GRASS LEAF HOPPERS.

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In the last Bulletin we gave the results of an experiment with the hopperdozer or tar pan on a piece of pasture land in increasing the capacity of pasturage. At the same time we were working upon the life histories of the more destructive species of leaf hoppers, and a summary of those results with their economic bearing will be presented here.

Our first effort was to determine the manner in which the winter is passed. Adults of several of the species studied had been observed late in autumn and early winter and even on mild days late in December, so that it was at one time thought they might hibernate and deposit eggs in spring. Careful search, however, in early spring failed to discover any of them except *Agallia sanguineolenta*, which, as heretofore shown, is mainly a clover insect, and *Tettigonia hieroglyphica*, which occurs mostly in wooded places. No specimens whatever of the species of *Deltocephalus* and *Diedrocephala*, which are the most destructive pasture species, were found. This seemed to show pretty certainly that the eggs were deposited in autumn, and the question next to determine was where they were laid. To determine this point, as well as to secure additional evidence as to the possibility of adults living over winter, a small patch of blue grass sod was enclosed by a tight board set on edge fitting closely into the ground and extending up about two feet so as to make it impossible for any of the leaf hoppers to enter from without. The enclosed patch was carefully examined to make sure that no hoppers, either young or old were present, and it was examined very frequently as well as the outside portions, to determine just when young hoppers appeared. As soon as the larvae appeared in grass land outside they appeared also in this enclosed patch in large numbers, showing we think conclusively that the eggs are deposited in the grass itself and as other observations have shown that they are placed in the blades of
of grass, there is apparently no reason to doubt that the eggs occur in the dead or withered leaves of grass near the ground through winter and in early spring.

Life histories of three of the particularly destructive species may be stated briefly.

*Deltocephalus inimicus* Say. Eggs are deposited beneath the epidermis of blue grass and form minute blister-like swellings near the tips. For the spring brood eggs hatch in latter part of April and early May varying with the season. They mature by the latter part of June or early in July, and larvae of the second brood begin to appear by the latter part of July and mature by the latter part of August. Some of these may simply survive during autumn and deposit eggs that pass the winter, but it is probable that many deposit eggs that produce another brood of adults by the latter part of October, and these deposit the winter eggs.

![Fig. 1. *Deltocephalus inimicus* Say. a. newly hatched larva; b. after first moult; c. after second moult; d. after third moult; e. hind tarsus from above; f. hind tarsus from below. (Original.)](http://lib.dr.iastate.edu/bulletin/vol2/iss20/5)

Five distinct stages of growth have been observed: newly hatched larva, first, second, third moult, this producing a final nymph stage or pupa, and this the mature insect. Moults occur at intervals of seven or eight days under the conditions in breeding cages, and in some cases passed from just hatched larva to adult stage in 32 days.

*Deltocephalus debilis* Uhl. The spring brood of this species appear to mature a little earlier than *inimicus* and the suc-
ceeding broods to come about two weeks earlier in general than that species. Aside from this, no particular differences have been observed that would affect methods of treatment.

*Diedrocephala mollipes* Say. Observations on this species have extended over a number of years, and it is doubtless one of the most widely distributed and injurious of the number. Adults are most abundant in June and again in early autumn, and Mr. J. A. Rolfs, a senior student in entomology in 1892, who has followed it particularly, found that the first larvae in spring occur mostly in low ground, but that these move to upland and deposit eggs mostly on grasses of higher ground, while the autumn brood of adults retire to lower and moister locations and deposit eggs to pass the winter quite commonly in the coarse grasses of low ground. The eggs are deposited under the sheaths of the grass blades mostly near the ground.

**REMEDIAL MEASURES.**

It is very evident that the determination of the winter habits of these pests indicates an important means of checking their injuries. Until this point was settled it was impossible to say whether burning in late fall or early spring would be of any service, but with this knowledge we can hardly doubt the efficacy of thorough burning. It is evident, too, that the burning of the coarse grasses of low ground will be important in preventing the increase of the last mentioned species.

This plan wherever it can be used, and coupled with the tar pan method reported upon in last Bulletin, makes it possible, we believe, to prevent a large part of the drain, that is so continuous from the presence of these pests in grassland.