

PSYCHE.

NOTES FROM THE CORNELL INSECTARY.

III.—SOME OBSERVATIONS UPON TWO SPECIES OF BRUCHUS.

BY M. V. SLINGERLAND, CORNELL UNIVERSITY, ITHACA, N. Y.

BRUCHUS OBTECTUS Say.

Although this cosmopolitan insect has been known in this country for over sixty years, and has been recognized as a common and destructive pest for more than a quarter of a century, still it is only within the past year that several interesting phases of its life history have been discovered. During the past two years not less than forty pages of our entomological reports and magazines have been devoted to discussing this pest. And even now there is need of a further study of the species. For instance, we know but little of its habits in the field and hence are not able to suggest any treatment for preventing its ravages until after the deadly work of the larva has begun in the seed.

The name of this insect has been in an unsettled condition for many years, but *obtectus* Say apparently has priority and is now generally adopted. In 1879 M. Maurice Girard (Jour. soc. centr. hort. France, pp. 95-99) said that "several entomologists believe that it has been described under different

names which come under the synonymy of *B. obtectus* Say. It is the *B. irresectus* Schönherr." Dr. Riley has tried for many years to establish his name *fabae*, but has recently (Ins. life, v, 27, 1892) reached a similar conclusion as M. Girard, placing *irresectus*, *fabae*, and other names under the synonymy of *obtectus* Say. Dr. Horn writes me recently that Dr. Riley is probably correct in his change of the name *obsoletus* to *obtectus*.

Previous to June, 1892, I had supposed, and it had always been so recorded, that the beetles laid their eggs upon the outside of the bean-pod, the young larva hatching therefrom boring through the pod and entering the seed. In May, 1892, I confined several beetles in cages containing growing bean plants. The beetles fed upon the surfaces of the leaves until the pods were nearly full grown but still green. I frequently saw beetles at work gnawing a narrow slit in the ventral suture of the pod, and trying it from time to time with their ovipositor; several beetles would work on the same slit, one driving another away and

continuing the work itself. The slits were about 1 mm. in length and were always in the ventral suture, sometimes almost at the point of attachment of the seed. May 23, I found a cluster of eggs in a cavity at one end of a pod, and later two or three eggs were laid upon the outside of the pod, but these were soon knocked off by the beetles themselves in running about. June 8 the eggs in the cavity hatched. It was not until June 18, however, that I discovered the normal nidus of the eggs of *obtectus*. Upon opening some of the pods I was surprised to find clusters of eggs within the pods attached to the ventral suture at the point where I had seen the narrow slit being made by the beetles. The slits do not close up and disappear but the tissues turn dark and the place is thus readily seen in green and even in riper pods.

On August 15 I presented these facts before the Association of economic entomologists at Rochester (Ins. life, v, 86). Two days later before the Entomological club of the A. A. A. S. (Ins. life, v, 31), Dr. Riley reported similar observations upon the oviposition of the bean weevil in his garden at Washington, thus confirming my laboratory experiments. It seems probable, however, that Dr. Riley's observations were made later than May or June, for in the August number of the Canadian entomologist, p. 186 he says: "The eggs are primarily laid upon the bean-pod in the field, but chiefly, if not entirely, on those which are already mature and ripening, and the larvae enter the same very much as does the pea weevil."

The eggs (plate 16, fig. 1, *b*) are about .75 mm. in length and .3 mm. in diameter at the widest part; the color is white and the surface finely granulate.

In 1879, Dr. Riley discovered the important fact that the insects continue to breed for many generations in stored beans. Although this very important fact was published in a newspaper in 1882, it did not become known to most entomologists until Dr. Lintner recorded similar observations in his seventh report for 1890. During the past year I have bred several generations of the beetles in the dry seeds. I find that even in the slightly varying temperature of an office, the season notably affects their development. When the eggs were laid in March adults issued in about eighty days, while in August beetles emerged from beans upon which eggs had been laid only thirty days before. The egg and pupal stages are of about the same length while the larval stage occupies about twice as many days as either.

Among dry beans the eggs are laid on the seeds but are so slightly attached that they are easily dislodged if the seeds are disturbed. The egg shell is, however, very strong and seldom broken by the movement of the beans. As Dr. Riley has shown (Ins. life, iv, 301) the newly hatched larvae (fig. 1, *c*, adapted from Riley's figure) present several interesting features not found in its further stages. Its long slender legs enable it to move quite readily over the beans until it finds a suitable place, when it bores a minute round hole through the shell and enters the seed.

Several larvae sometimes enter the seed through the same hole. At the first moult this post-embryonic larva loses its legs, hairs, and thoracic shield, and takes on the characters of the mature larva shown at figure 1, *d*. Figure 1, *c*, shows the head of a nearly full grown larva in front greatly enlarged; only the cephalic border of the front is brown, thus giving us a character which will enable us to readily separate the larva of *obtectus* in any stage after the first moult from those of *quadrимaculatus* shown at fig. 2, *e*.

The pupa is represented much enlarged at *f* (adapted from Marlatt). At *g* is represented a bean natural size from which beetles have escaped. Figure 1, *a* shows the adult; the much enlarged antenna and hind leg bring out the characteristics of these appendages. The beetles vary as much in size as do those of *quadrимaculatus*, but the markings of *obtectus* are quite constant.

After breeding several generations of *obtectus* among dry beans, I extended my experiments to other seeds and found that the beetles oviposited readily upon the seeds of our common pea, on corn, on buckwheat, on the large European bean, on lentils, on chick peas, and on the seeds of *Lathyrus sativus*. I have reared the beetles from all of the above seeds except the corn and buckwheat. Larvae are at work in the buckwheat at the present time; and although the larvae entered the corn kernels readily, they seemed to be unable to work well in the much harder interior of the kernel and all died shortly after the first moult.

BRUCHUS QUADRIMACULATUS Fabr.

In "Insect life," v, 32 and 165, Dr. Riley says that in January, 1885 the entomological department at Washington "received *B. quadrимaculatus* Fabr. swarming in what are called 'black-eyed table-beans' from Texas that were exhibited at the Atlanta Cotton exposition. In oviposition in the stored beans this species differs from the common bean weevil in that it deposits its eggs in the beans. Also bred from cow peas (*Dolichos* sp.) from Texas." This seems to be the extent of our recorded knowledge of the habits and life history of this *Bruchus*.

Nov. 18, 1892, Crosman Bros., seedsmen at Rochester, N. Y., sent me a package of peas returned to them from the south which was swarming with weevils. Dr. Horn identified them as *B. quadrимaculatus* Fabr. as recognized by him in his paper of 1873 (Trans. Am. ent. soc., iv, 318). I notice that F. Baudi (Deutsch. ent. zeit., xxxi, p. 36, 1887) considers *quadrимaculatus* a variety of *ornatus* Bohm.

Dr. Horn records the species from the West India islands and the southern states. Nov. 28, I received two more packages of infested peas from Crosman Bros. These had been returned to them from Texas. They have had beans returned to them from the south infested in the same manner.

The beetles were found to vary greatly in size and markings. Pl. 16, fig. 2, *a* represents the beetle; an antenna and a hind leg have been much more enlarged to bring out the characteristics of those

appendages. Fig. 2, *f* to *n* inclusive represent the right wing cover, showing the great variation in size (*f* and *g*) and in coloration(*g* to *n* inclusive). The wing covers from which *f* and *g* were drawn measure 1.2 mm. and 2 mm. respectively, so that the smallest beetles are scarcely more than one-half as large as the largest. The wing covers were all drawn with a camera lucida using the same power of the microscope in each case. No attempt was made to represent the pubescence or striae. I simply desired to bring out the gradual change from a wing cover which is of a plain rufous color as at *g* to one which has the rufous color almost entirely replaced by black with small whitish spots as at *n*. A longer series might have been taken in which the encroachment of the black upon the rufous would have been more gradual, but the eight forms shown will serve the purpose. In fact, every gradation exists in nature between *g* and *n*. Forms similar to *l* and *m* are the most numerous.

Soon after receiving the beetles I began experiments to study their habits and life history. Many beetles were confined among dry peas, beans, and corn. Egg laying soon began on all the seeds. The egg, figure 2, *b*, is oval in shape with flattened base, and is of a bright shining lemon yellow color. It is .6 mm. in length, .4 mm. wide, and .2 mm. thick. Each egg is firmly glued to the outside of the seed (not deposited in the seed as stated in "Insect life") by a thin sheet of transparent substance which extends beyond the egg as shown in the figure. Sometimes fif-

teen or twenty eggs are laid on a single seed, and I have seen a pea from which as many beetles have emerged.

The eggs hatched at this season in from thirteen to twenty days. Several days before hatching the brown heads of the larva can be distinctly seen through the shell, and the whole egg assumes an opaque creamish white color. In escaping from the egg, the larva invariably eats a round hole through one end of the shell where it is in contact with the seed, leaving the visible portion of the shell intact. Figure 2, *c* represents the basal aspect of an egg, showing the manner of escape of the larva. The larvae bore directly from the egg into the seed.

The newly hatched larva resembles somewhat that of *obtectus* shown in fig. 1, *c*, but more closely that of *pisi* figured in "Insect life," v, 205. It differs in the form of its thoracic armature from either, and its legs (fig. 2, *d*) are one-third shorter than those of *obtectus* and resemble those of *pisi* in form. Soon after entering the seed the larvae moult and lose their legs, hairs, and thoracic shield. When mature the larvae are very similar to those of *obtectus* (fig. 1, *d*) in size, shape, and color. Larvae in all stages after the first may be easily separated from those of *obtectus*, however, by a glance at the cephalic margin of the front of the head. The front is of a dark brown color for a considerable distance caudad as shown at *e*, fig. 2 (compare fig. 1, *c* of *obtectus*). Larvae are at present feeding in the seeds of peas, corn, and beans.

In December, 1892, I confined sev-

eral beetles in a cage containing growing peas in which the seeds were about one half grown. Dec. 10, several eggs were laid on the outside of one pod in the same manner as upon the dry seeds. No eggs were laid upon any other pods although there were several in the cage; and as time passed and the eggs that were laid did not hatch, I began to think that they must have been unfertilized. But as they held their shape and color I left them, and how wonderful has been the result! The pod ripened, turned yellow, and the vine was nearly killed by plant-lice and mealy-bugs. Finally, in the latter part of January, 1893, I picked the pod and placed it in a box to wait events. After it had been in the box for about a week, I examined it and what was my surprise to find that the brown heads of the larvae were plainly visible through the shells of several eggs. The eggs were hatching! The pod and its seeds were quite hard and nearly ripened. Fifty days had elapsed since these eggs were laid; and we have seen that ordinarily on dry seeds the eggs hatch in less than twenty days.

What unseen hand was it that held in abeyance the development of the embryo in the egg until the pea had reached the ripening stage—the only stage

when it seems to be fit for the food of the larva? How interesting and wonderful are Nature's ways as revealed in the lives of some of the tiniest of her creatures!

EXPLANATION OF PLATE 16.

Fig. 1.—*Bruchus obtectus* Say.

- a*, Beetle, enlarged; antenna and leg still more enlarged. (Original.)
- b*, Egg, greatly enlarged. (Original.)
- c*, First larval stage, much enlarged; with leg still more enlarged. (Adapted from Riley.)
- d*, Mature larva, enlarged. (Adapted from Marlatt.)
- e*, Front view of head of mature larva, greatly enlarged. (Original.)
- f*, Pupa, enlarged. (Adapted from Marlatt.)
- g*, Infested bean, natural size. (Original.)

Fig. 2.—*Bruchus quadrimaculatus* Fabr.

- a*, Beetle, enlarged; antenna and leg still more enlarged. (Original.)
- b*, Egg, greatly enlarged. (Original.)
- c*, Basal aspect of egg, greatly enlarged. (Original.)
- d*, Leg of post-embryonic larva, greatly enlarged. (Original.)
- e*, Front view of head of mature larva, greatly enlarged. (Original.)
- f* and *g*, Right wing covers of beetle, showing the variation in size of the adult. (Original.)
- g* to *n* inclusive, Right wing covers enlarged, showing variation and gradation in coloration. (Original.)

HYMENOPTERA OF MADAGASCAR.—A notable contribution to entomological literature has just reached this country in the volume treating of the Hymenoptera, forming a part of Grandidier's immense work on the physical and natural history of Madagascar, of

which it forms vol. xx. The first part is contributed by Dr. H. de Saussure and makes a quarto volume of more than 600 pp. and 27 exquisitely finished plates; the second by Dr. A. Forel on the ants alone, a volume of about 250 pp. and 7 plates.



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