NOTES ON DEFENSIVE SCENT GLANDS OF CERTAIN
COLEOPTERA.

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The attention of the writer was first directed to the functions of defensive or repugnatorial scent glands in certain Coleoptera during the study some time ago of the biology of some of the more common species of Coleoptera belonging to the Tenebrionid tribe Eleodini, inhabiting portions of the central Great Plains region. Later, a growing interest led to closer field observation and to the examination, as opportunity offered, of available literature on the subject. The notes which follow are intended merely to supplement data already published, to which reference is made.

It is obvious to anyone at all familiar with insect life, that the degree of sensitiveness and response in insects to certain external phenomena is enormously greater than in vertebrates, and that their organs of sense are developed accordingly. It always has been a cause for wonder to human beings as to the means by which the various lower animals recognize, distinguish and communicate with each other. Although we know very little about the senses of the lower animals, it long has been known that such senses as sight or touch are not nearly so important to insects as to us. We know that insects actually do distinguish and communicate with each other, or are attracted or repelled by each other, and as the means of communication are not known to use, may we not safely assume that such is brought about through factors, the existence of which is not yet recognized or understood? Packard (1898) has called attention to the ease and rapidity with which exceedingly delicate, attenuated, and highly volatile odors unknown to us are perceptible to insects. McIndoo (1917) has suggested the presence of a chemical sense or senses, somewhat comparable to our olfactory sense, which receives and transmits stimuli in a way somewhat like that of odors, and has ably discussed the results of observations and experiments upon certain insects, and has given a short historical review of the literature on the subject. In fact,

the subject as a whole in its relation to animal ecology makes a powerful appeal to the human imagination.

It has been well understood that the presence of defensive or repugnatorial scent glands in certain insects exists in direct adaptation to the needs and habits of their owners and in close response to their environment; also that such glands are of very frequent occurrence and with much variation as to position, form, and function; and that their presence is of value to the insect for repellent, defensive, and warning purposes. These eversible glands most frequently occur in the form of simple hypodermic pouches from which can be emitted, when desired, varying amounts of an odorous spray capable of permeating throughout considerable surrounding atmosphere. Biologically speaking, the principle involved in such cases, though often modified, is practically identical with that of the mephitic, sulphuretted, oil-like fluid ejected by the skunks. Thus far anal glands are known to be present in the following families of Coleoptera: Cicindelidæ, Carabidæ, Dytiscidæ, Gyrinidæ, Staphylinidæ, Silphidæ, and Tenebrionidæ. The blood itself serves as a repellent fluid in the Meloidæ, and in the Coccinellidæ and Lampyridæ, and it issues from a pore at the end of femur as a yellowish fluid. The cantharidine in the blood of some species of Meloidæ, commonly known as "Spanish Fly," forms an especially caustic protection against birds, predaceous insects and reptiles. A number of the Carabidæ eject from a pair of anal glands a pungent, acid, and often corrosive fluid, staining the hands a rust-red color, and in *Galerita janus* Fab., the "Bombardier beetles" (*Brachinus*), and others, it "explodes" or volatilizes as soon as it comes in contact with the air, and the discharge and puff of vapor is accompanied by an audible report. This occurrence may be repeated over and over again in succession at frequent intervals. Westwood (1839) has recorded that specimens of a *Brachinus* of large size from South America, when captured "immediately began to play off their artillery, burning and staining the flesh to such a degree that only a few specimens could be captured with the naked hand, leaving a mark which remained for a considerable time." The odor of rose or hyacinth given out by certain Cicindelidæ, or the fragrance exhaled by the European *Aromia moschata*, are secretions probably formed by similar glands.

The larvæ of certain Coleoptera, notably in the Chrysomelidæ, also are supplied with eversible hypodermal glands of various kinds. Folsom (1906) states that "the larvæ of *Melasoma lapponicum* evert numerous paired vesicles which emit a peculiar odor."

Packard has divided all scent-producing organs into repugnatorial and alluring organs, and a third class including those for recognition only, has been suggested by McIndoo, who has directed attention to the fact that it often is impossible to determine purposes for which such organs are used.

During the summer and fall of 1914 and the spring of 1915 collections of various species of adults of Eleodiini for breeding purposes, aggregating several thousand specimens, were made by the writer over a considerable area in Western Kansas and Western Nebraska, and during this period there were many opportunities for making observations relative to a curious habit possessed by many members of that tribe. When disturbed, many of them have a habit of standing on their anterior and middle legs, elevating the abdomen to its utmost height, appearing at times fairly to stand upon their heads, and spurting sidewise right and left from their eversible repugnatorial glands, a persistently malodorous liquid having a peculiar penetrant odor, and capable, when brought into accidental contact with the skin of the human hand, of making a stain almost impossible to wash off, and the odor of which varies in intensity with some of the species.

"The smell of the glandular secretions," says Gissler (1879), "is to my knowledge incomparable to anything else." The glands of the species examined, *Eleodes gigantea* Mann., are in both sexes embedded in the fat bodies on each side of the intestinal tract, and consist of two reddish-brown organs about 6 mm. in length, somewhat cylindrical at one end and roughly flattened at the other. Gissler has records concerning the fluid that "When the secretion is spurted on a glass slide, it solidifies within a few seconds, forming an orange-colored magma of minute crystals, in other cases it only partially crystallizes, and in others it remains entirely liquid. It is in all cases of an acid reaction, and of an intensely penetrant odor, causing the eye to lachrymate. It is soluble in water, alcohol and ether. Boiled with concentrated sulphuric acid and alcohol an ethereal aromatic vapor is produced, indicating the

presence of one or more organic acids. . . . Having tested for valerianic acid in the usual way with neutralized soda solution upon sesquichloride of iron, no red precipitate of valerianate of iron was formed, nor have I obtained a bluish-white opalescent liquid of butyrate of copper on adding acetate of copper. Uric acid was also found to be absent, on treating with nitric acid and ammonia in the usual way; neither could I detect formic or acetic acid, nor did boiling with caustic soda liberate ammonia. A few drops of the secretion, put on a piece of dry caustic soda, turned at first dark green, became in a few seconds dirty brown, and cleared up to a brownish red after several hours."

It was interesting to note that the quantity of the secretion voided varies noticeably with the different species under observation, both under field and under laboratory conditions, and some of the species, notably *Eleodes tricolorata* Say, undoubtedly have the habit of erecting the abdomen in a threatening manner when approached, though no secretion may be voided. Such species undoubtedly find protection through imitation of the threatening movements of their more formidable associates. Two of the characteristics of the Eleodes are their slowness of movement, and their habit of coming out of their hiding places about sunset for feeding purposes, and their presence is readily noticed on the bare sandy plains by birds, skunks, and other enemies, hence their protective secretion, or, in the absence of this, their threatening maneuvers are no doubt of highest value to them.

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