

INSECT GALLS AND GALL INSECTS.

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Insect or plant galls are the obvious and manifold deformities found upon all parts of a great variety of plants and usually given only a passing thought. Gall insects are the inhabitants of these insect or plant galls and, like the deformities themselves, are myriad in number, variety and structure. Insect galls are easily studied, since they are to be found at all seasons of the year and are readily located and preserved. Conversely, while gall insects exist throughout the year and in various stages, practically, it is difficult to obtain them except after some knowledge of their habits and the conditions which are necessary to complete their changes or transformations. Many issue direct from their galls and are easily reared, others enter the soil for the final transformations and are difficult to rear.

The oak apples are moderately common plant galls, occasionally being so numerous as to occur by the hundreds upon favoured trees. They are spherical, an inch or so in diameter, depend from leaves or twigs and are easily crushed. These curious developments are comparatively well known, though the little four-winged gall wasps issuing therefrom are very rarely seen by other than the professional entomologist. It is not so generally realized that there are over 350 different galls produced by various gall wasps upon our oaks and moreover that considerable series of these insects exist in two very different forms, namely, a perfect or complete generation, represented by males and females and usually appearing in midsummer or when warm weather is very favourable to insect activities, and the imperfect or incomplete generation, represented only by females, which issues from a very different gall, usually in early spring at a time when cool, inclement weather seriously restricts insect activities. This remarkable difference between parent and offspring is known as alternation of generations and may be summarized by the statement that it means dissimilar children and similar grandchildren. The great difference obtaining between the two generations is illustrated by a British oak apple which develops on the tips of the twigs and produces four-winged gall flies, whereas the alternate generation issues from masses of somewhat fig-shaped root galls and is wingless. In other words, the wingless insects issuing from root galls climb the trees to the tips of the twigs and those developing in galls at the tips of the twigs, although provided with wings, descend to the ground and make their way to root-lets before they deposit eggs. It is an interesting

migration from one extremity of the tree to the other. The peculiar relationship existing between many of the oak galls has been worked out for the European gall wasps, though as yet little is known concerning our very numerous American forms. It is not so very difficult to ascertain this, since it is only necessary to collect the mature galls, keep them under approximately normal conditions in a jar or other cage and when the flies appear give them a chance to follow their instincts under as nearly natural conditions as possible, or better still, if small oaks be in the vicinity, watch the behaviour of the gall wasps as they issue in the open, using those in the cage to indicate the time when observations can be made to the best advantage. Naturalists with nearby scrub oaks have an almost ideal outdoor laboratory for such work.

There appear to be more special adaptations among gall making insects than are found in most other groups, though it should be remembered that the gall makers are by no means a natural group, since representatives of several dissimilar orders of insects have acquired this habit. The alternation of generations in the gall wasps is closely paralleled by what is found in certain plant lice, except that with these we have an alternation of indeterminate series of generations, their extent being determined largely by seasonal conditions and the vitality of the food plant. Moreover, in this group, the alternate series of generations are very likely to develop upon such dissimilar plants as birch and witch hazel. Certain species of gall midges have a very similar development except that there is an indeterminate series of generations remarkable in that maggots continue to produce maggots (that is pupæ and adults are eliminated) and then eventually a generation continues its development to the perfect flies and these latter behave as other insects. The reason for this remarkable deviation from the normal appears to be due to the fact that these maggots subsist upon decaying wood and develop in places where neither flies nor parasites can penetrate readily, consequently a series of maggot generations gives an advantage which would not obtain if the insects were compelled to transform to flies and emerge in the open from generation to generation.

Insect galls, as intimated above, are simply abnormal developments of plant tissues. A little study of these deformities reveals surprising modifications. There is the comparatively simple swelling of catkin, leaf, leaf stalk, twig or root containing