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### GALLS AND THEIR ARCHITECTS.

In the language of Naturalists, "galls" are all such deformations of living and growing plants, as are produced by one or more insects or other allied animals residing therein, and deriving their nourishment therefrom. For example, the common "nut-galls" of commerce, to be found in every druggist's store, and which are such an indispensable ingredient in all our writing-inks, are caused by an exotic species of Gall-fly (*Cynips*) attacking an exotic species of oak, as our common oak-apples (Fig. 78) are caused by an American Gall-fly, very similar to that shown in figure 81, but smaller, attacking an American oak. In the language of surgeons and butchers, the word "gall" has a very different meaning, being applied to the fluid otherwise known as bile which is contained in the gall-bladder. But with this use of the term we have now nothing to do.

Galls are of various sizes and colors, and of almost every conceivable shape. Some resemble a large rose, some have the appearance of a pine-cone (Fig. 82), some imitate the sprouts from a cabbage-stalk (Fig. 81), some look like a tomato (Fig. 89), some like a potato, some like an apple (Figs. 78 and Fig. 85 *a*), some like smaller fruits (Figs. 79, and Fig. 80 *a*), some like the garden flower known as Cockscomb (Fig. 87), and some like the veritable comb of a cock (Fig. 90). Some again are smooth, some wrinkled, some downy or hairy, a few so transparent that the living insect can be seen inside them, but most of them impervious to light. Some on the other hand are so fragile that they

can be readily crushed in a child's fingers, some so hard and woody that it requires a sharp knife to cut into them. Finally in color they are of various shades of green, yellow, crimson and brown, often prettily speckled and mottled, and in many cases they have as rosy a cheek as a peach.

"As bitter as gall" is a very common expression, but galls are by no means generally bitter. The nut-galls, indeed, of commerce are well-known to be so, and the Oak-plum Gall (Fig. 80, *a*), when green, seems to contain the very concentrated essence of quinine. But the great majority of these vegetable excrescences scarcely differ in flavor from the plant upon which they grow. This is the case, for example, with some fifty different kinds of galls that grow upon different species of oak. And yet the very same species of oak which when punctured by the Oak-plum Gall-fly (Fig. 81) produces from the cup of the acorn this intensely bitter gall, when punctured by a very similar fly belonging to the same genus (*Cynips q. sculpta*, Bassett) generates from the leaf a gall which looks for all the world like a grape, and which is as fleshy and juicy and as pleasantly acid as a partially ripe grape. Strange that two such closely allied insects should cause upon the very same plant such very different products!

Almost every part of a plant is specially attacked by gall-makers. Some confine themselves to the flower, some to the woody parts such as the twigs and larger branches, some to the roots, and a great number to the leaves. As a general rule, each gall-maker confines itself to its special part of the infested plant; but we have noticed several remarkable specimens where a certain gall-maker which habitually attacks the twig, forming thereon a closely-compacted series of galls, each of them about the size of a pea (the oak-fig gall of Fitch), "slopped over," so to speak, when it arrived at the terminal bud of the twig, so as to cause several galls to develop next year, not from the twig itself, but from one of the leaves at the tip of the twig. And yet, strange to say, these abnormal galls, generated by mistake upon a part of the plant where they had no business to

be, namely upon the leaf instead of upon the twig, differed in no respect from those that occurred upon the adjoining twig! So definitely are the form, size, color and texture of these singular productions determined by the insect that cause the abnormal growth on the infested plant, so little does it matter from what particular part of the plant the abnormal growth is developed! Neither does it make any difference, as a general rule, if the same species of gall-making insect operates upon distinct species of plants belonging to the same botanical genus. We have collected, for example, numerous instances where the same Gall-fly (*Cynips*) attacks distinct but allied species of oak, and yet produces galls that are entirely undistinguishable, no matter upon what species of oak they occur.\*

We are all of us so familiarized with one or more of the wonderful processes by which animal and vegetable organisms reproduce themselves, that it seems in no wise astonishing that a sheep, for example, should generate a sheep, a honey-bee a honey-bee, an oak an oak, and a cabbage a cabbage. In all such cases, however, an animal reproduces an animal, or a vegetable reproduces a vegetable, and the same species, whether animal or vegetable, reproduces an almost exact image of itself either in the next or in some subsequent generation. But in the case of galls, we have the very astonishing and otherwise unparalleled fact of two organisms, the one animal the other vegetable, cooperating together to generate a third organism, entirely different in all its characters from any thing that either of the two parent organisms is capable by itself of producing, and just as definite and invariable in shape, size, texture and color, as animal and vegetable productions that belong to the same species usually are. Take, for instance, a thousand "oak-apples" (Fig. 78) off black oak, and a thousand apples from an apple-tree. You will find that the former resemble each other, both externally and internally, quite as closely as do the latter. Yet to produce an apple all that is required is a living and growing apple-tree of sufficient age; while

\*See *Proc. Ent. Soc. Phila.* III, p. 630, note. The gall resembling the oak-bullet gall (*Q. globulus*, Fitch) which is there mentioned as occurring on Burr oak, has been since ascertained by us to be produced by a distinct species of Gall-fly from that which produces the oak-bullet gall. The gall itself has the same very remarkable internal structure, but differs externally in being somewhat rougher and in usually having a little nipple at its tip, whence we may call it the oak-nipple gall (*Q. mamma*). The fly, like that of the oak-bullet gall, occurs only in the female sex, but is distinguishable at once from that species by having antennae that are shorter, stouter, and 13-jointed instead of 14-jointed. It is also, on the average, about one-third larger, and has the tip of the ventral valve in a somewhat obtuse, instead of in a somewhat acute angle, but in other respects agrees very closely. Thirty-eight specimens, all females, came out from galls of the same year's growth Oct. 22 to Nov. 7. It may be called *Cynips q. mamma*, as it is an undescribed species.

to produce an "oak-apple" there is necessarily required the joint co-operation of a gall-fly and an oak, the first an animal, the second a vegetable organism; and if either the gall-fly or the oak were swept out of existence to-morrow, the oak-apple that they unite to produce would at the very same time cease to exist in this world.

The insects which are known to be the architects of galls are by no means an isolated group, but belong to several different Families in no less than five different Orders. They may be enumerated as follows: The Snout-beetles and the Long-horned Beetles (*Coleoptera*), the Saw-flies and the Gall-flies (*Hymenoptera*), the Tinea and Tortrix Families (*Lepidoptera*), the Flea-lice (*Psylla*), Plant-lice and Bark-lice (*Homoptera*), and the Gall-gnats and certain groups belonging to the great Musca Family (*Diptera*). In none of these Families is the gall-making faculty universal, and in not many of them is it general, but is on the contrary confined to particular species, the very same genus often containing certain species that make galls and certain others that do not.\* Besides the above gall-making Families, all of which are true Insects, many of the Mites (*Acarus* family), which are not true Insects, construct upon various trees galls of no very conspicuous size, shape or structure. (See *AMER. ENTOM.*, p. 57).

Galls originate in two distinct modes, either first, by the mother insect depositing one or more eggs in or on the part of the plant which she attacks, or second, by a young larva stationing itself upon a leaf or other part of a plant, and irritating its surface with the organs of its mouth, until a hollow is gradually formed which eventually becomes a more or less tightly closed sack, inside which the larva develops to maturity and propagates its species. In this latter case, which is peculiar to the Plant-lice, the Bark-lice and the Mites, young larvæ born within the gall frequently stray away through the partially open mouth of the enclosing sack, and found new galls the same season either upon the same or upon adjoining leaves. This is the rule with gall-making Bark-lice and Mites. But in galls made by Plant-lice, the entire brood of larvæ reared within the gall remain therein till they have most of them reached maturity and acquired wings. The gall then, by a beautiful provision of nature, gapes open to allow of their escape, usually at the mouth of the sack formed by the mother insect, but in certain cases in some other part of the sack.

It will thus be seen that this second mode of

\*As, for example, the genus *Nematus* among the Saw-flies and the genus *Cecidomyia* among the Gall-gnats.

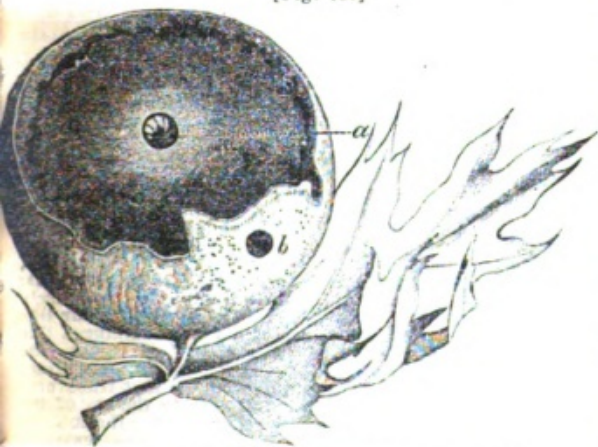
the formation of galls is the exception, and that the first mode, namely that when the mother insect deposits one or more eggs on or in the infested plant, is the rule. In the latter case, when but a single egg is deposited in one place, the larva that develops from that egg forms but a single cell, inside which it resides, as in Fig. 78 *a*. The gall is then technically said to be "monothalamous," i. e. one-celled. But whenever several eggs are deposited in one place, the larvæ developing therefrom inhabit several cells enclosed in a common envelope, as in Fig. 85, *b*. The gall is then said to be "polythalamous," i. e. many-celled. In the second group of galls, namely those made by Plant-lice, Mites, etc., the inhabitants of the gall, however numerous they may be, always reside promiscuously in the same large cell or hollow.

The number of galls formed by distinct species of insects or mites upon various plants in America is very great, and a large proportion of them are as yet undescribed and unknown to science. Of those that occur upon trees and shrubs, exclusively of herbaceous plants, we are ourselves acquainted with nearly two hundred different species, about a third part of which are undescribed. In the following paragraphs, we propose to give a brief account, illustrated by figures, of some of the more conspicuous ones out of the whole number, made by three different Families of insects, namely the Gall-flies, the Gall-gnats, and the Plant-lice.

#### Galls made by Gall-flies. (*Cynips*.)

THE TRUE "OAK APPLE," as it is popularly termed, (*Quercus spongifica*, Osten Sacken, Fig. 78) occurs exclusively upon the Black oak (*Quercus tinctoria*). It commences its growth in May, or as soon as the young leaves put forth,

[Fig. 78.]



Colors—Drab inside; yellowish-brown outside.

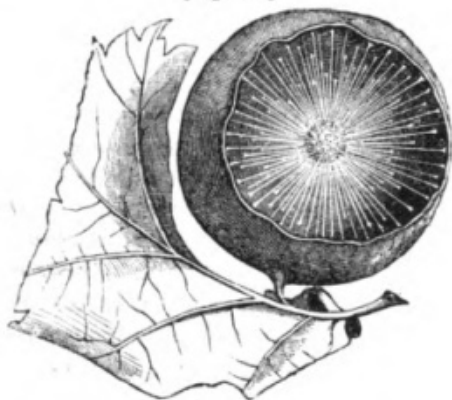
and reaches its full size in a few weeks. The central cell (Fig. 78 *a*) in which the larva re-

sides becomes eventually hard and woody, but the space between that cell and the external skin or rind of the gall is always completely filled by soft, drab, spongy matter. By the forepart or middle of June both male and female gall-flies (*Cynips q. spongifica* O. S.) eat their way out of a certain number—say about a fourth part—of these galls, having developed into the winged state from the larva in the central cell. The hole by which the fly makes its exit is shown at Fig. 78 *b*. The remaining larvæ lie dormant for more than two months, when they change into the pupa state, and subsequently about October eat their way out in the form of Gall-flies (*Cynips q. aciculata*, O. S.) closely allied to and yet quite distinct from those produced in June. Out of thousands of these autumnal flies examined by us, all were females with not a single male among them; and we have experimentally ascertained, by colonizing a number of these females upon isolated black oaks known to be not previously infested with oak-apples, that they cause oak-apples to be generated in the following spring upon such isolated Black Oaks. From Oak-apples produced in this manner we have bred two specimens of the spring form of Gall-fly (*q. spongifica*) which exists in both sexes, and five specimens of the autumnal form (*q. aciculata*) which exists exclusively in the female sex. Finally, treating these five autumnal specimens in the same manner, i. e. placing them upon another isolated Black Oak, we obtained galls in the following spring which produced two specimens of the spring form (*spongifica*), thus showing that the autumnal form sooner or later reverts to the spring form. Hence, as well as from other considerations, we may infer that the former is not a distinct species but a mere "dimorphous" female form of the latter; for otherwise, one form could not generate the other form. As to the supposed impossibility of females generating without any sexual intercourse with males, there are many species of insects where no males at all are known to exist.\*

\*That even with those species of insects where males are entirely unknown males may occasionally make their appearance, though perhaps only after the expiration of many years, we may infer, because there is a regular gradation from one extremity of the scale to another, 1st. In most insects the sexes are about equal in number. 2d. In other groups, as for example in many *Cynips*, the females are 4 or 5 times as numerous as the males. 3d. In the Cynipidous genus *Rhodites* the males are generally of extreme rarity. 4th. In the lepidopterous *Psyche helix*, as we are assured by Dr. Hagen, out of thousands of specimens bred within the last ten years by Prof. Siebold, all were females; but in 1857 the male was discovered to occur, but in very small numbers, by Prof. Clauss. 5th. Dr. Hartig long ago bred from the gall thousands of females of *Cynips folii*, and nine or ten thousand females of *Cynips divisa*, without a single male among them; and we have ourselves bred about two thousand females of *Cynips q. punctata*, Bassett (= *C. q. podagra*, Walsh) from the gall without being able to discover on the closest examination a single male in the number.

THE BASTARD OAK-APPLE (*Q. inanis*, Osten Sacken, Fig. 79), matures like the preceding in June, but is found exclusively upon the Red Oak (*quercus rubra*). It differs from the preceding in never reaching so large a size, in the central cell not being woody, but consisting of a mere shell which can be readily broken with the thumb-nail, and in its being only connected with the external rind by slender radiating filaments. Males and females (*Cynips q. inanis*, O. S.) absolutely undistinguishable from the

[Fig. 79.]

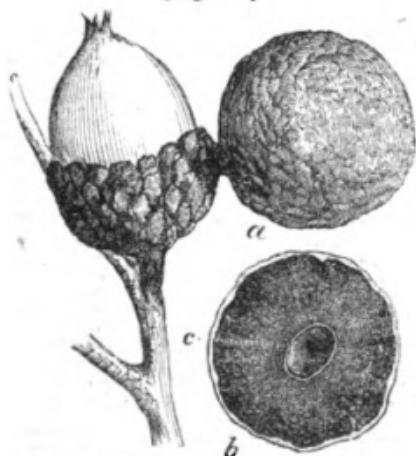


Color—Drab.

spring form of the preceding are attainable from this gall in June; but after repeated trials we have never succeeded in breeding from it a single autumnal female, and we do not believe that any such form exists in this species. Hence, and also in consequence of the very great dissimilarity of the galls, and their always growing upon distinct species of oak, we are compelled to consider these two gall-flies as distinct species, although when placed side by side the forms generated in the spring are exactly like each other.

THE OAK-PLUM GALL\* (Fig. 80 a) is remark-

[Fig. 80.]

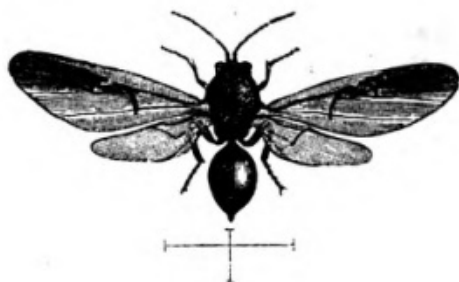


Color—Mottled with yellow and crimson.

\* First described by the senior Editor under the name of *Quercus prunus* in *Proc. Ent. Soc. Phil.* III p. 639, note. ]

able for being the only American gall that is known to grow out of the acorn. It occurs indiscriminately upon Black and Red Oak, reaching maturity in August and September. At that period it is solid but fleshy, and when cut into is of a pink color inside shading into yellow towards the middle. Subsequently, as it dries, it becomes so hard as to be cut with difficulty,

[Fig. 81.]



Color—Black.

its color inside changing, first to blood-red and afterwards to brown. The insect that produces this gall (*Cynips q. prunus*, new species, Fig. 81), makes its appearance in April, and is remarkable for lying two years in the gall before it eats its way out, remaining in the larva state for over a year; indeed some of them remain in the larva state for over two years, and do not eat their way out until the end of the third year.\* Figure 80, b, shows this same gall when cut open, and figure 80, c, the central cell inhabited by the larva.

\* These galls were found fully matured and in large numbers in August and September, 1864. In December, 1864, and in April, May, June and July, 1865, the insect was still in the larva state. In October, 1865, out of 28 galls that were cut open, 15 contained the larva, and 13 the perfect gall-fly. Of these larvæ 12 were re-enclosed in their galls. In April and September, 1866, they were still in the larva state, and it was not till April 12, 1867, that a single-winged fly ate its way out of a gall. On cutting into the gall from which it had emerged, the cell was found half full of excrement, showing that the larva had "fed up" since 1865. We annex a description of the perfect fly produced from this gall, as the species is new to science.

CYNIPS Q. PRUNUS, H. SP. ♀ Black. Head rather coarsely rugoso-punctate; face pubescent; antennæ rather more than half as long as the body, 13-jointed, joint 13 equal in length to joints 11 and 12 put together. Thorax opaquely and coarsely rugoso-punctate, not so coarsely as in *C. q. spongifica*, but very much more so than in *C. q. globulus*; dorsal groove only extending one-third of the way to the scutel, and the parallel carinae on each side of it only one-half way to the scutel. Scutellar fovea very large and deep, highly polished and separated only by an acute and lofty carina. Abdomen with the large or second joint polished, and with some sparse, rather large, shallow punctures upon its basal three-fourths; its terminal one-fourth, except the extreme edge, so densely covered with small confluent punctures as to appear like virgin silver. The whole of joints 3-7 sculptured like the terminal one-fourth of joint 2. Legs rufous, the coxæ, trochanters and tarsal tips black. Wings subhyaline, with a dark brown cloud extending from the first transverse vein over the areolet and the radial area to the tip of the wing. Veins all brown and distinct, but neither the subcostal, radial, cubital, nor anal veins attaining the exterior margin. Length ♀ 0.20-0.30 inch. Expanse 0.47-0.63 inch.

Described from 11 ♀ specimens; ♂ unknown. Differs from all described N. A. species by the beautifully opaque punctation, entirely unaccompanied by any pubescence, of the tip of the abdomen.

Galls made by Gall-gnats (*Cecidomyia*).

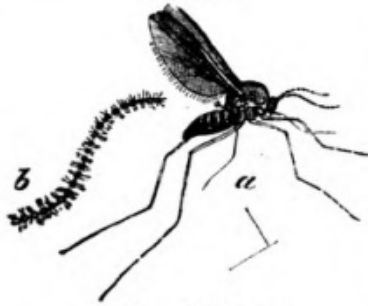


[Fig. 82.]

Color—Glaucous white.

THE PINE-CONE WILLOW-GALL (*Strobiloides*, Osten Sacken), Fig. 82.—This gall grows, often in the most profuse abundance, on the tip of the twig of the Heart-leaved Willow (*Salix cordata*), single bushes sometimes bearing over a hundred galls, but never more than one gall being found upon one twig. The gall-gnat that produces it (Fig. 83) appears in April or early in

[Fig. 83.]



Colors—Blackish.

May, and the gall commences its growth shortly afterwards, and is full sized by the middle of July.

When young and immature it is spherical and enveloped in a dense mass of foliage, which gradually falls off towards the autumn, and by November the twig on which

it grows, if small, is already killed for an inch or two downwards. At this date the larva may be found embedded in the very heart of the gall, and enclosed in a delicate membranous cocoon, somewhat of the texture of gold-beaters' skin, and thrice as long as the larva itself. In this cocoon it reposes without eating anything until the following spring, when it changes into the pupa, and shortly afterwards bursts the pupa-shell and escapes in the perfect or winged state. The gall itself is manifestly nothing but a deformed and enlarged bud; for leaf after leaf may be peeled away from it any time in the winter, as you would strip the leaves from a cabbage one after the other, until finally the larva that is quietly reposing in the very heart of the bud becomes exposed to view. It is remarkable that, although the leaves of the Heart-leaved Willow are always sharply toothed on their edges, those of the gall that grows upon it are never toothed at all.

There is a species of green Catydid inhabiting Willows, which is peculiarly addicted to depositing its elongate cylindrical eggs, for safe keeping through the winter, under the scales of this gall, as many as seventy-one of its eggs having been counted in a single gall. In the spring these eggs hatch out, and the young larvæ leave the dry galls, and disperse themselves in various directions for the purpose of obtaining green

food. There is also a very minute Guest Gall-gnat (*Cecidomyia alborittata*, Walsh), scarcely one-third as large as the species (Fig. 83) that makes the gall, but otherwise very much of the same appearance, which deposits its eggs in the same situation. The larvæ, however, that hatch out from these eggs, instead of leaving the gall, as do those of the Catydid just now referred to, remain in it till they have reached maturity, deriving their entire subsistence from the sap that they manage to extract from its leaves. In two galls, each containing of course but a single gall-making larva, we have counted as many as forty-one of these guest larvæ full fed and mature; and what is singular, numerous as the guests often are, they never seem to interfere in any degree with the health and prosperity of their host, by cutting off his due supply of sap or otherwise interfering with his domestic arrangements. With such exuberant profusion has Nature provided for the multiplication of life and happiness, and so carefully has she managed that, whether in the animal or in the vegetable kingdom, nothing shall go to waste, nothing be lost, nothing be created in vain!

THE CABBAGE-SPROUT WILLOW-GALL (*Salicis brassicoides*, Walsh). Fig. 84. Unlike the preceding, this gall is social in its location, as many

[Fig. 84.]



Color—Green.

as a dozen of them sometimes growing from a single twig, like the sprouts on a cabbage-stalk. It differs from that species also in not being confined to the extreme tip of a twig, but more usually taking its origin from the side of a twig or small branch. Furthermore, it is always found exclusively upon the Long-leaved Willow (*Salix longifolia*), and we have several times noticed bushes of this and of the Heart-leaved Willow that is inhabited by

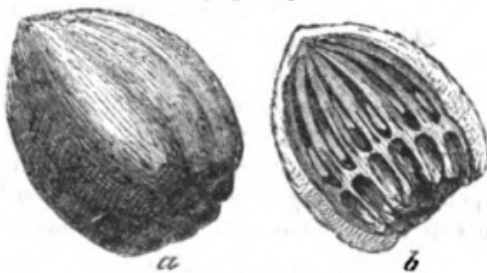
the Pine-cone Gall, promiscuously intermingled and each bearing its peculiar gall alone, and never that which is appropriate to its neighbor.

Fundamentally, the structure of the Cabbage-sprout Gall is the same as that of the Pine-cone Gall, but, as will be seen at once from the figure, it differs from that species in the leaves being more open and less deformed from their normal shape, and also in their retaining their natural green color instead of being covered with glaucous

cous-white pubescence. The larva resides in the very heart of the gall, as with the other species, but instead of the cocoon being thrice as long as the body of the larva, it is scarcely at all longer, and fits so closely that it is not a very easy matter to remove it. In these two species, the larva and pupa of one are absolutely undistinguishable from those of the other, and the perfect flies resemble one another so closely that the same figure answers equally well for both. Their transformations also take place in the same manner and very nearly at the same time; and the galls attain their full growth in the same month of July.

THE GRAPE-VINE APPLE-GALL, (*Vitis pomum*, new species,) Fig. 85 a.—In No. 2, page 28, and No. 3, page 54, of the AMERICAN ENTOMOLOGIST, we referred to a "vegetable phenomenon" said to be found in Virginia, in the form of an apple-like growth from a grape-vine. The prevailing opinion in that State seemed to be, that it was a kind of hybrid fruit formed by the union of a grape blossom with an apple blossom. But we intimated our opinion at the time, that it was no fruit at all, but simply a gall produced by some unknown species of gall gnat. We have since received specimens of what is undoubtedly the same thing, from two different sources, first from Mr. B. L. Kingsbury of Alton, Illinois, and second through the kindness of Mr. Stauffer, of Pennsylvania, from Thos. Meehan, the well known editor of the *Gardeners' Monthly*. Mr. Stauffer has also favored us with a good colored figure of one that he cut from the wild Frost Grape (*Vitis cordifolia*), August 9th, 1859, which agrees perfectly well with the two specimens in our possession. Hence, after carefully examining these specimens, we can now announce with certainty that this "vegetable phenomenon" is really what we originally inferred it to be—namely, a gall made by a gall gnat. Fig. 85 a, will give the reader

[Fig. 85.]



Colors—(a) green, (b) yellow.

a very good idea of this gall, and Fig. 85, b, of its internal structure, showing the larvæ that inhabit its numerous cells, a single larva in a single cell. All the galls that we have hitherto

been treating of, have been what are technically termed "monothalamous" or "one-celled" galls, inhabited by a single gall-making larva. But this, as will be seen at once, is a "polythalamous" or many-celled gall, inhabited by a great number of gall-making larvæ.

As the fly that generates this gall will, in all probability, not make its appearance until next spring or summer, and as we have consequently had, as yet, no opportunity to breed it; it may be very reasonably asked, how we know for certain that it will turn out to be some kind of Gall-gnat (*Cecidomyia*)? We answer that the larvæ of all Gall-gnats are distinguishable at once from other larvæ by a peculiar process known as the "breast-bone," and located on the lower surface of the first joint of the breast. (See Fig. 86, c.) Usually this "breast-bone" is of so dark a color that it can be readily seen, even in a very small larva, and its use apparently is to abrade the surface upon which the larva lives and thereby cause an abnormal flow of sap, which forms the food of the little insect that is thus working for its living. In Figure 86, c, the head of the larva is shown protruded; but all this group of larvæ have the power of retracting the head within the body, so as to bring the "breast-bone" well into play. In shape, this organ differs greatly, being sometimes what we have called "clove-shaped," as in Fig. 86, c, sometimes Y-shaped, as with the larvæ of the two Willow-galls figured above, and sometimes of other allied shapes. But in every case there are several sharp prongs in front of it, adapted for wounding and piercing. As a general rule, allied gall-gnats inhabiting the same genus of plants have larvæ with "breast-bones" of the same, or a very similar shape. For example, that of the larva to be next described is absolutely undistinguishable from that of our larva; and so is that of the larva of the Pine-cone gall from that of the larva of the Cabbage-sprout gall.\*

THE GRAPE-VINE FILBERT-GALL (*Vitis coryloides*, new species).—We have met with one or

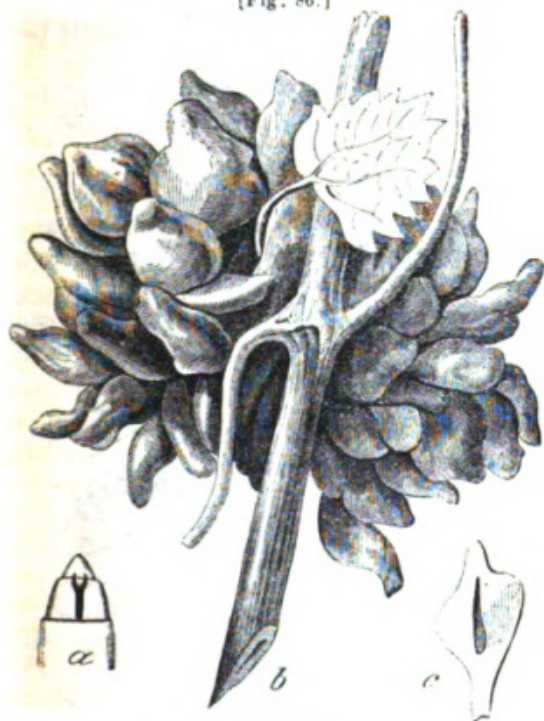
\*For the satisfaction of the scientific reader, we annex descriptions of the above gall and of its larva, drawn up from the Alton specimen.

GALL *VITIS POMUM*.—A smooth, globular, fleshy, grass-green gall, 0.90 inch in diameter, attached by a rough base of about 0.40 inch in diameter, like the base of a hazelnut, to the cane of the grape-vine. Its external surface with about eight or nine longitudinal striae, dividing it into eight or nine segments, like those of a watermelon. Internally fleshy and of the consistence of the hull of a walnut for one-eighth of its diameter; then a series of elongated cells, divided each into two cells by a regular series of transverse partitions, the lower tier about 0.2 inch, the upper tier about 0.3 inch long. From center of one cell to that of the adjoining cell is nearly 0.1 inch, and there are seven or eight cells side by side.

LARVA.—Bright yellow, of the normal shape. Breast-bone chestnut-brown, clove-shaped, the stem of the clove about 2½ times as long as one of the anterior prongs; tip of the anal joint ventrally with two transversely arranged slender brown spines, directed upwards and backwards, above which on the dorsal tip is a tubercle. Probably jumps by taking its tail in its mouth, and if so belongs to the subgenus *Diplosis*.

two small specimens of this gall growing upon the cane of the wild Frost Grape in Illinois; and we were presented with two very large specimens by Mr. Mills of Rock Island, Ill., which had grown upon a Frost Grape planted in his dooryard, from one of which the annexed drawing is copied (Fig. 86). The whole mass of galls springs from a common centre at the point

[Fig. 86.]



Color—Green.

where a bud would normally be, and is evidently a mere deformation of a bud. Occasionally an undeformed leaf with its peduncle still entire puts forth from the common centre, sometimes bearing a couple of galls at the junction of the peduncle with the leaf. Each gall is one-celled, the cell being about a quarter of an inch long and one-fourth as wide as long, and containing a single larva. (See Fig. 86, b). The larva closely resembles that of the Grape-vine Apple-gall, and is therefore no doubt that of some Gall-gnat. Large sized specimens of this gall bear a general resemblance to a bunch of filbert or hazel nuts, as they grow on the bush: hence the name that we have given it. Fuller details will be found in the foot-note.\*

\* GALL VITIS CORYLOIDES, N. Sp. On the cane of *Vitis cordifolia*.—A roundish mass,  $1\frac{1}{2}$  to  $2\frac{1}{2}$  inches in diameter, of from 10 to 50 opaque, wooly-pubescent, fusiform, or sometimes flattish-oval, green galls, each from 0.50 to 0.75 inch long, the whole springing from the point where normally a bud would be located. Generally it is only the terminal  $\frac{1}{2}$  of each gall that is pubescent, the basal  $\frac{1}{2}$  being smooth. The interior of each gall is fleshy, juicy and subacid, with a single longitudinally central cell 0.25 inch long and 0.06 inch in diameter.

LARVA.—Orange-yellow, with the disk of the dorsum paler. Breast-bone as in the preceding. Length 0.11-0.14 inch.

### Galls made by Plant-lice (*Aphidæ*).

The galls hitherto referred to have been those which are formed by the mother insect depositing one or more eggs in or on the tissues of the plant which she infests. Those to be now treated of belong to the second or exceptional group, which are formed by a young larva stationing itself externally upon some particular part of the infested plant, usually the leaf, and causing that part to bulge out into a sack, which finally closes at its mouth and shuts up the larva in a kind of prison of its own making. We see the abortive beginnings of this process in the case of many species of Plant-lice and of Mites; for example the common Currant Plant-louse (*Aphis ribis*), and sundry Mites that attack the leaves of oaks. For here, although the leaf bulges out into a capacious hollow inhabited by the leaf-feeders, yet the hollow never, under any circumstances, closes at its mouth into a true sack-like gall.

[Fig. 87.]



Color—Green.

—THE VAGABOND GALL (*Populi vagabunda*, Walsh), Fig. 87.—This gall occurs in particular years in prodigious abundance on the tips of the twigs of certain Cottonwoods, but in other years there is not one to be found in the same district. The old blackened galls, however, hang on to the twigs for several seasons, giving the tree a singular appearance when the leaves are off in the winter time. The fly was discovered and described before it was known to inhabit any gall, and received its name from the habit that it has of wandering to very great distances in its native forests.\* It may be called the Vagabond Plant-louse (*Pemphigus vagabundus*, Walsh), and is represented in Fig. 88.

\* See *Proc. Ent. Soc., Phil.*, I, p. 306, where the fly is described, and II, p. 462, where the gall is described. As to the generic determination of this Plant-louse, see *Ibid* VI., p. 280, note.

[Fig. 88.]

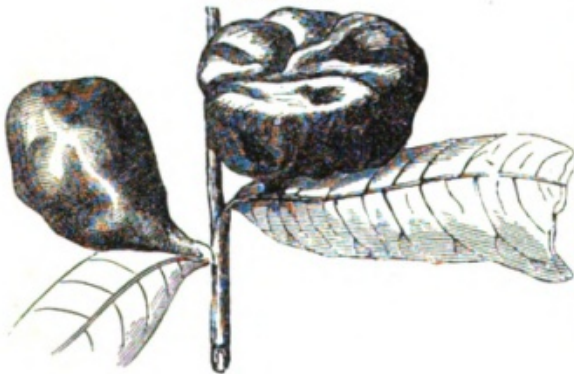


Color—Black.

It makes its appearance in the winged state in September, and early in the following summer the green and shining hollow gall, with its skin as thin as that of a capsicum, may be discovered almost full grown upon cottonwoods, and occasionally upon balsam poplars. At this period there is always found a single wingless Plant-louse inside it, which has by her sole exertions caused the growth of the gall, and which will subsequently give birth inside it to a very large and flourishing family of young Plant-lice, all of which will eventually acquire wings and leave the gall in the ensuing September.

THE SUMAC-GALL (*Rhois*, Fitch), Fig. 89.—This tomato-like gall occurs on the leaves both of the Smooth Sumac (*Rhus glabra*) and the Stag-horn Sumac (*Rhus typhina*), and in the States both of Illinois and New York. Like the preceding, its shell or skin is quite thin, and the winged flies are found inside it in prodigious

[Fig. 89.]



Color—Greenish yellow, with a rosy cheek.

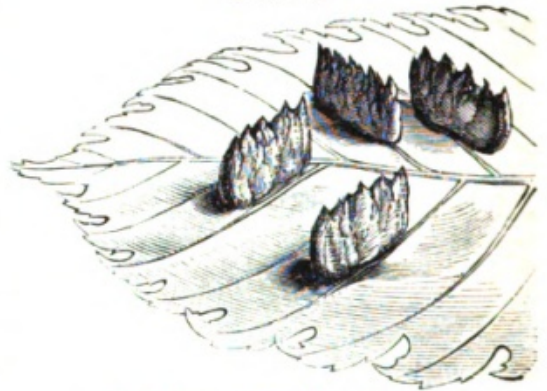
numbers in September. Early in the spring, as we have been informed by Dr. Wm. Manlius Smith, of Manlius, N. Y., each gall contains but a single wingless mother-louse in company with numerous larvæ. The winged fly has the veins of its wings arranged in the same pattern as those of the preceding species (Fig. 88), but differs in having four-jointed instead of six-jointed antennæ. It is also a very much smaller insect.

It is remarkable that there are two Chinese, one Japanese, and one Indian gall, growing upon different species of exotic Sumacs, and apparently analogous in their structure to our American Sumac-gall. They are described as

being, some of them like a radish-pod, some like an ox-horn and over two inches long, and some branched like a stag's horn. One of these Chinese Sumac-galls, which is not uncommonly to be met with in drug stores, is shaped much like ours, but has a much tougher and thicker rind. On breaking a specimen open, we found it to be filled with infinite numbers of plant lice, having wings exactly like those of our insect, being of the very same size, and apparently belonging to the very same genus. Thus we see, that even on the opposite sides of the globe, analogous galls are made on analogous plants by analogous insects.\*

THE COCKSCOMB ELM-GALL (*Umicola*, Fitch), Fig. 90.—This species has a much thicker and more fleshy rind than the two preceding. Young White Elms often have their leaves so densely covered by these galls that you can scarcely see the leaf for the galls. After trees

[Fig. 90.]



Color—Green, often with a red cheek.

get to be about twenty-five feet high the gall-making insect ceases to trouble them; and the younger the trees the more apt they are to be infested. The Plant-louse that produces these galls is exceedingly minute, and differs in the veining of its wings from figure 70, c, (p. 82), in the hind wing having but a single branch vein, the front wings corresponding in every respect. It is, however, remarkable for holding its wings, when in repose, horizontally on its back, instead of carrying them steeply roofed, as is the case with almost all the other genera of Plant-lice. Early in the spring but a single wingless mother-louse is to be found in a single gall; but in a short time she gives birth to hundreds of very minute and wingless young larvæ. By the end of June or the beginning of July, the gall becomes full of winged plant lice, when the slit on the under side of the leaf, through which the mother plant-louse built up the gall early in

\* For further details on this subject see *Proc. Ent. Soc., Phil.*, VI., pp. 281-2, notes.



the spring, gapes open and allows the insects to escape into the open air. When White Elms are planted as shade trees in large numbers in the neighborhood of houses, and become badly infested by these galls, the winged flies that are generated in such myriads in the middle of summer often become a very serious nuisance. Hence it is worth while for us to learn, that when such trees become large they will cease to be attacked in such manner.\*

There may probably be some of our readers who may be desirous of breeding the gall-making insects from the galls figured above, or from such other galls as they may have themselves discovered upon other plants. We would caution all such persons not to be deceived by a very common phenomenon. Besides the true gall-maker, they will obtain from almost every gall, one or two, and sometimes one or two dozen perfectly distinct insects. These will belong to two different groups, and it will sometimes require some considerable knowledge of entomology to distinguish them from the veritable authors of the gall that is being experimented upon. The groups above referred to may be catalogued as follows:

1st. Guest-insects, sometimes very closely allied to the gall-maker, sometimes as different as it is possible to conceive. We have already, under the head of the Pine-cone Willow-gall, referred to a small Guest Gall-gnat which dwells under the leaves of the Gall, without interfering in any way with the health or prosperity of the much larger Gall-gnat, that makes the gall and lives in the very centre of it. So again in the case of the Oak-apple of the Black Oak (Fig. 78). There is a minute Gall-fly (*Syaergerus lariventris*, Osten Sacken) which is occasionally found in considerable numbers in little cells located immediately under the external rind of this Oak-apple, where it lives in the larva state upon the substance of the gall, without troubling, in any

wise, the much larger tenant of the central cell that is the real gall-maker. From these little cells it escapes early in the summer through small pin-holes, each of which opens into one of the external cells; whereas the large hole (Fig. 78, *b*), through which the gall-maker escapes, may be always traced to the central cell. In both the above two cases the Guest-fly does not molest the Gall-maker; and this is the more general rule. But in certain other cases the larva of the Guest-fly, instead of living in a house of his own, makes his way to the house of the gall-making larva, and after having destroyed him, takes possession of his tenement. For example, there is a large undescribed Guest Gall-gnat\* which, as we have clearly ascertained, treats the author of the Oak-plum gall (Fig. 80, *a*), in this scurvy manner; and an allied species (*Syaergerus oneratus*) operates in the same way upon the Gall-making larva of the Oak-bullet gall (*Q. globulus*, Fitch). Still, even in such extreme cases as these, the Guest-fly does not cease to be a vegetable-feeder and a true Guest; for it is only incidentally, and for the sake of monopolizing the supply of vegetable food, that he destroys the gall-maker. Whereas, parasitic larvae feed exclusively upon the bodies of their victims, and make no use whatever of vegetable food.

2nd. Parasitic insects. These are usually quite distinct from the insects they infest, and are much more numerous, both in the number of distinct species and in the number of individuals belonging to each species, than the Guest-insects. There are certain species that peculiarly attack the Guest insects, and certain others that confine themselves to the Gall-makers, and it is often difficult to decide to which of the two groups they should be properly referred. Parasites belong to a great variety of different Families; but those that infest galls made by Gall-flies (*Cynips*) and Gall-gnats (*Cecidomyia*) most of them appertain to the great *Chalcis* family. For instance, there are three very distinct *Chalcis*-flies, the larvæ of which prey indifferently upon the gall-making larvæ of the two kinds of Oak-apples figured above (Figs. 78 and 79), and may often be found in the central cell of the gall. The first of these lives inside the body of its victim, as is the more usual practice with parasites, and produces a black and yellow fly (*Decaloma*) with a large black patch on its glassy wings. The second attaches itself externally to the body of its victim, and produces a beautiful bright metallic green fly (*Callinome*) with uniformly

\*The Red Elm, or Slippery Elm, as we have ascertained by close and long-continued observation, never bears these cockscorn-like galls. But there is occasionally found upon the upper face of its leaves in small numbers, a solitary gall with quite a thin rind, about an inch long, shaped much like one of those depicted in figure 80, and hitherto undescribed. It is made by a species of plant louse belonging to the same genus (*Pemphigus*) as Fig. 88. In Europe a well known elm-gall (*Ulm*) is made by another genus of Plant-lice (*Byrsocysta*, Haliday=*Tetraneura*, Hartig). So that on the same genus of trees, the Elm, we have three distinct galls made by three distinct genera of plant-lice; the more general rule being that the same genus of gall-makers attacks the same genus of plants. The above described gall on the Red Elm, which we may call the spindle-shaped Elm-gall (*Ulm fusus*), was first brought to our notice by Dr. W. M. Smith of N. Y.; but we have since found several specimens in South Illinois. The winged insect (*Pemphigus ulmi-fusae*, n. sp.), which only measures 0.07 inch to the tips of the wings, and is of a uniform dusky color, occurred July 11th. Out of 28 specimens, two have both wings, and one a single wing veined precisely like those of *Leucostoma* (Fig. 70, c, p. 82)—thus affording a practical exemplification of how one genus of Plant-lice may gradually in the course of indefinite ages merge into another.

\*Larger and darker than *Syaergerus oneratus* Fitch, and distinguishable at once from that species by the antennæ ♀ as well as ♂ being 15-jointed instead of 14-jointed.

glassy wings, and the female with a tail-like ovipositor almost as long as her body. The third is much smaller than the other two, and instead of a single parasite attacking a single victim, as is the rule with those two, eight or ten of them may often be found inside the almost empty skin of the poor gall-making larva. This last parasitic larva produces a small uniformly black fly with uniformly glassy wings (*Pteromalus*); and what is remarkable, they lie in a little bunch in the larva state inside the central cell of the gall all through the winter, and do not emerge in the winged form until the following spring; whereas, the other two species make their appearance in the winged state the very same summer that the gall is generated. Besides the above three *Chalcis*-flies, which occur in large numbers, we have also bred from the Oak-apple of the Black Oak, a single small *Ichneumon*-fly (*Bracon*), which is probably parasitic on the larva of a small moth (*Glechia gallagenitella*, Clemens) occasionally found as a Guest in that as well as in two other galls.

As to the other galls figured above, we have only space to say that the Plant-lice of the Elm-gall are extensively preyed upon by a small six-legged larva, with white cottony filaments growing out of his back, which produces a brown Lady-bird with a red tail (*Scymnus hæmorrhous*, Lec.); and that the Plant-lice of the Sumac gall are, in the State of New York, infested by the larva of a Syrphus fly, somewhat similar to that figured on page 83, of which we have succeeded in breeding two individuals to the perfect fly state. For specimens of these larvæ we have been indebted to Dr. W. M. Smith, of New York; and according to Dr. Le Baron, the fly belongs to the same genus (*Pipiza*) as that just now referred to, and is also like that insect, a new and hitherto undescribed species.

#### THE BOGUS COLORADO POTATO-BUG.

(*Doryphora juncta*, Germar.)

In a recent article we expressed our opinion that this insect could not live upon the potato vine, although it feeds naturally upon the closely allied horse-nettle. Mr. W. Julich, of New York, writes us word that at Newport News, in the neighborhood of Fortress Monroe, Va., he has seen thousands of this insect upon the horse-nettle, but never seen a single larva upon certain potato vines which grew in the immediate neighborhood, though he had occasionally observed the perfect beetle sitting upon, but not feeding on, these potato vines.

#### ANTS AND APHIDES.

We often see it stated in the papers that there is a species of insect called *Aphis*, that produces a honey-like substance, which is fed upon by ants.

Also, that another family of these *Aphides* are domesticated by the ants, and live with them in the ground.

If there is any truth in these stories will you please inform me through your paper, and also whether this honey-like substance is the excrement, or some peculiar provision of nature. Also, whether the *Aphides* are common among all species of ants. W. BATCHELOR.

Waverly, Pa.

The Plant-lice belonging to certain genera, almost invariably secrete a fluid resembling honey in sweetness. It issues in limpid drops not only from the end of the abdomen, but from two "honey tubes" which are placed, one on each side, just above it. The beaks of these Plant-lice are continually employed to pump up the juices of the plants which they attack, and these juices, after passing through their systems, are exuded as described above, and bear therefore some relation to excrement, being in fact little else but the feces of the lice. Ants are very fond of this sweet liquid, and may always be found amongst those aphides which secrete it, though the latter are not necessarily "common among all species of ants." For example, it has been shown by Dr. Fitch that no ants ever haunt the Grain Plant-lice (*Aphis avenæ*, Fabr.), which in certain years and certain districts does so much damage to our crops of small grain. But although this species of Plant-lice has full-sized honey-tubes, it does not appear that it ever exudes any honey-dew; which fully accounts for the ants not visiting them. As to those species of Plant-lice that, as you correctly phrase it, "are domesticated by the ants and live with them in the ground," they mostly belong to a genus (*Pemphigus*) which you will find figured on page 82 (Fig. 71), and which, unlike the genus *Aphis*, has no honey-tubes at all. Why, then, you will ask, should the ants domesticate them, seeing that these Plant-lice secrete no honey-dew? They do it for the sake of the sugary matter which is exuded from the bodies of these Plant-lice in the form of a whitish cottony substance; and we have ascertained that they often bring these sugar-producing lice home to their nests from the roots of certain plants, and keep the sugar-producers there till after a few hours a sufficient crop of the coveted dainty has been elaborated and harvested. After which they carry the Plant-lice back to the roots whence the due supply of sap is derived, just as a dairyman, after milking his cows, drives them back to pasture to elaborate a fresh supply of milk from the herbage that they find there.—Eds.]