flying in woods along the river banks.

Type and 32 paratypes, U.S.N.M. No. 61002.

#### 8. *PHOTURIS VERSICOLOR* (Fabricius), 1798

The type locality is recorded as "Habitat in America Borealis Dom. Hirschell," but a record of the residence of, or places visited by, Mr.



Hirschell in this country has not been found by the writer. The useful characters of the original description are: large size; black antennae with the articles a little pale at base; black elytra with margin, suture, and a short vitta yellow; black legs with knees yellow.

About 100 recently collected specimens from the Chesapeake region display this combination, but, although they are not believed to represent one homogeneous species, the writer's notes on behavior are insufficient for their separation. All notes refer to flickering coruscations, but unfortunately no timing device other than the experience from timing photographic exposures was used in making observations on any of them. The discrepancies in my records are, however, too great to ascribe merely to varying judgment. Although possibility of errors cannot be denied and temperature alters behavior to some extent, the following notes on observed flashes are offered as perhaps of help in future observations.

An early form was found in a field in Rock Creek Park (June 19, 1924, and June 2, 1925) and along the Virginia shore of the Potomac River near Stubblefield Falls (June 20, 1924), males flying slowly 5 to 15 feet above ground, emitting a rapid series of five or six short flashes of moderate intensity and greenish hue in less than one-half second and at short intervals. Numerous males were attracted excitedly to the mimic of the female light by a flashlight dimmed with green leaves and fingers, while the writer stood concealed in foliage at edge of field. Basal third to half of first joint of hind tarsi is yellow in preserved samples, except in two specimens (June 2, 1925) in which yellow extends to apical fourth. Elytral vitta varies from short basal vestige to two-thirds entire.

In a field near Cabin John Postoffice, Md. (June 7, 1927), males emitted three or four short flashes in about a second, followed by a long rest, but when observed the temperature was falling rapidly after a warm afternoon and we may suppose that persistent males were acting abnormally.

In the field below Black Pond (10:30 p. m., August 2, 1927) among the few females and very rare males of *hebes* and *lucicrescens* then surviving, a single male *versicolor*(?) flew swiftly along the edge of the woods, 15 to 30 feet above the ground, emitting greenish flashes in series of four in about three-fourths of a second and at 6- to 8-second intervals, the fourth of each series being much less brilliant than the first two. This individual was observed to fly 300 yards or more before descending within reach of the net, and since it displays no characters by which it can be separated from the above



series it is regarded as a stray from the earlier brood, belated, perhaps, by having transformed in a place chilled by a flow of cold spring water. Its elytral vitta is a mere vestige, and the antennal joints are not pale at base, but this may also be the result of a cold environment.

Among confusion of flashes by several species two specimens emitting only three flashes were taken June 8, 1927, at Breton Bay near Leonardtown, Md., one resting on foliage and leisurely producing three flashes in about  $1\frac{1}{2}$  seconds at rather long intervals, the other flying and emitting three flashes in one-half second at about 5-second intervals. In these the first joint of the hind tarsi is about three-fourths yellow.

Mr. McDermott observed a form at Claymont, Del., on June 11, 1927, which flew 3 to 10 feet above the grass, emitting three rapid successively brighter flashes at 2- or 3-second intervals.

Among what seemed to be five species of *Photuris* active at the mouth of a sharp ravine in Sherwood Forest on the Severn River near Annapolis, Md., June 29, 1927, were a few swift-flying males emitting a very rapid and brilliant flickering flash with perhaps eight or more vibrations too fast to count, in about one-half a second, at intervals of about 3 or 4 seconds, and at distances between flashes of from 10 to 20 feet. Attempts to distinguish the series of seven males and five females preserved from this locality have failed.

Near Winona, Minn., July 6, 1926, a series of 13 males was preserved by Miss E. Myers and Mr. Boland, who noted that they flew 2 or 3 feet above the tall weeds, emitting usually five greenish flashes as fast as one could count at intervals of perhaps 30 seconds. These specimens average a little smaller in size and are paler in color but otherwise appear not separable from the above forms.

#### 9. *PHOTURIS VERSICOLOR QUADRIFULGENS*, new variety

Three specimens captured out of a score observed May 21, 1927, near Cape Henry, Va., are darker colored, with scarcely a trace of the basal paleness on antennal or tarsal joints, the elytral vitta wholly absent in one specimen, an obsolescent vestige in another, and very short in the third, and the elytral apices black in two specimens, while the pale margin is very narrowly continued around apex in the third. They were emitting greenish, bright, perhaps one-half-second flashes in series of four, with short intervals of about a second and longer intervals of a quarter to a half minute, but the evening was not cold, and mosquitoes were very aggressive. The specimens were found



flying among scattered pines on the old sand dunes bordering a small fresh-water marshy area near the south end of the bridge over Long Creek about a mile east of Lynhaven Inlet. Length 13 to 14 mm.

Type and 2 paratypes, U.S.N.M. No. 61003.

10. **PHOTURIS PYRALOMIMUS**, new species

Size and habitus of *versicolor* but a little more robust and less deeply infusate. Individuals vary from pale brown with ill-defined pale marks to dark brown with sharply defined yellow markings. The lutescence of hind tarsal and antennal joints varies greatly, that of the former occupying one-third to five-sixths of the first joint. In about one-fifth of the specimens the epiplural infuscation is enlarged. The species was observed by the writer in vast numbers July 3, 1924, near Selkirk, N. Y., flying slowly about the lawns and hayfields, the males dipping, flashing, and poising at tips of tall grass very much like *Photinus pyralis*, but emitting their half-second flash during the descent as well as the ascent. Thirty-three males and three females preserved.

Type and 35 paratypes, U.S.N.M. No. 61004.

11. **PHOTURIS FAIRCHILDI**, new species

Varies from pale elytra with basal infuscation (three specimens) through darker shades of brown on infusate areas of elytra to the normal dark-brown infuscation (two specimens) more common in the genus. Fourth visible sternite is narrowly bordered with white in three specimens, the white more extended in others, until in three specimens the infuscation is only conspicuous at sides. The slightly shorter antennal joints and the uniform size of about 12 mm. are practically the only differences observed to support the distinct behavior and remote habitat. Ten specimens, one a female, were received from Graham Fairchild, with the information that they were caught over marshy ground at Baddeck, Nova Scotia (Cape Breton Island), about 9:30 p.m. on July 14, 1927; that they fly rapidly and emit two medium flashes separated by an interval about twice as long as one flash, but that the flashing is not very regular.

Type and 9 paratypes, U.S.N.M. No. 61005.

11a. **PHOTURIS TREMULANS**, new species

This species has been taken in low ground below Black Pond, Va. It resembles the type specimen of *Photuris fairchildi* but is somewhat



darker and has short and narrow elytral vittae; the antennae and posterior legs are proportionately longer, the elytra somewhat wider, and the pronotum tends to be longer relative to the width. The very characteristic male flash, a long tremulous coruscation lasting one-half second to a second, differentiates this species clearly from others of similar appearance.

Type and 4 paratypes, U.S.N.M. No. 61006.

#### 12. *PHOTURIS CAERULUCENS*, new species

Form and colors as in the paler variety of *versicolor* from vicinity of Winona and hardly distinguishable from it in the cabinet. The shorter antennal joints, slightly broader first joint of hind tarsi, and very slightly smaller average size help in the recognition of preserved specimens of the present species, whose lights were observed as very different from the *versicolor* also present there. According to the collectors, who called this species the "slow blue," the normal male flash is a steady bluish-green light of about a second's duration, dimly visible for some time after the flash. Twenty-six males and four females were collected by Miss E. Myers and Mr. Boland on July 8, 1926, over damp ground close to a tamarack swamp near Bluff Siding (type locality) in Wisconsin, 10 miles east of Winona, Minn., in company with another species (*aureolucens*), and four males and two females were preserved two days earlier near Stockton, Minn. (10 miles east of Winona), where they were less abundant among the pale variety of *versicolor*.

Type and 35 paratypes, U.S.N.M. No. 61007.

#### 13. *PHOTURIS AUREOLUCENS*, new species

Form and coloration of *caerulucens*, from which it is almost indistinguishable in cabinet specimens. The smaller size and slightly more slender antennal and hind tarsal joints are inadequate recognition marks, but the information kindly supplied by the collectors states that this species emits a single, short yellowish flash not to be distinguished from that of *Photinus castus*, and flies about the tops of tall weeds in marshy ground, appearing in the dusk before *caerulucens*, with which it occurred but from which it is conspicuously different in the color and the duration of the flash. Twenty-three males and one female collected near a tamarack swamp in Wisconsin, near Bluff Siding, 10 miles east of Winona, Minn., July 8, 1926, by Miss E. Myers and Mr. B. Boland.

Type and 23 paratypes, U.S.N.M. No. 61008.



14. *PHOTURIS LUCICRESCENS*, new species

This is the largest, palest-colored, and most brilliantly luminous of the species encountered by the writer in the Chesapeake region, but much remains to be learned of its behavior. It may be the species figured by G. A. Olivier, 1790, as *pensylvanicus* DeGeer. Cabinet specimens may be recognized by their pale coxae, brownish color of infusate areas, usually strong development of the lutescent borders and oblique vitta of elytra, and the irregularly lutescent areas in the first three or four visible sternites. The series from the densely wooded low shores of the Patuxent River at Priest's Bridge, Md., 20 miles east and slightly north of Washington, D. C., has been chosen as typical because in this locality no other species was observed during July, and especially because the puzzling short flashes in the treetops, mentioned below, appeared to be absent. Here the myriads of flashing males usually flew lower in the forest, and emitted lights of greenish-white color, which began dim, grew brighter, became very brilliant, illuminating foliage for several feet around, and ended abruptly, having lasted from about three-fourths second to  $2\frac{1}{2}$  seconds, as timed by a pendulum of one-half-second beat. The type, allotype, and 11 paratypes were taken from this colony on June 29, July 1, and July 22, 1927, and the behavior of the numerous population of the species was also watched on the evenings of July 5 and 12. On the latter date special attention was given to the presence with *lucicrescens*, in woods of adjacent valleys, of a similar or identical form flying about the upper branches of the trees and emitting extremely short (perhaps one-tenth second) and bright flashes at intervals of 3 to 5 seconds. Satisfactory samples of those thus flashing could not be obtained, but on July 22 a male observed to be emitting these instantaneous flashes was caught by a wind eddy and descended, still flashing, within reach, where it was illuminated by the flashlight beam and taken. No characters have yet been found by which it can be differentiated from typical *lucicrescens*. Among a series of males from Sherwood Forest, Severn River, near Annapolis, Md., July 5, three specimens were thought to be giving these very short flashes, but not having been illuminated by flashlight before netting it was feared that a nonflashing *lucicrescens* might have been taken.

In some localities, or under some conditions, this species appears to poise for its long flash. At other times and places what may be this species flies a zigzag course over the bushes, coruscating only while on a short sidewise flight at nearly right angles to the general direction of its advance, and in some localities the size averages a little smaller



and the flash shorter. At times a definite vibration to the light can be seen. F. A. McDermott, at Claymont, Del., July 19, 1927, describes in a letter the strong crescendo flash as "unquestionably vibrating" and recounts his attraction and capture of males by producing short flashes with a small pocket flashlamp covered by two layers of plantain leaves. The writer's success in similar attempts has been variable and leads to the belief that the searching males have extremely good vision and readily perceive an enemy unless the observer stands concealed in foliage. His most striking success, however, was not with a flashlight but by the use of the light of the fireflies dying and glowing brightly in the cyanide bottle. The latter was held concealed, its light being exposed for very short periods by quickly opening and closing the hands, and several males were observed to alter their course and approach as if for courtship.

Although the dates on preserved specimens range from June 21 to August 29, the period of chief abundance usually covers about 3 weeks in early July, after which males are less in evidence and through August most of the individuals encountered are females. The 136 specimens are from the following localities: Maryland—Priest's Bridge (type locality), Plummers Island and vicinity, Lanham, Berwyn, Sherwood Forest, and Breton Bay; Washington, D. C.; Virginia—Hunting Creek (1 mile south of Alexandria), Black Pond, near Great Falls; Delaware—Claymont. (One specimen seen at Louisville, Ky., June 1945.—McD.)

Type and 135 paratypes, U.S.N.M. No. 61009.

#### 15. *PHOTURIS HEBES*, new species

Forty-two specimens are preserved from the type locality, Black Pond, Va. (Potomac River, 2 miles below Great Falls), collected June 28, 1925, July 21 and 26, 1926, July 3 and 28, and August 2, 1927. These are of small size (about 11 mm. long) and have relatively long antennae, and pale (sometimes slightly infusate) labrum, but exhibit considerable variation in the extent of the elytral vitta, which usually passes the middle, although it is sometimes evanescent, or may be broader and attain the apical fourth of elytra. The pronotal infuscation is rarely interrupted by medium coalescence of the orange spots, but may sometimes attain a width approaching that of one of the orange spots. Fourteen specimens from Chalk Point (7 miles south of Annapolis, Md.) were preserved July 13, 1926, out of many seen flying about *Baccharis* bushes and over the intervening tall grass bordering the salt water. The flying males emitted short,



sharp, yellow flashes at about 1-second intervals, in strong contrast with the much brighter, greenish flashes of another species occupying adjacent trees. On searching for the females they were found in numbers in the bushes and grass. At this place the impression of the yellowish character of the light was very strong, while in the type locality the impression of contrast was less marked.

Four other specimens seem referable to this species and are from Plummers Island, Md., July 9 and 24, 1902 (H. S. Barber), the Virginia shore near the same island, July 21, 1923 (H. S. Barber), and Lakeland, Md., July 5, 1909 (F. Knab). Preserved samples of *hebes* resemble the average specimen of *pensylvanica* in their small size and dorsal coloration, but the intermediate joints of the antennae are longer and the coxae are pallid. The very similar specimens found by Wenzel in the sea-water meadows at Anglesea, N. J., have much shorter antennal joints and are here referred to *salinus*; they are probably one of the "two forms of *Photuris frontalis*" taken there and mentioned by Wenzel, 1896. A closely related form inhabiting the Florida Everglades is omitted, the writer having failed to make sufficiently definite observations upon its habits.

Type and 59 paratypes, U.S.N.M. No. 61010.

#### 16. PHOTURIS SALINUS, new species

Similar in size, form, and flashing habits to *hebes* but peculiar to the drier margins of salt marshes near Chesapeake Bay, and differing in having the labrum black, the antennae shorter and slightly stouter, the eyes larger, and the infuscation of the mesopleurae more pronounced.

Type locality, a *Baccharis* thicket on sand spit at Sherwood Forest, 7 miles northwest of Annapolis, Md. (July 7 and 9, 1928). Other localities: a *Baccharis*-bordered salt-grass area on St. George Creek, St. Marys County, Md. (July 1, 1931).

Specimens doubtfully referred to this species were collected near Lloyds, Dorchester County, Md., on July 10, 1907, by the writer, and at Anglesea, N. J., by H. W. Wenzel, probably being one of the two forms mentioned by him (1896) as *Photuris frontalis*.

Type and 43 paratypes, U.S.N.M. No. 61011.

#### 17. PHOTURIS CINCTIPENNIS, new species

There is a possibility that the small (11 to 12 mm.) species for which this name is proposed may be identical with either *Photuris lineaticollis* LeConte, 1852, or *Telephoroides lineaticollis* Motschulsky,



1854. The small size, almost wholly white legs, white elytral epipleura, deep black elytral disc, broad pale elytral margins, and usually total absence of oblique median pale vitta make this form conspicuously distinct in collections. Unfortunately its distinctness was not recognized at time of collection, when attention was concentrated upon other species, and its lights were not particularly noted. Among the flashes observed on that occasion, and not ascribed specifically to individual fireflies, were, however, only the more ordinary short and regular flashes commonly given by restless females of most *Photuris* species and by searching males of a few species. Two females were collected at Breton Bay, Md., July 8 and 13, 1923, and a series of three males and six females at Sherwood Forest (type locality) on the Severn River near Annapolis, Md., June 28 and 29, and July 5, 1927, only females being taken on the last date.

Type and 10 paratypes, U.S.N.M. No. 61012.

18. **PHOTURIS LINEATICOLLIS** LeConte, 1852

?*Telephoroides lineaticollis* MOTSCHULSKY, 1854.

Under this name are placed six very large, dark-colored female specimens from Florida and Louisiana, as listed below. There is, however, considerable doubt about their identity, since the writer failed to notice a specimen in the LeConte collection which might be the type of that author's short remark of 1852 validating the nomen nudum of the Dejean Catalogues. The identification of *lineaticollis* Motschulsky by Gorham, 1880 (p. 110), from Quebec, requires re-examination. Blatchley (Can. Ent., vol. 56, p. 165, 1924) has quoted this remark and added some discussion, but states the length as 14 mm., agreeing in this respect with the form described by Motschulsky, 1854. In only two of the specimens, all of which are larger than the length just stated, is the median infuscation of pronotum of linear form, the other four having this dark line interrupted broadly at middle, forming a larger rounded anterior spot and a narrow pre-scutellar spot.

This is probably our largest North American firefly, and if the large area of the urate reflector in the lumious segments is an indication of its light, it may be our brightest-flashing species as well. No notes on its habits are now available, however. The six specimens are labeled as from Archer, Fla., March 1882 (Koebele); Hillsboro County, Fla., May (Hubbard and Schwarz); Lakeland, Fla., April 1912 (G. G. Ainsley); Duval County, Fla., and Covington, La., May 28 (Soltau).



## ADDENDUM

### NOTES ON SOME GENERAL CHARACTERS OF NORTH AMERICAN PHOTURIS

BY FRANK A. McDERMOTT

A somewhat detailed examination has been made of 28 specimens representing 19 species and varieties of *Photuris* which Mr. Barber had assembled as representing most of the species discussed in the foregoing monograph, and also of type specimens of *tremulans* and *salinus*. Measurements and points of particular difference or interest are given later in this section.

Certain characters are in general very similar in all the species, these being of some generic importance. There is, of course, some variability between different specimens of the same species in all characters; such phenotypic differences are to be expected, and there are instances where the variation may overlap between species, for example in over-all length or width. It is difficult to describe accurately in words, or even to illustrate properly, the shape of some of the appendages—e.g., the labial palpi—though an attempt has been made to make them recognizable. Some of these general features are discussed in detail below, and in some instances may be compared with the generic characters as given by LeConte, Olivier, and others. For the sake of reference, the generic descriptions by LeConte, Lacordaire, and Olivier are also given.

*Pronotum*.—Unlike the conditions in the commoner species of the genera *Photinus* and *Lecontea*, the carapacelike pronotum does not completely cover the head, so that, as viewed from above, a portion of the eyes and frons is visible. The shape of this structure is generally roughly scutate, or perhaps more accurately, rounded ogival, broader than long, and with rounded angles at the posterior lateral corners. In most species there is a median pigmented area, usually consisting of a central dark-brown or black figure, between two orange or pink areas; in some species this pigmented area is absent, being represented by a merely shaded or dusky spot in the otherwise uniform chitin. Outside of this pigmented area, the remainder of the pronotum may be opaque yellow or white, translucent, or even transparent. The shape of the dark pigmentation is at least somewhat characteristic of the species, though somewhat variable in different specimens. The



characteristic form, as represented by *Ph. versicolor*, is a T on a triangular base, the apex of the latter coinciding with the median line at the anterior edge of the pronotum, and the cross bar of the T lying along the posterior edge; this T-form is subject to several specific modifications, as given in the descriptions of the species. There may or may not be a median sulcus in the pronotum, and there would seem to be some doubt as to whether, when present, it is a natural character or an artifact resulting from distortion in drying.

In the specimens examined the ratio of width to length of the pronotum varied from 1.2 to 1.5; no relation was evident between this ratio and the over-all size of the insects. The proportion of the total length (pronotum plus elytra) represented by the pronotum varied from 18 to 21 percent, averaging about 19.7 percent.

*Scutellum*.—This small structure is roughly kite- or coffin-shaped, and varies in coloration more or less, and to some extent in outline, with the species; again, it is difficult to express the exact shape in words. Anteriorly to the scutellum, the two mesonotal plates may usually be seen sufficiently to note the color, which is frequently the same as that of the scutellum.

*Elytra*.—Since the elytra represent about 80 percent or more of the total area of the insects as seen from above, differences in them are the most easily recognized characters. In general, two types of elytral outlines are found in these species: (1) Those in which there is no marked widening or outward curvature of the lateral edges, and which are therefore described as parallel or practically parallel; (2) those in which such a widening is definitely noticeable, usually as the result of the presence of a distinct margin, and where the resulting outline is at least subparallel and approaches a long oval. This condition results in a considerable range of variation in the ratio of length to width, the figures found for the species embraced here varying from 2.3 to 3.81.

The base or ground color of the elytra varies from a very dark brown—nearly black in some specimens—to a pale grayish tan. Perhaps it is in the base color that the greatest amount of individual variation will be found. For instance, three specimens of *Ph. lucicrescens* in Barber's collection, dated 1927, are all light, although there is some difference between them; two taken by the writer in Wilmington in 1948 are both much darker than Barber's specimens, although otherwise very similar. Of course the expression of such color tones in words may convey to another reader a different shade from that intended, and hence an attempt to give a very definite color classification



is not justified. Another difficulty is the darkening of the specimens with age; the originally practically pure white of the luminous segments becomes eventually a brownish yellow, and other light areas undergo a similar darkening; presumably the darker portions also deepen in tone. Still a third factor is that in examination under a binocular microscope with intense illumination, all colors appear lighter and brighter than under general illumination; hence the appearance under the latter condition may really be more significant than under the microscope.

In the majority of the species, a rather definite lighter border or margin is present on both the lateral and sutural edges of the elytra, and these margins may be continuous by meeting around the tips of the elytra. In some, the lateral margins are relatively quite wide for a considerable part of the elytral length, and are associated with an increase in the maximal width. The sutural margin is usually rather narrow, not much more than a line. A further feature characteristic of many species is a light-colored stripe, called a *vitta* by LeConte and Barber, beginning at or near the shoulder (humerus) and extending lengthwise of the elytron, and obliquely so as to approach the suture; this stripe may vary in length from one-fourth to seven-eighths of the elytral length, a variation of some diagnostic value. It is usually fairly wide at the anterior end, narrowing rapidly at first, and then gradually for the greater part of its length, eventually becoming indefinite and no longer traceable. Usually each elytron has one or more ridges or costae, which appear to be lines along which there is an exaggeration of the general tuberculation. These costae usually begin at or near the humerus, and may extend for almost the entire length of the elytron, but more frequently end indefinitely at one-half to two-thirds the length. They tend to diverge, and when oblique stripes or vittae are present, the most prominent ridges may mark the middle of these stripes. However, it has been noted that the number of such costae is not necessarily constant in all specimens of a species, and although not infrequently given in the description of a species, they appear to be unreliable as a specific character. This is also true of the hair, which is a prominent feature of most species; occasionally this may be locally developed in a manner requiring mention, but usually it is a general condition and rather variable.

*Head.*—Viewed from the front the head appears to be composed mainly of the two large eyes and the frons—the area between the eyes and bearing the antennal sockets. The width of the frons, its color, unusual details of the antennal sockets, the slope or divergence of the



interocular margins, etc., may be of diagnostic importance, but for most species the measurements do not provide means of identification. The ratio of the frontal width across the eyes to the total length varies from 0.18 to 0.24 for the specimens examined, without parallelism to the total length. In these species, the frons is usually depressed medially.

The terminal joint of the maxillary palpi is the portion of this structure most easily observed; this joint is usually long-conoidal in outline, flattened and lighter on the inner surface, and frequently the tip is flattened or bent to give a finger-tip appearance; usually this tip is rounded, sometimes nearly straight across, and may appear as a sharp point by lateral view. The labial palpi, described as lunate by LeConte, is rarely even approximately crescentic in these species—at least it is a very asymmetric crescent. Perhaps it is best described as being of a long, narrow mitten shape, with the “thumb” projecting at a right angle; this thumb may be curved at the end, and may have a low protuberance at its base. For most of the species, the variations in outline are slight.

The labrum (perhaps more properly the clypeus) shows some variation; the edge may have one or more small projections, and the whole structure may be short, not completely covering the closed mandibles. The mandibles are curved, sickle-shaped rather than semicircular, and under the microscope may appear to be hollow; they are brown, lighter in the proximal portion, and although appearing rather thick (0.05-0.1 mm.) for insects of the size of these, are sharp-pointed.

*Antennae*.—Perhaps next to the elytra and the pronotum, the antennae are the most conspicuous features in *Photuris*. They are longer than in many lampyrids, but are simple, 11-jointed, and slightly tapering. Their length, expressed as a fraction of the total length of the insects, varies from 0.455 in *pensylvanica* to 0.69 in *hebes*, the majority being between 0.5 and 0.6. The third joint is little if any longer than the second; the first joint is usually the longest, and any one of joints 4 to 10 is usually as long as or longer than the sum of the second and third; the eleventh is usually somewhat shorter.

*Sternites*.—The first four visible sternites are of about the same length, and usually mainly some shade of brown, the posterior one frequently being one-third to one-half white; the posterior edges are but little sinuate, being nearly straight. The sixth and seventh sternites are completely white and represent the main luminous area; the eighth is usually much smaller and white, but not apparently luminous, and in a number of species it bears a long (0.25 mm.) median projec-



tion, with a base which may be broad or narrow. The posterior edges of the sixth and seventh sternites are usually more or less emarginate or "notched," sometimes deeply; usually both are 1.3 to 1.5 times the length of any of the first four sternites. The "foveae" (points of muscle attachment), noticeable on the ventral side of the luminous segments in *Photinus* and *Lecontea*, are rarely observable.

The aedeagus was extruded in 10 of the 28 specimens examined; in all cases it was of exactly the same type as far as could be determined without dissection; it varied from 1.75 to 3.0 mm. in length, representing 17 to 21 percent of the total body length, and tending to be longer in the larger species. The same type has been found in dissections of *Ph. versicolor* and *Ph. lucicrescens* collected in Delaware by the writer, and in Marthas Vineyard, Mass., by Dr. Frank M. Jones, and is very similar to that of *Ph. jamaicensis* collected in Jamaica by Dr. John B. Buck.

*Legs.*—The legs of *Photuris* are proportionately much longer than those of *Photinus* and *Lecontea*, and in occasional specimens impress one as being unusually long, especially the posterior pair. Measurements show that these posterior legs vary in length from about 0.65 to 0.85 of the total length of the insects, averaging about 0.75. The outer claws are bifid on all legs, and sometimes there is a small protuberance at the base of one or both claws. Pronounced tibial spurs are present on the two posterior pairs of legs. Claws and spurs are usually a clear brown. The lobes of the fourth tarsal joint usually extend well toward the claws, covering most of the fifth joint. Each lobe has a furry pad on the under surface, which may be gray or black, instead of yellow or brown.

The generic descriptions referred to above are given here.

LECONTE, J. L. Proc. Acad. Nat. Sci. Philadelphia, vol. 5, pp. 331-347, 1852. *Photuris* Dejean, p. 337:

Antennae 11-jointed, slender, elongated, joints 2 and 3 short, last joint of maxillary palpi acutely triangular, last joint of labial transversely lunate; 4th joint of tarsi long lobate, claws externally divided, internally simple; three last abdominal segments phosphorescent; last superior segment with rounded apex.

LACORDAIRE, TH. Histoire naturelle des insectes, Genera des Coléoptères, vol. 4. *Lampyres*, pp. 307-340, 1857. *Photuris*, pp. 338-340:

Head moderately elongated or short; eyes of at least ordinary size; antennae fairly long, most frequently very slender and bristle-like, of 11 joints, the first a reversed cone, the 2nd and 3d of relatively variable length, the 4th often longer than those following, these sub-equal. Prothorax transversal or not, semi-



circular in front, widely edged except at the base, the angles more or less prominent. Elytra soft, sub-parallel for the most part, more rarely oval. Legs long and slender, posterior femora very prominent on the inner edge, 1st joint of the posterior tarsi at least as long as the two following together, the 4th very long, deeply divided into two slender lobes, the 5th long, in part free; claws simple or bifid at the end. Abdomen not lobed on the sides. Body elongated, parallel or oval, flat.

LECONTE, J. L. Trans. Amer. Ent. Soc., vol. 9, 1881. *Luciolae*, p. 37:

The eyes are large, convex and widely separated above and beneath in both sexes, not conspicuously larger in ♂; the head is rounded, narrowed behind, and not retractile; it is but partially covered by the prothorax, which is, however, of the usual hood-like form and rounded in front. The antennae are longer than one-half of the body, filiform, slender, not compressed, inserted near the anterior margin of the front, and moderately approximate; the second and third joints are about equal, and together are as long as each of the following joints.

The sexes are similar in form, with long elytra and well developed wings; the light organs occupy the whole of the fifth and following segments; stigma-like pores are not obvious, being situated at the base of the fifth and sixth segments and less strongly marked than in *Pyraetomena* and *Photinus* ♂. The seventh ventral in ♀ is obtusely triangular; in ♂ the fifth and sixth are broadly emarginate, and seventh is smaller than in ♀, sinuate at the sides and prolonged at the middle, the eighth is a little wider and longer than the prolongation of the seventh. In our species the outer (or anterior) claw is cleft at the tip. The prothorax and elytra are densely rugosely punctured, the former is yellow with a black stripe or spot, each side of which the disc is red; the latter have the whole margin and frequently a discoidal stripe pale. A single genus occurs in our fauna with limited representation.

OLIVIER, ERNST. Wytsman's Genera insectorum, fasc. 53, p. 57, 1907:

Body elongated, parallel or oblong-oval, having a soft tegument; head hardly visible, attenuated, on a sort of collar projecting from the prothorax; labrum wanting or indistinct because of the proportions of the epistome; antennae long, very slender, the second joint of variable size but always fairly long; prothorax rounded or ogival in front, with the posterior angles sometimes obtuse and scarcely projecting, sometimes very sharp and prolonged posteriorly; legs long and slender; 4th joint of the tarsi bilobed, claws entire or divided . . . ; abdomen composed of 7 segments, the last ones containing the luminous apparatus, which is much more developed in the males. Both sexes have wings and elytra.

. . . the sexual differences consist in the integrity or division of the claws, and particularly in the ♂ the last ventral segment is short, laterally sinuate, and terminated by a linear lobe more or less enlarged; in the ♀ it is large, triangular, with an obtuse point, or slightly incised. As generally among the Lampyridae, the eyes of the ♂ are very large and prominent, and the head appears deeply concave.



OLIVIER, ERNST. Ann. Soc. Ent. France, ser. 6, vol. 6, pp. 201-240, 1886, is essentially the same as the above. He criticizes Motschulsky's splitting of *Photuris* into several new genera, saying that it would put the two sexes of some species into separate genera.

BRADLEY, J. C. Manual of the genera of beetles of North America, p. 98, 1930, follows LeConte (1881) and Olivier.

## RESULTS OF THE EXAMINATION OF BARBER'S SPECIMENS

### 2.<sup>1</sup> *brunnipennis* var. *floridana*.

General: A small (9.5 × 3.5 mm.) lampyrid, dark brown, without dark pronotal spot or elytral stripes.

Pronotum: Opaque white with central yellowish area; no black or orange spots, and no sulcus. 1.8 × 2.6 mm.<sup>2</sup>

Scutellum: Yellow anteriorly, white posteriorly; rather narrower posterior point than in most species; mesonotal plates yellow, rather large.

Elytra: 7.75 × 1.75 mm.; rather wide lateral, and narrow sutural margins yellow; margins continuous around tips; no stripes or vittae.

Head: Width across eyes 1.95 mm.; eye length 0.6 mm.

Frons yellow, 0.4 mm. wide above antennal sockets, 0.75 mm. above eyes; interocular margins rather divergent; inner edges of antennal sockets 0.05 mm. apart.

Maxillary palpi light brown; labial palpi almost white. Labrum short, light brown, with very narrow darker edge, and no protuberances.

Antennae: 5.1 mm. long, brown; white visible in joint sockets.

Sternites: 2 to 5 brown; 6 and 7 luminous; 8 white, with rather wide-angled posterior point.

Legs: Coxae yellow, third pair slightly infuscate; femora yellow with brown knees; tibiae and tarsi brown; outer claws bifid, but the inner prong distinctly shorter than the outer one. Posterior legs 7.05 mm. long, 0.74 of the total length.

### 3. *divisa* (two specimens differing in color and slightly in size).

General: A small lampyrid (9.5-10.0 × 3.1 mm.) brown to dark brown, with a trapezoidal median pronotal pigmentation divided longitudinally by a narrow light streak partially in a narrow sulcus; elytra with distinct white margins, but no stripe.

Pronotum: 1.75-2.0 × 2.25-2.6 mm.; central trapezoidal brown area divided longitudinally by a narrow light line or streak, part of which is in a narrow sulcus; in one specimen the angles are definitely produced posteriorly, in the other they are not.

Scutellum: Light brown or yellow; mesonotal plates dull brown or yellow.

<sup>1</sup> Numbers are those given the species in Barber's table.

<sup>2</sup> Length and width, respectively.



Elytra: 7.75-8.2  $\times$  1.55 mm.; brown or dark brown; distinct lateral and sutural margins white, continuous around tips; no stripes or vittae; humeri distinctly inclined inward and backward toward scutellum (different from other species).

Head: Width across eyes 1.85-2.0 mm.; eye length 1.0 mm.

Frons brown, very wide, 0.75 mm. above antennal sockets, 0.85-0.9 mm. above eyes; interocular margins very slightly divergent (different from most species).

Maxillary palpi brown, labial palpi white or light brown; labrum short, light brown.

Antennae: 4.5-5.35 mm. long, brown, unmarked, although joint sockets may be white.

Sternites: 2 to 5 brown, 5 may be darker with narrow white posterior edge; 6 and 7 luminous; 8 white, with a rather sharp central point about 0.25 mm. long.

Aedeagus: 2.0 mm. long.

Legs: Coxae and femora brownish yellow, knees darker; tibiae and tarsi brown; lobes of fourth tarsal joint relatively short. Posterior legs 6.3-6.6 mm. long, 0.65-0.665 of total length.

4. *congener* (old specimen, 1914).

General: A small lampyrid (9.7  $\times$  4.0 mm.) with parallel dark-brown elytra without stripes, and pronotum with central yellow spot, no black area.

Pronotum: 1.85  $\times$  2.6 mm.; central yellow area bearing 2 indefinite longitudinal brown streaks; sharp sulcus in anterior half.

Scutellum: Light brown; mesonotal plates yellow.

Elytra: 7.85  $\times$  2.0 mm., brown without stripes or vittae; practically parallel; 0.45-mm. lateral and narrow sutural margins yellow, continuous around tips.

Head: Width across eyes 2.05 mm.; eye length 1.25 mm.

Frons yellow, 0.5 mm. wide above antennal sockets, 0.95 mm. above eyes; interocular margins more divergent than in most species; inner edges of antennal sockets very close together, 0.05 mm.

Maxillary palpi brown, finger-tipped; labial palpi light brown, more nearly symmetrically crescentic than in most of the species—more like the securiform usual in *Photinus*.

Labrum brown, with a visible point.

Antennae: 4.95 mm. long, proportionately rather short; brown, with white joint sockets.

Tergites: Brown, last 3 with lighter edges.

Sternites: 2 to 5 brown, posterior edge of 5 lighter; 6 and 7 luminous, probably originally white, now yellow brown; 8 has a median posterior point.

Legs: Coxae light brown; femora proximally light brown, shading to dark brown at knees; tibiae and tarsi dark brown; fifth tarsal joint appears shorter than in most species. Posterior legs 7.5 mm. long, 0.775 of total length.



5. *frontalis* (2 specimens which differ mainly in size).

General: A medium-sized lampyrid (12.0-13.5 × 4.2-5.2 mm.), dark, with wide lateral elytral margins and rather short pronotum having an indefinite brown spot.

Pronotum: 2.25-2.75 × 3.25-4.0 mm.; very short, almost semicircular; large central triangular ivory area, base posterior, having an indefinite brown area; angles large and produced posteriorly about 0.25 mm. beyond median line.

Scutellum: White; mesonotal plates dull white.

Elytra: 9.0-10.6 × 2.1-2.6 mm.; brown, distinctly widened by the 0.55-mm. lateral margins, giving a somewhat oval appearance; margins not quite continuous around tips; no stripes or vittae.

Head (larger specimen): Width across eyes 3.2 mm.; eye length 1.55 mm.

Frons ivory white, 0.7 mm. wide above antennae sockets, 1.25 mm. above eyes; antennal sockets 0.1 mm. apart.

Maxillary palpi large, dark brown; labial palpi yellow. Labrum short, dark brown, with 3 points or denticles.

Antennae: 7.65 mm. long in larger specimen; dark brown to practically black; joint sockets white.

Sternites: 2 to 5 brown; 6 and 7 luminous, and apparently not as much longer than the fifth as in most species; 8 yellow, with posterior point.

Aedeagus: 2.0 mm. long.

Legs: Coxae light brown; femora light brown proximally, darker distally; tibia and tarsi dark brown. Posterior legs of larger specimen 10.15 mm. long, 0.76 of total length.

6. *pensylvanica*.

General: A small lampyrid (9.0-10.0 × 3.0-3.5 mm.) with medium brown, white-margined elytra, and pronotal black and orange pigmentation.

Pronotum: 1.75 × 2.25 mm.; median black or very dark brown T-shaped area with large orange spot on each side; no sulcus.

Scutellum: Brown anteriorly, to nearly white at posterior point.

Elytra: 7.5 × 1.6 mm.; base color brown; 0.45-mm. wide lateral and 0.3-mm. sutural margins yellow, continuous around tips; outline nearly oval; oblique stripe from humerus about 5.0 mm. long, about 0.1 mm. wide at humerus, narrowing to end.

Head: Width across eyes 1.85 mm.; eye length 1.0 mm.

Frons ivory, 0.5 mm. wide above antennal sockets, 0.9 mm. above eyes.

Maxillary palpi light brown; labial pale brown.

Labrum short, dark brown, with dull median point.

Antennae: 4.2 mm. long, rather short, brown; joint sockets white.

Tergites: Brown to eighth, latter ivory.

Sternites: 2 to 5 mainly light brown, posterior one-third of fifth, white; 6 and 7 luminous; 8 ivory with median point 0.25 mm. long.

Aedeagus: 1.75 mm. long.



Legs: Coxae light and darker brown; femora mostly light or yellowish brown, darker distally; tibiae and tarsi dark brown. Posterior legs 6.8 mm. long, 0.736 of total length.

7. *potomaca* (two specimens, varying principally in size).

General: A small to medium-sized lampyrid (9.35-12.0 × 3.2-4.5 mm.), light brown, subparallel, white margins and oblique stripes; black and orange spot on pronotum.

Pronotum: 1.85-2.5 × 2.5-3.0 mm.; angles not produced posteriorly; median long-triangular brown mark with apex anterior, and short triangle from this apex to anterior edge of pronotum; large orange area on each side of brown triangle.

Scutellum: White; mesonotal plates dull dark brown.

Elytra: 7.5-9.5 × 1.6-2.25 mm.; light brown with 0.5-mm. lateral and 0.25-mm. sutural margins white; white oblique stripe 0.2 mm. wide at humerus, narrowing to become indefinite at a length of about 5.0 mm.

Head: Width across eyes 2.25 mm.; eye length 1.2 mm.

Frons ivory white, 0.7 mm. wide above antennal sockets, 1.0 mm. above eyes—perhaps less divergent than usual.

Maxillary palpi brown; labial light brown.

Labrum dark brown, with three dull points.

Antennae: 6.0-6.6 mm. long, brown with white rings at joint sockets; seventh joint somewhat the longest.

Tergites: Posterior two mainly white; others brown.

Sternites: 2, 3, and 4 brown, 5 mostly white medially; 6 and 7 luminous; 8 white with median point 0.25 mm. long.

Legs: Coxae brown; femora one-half to two-thirds yellow-brown, distally infusate; tibiae and tarsi darker brown; lobes of fourth tarsal segment appear longer than usual. Posterior legs of larger specimen 9.15 mm. long, 0.762 of total length.

8. *versicolor*.

General: A fairly large lampyrid (13.0-14.0 × 4.5-5.0 mm.), brown elytra with yellow margins and yellow oblique stripe; black T and orange pigmentation on pronotum.

Pronotum: 2.75 × 3.55 mm.; a median black or dark-brown area having the form of a T with the cross bar lying along the posterior edge of the pronotum; the area between the bar and foot of the T is orange; the foot of the T connects with the slightly wider base of a triangle, the apex of which coincides with the anterior median line of the pronotum. Angles rounded, not produced posteriorly; a row of long yellow hairs on the posterior edge of the pronotum.

Scutellum: Brown; mesonotal plates brown.

Elytra: 11.5 × 2.5 mm., subparallel; base color brown; 0.5-mm. lateral and narrow sutural margins yellow, continuous around tips; yellow oblique stripe 0.25 mm. wide, not appreciably wider at humerus, 7.5 mm. long.

Head: Width across eyes 2.6 mm.; eye length 0.8 mm.

Frons yellow, 0.7 mm. wide above antennal sockets, 1.25 mm. above eyes; inner edges of antennal sockets 0.1 mm. apart.



Maxillary palpi and labial palpi brown.

Labrum brown; appears truncate-triangular with nearly straight edge.

Antennae: 9.2 mm. long (rather long); black, each joint with lighter base; joint 3 rather longer than 2, joints 4 to 10 longer than first joint (exceptional).

Tergite 8 appears to overlap sternite 8.

Sternites: 2, 3, and 4 brown, becoming darker in this order; 5 brown, posterior one-third white; 6 and 7 luminous; 8 white with posterior point.

Aedeagus: About 2.5 mm. long.

Legs: Coxae dark brown; femora light or yellowish brown for proximal two-thirds, distally darker; tibiae and tarsi of anterior two pairs of legs dark brown, of posterior pair lighter. Posterior legs 10.5 mm. long, 0.763 of total length.

9. *versicolor* var. *quadrifulgens*.

General: Much like *versicolor* but darker and narrower; short, indistinct elytral stripe.

Pronotum:  $2.6 \times 3.25$  mm.; pigmentation like *versicolor* except that the upright of the T widens at the base to meet the base of the terminal triangle; shallow sulcus in posterior half of the T.

Scutellum: Dark brown with lighter posterior tip; mesonotal plates dark and light brown.

Elytra:  $11.2 \times 1.8$  mm., dark brown, subparallel; 0.4-mm. lateral and 0.13-mm. sutural margins ivory, continuous around tips; oblique light stripe and ridge from humerus to one-half elytral length.

Head: Width across eyes 2.5 mm.; eye length 1.5 mm.

Frons nearly white, 0.75 mm. wide above antennal sockets, 1.25 mm. above eyes.

Maxillary palpi dark brown, labial dark and light brown.

Labrum short, dark brown, front edge almost straight, except for distinct median protuberance and an indistinct one at each side.

Mandibles large and thick.

Antennae: 8.35 mm. long, practically black; proximal ends of joints a little lighter, and joint sockets white.

Sternites: 2, 3, and 4 brown, 5 mainly brown, posterior one-third white; 6 and 7 luminous, posterior edge of 6 nearly straight; 8 white with posterior point.

Aedeagus: 3.0 mm. long.

Legs: Coxae brown; femora yellow-brown proximally, distal two-thirds dark brown; tibiae and tarsi dark brown. Posterior legs 9.6 mm. long, 0.703 of total length.

10. *pyralomimus* (two specimens, one somewhat lighter than the one described).

General: Much like *versicolor*, but darker, somewhat more oval, and with pronounced oblique stripes on elytra.

Pronotum:  $2.55 \times 3.8$  mm.; pigmentation like *versicolor*; angles much produced posteriorly; no sulcus.

Scutellum: Brown, fading to nearly white at the posterior point; mesonotal plates dull brown.



Elytra:  $10.5 \times 2.45$  mm., distinctly widened by the 0.5-mm. yellow lateral margins; sutural margins 0.35 mm.; margins continuous around tips; outline nearly oval. Oblique stripe 0.5 mm. wide at humerus, becoming narrower, and extending almost to ends of elytra.

Head: Width across eyes 2.5 mm.; eye length 1.2 mm.

Frons ivory, 0.9 mm. wide above antennal sockets, 1.25 mm. above eyes.

Maxillary and labial palpi brown, latter with a low point on the base of the thumb; tips of maxillary palpi rather wide and flat, square-ended rather than round as usual.

Labrum dark brown with median dull point.

Antennae: 7.8 mm. long, practically black, joint sockets white.

Tergites: 3 posterior tergites white.

Sternites: 2, 3, and 4 light brown, 5 white on posterior one-third; 6 and 7 luminous; 8 white with rather sharp posterior point.

Legs: Coxae brown; femora brown for distal one-half to two-thirds, proximally lighter; tibiae and tarsi dark brown. Posterior legs 10.35 mm. long, 0.797 of total length.

#### 11. *fairchildi*.

General: A medium-sized lampyrid ( $12.0 \times 4.0$  mm.), light-brown, narrow elytral margins and oblique stripes; pronotal pigmentation similar to *versicolor*, but lacks the cross bar on the T.

Pronotum:  $2.15 \times 2.85$  mm.; median black mark and orange areas much as in *versicolor*, but lacks the cross bar on the T; orange area extends nearly to the posterior margin.

Scutellum: Light brown; mesonotal plates brown.

Elytra:  $9.8 \times 2.0$  mm., light brown; very narrow light-colored lateral and sutural margins; narrow oblique stripe extending to within 2.0 mm. of elytral tip.

Head: Width across eye 2.15 mm.; eye length 1.3 mm.

Frons practically white, brownish under pronotum; 0.55 mm. wide above antennal sockets, 1.0 mm. above eyes; antennal sockets 0.05 mm. apart.

Maxillary palpi brown; labial, dark and light brown.

Labrum brown, filling the mandibular circle.

Antennae: 6.1 mm. long, brown, proximal ends of joints lighter.

Sternites: 2, 3, and 4 brown, 5 about one-half white; 6 and 7 luminous; 8 white with posterior point.

Aedeagus: 2.3 mm. long.

Legs: Coxae light brown; femora yellowish brown; tibiae and tarsi mostly dark brown. Posterior legs 8.2 mm. long, 0.686 of total length.

#### 11a. *tremulans* (description prepared from two selected from a series of very similar specimens).

General: A medium-sized lampyrid ( $10.25-12.5 \times 4.2-4.6$  mm.); brown elytra with wide margins, and a short, narrow, oblique vitta on each; pronotal pigmentation similar to that of *Ph. fairchildi*, but brown area less definite. Form slightly oval.



Pronotum:  $2.0-2.5 \times 2.55-3.0$  mm., rounded ogival, posterior edge straight but depressed just adjacent to the angles; a row of long yellow hairs at the median posterior edge. A median long, narrow, brown triangle, extending as a line to the median point of the anterior edge, separates two large orange areas, and may have a short transverse extension along the posterior edge. A 0.1-mm. white margin, lateral and anterior, between which and the orange area the pronotum is dense ivory-colored. No sulcus.

Scutellum: Kite-shaped, with a rather sharp posterior apex, and angular rather than rounded anteriorly; brown, fading to yellow at the apex. Mesonotal plates dull darker brown.

Elytra:  $8.25-10.0 \times 2.1-2.3$  mm.; base color medium brown; lateral margins yellow and 0.5-0.6 mm. wide; sutural margins 0.2-0.25 mm. wide; margins continuous around elytral tips. On each elytron a very narrow (0.1 mm. or less) pale oblique vitta from the humerus to 0.25 to 0.4 of the elytral length. No pronounced costae.

Head: Width across eyes 2.05-2.35 mm.; eye length 1.15-1.25 mm.

Frons ivory, 0.55-0.75 mm. wide above antennal sockets, 1.0-1.1 mm. above eyes.

Maxillary palpi rather large, brown.

Labial palpi ivory to light brown, usual mitten-shape.

Labrum short, dark brown, sinuate to give three low dull protuberances.

Mandibles large, brown.

Antennal sockets white-ringed, 0.05 mm. between inner edges.

Antennae: 6.45-7.4 mm. long, practically black; yellow rings at both proximal and distal ends of each joint; joint sockets white; first joint longest, second shortest, third slightly longer than second, fourth to tenth each of the same length, eleventh slightly shorter than tenth.

Thorax: Ventrally dark brown.

Tergites: Dark brown except eighth, which is white.

Sternites: 2 to 5 mainly brown, 5 has a narrow white posterior margin; posterior edges practically straight. 6 and 7 luminous, 6 shallowly and 7 more deeply notched medially, and 1.3-1.5 times as long as 5. 8 ivory white with median point 0.25 mm. long. 9 small, ogival, ivory white. No foveae evident.

Legs: Coxae of the first two pairs light brown, of posterior pair dark brown; femora mainly yellow, but brownish infuscation may extend to nearly one-half length; tibia dark brown; tarsi somewhat lighter; lobes of fourth tarsal joint extend three-fourths length to claws; tibial spurs large, 0-2-2. Posterior legs long, 8.6-9.5 mm.

12. *caerulucens* (a second specimen slightly lighter than the one described).

General: A medium-sized lampyrid (about  $12.0 \times 4.0$  mm.), dark brown; elytra rather widely margined and with long oblique stripe; pronotal markings like *versicolor*.

Pronotum:  $2.5 \times 3.15$  mm., marked like *versicolor*; no sulcus.

Scutellum: Brown with white posterior tip; mesonotal plates dull brown.



Elytra:  $9.25 \times 2.05$  mm.; base color dark brown; 0.5-mm. wide lateral and 0.2-mm. sutural margins white and continuous around tips; oblique white stripe distinct for 5.0 mm. from humerus, becoming indefinite.

Head: Width across eyes 2.4 mm.; eye length 1.25 mm.

Frons ivory, 0.85 mm. wide above antennal sockets, 1.05 mm. above eyes, rather less divergent than usual.

Maxillary palpi dark brown, labial light brown; thumb of latter pointed and curved slightly downward.

Labrum dark brown, apparently with 3 dull points.

Antennae: 6.3 mm. long, dark brown, joint sockets white.

Tergites: Brown, except 8th which is white.

Sternites: 2, 3, and 4, dark brown, 5 white on posterior one-third; 6 and 7 luminous; 8 white with rounded posterior point rather wide-angled.

Legs: Coxae dark brown; femora and tibiae yellow brown for proximal half, distally dark brown; tarsi darker. Posterior legs 8.95 mm. long, 0.761 of total length.

13. *aureolucens* (a second specimen darker, and somewhat smaller,  $10.75 \times 3.9$  mm., than the one described).

General: A medium-sized lampyrid ( $12.8 \times 4.0$  mm.), light brown with yellow elytral margins and oblique stripe; pronotal pigmentation as in *versicolor*, but cross bar on T narrower and basal triangle relatively larger.

Pronotum:  $2.5 \times 3.0$  mm.; pigmentation as in *versicolor*, but the cross bar on T narrower, and the triangle at the foot of the T relatively larger. Angles slightly produced posteriorly.

Scutellum: Brown, tip white; mesonotal plates brown.

Elytra:  $10.3 \times 2.0$  mm., base color light brown; 0.5-mm. lateral and 0.1-mm. sutural margins yellow; oblique yellow stripe covers outer corner of humerus, narrowing rapidly to 0.2-0.25 mm., and becoming indistinct at a length of 7.5 mm.

Head: Width across eyes 2.25 mm.; eye length 1.3 mm.

Frons ivory, 0.8 mm. wide above antennal sockets, 1.1 mm. above eyes.

Maxillary palpi dark brown, labial brown.

Labrum dark brown, sinuate rather than toothed, to show three protuberances.

Antennae: 6.45 mm. long, practically black, with bases of joints paler, and sockets white.

Tergites: Brown except last, which is white.

Sternites: 2, 3, 4, and 5 brown, a little white on posterior edge of 5; 6 and 7 luminous; 8 white with median point 0.25 mm. long.

Legs: Coxae brown; femora light yellowish brown, infusate toward knees; tibiae and tarsi dark brown. Posterior legs 8.85 mm. long, 0.692 of total length.

14. *lucicrescens* (three specimens, all light-colored, though slightly different, and of nearly the same size and proportions).

General: A fairly large lampyrid ( $12.5-13.5 \times 4.9-5.2$  mm.), practically parallel, with margined and striped elytra and pronotal pigmentation resembling *versicolor*.



Pronotum: 2.5-2.6 × 3.5-3.6 mm.; pigmentation similar to that of *versicolor* but cross bar on the T very short, and orange areas somewhat smaller.

Scutellum: White, and proportionately rather long; mesonotal plates yellow.

Elytra: 10.25-10.8 × 2.45-2.6 mm.; base color light grayish brown, becoming paler toward tips; practically parallel; 0.3-0.5-mm. lateral and 0.1-0.15-mm. sutural margins continuous around tips but indistinct because of pale color of elytra; oblique stripe 7.5 mm. long from humerus.

Head: Width across eyes 2.6 mm.; eye length 1.4 mm.

Frons white, 0.85 mm. wide above antennal sockets, 1.25 mm. above eyes.

Maxillary palpi dark brown, labial light brown.

Labrum short, white with dark brown distal edge, and an indefinite median protuberance.

Mandibles appear large for the other proportions.

Antennae: 8.0-8.25 mm. long, very dark brown with proximal ends of joints white, giving a beaded appearance; tenth and eleventh joints shorter than fourth to ninth.

Tergites: Last tergite white, the two penultimate ones medially white; remainder brown.

Sternites: 2, 3, and 4 light brown; 5 mostly white; 6 and 7 luminous; 8 ivory with triangular median point 0.35 mm. long—not as sharp as in most species.

Aedeagus: 2.6-2.75 mm. long.

Legs: Coxae light brown to yellow; femora, tibiae, and tarsi proximally yellow, distally brown. Posterior legs 10.1 mm. long, 0.76 of total length.

(Specimens of this species collected in northern Delaware in 1947-48 agree with the above except in color, being darker throughout.)

15. *hebes* (a second specimen is very similar).

General: A small lampyrid (10.5 × 2.8 mm.), light brown, practically parallel, wide lateral margins, and pronotal pigmentation somewhat resembling *versicolor*.

Pronotum: 2.2 × 2.7 mm., with median brown area resembling *versicolor*, but lighter and less definite; orange areas similar to *versicolor*.

Scutellum: White; mesonotal plates dull white.

Elytra: 8.3 × 1.4 mm., light brown; 0.5-mm. lateral and narrow sutural margins white; margins barely continuous around tips; a very narrow oblique white stripe on each elytron ending at about three-fourths of the elytral length.

Head: Width across eyes 2.15 mm.; eye length 1.125 mm.

Frons ivory white, 0.6 mm. wide above antennal sockets, 1.0 mm. above eyes; inner edges of antennal sockets 0.1 mm. apart.

Maxillary palpi brown, appearing large for this insect; labial palpi brown.

Labrum short, brown, sinuate.



Antennae: 7.25 mm. long, dark brown with proximal ends of joints lighter; tenth and eleventh joints shorter than fourth to ninth.

Tergites: 6, 7, and 8 white, almost transparent; others brown.

Sternites: 2 yellow, 3 light brown, 4 darker, 5 mostly mottled white; 6 and 7 luminous; 8 white with long posterior point.

Aedeagus: 2.25 mm. long.

Legs: Coxae yellow; femora yellow-brown, knees somewhat infuscate; tibiae and tarsi mostly dark brown, lighter proximally. Posterior legs 8.5 mm. long, 0.81 of total length.

16. *salimus* (44 specimens, including ♀♀, available, of which 10 ♂♂ were selected as covering the range of variation. The ♀♀ tend to be larger and darker, and have smaller eyes and shorter antennae).

General: A medium-sized lampyrid (9-12 × 3.2-4.1 mm.), grayish to yellowish brown under general illumination, with fairly wide, light lateral elytral margins, narrow sutural margins, and a narrow but distinct oblique yellow or white vitta past the midlength of each elytron; pronotum broadly rounded to scutate with a median brown vitta between large orange-colored areas.

Pronotum: 1.9-2.5 × 2.5-3.0 mm.; edges transparent yellow, mottled; scutate to broadly rounded, posterior edge sinuate, but angles not produced beyond median; a row of long yellow hairs along the median half of the posterior edge. The pigmentation consists of a median brown area, hourglass-shaped, 0.2 to 0.6 mm. wide at the constriction, extending from the posterior edge nearly to the anterior edge, sometimes narrowing to a line completely to the anterior edge; occasionally the brown area may widen to a short transverse bar at the posterior edge; large orange-colored areas on each side of the brown area.

Scutellum: Transparent yellow to brown, with lighter posterior apex; mesonotal plates the same color as the scutellum in each specimen.

Elytra: 7.5-9.25 × 1.65-2.05 mm.; base color brown to light brown, appearing grayish or yellowish under general illumination. Distinct lateral margins about 0.5 mm. wide, slightly widening the elytra, giving a slightly oval outline. A narrow white to yellow oblique vitta from the humerus to past the midlength of each elytron. Margins continuous around the tips of the elytra, but indistinct in lighter specimens.

Head: Width across eyes 2.1-2.4 mm.; eye length 0.9-1.35 mm.

Frons yellow, smooth or but little hairy; medially brown toward tops of eyes. Interocular margins constricted over antennal sockets, and divergent toward tops of eyes, intermediate edges nearly parallel.

Maxillary palpi brown; labial palpi light brown, of the usual mitten shape.

Labrum dark brown—practically black; distinctly tridentate in some specimens, obscurely so in others.

Mandibles large.

Antennae: 5.55-6.35 mm. long, brown to light brown, distal ends of joints paler, and proximal ends with a narrow light ring, giving a distinct jointed appearance even by general illumination. Third joint but little longer than the second.



Thorax: Ventrally light to dark brown.

Tergites: 6, 7, and 8 white; the anterior ones may be white or light brown; eighth usually rounded, but truncate-triangular in some specimens.

Sternites: 2 to 5 light to dark brown; 5 may have a white posterior margin; 6 and 7 luminous, white or yellow; 8 white, with a hairy median point; 9 white, ogival.

Aedeagus: Where extruded, of the same type as in the other species.

Legs: Femora yellow, tibia and tarsi brown; tarsal spurs large, 0-2-2. Lobes of fourth tarsal segment fairly long. Posterior pair of legs 7.0-7.9 mm. long.

17. *cinctipennis* (a second specimen a little longer than the one described; otherwise similar).

General: A rather small lampyrid ( $10.75 \times 3.5$ ), dark brown elytra, margined, and with narrow and short oblique stripes; pronotal marking somewhat like *versicolor*.

Pronotum:  $2.25 \times 2.75$  mm., brown pigmentation similar to *versicolor*, but upright of the T very narrow and cross bar short; distinct sulcus, widening posteriorly to include most of the short cross bar on the T; orange area similar to *versicolor*.

Scutellum: Ivory white with central brown spot; mesonotal plates dull pale brown.

Elytra:  $8.5 \times 1.75$  mm., apparently a uniform dark brown except for 0.45-mm. wide lateral and 0.2-mm. sutural margins, which join at the rather unusually pointed tips. A very narrow light-brown oblique stripe extends from the humerus about half the elytral length.

Head: Width across eyes 2.1 mm.; eye length 1.2 mm.

Frons white, 0.7 mm. wide above antennal sockets, 1.0 mm. above eyes.

Maxillary palpi light brown; labial palpi ivory, with a low protuberance on the thumb.

Labrum dull white, edge brown, with a definite median tooth, and a duller one on each side.

Antennae: 6.65 mm. long, mostly dark brown; joints with white proximal ends and white rings at the sockets.

Tergites: Dark brown.

Sternites: 2 to 5 mainly brown, irregularly white in posterior one-third to one-half; 6 and 7 luminous, 6 only very slightly notched, and 7 but little more—both less than in most species; 8 white.

Aedeagus: 2.0 mm. long.

Legs: Nearly all white, hairs brown. Posterior legs 9.1 mm. long, 0.845 of total length.

18. *lineaticollis* (an old specimen, 1882).

General: A large lampyrid ( $14.5 \times 5.2$  mm.), very dark, margined elytra, with pronotal pigmentation similar to *versicolor*, but no cross bar on the T.

Pronotum:  $2.75 \times 3.6$  mm., with pigmentation similar to that of *versicolor*, but no cross bar on the T along the posterior edge.

Scutellum: Yellow, nearly translucent in posterior half; mesonotal plates yellow.



Elytra: 11.8 × 2.6 mm., appear dark brown except for rather narrow (0.35-mm.) lateral margin and (0.25-mm.) sutural margin; margins yellow, and not continuous around the tips. There is an obscure lighter-brown oblique stripe from the humerus.

Head: Width across eyes 2.85 mm.; eye length 1.25 mm.

Frons yellow, 1.2 mm. wide above antennal sockets, 1.5 mm. above eyes, rather wider and less divergent than usual; inner edges of antennal sockets 0.2 mm. apart.

Maxillary palpi dark brown, labial light brown.

Labrum dark brown; a dull median tooth or protuberance, and a sharper one on each side.

Antennae: 7.65 mm. long, mainly almost black, proximal ends of joints lighter; ninth to eleventh joints shorter than fourth to eighth.

Tergites: Brown.

Sternites: 2 to 5 dark brown, 5 lighter on posterior edge; 6 and 7 luminous, yellow; 8 triangular, yellow.

Legs: Coxae of first two pair light brown, of third pair very dark brown; femora mostly dark brown, lighter proximally; tibiae and tarsi dark brown; lobes of fourth tarsal joint rather long. Posterior legs 10.6 mm. long, 0.73 of total length.

In the writer's semipopular "Common Fireflies of Delaware" he expressed the idea that the species giving three to five rapid coruscations per flash and flashing at 5- to 10-second intervals is the one which was sent to DeGeer by Acrelius from Wilmington and described by the former in 1774 as (*Photuris*) *pensylvanica*. The reason for this opinion was that this is by far the commonest type of *Photuris* flash now seen in the vicinity of Wilmington, although both the sharp and crescendo flashes of *lucicrescens* and some of the other types described by Barber are also present. This is a dry-land species and has been taken in copula by the writer in a nearby wheatfield where hundreds of the insects were flying over the wheat, around the border growth, and among the trees across an adjacent road. Barber, however, calls this species *Photuris versicolor* Fabricius, 1798, and restricts the specific name *pensylvanica* to a marsh species giving a two-component flash, the first component of which is short and sharp and the second long, basing his opinion on the probable character of the land surface around Wilmington about 1750. He is doubtless correct in his conjecture as to the marshes at this locality at that time; there is still plenty of marsh land along the Delaware River and the estuary of Christiana Creek, though most of that along the Brandywine has been filled in. Mr. Barber did not, so far as I remember, ever tell me that he had arrived at this conclusion, although he did write to me about DeGeer's use of the word "prairies" in connection with his description of the locale of the specimens sent by Acrelius. From the



translation of Hesselius' Journal (Delaware History, vol. 2, No. 1, p. 83, 1947), flying over meadows might be interpreted as "fields," and the "sparkling" might be more like the three- to five-flasher than the double coruscation of Barber's *pensylvanica*. I have been unable to find out what Swedish word in Acrelius' letters to DeGeer was translated as "prairie" by the latter. Observations in both northern Delaware and on the opposite New Jersey shore of the Delaware River have so far failed to reveal the presence of a species giving the double flash of Barber's *Photuris pensylvanica* DeGeer, but conditions here have undoubtedly changed materially in the last 200 years, and it is not impossible that industrial wastes have exterminated a once-plentiful species.

Free translations of the descriptions given by DeGeer and by Fabricius are given below:

DeGeer, Hist. Ins., vol. 4, pp. 52-53, 1774:

Lampyrid elongated, elytra of a pale yellowish-gray, and thorax black in the middle with two red spots.

*Lampyris pensylvanica* oblong, elytra pale grayish brick-colored, thorax black between the margins with two red spots.

The lampyrids of this species are found in Pennsylvania. Mr. Acrelius, who sent me them from this country, says that they are found particularly on the prairies during the whole summer, where they glitter and appear to the eyes of the observers as a multitude of sparks; but they sparkle even more when they fly. One can distinguish them easily from the other species.

In size and shape they resemble the three preceding species (of lampyrids), but the head is larger and less hidden in the thorax, which is smaller than in the other species; there is also a greater distance between the two large black eyes, and the antennae, which almost equal the length of the abdomen, are slender and a little hairy. On the thorax and elytra there are many small hairs.

The disc of the thorax is pale yellow, with a large oval black spot in the middle, beside which there are two small round red spots near the edges; the elytra are yellowish gray, with brown shading near the anterior ends. The abdomen is brown below, but the last three segments are sulfur yellow. The wings are dark brown, the antennae lighter brown, and the legs ochre yellow with some small brown spots.

Fabricius, Suppl. Entomol. Syst., p. 125, Hafnia, 1798:

*L(ampyris)* black, thorax spotted, elytral margins and median vitta yellowish, apex of abdomen very light. Habitat in North America. Dom. Hirschell.

Body large; antennae black, bases of joints yellowish. Head yellowish or black. Thorax rotund, black spot in the middle, large red spots on both sides, and broad yellowish margin. Elytra smooth, margined with black becoming yellowish, with abbreviated vitta. Abdomen broad, white. Legs black, knees yellowish.

DeGeer's description of the pronotal pigmentation sounds more like a *Photinus* than a *Photuris*, but his mention of the partially exposed



head and the long antennae would seem to leave no doubt of the genus of the species described. Fabricius' description of the pronotal pigmentation is more correct for Barber's specimens of both *pensylvanica* and *versicolor*. DeGeer fails to mention the oblique elytral stripe or vitta; this is quite definite in Barber's specimen of *pensylvanica*, and rather shorter in his *versicolor*, agreeing with Fabricius' description. DeGeer's drawing is unconvincing.

Just which is *pensylvanica* and which *versicolor*, must perhaps remain in some doubt for the present, since neither DeGeer nor Fabricius record definitely the flashes of the species they describe. Unless further data become available, it seems well to accept Barber's decision.

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