THE ELM LEAF BEETLE.

(GALERUCA XANTHOMELÆNA, Schrank.)

BY JOHN B. SMITH, SC. D.

My first practical acquaintance with this species began at New Brunswick, N. J., in the spring of 1889. In the Rutgers College campus there are a considerable number of elms, many of them grand old trees, which for several seasons in succession and up to 1888 had been defoliated by *Galeruca xanthomelæna*, larva and imago. A double row of young trees, many of them elms, extends from the College campus to the Theological Seminary, a distance of about 280 yards, and at the beginning of this row, most distant from the Seminary, the Experiment Station building is situated. There are also a considerable number of elms among the other shade trees in this part of the city. It was my intention to protect the trees in and near the College campus, and near the Experiment Station, from injury; and, to obtain accurate data for a full history of the species, I noted the dates of the principal occurrences in the life of the insect. According to these notes, the hibernating beetles began appearing in 1889 about the middle of April, very gradually increasing in number to the beginning of May, when they became more plentiful. Eggs were first noticed May 12, giving larvæ May 24. The details of the destructive measures adopted are immaterial here, and are published in my Report for 1889. June 28 nearly all the beetles of the hibernating brood had disappeared, and after July 3 no more were seen. At this time all eggs were hatched. July 5th pupation was quite general, and imagos of the summer brood were developing in numbers July 15. There was a distinct period of a week or ten days during which no beetles could be found, and at that time no unhatched eggs were on the trees. The watch had been close, and I was positive that at the time the last of the hibernating insects had disappeared, the larvæ from the first lot of eggs laid were no farther advanced than full fed and ready for pupation. After the last days of June there were no egg masses to be found on the trees, and by the middle of August the beetles had all disappeared. I felt positive of my results, and published as a fact that the species was single brooded at New Brunswick. This was contrary to all that had been previously written; but in no published accounts were details of actual observations given. I repeated my observations in 1890 and 1891, and presented them at the Washington meeting of the Club. Dr. Riley felt quite certain that I was mistaken, though he could not question my observations, while

Dr. Lintner expressed surprise that the beetles should go into winter quarters in midsummer, and yet more that they should feed for so long a time previously. To settle the matter, if possible, I repeated my observations during the present season, while Dr. Riley carried on a series of observations at Washington, D. C. Dr. Riley, in *Science* No. 492 for July 8, 1892, records the facts that he then had imagos of a summer brood, and that these imagos had oviposited June 28. In a letter dated July 27, he informed me that the larvæ from these eggs had pupated. It is thus positively settled, that at Washington, D. C., there are two broods at least of this insect. My observations at New Brunswick gave an opposite result.

The season was rather later than that of 1889, and I saw no trace of beetles until May 17, and no beetles until May 19. The elms were at this time in full leaf, and began to show the characteristic little holes eaten by the insects. Eggs were first observed May 29, on a small tree, every part of which I could readily scan, and I selected this tree, which was a prime favourite with the insects, for special observation, while I also examined daily the trees in front of the Experiment Station building, the lower branches of which were within easy reach. Dissections made at this time showed that the ovaries of all the females were fully distended, each containing a considerable number of mature eggs, so many, indeed, that it was impossible to get out an ovary entire. The males, when examined, showed rigid, fully-developed testes, which were easily found and removed. The first batch of eggs gave larvæ June 6, and oviposition continued to June 20th, or perhaps a little later. The hibernating beetles gradually lessened in number, and had disappeared entirely June 30. On June 29, I found the first pupa, and on that day collected all the unhatched egg clusters I could find—a very few only. One of these clusters gave larvæ July 1, and all the others failed to hatch. During the first days of July, I gathered about 200 pupæ or larvæ ready for pupation, and beetles began appearing July 8 in the open air, as well as in my jars. There were then on the trees at this date larvæ of all sizes, pupæ and beetles of the summer brood, but *no* egg masses. The beetles in my breeding jars were fed until August 1, at which date all refused to feed further. I had noticed, a few days previously an indisposition to feed among some of the older beetles, and had noted, too, an unusual accumulation of excrement at the bottom of the jar. I found, later, that the last thing done by the beetles before retiring to winter quarters is to

empty the entire digestive tract. During the three weeks or more that the beetles were in my possession, I did not notice a single copulation, nor did I get an egg mass. Observations outdoors were to the same effect; not a copulation; not an egg-mass. On the new shoots put out by the trees early in August, there are now—the 13th—plenty of beetles, but neither eggs nor larvæ. When I observed this disposition to cease feeding, I dissected a number of the beetles, and in all of them I found the sexual structures undeveloped. The ovaries were minute, and could only be found by securing the large vagina to which they were attached. In the male it was almost impossible to get the testes entire, as they were mere empty tubules, which tore with the slightest strain. A number of newly-hatched beetles were secured and dissected, with the same results. Then a collection was made, selecting those with fully distended abdomen. In none was there more than a slight development of the ovaries, while in all, the digestive tract was gorged with food, and fat globules and masses were forming. I observed also that on the leaves some beetles had discharged long strings of excrement, and they were beginning to appear on the windows of my laboratory and in my house. I accepted this as an indication of a desire for retirement, and as I knew that the bell tower on the main college building was a favourite resort, I sent my assistant to investigate it, August 8. He brought back a vial filled with beetles, and reported that in a rubbish heap on the floor, covered by an old board, the beetles were to be found in large numbers. The bell tower was dark enough to make the use of a lantern necessary, and as there was no other explanation of their presence there in such large numbers, I feel justified in assuming that these beetles were in winter quarters. A number of these specimens were dissected, and in all of them the most prominent feature was the great mass of fatty tissue stored in the abdominal cavity. In all of them the entire digestive tract was free from food or excreta, and in all, the sexual organs were undeveloped.

I consider it positively proved that there is only one generation of this species annually at New Brunswick, N. J. The life of an individual beetle may extend from early in July of one year to well along in June of the following year, and the three weeks feeding time in summer is necessary to enable the insects to store a sufficient quantity of fatty tissue to help them through the nine months of lethargy. The feeding in early spring is again necessary to mature the sexual organs and develop the eggs in the ovaries of the female.

Mr. Riley accepted the facts brought forth by Mr. Smith, and remarked on the statement that the latter had found the ovaries more or less developed in some individuals. He had no doubt but that the species was normally single brooded at New Brunswick. This year the beetles had appeared at New Brunswick two weeks later than last year, which showed that the time of appearance varies greatly. One curious fact brought forth was that the beetles appeared at the same time as at Washington. He remarked also on the fact that during the month of June at New Brunswick there was no evidence of the development of larvæ, which was not the case at Washington. Life is quicker in the more northern regions, and under such conditions acceleration might be expected which was not the case with this species. There is a difference between the life at New Brunswick and that at Washington, and somewhere between these two places there must be a dividing line. Such cases of peculiar characteristics may be explained by heredity. Acquired characters which are beneficial have fixed themselves upon the species, and this, no doubt, accounts for the single or double broodedness of this or any other species.

Mr. Smith called attention to the fact that the observations recorded in the present paper were made in 1889 and the present year, while the observations of '90 and '91 were reported in the proceedings of the Club last year.

Mr. Southwick stated that in New York City spraying for this species was begun about the last of May and that he thought the species was there two, or perhaps three brooded, although Mr. Beutenmeuller of the American Museum has so far noticed but one brood.

In reply to a question by Mr. Lintner, Mr. Riley stated that at Washington the greater part of the second brood of beetles hibernated, although some doubtless laid eggs for a third generation. They disappear in August at Washington at the same time the first brood disappears at New Brunswick.

Mr. Schwarz called attention to the fact that there was a vast difference between the climate of Washington and New Brunswick, which difference he had especially noticed in the coleopterous fauna of these two places. An important investigation in this regard would be the behaviour of the species in the latitude of Baltimore and Philadelphia. The first brood did more damage at New Brunswick than did the same brood at Washington. In Washington it is the second brood that does the most damage, this brood being much more numerous.

Mr. Smith stated that as much difference as is noticed between the fauna of Washington and New Brunswick was also noticed in New Jersey itself between the red shale and the sandy plains regions, while many peculiar forms were found in the hilly north.

Mr. Riley thought that by an exchange of specimens between Washington and New Brunswick it could be easily proved that the single or double broodedness of the species was an acquired habit. He was strongly of the opinion that those received at Washington from New Brunswick would remain single brooded irrespective of climate, while those received at New Brunswick from Washington would be double brooded there.

Mr. Lintner asked if this matter of heredity was not the same in the difference noted between the thirteen and seventeen year Cicada.

Mr. Riley thought that this was the case, the seventeen year Cicada being a northern, and the thirteen year Cicada being a southern species.

In reply to a question, Mr. Smith stated that most of the larger Bombycids (*Saturniidae*) were double brooded in New Jersey.

The Club then adjourned until the afternoon, immediately after the adjournment of Section F.

The afternoon session was called to order by President Schwarz at 4.15, eleven members present.

Mr. Hubbard read the following paper:—

THE INHABITANTS OF A FUNGUS.

BY HENRY G. HUBBARD.

In the forest-clad portions of the Pacific Coast Range, from the Columbia River northwards into British Columbia, there are frequently seen on the trunks of pine trees which have been injured and blackened by fire, small white fungi almost globular, or slightly flattened and kidney-shaped, varying much in size, but frequently attaining the dimensions of a pigeon's egg. This fungus, kindly determined for Mr. E. A. Schwarz and myself by Prof. Galloway, is *Cryptoporus (Polyporus) volvatus*, Peck., var. *obvolutus*, Peck. It is very tough and leathery, and is remarkable for the extension of the pileus, which forms a thick coriaceous veil, covering the hymeneal surface below, and entirely enclosing it in a cavity which retains the spores as they fall. A small aperture in the veil, less than one-fourth of an inch in diameter, penetrates the cavity from beneath. This opening is never in the centre of the underside, but is placed near