### GARDEN DESTROYERS.—GALL FLIES OF THE OAK—"CYNIPIDÆ."

There are few more interesting insects to the lovers of plants and to entomologists than those which, in their immature states, inhabit the leaves, stems, etc., of plants, causing the plant in which they are to form an abnormal growth round them.

These peculiar formations are known as galls. They may be found on nearly all kinds of plants, and are caused by insects belonging to various orders.

It is not often that a plant is so infested with galls as to be seriously injured by them, but I have seen young oaks so covered with various galls that their growth was quite stunted; and it should always be remembered that though a certain insect is not common enough to be really injurious to plants, should circumstances favor its increase, it may, in the course of a few years, positively swarm.

The common marble gall was almost unknown in this country thirty years ago, when it suddenly became common and has remained so. Were it again to increase as rapidly our oak plantations would be in a dismal condition indeed.

Though these insects will always be looked upon with suspicion by horticulturists, we must always remember what we owe to a foreign gall fly (*Cynips gallæ tinctoria*), which

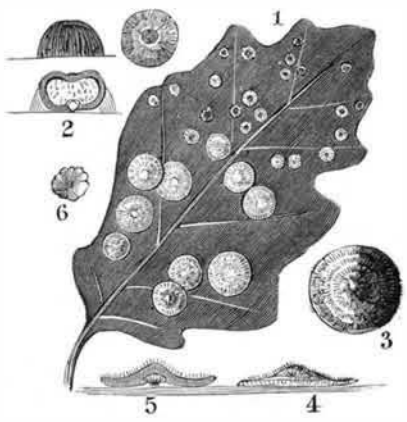


Fig A.—1, Oak leaf with spangle galls and button galls; 2, button galls (magnified); 3, 4, 5, spangle galls (magnified): 6, grub from spangle (magnified).

forms the gall so largely used in the manufacture of writing ink; these oak galls of commerce much resemble our common marble galls. In the present article I intend to draw attention only to those formed on oak trees by certain small four-winged insects which are known as gall flies, or cynips. They are members of the family Cynipidæ, a family in the same order as bees and wasps, but more nearly related to the ichneumons or parasitical flies.

The number of these insects which attack the oak is very considerable. Dr. Adler, of Schleswig, in a most interesting and valuable pamphlet on these insects (to which I am indebted for much valuable information contained in this paper), enumerates nearly one hundred and thirty species living on various kinds of oaks in Europe; but this number probably includes several which are, most likely, different forms of the same insect. I have selected a few of the common and more conspicuous galls for illustration. The various galls differ very much in appearance and substance. Some, the marble galls (Fig. F) and the artichoke galls (Fig D), become quite hard and almost woody: others, like the currant gall (Fig. B) and the oak apple (Fig. E), are soft. Another kind, which may sometimes be found on the catskins or mole blossoms of the oak, resemble a small mass of


Fig. B.—1, Currant gall on leaf; 2, ditto on male flowers; 3, ditto and section.

cotton wool more than anything else. It is very curious that the grubs, which are so much alike in every way, though belonging to different species, should cause the growth of galls so very dissimilar in appearance. The marble and artichoke galls are both formed from buds, yet how unlike they are. The currant galls and the woolly ones just mentioned are both found on the male flowers of the oak, and have no point of similarity.

These differences may, however, be the result of the grub occupying a different position in the bud or flower, one species placing its eggs in a different layer of cells to the other. A question which has been much discussed among entomologists is: What is the cause of this growth of the gall? Does the gall fly, in puncturing the tissues of the plant, inject a fluid which promotes the abnormal growth? Or is it the action of the grub in obtaining nourishment from the surrounding cells? Dr. Adler is decidedly in favor of the latter solution, and has conclusively proved that the

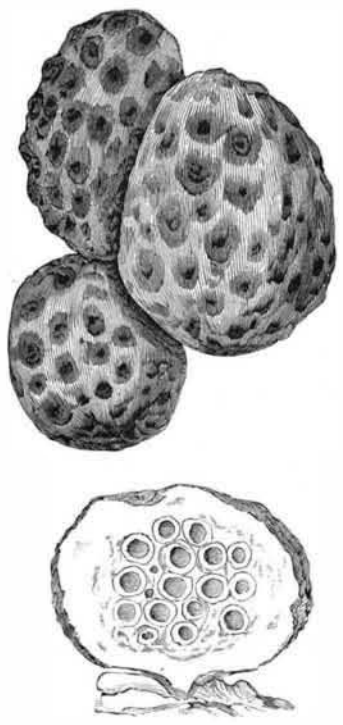

Fig. C.—Oak root gall and section.

formation of the gall does not commence until the grub is hatched, and that as soon as the grubs (which are furnished with sharp jaws) begin feeding a rapid growth of cells round

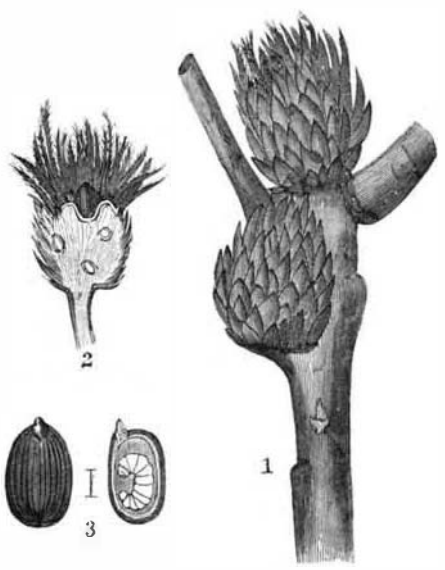


Fig. D.—1, Artichoke gall; 2, ditto, section; 3, internal gall (magnified).

them is induced; and that if a grub dies before the gall is fully formed its growth is arrested. The life history of the gall fly is most interesting. Dr. Adler, with the most unwearying patience and perseverance, has proved by very carefully made experiments that gall flies which had hitherto been considered as different species, which made very dissimilar galls, were in many cases really only the different forms which occur in alternate generations of the same, the insects and the galls they make resembling their grandparents and their galls, and not their immediate parents. For instance, the currant gall (Fig. B) produces an insect which, instead of piercing the male flowers of the oak, as its parents did, attacks the under sides of the leaves and deposits its eggs within them, the grubs from which cause the oak spangles (Fig. A, 3, 4). From these are produced, in spring, insects which, like their grandparents (and not their parents), attack the male blossoms of the oak, and thus the cycle of their transformation is completed. Another curious fact is that the generation which survives the winter consists entirely of females, or perhaps, to speak more correctly, I

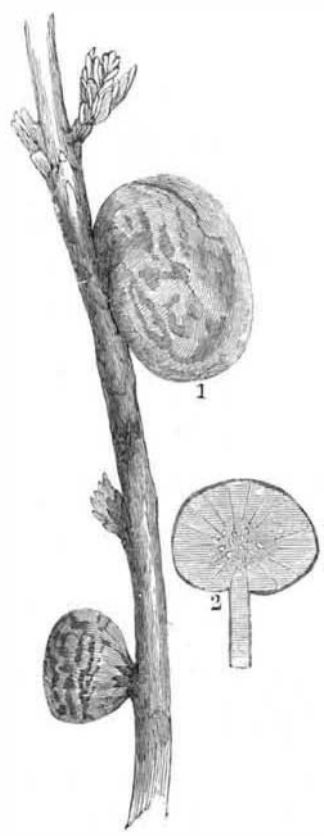


Fig. E.—Oak apple gall; 2, ditto, section.


Fig. F.—1, Marble galls; 2, ditto, section; 3, grub (magnified).

should say non-sexual individuals; I shall, however, for the sake of brevity, allude to them as females; while the generation bred from eggs laid in the spring is composed of both males and females.

The gall flies all resemble one another to a great extent, though different species, and even the alternate generations of the same, show marked difference in size, color, etc., their color varying from black to yellowish brown. The species (Fig. G) bred from the marble galls may be taken as an example of this insect. The grubs are scarcely to be distinguished from one another.

The female gall flies are each provided with a long ovipositor, which is hidden within their bodies when not in use. They are of a very curious and complicated construction (Fig. G, 4), and are composed of two plates, which form a kind of sheath, and the actual instrument which is used for piercing the buds, etc., and placing the eggs at the bottom of the perforations. This piercer is composed of three pieces, one stout, and deeply grooved longitudinally for the reception

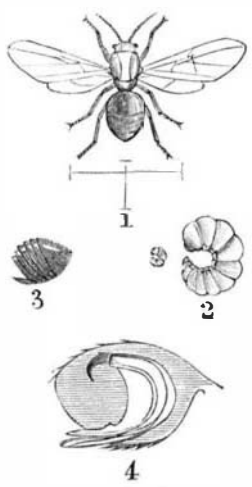


Fig. G.—1, Cynips kollari (magnified); 2, grub (magnified); 3, ditto, side view of body (magnified); 4, section of body (magnified).

of the others, which are hair-like and work within this channel, beyond which they can be protruded when in use. This apparatus has its origin at the back of the body, near the apex; it then passes in a curve toward the front, and afterward finds an aperture just below its point of origin. When the insect wishes to deposit its eggs, she (if it be a bud which she selects) settles upon it, and having carefully examined it with her antennæ, passes her ovipositor under one of the scales, and thrusts it, working the hair-like organs up and down, like saws, into the bud, until the position is reached which she wishes her eggs to occupy. This operation seems to require great exertion on the part of the insect. She then withdraws her ovipositor, deposits an egg

at the entrance, and pushes it to the bottom. The eggs are oval and have each a long stalk. The only practicable way of keeping these gall flies in check is to collect and destroy the galls before the insect leaves them, and in every way to promote the healthy growth of the trees. If the galls are gathered when quite young they need not be destroyed, as the grub will certainly die as the gall shrivels. Some kind of birds, such as titmice, are of great use, as they destroy the marble galls to obtain the grub which they contain, and the pheasants devour large numbers of the oak spangles when they fall with the leaves to the ground. One of the most abundant galls on the oak is

*The common oak spangle.* (Fig. A.) I have counted as many as 184 on one leaf; they are formed by an insect known as Spathegaster baccarum, which deposited its eggs within the leaf on the under side at the beginning of June.

The galls begin to form in July, and are fully formed in September, when they are about two-tenths of an inch in diameter, or somewhat larger. They are flat and circular, with the center raised in a flat cone; they are of a greenish yellow color, with tufts of short brown hairs; in the center is the grub, a soft, white, footless maggot, lying in a curved position, with its head and tail in close proximity. The insects lie dormant during the winter within the galls, and appear in the winged form in April or May. It is known as Neuroterus lenticularis; it is about one-eighth of an inch long, and of a reddish brown color; in this generation there are no males. The virgin females deposit their eggs in the buds containing the male flowers, or on the under sides of the leaves. These galls (Fig. B) when mature are round, like small balls, of a transparent green color, often streaked and speckled with red; they are of a moist, soft consistency, with a considerable hollow space in the center, in which is the grub. The galls formed on the male flowers are called Currant galls, from their resemblance to a bunch of currants. The gall flies from these emerge in June, and are of both sexes; the females attack the under sides of the oak leaves; when the grubs are hatched oak spangles begin to form; thus the cycle of their existence is completed. The other gall shown on the leaf with the oak spangle is formed by Spathegaster vesicatrix, a small species scarcely one-tenth of an inch in length, both sexes of which are found. The female deposits her eggs within the leaves, attacking the lower surface in June, and the galls which result are about one-tenth of an inch in diameter when fully grown. They much resemble a small somewhat conical button covered with silk threads, and are slightly depressed at the top. Under a low magnifying power one of these galls is a very beautiful object. The gall fly does not emerge from these galls until spring, when only females are found; these attack the under sides of the young leaves, which causes small galls, somewhat resembling the oak spangles; from these perfect insects of both sexes are bred in June, which are the parents of the grubs forming the button-like galls.

*The Oak root gall.*—Fig. C is formed by Andricus noduli, a small species scarcely one-tenth of an inch in length, of which both sexes are present. The females deposit their eggs within the roots, which are sufficiently near the surface for them to obtain access to. A large number of eggs are laid near one another, and no doubt two or more females often lay their eggs so close together that they form one gall. Dr. Adler has bred more than one thousand from one gall, and finds that each female lays about five hundred eggs. This habit of the females laying their eggs together may be accounted for by the difficulty they may have at times of gaining access to the roots except at a few points. The eggs are laid in August, and the gall begins to grow in September; but from the fall of the leaf until the spring it does not increase. In May it is full grown, but the gall flies do not emerge until the following April. The galls vary in size from about three quarters of an inch to three inches in diameter, and will be found to be full of small oval cells, each containing an insect. When young they are yellowish white with brownish spots, and are soft, like a potato; as they become older they harden, and are darker in color. The gall flies which issue from these galls are known as Aphilotrix radicis, and only females appear in this generation. They are much larger than their parents, measuring nearly a quarter of an inch in length; they leave the galls in April or May, and deposit their eggs in buds which will form young shoots. The presence of the grubs causes gouty swellings to form at the base of the young shoots round the grubs. This insect attains maturity and leaves the galls in August. This species, therefore, requires two years to complete the cycle of its transformation. Another very interesting gall is

*The Artichoke gall* (Fig. D), so called from its somewhat resembling in form a globe artichoke. This species is very common, and I have seen branches of a young oak nearly every bud on which was turned into one of these galls, which are formed by Andricus pilosus. Both sexes appear in June. The females deposit a single egg in each bud, which they select, causing them to grow into bunches of scaly bracts. On cutting open one of these galls (Fig. D, 2), when fully formed, the interior will be found of a woody texture, and that partly embedded in the top is a small, hard, brown, oval, striated gall, which contains the grub. This gall (Fig. D, 3) eventually falls to the ground, where the transformations of the insects are completed. In the woody portion of the outer gall may often be found cells containing grubs of some other species which has laid its eggs in the gall after its formation was begun. The perfect insects (Aphilotrix fecundatrix) bred from the internal galls are about one-eighth of an inch in length, and are always females. They appear in April, and attack the buds containing male flowers, within which their eggs are laid. The galls which result are oval, pointed, about one-tenth of an inch in length, covered with stiff hairs, and of a green color. The perfect insects, which are of both sexes, escape from the galls in June, and attack the leaf-buds, as already mentioned. One of the commonest and best known of the Oak galls is

*The Oak Apple* (Fig. E), which is often very abundant. It is a large gall, varying from ½ in. to 1½ in. in diameter, of a greenish white color, streaked and spotted with red. Its consistency when young is much that of an apple, but it hardens when it reaches maturity. When opened it is found to contain a great number of grubs, each within a separate cell. These galls are generally found at the end of a shoot, but are at times formed on the buds at the side. The perfect insects (Teras terminalis), of which there are both sexes, emerge from the galls in July. The males are winged, but the females are wingless, or have only rudimentary wings; they are about one-eighth inch in length. The females puncture the roots of the oak and deposit their eggs within them. The galls vary much in size; some are only the size of a pea, but many are much larger. The gall flies (Biorhiza aptera) bred from these are wingless and are all females, measuring from two-tenths to three-tenths of an inch in length. They leave the galls in December or January, and climb up the stems and usually select the terminal buds in which to lay their eggs. The galls (the oak apples) begin to form in April or the beginning of May, and are full grown in about a month.

*The common marble gall* (Fig. F) produces an insect known as Cynips Kollari, a large species measuring ¼ in. in length (Fig. G, 1), and is of a brownish color, the body being darker than the head, thorax, or legs. The history of this insect is not yet fully made out, only one generation, that without males, being known. Where these females lay their eggs is a mystery, and the insects which pierce the buds previous to the growth of the marble galls are not known. These galls may often be found in clusters, and are exceedingly common at times on young oaks. I have counted twenty-four on a small bough, about two feet long, composed of four shoots; one bore eight, the others six, four, and six each. The full grown galls vary in size from ½ in. to nearly 1 in. in diameter. When young they are green and soft, but afterward they become hard and brown. The grub occupies the center, and lies in a very curved position. Other grubs may often be found in the gall, but they are the progeny of some species which pierces the already formed gall. These galls about thirty years ago suddenly became very common, whereas hitherto it was hardly known, and for some time was called the Devonshire gall, from its having been first noticed in abundance in that county.—*G. S. S., in the Garden.*

### The Coming University.

The *Grocer's Bulletin* makes the following extracts from a recent lecture by Mr. James Parton, the historian:

"I have in my mind's eye," says Mr. Parton, "a glorious university, completely organized and equipped, to afford an education such as the future man will be given. It looks not at all like Oxford or Cambridge, nor even like Harvard. It looks more like a factory village situated in the midst of a finely cultivated farm of 1,000 acres, with beautiful gardens and parks, the whole the center of a thriving industry such as our factory villages might be, must be, shall and are just going to be, for man will not long be the submissive vassal that he is now. This university of mine shall have a chime of bells, which at 6 A.M. summons 2,000 men to rise and cast off cloth and put on workingmen's clothes and prepare for labor. At 7 they are in their different shops, workers in wood, in metals, in leather, in stone, in hemp, in cotton, in flax, in wool. For three hours they labor, being held to a strict account for the use or abuse of tools, material, and time. In summer a portion of each day is spent by all upon the land, so that they may have insight, some practical knowledge, of farming, of horses, of cattle, of the dairy, the garden, the orchard. At 10 all this is over, except in harvest and other periods of pressure. The chimes now send these workmen to their rooms, where they remove the dress and garments of manual labor, and come out to class and remain all day university students.

"Separated from the soil, man never yet has succeeded in thriving. At best, without it, he is a potted plant, and some of the pots are miserably small. I have visited many factories in New England, and I find that wherever the operatives have a reasonable chance at the soil, where every family can have a good sized garden, with access to pasture for a cow, the people are healthy, contented, and saving. Wherever this is the case, the factory population is able to live without actual starvation or extreme destitution in the event of the mills being closed for even a very long period. Whenever they are separated from the soil, as in some of our large cities, there is squalor, demoralization, and despair."

### The Beni River Rubber Region.

The recent extraordinary rise in the price of Para rubber, and the manifest need of a new source of supply for that valuable commodity beyond the control of the parties who have cornered the Brazilian supply, serve to bring to notice the promising rubber district explored by Mr. E. R. Heath in Bolivia, two years ago. An account of Mr. Heath's discoveries along the course of the Beni River to its junction with the river Mamore, one of the tributaries of the Amazon, was given in this paper about a year ago. We learn from the *World* that a full account of Mr. Heath's researches, geographical and scientific as well as commercial, will soon be published by the American Geographical Society and the Royal Geographical Society of England. He describes the Beni River as navigable by large steamers for a distance of 525 miles from its junction with the Mamore, and for 300 miles more by craft of less than three feet draught. The forests on both sides of the river are full of rubber trees, offering a supply of rubber "practically inexhaustible."

On the north side of the Beni River the forest extends from the water's edge over fifteen degrees of latitude. Mr. Heath penetrated this dense forest at one place as far as twenty-one miles from the river, and the further he went inland he found the rubber trees increase in size and number. Each square league contains from 300 to 5,000 trees. On the south side of the river the forest is only from three to ten miles wide, but it abounds in rubber trees.

The supply of rubber, Mr. Heath says, is sufficient to give employment to 100,000 men, and as soon as the chain of communication by steamer and railway is completed that number of men will soon be engaged in that field of labor. The rubber, though at present commanding only the same market price, is of a slightly finer quality than that obtained from the old-established districts between the falls and the mouth of the Madeira River and on the river Tapajoz and other tributaries of the Amazon near Para. It possesses other more important advantages over the older districts. The climate is healthy. There is an abundant supply of cheap labor at hand, the Indians obtained from the department of the Beni, who are practically slaves, working at from $3 to $4 a month, equivalent to from $2.40 to $3.20 in American money.

The abundant supply of palm-nuts, which are used in smoking the rubber—a necessary process previous to evaporation—enables the collectors to work ten months out of the twelve, instead of six, as in the other districts.

### The Best Door to Stop Fire.

A number of experiments have been made in this country to test the value of different materials for doors that may be exposed to fire, from which it appears that perhaps the best door yet devised is one made of wood and covered with tin. The door is formed of solid planks, or boards matched and fastened together and crossing at a right angle, or at forty-five degrees. There should not be less than two thicknesses in any door, and as many more should be used as the size of the opening to be closed demands. This solid wooden door is then to be completely covered on every side with tinned sheet-iron, all the joints being soldered as in making tin roofs. The tinned door is supported by hangers moving on an inclined rail or track over the doorway, so that when free to move it will close by its own weight. At the door-jamb opposite the door, when it is open, should be a wooden casing covered on every side with tin, and into which the door will fit tightly when it closes, by moving on its track, the inside of the casing being wedge-shaped. The casing on the opposite side must fit the door closely so as to leave no cracks at the sides of the door. To keep the door open a small bolt is placed on the inside of the door-jamb, the pressure of the door keeping the bolt in position. On the under side of the arch or top of the door is a wire having a joint or link in the center, this link being soldered with fusible metal that will melt at one hundred and sixty degrees Fahrenheit. Just above the bolt that holds the door open is a weight supported by a wire connected with the wire holding the fusible link. This weight moves in guides and is wedge-shaped below. The threshold of the door should be of brick or stone to resist fire, and high enough to keep out water in case the room is flooded. From the reports and experiments it appears that such a door is thoroughly reliable, the soft metal link parting even in the heat of a fire in a building on the opposite side of the street, and allowing the weight to fall, pushing the bolt one side and permitting the door to close. Such wooden tin-covered doors and window shutters are reported to stand unharmed through severe trials when iron doors have failed, melted, or warped under less exposure to fire. The door and the automatic device for closing it are officially recommended by some of the leading fire insurance companies of this country.—*Fireman's Journal.*

### Wood Pavement in Paris.

The Improved Wood Pavement Company was authorized about a year ago to lay down, as an experiment and at its own expense, a pavement of wood blocks in the Rue Montmartre and the Boulevard Poissonnière, two of the most crowded thoroughfares in Paris. The city engineers have reported so favorably respecting the new pavement that the municipal authorities have just given an order to the same company for the paving of the entire length of the roadway of the Champs Elysees, from the Place de la Concorde to the Rond Point. The preliminary works necessitated by the change have already been commenced, and the laying down the blocks will begin next month. It is expected to be entirely finished by March 1, and will be executed in longitudinal sections, so as to interfere as little as possible with the traffic of the finest roadway in Europe.

TWELVE hundred head of sheep sold in England lately for $16,850, the highest price on record at a large sale.