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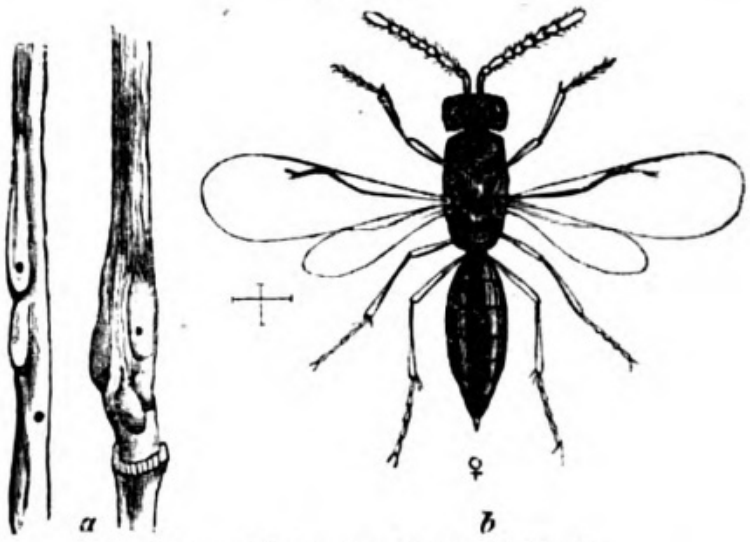
THE JOINT-WORM.

(*Isosoma hordei*, Harris.)

Its Operations upon small Grain.

In certain years and in particular States the crops of wheat, of barley, or of rye are observed to be greatly injured by a minute maggot, popularly known as the "Joint-worm." This maggot is but little more than one-eighth of an inch long, and of a pale yellow color with the exception of the jaws, which are dark brown. It inhabits a little cell, which is situated in the internal substance of the stem of the affected plant, usually a short distance above the first or second knot from the root, the outer surface of the stem being elevated in a corresponding elongate blister-like swelling; and when, as is generally the case, from three to ten of these cells lie close together in the same spot, the whole forms a woody enlargement honey-combed by cells, and is in reality a many-celled or "polythalamous" gall, analogous in its nature and structure to those which we have described in a preceding article. (No. 6 of the AMER. ENTOM.) In Figure 113, *a*, will be seen a sketch of one of these galls, the little pin-holes being the orifices through which the flies produced from the joint-worms have escaped. At first sight, these knotty swellings of the stem are apt to elude observation, because, being almost always situated just above the joint or knot on that stem—whence comes the popular name "Joint-worms"—they are enwrapped and hidden by the sheath of the blade; but on stripping off the sheath, as is supposed

[Fig. 113]



Colors—(*a*) straw-yellow; (*b*) black

to have been done in the engraving, they become at once very conspicuous objects. We have observed that the "internodes," as botanists call them, or the spaces between the knots, in infested straws are always much contracted in length, none out of a lot of over fifty specimens examined by us exceeding six inches in length, and many being reduced to only one and a half inches. A similar phenomenon occurs in two "polythalamous" galls formed by certain Gall-gnats (*Cecidomyia*) upon the tips of the twigs of certain species of Willow.* There were only three straws in this lot of over fifty straws, where two Joint-worm galls were found in the same straw; and in all those three cases they were found in two adjoining internodes. In a very few instances the galls were situated in the middle of the internode, or even close to the upper knot, instead of being situated as usual immediately above the lower knot.

Amount of Damage done by the Joint-worm.

The damage occasioned by the Joint-worm is, in certain seasons and in certain localities, ruinously great. In the year 1851, throughout a large part of Virginia, according to the Editor of the *Southern Planter*, "many crops of wheat were hardly worth cutting on account of its

*The Willow Wheat-gall (*Salicis triticoides*, Walsh) and the Willow Barley-gall (*Salicis hordeoides*, Walsh), growing respectively on the Heart-leaved Willow (*S. cordata*) and the Humble Willow (*S. humilis*), and described in *Proc. Ent. Soc. Philad.* III. pp. 598-9. They received these names from their resemblance respectively to ears of wheat and barley.

attacks, and all that we have seen or heard of, except one, were badly hurt by it." It first began to be observed in that region in 1848, and in subsequent years it increased gradually in numbers. According to Prof. Cabell, of the University of Virginia, the loss occasioned by this insect often amounts to one-third of the average crop, and is sometimes much greater; and in 1851 "some farmers did not reap as much as they sowed* In 1860 the rye crop was considerably injured by this little pest in Lycoming Co., Pennsylvania; and according to our entomological friend, Mr. Norton, the species is very common upon rye "in Connecticut and probably the other New England States.† As long ago as 1829, it had been noticed in various parts of the New England States to attack the barley, causing it in some places "to yield only a very small crop, and on some farms not much more than the seed sown;"‡ although since that date it does not appear to have been materially troublesome in that region. But in Central New York, formerly the great barley-growing district of America, it has been ruinously destructive to the barley since about 1850. In the words of Mr. George Geddes, the late President of the N. Y. State Agricultural Society—"Formerly we expected forty bushels of barley to the acre; now we cannot rely on more than twenty."‖ And he goes on to state that this falling off is principally due to the depredations of the Joint-worm; and that, unless some relief from it is found, the farmers of Central New York will have to discontinue raising this crop. Lastly, in Canada West, in the neighborhood of Grimsby, it was very abundant upon barley in the years 1866 and '67, as we learn from our esteemed correspondent, Mr. J. Pettit, of that town.

It is a curious fact that—so far as can be at present ascertained—this destructive insect does not seem to have reached the Valley of the Mississippi. At all events, no complaints from the West of any such attacks as those described above, either upon wheat, rye or barley, have hitherto been made public. It is very possible, however, that the Joint-worm may have been confounded in the West with the Hessian Fly (*Cecidomyia destructor*, Say), the larva of which infests precisely the same part of the wheat plant, namely the space immediately above one of the lowermost knots in the straw. But this last may be distinguished from the Joint-worm by living in the open space between the stem and the sheath of the blade, although it occasionally imbeds itself pretty deeply in the *external* surface of the stem; whereas, the true Joint-worm always inhabits a smooth egg-shaped cell in the *internal* substance of that stem.

It may also seem a strange thing that—so far as is known—the Joint-worm should in Virginia attack wheat exclusively, and in New England and New York barley exclusively. This, however, may be partly due to the fact that but very little barley is grown in Virginia, and but very little wheat in New England; and partly, perhaps, to the very limited extent to which the depredations of our various noxious insects have hitherto been observed and recorded. Up to quite a recent period, even otherwise intelligent men have been in the habit of considering all "bugs" and "bug-hunters" as beneath their notice. And the consequence is that, when we search the back numbers of our Agricultural Journals for information on the past history of any particular "bug," we often find nothing but a mass of error and confusion, and are almost always utterly incapable of ascertaining of which particular "bug," out of the thirty thousand "bugs" found within the limits of the United States, the few entomological articles that we meet with, are intended to treat.

Natural History of the Joint-worm.

The mode in which the Joint-worm produces its destructive effects upon small grain, may be readily explained. Not only is the sap of the plant abstracted on its road to the ear, in order to form the abnormal woody enlargement or gall, in which the larvæ are imbedded, each in his own private and peculiar cell, but a very large supply of sap must be wasted in feeding the larvæ themselves. Hence the ear that would otherwise be fully developed becomes more or less blasted and shriveled; although we are told that, in the case of barley more particularly, the plant tillers out laterally, so as partially to supply the loss of the main crop of ears. A similar phenomenon occurs with almost all galls that grow upon a slender stem or twig, that is, the stem or twig is more or less killed or blasted thereby; but when a twig is quite large, this result often fails to be developed.

The Joint-worm Fly (Fig. 113, *b*, ♀) makes its appearance in the North in the fore part and

*Quoted by Harris, *Injurious Insects*, p. 557.
†See his note in Harris, *ibid*, p. 561. Also Fitch's *N. Y. Rep.* III, p. 163.
‡Harris, *ibid*., p. 551.
‖*Trans. N. Y. St. Agric. Society*, 1859, p. 332, quoted by Fitch.

middle of June, and in southern latitudes in the middle of May. From a large lot of galls that had been found upon barley, obligingly furnished to us by Mr. J. Pettit, of Grimsby, Canada West, the first flies came out June 9th, and they continued coming out in very large numbers till June 16th and subsequently. As is usual with most insects, the males came out first, and not a single female appeared until June 11th; whereas from and after June 15th there were nothing but females to be met with, the whole number of females, however, greatly exceeding that of the males. The cause of this singular phenomenon of the males preceding the females by several days—which has been noticed by other writers in the case of other insects, and which we believe to be a very general law—has never been explained. But it is probably due to the desire of nature, that the males may have time to gain their full strength and vigor, before the females come into the world and require their immediate attentions. Be this question as it may, after coupling in the usual manner, the female Joint-worm Fly proceeds to lay her eggs in the stems of the growing grain. The following excellent account of this operation, from the pen of Mr. Pettit, we extract from the *Canada Farmer* for 1867, page 268:

> About the 8th of June of the present year the perfect insects began to make their way out of the galls. * * * * * Being desirous of knowing more of their habits, I watched the growing barley, and on the 10th of June found them actively at work ovipositing in the *then healthy stalks* of the plant. Before commencing operations they walk leisurely up one side of the plant as far as the last leaf, and then down the other, apparently to make sure that it has not already been oviposited in. Head downward, they then begin by bending the abdomen downward, and placing the tip of the ovipositor on the straw at right angles with the body, when the abdomen resumes its natural position, and the ovipositor is gradually worked into the plant to its full extent. With the aid of a good lens, and by pulling up the plants on which they were at work (which did not appear to disconcert them in the least), I could view the whole operation, which, in some cases, was accomplished in a few minutes, and in others was the work of an hour or two. When a puncture was completed, they usually backed up a little and viewed it for a few seconds, and then apparently satisfied, moved to one side and commenced another.

Very shortly after this time, the egg must hatch out. For, upon July 3rd, we examined a large lot of the green barley-galls, which had been obligingly forwarded to us by Mr. Pettit, and found the larva of the Joint-worm Fly almost half-grown, that is from 0.004 to 0.006 inch long, and about five times as long as wide. In these green galls, upon the most careful search, we could find no Gall-gnat larvæ, nor any vestiges of any such larvæ. So that we are now fully persuaded, that the idea originally entertained by Dr. Harris and Dr. Fitch, and subsequently favored by the Senior Editor of this JOURNAL, namely, that these galls are in reality made by some undiscovered Gall-gnat, upon which the so-called Joint-worm Fly that has been figured above is a parasite, is a false and fallacious one. Otherwise, if the so-called Joint-worm Fly were really a parasite, we must certainly have discovered, at this early period in the year, a few specimens of the larvæ upon which it was parasitic, or at all events some traces of their handiwork. Both Harris and Fitch afterwards became of opinion, that the Joint-worm Fly was the real author of these galls; and we think it right to bear this public testimony to the correctness of their entomological inferences. We write for truth, and not for victory, and have never claimed to be infallible.*

By the beginning of September, the infested grain having ripened long before this period, the galls are already dry and hard, and the larvæ contained in them full grown, measuring now about 0.13 inch in length. The great majority of these larvæ are destined to remain in that state, enclosed in their little cells, until the succeeding spring; but—as happens with many different insects—a small percentage of them seem to pass into the pupa, and thence into the perfect state, the same summer that the eggs are deposited. For, out of a lot of 124 barley-galls, received September 10th from Mr. Pettit of Upper Canada, 39 galls, or very nearly one-third part, were already bored with the same kind of small round holes as are made in the succeeding spring by the escaping Joint-worm Flies, some galls containing six such holes, but most of them about three. It is true that we are not personally cognizant of the fact, that these holes are bored by the same Joint-worm Fly, that escapes from similar holes in such profuse abundance in the following June; but Prof. Cabell, of Virginia, stated to Dr. Harris with reference to the wheat-inhabiting Joint-worm, that he had known a few flies to leave the straw the first year, but in each instance the

*The Senior Editor of this Journal published in the *Canada Farmer* for 1867, pp. 267—8, a letter on the Barley Joint-worm, in which he disavowed and repudiated his former skepticism (as given to the world in the *Practical Entomologist*, I, pp. 10—12, and 37—8), on the subject of this insect being a true gall-maker. Dr. Packard, not being scientifically bound to read all the Agricultural Periodicals that are printed in America, has erroneously, and no doubt inadvertently, quoted him in November, 1868, in his *Guide to the Study of Insects*, p. 305, as still retaining his original belief. It is proper to add here that, in the letter in the *Canada Farmer*, the same opinion on the classification of this insect which will be subsequently elaborated in this article, was briefly expressed as follows: "The Joint-worm Fly differs generically from all the numerous species of the *Eurytoma* group, which I have ascertained to be parasitic on other insects, and cannot, I think, be referred with any propriety to the genus *Eurytoma*, although it undoubtedly belongs to the *Eurytoma* group."

fly which came forth thus was the true Joint-worm Fly.* As already shown, the flies that emerged from these Canada galls in the succeeding summer, came out from June 9th to June 16th and subsequently.

Parasites of the Joint-worm.

On cutting open a great number of the cells of the dry barley-galls, obtained from Canada in September, we found in one of them a small stout parasitic larva, of a pale glaucous color, attached externally, in the manner common with the larvæ of many *Chalcis* flies, to the half-dead and blackened and partially shrunken carcass of one of the true gall-making Joint-worms. In another cell we found a much larger parasitic larva, evidently belonging to the same species, which had apparently devoured entirely the body of its victim. And from the body of still another Joint-worm, wounded by accident in opening the cell, but which was neither shrunken nor discolored, there emerged under our very eyes a third parasitic larva, of medium size, and apparently belonging to the same species as the two just now referred to. Thus it would seem that in the earlier stages of its existence this parasite is an external feeder, but subsequently penetrates inside the body of its victim after the more usual fashion in such cases. In the summer of the succeeding year, we bred 31 specimens of what is evidently the perfect fly of this same parasitic larva, from the same lot of barley-galls in which we found the above three parasitic larvæ, and from which we reared such hosts of the true Joint-worm Fly. Out of this lot of galls, 17 male parasites came out from June 11th to 22nd, and 14 female parasites from June 14th to 28th, thus showing that in this species also the males appear several days on the average before the females. Below we give figures of both sexes of this insect, which is an entirely new and undescribed species, and which we have called "The *Chalcis*-

[Fig. 114.]

Colors—Blue-black; abdomen coppery.

eating *Chalcis*-fly" (*Semiotellus chalcidiphagus*). It is a true *Chalcis*-fly like the Joint-worm Fly, but belongs to an entirely different group of that extensive and much neglected family. The female (Fig. 114, *a*,) is distinguishable at the first glance from the male (Fig. 114, *b*,) by the front wings having a large dark smoky cloud on their middle. Those that desire a fuller description of this species in its different stages, are referred to an article upon certain groups of *Chalcis* flies, from the pen of the Senior Editor, which will probably appear before long in the *Transactions of the American Entomological Society*.

Two other *Chalcis* flies, quite distinct from the above, were found by Dr. Harris and Dr. Fitch to be parasitic upon the Joint-worms that infest wheat in Virginia. But as we have no personal knowledge of these insects, and the descriptions given of them are very brief and imperfect, we shall say nothing further on this subject.

Are there different Species of Joint-worm?

It will have been long ago noticed by the entomological reader that, in all that we have said above respecting the Joint-worm and its habits, we have assumed the race that infests barley to belong to the same species as that which infests wheat, and both of them to the same species as that which infests rye. Such was also the opinion of Dr. Harris, who had bred very numerous specimens of the perfect Fly, both from Massachusetts barley-galls and from Virginia wheat-galls. "The only apparent difference," he observes, "between them consists in the color of the front shanks; these, in the wheat-insects, being pale yellow, and faintly tinged with black only on the outer edges in a few individuals;" whereas the same author describes the barley-insects as having their front shanks "blackish."* Dr. Fitch, however, has manufactured four species out of the Joint-worm Fly, two of them infesting barley, one wheat and one rye, to each of which he has given distinctive names. These four so-called species he acknowledges to differ only in the coloration of their shanks, and—so far as regards the fourth species—in the antennæ of the males being less profusely surrounded by whorls of hairs than in the other three species. The colorational differences specified by Dr. Fitch may be concisely expressed in the following tabular form, copying as near as may be Dr. Fitch's own language.† The number of males examined by this author was so limited—in some of his so-called species but one or two—that the assumed difference in

* Quoted by Fitch, *N. Y. Rep.* III. p. 149.

* See Harris, *Injurious Insects*, pp. 554 and 556.
† See his *N. Y. Reports* III., p. 154.

so fugitive a character as the hairs on the male antennæ is scarcely worth talking about. We have ourselves, by immersing a male in hot water, caused the conspicuous whorls of hairs on the antennæ to disappear thereafter almost entirely from view.

JOINT-WORM FLY (*Eurytoma tritici*, Fitch). On Wheat.—Front shanks dull pale yellow; middle and hind shanks black.

RYE-FLY (*Eurytoma secalis*, Fitch). On Rye.—Front and hind shanks dull pale yellow; middle shanks black.

BLACK-LEGGED BARLEY-FLY (*Eurytoma hordei*, Harris). On Barley.—Front shanks of the same dusky or blackish color with the middle and hind ones.

YELLOW-LEGGED BARLEY-FLY (*Eurytoma fulvipes*, Fitch). On Barley.—Legs, including all the shanks, bright tawny yellow.

In order to test this question, we mounted and preserved 70 specimens of the Joint-worm flies, bred by us in June from Canada barley-galls all received from the same quarter, 23 of these specimens being males and 47 females. On carefully examining all these specimens time after time under the lens, we find that most of them have the pale yellow front shanks stated by Fitch to be peculiar to the Joint-worm Fly that infests wheat; that not a single specimen has the distinctly black front shanks stated by Fitch to be peculiar to the Black-legged Barley-fly, although a very few have the front shanks slightly clouded outside with black; that two female specimens have the shanks colored in the style which Fitch asserts to be characteristic of the Rye-fly; and that but seven female specimens have, with the exception of the front thighs being black, the yellow legs which Fitch assigns as the peculiar character of the Yellow-legged Barley-fly. We also find numerous intermediate grades between these different forms; so that it would be utterly impossible for any rational entomologist to separate the 70 specimens into four, three, or even two parcels, and to consider each parcel as a distinct species, for the simple reason that it would be impossible for him to draw a distinctive line anywhere. Hence we incline to consider Dr. Fitch's four species of Joint-worm Fly—as several other species which he has published are now generally considered—to be mere varieties of one and the same species, and not four distinct species. At all events the colorational characters of the shanks, as laid down by Dr. Fitch, do not coincide with the particular plants to which he assigns each colorational form. For the majority of our barley-feeding flies correspond exactly in their coloration with his wheat-feeding flies; and two of them correspond with his rye-feeding flies.

In further confirmation of the fact, that the Joint-worm Fly which infests barley is the same species as that which infests rye, Dr. Fitch's own evidence may be adduced. For he says himself that he captured off the growing rye of a rye-field, at the end of May and beginning of June, three males and several females of what he identified as being the genuine Black-legged Barley-fly. (*N. Y. Rep.* III. p. 159.) Now, if these insects did not want to lay their eggs on the rye, what business did they have there?

It is true that Dr. Fitch observes that, out of about 15 males and 45 females bred by him from a single lot of New York barley-galls, all the specimens without exception had yellow legs. But we have ourselves remarked, that peculiarities of treatment in the breeding of gall-insects sometimes affect their coloration in a most remarkable and hitherto unprecedented manner. For example, from a certain lot of Oak-galls gathered in the autumn and kept through the winter in a warm room until the following spring, we bred April 8th–28th no less than 47 female gall-flies (*Cynips q. podagræ*, Walsh), all of which without exception proved to have perfectly black abdomens, on being carefully examined when recent. The same year, from another lot of the same galls gathered off the same tree about April 1st, and therefore only retained in the breeding-jar for a few weeks instead of six months, and not subjected to an unnaturally warm temperature through the winter like the first lot, we bred April 18th–24th about 426 females of the same species, fully one-third part of which, when recent, had the abdomen decidedly rufous, pitchy-rufous, or with the base of the segments rufous, the remaining part of them having black abdomens. Thinking that this rufous color of the abdomen might be due to the immaturity of the specimens, we kept four of those that had rufous abdomens alive in a vial for four days; but at the end of that period their abdomens were still as red as ever. We may add that the 23 females from which the above species of gall-fly was originally described by the Senior Editor, and which had been bred in the same manner as the first lot referred to above, all of them had abdomens of the same uniform black color as the first lot, as is particularly specified in the published description. Thus it results that 70 gall-flies, bred in a particular manner, all of them had black abdomens; and that about 426 gall-flies, belonging to the same species, but bred in a different manner, had, at least one-third part of them, rufous or partly rufous abdomens. Hence we infer that the great difference in the coloration of the legs of Joint-worm Flies, bred respectively from similar barley-galls by Harris, by Fitch, and by ourselves, is very probably due

to the differences in the mode of breeding adopted by each of these three parties; and that Dr. Fitch's four different species of Joint-worm Flies are not true species, but mere varieties, so far at least as can be established from their colorational differences.

Unity of Habits in Insects and other Animals.

If we consider for a moment the habits of the larger animals, with which most of us are better acquainted than with those of insects, we shall find that the same genus of animals always has the same general habits. For example, the species of the Horse genus—the Horse, the Quagga, the two species of Zebra, and two or more species of wild Ass—all of them feed upon herbage, live in the plain and not in the forest, feed in the day time and not in the night, gather together in large herds led by the old males, and when attacked defend themselves by the hoofs of their hind legs. On the other hand, the multifarious species of the Cat genus—the Lion, the Bengal Tiger, the various Leopards and Panthers of the Old World, and the Puma (Couguar) and Panther (Jaguar) of the New World—all of them feed upon flesh, haunt the forest rather than the plain, seek for their prey in the night rather than in the day-time, never gather together in herds but live either solitary or in pairs, and fight with their mouths and their front paws rather than with their hind paws. Look where we will among the larger animals, whether among the Bear genus, the Dog genus, the Owl genus, the Hawk genus, the Pigeon genus, or the Sparrow genus, we shall find the same law to hold good. And the reason of it, upon a little consideration, becomes at once manifest to our minds. Different species are classified under the same genus, because they have very nearly the same structure. Now, it is the structure that determines what the habits of the species are to be. For example, a bird with a hooked bill like that of an Eagle is necessarily debarred from pecking vegetable food like a Sparrow, and is compelled by that and the other corresponding parts of its organization to live by tearing and rending living animals. Conversely, a Sparrow is physically incapacitated from preying upon animals of its own size, as does the Eagle, and is driven by its structural peculiarities to peck at small insects, fruits and seeds. Consequently, as the Genus and the Habits of any particular species of animal are both of them determined by the Structure, when the Genus of two species is the same, the Habits also must of necessity be the same or very nearly the same. To this great and universal law has been given the name of the UNITY OF HABITS; and it may be recognized everywhere, not only among the higher animals, but also among Insects.

Prof. Agassiz has used language which would seem to imply that he extends to a certain degree the operation of this law, not only to all the species belonging to the same genus, but also to all the genera belonging to the same Family. "The more I learn upon this subject," he says, "the more am I struck with the similarity in the very movements, the GENERAL HABITS, and even the intonation of the voices of animals, belonging to THE SAME FAMILY."* But there are several cases among the higher animals, where genera classified by all authors in the same Family have very widely distinct habits; and we find many such examples among the great Class of Insects. For instance, most of the multifarious genera of the Ground-beetles (*Carabus* family) are cannibals and prey upon other insects; but there is a particular genus of them (*Zabrus*), found in Europe but not in America, which feeds upon living and growing vegetables. Again, most genera of the above-named Family of Beetles are terrestrial in their habits; but there is a particular genus of them (*Oödes*) which habitually in the perfect beetle state lives under water, and when endeavoring to escape generally makes for the water, and as soon as it has reached it immediately crawls under any floating rubbish and disappears from view.† Lastly, the genera *Arma* and *Stiretrus* (Fig. 41, p. 46 and fig. 43, p. 47 of the AMER. ENTOM.), both of which have very stout robust beaks suitable for piercing the bodies of other insects, are cannibal in their habits, as we showed in the pages just now referred to; while all the genera of the same group (*Scutellera* family) of the True Bugs (*Heteroptera*), which have slender beaks adapted only for piercing vegetation, are almost exclusively vegetable-feeders.

The law then, as we assume it to exist, may be briefly stated as follows: In the case of all known animals, species belonging to the same genus have the same, or nearly the same habits; and this is also partially true of genera belonging to the same Family; but not unfrequently genera belonging to the same Family have very widely distinct habits.

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*Essay on Classification, p. 59.

†For the habits of *Oodes fluvialis* Lec., see a Paper by the Senior Editor in *Proc. Ent. Soc. Phil.* III p. 643. We have kept this insect in an aquarium and know the facts to be as stated. Mr. H. Ulke, of Washington, D. C., has since informed us that he has detected the same habits in *Oodes amaroides* Dejean.

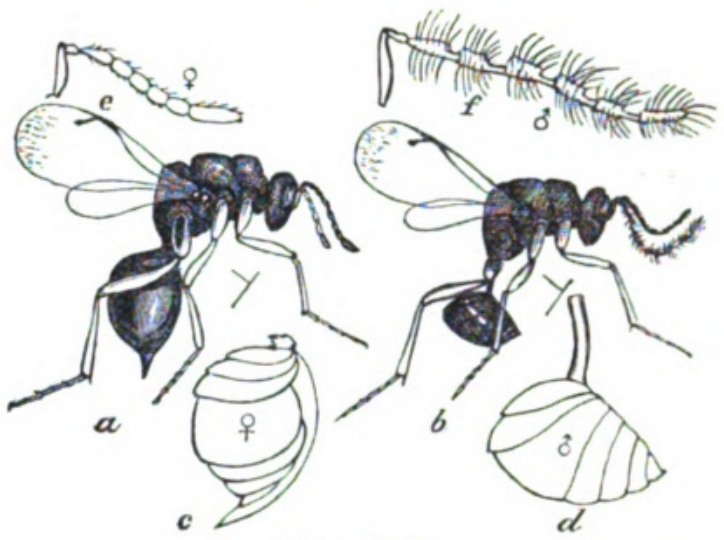
Generic Classification of the Joint-worm Fly.

It will be within the knowledge of most American entomologists, that the Joint-worm Fly has always been referred by all writers, from Harris and Fitch down to the times of Glover and Packard, to a genus of *Chalcis* Flies (*Eurytoma*) known to be generally parasitic in its habits. But—as has been shown above from the examination of its larval history in its earlier and immature stage as well as in its mature stage, and as was long ago asserted, both by Dr. Fitch and by Dr. Harris, from the examination of its larval history, solely in its mature stage—the Joint-worm Fly is a true gall-maker and therefore a true vegetable feeder. Here, then, as it seems at first sight, we have at once a glaring exception to the law of the UNITY OF HABITS, which has been laid down above as universally prevalent in the Animal Kingdom; for we have one species, the Joint-worm Fly, of a particular genus (*Eurytoma*), which is a vegetable feeder, and a great number of other species of the very same genus which are parasitic upon other insects. Indeed it was principally from his unwillingness to believe in the violation of the above great Law, that the Senior Editor of this journal formerly discredited the theory, that the so-called Joint-worm Fly was a gall-maker and a vegetable feeder, and strongly inclined to suspect that these galls were in reality made by some unknown species, probably a Gall-gnat, upon which the so-called Joint-worm Fly was parasitic.

In reality, however, there is here no real violation of the law of the UNITY OF HABITS; for—as we shall now proceed to show—the Joint-worm Fly does not belong by any manner of means to the parasitic genus (*Eurytoma*), to which all preceding authors have been in the habit of referring it; but to an entirely distinct genus (*Isosoma*), none of the species belonging to which have ever, so far as we are aware, been shown to be parasitic in their habits.

Below will be found magnified figures (Fig. 115, *a* ♀, *b* ♂) of both sexes of the true genus *Eurytoma*, all the species of which are closely alike in shape and structure, though they differ very greatly in size, and occasionally in coloration, and at least five species of which are personally known to us to be one or more of them parasitic on the insects of twenty-four different kinds of galls, growing respectively on Oak, Blackberry, Rose, Willow, Hickory, Goldenrod, and Ironweed. Of these twenty-four galls, ten are made by Gall-flies (*Cynips*) upon Oak, one by a Gall-fly upon Blackberry,

[Fig. 115.]

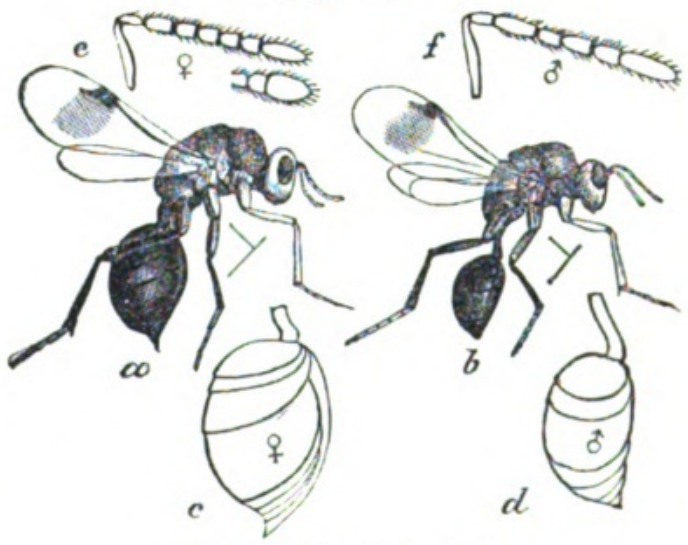


Color—Black.

one by a Gall-fly upon Rose, three by Gall-gnats (*Cecidomyia*) upon Willow, five by Saw-flies (*Tenthredo*) upon Willow, one by a Gall-gnat upon Goldenrod and Ironweed indiscriminately, one by a Plant-louse (*Aphis*) upon Hickory, one by a Bark-louse (*Coccus*) upon Hickory, and one by a small Moth (*Tinea*) upon Goldenrod; and in addition, a few specimens of the very same parasitic genus have been bred by us from certain large black woody funguses, growing respectively upon Oak and Hickory and inhabited by other insects. The whole number of specimens of this parasitic genus (*Eurytoma*), bred from the above galls and funguses and now contained in the collection of the Senior Editor, is 279.

There is another closely allied parasitic genus (*Decatoma*), the sexes of which are represented in the annexed drawings (Fig. 116, *a* ♀, *b* ♂), and of which four different species, all closely

[Fig. 116.]



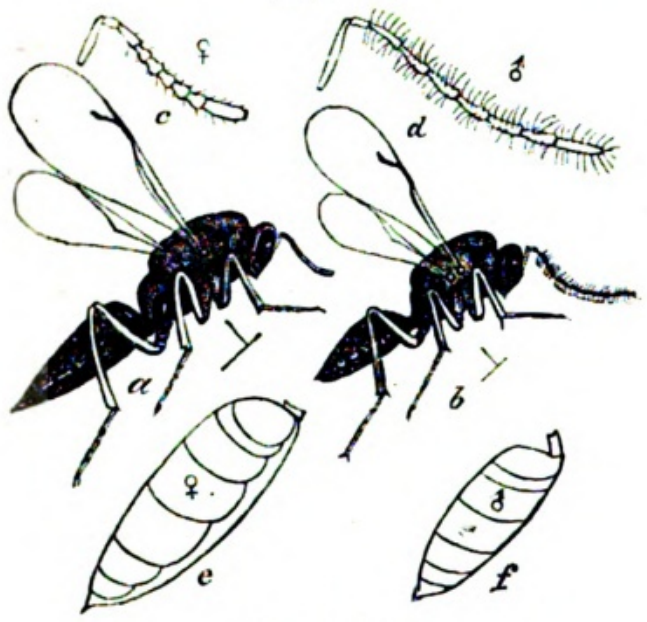
Colors—Rufous and black.

alike except in size and color, are personally known to us to be parasitic on the insects of eleven different galls. Of these eleven galls, no less than ten are made by Gall-flies on Oak, and but a single one is made by a Gall-gnat on Willow. The whole number of specimens of

this genus (*Decatoma*), bred from the above galls and now in the collection of the Senior Editor, is 217. Those that require further information on this somewhat dry subject are referred to the forthcoming Scientific Article by the Senior Editor, in which will be found descriptions of about a dozen new species belonging to these two parasitic genera (*Eurytoma* and *Decatoma*).

We will now give lateral or profile views of the same Joint-worm Fly, the female of which has been drawn as viewed from above in Figure 113, *b*. Compare these profile views with those

[Fig. 117.]

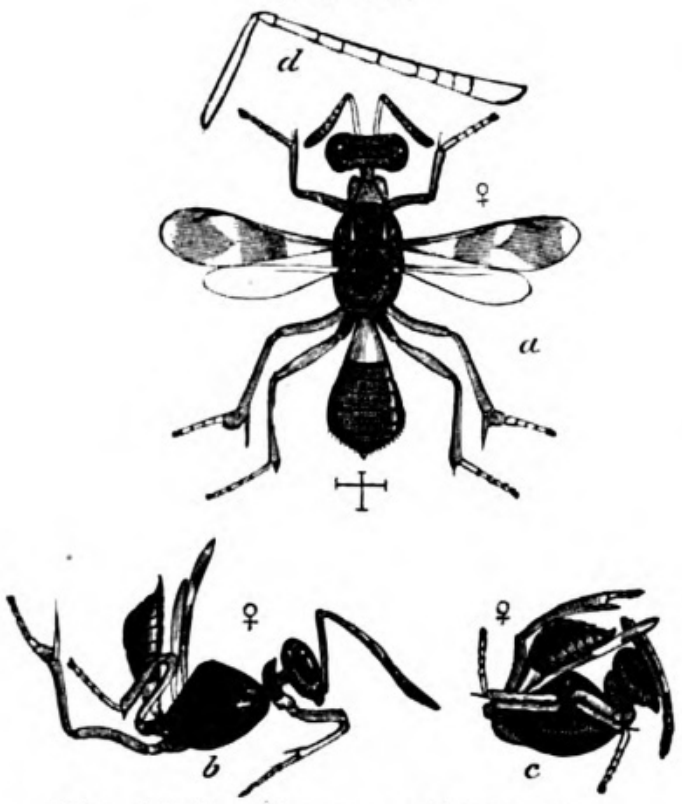


Color—Black.

of the two true parasitic genera (*Eurytoma* and *Decatoma*) given in figures 115 and 116, and it will be seen at once, even by the unscientific reader, that the last insect is totally unlike either of the two first, and manifestly can not be referred to the same genus. Not to dwell upon structural minutiæ which will be explained elsewhere, it will be seen at once that in the Joint-worm Fly (Fig. 117, *a* ♀, *b* ♂) the abdomen in both sexes, but especially in the female, is shaped quite differently from that of either of the two parasitic genera (Figs. 115 and 116), and that the body is nearly straight in repose, instead of being curled into a semicircle as in the two first genera. This latter peculiarity is not a mere fortuitous circumstance, happening to particular individuals, but is universal in all specimens belonging to the two genera first figured (*Eurytoma* and *Decatoma*); so that it is with great difficulty that their bodies can be sufficiently straightened out in death, to admit of their being mounted upon card in the comparatively straight posture shown in the figures (115 and 116), their heads being usually found stiffly doubled up downwards upon their tails. Even in life, they frequently assume this posture, when they wish to "play opossum" and escape the attention of the observer. On the other hand, the Joint-worm Fly has no such peculiarity either in life or in death, or at all events but to a very limited extent.

A very curious chapter might be written on the different modes in which different insects—upon the same principle as that just now explained—form themselves into the similitude of a round ball-like seed or pellet of dung, and thereby escape the attention of their enemies. To refer to but a few of such cases: Among the Beetles, one genus (*Byrrhus*) has separate cavities on the lower surface of its plump oval body to receive each leg, the leg doubling up and fitting into the cavity as smoothly, as does each particle of the finest piece of mosaic work into its appropriate position. In other genera (*Agathidium*, *Leiodes*, *Clambus* and *Sphæromorphus*) the body itself is rolled up downwards, head and tail together, into a more or less complete and smooth ball. In the well known Curculio (*Conotrachelus nenuphar*, Herbst) and many other Snout-beetles, the beak in repose is laid along the breast between the front legs, certain genera having a deep groove there to receive it; and the legs being then crumpled up close to the body, the whole creature looks exactly like the dead bud of a tree. In other genera of beetles (*Chlamys* and *Exema*), belonging to the same great Family (*Chrysomela*) as the Colorado Potato Bug, the whole upper surface of the body is rough, dark-colored and opaque; and when the legs are retracted, even good entomologists have been often deceived into mistaking the insect for a pellet of dung voided by some large caterpillar. Lastly, among the Golden-tail Flies (*Chrysis* family) in the Order *Hymenoptera*, all the genera, when threatened with danger, roll themselves up head and tail together, leaving their wings exposed. In this case, as indeed in all other such cases hitherto recorded in any Order of Insects, the little creature curls itself up downwards, and the back forms the convex and the breast the concave side of the ball into which it contracts itself. The same thing holds good with certain genera of Sow-bugs (*Oniscus* family) belonging to the Crustaceans, which roll themselves up into a more or less complete ball. But there is a remarkable and hitherto undescribed genus of *Chalcis* flies, a single species of which (*Antigaster mirabilis*, n. sp.) exists in the Cabinet of the Senior Editor, and which will be found figured below, 1st in Figure 118, *a*, as viewed from above with the wings and legs expanded, 2nd in Figure 118, *b*, in profile when preparing to curl up, and 3rd in Figure 118, *c*, in profile,

[Fig. 118.]



Color—Black, with some metallic reflections.

when almost completely curled up. And in this genus—wonderful to relate—the insect rolls itself up in an upward instead of a downward direction, like a clown turning a back summerset, so that the breast becomes the convex side of the curve, and the back the concave side.* No such example, so far as we are aware, has hitherto been recorded by authors as found in any Order of Insects; and we may learn from this and other such cases what pains Nature has taken, and how many various devices she has adopted, to enable these poor despised little "bugs," that are considered by many as beneath the notice even of children, to escape the observation of the myriads of foes that are constantly seeking to devour them.

For the reasons stated above, and others to be enumerated elsewhere, we have referred the Joint-worm Fly, as will be seen at once from the heading of this Article, to the genus *Isosoma*, instead of the genus *Eurytoma*, which consists exclusively of parasitic insects. Thus, as the reader will perceive, the seeming violation of the great law of the UNITY OF HABITS, in the case of the Joint-worm, is shown to be no violation at all, and to have been based upon pure ignorance of the true classification of that very extensive and interesting and important, but too much neglected group—the great *Chalcis* family.

Practical Results.

"But," it will be perhaps objected by the utilitarians, "of what practical benefit is all this discussion? What possible odds can it make to the farmer, for example, whether it is the so-called Joint-worm Fly that produces the galls on wheat, rye and barley, or whether this fly is in reality a parasite, and the galls are caused by some unknown gall-gnat never yet seen by mortal entomologist? What odds again is it to the farmer, whether the same fly produces the knotty galls on wheat, rye and barley, or whether there is a distinct species infesting each of these three plants, and even, as Dr. Fitch maintains, two distinct species producing galls upon barley straws? Lastly, what odds is it to the plain practical farmer, whether or not this fine law of the UNITY OF HABITS, about which you have been making such a pother, has any real existence in nature?"

Men and brethren! it makes all the odds in the world! If the joint-worm galls are produced by a gall-gnat, that gall-gnat must necessarily come out long before the autumn; for otherwise—so many thousands of these galls as have been handled by entomologists in the autumn—somebody or other would have certainly bred the supposed gall-making gall-gnat therefrom, or at all events found some traces of it. Upon this hypothesis, therefore, namely, that Joint-worm galls are made by a Gall-gnat, it would be utterly useless to burn up and destroy the infested straw in the autumn or subsequently; for the culprit gall-gnat will have left it long ago in the summer. Nay, it will even be a positive injury to do this; for the straw is then swarming with the so-called Joint-worm Flies in the larva state, which, on the hypothesis of the galls being caused by some unknown Gall-gnat, must necessarily be parasitic upon that Gall-gnat and therefore be our friends instead of our foes. If, on the other hand, the joint-worm galls are really caused by the Joint-worm Fly—as we have shown above—then it must be highly beneficial to burn up the infested straw in the autumn or subsequently; for almost all the Joint-worms lie in the straw until the following summer, and of course, if you burn the straw, you burn the culprit Joint-worms at the same time.

Again: If the very same Fly that causes Joint-worm galls upon Wheat can also cause similar galls, as we incline to believe, upon Barley and upon Rye, then the farmer cannot escape from the damage inflicted upon him by this little pest, by ceasing to grow Wheat and seeding down his fields to Barley or Rye. If, on the other hand, the converse proposition, which is that maintained by Dr. Fitch, be the true one, then the remedy just now indicated,

* A full notice of this most remarkable and anomalous insect will be found in the Scientific Article by the Senior Editor.

namely, shifting from one kind of small grain to another, would be a perfectly effectual one.

Lastly, if the law of the UNITY OF HABITS be a false and fallacious law, then no American farmer can of himself find out anything about the habits of any new insect that is infesting his crops, without studying out those habits in detail—which is often a good twelvemonths' job of work. We hope it is not now necessary to add, for the information of our regular readers at all events, that, without becoming acquainted with the habits of any particular noxious insect, it is folly to attempt to fight him. If, on the contrary, as we maintain and firmly believe, the great Law of the UNITY OF HABITS be universally true throughout the Animal Kingdom, then a moderate knowledge of Entomology will enable the farmer to tell, at a glance, to what particular group of insects the new species that is infesting his crops belongs; and he may then infer the habits of the stranger, with a close approximation to accuracy, from the habits of species which are already well known and are closely allied to that stranger.

Messieurs the Utilitarians, are you answered?

The Remedy.

We repeat, however, for the benefit of those who like to "go it blind" and adopt a prescription without knowing the why and the wherefore, that, whenever you discover the stems of your small grain to be badly affected near the root, in the manner shown in Figure 113, *a*, then you ought to burn off your stubble ground any time before the following summer, and burn up all the tailings and refuse straw after threshing. If you do this, and can persuade your neighbors to do the same, you will soon kill out the Joint-worm; if you neglect it, the parasites sent by a kind Providence may perhaps do the work for you; and again it may be possible that, in spite of the parasites, the Joint-worm may increase upon you year after year, as it did in Central Virginia from 1848 to 1851, till at length it becomes an almost unbearable nuisance.

Postscript.

We have only to say in conclusion, that we shall be greatly obliged by specimens of Joint-worm work either on Wheat, Rye or Barley, but especially on the two former plants, from any State in the Union, or from any part of the British Provinces to the North of us. There are still several interesting problems respecting this insect that remain to be definitively solved. For example, does Joint-worm work ever occur upon Oats?

THE WAVY-STRIPED FLEA-BEETLE.

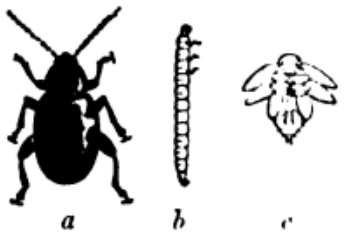
(*Haltica* [*Phyllotreta*] *striolata*, Illiger.)

This insect appears quite early in the spring, and proves very destructive to many of the garden plants and flowers belonging to the natural order CRUCIFERÆ, and is especially hard on mustard and all kinds of cresses. Common as is this Flea-beetle, its transformations had never been observed, in this country, till quite recently. A closely allied and very similarly marked species (*Haltica nemorum*, Linn.), occurs in Europe, where it is known as the Turnip Flea-beetle. This last species lives in the larva state, above ground, by mining the leaves of the same kinds of plants upon which the beetle feeds; and its transformations were first made known by Mr. H. Le Keux in a valuable paper published in the Transactions of the Entomological Society of London, Vol. II, page 24.

Our American species, being so closely allied to that of Europe, Dr. Fitch inferred its habits to be the same, and in his eleventh New York Report, he quotes Le Keux's observations as applying to our insect, and reproduces from Curtis's "Farm Insects" the figure of a mined turnip leaf, in illustration. In the December (1868) number of the *American Naturalist*, however, Dr. Henry Shimer of Mt. Carroll, Ills., shows that our American insect lives in the larva state underground, where it subsists on the roots of plants, in the same manner as does the larva of the common Cucumber-beetle (*Diabrotica vittata*, Fabr.); and we thus see that it is not always safe to judge of an insect's habits by those of its nearest allies. We have ourselves frequently searched in vain for the larvæ on the leaves of both mustard, cress, radish, and lettuce plants that were thickly covered with the perfect beetles, and as Dr. Shimer's observations are of interest, we quote them in part:

"The Striped Turnip-beetle (Fig. 119 *a*) is less than one-tenth of an inch in length. Its general appearance is black, with a broad wavy yellowish, or buff-colored stripe, on each wing-cover. The larva (Fig. 119 *b*) is white, with a faint darkened or dusky median line on the anterior half of the body, being probably the contents of the alimentary canal seen through the semi-translucent skin. The head is horny and light brown. On the posterior extremity is a brown

[Fig. 119.]



a *b* *c*

Colors—(*a*) black and buff-color; (*b* and *c*) whitish.