

## CYNIPID GALLS OF THE CHICAGO AREA.

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The cynipid fauna of the Chicago area is probably better known than that of any other American locality. For this reason it seems desirable to collect the descriptions of the galls of this area from the scattered technical literature that they may be available for the use of biology teachers not only in this area but in all northern Illinois, Indiana and Ohio as well as southern Wisconsin and Michigan. In this field lies much readily accessible illustrative material for biology teaching and any number of original problems in the working out of life histories and the interrelationships of the many various species sometimes associated in a gall. These descriptions have been considerably condensed and grouped first by host plants and then by part of plant affected and it is hoped that this may serve as a means for the determination of the galls of this area. How successful it may be in accomplishing this purpose only time and its continued use in the field can tell. To make it as complete as possible several galls are included which have not as yet been determined or reared and which are probably undescribed. Field observation will no doubt find still other kinds and add other hosts to those already known.

For the beginner in the study of insect galls it may be well to state that this treats only of the galls made by the true gallflies, or the family Cynipidae of the order Hymenoptera, whose galls are principally on oak but some occur on roses and a few other plants in the rose family and a few on various composites as will be seen in detail later, the record of the one reported on *Smilax* being questionable. These hosts often bear at the same time galls made by other agents e. g. by mites, aphids, psyllas, gall midges, trypetid flies or moths and some field experience will be necessary before one can assign the maker of the gall to its proper group. In general however the Cynipid galls may be recognized by being closed in every case and containing white, non-hairy larvae of characteristic shape soon learned by experience.

From a collection of galls from the field and placed in rearing, insects belonging to one or more of four classes are liable to be secured.

(1) The Cynipid maker which stimulated the plant to form the gall and which, having passed through the earlier stages of its life within, chews out as an adult to lay its eggs and die.

(2) Commensals which feed on the tissue of the gall. If the commensal is a beetle larva or a caterpillar no change is produced in the gall. But there are five genera of Cynipids which, unable themselves to stimulate a plant to form a gall, lay their eggs in the peripheral parts of a gall already started and cause it to become more or less deformed. This deformation may or may not kill the larva of the maker of the gall. The larvae of some species of one of these—*Synergus*, after feeding on the plant tissue, are known to break their way into the central cell and parasitize the maker. These five genera are often called guest flies or inquilines and were often mistaken by the early entomologists for the maker of the gall. These guest flies always leave the gall later than the maker.

(3) Parasites and hyperparasites such as chalcids, braconids, ichneumons etc., which feed upon the body of the maker or of a guest fly or on another parasite.

(4) Successors or lodgers which utilize an empty gall as a nest or simply as a shelter or place of hibernation.

The beginner in the study of the gall-making Cynipidae is handicapped and often discouraged by the lack of published information as to the date of emergence of the maker of the gall. Not knowing at what time of year to collect the galls to get the maker, he rears nothing or gets only guests or parasites. Some general suggestions on rearing methods, applying only to Cynipid galls however, may be of value. Galls on herbaceous plants like *Fragaria*, *Potentilla*, *Nepeta*, *Silphium*, *Ambrosia*, *Lactuca* and *Pre-nanthes* may be collected in the fall if they can be put where they will not dry out too much but are better left in the open all winter and brought into the laboratory in the spring. A pasteboard box with a vial or test tube in one side makes a convenient breeding cage. Many galls on shrubby plants like *Rosa*, and *Rubus*, may be treated in the

same way. The succulent vernal galls on the leaves, buds or the flowers of oak must, however, usually be left on the tree until the larvae within use up all the nutritive layer of plant tissue and transform into pupae but such species develop rapidly and it is a matter of leaving them some days or at most but a few weeks longer. When the larvae are about mature or the pupa stage is reached, twigs bearing such galls can be put in a bottle of water and cotton plugged tightly around the stems at the mouth of the bottle so that the emerging flies can not crawl into the water and become drowned. This bottle should then be set in a battery jar with muslin tied over the top—if set under a bell jar the condensation water on the glass will wet the wings of the emerging flies. From galls of this type come fully-winged, active adults of both sexes whose adult life is short, a few days at most.

The more solid autumnal galls on oak, maturing and dropping just before or with the leaves, contain at that time, which is when they are usually gathered, a scarcely visible larval cavity in a thick translucent nutritive layer which is used up slowly during the winter. Such galls should be kept under more or less natural conditions out-of-doors on the ground in some sort of a wire cage. Select a shady spot in the woods if possible where there is a deep layer of leaf mold, safe from molestation and from fire in summer and well buried under snowdrifts in winter. Mice and squirrels are liable to destroy collections unless wire cages are used. Labels inside should give locality, date and host and may be written with waterproof ink on paper and then dipped in melted paraffin or better enclosed in a well-corked 7 by 25 mm. vial. The year of collection should not be omitted in the date. Two winters often pass before any flies appear and then some may emerge each spring for several years. The larvae transform in the fall before they emerge and remain in the galls as adults during the winter to come out when conditions are suitable in the spring. Adults may often be secured by cutting open galls in the late fall or winter but in this case it is better to let them crawl about in a vial until the chitin hardens and takes on its normal color rather than to kill them at once in a cyanide bottle. Adults from

galls of this type are all agamic females and are comparatively long-lived, often surviving for a month or more in captivity. Many species normally emerge in late fall, for example all those of the genus *Disholcaspis*, (whose galls on twigs are in general bullet-shaped, detachable but not deciduous) and many wingless agamic forms such as species of *Acraspis*, *Xanthoteras*, *Zopheroteras*, etc. Some woody stem swellings on oak become so hard after being gathered that the insects even if they have already transformed can not chew their way out and it is necessary to cut them out. These are but general suggestions for the beginner and their value is indicated by the fact that the writer knows many kinds of galls which he has never yet been able to rear. A single gall casually collected is seldom worth the trouble of rearing. It may be the normal reaction of the plant to the stimulation of the Cynipid maker or it may be quite abnormal if that structure is modified by the attacks of guest flies or parasites and some field observation may be necessary to determine whether this is the case. Collecting to be of value usually requires definite search for quantities of material with the object of rearing in view. When gathering galls from the ground in the fall especial care must be taken to see that no galls of other kinds are included in the breeding galls.

For a number of years the writer lived at Evanston, Illinois and collected galls either within the city limits or along the north branch of the Chicago river four miles west or along the "north shore" as far north as Waukegan with occasional trips to the sand dune area at the southern end of Lake Michigan in Indiana and less frequent trips to the general region of the "sag" south-west of Chicago. In this Chicago area the writer found a total of 124 species of gall-making Cynipidae and in addition has field notes on some 30 other galls from this area either not determined or not reared, some of the more conspicuous of which are included in this paper. Further collecting will no doubt yield still other species for during the last year of residence there it was no unusual experience to find galls that years of previous collecting had never discovered. Moreover collecting on three of the nine oaks in the region was very fragmentary, these being seen hardly more than once or twice a

year. Strangely enough the only species previously described from this area the writer has never been able to find although he has looked for it for years. This is *Diastrophus smilacis* Ashmead, described from "Chicago" in 1896 as producing a gall on *Smilax*. The oak openings at the edge of the prairie now transformed into the suburbs of a densely populated metropolitan district would not be suggested as an ideal region for Cynipid collecting and yet it will be interesting to compare its 125 species with the few published local lists available. In 1904 Beutenmueller listed 46 of the more conspicuous Cynipid galls in the vicinity of New York City. Stebbins listed 66 from Springfield, Mass. in 1910. Sixty-four are known for the Toronto area.

It is to make available to students of this group the writer's experience with those species of the Chicago area that have been reared or are felt to be determined with some certainty from the galls that this paper has been prepared. The emergence dates given apply to the Chicago region. Some variation will be found from year to year depending on the earliness or lateness of the season.

The generic names here used are in general those of the latest monograph on the Cynipidae, that of Dalla Torre and Kieffer, published in 1910 as Lieferung 24 in Das Tierreich. Those already somewhat familiar with generic names in this group will notice that *Disholcaspis* is now used for *Holcaspis* and *Diplolepis* instead of *Dryophanta*. The names used for the oaks are those of the seventh edition of Gray's Manual.

#### Gall on Smilax.

Described as irregularly rounded, abrupt pithy swellings on stem, one inch long by one-half inch in diameter. Polythalamous. Described from Chicago in 1896 and not collected since. Specimens much desired. It is suspected that there is an error here in the identification of the host plant. The adults are said to have emerged in Jan. and Feb. but the type flies in the National Museum bear the date label of May 1-8.

1. *Diastrophus smilacis* Ashm.

#### Gall on Fragaria.

STRAWBERRY PETIOLE GALL. A cylindrical gall on the petiole of a leaf, 20-60 mm. long by about 5 mm. in dia-

meter, containing 8-20 cells, red in summer, turning brown later. Flies emerged June 2, 1918.

2. *Diastrophus fragariae* Beut.

#### Galls on *Potentilla*.

Fusiform or cylindrical swelling of stem or peduncle, 10-35 mm. long by 5 mm. in diameter. Polythalamous. Adults emerge Apr. 15-May 1.

3. *Diastrophus niger* Bass.

CINQUEFOIL AXIL GALL. Globular, 8-13 mm. in diameter, in axils of leaves, green in summer with rudiments of leaves at apex, fleshy, spongy within, turning brown later. Monothalamous. Flies emerge the latter half of May.

4. *Gonaspis potentillae* (Bass.)

#### Galls on *Rubus*.

On blackberry.

BLACKBERRY SEED GALL. Cluster of reddish-brown, seed-like bodies closely set about the stem sometimes for several inches, the cluster being on the weaker canes about a foot or so from the ground, each seed-body bearing several filaments and monothalamous. Adults begin to emerge early in June.

5. *Diastrophus cuscuteaeformis* O S

BLACKBERRY KNOT GALL. Abrupt, elongated, pithy, subterminal stem swelling, 1-3 inches long by an inch in diameter. Surface uneven with irregular tubercles or longitudinal grooves, green or reddish-brown. Polythalamous. Adults probably emerge early in June. Not common in Chicago area.

6. *Diastrophus nebulosus* (O S)

On raspberry.

Abrupt stem swelling, up to 65 mm. long by 30 mm. in diameter, densely covered with short prickers, green in summer, turning brown later, polythalamous. The flies emerged May 1-15, 1912.

7. *Diastrophus turgidus* Bass.

#### Galls on *Rosa*.

"Root" galls.

Deeply incised on top. Diameter up to 55 mm. When mature light in weight, of a brittle spongy texture within

with large deeply imbedded larval cells. The makers issue in May.

8. *Rhodites utahensis* Bass.

Irregularly lobed, not incised, smaller, tissue more compact, adults emerging later in May or early June.

9. *Rhodites semipiceus* (Harris)

Stem galls.

Fusiform stem swelling up to 50 mm. long by 13 mm. in diameter, densely covered with prickers, rarely smooth. Polythalamous. Adults emerged May 27-June 21, 1909.

10. *Rhodites dichlocerus* (Harris)

Smaller fusiform or abrupt one-sided corky enlargements of the stem, up to 30 mm. by 7 mm., with a longitudinally fissured brown surface. Polythalamous. Flies emerged May 15-June 15.

11. *Rhodites fusiformans* Ashm.

Abrupt, irregularly lobed, subterminal stem swellings, up to 35 mm. in diameter, densely covered with sharp spines. Reddish-brown. Contain 30-50 cells arranged radially along the long axis. Adults emerged Apr. 27-May 13, 1915.

12. *Rhodites multispinosus* Gill.

Scarcely noticeable enlargement at base of small lateral branches bearing many leaf scars, the distal end of twig dead. Contains up to 5 larval cells but usually only one. On sweetbriar. Adults emerged May 25 until early in June.

13. *Rhodites nodulosus* Beut.

MOSSY ROSE GALL. A globular mass of mossy green filaments appearing in June and turning brown later. Polythalamous. Adults emerged Apr. 27-May 4, 1907. An European species most common on the introduced sweetbriar rose but occasionally found on *Rosa rugosa*.

14. *Rhodites rosae* L.

Leaf galls.

SPINY ROSE GALL. Globular, 8-10 mm. in diameter, 3-10 in a cluster, the leaf obliterated if the cluster is large, covered with numerous tapering spines about as long as the diameter of the gall. Succulent in summer, often tinged

with red, turning brown and persisting through the winter. Monothalamous, cavity large, wall over 1 mm. thick. Flies emerge in May.

15. *Rhodites bicolor* (Harris)

Similar but smaller, 4-5 mm. in diameter, covered with short weak spines, wall thin. On upper side of leaflets near margin, dropping with the leaves. Flies emerged May 24. Galls of this type need further study as there may be more than one species.

16. *Rhodites pustulatoides* Beut.

MEALY ROSE GALL. Globular, up to 15 mm. in diameter, several often coalescing into a mass, covered with a mealy white efflorescence. Hard, polythalamous, attached to the under side of leaf. Adults emerge about the middle of April.

17. *Rhodites ignotus* O S

REGAL ROSE GALL. Globular with a flattened top like that of a patty-pan squash, single or in clusters on under side of leaflets. Diameter 5-6 mm. Dropping with the leaves in the fall. Adults emerge May 15-June 10.

18. *Rhodites gracilis* Ashm.

ROSE LENTIL GALL. A lentil-shaped hard thickening of the parenchyma of the leaf, green, more convex on lower surface, single or in small groups, 3 mm. in diameter. Drop with the leaf. Adults emerged May 11-June 14.

19. *Rhodites rosaefolii* Ckll

**Gall on Nepeta.**

Globular, green, fleshy, 8-11 mm. in diameter. Galls turn brown in Aug., the larvae transforming in Sept., the adults remaining in the galls over winter and emerging in the spring. An introduced European species on the introduced European host plant *Nepeta* (*Glechoma*) *hederacea*, Gill-over-the-ground.

20. *Aylax glechomae* (L.)

**Galls on Silphium.**

Cells in a small group hidden in among the disk florets in the flower head and found only when the head is broken open. Adults emerge in the spring, probably in May.

21. *Aylax laciniatus* Gill.

Cells in the pith with no external evidence until the exit holes are seen. Adults of two species emerged May 15-June 24.

22. *Aylax rufus* (Gill.)

23. *Aylax gillettei* (Kieffer)

#### Gall on Taraxacum.

DANDELION GALL. Irregular fusiform or nodular swellings on petiole, base of peduncle or scattered along the midrib. Green and fleshy in June, after maturity becoming dry, brown and pithy. Polythalamous. Adults emerge the next spring about June 1. Another European species on an introduced European host plant.

24. *Aylax taraxaci* (Ashm.)

#### Galls on Lactuca.

LETTUCE TUMOR GALL. Fusiform pithy stem swellings, high up on stem, bearing many leaves or branches of the panicle. Diameter up to 30 mm., polythalamous. Adults emerged May 4-June 1.

25. *Aulacidea tumida* (Bass.)

Knotty enlargements scattered along the stem at base of leaves. Polythalamous. Flies emerge early in June.

26. *Aulacidea podagrae* (Bass.)

Cells in the pith—no external evidence until exit holes are made in the spring. Flies emerge the first week in June.

27. *Aulacidea harringtoni* (Ashm.)

#### Gall on Prenanthes.

Abrupt hemispherical swellings just below the surface of the ground at base of plant, often so grouped as to surround the stem, resembling a raw potato in consistency in summer, becoming corky in fall. Polythalamous. Flies emerged June 8-11.

28. *Aulacidea nabali* (Brodie)

#### Galls on Quercus.

A. "Root" galls	-	-	-	-	-	-	p.
B. Acorn galls	-	-	-	-	-	-	p.
C. Flower galls	-	-	-	-	-	-	p.
D. Bud galls	-	-	-	-	-	-	p.
E. Stem galls	-	-	-	-	-	-	p.
L. Leaf galls	-	-	-	-	-	-	p.

## A. Galls on the "roots."

1. True root galls, found on the small fibrous rootlets covered with an inch or two of leaf mold underneath large forest trees.

Single or in small clusters, ellipsoidal, brown, 5 mm. long, wall thin and fleshy, monothalamous. On *Q. bicolor*. The larvae transform in the fall after the nutritive layer has been used up, the flies emerging the next spring between Apr. 15 and May 7. They are all females and oviposit at once in the swelling buds of the same tree but the alternating sexual generation is unknown.

29. *Callirhytis ellipsoida* Weld

Similar on *Q. alba*. Flies of this species were taken ovipositing in buds of *Q. alba* on May 11.

30. *Callirhytis elliptica* Weld

2. Irregularly globular, abrupt, subterranean stem swellings at the base of sprouts from stumps. Woody, 10-30 mm. in diameter, polythalamous, the cells just underneath the bark which is not greatly thickened, the bark bulging slightly over a cell causing the surface to present a pebbled appearance. Adults probably emerge in the spring. On *Q. coccinea* and *rubra*.

31. *Eumayria floridana* Ashm.

3. Cells imbedded in the greatly thickened bark at the crown of the tree.

Occurring in large numbers forming hypertrophied patches of considerable area without sharply defined limits.

On the main roots of trees of *Q. alba*, the flies emerging in spring (May 12, 1917) to oviposit in the swelling buds on the same tree. See 115.

32. agamic gen. of *Callirhytis* *futilis* (O S)

At the base of saplings of *Q. macrocarpa*, causing a swelling 4-5 times the normal diameter and extending for nearly a foot sometimes. Flies emerge in early Nov.

33. *Compsodryoxenus illinoisensis* Weld

Occurring in small groups of less than a dozen usually, sometimes single.

Cells in thick brown bark forming an abrupt local swelling, these hemispherical swellings sometimes confluent and surrounding the stem. At the base of stumps or

trees. Polythalamous, the number of cells within more or less evident. Adults probably emerge in the spring as the larvae transform in the fall. On *Q. rubra* and *coccinea*.

34. *Callirhytis rubida* Weld

Similar local swelling, the number of cells within not so apparent. Single or confluent, on sprouts or saplings of *Q. coccinea*. Adult emerged April 25. They oviposit in the swelling buds of the same clump of sprouts at whose base the galls were found.

35. *Callirhytis marginata* Weld

4. Detachable galls or masses of galls at the crown.

Single or scattered about in small numbers.

Hemispherical, 10-15 mm. in diameter, rugose to nearly smooth, covered with normal brown bark, leaving a radiating scar when detached, woody when mature, monothalamous. At base of thrifty sprouts from stumps of *Q. alba*, *bicolor* and *macrocarpa*. Transformation takes place in the fall, an adult emerging April 28, the emergence probably distributed over a period of two years. The flies oviposit in buds of vigorous white oak sprouts but alternating generation is unknown.

36. *Callirhytis badia* (Bass.)

Large, polythalamous, rounded masses, up to 90 mm. long, growing out of one side of main root at base of tree or stump. When mature the interior resembles well-rotted wood in which scattered hard, thin-walled, brittle, brown larval cells are imbedded. Light as cork when dry. On *Q. alba*, *bicolor* and *macrocarpa*. The larvae transform in the fall, the adults emerging the next spring in late April.

37. *Callirhytis maxima* Weld

In clusters of separable elements.

Pure white or rosy when fresh in May, fig-shaped, polythalamous, fleshy, decaying or shriveling up after the emergence of the adults, June 12-26. Frequently at base of stumps of *Q. alba* on whose sprouts the oak fig gall was formed the fall before. See 83.

38. *Trigonaspis radicola* (Ashm.)

Gall not transitory and fleshy but more or less woody and persistent.

Individual galls less than 6 mm. in diameter.

Cluster spherical or elongated, 20-25 mm. in diameter, consisting of 30-150 galls, 4 by 6 mm., roughly ellipsoidal, faintly grooved. They contain adults in the fall which probably emerge some time in the spring. On *Q. rubra* in the fall at the base of sprouts.

39. *Callirhytis enigma* Weld

Clusters spherical, up to 60 mm. in diameter, made up of as many as 400 elongated wedge-shaped bodies resembling long kernels of corn. Monothalamous, the larval cell in the basal part of the gall. Adults emerge in Dec., Feb. and March. On *Q. rubra* and *coccinea*.

40. *Dryocosmus favus* Beut.

Clustered at base of vigorous sprouts, up to 30 in a group, onion-shaped, 5-8 mm. long, pointed at apex, longitudinally striate, brown, hard and brittle when mature in the fall, monothalamous. Often enclosed in a "shed" by ants which are fond of the honeydew the growing galls secrete. On *Q. rubra* and *velutina*. Adults emerge in the late fall, Nov. 23-Dec. 2.

41. *Biorhiza caepuliformis* (Beut.)

Individual galls averaging over 7 mm. in diameter.

Globular bullet galls with a distinct inner cell often free in an irregular cavity within. Up to 40 in a cluster at base of sprouts from stumps of *Q. alba*. Adults emerge in late Oct. and early Nov.

42. *Disholcaspis globosa* Weld

### B. Galls on acorns.

1. Galls on or in the tissue of the cup not involving the acorn proper.

ACORN PLUM GALL. Globular, 15-25 mm. in diameter, hard, mottled brown or reddish, attached on side of acorn cup and dropping to ground in the fall. Monothalamous. Adults issue in the spring, the emergence distributed over a period of several years. On *Q. rubra*, *velutina* and *coccinea*.

43. *Amphibolips prunus* (Walsh)

FIMBRIATE CUP GALL. A smooth elongated gall, 4 by 7 mm., partly imbedded in a fimbriate depression in the side

of the acorn cup and slipping to the ground when mature in the fall. On *Q. bicolor*. Flies emerge the second and third springs Mar. 25-Apr. 18 and oviposit in buds of *Q. bicolor*. Alternating generation unknown.

44. *Andricus incertus* Bass.

Cell in the tissue of the cup and not separable from it directly underneath the acorn causing it to become lopsided. On *Q. bicolor* in the fall.

45. *Undescribed species*

2. Galls of the type known as "pip" galls produced between the acorn and the cup, always on red oaks.

Pip galls alongside full grown acorns of *Q. rubra* slipping out to the ground in late summer. Adults emerging in late Apr. or early May the second spring. See 53.

46. agamic gen. of *Callirhytis operator* (O S)

Pip galls alongside immature acorns.

On *Q. coccinea* in spring as buds are swelling, on the partly grown acorns of the previous season. Fleshy, smooth, greenish mottled with purple, laterally compressed, rounded at end and secreting honeydew. Monothalamous. Drop in May. Adults emerge the second and third springs Apr. 22-May 11.

47. *Callirhytis balanosa* Weld

On *Q. velutina* in fall on small acorns of current season, sometimes 2-3 on one acorn, secreting honeydew. When detached somewhat triangular, flattened, the larval chamber transversely placed in upper half of gall. Flies issue early in May the second spring.

48. *Callirhytis balanoides* Weld

On *Q. velutina* and *rubra* in fall on acorns of the current season. Globular, color green to tan, 3-4 mm. in diameter.

49. *Undescribed species*

3. Galls inside the acorn.

ACORN STONE GALL. Cells thick-walled and coalescing into a stony-hard mass which more or less fills the interior of the acorn so that the cotyledons are reduced or absent. On *Q. rubra* and *coccinea* in the fall. Adults emerge in early May the second and third springs.

50. *Callirhytis fructuosa* Weld

Cells separable and with thin walls.

On *Q. bicolor*. Cells in a group of as many as 15, shaped like apple seeds, underneath or slightly to one side of the cotyledons, causing the acorn to bulge somewhat on one side. Occurs in fall in large acorns. Flies issue Apr. 25-May 16 the second and third springs.

51. *Callirhytis lapillula* Weld

On *Q. alba*. Similar, less common.

52. *Undetermined species*

### C. Galls on the staminate flowers.

Woolly white mass on the flowers of *Q. rubra*, *velutina*, *coccinea* and *imbricaria* becoming tan colored as it matures in late June when the insects emerge and oviposit in the one-year-old acorns to produce the pip galls in the late summer. See 46.

53. sex. gen. of *Callirhytis operator* (O S)

Pea-shaped, smooth, green, bare, fleshy, scattered in small numbers along the flower axis, dropping with the flowers in late May or early June. Contain 4-5 cells. Flies emerge early in June of the same season. On *Q. rubra* and *coccinea*.

54. *Callirhytis pulchra* (Bass.)

### D. Bud galls.

(Galls which are quite obviously modified buds and hence arising at definite places on the stem such as at the nodes, in the axils of the leaves or developing and sometimes hidden in the inside of buds. Detachable and often deciduous when mature.)

1. Over 10 mm. in diameter or in length.

Large, globular, spotted, with a thick outer wall and a central cell supported by stout radiating fibers, 11-13 mm. in diameter. In axils of leaves of large trees of *Q. rubra*, dropping about the middle of Sept., after which they turn brown and the surface becomes characteristically wrinkled. Brodie says that in Toronto adults emerge late the next Oct., all females, and oviposit in buds. Male unknown.

55. *Amphibolips cookii* Gill.

Cylindrical, 5 by 14 mm., tapering toward the blunt ends, mottled. In early spring from weak lateral buds on *Q. palustris* and *imbricaria*. Deciduous. The fly probably emerges early the next spring as one was found dead in breeding cage April 10.

56. *Amphibolips ellipsoidalis* Weld

Gall slender, elongated, fusiform, long-stalked, longitudinally grooved, up to 31 mm. long. Found in late summer sticking out obliquely upward from weak lateral buds on current season's growth, dropping in early Sept. Adult emerges the second spring after, probably in Apr. or May. On *Q. rubra*.

57. *Callirhytis gallaestriatae* Weld

2. Under 10 mm.

Gall almost wholly exposed, not much concealed by the bud scales.

Spherical, smooth, bare, milky-white mottled with purple, consisting of a thin fleshy layer outside a hard brittle brown shell. Diameter 3-6 mm. monothalamous, deciduous. Occurs as buds are opening in spring on *Q. alba*, *bicolor* and *macrocarpa*. The larvae transform in late fall, the adults emerging in spring.

58. *Andricus pisiformis* Beut.

Spherical, slightly elongated at apex, 4 mm., greenish-gray with longitudinal purple streaks, monothalamous. Develop from weak lateral buds near base of season's growth or from dormant buds on older twigs. After they drop about the end of Sept. the thin fleshy outer layer rots away leaving a hard thin-walled shell. Adults emerged the second spring on April 10. On *Q. bicolor*.

59. *Andricus deciduatus* Weld

Globular or kidney-shaped, thin-walled, fleshy, green or brownish, 3-5 mm. in diameter. Monothalamous. Usually occurs in terminal bud cluster in Mar. or Apr. as buds begin to swell, the flies emerging as the buds open in early April. On *Q. alba*, *bicolor* and *macrocarpa*.

60. *Neuroterus vesicula* (Bass.)

Conical, white or tan-colored, 3 mm. high, wall very thin and brittle. In the terminal cluster of buds in spring,

flies are said to emerge in Conn, in the middle of May. On *Q. alba*, and there is a similar gall perhaps made by the same species on *Q. bicolor* and *macrocarpa*.

61. *Diplolepis gemula* (Bass.)

Conical, greenish becoming brown when mature, 3-4 mm. high, from weak dormant buds on limbs or from adventitious buds on trunk of large trees of *Q. alba* in Sept. and Oct. Deciduous. Adults emerge the second spring, transforming the fall before.

62. *Callirhytis gemmiformis* (Beut.)

Fusiform or ellipsoidal, 3 by 5 mm., greenish when young becoming yellowish with rosy stripes and covered with stellate hairs, monothalamous, the wall thin. At apex there is a slight papilla surrounded by a circlet of reflexed hairs. From weak lateral buds at base of branches on strong sprouts from stumps in May in clusters of from 2-8, deciduous. Flies emerge early the next spring probably in April. On *Q. coccinea*.

63. *Callirhytis rugulosa* (Beut.)

Melon-shaped, with longitudinal grooves like some types of cantaloupe, 3-4 mm., rose-pink, with a small tuft of hairs at the apex. On *Q. velutina*. Found but once—on May 1. Not reared.

64. *Undescribed species*

Gall at least half concealed by the bud scales about its base.

Smooth, greenish, 3 mm. high, ribbed, in June, the bud scales developing into leafy bracts which after the gall is pushed off to the ground in July become more and more leaflike and form a compact persistent mass conspicuous in winter. In terminal buds of *Q. bicolor* and *macrocarpa*, on vigorous sprouts. Adults probably emerge the next spring.

65. *Callirhytis flavohirta* (Beut.)

Greenish-brown, smooth, globular with a papilla at apex, half protruding beyond the normal bud scales. In buds of terminal cluster in the fall. On *Q. alba*. Adults emerge the second spring.

66. *Callirhytis mamillaformis* Weld

Similar on *Q. bicolor* and *macrocarpa* in the fall.

67. *Undetermined species*

Similar on *Q. rubra* in the fall.

68. *Undetermined species*

Similar on *Q. coccinea* in early spring, smooth, polished, tan-colored, scarcely protruding.

69. *Undetermined species*

Found under large trees of *Q. coccinea* in May and probably bud galls. Globular, slightly compressed, with a scar and short stalk at base, a linear indentation at the apex, no nipple, 3 by 4 mm., brownish or purplish, mottled.

70. *Undetermined species*

Gall a blister on the inner concave face of bud scale, not visible until bud is dissected, wall thin, brittle, white or tan-colored. But one or two on a scale. Occurs as buds open in early spring on trees of *Q. alba* where the hedgehog gall was found the previous fall. Adults issue early in May. See 126.

71. sex. gen. of *Acraspis erinacei* (Beut.)

### E. Stem galls.

(Not obviously derived from buds.)

1. Cells in the twigs, no deformation evident.

Cells in the tissue of the twig under leaf scar, the tip protruding so slightly as to be scarcely visible until the adult begins to chew its way out in the latter half of April. Sometimes two cells under the same leaf scar. Near the terminal cluster of buds on *Q. bicolor*.

72. *Neuroterus escharensis* Weld

Cells scattered along the internodes in the wood under the normal bark. Date of emergence unknown. On *Q. coccinea*.

73. *Bassettia ceropteroides* (Bass.)

2. Woody, persistent, polythalamous stem swellings.

HORNED KNOT GALL. Abrupt irregular mass up to 2 in. in diameter covered with normal bark and consisting of tissue which cuts like cheese until the galls are full grown about the middle of May; then long, pointed horns begin to

protrude from the surface and drop to the ground early in July. Each is cylindrical, 2 by 8 mm., with a larval cell at base, the adults emerging the next spring early in May. The twig beyond the gall dies and the gall becomes woody and persists on the tree for years. On *Q. rubra*.

74. *Callirhytis cornigera* (O S)

OAK KNOT GALL. Irregularly lobed, confluent stem swellings sometimes encircling twigs for several inches and eventually killing the twig beyond that point. Up to 40 mm. in diameter, covered with normal bark, polythalamous. Full grown by middle of June, the larvae transforming to adults in late fall, the adults emerging the next spring in April or May—all females. On *Q. rubra*, *coccinea* and *velutina*.

75. *Callirhytis punctata* (Bass.)

OAK POTATO GALL. Irregularly fusiform, tuber-like stem swellings, 10-40 mm. long by 15 mm. in diameter, deforming the terminal twigs of small trees or sprouts of *Q. alba*.

In spring at base of the new growth, fleshy, green, glaucous, the adults emerging the latter half of June. See 77.

76. sex. gen. of *Neuroterus batatus* (Fitch)

In winter a similar but woody gall covered with normal brown bark, the adults emerging the latter half of April and ovipositing in the buds. See 76.

77. agamic gen. of *Neuroterus batatus* (Fitch)

NOXIOUS OAK GALL. Irregular woody enlargement at or near the ends of twigs on trees of *Q. bicolor*, up to 40 mm. long by 25 mm. in diameter, covered with normal bark, polythalamous, conspicuous on the trees in winter. The adults emerge in early April and oviposit in the buds just as they are beginning to swell. See 104.

78. agamic gen. of *Neuroterus noxiosus* (Bass.)

OAK CLUB GALL. Terminal, club-shaped, about 15 mm. in diameter with several leaves growing from it, containing one to three larval cells. Green while growing but becoming brown and woody after the escape of the adults in early July, the old galls persisting for years. On trees of *Q. alba*.

79. *Callirhytis clavula* (O S)

Abrupt enlargement at end of the new growth on *Q. coccinea* in June, checking the growth in length and bearing several leaves, the internodes short. Green, about 15 mm. in diameter at base and gradually tapering above. Usually several in close proximity on the tree. Adults emerge in early July.

80. *Callirhytis scitula* (Bass.)

Slight enlargement on one side of the new growth of *Q. bicolor* in early May causing the branch to be dwarfed and bent over to one side, green, polythalamous, the flies emerging about the middle of May.

81. *Neuroterus distortus* Bass.

3. Detachable and often deciduous.

OAK SEED GALL. A globular or elongated woolly or spongy white mass often tinged with spots of pink, 20-30 mm. in diameter, consisting of numerous slender fusiform bodies attached by one end to a common point on the twig—probably a bud gall morphologically. Each seed-like body contains one larval cell and the distal part bears the white filaments. Occurs on trees of *Q. alba*, starting about the middle of May, the adults emerging June 29-July 12.

82. *Callirhytis seminator* (Harris)

OAK FIG GALL. A cluster of tan-colored, hollow bodies surrounding the twig for several inches at or near its upper end and occasionally scattered along the midrib of leaves, the diameter of the cluster about one inch. On strong sprouts from stumps of *Q. alba* in the fall and within reach from the ground. Individual galls are much distorted by mutual pressure, monothalamous, the larval cell in the base surrounded by fine radiating fibers. Appear about the end of June. Adults emerge on thawing days in Dec., Feb. and March, all females and wingless. Is suspected of being the agamic form of *Trigonaspis radicola* (Ashm.) See 38.

83. *Xanthoteras forticornis* (Walsh)

PINE-CONE OAK GALL. Globular cluster, up to 35 mm. in diameter, at end of twig, consisting of 25 or more wedge-shaped bodies attached by their tapering bases to a common point on twig. Hard, breaking off easily when mature, brown, monothalamous, dropping in the fall. Some flies

emerge in the spring for at least three seasons. On *Q. bicolor* and *macrocarpa*.

84. *Cynips strobilana* O S

Globular cluster of fig-shaped galls on one side of the twig on strong shoots of *Q. coccinea* in May, the cluster made up of about a dozen or more galls, each 15 mm. long by 10 mm. in diameter, green, fleshy, monothalamous, the distal end blunt with a depression in the center. They turn brown and drop off in summer. The larvae transform in the galls in the fall, the adults probably emerging in early spring.

85. *Andricus formosus* (Bass.)

Seed-like bodies in rows bursting out of longitudinal cracks in the bark of vigorous young shoots in late summer, dropping to the ground in the fall. The individual galls are lenticular in shape with a scar at the base, about 6 mm. long, hard, smooth and polished. Ashmead reared the type flies from galls from N. Carolina on June 6. On *Q. imbricaria* and probably other red oaks.

86. *Andricus excavatus* Ashm.

ROUND BULLET GALL. Single or in small cluster on small twigs on trees of *Q. alba* in late summer and fall. Diameter 10-15 mm., yellow or tinged with red, corky with a thin-walled free larval cell in center. Young galls appear in July, contain pupae in late fall, and adults emerge Oct. 20-Nov. 1.

87. *Disholcaspis globulus* (Fitch)

POINTED BULLET GALL. Similar but pointed at the apex, subclasping at base, often distorted by crowding and extending along the stem for several inches sometimes. Frequently on sprouts from stumps or on small trees in large numbers in the fall. On *Q. macrocarpa* and *bicolor*. Adults emerge Oct. 20-Nov. 10.

88. *Disholcaspis mamma* (Walsh)

BASSETT'S BULLET GALL. Broadest at the clasping sessile base and tapering gradually above, the apex often lopsided, 15-20 mm. high, the larval cell basal. Single or in crowded clusters on twigs of trees of *Q. bicolor* in fall. Adults emerge in early Oct.

89. *Disholcaspis bassetti* (Gill.)

PUBESCENT BULLET GALL. Clasping, conical, single or in small clusters on twigs or on scar tissue on main trunk or large limbs of trees of *Q. coccinea* and *imbricaria* in spring. Green and fleshy when fresh in May and covered with dense short white pubescence which weathers away after the galls mature. They turn brown and drop off in July. The larvae transform in the fall and the adults emerge some time in the spring probably.

90. *Callirhytis ventricosa* (Bass.)

BANDED BULLET GALL. Reddish-brown, globular, 7-10 mm. in diameter, in rows from vertical slits in the bark usually near top of vigorous sprouts from stumps of *Q. rubra*, *velutina* and *coccinea*, beginning to develop about Aug. 1 and dropping in late Sept. Adults emerge the next and the succeeding fall in late Sept. or early Oct.

91. *Dryocosmus imbricariae* (Ashm.)

Cluster of small barrel-shaped green or purplish galls bursting out of cracks in the bark of 2-3 year old twigs, the blunt galls sticking out in all directions for a distance of an inch or two along the twig. Each is 3 mm. long by 2 mm. in diameter, longitudinally grooved and when growing secretes honeydew from a gland in the truncate and depressed distal end. On *Q. rubra*, *velutina* and *coccinea*. They begin to develop in late May or early June and unless attacked by guest flies drop off early in July. Adults probably emerge in early spring. Attacked by guest flies the gall fails to drop, continues to grow, becomes woody and covered with normal bark and persists for years.

92. *Callirhytis gemmaria* (Ashm.)

Gall unknown but probably a bud or stem gall. A fly of this species was taken at Evanston, Ill., on April 9, 1910 ovipositing in bud of *Q. alba*.

93. *Bassetia gemmae* Ashm.

#### F. Leaf galls.

1. Gall an integral part of the tissue of the leaf (a thickening of vein or parenchyma or prolongation of a vein) and detachable only by tearing the tissue of the leaf, including here the hollow galls, those with a free-rolling

cell inside and the oak apples with a central cell supported by radiating fibers.

a. Oak apples. Spherical galls containing a central larval cell supported from the thin outer wall by fine radiating fibers or by a spongy network.

LARGE SPONGY OAK APPLE. Galls appear with the leaves in spring, becoming 40 mm. in diameter, green until full grown early in May, turning brown about the time the flies, males and females, emerge the latter half of June. On *Q. velutina*.

94. *Amphibolips spongifica* (O S)

Similar but the adults, all females, emerge in Nov. Probably an alternating generation of the above but the life history needs further study.

95. *Amphibolips confluentus* (Harris)

LARGER EMPTY OAK APPLE. Green with scattered purplish spots, 18-32 mm. in diameter, produced singly on under side of the leaf of *Q. rubra*. Adults emerged June 11, June 25, and July 6 in different seasons.

96. *Amphibolips inanis* (O S)

SMALLER OAK APPLE. Diameter 14 mm., a third of the sphere projecting from the upper surface of the leaf, the rest on under side, seldom more than one on a leaf, green, not spotted. On *Q. rubra* in May and June, the adults emerging early in July.

97. *Andricus singularis* (Bass.)

Similar but smaller, diameter about 8 mm., on *Q. coccinea* in June. Adults emerged July 8-15.

98. *Andricus osten sackenii* (Bass.)

b. Midrib or petiole swellings.

OAK PETIOLE GALL. Somewhat globular, conical above with a depression at apex, hard, green, polythalamous, the larval cells radiating out from the center. On the petiole or basal part of midrib, usually several in close proximity on the tree. In May and June, the adults emerging in late June. On *Q. alba*, *bicolor* and *macrocarpa*.

99. *Andricus petiolicola* (Bass.)

Abrupt smooth midrib swelling on lower side of leaf on basal half, 25 mm. long by 12 mm. wide, green, fleshy,

polythalamous, appearing in June the flies said to emerge in autumn or the next spring. On *Q. velutina*, *coccinea* and *imbricaria*.

100. *Callirhytis pigra* (Bass.)

Enlargement of petiole and basal part of midrib, green, smooth, polythalamous, appearing in June, 20 mm. long by 13 mm. in diameter, the adults emerging during July. On *Q. rubra*.

101. *Callirhytis tumifica* (O S)

Smooth fusiform swelling along midrib of *Q. macrocarpa* in spring. Green, fleshy, polythalamous, the adults emerging about June 20.

102. *Callirhytis flavipes* (Gill.)

Slight local thickening of midrib on leaf of *Q. bicolor* with a rosette of leafy bracts both above and below. Green, fleshy, containing 1-6 cells, only one on a leaf, usually on the basal third, first appearing in May when the leaves are about one-third grown. Adults emerge in late June.

103. *Andricus foliosus* Weld

NOXIOUS OAK GALL. Fleshy smooth green swellings of midrib on under side causing the leaves to curl. Developing with the leaves in early spring, full grown during June, adults emerging June 12-July 3. On *Q. bicolor*. See 78.

104. sex. gen. of *Neuroterus noxiosus* (Bass.)

Swollen base of the petiole of *Q. imbricaria*, 6 mm. long by 2 mm. in diameter, remaining attached to the twig during the winter.

105. *Undetermined species*

c. Woolly galls of small size on under side of leaves of *Q. bicolor* and *macrocarpa* in large numbers in the fall, showing on the upper side only as smooth shining blisters. Often deforming all the leaves near the top of thrifty shoots. Adults emerge the next spring about April 15.

106. *Neuroterus floccosus* (Bass.)

(For detachable woolly galls on leaves see 2 b on p—)

d. Prolongations of veins beyond the margin of the leaf.

Gall fusiform, green, long-stalked, total length 15 mm., no free cell inside.

On *Q. alba* and *bicolor* in May. Adults emerged June 10-23.

107. *Andricus chinquapin* (Fitch)

Similar in appearance but has a separate larval cell inside (not free-rolling for it fills the cavity). On *Q. coccinea* in May. Adults emerge the last of June.

108. *Diplolepis pedunculata* (Bass.)

e. Galls with a free-rolling larval cell inside.

Globular, 10-12 mm. in diameter, wall thick, succulent, green with opaque white spots. On *Q. rubra* and *velutina* as leaves develop in early spring. Occasional on the staminate flower axis. Adults emerge during the first two weeks in June.

109. *Diplolepis palustris* (O S)

Hemispherical, slightly elongated, sessile by its flat face on the lower side of leaf of *Q. rubra* in spring. Greatest diameter 6 mm., wall very thin, green, veiny and translucent. Flies emerge about the last of May.

110. *Diplolepis cinereae* (Ashm.)

Elongated, blister-like, at edge of leaf, the conical tip prolonged on upper side of leaf into a sharp point, the walls very thin, green, veiny and translucent. In May on *Q. rubra*, *velutina* and *coccinea*. The flies emerge early in June.

111. *Diplolepis notha* (O S)

f. Deformed and much reduced leaves in early spring as buds open.

Cluster of thickened petioles without leaf blades, each about 5 mm. long and containing a dozen or so rounded cells. Slightly pubescent and pinkish. On *Q. alba* as buds open in the spring. Adults emerge the last of May.

112. *Neuroterus minutus* (Bass.)

Swollen leaf petioles and dwarfed and deformed leaves of *Q. macrocarpa* in May. Adults are said to emerge in May or June.

113. *Neuroterus vernus* Gill.

g. Galls in the parenchyma of the leaf, projecting on one or both surfaces, one or many celled.

Galls 3 mm. or more in diameter, not confluent into masses, 1-3 celled at most.

Gall hollow, spherical, 3 mm. in diameter, projecting equally on both sides of the leaf, green, fleshy, cavity large, solitary on leaf. In May on *Q. alba*. Flies probably emerge about the middle of June.

114. *Andricus utriculus* (Bass.)

OAK WART GALL. Lenticular, projecting more on the lower side of leaf, usually several on a leaf. Each contains 2-3 larval cells supported by radiating fibers. On *Q. alba* and *bicolor* in June. Adults emerge about the middle of July. See 32.

115. sex. gen. of *Callirhytis futilis* (O S)

Lenticular, more prominent on lower side of leaf, the upper surface depressed, hard, lighter in color than the leaf, but one or two on a leaf, typically containing two cells. On *Q. rubra* in May. Adults probably emerge in early July.

116. *Callirhytis rugosa* (Ashm.)

Individual galls less than 3 mm. in diameter or else coalescing so as to form large thickened patches of hypertrophied leaf blade.

Confluent so as to form an abrupt thick swollen area from 10-30 mm. long and 7-11 mm. thick. Green, smooth, somewhat translucent, usually but one on a leaf, polythalamous. On *Q. alba* in May. Adults emerge during the first half of June.

117. *Neuroterus majalis* (Bass.)

Confluent or single, hard, not succulent, upper surface of patches papillose, many such warty patches on leaf. On *Q. rubra* in June. Adults emerge in late June.

118. *Callirhytis modesta* (O S)

Cells isolated, more prominent on upper surface, scarcely projecting below, elliptical in outline, 1 mm. long, very numerous on leaf, exit hole below. On *Q. bicolor* in June. Adults emerge the last of June.

119. *Neuroterus papillosus* Beut.

Cells separate, numerous, elliptical, 1-2 mm. long, showing on both sides of the leaf but more distinct on

upper. On *Q. alba* in June and similar galls in the fall. Flies emerge from the overwintering galls April 1-23.

120. *Neuroterus perminimus* Bass.

Cells separate but in more or less definite rows along the midrib or a main vein, more prominent on upper side, a faint papilla in center below, round in outline, about 1.5 mm. in diameter. Exit hole on the lower surface. On *Q. alba* in the fall.

121. *Undetermined species*

Cells lenticular, adjacent to a vein in rows, more conspicuous on lower side which is covered with sparse rosy hairs, the wall thinner above. In early spring when leaves are one-third grown on *Q. macrocarpa*. Adults emerged May 30.

122. *Neuroterus fugiens* Weld

2. All leaf galls, single or in clusters, which when mature are deciduous or are easily detachable without damage.

a. *Acraspis* galls. Stony hard, whitish, more or less spherical, with a reticulated rough and often spiny surface. On white oaks in the fall, dropping with the leaves, the adults all females, wingless and emerging in late fall.

SPINY OAK GALL. Globular, 5-15 mm. in diameter, on under surface of leaf on midrib of *Q. macrocarpa*. Yellowish-green, monothalamous, the surface tuberculate, each tubercle conical and prolonged into a long hair of same color as gall or often red. Solitary or in a small group. Flies emerge after Nov. 1.

123. *Acraspis villosa* Gill.

Ellipsoidal, 3 by 4 mm., scattered on lower or sometimes upper surface of leaf of *Q. macrocarpa*, often one or two dozen on a leaf. Surface rough with blunt tubercles but not spiny. Monothalamous. Adults emerge about the middle of Nov.

124. *Acraspis macrocarpae* Bass.

OAK PEA GALL. Spherical, 5-8 mm. in diameter, two-celled, on under side of leaf of *Q. alba* on a vein. Surface reticulated by fissures into polygonal areas each bearing a slight papilla, yellowish, often tinged with red on one side

when developing in June, turning brown in fall. Adults probably emerge in late Nov.

125. *Acraspis pezomachoides* (O S)

HEDGEHOG GALL. Two to five-celled, ellipsoidal, 8-15 mm. long, usually on upper side of leaf on midrib, often several in a row, the surface tuberculate and bearing conspicuous red hairs. On large trees of *Q. alba*, starting to develop in late June. The flies emerge about Nov. 1 just before the leaves fall and oviposit on the same tree in the buds of the terminal cluster. See 71.

126. agamic gen. of *Acraspis erinacei* (Beut.)

b. Woolly galls on leaf. Occur in autumn. Deciduous or dropping with leaves.

OAK WOOL GALL. White woolly mass, 5-25 mm. long, on midrib above or below, containing 2-10 brown seed-like cells attached at one end. Falls with the leaf. On *Q. alba*. Adults emerge the next spring in May.

127. *Andricus flocci* (Walsh)

OAK FLAKE GALL. Similar but somewhat smaller more fluffy woolly masses scattered in large numbers on the under side of the leaf of *Q. bicolor* and *macrocarpa* attached to veins. They drop with the leaf and the wool weathers away during the winter exposing the 1-12 brown elliptical cells lying parallel with the leaf surface. Adults emerge the next spring during the first half of April.

128. *Diplolepis ignota* (Bass.)

Hemispherical brownish woolly mass on midrib on under side of leaf of *Q. rubra* and *velutina*. Made up of a cluster of easily detached separate angular galls which drop to the ground in the fall in Oct. before the leaves, each covered with a dense coating of wool. They are then fleshy and apparently solid as the larval cavity is very minute. Adults emerge the second and third springs in April.

129. *Callirhytis lanata* (Gill.)

c. Midrib clusters on leaf, the individual galls not so densely pubescent as to obscure the outline. These galls all develop in the late summer and drop to the ground before the leaves fall in the autumn. At this time they are fleshy, cutting like cheese, and apparently solid as the larval cavity

is very minute. During the winter or several winters on the ground the thick nutritive layer is used up by the larva leaving but a shell.

Galls angular.

A globular cluster, 8-20 mm. in diameter, on under side of petiole at its junction with the leaf blade, consisting of a dozen or more reddish-brown galls, closely pressed together, tuberculate at the distal end, flattened at the sides, tapering to the point of attachment, dropping to the ground in late Sept. or Oct. before the leaves. On trees of *Q. alba*. The emergence of the flies is in March or early April and distributed over a period of five or six years, none probably appearing until the second spring.

130. *Cynips weldi* Beut.

An elongated cluster, 20 mm. long by 10 mm. wide, on under side on basal half of leaf of *Q. bicolor*. About a dozen galls in the closely packed cluster, color light brown. They start to develop about Aug. 1 and begin to drop in late Sept. Adults issue the next spring in the latter half of April.

131. *Cynips nigricens* Gill.

Galls not angular.

Globular, tapering below into a short stalk for attachment. In an elongated mass 6-18 mm. long consisting of from a few to about 30 closely packed light brown galls on basal third of leaf on under side. Individual galls 4-6 mm. in diameter, the basal half rusty, distal half bare and smooth, dropping in Oct. On *Q. alba* and *macrocarpa*. Emergence is in late April but does not begin until the second spring and is distributed over at least three seasons.

132. *Cynips dimorphus* Beut.

Similar in size and shape but red in color, in an elongated less compact cluster on upper or lower side of large leaves on thrifty shoots of *Q. rubra*, dropping in Oct. Pubescent under lens. Adults emerged Apr. 22-May 11 the second spring and some hang over to emerge still later.

133. *Dryocosmus piperoides* (Bass.)

Similar in shape but smaller, 2-3 mm. in diameter, whitish, sparsely covered with sprawling hairs, dropping in

Oct. In loose elongated clusters of 2-12 galls on under side of the larger lower leaves on vigorous sprouts from stumps of *Q. alba*. Galls collected in Oct. 1914 gave adults in Nov. 1915 and some hang over to emerge a year later.

134. *Diplolepis capillata* Weld

BLACK OAK WHEAT. Individual galls about size and shape of a kernel of wheat with a fleshy knob at upper end, greenish, smooth, bare. When young concealed in the swelling midrib but later bursting out of a crack in a compact cluster of from a few to 40 galls often rupturing the leaf blade so as to be visible from above, dropping in Oct. On *Q. rubra* and *velutina*. Galls collected in Oct. 1916 gave adults Mar. 23-Apr. 22, 1918.

135. *Dryocosmus deciduus* (Beut.)

d. Galls of other sorts attached separately, one or many, on a leaf.

Galls 5 mm. or more in diameter.

OAK GRAPE GALL. Large, spherical, 12-18 mm. in diameter, greenish-white, translucent, attached to under side of leaf in May, resembling a white grape. Monothalamous, smooth, bare, succulent, sour, shriveling to a shapeless black mass after the adult emerges early in June. On *Q. rubra* and *coccinea*.

136. *Amphibolips nubilipennis* (Harris)

Spherical, 6-11 mm. in diameter, covered with short felt-like grayish pubescence, the central cell supported by a layer of short dark brown radiating fibers and the outer wall thick. Attached to veins on the under side of leaf, often several on a leaf, dropping in late Sept. or Oct. and then turning brown. On *Q. alba* and *macrocarpa*. From galls collected in Oct. 1916 some adults issued Nov. 23-Dec. 11, 1916, more Nov. 1-19, 1917, more Dec. 2, 1919, all females and wingless.

137. *Philonix nigra* (Gill.)

Galls less than 5 mm. in diameter.

Spherical with a fleshy protuberance at the apex, 3-4 mm. in diameter, smooth, bare, greenish or tinged with red, bursting out of a crack in the side of midrib or main vein on under side of leaf in the fall, dropping before the leaf,

but few on a leaf. Adults emerge the second or third seasons in June or July. On *Q. rubra*, *coccinea* and *velutina*.

138. *Dryocosmus rileyi* (Ashm.)

Spherical or slightly ellipsoidal, not depressed, 3 mm. in diameter, smooth, bare, yellowish-green or tinged with red. On upper or lower side of leaves of *Q. rubra*, dropping before the leaves in the fall. From galls collected in Oct. 1916 adults emerged Mar. 13-Apr. 6, 1918.

139. *Zopheroteras sphaerula* Weld

Spherical but depressed, pure white, bare, 3-4 mm. in diameter. On under side of leaf of *Q. alba* in the fall, dropping before the leaf. Adult probably emerges the second spring.

140. *Biorhiza rubina* Gill.

Similar, depressed, pure white, 4 mm. in diameter on under side of leaf of *Q. coccinea* in fall, dropping in Oct.

141. *Undetermined species*

WHITE OAK SPANGLE GALL. Button-shaped; 3-4.5 mm. in diameter, with a heavy rounded ring of tissue on under side between pedicel and rim, concave above with a slight nipple in center, covered with a whitish bloom. In large number on under side of leaves of *Q. alba*, dropping in the fall. The flies emerge in late March the second spring.

142. *Xystoteras poculum* Weld

SPANGLE GALL. Concave above with no papilla in center, convex below without ring-like ridge, covered with whitish bloom, 3 mm. in diameter. On *Q. bicolor* and *macrocarpa* in August. Not reared.

143. *Undetermined species*

JUMPING NEUROTERUS GALL. Small ellipsoidal galls in cup-like depressions on under side of leaf in large numbers, dropping in July or Aug. and then exhibiting the jumping movements for some time. Showing on upper surface of leaf as smooth convex elevations of a lighter color. Galls 1 mm. in length, truncate or saucer-shaped above with a papilla in center, light yellow in color. Adults emerge some time the next spring. On *Q. macrocarpa* and *bicolor*.

144. *Neuroterus saltarius* Weld

Globular, pure white, bare, smooth, 1.5 mm. in diameter, scattered on under side of leaf of *Q. alba* in the fall.

145. *Undetermined species*

Globular, red, finely pubescent with a scar at apex, 1 mm. in diameter, very numerous on under side of leaf of *Q. alba* in the fall.

146. *Undetermined species*

### Galls on Oak Arranged by Hosts.

#### Quercus alba.

- Root—  
 Ellipsoidal, 5 mm., brown, on rootlets  
 Cells in thick bark  
 Button-shaped, rugose, 10-5 mm.  
 Potato-like, brown  
 White fleshy cluster in May  
 Cluster of bullet galls
- Acorn—  
 Cells inside acorn
- Bud—  
 Pea-like, mottled, in spring  
 Fleshy green or brown vesicle in spring  
 Small, pointed, white, in spring  
 Small, pointed, brown, in fall  
 Green, inside bud in fall  
 Blister on bud scale in spring
- Stem—  
 Oak potato gall  
 Oak club gall  
 Oak seed gall  
 Oak fig gall  
 Round bullet gall  
 Gall unknown—probably bud or stem
- Leaf—  
 Oak petiole gall  
 On prolonged vein  
 Dwarfed leaves in early spring  
 Hollow, green, spherical, 3 mm.  
 Oak wart gall  
 Succulent thickened patch of blade
30. *Callirhytis elliptica* Weld  
 32. Agamic gen. of *Callirhytis fultilis* (O S)  
 36. *Callirhytis badia* (Bass.)  
 37. *Callirhytis maxima* Weld  
 38. *Trigonaspis radicola* (Ashm.)  
 42. *Disholcaspis globosa* Weld  
 52. *Undetermined species*  
 58. *Andricus pisiformis* Beut.  
 60. *Neuroterus vesicula* (Bass.)  
 61. *Diplolepis gemula* (Bass.)  
 62. *Callirhytis gemmiformis* (Beut.)  
 66. *Callirhytis mamillaformis* Weld  
 71. Sex. gen. of *Acraspis erinacei* (Beut.)  
 76-7. Sex. gen. and agamic gen. of *Neuroterus batatus* (Fitch)  
 79. *Callirhytis clavula* (O S)  
 82. *Callirhytis seminator* (Harris)  
 83. *Xanthoteras forticornis* (Walsh)  
 87. *Disholcaspis globulus* (Fitch)  
 93. *Bassetia gemmae* Ashm.  
 99. *Andricus petiolicola* (Bass.)  
 107. *Andricus chinquapin* (Fitch)  
 112. *Neuroterus minutus* (Bass.)  
 114. *Andricus utriculus* (Bass.)  
 115. Sex. gen. of *Callirhytis fultilis* (O S)  
 117. *Neuroterus majalis* (Bass.)

## QUERCUS ALBA—(Concluded.)

- |  |  |
|--|--|
| Elliptical cells in parenchyma,<br>1-2 mm. | 120. Neuroterus perminimus<br>Bass.              |
| Round cells in blade in rows<br>near vein  | 121. Undetermined species                        |
| Oak pea gall                               | 125. Acraspis pezomachoides<br>(O S)             |
| Hedgehog gall                              | 126. Agamic gen. of Acraspis<br>erinacei (Beut.) |
| Oak wool gall                              | 127. Andricus flocci (Walsh)                     |
| Cluster on petiole in fall                 | 130. Cynips weldi Beut.                          |
| Midrib cluster globular brown<br>galls     | 132. Cynips dimorphus Beut.                      |
| Midrib cluster globular whitish<br>galls   | 134. Diplolepis capillata Weld                   |
| Globular, 6-11 mm., felt-like              | 137. Philonix nigra (Gill.)                      |
| Depressed, pure white, in fall             | 140. Biorhiza rubina Gill.                       |
| White oak spangle                          | 142. Xystoteras poculum Weld                     |
| Globular, white, 1.5 mm.                   | 145. Undetermined species                        |
| Globular, red and hairy, 1 mm.             | 146. Undetermined species                        |

## Quercus bicolor.

- |  |   |
|--|---|
| Root—                                      |   |
| Ellipsoidal, brown, 5 mm., on<br>rootlets  | 29. Callirhytis ellipsoida Weld                   |
| Button-shaped, rugose, 10-5<br>mm.         | 36. Callirhytis badia (Bass.)                     |
| Potato-like, brown                         | 37. Callirhytis maxima Weld                       |
| Acorn—                                     |   |
| Fimbriate cup gall                         | 44. Andricus incertus Bass.                       |
| Cell in cup under acorn                    | 45. Undescribed species                           |
| Cells inside acorn                         | 51. Callirhytis lapillula Weld                    |
| Bud—                                       |   |
| Pea-like, mottled, in spring               | 58. Andricus pisiformis Beut.                     |
| Gray, spherical, 4 mm., in fall            | 59. Andricus deciduatus Weld                      |
| Fleshy green or brown vesicle<br>in spring | 60. Neuroterus vesicula (Bass.)                   |
| Small, pointed, white, in spring           | 61. Diplolepis gemula (Bass.)                     |
| Smooth, among leafy bracts                 | 65. Callirhytis flavohirta (Beut.)                |
| Green, inside bud, in fall                 | 67. Undetermined species                          |
| Stem—                                      |   |
| Cells under leaf scar                      | 72. Neuroterus escharensis<br>Weld                |
| Noxious oak gall                           | 78. Agamic gen. of Neuroterus<br>noxiosus (Bass.) |
| Slight enlargement of new<br>growth        | 81. Neuroterus distortus Bass.                    |
| Pine-cone oak gall                         | 84. Cynips strobilana O S                         |
| Pointed bullet gall                        | 88. Disholcaspis mamma<br>(Walsh)                 |
| Bassett's bullet gall, conical             | 89. Disholcaspis bassetti (Gill.)                 |
| Leaf—                                      |   |
| Oak petiole gall                           | 99. Andricus petiolicola (Bass.)                  |
| Rosette of bracts on leaf                  | 103. Andricus foliosus Weld                       |
| Midrib swellings in spring                 | 104. Sex. gen. of Neuroterus<br>noxiosus (Bass.)  |
| Small, woolly, numerous, in fall           | 106. Neuroterus floccosus (Bass.)                 |
| On prolonged vein                          | 107. Andricus chinquapin (Fitch)                  |
| Oak wart gall                              | 115. Sex. gen. of Callirhytis fu-<br>tilis (O S)  |
| Elliptical cells in parenchyma             | 119. Neuroterus papillosus Beut.                  |

## QUERCUS BICOLOR—(Concluded.)

- |                         |                                |
|-------------------------|--------------------------------|
| Oak flake gall, woolly  | 128. Diplolepis ignota (Bass.) |
| Midrib cluster in fall  | 131. Cynips nigricens Gill.    |
| Spangle galls           | 143. Undetermined species      |
| Jumping Neuroterus gall | 144. Neuroterus saltarius Weld |

## Quercus macrocarpa.

- |  |   |
|--|---|
| Root—                                      |   |
| Cells in thick bark                        | 33. Compsodryoxenus illinoisen-<br>sis Weld |
| Button-shaped, rugose, 10-5<br>mm.         | 36. Callirhytis badia (Bass.)               |
| Potato-like, brown                         | 37. Callirhytis maxima Weld                 |
| Bud—                                       |   |
| Pea-like, mottled, in spring               | 58. Andricus pisiformis Beut.               |
| Fleshy green or brown vesicle<br>in spring | 60. Neuroterus vesicula (Bass.)             |
| Small, pointed, white, in spring           | 61. Diplolepis gemula (Bass.)               |
| Smooth, among leafy bracts                 | 65. Callirhytis flavohirta (Beut.)          |
| Green gall inside bud in fall              | 67. Undetermined species                    |
| Stem—                                      |   |
| Pine-cone oak gall                         | 84. Cynips strobilana O S                   |
| Pointed bullet gall                        | 88. Disholcaspis mamma<br>(Walsh)           |
| Leaf—                                      |   |
| Oak petiole gall                           | 99. Andricus petiolicola (Bass.)            |
| Midrib swelling                            | 102. Callirhytis flavipes (Gill.)           |
| Small, woolly, numerous, in fall           | 106. Neuroterus floccosus (Bass.)           |
| Dwarfed leaves in spring                   | 113. Neuroterus vernus Gill.                |
| Cells along veins in early<br>spring       | 122. Neuroterus fugiens Weld                |
| Spiny oak gall                             | 123. Acraspis villosa Gill.                 |
| Ellipsoidal Acraspis gall                  | 124. Acraspis macrocarpa Bass.              |
| Oak flake gall, woolly                     | 128. Diplolepis ignota (Bass.)              |
| Midrib cluster of globular<br>brown galls  | 132. Cynips dimorphus Beut.                 |
| Globular, 6-11 mm., felt-like              | 137. Philonix nigra (Gill.)                 |
| Spangle galls                              | 143. Undetermined species                   |
| Jumping Neuroterus gall                    | 144. Neuroterus saltarius Weld              |

## Quercus rubra.

- |                                      |  |
|--------------------------------------|--|
| Root—                                |  |
| Globular, brown, bark thin           | 31. Eumayria floridana Ashm.                     |
| Local swelling in bark               | 34. Callirhytis rubida Weld                      |
| Cluster small oval galls             | 39. Callirhytis enigma Weld                      |
| Cluster wedge-shaped galls           | 40. Dryocosmus favus Beut.                       |
| Onion-shaped, in group               | 41. Biorhiza caepuliformis<br>(Beut.)            |
| Acorn—                               |  |
| Acorn plum gall                      | 43. Amphibolips prunus<br>(Walsh)                |
| Acorn pip gall                       | 46. Agamic gen. of Callirhytis<br>operator (O S) |
| Green, globular, 3-4 mm., in<br>fall | 49. Undescribed species                          |
| Stony mass inside acorn              | 50. Callirhytis fructuosa Weld                   |
| Flower—                              |  |
| Woolly white mass                    | 53. Sex. gen. of Callirhytis op-<br>erator (O S) |
| Like green peas                      | 54. Callirhytis pulchra (Bass.)                  |

## QUERCUS RUBRA—(Concluded.)

- Bud—  
 Large, spotted, in axils, in fall  
 Fusiform, long-stalked, ribbed  
 Green, inside bud in fall
- Stem—  
 Horned knot gall  
 Oak knot gall  
 Banded bullet gall  
 Cluster small ribbed galls in spring
- Leaf—  
 Larger empty oak apple  
 Smaller empty oak apple  
 Midrib swelling  
 Spherical, 10-2 mm., free-rolling cell  
 Hemispherical sessile blister  
 Elongated, pointed blister at edge  
 Hard, lenticular, two-celled  
 Papillose patches on leaf  
 Woolly mass on midrib  
 Midrib cluster globular red galls  
 Midrib cluster, green, like wheat  
 Oak grape gall  
 Globular with fleshy knob  
 Rosy sphere, 3 mm., in fall
- Root—  
 Globular, brown, bark thin  
 Local swelling in bark  
 Local swelling in bark  
 Cluster wedge-shaped galls
- Acorn—  
 Acorn plum gall  
 Pip gall in spring, honeydew  
 Stony mass inside acorn
- Flower—  
 Woolly white mass  
 Like green peas
- Bud—  
 Cluster small greenish galls in spring  
 Globular, inside bud in spring  
 Globular, under trees in spring
- Stem—  
 Cells in twig—no gall  
 Oak knot gall  
 Terminal swelling of new growth
55. *Amphibolips cookii* Gill.  
 57. *Callirhytis gallaestriatae* Weld  
 68. Undetermined species  
 74. *Callirhytis cornigera* (O S)  
 75. *Callirhytis punctata* (Bass.)  
 91. *Dryocosmus imbricariae* (Ashm.)  
 92. *Callirhytis gemmaria* (Ashm.)  
 96. *Amphibolips inanis* (O S)  
 97. *Andricus singularis* (Bass.)  
 101. *Callirhytis tumifica* (O S)  
 109. *Diplolepis palustris* (O S)  
 110. *Diplolepis cinereae* (Ashm.)  
 111. *Diplolepis notha* (O S)  
 116. *Callirhytis rugosa* (Ashm.)  
 118. *Callirhytis modesta* (O S)  
 129. *Callirhytis lanata* (Gill.)  
 133. *Dryocosmus piperoides* (Bass.)  
 135. *Dryocosmus deciduus* (Beut.)  
 136. *Amphibolips nubilipennis* (Harris)  
 138. *Dryocosmus rileyi* (Ashm.)  
 139. *Zopheroteras sphaerula* Weld  
 31. *Eumayria floridana* Ashm.  
 34. *Callirhytis rubida* Weld  
 35. *Callirhytis marginata* Weld  
 40. *Dryocosmus favus* Beut.  
 43. *Amphibolips prunus* (Walsh)  
 47. *Callirhytis balanosa* Weld  
 50. *Callirhytis fructuosa* Weld  
 53. Sex. gen. of *Callirhytis operator* (O S)  
 54. *Callirhytis pulchra* (Bass.)  
 63. *Callirhytis rugulosa* (Beut.)  
 69. Undetermined species  
 70. Undetermined species  
 73. *Bassettia ceropteroides* (Bass.)  
 75. *Callirhytis punctata* (Bass.)  
 80. *Callirhytis scitula* (Bass.)

## Quercus coccinea.

## QUERCUS COCCINEA—(Concluded.)

Cluster fig-shaped galls in spring	85. <i>Andricus formosus</i> (Bass.)
Pubescent bullet in spring	90. <i>Callirhytis ventricosa</i> (Bass.)
Banded bullet gall	91. <i>Dryocosmus imbricariae</i> (Ashm.)
Cluster small ribbed galls in spring	92. <i>Callirhytis gemmaria</i> (Ashm.)
Leaf—	
Small oak apple, 8 mm.	98. <i>Andricus osten sackenii</i> (Bass.)
Midrib swelling	100. <i>Callirhytis pigra</i> (Bass.)
On prolonged vein	108. <i>Diplolepis pedunculata</i> (Bass.)
Elongated, pointed blister at edge	111. <i>Diplolepis notha</i> (O S)
Oak grape gall	136. <i>Amphibolips nubilipennis</i> (Harris)
Globular with fleshy knob	138. <i>Dryocosmus rileyi</i> (Ashm.)
Depressed, white, in fall	141. Undetermined species

**Quercus velutina.**

Root—	
Onion-shaped, in group	41. <i>Biorhiza caepuliformis</i> (Beut.)
Acorn—	
Acorn plum gall	43. <i>Amphibolips prunus</i> (Walsh)
Pip gall on young acorn in fall	48. <i>Callirhytis balanoides</i> (Weld)
Green, globular, 3-4 mm., in fall	49. Undescribed species
Flower—	
Woolly white mass	53. Sex. gen. of <i>Callirhytis</i> op- erator (O S)
Bud—	
Melon-shaped, 4 mm., in spring	64. Undescribed species
Stem—	
Oak knot gall	75. <i>Callirhytis punctata</i> (Bass.)
Banded bullet gall	91. <i>Dryocosmus imbricariae</i> (Ashm.)
Cluster small ribbed gall in spring	92. <i>Callirhytis gemmaria</i> (Ashm.)
Leaf—	
Large spongy oak apple, adults in June	94. <i>Amphibolips spongifica</i> (O S)
Large spongy oak apple, adults in November	95. <i>Amphibolips confluentus</i> (Harris)
Midrib swelling	100. <i>Callirhytis pigra</i> (Bass.)
Spherical, 10-2 mm., free-roll- ing cell	109. <i>Diplolepis palustris</i> (O S)
Elongated, pointed blister at edge	111. <i>Diplolepis notha</i> (O S)
Woolly mass on midrib	129. <i>Callirhytis lanata</i> (Gill.)
Midrib cluster, green, like wheat	135. <i>Dryocosmus deciduus</i> (Beut.)
Globular with fleshy knob	138. <i>Dryocosmus rileyi</i> (Ashm.)

**Quercus imbricaria.**

- |                                      |  |  |
|--------------------------------------|--|--|
| Flower—                              |  |  |
| Woolly white mass                    |  | 53. Sex. gen. of <i>Callirhytis</i> operator (O S) |
| Bud—                                 |  |  |
| Cylindrical, in spring               |  | 56. <i>Amphibolips ellipsoidalis</i> Weld          |
| Stem—                                |  |  |
| Seed-like, in cracks in bark in fall |  | 86. <i>Andricus excavatus</i> Ashm.                |
| Pubescent bullet in spring           |  | 90. <i>Callirhytis ventricosa</i> (Bass.)          |
| Leaf—                                |  |  |
| Midrib swelling                      |  | 100. <i>Callirhytis pigra</i> (Bass.)              |
| Swollen petiole                      |  | 105. Undetermined species                          |

**Quercus palustris.**

- |                        |  |   |
|------------------------|--|---|
| Bud—                   |  |   |
| Cylindrical, in spring |  | 56. <i>Amphibolips ellipsoidalis</i> Weld |

SUMMARY

Galls on plants other than oak.....		28
Galls on oak.....		
Root galls.....	14	
Acorn galls.....	10	
Flower galls.....	2	
Bud galls.....	17	
Stem galls.....	22	
Leaf galls.....	53	118
		<hr/>
Total numbered galls in key.....		146
Undetermined.....	14	
Alternating generations.....	5	
		<hr/>
		19
		<hr/>
Total number of determined species in the Chicago area.....		127
On plants other than oak.....	28	
On oak.....	99	