

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE PRODUCING SUBTERRANEAN GALLS ON OAK.

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Few galls on the roots of oaks, produced by the hymenopterous family Cynipidae, have ever been described. The present paper is an attempt to bring the American instances together from the scattered literature and to make considerable additions from the records of the bureau and from the writer's personal field notes made in various parts of the United States during a period of several years collecting. To the seven species already described as producing underground galls on oak, twenty-three new species are here added, several changes made in synonymy, revisions given of four of the smaller genera, and field notes included on eight additional subterranean galls not reared as yet, the galls being described without name. The paper is a contribution from the Branch of Forest Insects, Bureau of Entomology, and was undertaken at the suggestion of Mr. S. A. Rohwer, specialist in forest hymenoptera, to whom the writer is indebted for many helpful suggestions and for access to the records and collections in the Division of Forest Insects and in the United States National Museum.

Not all the species mentioned in the subjoined key to the galls have been reared, but in order to make the paper as complete as possible it was thought best to include these unreared galls under the writer's note numbers without generic determination in order that others may be stimulated to look for them and rear them if possible. Many interesting cases of alternation of generations are no doubt connected with galls on the roots of oak, and much biologic work will remain to be done when all the species have been discovered. Little collecting has as yet been done in the Rocky Mountain region, and new host oaks will be found for many of our better known eastern species.

In order better to study the characters used in classification, a specimen of each species here treated was dissected and the parts mounted in balsam.¹ Drawings were then made with a projection

¹ For this purpose alcoholic material can be used or pinned specimens can be relaxed by soaking overnight in 70 per cent alcohol to which some caustic potash has been added. Dissections are then made under binocular, the parts being removed to 70 per cent alcohol in a watch glass. After a few minutes this is drawn off by a fine pipette and replaced by absolute alcohol, then by carbol-xylol, and then parts are mounted in balsam.

microscope and certain ratios determined, using the width of the head as a convenient firmly chitinized base. The length of the mesonotum is the distance from the front margin of the mesoscutum to the hind end of the scutellum, these two remaining connected in a successful dissection. The mesonotum ratio is obtained by dividing this distance by the width of the head. The lengths of antenna and ovipositor were found by stepping dividers set for convenience at 5 mm. along the curves of the drawing and the ratio found by dividing by the width of the head. Some preliminary study indicates that these ratios are fairly constant regardless of the size of the individual in the species. The interocular area ratio can be determined from balsam slide or from pinned specimen by measuring the distance between the compound eyes at level of the antennae and dividing by length of eye as measured by a filar micrometer with a 2-inch or with a two-thirds inch objective.

In this paper galls are not regarded as a part of a species any more than is the work of a leaf-mining lepidopteron or the galleries of an engraver beetle, characteristic as such work may be of the species in question. A gall is a part of a plant and most cecidologists now hesitate to attach to such abnormalities alone binomial Latin names. One can not predict with any certainty what genus is responsible for a gall. Thus when it seems desirable to mention new unreared galls they will be referred to simply by number to avoid adding useless names to the bibliography. The classification of the Cynipidae will progress only by a study of the adults. The more biology that can be correlated the better, and the work of a species may often be the means of its quickest recognition, but the taxonomy of the group must rest on structural characters in the insects themselves. This policy would logically lead to the exclusion of the galls from the type material of a species, and yet it seems desirable that those examples of the work which the author associates with a certain species should be preserved and kept separate for future reference. There is no way to designate them at present except to call them types; and with this meaning only in mind, type labels have been attached to the galls which the author associates with the species. This association is absolutely certain in those rare cases where the identical gall from which the type fly came has been preserved, and this may be properly designated as a type gall. In most cases the association is a matter of judgment. Usually a lot of galls are put in a breeding cage together, and it is impossible to select the one from which a given adult emerged, and in some cases the type flies are cut from galls and the fragments are worthless for purposes of identification and others like them from the same or even different locality are the only ones at hand. They are at best only illustrations of what the author considers to be the work of the species; and with this meaning only

attached, they are labeled as cotypes or paratypes in the collection, but they are not listed as type material in the body of the paper or in Museum type book.

In conformity with this view, the authorship of a species must be credited not to the one who first described and named the gall but to the one who first described the maker of the gall.

The number of specimens from which a new species has been described may be seen at the end of each description where the number of specimens measured to get size and range in length is indicated. Type material of all the new species has been deposited in the United States National Museum, and the number of specimens so deposited may be seen under the heading "*Type.*" The balance has been retained by the author for reference or exchange, for in many cases the material is sufficiently abundant so that exchanges can be arranged with other museums or workers. When the type material consists of specimens bred from different hosts or from different localities or consists of both reared and captured specimens, a "type" has been selected and the rest called "paratypes." When the series has been reared from a single polythalamous gall it is obvious that they are of equal value, and here the term "cotype" has been applied. The term "cotype" is also used for a series reared from a lot of monothalamous or polythalamous galls all collected on the same host from one locality. Few errors are likely to arise in this application of the term.

The arrangement of genera here given follows that of Dalla Torre and Kieffer in the 1910 monograph in *Das Tierreich* (Lief. 24), and their usage has been followed also in numbering the segments of the abdomen, calling the first free tergite of the apparent abdomen the second, the first being fused with the first sternum to form the petiole. The term parapsides is often here used for parapsidal grooves. Figures 23 and 25 are from negatives in the Division of Forest Insects, eastern station: the rest are from photographs by the author. Unless otherwise noted the galls are represented in natural size.

The names used for the oaks are those of the seventh edition of Gray's Manual for the northeastern United States, and for other regions what seemed to be the best names available. Throughout the paper the same name has been consistently applied to a given oak, but the name used may not in all cases be the one on which all botanists would agree. A study of the host relationships of the gall-making Cynipidae will undoubtedly throw light on the relationships of the oaks. Some species attack many oaks and others discriminatingly confine themselves to a single kind. One rootgall-forming species here treated occurs on at least ten species, all in the red oak group, and no doubt will be found on still others. One Californian oak has over forty different galls upon it, none of which

occurs on any other oak in that region, so that finding one of these galls the identity of the oak is known at once. A few of these galls occur on a rare oak in southern Arizona and a few on an oak on the Channel Islands, showing, were botanical evidence not at hand, the close relationship of these local and isolated oaks. It is no uncommon thing to find herbarium sheets of oaks wrongly determined, the evidence being a gall accidentally included. There is one American oak on which no Cynipid galls have yet been found. The author hopes at some time to be able to make a contribution to the botany of the oaks based on field observations on the galls.

SYNOPSIS OF SUBTERRANEAN CYNIPID GALLS ON OAK.

1. True root galls p. 190.
2. Underground woody stem swellings, polythalamous, cells under bark p. 190.
3. Cells in the thickened bark at crown of tree p. 191.
4. Detachable galls at crown p. 191.

1. Galls on the true roots.

On small fibrous rootlets:

Single or few in cluster, brown, ellipsoid, 5 mm. in diameter, under large tree in forest, 1-5 cm. underground. *Q. bicolor* ..27. *Callirhytis ellipsoidea* Weld, p. 227.

Similar but on *Q. alba*28. *Callirhytis elliptica* Weld, p. 228.

On roots 5-15 mm. in diameter:

Large brown woody, single or agglomerated into irregular masses as big as a man's fist. *Q. stellata*14. *Odontocynips nebulosa* Kieffer, p. 210.

Similar to above but on *Q. lyrata* and *Q. virginiana*.

Probably No. 14. See note, p. 211.

Fleshy, fig-shaped, white, in clusters, in spring, drying to a dark brown mass.

Q. virginiana, geminata35. *Belonoecema treatae* Mayr, p. 238.

2. Underground stem swelling, woody, polythalamous, cells under bark, which is not greatly thickened.

Large abrupt swelling covered with normal bark, at base of sprouts or on small saplings. *Q. agrifolia, californica, wislizeni*41. *Weld No. 1501*, p. 243.

Abrupt, irregularly rounded, 1-3 cm. in diameter, brown, *Q. velutina, marilandica, texana*29. *Eumayria floridana* Ashmead, p. 230.

Similar in size and shape but perhaps fleshy when fresh. Terminal on etiolated sprouts of a deciduous oak in stone pile or under humus, in Colorado, New Mexico. Arizona38. *Weld No. 706*, p. 242.

Similar gall on *Q. emoryi*39. *Weld No. 707*, p. 242.

Slight one-sided enlargement on stems 1 cm. or less in diameter. Cells thin-walled, nested under bark. Adults found in September. *Q. fendleri*. Colorado, New Mexico33. *Compsodryoxenus tenuis* Weld, p. 235.

Similar on larger stems of *Q. gambelii*. Adults found in April. Colorado.

30. *Bassettia tenuana* Weld, p. 232.

Slight spindle-shaped enlargements at base of current year's shoots, in fall. Cells not twice as long as broad, not nested but scattered. *Q. chapmani, stellata*.

34. *Compsodryoxenus humilis* Weld, p. 236.

Similar in external appearance but cells elongated, at least twice as long as broad placed lengthwise. *Q. chapmani*31. *Bassettia floridana* Ashmead, p. 233

3. Cells in thickened bark at crown of tree.

Occurring in large numbers forming swollen areas in the bark:

On main roots of trees of *Q. alba*, *prinus*.

21. *Callirhytis futilis* (Osten Sacken) (agamic generation), p. 221.

On main roots of tree or where bending limbs touch ground. *Q. chrysolepis*.

17. *Callirhytis hartmani* Weld, p. 214.

At base of sprouts or saplings. *Q. macrocarpa*.

32. *Compsodryoxenus illinoisensis* Weld, p. 234.

Small cells in swollen and distorted bases of sprouts. *Q. breviloba*, *stellata*.

13. *Xystoteras contorta* Weld, p. 209.

Thin-walled, nested cells in one-sided gradual swelling on small shoots of *Q. fendleri*.....See No. 33, p. 235.

Similar but on *Q. gambelii* and adults in spring.....See No. 30, p. 232.

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

Ellipsoidal cells protruding abruptly from the bark in rows or groups or single and detachable, sometimes confluent, brown. *Q. catesbaei*, *myrtifolia*, *texana*.

23. *Callirhytis ovata* Weld, p. 222.

Cells in thick brown bark, forming a smooth abrupt local swelling of a small area of one to five square centimeters, number of cells evident from outside. *Q. coccinea*, *rubra*.....24. *Callirhytis rubida* Weld, p. 224.

Similar local swelling, number of cells not so apparent. *Q. coccinea*.....

25. *Callirhytis marginata* Weld, p. 225.

4. Detachable galls at crown (either on main stem or at base of sprouts from stumps or on "runner oak" sprouts).

Single or scattered in small numbers:

Monothalamous—

Hemispherical, rugose to nearly smooth, 10–15 mm. in diameter, leaving a radiating scar when detached, woody when mature. *Q. alba*, *macrocarpa*, *bicolor*, *prinus*, *stellata*, *chapmani* 18. *Callirhytis corallosa* Weld, p. 216.

Fleshy, thin-walled, gray, densely short pubescent, spherical or with pointed apex. In spring. *Q. chapmani*, *margaretta* 12. *Biorhiza ocala* Weld, p. 207.

Small, pointed at apex, shell thin and brittle. *Q. fendleri*. Colorado.

37. Weld No. 704, p. 242.

Spherical, 5 mm. in diameter, wall thin, surface brown and pubescent. On a deciduous oak at Las Vegas, New Mexico....40. Weld No. 708, p. 243.

Hemispherical, 2–3 cm. in diameter, brown when mature, disintegrating in time leaving a rough cell on bark persisting for years. *Q. wislizeni*, *californica*, *agrifolia*.....See No. 22, p. 222.

Oval, brown, on thick bark at crown. *Q. catesbaei*, *texana*, *myrtifolia*.

See No. 23, p. 222.

Onion-shaped, longitudinally striate, pointed at apex, reddish-brown to white. *Q. rubra*, *velutina*, *marilandica*, *texana*.....See No. 11, p. 206.

Polythalamous—

Large, rounded, brown, up to 9 cm. in diameter, when mature like rotten wood inside with many thin-walled brittle cells. *Q. alba*, *macrocarpa*, *bicolor*, *prinus*.....19. *Callirhytis maxima* Weld, p. 217.

Similar to above on *Q. stellata*.....Probably No. 19, p. 217.

Smooth, brown, 15 mm. in diameter, spongy interior decays leaving a mass of loosely-connected ribbed woody cells. *Q. rubra* 36. Weld No. 405, p. 242.

Hemispherical, dense tawny yellow tissue inside with a few cells at base.

Q. chrysolepis.....See No. 26, p. 226.

In clusters:

When fresh fleshy, pure white, or rosy red at apex, fig-shaped, growing quickly in spring and after insects emerge either rotting or shriveling into a hard but not woody mass. Galls of this sort, producing the sexual generation, seem to be limited to the genera *Trigonaspis* and *Belonocnema*. While the flies differ, it is not possible at present to separate the different kinds of galls except as the host oak and locality may be known. Other hosts for these species listed and other species will no doubt be found—

On *Q. alba, stellata, chapmani*....8. *Trigonaspis radicola* (Ashmead), p. 203.

On *Q. douglasii*.....7. *Trigonaspis obconica* Weld, p. 202.

On *Q. gambelii*, in Santa Catalina Mountains, Arizona.

9. *Trigonaspis fumosa* Weld, p. 204.

On *Q. reticulata* in Santa Catalina Mountains, Arizona..Probably No. 9, p. 205.

On roots of an unknown oak in Utah and Colorado.

10. *Trigonaspis pumiliventris* (Bassett), p. 205.

On *Q. virginiana*. Fresh galls probably similar to above and drying to a dark brown hard mass.....See No. 35, p. 238.

On *Q. laceyi*, Texas. Dry galls 5 mm. in diameter, smooth.

42. *Weld No. 407*, p. 242.

On *Q. laceyi* and *virginiana*, surface pubescent.....43. *Weld No. 408*, p. 243.

Tissue not so spongy, at least part of gall ultimately becoming brittle or woody and persisting:

Individual galls less than 6 mm. in diameter—

Cluster of 30-100. Cells fig-shaped with a slender stalk, ribbed surface and brittle wall, 6 mm. long by 4 mm. in diameter. *Q. rubra, texana, catesbaei, myrtifolia*....20. *Callirhytis enigma* Weld, p. 219.

On *Q. stellata*. Appearance when fresh unknown. Disintegrates and leaves about 20 hard brittle cells.....Probably No. 19, p. 217.

Cluster of scores of elongated angular wedge-shaped cells with rounded ends which decay away. Cluster measures up to 6 cm. in diameter and resembles ear of corn. White when fresh, becoming tan and brittle. *Q. rubra, texana, catesbaei, marilandica, brevifolia, nigra, myrtifolia*.

6. *Dryocosmus favus* Beutenmueller, p. 200.

Onion-shaped, pointed, longitudinally striate, white or rosy when fresh, later tan and brittle. Base of sprouts of *Q. rubra, velutina, texana, marilandica, falcata, laurifolia, catesbaei, brevifolia, myrtifolia*.

11. *Biorhiza caepuliformis* (Beutenmueller), p. 206.

Individual gall, averaging more than 7 mm. in diameter—

Hemispherical cluster up to 8 cm. in diameter, consisting of from 1 to 35 galls, each 2-3 cm. in diameter. White and fleshy, later tan, rough, cavernous within and disintegrating in time, so as to leave a rough cell at base, persisting on bark for years. Monothalamous. *Q. wislizeni, californica, agrifolia*.

22. *Callirhytis apicalis* (Ashmead), p. 222.

Hemispherical cluster of a few galls, measuring up to 3 cm. Tissue of gall dense, tawny yellow. *Q. chrysolepis*.

26. *Callirhytis fulva* Weld, p. 226.

Bullet galls on base of shoots, resembling *Disholcaspis globulus* (Fitch) in appearance and texture. Inner cell distinct and often free—

On *Q. alba*, galls often reddish...3. *Disholcaspis globosa* Weld, p. 196.

On *Q. prinus*.....See note under No. 3, p. 197.

On *Q. stellata* and *margaretta*. Galls reddish and becoming wrinkled on surface when dry.

5. *Disholcaspis terrestris* Weld, p. 193.

On *Q. breviloba*.....4. *Disholcaspis brevinota* Weld, p. 197.
 On *Q. gambelii*. Larger and more irregular than those of *globulus*.
 2. *Disholcaspis lacuna* Weld, p. 195.

Bullet galls of harder texture and no separable inner cell—

Blunt, reddish, 7-8 mm. in diameter. *Q. gambelii*.
 1. *Disholcaspis acetabula* Weld, p. 194.
 Similar on *Q. grisea*, *toumeyii*, *reticulata* and probably other oaks in
 the Rocky Mountain region..Probably No. 1. See note, p. 195.

TRUE STEM GALLS ERRONEOUSLY DESCRIBED AS ROOT GALLS. POLYTHALAMOUS.

Globose, hard, densely granular inside. On *Q. reticulata*, *arizonica*, *oblongifolia*,
toumeyii.....15. *Andricus rhizoxenus* (Ashmead), p. 211.
 Irregularly oblong, grayish, brown, and very hard and granular inside. Large
 Unknown oak. Mexico.....16. *Andricus championi* Ashmead, p. 212.

CAPTURED SPECIES REPORTED IN LITERATURE AS FROM UNKNOWN GALLS ON ROOTS OF OAK.

Biorhiza nigra Fitch. See Ashmead, Trans. Amer. Ent. Soc., vol. 9, Proc., p. 24,
 and Riley, Science, new ser., vol. 1, p. 462. Later Ashmead placed this species in
 the genus *Xystoteras*.

Philonix fulvicollis Fitch.

Philonix nigricollis Fitch.

All three species were captured on snow. It is more than probable that they
 are not from root galls at all, but from leaf galls, as all the species of *Xystoteras*
 and *Philonix* whose galls are known come from leaf galls, which drop to the
 ground in late autumn. In several cases the adults are known to emerge in
 November or December after snow has begun to fly. They are very resistant
 to cold, are long lived, and oviposit in buds on pleasant days in winter.

Genus DISHOLCASPIS Dalla Torre and Kieffer.

KEY TO THE SPECIES OF DISHOLCASPIS HEREIN MENTIONED.

1. Scutellum not rugose on disk, but lacunose, i. e., with shallow contiguous pits
 in each of which is a setigerous puncture (best seen in balsam). Rocky Mount-
 ain species..... 2
 Scutellum rugose, with setigerous punctures..... 3
2. Scutellum with shallow median groove on disk, head somewhat angular on sides,
 malar space striate, face with only a narrow dark transverse band across base of
 antennae, cubitus distinct.....*acetabula* Weld, p. 194.
 Scutellum without median groove, sides of head rounded, malar space not striate,
 whole face infuscated, cubitus and apex of areolet very pale...*lacuna* Weld, p. 195.
3. Areolet reaching one-fourth way to basal and cubitus nearly reaching basal, the
 gap being less than length of areolet.....*globosa* Weld, p. 196.
 Areolet reaching only one-sixth to one-fifth way to basal, gap between basal and
 proximal end of cubitus greater than length of areolet..... 4
4. Mesoscutum distinctly broader than long (length about three-fourths width).
brevinota Weld, p. 197.
 Mesoscutum length and breadth subequal or else longer than broad..... 5
5. Ocellar area black, pronotum infuscated on sides, mesopleura with an oblique
 black line across, mesoscutum infuscated between parapsides clear to scutellum,
 second abdominal tergite with broad dorsal infuscation, but red on sides.
globulus (Fitch).
6. Ocellar area not infuscated, no black line across sides of pronotum or across meso-
 pleura, the infuscation between parapsides stops abruptly two-thirds way back
 to scutellum, second abdominal tergite with narrow dorsal black stripe and
 black on hind margin, sides red.....*terrestris* Weld, p. 198.

1. DISHOLCASPIIS ACETABULA, new species.

Plate 28, fig. 1.

Agamic female.—Reddish brown; eyes, ocelli, flagellum, area about parallel lines, areas about lateral lines, base of scutellum, mesosternum, metathorax and propodeum black, abdomen infuscated dorsally. Head finely rugose, face with setigerous punctures and a transverse dark band through base of antennae, clypeus truncate, malar space striate, four-tenths eye, interocular area one and one-third times as broad as high, transfacial line 1.2–1.4 times facial, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third and fourth subequal, 5–12 gradually shorter, last twice as long as preceding. Mesoscutum smooth with setigerous punctures, parapsides deep, smooth, reaching half-way, wider behind, median black area extending two-thirds way back to scutellum, black area about each lateral line. Scutellum granular under lens, in balsam seen to be pitted with shallow contiguous depressions in each of which there is a setigerous puncture, faintly rugose behind, arcuate base opens out on to disk on which is a shallow median longitudinal groove. Propodeum with almost perfect semicircular ridge reaching two-thirds way to upper margin. Legs stout, coxae infuscated, hind femur spindle-shaped, tibia longer than tarsus, claws with tooth. Wings hyaline, veins black, first abscissa of radius angled above middle with spur, areolet reaching one-third and cubitus two-thirds way to basal, surface brown pubescent, margin ciliate. Abdomen smooth and shining, not compressed, second segment making about one-half in living specimen, well-separated patches of pubescence on sides, seventh sparsely pubescent, ventral spine tapering, in balsam twice as long as broad, ovipositor when dissected out over one and one-fifth times length of antenna. Using width of head as a base the length of mesonotum ratio is 1.5–1.6; antenna, 2.35; ovipositor, 2.85–3.0; wing, 4.5–4.8.

Length of 58 pinned specimens ranges from 4.0–5.3 mm. Average, 4.5 mm.

Type.—Cat. No. 22574, U.S.N.M. Forty cotypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—Brownish-red hard bullet galls in clusters at base of small sprouts, hidden by débris. Individual galls are 6–9 mm. in diameter, sessile, somewhat elongated, usually blunt, but sometimes pointed at apex. Surface finely wrinkled in preserved specimens. Interior of dense cellular tissue with a central thick-walled non-separable stony white larval cell. Exit hole in side. Occur in fall.

Type locality.—Colorado Springs, Colorado, in the Garden of the Gods. The writer found old empty galls there June 30, 1915, and fresh galls not yet full grown. On November 14, 1918, Mr. J. H.

Pollock collected these galls on a small oak at Palmer Park, but emergence was almost complete, as only one dead fly was found inside the galls. On August 24, 1919, he collected the galls from which the type flies were obtained and sent in as Hopkins U. S. No. 10781 *v*¹. They were from Garden of the Gods and then contained pupae. Living flies were cut out of the galls on September 12 and October 3 and 7. The normal emergence is probably in October. The Division of Forest Insects has old galls collected at Manitou in January, 1914, by Mr. B. T. Harvey. The host species of this Colorado material is not determined. But the writer has collected similar galls on *Q. gambelii* on the Sandia Mountains, New Mexico, at 2,933 meters (8,800 feet), and in Arizona at Flagstaff and Williams and in the Santa Catalina and Huachuca Mountains.

Note.—Similar galls have been seen on *Quercus grisea* Liebmann in Sandia Mountains, New Mexico, at Prescott, Arizona, and Alpine, Texas; on *Q. toumeyii* Sargent at Patagonia, Arizona; and on *Q. reticulata* Humboldt, Bonpland, and Kunth in Huachuca Mountains, Arizona.

2. DISHOLCASPIIS LACUNA, new species.

Plate 28, fig. 2.

Agamic female.—Reddish-brown to black; eyes and median area on face from ocelli down black; thorax with median black area on mesoscutum tapering to a point on scutellum and two lateral black areas enclosing lateral lines; metathorax, propodeum, and dorsal part of abdomen black. Vestiture whitish. Frons coriaceous, a short median groove below median ocellus and then a ridge to antennae, face pubescent and with coarser sculpture, interocular area from 1.3–1.5 times as broad as high, malar space a trifle less than half eye and equal to ocellocular space, mandibles 2-toothed, palpi 5- and 3-segmented, antennae reddish, filiform, 13-segmented, fourth and fifth equal, 6–11 gradually decreasing, last twice as long as preceding and incompletely divided below middle by a transverse furrow. Mesoscutum smooth with setigerous punctures, the two black, tapering, half-complete parapsides lying in the colored stripes between the median and lateral black areas, parallel and lateral lines smooth and bare. Scutellum in balsam lacunose with a setigerous puncture near front margin of each crescent-shaped depression, arcuate furrow at base smooth and not continuous with steep impressed areas on sides. Propodeum with carinae forming a semicircle almost touching upper margin. Hind leg with femur as broad as coxa, tarsus shorter than tibia, second shorter than fifth, claws with tooth. Wings hyaline with yellowish-brown veins. a brown knot just beyond costal hinge, first abscissa of radius angled, areolet large (its apex and cubitus very pale), surface pale pubescent, margin ciliate. Abdomen smooth

and shining, second segment making two-fifths and with large light-colored pubescent areas at base well-separated dorsally, but reaching hind margin at sides, exposed part of seventh pubescent, ventral spine tapering, twice as long as broad, ovipositor when dissected out longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.5; antenna, 2.5; ovipositor, 3.1; wing, 4.3.

Length of 20 pinned specimens, 3.7–5.1 mm. Average, 4.3 mm.

Type.—Cat. No. 22575, U.S.N.M. Ten coty pes.

Host.—*Quercus gambelii* Nuttall.

Gall.—Globular bullet galls in clusters at base of strong sprouts similar to those of *Disholcaspis terrestris* Weld on *Quercus stellata* Wangenheim. When fresh the galls are yellowish tinged with more or less rosy red, fleshy, 12–20 mm. in diameter, often distorted by mutual pressure. Inside there is a distinct but not loose thin-walled white larval cell.

Type locality.—Williams, Arizona. The type galls were collected August 1, 1916, and living adults were cut out of them on September 15, 1916. Similar galls were collected at Flagstaff, July 25, Grand Canyon, July 27, and near Monument Rock in the canyon east of Santa Fe, New Mexico, on July 18. Old galls were seen at Prescott, Arizona, April 14, 1918, and on June 27, 1918, at Soldier Camp in the Santa Catalina Mountains, both old and fresh ones, the latter in all stages of growth, only a few being full grown.

3. DISHOLCASPIS GLOBOSA, new species.

Plate 29, fig. 4.

Agamic female.—Black; first segment of antenna, ring around eye, vertex, two stripes on mesoscutum outside parapsides, basal third of space between parapsides, disk of scutellum except dark spot in center, legs except infuscated coxae, reddish-brown. Head coriaceous on frons with slight median ridge above antennae, faint radiating ridges about mouth, transfacial line 1.4 times facial, interocular area 1.35 times as broad as high, malar space over one-third eye, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third and fourth subequal, 5–12 gradually shorter, last over twice as long as preceding and incompletely divided by a transverse suture below middle so that in some positions it would be counted as 14. Mesoscutum smooth with setigerous punctures, parapsides deep, smooth, broader behind and reaching two-thirds way to front, anterior and parallel lines bare and polished. Scutellum rugose with setigerous punctures, the rugose arcuate furrow at base with two deeper places at sides. Propodeum with semicircular ridge above petiole reaching two-thirds way to upper margin. Wings hyaline, veins brown, first abscissa of radius angled, areolet large, reaching one-fourth distance to

basal along prolonged axis of cubitus, cubitus reaching at least two-thirds distance to basal, surface pubescent, margin ciliate, first and second cross-veins slightly clouded. Abdomen smooth and shining, longer than high, second segment making three-fourths with well-separated large pubescent patches on sides, ventral spine tapering, in balsam three times as long as broad, ovipositor when dissected out longer than antenna. Using width of head as base, the length of mesonotum ratio is 1.4–1.5; antenna, 2.5–2.7; ovipositor, 3.4; wing, 4.6–4.8.

Length of 28 pinned specimens, 2.3–5.0 mm. Average, 4.0 mm.

This species is close to *Disholcaspis globulus* (Fitch) from which it may be separated by the following contrasts:

<i>globosa.</i>	<i>globulus.</i>
Clypeus distinctly emarginate.	Clypeus almost truncate.
Head rounded laterally.	Head somewhat angular.
Ratio transfacial to facial line less than 1.5.	Ratio between 1.5 and 1.6.
Well developed black spot on disk.	Only trace of spot on disk of scutellum.
Areolet reaching one-fourth way to basal.	Areolet reaching one-sixth to one-fifth way.
Cubitus reaching two-thirds way to basal.	Cubitus reaching one-half way to basal.

Type.—Cat. No. 22576, U.S.N.M. Fourteen cotypes.

Host.—*Quercus alba* Linnaeus.

Gall.—Similar to those of *Disholcaspis globulus* (Fitch) in appearance, but less regular in shape and dark red or sometimes yellowish. They occur in clusters at base of 2–3-year-old sprouts from stumps and are almost always hidden by débris. Scattering small ones are sometimes seen exposed a few inches above the surface. They are closely crowded together about the base of sprouts and there may be from two or three to as many as forty in the cluster. Each is 8–12 mm. in diameter, the interior spongy, with a distinct thin inner shell.

Type locality.—Fort Sheridan, Illinois. The writer has also collected these galls at Highland Park, Ravinia, Evanston, Glen Ellyn, and New Lenox, Illinois; at Ithaca, New York; and at Tuskahoma, Oklahoma. About Chicago the galls have been found containing pupae on September 12, and with adults October 3. Adults emerge in the late October and early November. At Ithaca pupae were found as early as September 1. The American Museum of Natural History has galls from Bartow, New York, collected by E. B. Southwick.

Note.—Similar galls were collected on *Quercus prinus* Linnaeus at East Falls Church, Virginia, August 31, 1919, and contained pupae September 13.

4. DISHOLCASPIIS BREVINOTA, new species.

Agamic female.—Red; eyes, ocelli, area inclosing parallel lines, areas inclosing lateral lines black, propodeum, base of scutellum and dorsal part of abdomen infuscated. Head finely rugose, malar space

striate, interocular area 1.1–1.3 times as broad as high, malar space less than 0.4 eye, transfacial line 1.5–1.6 times facial, clypeus truncate, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third and fourth subequal, 5–12 gradually shorter, last twice as long as preceding. Pronotum not infuscated on sides. Mesoscutum length to breadth as 21:27, smooth and with setigerous punctures, median black spot around narrow smooth parallel lines bilobed behind and reaching two-thirds way back to scutellum, lateral line areas black, parapsides not reaching over half-way. Scutellum rugose, with arcuate furrow at base in which are deeper places on sides. Propodeum with semicircular ridge above petiole touching upper margin. Mesopleura without oblique dark line across middle. Hind tarsi infuscated but exposed parts of coxae are not. Wings hyaline, veins black, first abscissa of radius angled above middle, areolet reaching one-fifth way to basal, cubitus reaching two-thirds. Abdomen not compressed, second segment infuscated dorsally and on hind margin, pubescent on sides, ovipositor when dissected out one and one-fifth times antenna. Using width of head as a base, the length of mesonotum ratio is 1.39; antenna, 2.2; ovipositor, 2.4; wing, 4.27.

Length of two pinned specimens, 3.9 and 4.1 mm.

Closely related in coloration to *Disholcaspis terrestris* Weld, but separated by the much broader thorax.

Type.—Cat. No. 22577, U.S.N.M. One cotype.

Host.—*Quercus breviloba* Sargent.

Gall.—A bullet gall at base of sprouts similar to those of *Disholcaspis terrestris* Weld on *Quercus stellata* Wangenheim.

Type locality.—Austin, Texas. Collected a few galls October 30, 1917. Cut out three living flies and one pupa November 13. Collected galls also at Boerne, Texas, October 27, and one gall opened on that date contained a pupa which transformed before November 10. The normal emergence is probably in the late fall.

5. DISHOLCASPIIS TERRESTRIS, new species.

Plate 28, fig. 3.

Agamic female.—Head, thorax, and legs reddish-brown, but eyes, tip of mandibles, antennae, base of scutellum, metathorax, and propodeum black and black areas inclosing lateral lines and a median black area inclosing parallel lines and reaching back to middle of parapsides. Pubescence tawny. Abdomen very dark clear red, second tergite infuscated dorsally and on hind margin. Head coriaceous with radiating striae on malar space which is about four-tenths of eye and about equal to ocellocular space, interocular area 1.15–1.3 times as broad as high, facial line two-thirds of transfacial, axial four-tenths of transfacial, mandibles 2-toothed, palpi 5- and 3-

segmented, antennae filiform, 13-segmented, fourth and fifth subequal, 6-12 becoming shorter, last twice preceding with transverse suture below middle on one side incompletely separating it into two parts. Mesoscutum only a trifle broader than long, smooth with setigerous punctures, parapsides smooth, deep, wider behind, not extending over half-way, anterior and lateral lines polished black and bare. Scutellum broader than long, length 0.58 the width of head, rugose with setigerous punctures, groove at base also rugose, faintly margined behind. Propodeum with the median distance less than the width of petiolar fossa, with a semicircular ridge above petiole almost touching upper margin. Legs stout, hind femur broader than coxa, tarsus shorter than tibia, second shorter than fifth, claws with tooth. Wings subhyaline with distinct brown veins, second cross-vein slightly clouded, first abscissa of radius angled and with spur, areolet reaching about one-fifth and cubitus slightly over half-way to basal, surface pubescent, margin ciliate. Abdomen smooth and shining, not compressed, longer than high, second segment occupying three-fifths, with two large well-separated pubescent patches nearly reaching hind margin on sides, ventral spine in balsam tapering, over three times as long as broad, ovipositor when dissected out nearly one-third longer than antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.49; antenna, 2.6; ovipositor, 3.6; wing, 4.5.

Length of 89 pinned specimens, 3.8-5.7 mm. Average, 4.8 mm.

Type.—Cat. No. 22578, U.S.N.M. Type and 58 paratypes.

Host.—*Quercus stellata* Wangenheim and *Quercus margaretta* Ashe.

Gall.—Globular bullet galls up to 17 mm. in diameter in clusters on runner sprouts or sprouts from stumps at surface of ground hidden by loose débris. When fresh finely mottled with red, but when dry almost uniformly red and finely wrinkled. Inside is a distinct thin-walled central cell in the center of spongy brown tissue.

Type locality.—Ironton, Missouri. Type galls collected on *Q. stellata*, October 5, 1917, when a few of best developed contained adults and the rest pupae. The flies issued in breeding cage out of doors at Evanston, Illinois, November 6, November 11, and December 1, 1917, and living adults were also found in cage February 19 and March 11, 1918. Galls were also collected at Poplar Bluff, Missouri, October 8, 1917, and 18 flies were found alive in cage on December 18, the thermometer having registered -14° F. on December 10. Collected galls at Webster Groves, Missouri, September 9, 1915, and cut out living adults November 2. Have collected these galls also at Hoxie, Hot Springs, and Texarkana, Arkansas; and at Palestine and Trinity, Texas; Dothan, Alabama; Marianna, Tallahassee and Madison, Florida—all on *Q. stellata*. In the United States National Museum are galls from Shovel Mount, Texas, collected by F. G.

Schaupp on roots of post oak, with the label "Issued Febr. '97," but there are no flies with the galls.

The same species occurs on runner sprouts of *Q. margaretta*. A large number of the galls containing pupae were collected at Ocala, Florida, October 30, 1919, and adults began to issue in the breeding cage in early December. Galls at Green Cove Springs, Florida, contained adults on November 23. Flies from galls on *margaretta* are a little smaller (average of 24 was 4.1 mm.) than those from *stellata* (average of 65 was 5.1 mm.).

Genus DRYOCOSMUS Giraud.

6. DRYOCOSMUS FAVUS Beutenmueller.

Plate 29, figs. 5, 6, 7.

Dryocosmus favus BEUTENMUELLER, Ent. News, vol. 22, 1911, p. 197.—FELT, N. Y. State Mus., Bull. 175, 1915, p. 48; Key to Amer. Ins. Galls, N. Y. State Mus., Bull. 200, 1918, p. 60.

This species was originally described from Louisiana and Pennsylvania from galls on *Quercus rubra* Linnaeus and *Q. coccinea* Muenchhausen. The writer has collected galls on *Q. rubra* in Illinois at River Grove, Willow Springs, Evanston, Winnetka, Ravinia, and Fort Sheridan; and at Ironton, Missouri; Hot Springs, Arkansas; and Plummer Island, Maryland. He has also taken the galls on six other host oaks not previously recorded, as follows:

Q. catesbaei Muenchhausen at Jacksonville, Palatka, Madison, Marianna, Ocala, Clearwater, Florida, and Troy, Alabama.

Q. marilandica Muenchhausen at Marianna, Florida.

Q. nigra Linnaeus at Gainesville, Florida.

Q. brevifolia Sargent at Marianna and St. Petersburg, Florida.

Q. myrtifolia Willdenow at Daytona, Florida.

Q. texana Buckley at Boerne and Kerrville, Texas.

The appearance of the fresh galls has never been described. As many as 400 often occur in a cluster, which may measure 6 cm. in diameter (fig. 6) and is found just at or below the surface of the ground and is usually hidden by débris. The cluster sometimes entirely surrounds the host stem when the latter is not more than 1 cm. in diameter. In the fall about one-half of the clusters found are galls that are just starting in early October or nearly full-grown later in the month and containing larvae and they still contain them as late as November 14 and through the winter. These fresh galls are white and fleshy, smooth on the surface, blunt-pointed at the tip (fig. 5). The other half are white and juicy or just beginning to turn brown. These contain adults as early as September 15 about Chicago, and they were still inside the galls on November 14. These galls were put out of doors in breeding cage and three flies issued by December 1, and on December 28 twenty-seven were found, the thermometer

having registered -14° F. in the interval. On the 19th of the next February over 200 were found alive in the cage, which had been buried up in the snow for six weeks without a thaw. On March 12 there were two more out. In Florida pupae were found in galls on October 11, 21, 23, and November 3, and the earliest record of finding adults in the galls was November 20 and the earliest emergence December 1.

The life history suggested from the above data is that the galls start in the autumn and get their full size quickly the first season and that the larvae do not transform until the next autumn when the galls are over a year old. After the larvae transform, the galls soon turn brown, the proximal part about the larval cell becomes hard and brittle, and during the winter the distal fleshy half of the gall becomes converted into soft spongy granular tissue through which the adults can easily chew their way (fig. 7) and it finally decays away entirely leaving the hard wedge-shaped bases containing the cells to persist for years. The adults either emerge in very late autumn or very early spring, and are wonderfully resistant to cold. But if there is an alternating generation it is unknown.

Genus TRIGONASPIS Hartig.

(Sexual generation.)

In the Dalla Torre and Kieffer monograph of 1910 the sexual generation of this genus is represented in the American fauna by only one species, namely, *radicis* Ashmead. Two more are here described and two are here transferred to *Trigonaspis* from other genera.

The galls of this group are all of the same type. They are all white or rosy, fleshy, fig-shaped, polythalamous, in hemispherical clusters at base of tree or stump. They reach maturity quickly in the spring, and with the escape of the winged flies either decay or shrivel up into an unrecognizable hard but not woody dark mass. They can not at present be distinguished except as host oak and locality may be known. Galls of *Belonocnema treatae* Mayr are also of this type but are said to occur in clusters on the small roots away from the trunk of the tree.

KEY TO SEXUAL GENERATION OF TRIGONASPIS

1. Wings with at least 4 distinct dark spots. A red and black species from California.....*obconica* Weld, p. 202.
Wings clear or at most faintly clouded, not spotted. Not red and black..... 2
2. Wing with very faint clouds in apical cell. Female with interocular area at least 1.4 times as broad as high. Hypopygium with spindle-shaped ventral spine.....*radicola* (Ashmead), p. 203.
Wing clear. Female with interocular area not over 1.3 times as broad as high even when measured in widest place. Ventral spine scarcely broadened..... 3

Host.—*Quercus douglasii* Hooker and Arnott.

Gall.—An underground cluster of fleshy white galls at base of stumps similar to galls of *T. radicola* (Ashmead), but with longer and more slender pedicels. After flies emerge the galls decay. In May.

Type locality.—Los Gatos, California. Paratypes from Paso Robles also.

Biology.—Collected at Los Gatos May 14, 1918, when galls contained pupae and exit holes showed where some adults had already emerged. In breeding cages three males issued May 16 and three more on May 17. At Paso Robles on May 6 galls contained larvae and pupae. In cage four adults issued by May 13, six by May 25, and one June 2.

8. TRIGONASPIS RADICOLA (Ashmead).

Plate 30, fig. 8.

Dryophanta radicola ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 116, No. 5.—BRIDWELL, Trans. Kan. Acad. Sci., vol. 16, 1899, p. 204.—COOK, 29th Rept. Dept. Geol. & Nat. Res. Indiana (1904), 1905, p. 836, fig. 29; Proc. Ind. Acad. Sci., (1904), 1905, p. 225.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 30, 1911, p. 354, pl. 15, figs. 9-10.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 5 and p. 38.—FELT, Key to Amer. Ins. Galls N. Y. St. Mus., Bull. 200, 1918, p. 54, fig. 87, 9-10.

Dryophanta radiceicola DALLA TORRE and KIEFFER, in Wytsman Gen. Ins. Cynipidae, 1902, p. 53, No. 36.

Amphibolips radicola Ashmead, COOK, Ohio Nat., vol. 4, 1904, p. 117, figs. 76 a and b.

Diplolepis radicola Ashmead, DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 360.

The galls of this species occur in clusters of a dozen or less, bursting out through the bark just below the surface of the ground in places where there is an abundance of humus at the base of tree or stump of *Quercus alba* Linnaeus. They are of white, soft, succulent tissue, rounded at end, but compressed into wedge shapes on sides, sometimes rosy if exposed. They develop rapidly in spring, becoming full grown and maturing the flies in about a month and then decaying. The writer has collected the galls at Miller, Indiana; Winnetka and Fort Sheridan, Illinois. Growing galls can be found in late May and the flies issue June 12-26, although in the late season of 1912 the first to issue came out on June 22, and they continued to come out until July 1. Males issue first. The fact that in 36 cases these galls were found at the base of stumps whose sprouts carried last year's oak-fig galls leads to the suspicion that this may be the alternating sexual generation of the wingless *Biorhiza forticornis* (Walsh). In one case there was failure to find them, and in one they were found where there were no fig galls. The *radicola* adults issuing in June are good fliers and are thought to fly to developing sprouts where they lay eggs and produce the fig galls in the fall. From these wingless adults (all females) issue in winter (in late December or in February and

March in breeding cage) to crawl down to base of same sprouts and lay eggs to produce this *radicola* gall in the spring. This cycle is not proven, and it remains for others to work out the details of the life history. Brodie was the first to suggest a connection between the fig gall and a root gall when in Annals of Report of Clerk Board Forestry, Ontario, 1896 (pp. 114-116), he says *forticornis* burrows into ground finding rootlets a few inches down in which they oviposit and in which are formed subterranean galls, but he does not describe them further. *Radicola* is not on "rootlets," but at base of tree.

In the forest insect collection at the United States National Museum are three males and three females of what seem to be this species reared in March, 1897, at Shovel Mount, Texas, by F. G. Schaupp "on roots of post oak."

9. TRIGONASPIS FUMOSA, new species.

Female.—Dark brown, front legs and thorax lighter. Head broader than thorax, very finely rugose, pubescent on face, clypeus truncate and reflexed, interocular space measured at top less than 1.1 times as broad as high, malar space .43 eye and with malar groove, antennocular space equal to ocellocular, palpi 5- and 3- segmented, mandibles with two sharp teeth, antennae 14-segmented, third longest, last not one and one-half times preceding, distal third not thinner. Pronotum smooth. Mesoscutum smooth and polished with two percurrent parapsides, no trace of lateral or anterior lines and no median although so transparent that the dark space between two underlying muscles might be mistaken for one. Scutellum finely and evenly rugose except for a small polished area on disk, with a few scattered punctures, six-tenths width of head, transverse arcuate furrow at base with faint median ridge, not margined behind, with two impressed areas on sides. Propodeum with two outwardly bent ridges inclosing an area smooth in center nine-tenths as broad as high, narrowed at top to two-thirds its widest width. Spiracular areas rugose, punctate, spiracles elliptical. Mesopleura smooth and polished except for finely striate area above, sparsely pubescent below. Legs pubescent except for bare areas on coxae, hind tarsi shorter than tibiae with second longer than fifth and claws with tooth. Wings clear with distinct brown veins, areolet present, surface pubescent except at base, margin ciliate. Abdomen smooth and polished, second segment with scattered pubescence on sides. Ventral spine tapering and in balsam slightly spindle-shaped. Ovipositor when dissected out not three-tenths length of antenna, ovarian eggs well developed. Using width of head as base, the length of mesonotum ratio is 1.46; antenna, 3.6; ovipositor, 1.3; wing, 4.7.

Male.—Thorax and legs darker than in female. Antennae with third segment strongly bent, broken but probably 15-segmented.

Length of six females, 3.4–4.1 mm. Average, 3.9 mm. One male, 3.2 mm.

Type.—Cat. No. 22584, U. S. N. M. Six cotypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—White, fleshy, fig-shaped, polythalamous, in clusters on root at base of tree like those of *T. radicola* (Ashmead). They rot after flies emerge.

Type locality.—Santa Catalina Mountains, Arizona. Galls collected June 27, 1918, on the Mount Bigelow trail near Soldier Camp at an elevation of 2,350 meters. Many adults had already emerged, and flies and pupae were found inside when galls were cut open. One fly was captured on oak at Mount Bigelow lookout tower.²

Similar galls were seen in same locality on *Q. reticulata* Humboldt, Bonpland, and Kunth, and adults were emerging on June 26, but unfortunately none were preserved.

10. TRIGONASPIS PUMILIVENTRIS (Bassett).

Dryophanta pumiliventris BASSETT, Trans. Amer. Ent. Soc., vol. 17, 1890, p. 69, Male.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 54.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Cynipidae, 1902, p. 53, No. 34.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 20, 1904, p. 26; vol. 30, 1911, p. 354.—THOMPSON, Cat. Amer. Ins. Galls, 1915, pp. 8, 38.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 62.

Diplolepis pumiliventris Bassett, DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 361.

Belonocnema colorado GILLETTE, Ent. News, vol. 4, 1893, p. 210, Female.—COCKERELL, Ent. Student, vol. 1, 1900, p. 9.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Hym. Cynipidae, p. 80, No. 1; Das Tierreich, Lief. 24, 1910, p. 725.

Belonocnema colorado Gillette, BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 279.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 36.

Trigonaspis radialis ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 113, No. 1, Male and female.—COCKERELL, Ent. Student, vol. 1, 1900, p. 10.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Hym. Cynipidae, 1902, p. 56, No. 6; Das Tierreich, Lief. 24, 1910, p. 397.—THOMPSON, Cat. Amer. Ins. Galls, 1915, pp. 5, 42.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

D. pumiliventris was described from males only and "from an unknown source" although there is a specimen in the American Entomological Society collection marked "cotype" bearing the label "Ct." The galls are described as "shrunken and distorted, probably soft and succulent when fresh, polythalamous, probably on oak." The writer has not seen the types but this description fits almost any preserved root gall of *Trigonaspis* very well. Bassett thought, however, that they were produced in the axils of leaves. Perhaps a branch had been inclosed in the sending to aid in the determination of the host plant and he thought they had fallen from

² Since the above was written the writer has seen in the United States National Museum collection a gall cluster with three females and one male from Williams, Arizona, bred in June, 1901 (Barber and Schwarz); one gall and a male (with 15-segmented antennae) from Pecos, New Mexico, bred June 22 (M. Grabham); and a female captured at light June 17, Pecos, New Mexico (Cockerell).

the axils of this twig. Three flies from Bassett are in the United States National Museum from the Ashmead collection, and Ashmead had placed them in the genus *Trigonaspis* in the case. They can not be separated in size, coloration, or sculpture from the males of *radicis* Ashmead. Using the width of the head as a base, the length of mesonotum ratio in *pumiliventris* is 1.5 and 1.6; in *radicis*, 1.5; wing ratio in *pumiliventris*, 5.5 and 5.6; in *radicis*, 5.27; length of antenna ratio in *pumiliventris*, 4.77; in *radicis*, 5.01; third segment of antenna in *pumiliventris* measures 0.61, 0.63, 0.67, 0.69 of width of head; in *radicis*, 0.59, 0.61.

T. radicis was described from one male and four female specimens from Utah, June 20, 1885, the gall being on the roots of an unknown oak. The types are in the United States National Museum together with ten others determined by Ashmead as *radicis* collected by E. A. Schwarz at four different localities in Utah in June, 1893. The writer has twenty males and two females which agree with these. They were taken at Colorado Springs, Colorado, on July 1, 1915, by sweeping on scrub oaks. As the males of these can not be separated from those of *pumiliventris* Bassett, *radicis* becomes a synonym of the older name.

B. colorado was described from a single female captured June 18, 1892, at Dolores, Colorado. Through the kindness of Professor Gillette the writer has been able to examine the type and finds that the front tibiae lack the characteristic spur of a *Belonocnema* and that it is a *Trigonaspis* and can not be separated from the female of *radicis* Ashmead. The head is not widened behind the eyes, the malar space has a groove and is 0.39 length of eye (in types of *radicis*, 0.36-0.40). Claws with tooth. Wing without spots or clouds. Wing ratio, 5.0 (in *radicis*, 4.82). *Mesonotum* ratio, 1.6 (in *radicis*, 1.56). Both have transfacial line about 1.1 times facial. Both have interocular area about 1.1 times as broad as high. Both have antennocular space less than ocellocular. As *radicis* is a synonym of *pumiliventris* based on a comparison of the males, and the female *colorado* agrees with the female of *radicis*, both *radicis* Ashmead and *colorado* Gillette become synonyms of *pumiliventris* Bassett.

Genus BIORHIZA Westwood.

11. BIORHIZA CAEPULIFORMIS (Beutenmueller).

Plate 30, fig. 9.

Andricus caepuliformis BEUTENMUELLER, Ent. News, vol. 22, 1911, pp. 67-70.

Biorhiza caepuliformis Beutenmueller, BEUTENMUELLER, Canad. Ent., vol. 49, 1917, p. 348.— FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 66.

The galls of this species occur singly or in clusters of as many as 30 at the base of vigorous young saplings or sprouts from stumps, usually hidden by débris and often inclosed in a cylindrical case

made by ants about the cluster, as the galls give off an exudate when young of which the ants are fond. They burst out through a crack in the bark and when detached leave a characteristic cup-shaped cavity in the bark. Fresh galls are full grown about Chicago by August 1 and contain pupae by September 12 and the adults by October 3. In breeding cages the flies emerged November 23-26 and in greater numbers by December 2. In Florida pupae were seen October 10, 17, and 23, the earliest adults in the galls November 20 and the earliest emergence was December 1. The alternating generation is unknown.

The species was originally described from *Quercus velutina* Lamarck from Indiana. The writer has taken it on *Q. velutina* at Poplar Bluff and Ironton, Missouri; Hot Springs and Texarkana, Arkansas; and Falls Church, Virginia. He has also taken it on eight other host oaks as follows: On *Q. rubra* Linnaeus at Fort Sheridan, Ravinia, Winnetka, Evanston, River Grove, Glenn Ellyn, Willow Springs, and New Lenox, Illinois, and at Tuskahoma, Oklahoma; on *Q. marilandica* Muenchhausen at Hot Springs, Arkansas; Palestine, Texas; and Marianna, Florida. On *Q. texana* Buckley at Boerne and Kerrville, Texas. On *Q. falcata* Michaux at Dothan, Alabama. On *Q. laurifolia* Michaux at Daytona and Gainesville, Florida. On *Q. catesbaei* Michaux at Marianna, Florida. On *Q. brevifolia* Sargent at Marianna, Madison, Jacksonville, Ocala, and Gainesville, Florida. On *Q. myrtifolia* Willdenow at Carrabelle and Daytona, Florida. About Chicago these galls seem to be much more abundant some seasons than others.

From these galls come only agamic females. The antennae were described as 14-segmented. In this case the last is one and three-fourths times the preceding and often bears a more or less distinct transverse suture so that it is sometimes 15-segmented. The galls are largest on *Q. rubra*, and 30 flies from these galls in writer's collection measure 3.9-5.2 mm. Average, 4.6 mm. Using width of head as a base, the length of mesonotum ratio is 1.0; antenna, 2.7-2.9; ovipositor, 4.3-4.7; wing, 2.5-2.6. Ten flies from *Q. laurifolia* galls measure 3.6-4.2 mm. Average, 3.9 mm.

12. BIORHIZA OCALA, new species.

Female.—Head, thorax, and flagellum black; rest of body reddish-brown. Head broader than high, as broad as thorax, cheeks not wider than eyes, malar space about 0.3 eye and without furrow, palpi 5- and 3-segmented, antennae 14-segmented, third longest, fourth 0.7-0.8 third and equal to 1 plus 2, fifth 0.6 third, last one and one-half times preceding, distal third tapering to tip, mandibles three-toothed. Interocular area as broad as high. Mesoscutum smooth and shining with two complete, narrow, smooth parapsides

and a few microscopic hairs along grooves. Scutellum rugose with transverse arcuate furrow at base divided by a median ridge which extends back to hind margin, faintly margined behind and overhanging the metathorax. Propodeum with two outwardly curved ridges inclosing a rugose area broader than high and only half as wide at top as at widest part. Spiracular areas rugose. Mesopleura polished except for sparsely pubescent patches above and below. Metapleura rugose with distinct oblique groove above. Legs inconspicuously pubescent, hind tarsi much shorter than tibia, second segment shorter than fifth, claws simple. Wings dusky, with distinct brown veins all of which are margined by clouds especially those forming marginal cell which has clear spot in center, areolet distinct, cubitus reaching basal, surface pubescent, margin ciliate. Abdomen smooth and polished, second tergite with scattered pubescence on sides, making up over two-thirds length, ventral spine in balsam broadened at base and hairy with acuminate apex, ovipositor when dissected out only little over half length of antenna, ovariañ eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.5-1.8; antenna, 2.8; ovipositor, 1.5; wing, 4.1.

Male.—Similar to female in color, malar space one-eighth eye, interocular area three-fourths as broad as high, antennae longer, 15-segmented, third longest and not excavated, rest gradually getting shorter to the last which is shortest, gradually tapering toward end from about fifth, 3.9-4 times width of head. Median longitudinal ridge on scutellum evident only in transverse groove at base. Veins of wing not so heavily clouded as in female.

Range in length of seven females, 4.0-4.8 mm.; average, 4.4 mm. Of eight males, 3.7-4.3 mm.; average, 4 mm.

Type.—Cat. No. 22582, U. S. N. M. Type female, allotype, 3 male and 3 female paratypes.

Host.—*Quercus chapmani* Sargent.

Gall.—A thin-walled, fleshy gall growing singly and sessile on the side of roots which are 5-15 mm. in diameter. Galls are globular or with a point at apex, 4-6 mm. in diameter and covered with a very short dense pubescence, grayish if exposed or pale yellow if buried in the sand. In early spring.

Type locality.—Ocala, Florida. Collected April 17, 1914, when some flies had already emerged and others were cut out of the galls alive. They were not different from several males and females captured on April 17 and 18 at Ocala by sweeping on *Q. chapmani*, and these captured specimens form part of the type series.

Genus XYSTOTERAS Ashmead.

13. XYSTOTERAS CONTORTA, new species.

Plate 30, figs. 10, 11.

Agamic female.—Abdomen and eyes black, rest of body tan, with dorsal part of head and distal part of antennae infuscated. Head broader than thorax, coriaceous, shining, face with setigerous punctures, axial line 0.55 of transfacial, interocular area broader than high, malar space about one-third eye and with groove, ocellocular space longer than antennocular, antennae 13-segmented, first two not stouter than rest, second as long as a fourth. 5–13 gradually incrassated and bearing sense organs, last one and one-half times as long as preceding. Mesoscutum smooth and polished without trace of grooves, broader than long, concave on hind margin and united to scutellum without trace of suture except laterally on scapulae. Scutellum faintly coriaceous, with transverse groove at base in which is a median depression, rounded behind. Propodeum without carinae. Legs pale, hind tarsus shorter than tibia, second shorter than fifth, claws with weak tooth. Wings hardly protruding beyond tip of abdomen and here considered abbreviated but with complete and distinct venation, first abscissa of radius angled and a cloud from angle includes free part of subcosta, areolet complete, cubitus reaching basal, surface pubescent and margin ciliate. Abdomen compressed, broader than long, as long as head and thorax together, second segment making about one-third, ventral spine very short, ovipositor when dissected out one and four-tenths times antenna. Using width of head as a base, the length of mesonotum ratio is 1.0; antenna, 2.2; ovipositor, 3.1; wing, 2.4.

Length of 6 pinned specimens, 1.7–1.8 mm.

The only other described species in this genus is black, and the wings hardly reach base of abdomen. If wings are considered normal, it would run in the key to *Neuroterus*, to which it is not closely related.

Type.—Cat. No. 22585, U.S.N.M. Four cotypes.

Host.—*Quercus breviloba* Sargent, *Quercus stellata* Wangenheim

Gall.—Gnarled woody swellings at base of young sprouts which are only a few millimeters in diameter. Covered with normal bark. Polythalamous.

Type locality.—Austin, Texas. Collected galls on *Q. breviloba* October 30, 1917, both old galls and fresh ones with pupae in. Living adults were cut out on December 12. Collected one gall on *Q. stellata* at Palestine, Texas, October 16, 1917, and cut out one fly December 1.

Genus ODONTOCYNPS Kieffer.

14. ODONTOCYNIPS NEBULOSA Kieffer.

Plate 31, fig. 12.

Odontocynips nebulosa KIEFFER, Bull. Laboro. Zool. Portici, vol. 4, 1910, p. 112, Female.—DALLA TORRE, in Krancher Ento. Jahrb., 20 Jahrg., 1910, p. 176.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.—BEUTENMUELLER, Ent. News, vol. 29, 1918, p. 329.

This new genus and species was described in 1910 from flies only, captured in Georgia by Klug and in Texas by Boll. The types are in the Museum of Zoology, Berlin.

The writer recognized the genus in March, 1917, in specimens from Woodstock, Georgia, bred from a root gall on oak received by Doctor Felt and submitted to William Beutenmueller for examination. The flies agree fairly well with the published description of *nebulosa* Kieffer. As the only description of the gall is the brief characterization by Doctor Felt in 1918 in his Key to American Insect Galls (p. 54) as "Irregular, polythalamous root gall, diameter 3.5 cm. on *Q. minor*," a more extended description may be given here.

Host.—*Quercus stellata* Wangenheim.

Gall.—On the roots of young shoots that come up under larger trees. These shoots are only 30–90 cm. high and often occur in large numbers so that their tangled roots form a mat, and it is on these horizontal roots where the thicket is dense enough to accumulate humus that the galls are found. They occur on roots 5–15 mm. in diameter and are sometimes 5–10 cm. underground. Single galls are globular, 10–13 mm. in diameter, but they are usually aggregated into irregular lobed polythalamous masses as large as a man's fist or 8 cm. in diameter. They are covered with smooth bark, light colored like the normal bark of roots, but brown when dry. They are easily cut when fresh, but very hard and woody when dry. The larval cavities are about 6–8 mm. in diameter and the walls about 2 mm. thick. Exit holes 3 mm. in diameter. They are often attacked by whitish wingless plant lice attended by a pale yellowish ant.

Habitat.—The writer first collected the galls on September 9, 1915, at Webster Groves, Missouri, on *Quercus stellata*. They contained pupae on October 3, and adults October 26, but a few had a thick nutritive layer instead. The galls were buried in soil in greenhouse to determine date of emergence and still contained living flies January 17, 1916, but by March 20 all were gone. On October 4, 1917, the same locality was again visited and only one gall found where they had been very abundant two years before. Collected galls at Hoxie, Arkansas, October 10, 1917, and cut out living flies November 16. At Hot Springs, Arkansas, galls contained pupae on October 12. From others collected at Palestine, Texas, October 16, flies emerged

indoors the next spring from February 20 to March 8. Old galls were seen at Marianna, Florida, October 11, 1919.

Agamic female.—The antennae of *nebulosa* are described as 16-segmented, but these are really 15-segmented, the last over twice as long as preceding and incompletely divided by a transverse groove a little below the middle so that in certain positions it would be counted as two.

Note.—Found a similar old gall on *Quercus lyrata* Walter and from it cut out a moldy fly belonging to the genus *Odontocynips*; and it is probably the same species, as these two oaks have many galls in common, but until reared it is better not to publish *lyrata* as a host of *nebulosa*.

At Cuero, Texas, October 23, and Austin, Texas, October 30, similar galls were found on roots of *Quercus virginiana* Miller, and a fragment of an adult in an old gall showed it to be due to an *Odontocynips*. Three stages of the galls were observed: 1, old galls with numerous exit holes where flies had emerged the previous spring; 2, fresh galls containing pupae; 3, fresh galls not distinguishable from the above but containing a thick transparent mass of nutrient material with a barely visible larval cavity. This suggests that the galls take two years to develop. Similar empty galls were seen at Kerrville, Texas, July 21, 1918. Until adults can be reared it is better not to publish *virginiana* as a host of *nebulosa*, however.

Genus ANDRICUS Hartig.

15. ANDRICUS RHIZOXENUS (Ashmead).

Plate 32, fig. 14.

Callirhytis rhizoxenus ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 132, No. 35.—COCKERELL, Ent. Student, vol. 1, 1900, p. 9.—THOMPSON, Cat Amer. Ins. Galls, 1918, pp. 5, 30.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

Callirhytis rhizoxena Ashmead, DALLA TORRE and KIEFFER, in Wytzman Gen. Ins. Cynipidae, 1902, p. 67, No. 28; Das Tierreich, Lief. 24, 1910, p. 574.

This species was described as *Callirhytis rhizoxenus* from a gall "on the roots of a live oak at Fort Grant, Arizona." The type gall in the United States National Museum is ellipsoidal, 36 by 22 by 25 mm., smooth on outside, very dark brown, hard and granular inside instead of woody but contains no normal cells or exit holes. The type flies have the tarsal claws with a tooth and run to *Andricus*. They agree with adults the writer has reared from a rougher brownish (not carbonaceous black) gall terminal on twigs of *Quercus oblongifolia* Torrey at Patagonia, Arizona. They were collected July 6, 1918, and contained pupae, the flies issuing by July 19. The types agree also with flies from a similar gall on *Quercus toumeyii* Sargent collected at same time and place and from which living adults were cut out August 21. Similar galls occur also on *Quercus arizonica*

Sargent in this region, but no adults were reared. A smoother gall quite similar to the type of *rhizoænus* in shape and size and color occurs on *Quercus reticulata* Humboldt, Bonpland, and Kunth (Plate 32, fig. 14) (seen in the Santa Catalina and Huachuca Mountains) but no adults were reared. As these always occur in the lower part of the clump of bushes, within 1 or 2 feet of the ground, terminal on the oak runner sprouts characteristic of this oak, it may well be that it was galls from this oak, occurring under débris perhaps, that were originally collected and described as root galls. The species should be considered as producing a stem gall, not an underground gall, and is treated in this paper merely to clear up the error in the literature.

16. *ANDRICUS CHAMPIONI* Ashmead.

Plate 31, fig. 13.

Andricus championi ASHMEAD, Ent. News, vol. 10, 1899, pp. 193-4, gall and female.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Cynipidae, 1902, p. 59, No. 7.—FELT, Key to Amer. Ins. Galls N. Y. St. Mus., Bull. 200, 1918, p. 54.—KINSEY, Bull. Amer. Mus. Nat. Hist., vol. 42, 1920, p. 305.

Cynips ashmeadi DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 440.

Andricus championi CAMERON, CRAWFORD, Proc. U. S. Nat. Mus., vol. 48, 1915, p. 580.

Gall only.

Cynips championi CAMERON, Biol. Cent.-Amer. Hym., vol. 1, 1883, p. 70, gall only.—DALLA TORRE and KIEFFER, Wytzman, Gen. Ins. Cynipidae, 1902, p. 60; Das Tierreich, Lief. 24, p. 446, Fig. 190-1.

Cynips championii CAMERON, DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 67.

The gall was described as a twig gall by Cameron in 1883 from Chiriqui, Mexico, collected by a Mr. Champion. Later Doctor Duges sent specimens of a large woody gall (the largest now preserved measures 11 by 8 by 7 cm.) to Doctor Ashmead, who curiously enough considered it to be a root gall and as such described it together with the maker under the name of *Andricus championi*. It is a true *Andricus*, and the three types are in the United States National Museum together with the nine galls and eight other flies from the same locality not labeled as types. Thinking that this was a root gall and hence different from Cameron's, the authors of the Tierreich monograph gave it the new name of *ashmeadi*. As Crawford has pointed out, however, Doctor Duges later wrote to Dr. L. O. Howard that he had never sent any root galls to Ashmead, and the specimens in the National Museum plainly show that they are twig galls, and without doubt they are the same as those described by Cameron. The species should then take the name which Ashmead gave it and be credited to him, as he was the first to rear and describe the maker.

In August, 1910, the writer saw these galls (Plate 31, fig. 13) fairly common on the oaks which grow on the higher slopes of the moun-

6. Antennae arising below level of the middle of eye, reaching beyond tip of scutellum, 15-segmented, length at least twice width of head, last segment of flagellum stoutest. Mesoscutum highly polished and beautifully punctate. Abdomen ovate, ventral spine inconspicuous and not longer than broad. Size, 3.5-4.1 mm.....*enigma* Weld, p. 219.
- Antennae arising at level of middle of eye, not reaching base of scutellum, length less than twice width of head, 14-segmented, last segment of flagellum not the stoutest, flagellum tapering toward tip. Abdomen truncate, ventral spine prominent and four times as long as broad. Size, 2.0-3.8 mm.
7. Mesopleura mostly highly polished. Size, 5.0-7.5 mm. California.
futilis (Osten Sacken) (agamic gen.), p. 221.
- Mesopleura not polished, sculptured.....8
apicalis (Ashmead), p. 222.
8. Whole body brownish red, pits deep and shining, mesopleura finely rugose without parallel ridges.....*ovata* Weld, p. 222.
- Head and thorax dark red to black, pits rugose, not shining, mesopleura with closely parallel ridges.....*rubida* Weld, p. 224.
9. Head and thorax black.....*marginata* Weld, p. 225.
- Head and thorax not black.....10
10. Antennae at least two and one-half times width of head, pedicel not as long as third segment. Maxillary palpi 5-segmented. Pits of scutellum longer than broad, opening out on to disk. California.....*fulva* Weld, p. 226.
- Antennae not twice width of head, pedicel as long or longer than third. Maxillary palpi 4-segmented. Pits normal.....11
11. Basal two-thirds of second abdominal tergite black. Anterior lines black. Base of scutellum including pits black. Veins in distal half of wing distinct. Distal two-thirds of antennae infuscated.....*ellipsoidea* Weld, p. 227.
- Whole of second abdominal tergite red. Anterior lines at most slightly infuscated. Only margins of pits infuscated. Veins in distal half of wing pale. Antennae not infuscated.....*elliptica* Weld, p. 228.

17. CALLIRHYTIS HARTMANI, new species.

Plate 32, fig. 15.

Female.—Head and thorax yellowish, often more or less infuscated, with eyes, ocelli, antennae, anterior and lateral lines on mesoscutum, base of scutellum, metathorax, tibiae, and tarsi piceous or almost black; abdomen red and black. Head, except frons, and thorax clothed with dense whitish pubescence as in *Disholcaspis*. Head wider than thorax, granular, finely rugose on frons and a few fine striae on malar space, interocular area 1.4-1.6 times as broad as high, malar space slightly more than half eye, antennocular space less than ocellocular, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 17-segmented, tapering gradually from about tenth to tip, first longest, second half of first, third slightly shorter than first, rest gradually shorter to sixteenth which is hardly longer than wide, last but trifle longer than preceding. Mesocutum in balsam longer than broad, smooth with setigerous punctures, parapsides deep, widened behind, not reaching to anterior lines but showing again at front

margin, anterior and lateral lines enclosed in dark field, median groove a mere notch on hind margin. Scutellum broader than long, truncate and becoming rugose behind, slightly margined on sides, the two smooth quadrate, shallow foveae at base obscured by pubescence. Propodeum with two stout parallel carinae inclosing a smooth and nearly square area. Legs with hind tarsus shorter than tibia, second and fifth subequal, tarsal claws simple. Wings with distinct brown veins, third abscissa of subcosta straight not reaching margin, first abscissa of radius angled and with spur, areolet complete but small reaching only one-tenth way to basal, cubitus almost reaching basal, surface short brown pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and shining, not compressed, second segment occupying over seven-tenths with two triangular densely pubescent patches on sides at base and basal two-thirds black. Ventral spine tapering, in balsam twice as long as broad. Ovipositor when dissected out shorter than antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.4; antenna, 1.75; ovipositor, 1.67; wing, 4.0.

Range in length of 36 pinned specimens, 4.4–5.5 mm. Average, 4.8 mm.

Only female gall-making Cynipid known with 17-segmented antennae.

Type.—Cat. No. 22566, U.S.N.M. 30 cotypes.

Host.—*Quercus chrysolepis* Liebmann.

Gall.—Large area of greatly thickened bark causing a large swelling at the base of saplings or rough swollen areas at the crown of large trees, especially on callus tissue. This thickened bark contains hundreds of larval cells about 6 mm. long. Such areas also occur where a limb bends over and the elbow touches the ground. The bark becomes over an inch thick and the wood underneath very rough and knotty. On trees in moist gulches.

Type locality.—Los Gatos, California. The type galls containing living adults were collected November 2, 1918, by Mr. R. D. Hartman and sent in under Hopkins No. 15922^a and placed in rearing at the Eastern Station, East Falls Church, Virginia. The flies emerged April 9, 16, 26, 1919.

The writer saw old galls in the San Gabriel Mountains on August 8, 1916, near Coldbrook camp, and at Camp Baldy on June 17, 1918. Empty galls were also seen at St. Helena, California, on May 28, 1918. On May 13, 1918, while collecting with Mr. Hartman at Los Gatos, galls were found in which there was a thick layer of translucent nutritive tissue with no larval cell visible. These were perhaps formed by the flies that had emerged earlier in spring.

18. CALLIRHYTIS CORALLOSA, new species.

Plate 32, figs. 16, 17.

Female.—Reddish brown to black in some individuals, with compound eye, anterior and lateral line areas on mesonotum black; head, thorax and legs covered with whitish or tawny pubescence as in *Disholcapis*. Head finely punctate, not as broad as thorax, mandibles two-toothed, palpi 5- and 3-segmented, antennae 13-segmented with the last not quite twice as long as preceding and in one specimen in balsam showing a faint subdivision into two, facial quadrangle transverse. Mesoscutum punctate, parapsidal grooves deep, smooth, percurrent; smooth bare parallel lines extend back half way, longer and more distinct than the lines over base of wing, median groove wanting or a mere notch on hind margin. Scutellum broader than long and truncate or faintly excavated behind with two well-separated smooth, oval pits at base; propodeum with two almost straight and parallel ridges inclosing a somewhat rugose area broader than high, no median ridge. Legs stout, hind coxae with a sharp ridge behind, tarsal claws simple, divergent. Wings dusky with distinct brown veins, second cross-vein angled, areolet reaching one-fifth and cubitus two-thirds way to basal, surface pubescent, margin ciliate. Abdomen smooth and shining, not compressed, the large pubescent areas on sides of second segment widely separated dorsally and nearly reaching the hind margin, exposed parts of the other segments microscopically punctate and the seventh pubescent. Ventral spine tapering and in balsam about five times as long as broad. Ovipositor when dissected out a little longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.4–1.6; antenna, 2.1–2.3; ovipositor, 2.0–2.6; wing, 3.5–4.0.

Range in length of 14 specimens, 4.6–6.3 mm. Average 5.4 mm.

Runs in Dalla Torre and Kieffer's key (1910) to *Callirhytis crypta* Ashmead, from which it is separated by its large size, distinct parapsides, lack of median groove, and presence of a distinct areolet.

Type.—Cat. No. 22567, U.S.N.M. Type and 4 paratypes.

Host.—*Quercus macrocarpa* Michaux, *Quercus alba* Linnaeus, *Quercus bicolor* Willdenow, *Quercus stellata* Wangenheim, *Quercus prinus* Linnaeus, and *Quercus chapmani* Sargent.

Gall.—At base of thrifty sprouts about stumps or on bark of small trees just below surface of ground, 12–15 mm. in diameter and 6–10 mm. high, brown, convex, button-shaped, irregularly ridged exteriorly, some being much more rugose than others, with a clasping or sessile base and when broken off showing an impressed scar with radiating ridges which become more conspicuous in decaying galls. Galls on *stellata*, *chapmani*, and *pinus* are much smoother externally than those on the other three hosts mentioned and those figured

(plate 32, fig. 16) are from *chapmani*. The outer spongy layer disintegrates with age leaving a hard woody cell 7 by 5 mm., with a wall one-half millimeter thick.

Type locality.—Fort Sheridan, Illinois. Galls collected October 3, 1914, on *macrocarpa* and *alba*, about half containing living adults and half full-grown larvae. Others were found there on October 30, on *bicolor*, and from another collected October 29, 1916, the adult emerged in breeding cage on April 28, 1917. These galls have been taken also at Winnetka, New Lenox, and Glen Ellyn, Illinois, on the above hosts.

Smoother button-shaped galls with the same radiate scar when detached were found on the roots of *chapmani* at Ocala, Florida, April 17, 1914, some empty and others containing full-grown larvae, and again October 30, 1919, when half contained pupae and half adults. More were seen at Clearwater and at Daytona and Daytona Beach, Florida. Some of these, when opened December 3, gave five larvae and two pupae which transformed December 12. These smooth galls were also taken on roots of *stellata* at Mincola, Texas, September 2, 1915. They were empty. More were taken in fall of 1917 at Poplar Bluff, Missouri, Texarkana, Arkansas, and two at Palestine, Texas, from one of which a living fly was cut November 20, 1917. Similar smooth galls were found on roots of *pinus* at East Falls Church, Virginia, September 1, 1919, and one then cut open contained a pupa, and three living flies were cut out on December 9.

The normal emergence seems to be in spring, in April, and to be distributed over two years.

19. CALLIRHYTIS MAXIMA, new species.

Plate 33, fig. 18.

Female.—Very dark reddish-brown to black, with head, thorax, and legs white-pubescent. Head finely granulate, eyes bare, mandibles two-toothed, palpi 5- and 3-segmented, antennae 14-segmented, the last one and a half times as long as the preceding and in some specimens incompletely or rarely completely divided into two parts. Mesoscutum finely punctate, parapsidal grooves narrow, deep, smooth, and percurrent; smooth black parallel lines extend back about as far as lines over the base of wings extend forward; a notch on hind margin is the only trace of a median groove. Scutellum rugoso-punctate, with arcuate furrow at base separated by a more or less distinct low median ridge into two smooth pits which open behind on to disk. Propodeum with two straight almost parallel ridges inclosing a slightly rugose area broader than high. Wings large, transparent, veins brown, areolet distinct, pubescent, ciliate on margin. Legs stout, punctate, tarsal claws simple, divergent. Abdomen not compressed, smooth and shining except for large punc-

tate pubescent patch on either side of base of second segment, a very few hairs on exposed part of seventh. Ventral spine in balsam three times as long as broad, ovipositor when dissected out equal to length of antenna, ovarian eggs well developed. Using width of head as base, the length of wing ratio is 3.6-3.8; mesonotum, 1.5; antenna, 2.0-2.2; ovipositor, 2.1-2.2.

Range in length of 40 pinned specimens is 4.2-4.8 mm. Average, 4.5 mm.

Runs in Dalla Torre and Kieffer's key (1910) to *Callirhytis radialis* Bassett, from which it may be distinguished by the larger size, longer pubescence on wing, and presence of white pubescence on body.

Type.—Cat. No. 22568, U.S.N.M. 20 cotypes.

Host.—*Quercus alba* Linnaeus, *Quercus macrocarpa* Michaux, *Quercus bicolor* Willdenow, *Quercus prinus* Linnaeus.

Gall.—A large rounded mass, 90 by 50 by 50 mm. or smaller, growing out from side of one of main roots at base of tree or stump just below surface of the ground. Surface uneven but smooth, brown. When mature the interior is soft and easily cut or crumbled with the fingers, and might be taken for a piece of well-rotted wood until the numerous hard shell-like thin-walled brown cells are noticed imbedded in the whitish matrix. When the moisture is dried out the galls are as light as cork.

Type locality.—Fort Sheridan, Illinois.

Biology.—On October 4, 1914, galls were found on *Q. macrocarpa* with adults ready to emerge; others with the substance of the gall firmer contained full-grown larvae, others less than half an inch in diameter were fleshy with larval cavities barely visible, suggesting that the gall takes three years to mature, or else two, and the larvae in some do not transform the second fall but hold over until the third. At Winnetka, Illinois, October 30, some galls contained adults and others were very small. On November 1, immature galls were found at New Lenox, Illinois. On April 24, 1915, a small gall was found on *Quercus alba* from which adults were issuing. They were smaller, averaging 3.4 mm., but otherwise similar. Found gall at Highland Park, Illinois, on May 12, 1917, looking as if the adults had but recently issued; another at Fort Sheridan May 25 showed exit holes where all the adults had escaped. Collected a fine gall on *Quercus alba* May 6, 1914, on Plummer Island, Maryland. Adults evidently transform in autumn and emerge the next spring in late April or early May. A single fly of what seemed to be this species was noted in the stomach contents of blue-headed vireo (*Lanivireo solitarius* (Wilson) at Washington, District of Columbia, on April 15. A single old gall of this species was found on roots of *Quercus prinus* in September, 1919, at East Falls Church, Virginia, and another at Plummer Island, Maryland.

20. CALLIRHYTIS ENIGMA, new species.

Plate 33, figs. 19, 20.

Female.—Almost bare and almost black, the legs and antennae reddish-brown. Head broader than high, as broad as thorax, cheeks a trifle longer than half the eye, finely pebbled above and punctate pubescent on face which has a broad median elevation from base of antennae to the impressed clypeus, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 15-segmented, arising below middle of eyes, first longest and stoutest, third one and one-half times fourth, the rest becoming gradually shorter and stouter, the last at least one and one-half times as long as preceding (which is as broad as long) and as stout. Mesoscutum not high-arched, polished, beautifully coriaceous with scattered punctures bearing scarcely visible hairs. Parapsidal grooves distinct, percurrent, broader behind, deep with transverse ridges in bottom, median groove extending forward nearly half-way, anterior and lateral lines very faint impressions. Scutellum rugose behind with a median smoothish area on disk, the rugose pits are distinctly bordered behind and separated by a septum as broad as a parapside in which there is often a trace of a median groove; with impressed hairy areas at sides. Propodeum with two outwardly bent ridges inclosing a smooth area slightly narrower above, in which are two faint longitudinal lines, spiracular areas hairy, spiracles nearly round, petiole very rugose. Mesopleura longitudinally striate below. Legs punctate pubescent, hind coxae with bare ridge behind, tarsal claws simple, divergent. Wings with pale yellow distinct veins, second cross-vein heaviest and not angled, arcolet present, surface pubescent, margin distinctly ciliate only on hind margin of hind wing. Abdomen slightly compressed, longer than high, smooth and shining, posterior edge of second and exposed parts of others microscopically punctate, second with widely separated, small, narrow pubescent patches at base. Ventral spine mostly concealed, not twice as long as wide. Ovipositor when dissected out one and one-third times as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.2; antenna, 2.4–2.5; ovipositor, 3.3; wings, 3.65.⁴

Range in length of 76 pinned specimens, 3.0–4.1 mm. Average, 3.7 mm. Mode, 3.9 mm.

This species is closely related to *saltatus* which Ashmead in 1881 made the type of the new genus *Trisolenia* separated from *Andricus*, which he understood to have simple claws by the sharply defined

⁴These ratios are from the type material from *Q. rubra* from Winnetka, Illinois. Paratype flies from Florida from *Q. catesbaei* and *Q. myrtifolia* agree with these in sculpture but have length of antenna ratio 2.0; ovipositor, 2.6; and wing, 3.1.

parapsides, complete median groove, 15-segmented moniliform antennae, and bare wings. Both species have a characteristic "planed-off" appearance of the mesonotum, with the scutellum in the same plane as the mesoscutum. The same is true of the root-gall (or *radicicola* Dalla Torre) form (agamic generation) of *Callirhytis futilis* (Osten Sacken). At present *Trisolenia* has been reduced to synonymy under *Andricus* (it should have been made a synonym of *Callirhytis* instead), and if this group of species is ever segregated into a separate genus it would take the name of *Trisoleniella* Rohwer and Fagan 1917 (*Trisolenia* having been preoccupied by Ehrenberg in *Protozoa* in 1861).

Type.—Cat. No. 22573, U.S.N.M. Type and 42 paratype flies.

Host.—*Quercus rubra* Linnaeus, *Quercus catesbaei* Michaux, *Quercus myrtifolia* Willdenow, *Quercus texana* Buckley.

Gall.—In clusters of as many as 150 at the base of young sprouts 4–10 cm. underground. Clusters are roughly spherical and may measure 2.5 cm. in diameter. The appearance of the fresh galls is unknown. The type flies are from a disintegrated cluster, and a fleshy layer had evidently rotted away, leaving a hard and brittle shell 4 by 6 mm., longitudinally ridged, with a wall about one-half a millimeter thick. (Plate 33, fig. 20.) The fleshy layer is evidently thin, for in the sandy soils of Florida it seems to dry down on the inner shell instead of decaying as in the more humid northern soils, and the ridges show through. The species was known to the writer years before an intact cluster was found, and it was not until flies were reared from these Florida galls, in 1919, agreeing with the types that the character and appearance of the cluster was known. The galls figured are from *Q. catesbaei*. (Plate 33, fig. 19.)

Habitat.—The type flies are from Winnetka, Illinois, where a disintegrated cluster containing adults was found October 22, 1914, at the base of a young sapling of *Q. rubra*. Empty galls of this species were also seen at Ravinia and Highland Park, Illinois. Intact clusters of galls were collected at Madison, Florida, October 21, 1919, on *Q. catesbaei*. They then contained pupae, and adults were cut out December 4, agreeing with the Winnetka specimens. Others were seen at Gainesville, Ocala, Marianna, and Jacksonville. The same species was found on *Q. myrtifolia* at Carrabelle, Florida, October 19, and at Daytona November 20, and both pupae and adults were found when cut open on December 3. Empty galls were seen on *Quercus texana* at Boerne, Texas. The United States National Museum has a single similar fly from Jacksonville and a gall cluster from Georgiana, Florida, both without date or host records; also an empty gall cluster from Ocean Springs, Louisiana, collected February 3, 1898, on "*Q. phellos?*"

21. CALLIRHYTIS FUTILIS (Osten Sacken.)

(Agamic generation=*radicis* Bassett=*radicola* Dalla Torre.)

Plate 33, fig. 21.

Callirhytis radicis BASSETT. Psyche, vol. 5, 1889, p. 237.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Hym. Cynipidae, 1902, p. 66, No. 26.—Das Tierreich, Lief. 24, 1910, p. 571.—BEUTENMUELLER, in Smith Ins., N. J., 1910, p. 601.—THOMPSON, Cat. Amer. Ins. Galls, 1915, pp. 5, 30.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

Andricus radicola DALLA TORRE, Cat. Hymen., vol. 2, 1893, p. 95.

Callirhytis radicola Dalla Torre, MAYR, Verh. Zool.-Bot. Ges. Wien, vol. 52, 1902, p. 289.

Andricus (Callirhytis) radicis Bassett, VIERECK, Hym. of Conn., 1916, p. 426.

On May 12, 1917, a dozen or more Cynipids of the same species were seen ovipositing in the unopened buds of *Quercus alba* Linnaeus at Fort Sheridan, Illinois. Investigation showed that there were hundreds of cells (*radicis* form of *C. futilis*) in the bark of the main roots (Plate 33, fig. 21) at the base of the tree from which these flies were coming and they were seen crawling up the trunk, and from these cells similar flies were cut. On May 6, 1914, at Plummer Island, Maryland, oak-wart galls were seen on the leaves of *alba*, and a large number of cells were found in the bark of the main roots and from them two living adults were cut. At Starved Rock, near Utica, Illinois, May 31, 1913, the wart galls were very common on one tree of *alba*, and the old *radicis* cells in the bark of the root were found, exit holes showing where adults had emerged earlier in spring to produce the current crop of leaf galls. In this thickened bark, however, there were nests of cells with a thick nutritive layer. These were probably formed in the fall of 1912 by flies from the 1912 wart galls and would not give adults until the spring of 1914. Old cells of what is probably this species were observed in the thick bark at the crown of a large tree of *Quercus prinus* Linnaeus, at East Falls Church, Virginia, on September 1, 1919.

Measurements of 75 pinned specimens, of which 53 were Bassett "cotypes," gives the range in size as 1.9–3.4 mm. Average, 2.7 mm. Using the width of the head as a base, the length of mesonotum ratio is 1.2; length of antenna, 1.6–1.8; ovipositor, 2.5–2.8; wing, 3.4–3.6. Wing not ciliate on margin. The antennae were described as 14-segmented. In some of the cotypes they are 13-segmented, the last over twice preceding, but often with a transverse suture, which may completely divide it into two separate segments.

22. *CALLIRHYTIS APICALIS* (Ashmead).

Plate 34, fig. 22.

Andricus apicalis ASHMEAD, Proc. U. S. Nat. Mus., vol. 19, 1896, p. 120. No. 12.—COCKERELL, Ent. Student, vol. 1, 1900, p. 9.—DALLA TORRE and KIEFFER, Wytzman, Gen. Ins. Hym. Cynipidae, 1902, p. 61, No. 6.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 5, 31.

Callirhytis apicalis Ashmead, MAYR, Verh. Zool.-Bot. Ges. Wien, vol. 52, 1902, p. 289.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 573.—FULLAWAY, Ann. Ent. Soc. Amer., vol. 4, 1911, pp. 354.—FELT, Key to Amer. Ins. Galls N. Y. St. Mus., Bull. 200, 1918, p. 54.

This species was described from material from *Quercus wislizeni* A. de Candolle. The writer has taken galls on that oak in the San Gabriel Mountains, at Los Gatos, and Bagby, California. He has also found them on *Quercus californica* Cooper in Sequoia National Park, at Los Gatos and Dunsmuir, California, and on *Quercus agrifolia* Née at Carpinteria, Santa Margarita, Paraiso Springs, Los Gatos, and St. Helena, California. The fresh galls are greenish-white, tinged with red if exposed to light, fleshy, single, or in groups of a few or in clusters that may be as much as 8 cm. in diameter and contain as many as 35 galls. The fresh galls are found in May in all stages of growth. By June 1 they are full grown. They then turn brown and the juicy interior becomes converted into brittle, cavernous tissue, with a series of thin plates radiating out from the hard basal cell. In galls taken to Evanston, Illinois, pupae were found by September 1 and also on October 10, November 17 (transformed December 6), and December 23. Living adults were cut out of this lot of galls on December 23, March 20, and April 18. Some larvae do not pupate until the second autumn, however. The normal emergence is probably in early spring, one of the type series having been reared February 17. After the insects escape, the peripheral tissues weather away in time, leaving the rough hard larval cells attached to the bark to persist for years.

Measurements of 33 pinned specimens, including the types, give the range in size as 5.3–7.5 mm. Average, 6.1 mm. Using the width of head as a base, the length of mesonotum ratio is 1.38; length of antenna, 2.28; ovipositor, 4.26; wing, 3.6. Wing not ciliate on margin. Propodeum with a median longitudinal ridge.

23. *CALLIRHYTIS OVATA*, new species.

Plate 34, fig. 23.

Female.—Brownish-red, antennae infuscated distally and abdomen dorsally, eyes black. Head broader than thorax, finely granulate with whitish hairs on face, clypeus almost smooth, interocular area 1.1–1.2 times as broad as high, malar space 0.3–0.4 eye, mandible 2-toothed, palpi 5- and 3-segmented, antenna 13- or 14-segmented, third longer than first, fourth three-fourths of third, fifth equal to second,

rest gradually shorter to twelfth which is as broad as long, thirteenth more than twice as long as preceding and partially or wholly subdivided by a transverse groove a little back of middle. Pronotum rugose. Mesoscutum shining, coriaceous with setigerous punctures anteriorly but not rugose, parapsides complete but less distinct in front, median nearly complete, anterior and lateral lines faintly impressed. Scutellum rugoso-punctate, pits at base narrow, deep, shining, smooth or with faint longitudinal ridges, triangular impressed areas on sides. Propodeum with two ridges slightly bent inwardly and inclosing a reticulate area broader at the top, spiracular areas and petiole rugose. Mesopleura finely rugose. Hind tarsi shorter than tibiae, second shorter than fifth, claws weak, simple, divergent. Wings subhyaline, veins brown, first abscissa of radius faintly angled and slightly clouded, areolet not reaching over one-fifth way to basal, cubitus not reaching basal, surface pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and shining, longer than high, slightly compressed, second segment occupying about two-thirds and with only inconspicuous patches of hair on sides, its hind margin and exposed parts of rest microscopically punctate, ventral spine short, hardly longer than broad, ovipositor when dissected out nearly one and two-thirds times as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.2-1.3; antenna, 1.5-1.7; ovipositor, 1.9-2.0; wing, 3.0-3.1.

Range in length of 77 pinned specimens, 2.8-4.8 mm. Average, 3.9 mm. Mode, 4.0 mm.

Type.—Cat. No. 22569, U.S.N.M. Type and 42 paratypes.

Host.—*Quercus catesbaei* Michaux, *Quercus myrtifolia* Willdenow, *Quercus texana* Buckley.

Gall.—Cells in and protruding from the brown bark at crown of small trees, 5 to 10 cm. underground. When single, they are elliptical in outline, sessile, 6 mm. high by 5 mm. in diameter, light brown in color and smoother than the surrounding bark. Exit hole 2.6 mm. in diameter at distal end. They are sometimes detachable. They often occur in rows or in groups of a dozen or more. When confluent, a local swelling of the bark is produced, but the number of cells contained is evident. The figure shows galls on *Q. myrtifolia*. On *Q. catesbaei* they usually occur on larger roots at least 2 to 5 cm. in diameter and often in the angles where branch roots arise.

Habitat.—The type galls were collected at Marianna, Florida, October 11, 1919, on *Q. catesbaei* and then contained pupae. Living flies were cut out of the galls on December 3. More were taken at Ocala October 30, and these also contained pupae. Galls found at Ocala April 15, 1914, were empty. These galls were also found at Madison and Jacksonville. The species transforms inside the galls in November and probably emerges in early spring. The fact that some galls

still contained larvae in December when others in the same groups contained adults suggests that the emergence is distributed over two years. Similar galls were collected on *Q. myrtifolia* at Daytona, Florida, on November 20, 1919. Some pupae had already transformed into adults and a few were still in pupa state when flies were cut out on November 28 and December 3. At Boerne, Texas, October 26, 1917, old galls were seen on *Q. texana* as well as full-grown fresh ones, some of which contained a thick nutritive layer and others pupae or adults.

24. CALLIRHYTIS RUBIDA, new species.

Plate 36, fig. 31.

Female.—Head and thorax deep red to black, legs and antennae brownish-red, abdomen infuscated, red at base. Head broad as thorax, rugose, whitish hairs on face, clypeus almost smooth, interocular area 1–1.2 times as broad as high, malar space 0.3–0.4 eye with a few parallel ridges, mandibles 2-toothed, palpi 5- and 3-segmented, antenna 14-segmented, third a trifle shorter than first, second and fifth equal, 4–13 gradually shorter, last a little longer than preceding. Some specimens have 12 segments, the last with one or even two incomplete transverse grooves. Pronotum rugose. Mesoscutum distinctly coriaceous with setigerous punctures scattered along grooves, parapsides complete, rugose, slightly wider behind, median complete, parallel and lateral lines not polished, but sunken. Scutellum coarsely rugose with coriaceous spot on disk sometimes, arcuate furrow at base rugose, and separated from impressed areas on sides, divided into two pits. Propodeum with two straight parallel ridges inclosing a reticulate area in which there is sometimes a trace of a median ridge. Mesopleura finely rugose with parallel longitudinal ridges across middle. Hind tarsus shorter than tibia, second shorter than fifth, claws simple. Wings hyaline, veins brown, first abscissa of radius slightly clouded and faintly angled in middle, arcolet complete, reaching about one-fifth distance to basal, cubitus not reaching basal, surface pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and shining, longer than high, laterally compressed, second segment occupying about two-thirds and with only inconspicuous patches of hair on sides, its hind margin and exposed parts of rest microscopically punctate, ventral spine short, in balsam about twice as long as broad, ovipositor when dissected out nearly one and two-thirds times length of antenna. Using width of head as a base, the length of mesonotum ratio is 1.3–1.4; antenna, 1.9; ovipositor, 2.9–3.0; wing, 3.6.

Length of 9 pinned specimens, 3.4–3.8 mm. Average, 3.6 mm.

Type.—Cat. No. 22570, U.S.N.M. Type and 8 paratypes.

Host.—*Quercus coccinea* Muenchhausen. *Quercus rubra* Linnaeus.

Gall.—Cells in the thick brown bark at or just below surface of ground on stumps or trees. Abrupt local swellings are formed

which may even surround small saplings, the number of contained cells somewhat evident externally. (Plate 36, fig. 31.)

Type locality.—Ravinia, Illinois. Galls collected October 22, 1916, and when cut open about half contained full-grown larvae and half living adults. Host oak not recorded. On May 19 a similar gall was found at Millers, Indiana, in the thick bark of a stump of *Q. coccinea*, and a living fly was cut out, which agrees with the Ravinia specimen in structure, but measures only 2.5 mm. Galls found on *Q. rubra* at Plummer Island, Maryland, and cut open September 21, 1919, gave five adults, two pupae, and several full-grown larvae.

25. *CALLIRHYTIS MARGINATA*, new species.

Female.—Head and thorax black, legs and antennae brown, abdomen almost black. Head evenly rugose, face with whitish hairs, clypeus impressed, rough, as long as broad, interocular area 1.1 to 1.2 times as broad as high, malar space without groove and 0.38–0.47 eye, antennae 14-segmented, distal half infuscated, first shorter than third, third and fourth subequal, 6–13 gradually shorter, last about twice preceding and incompletely divided above middle by transverse groove. Pronotum rugose with parallel ridges on sides. Mesoscutum finely pebbled, becoming slightly rugose in front, grooves with upturned margins posteriorly, parapsides wider behind, rugose and percurrent, median complete, wider behind, lateral lines smooth, anterior not smooth and somewhat indistinct and sunken. Scutellum coarsely rugose with two narrow, deep, rugose pits at base separated by a septum, impressed areas at sides. Propodeum with two outwardly-curved ridges inclosing a rugose area wider than high, in which in some specimens there is a trace of a median ridge. Mesopleura finely rugose with no parallel ridges. Legs with coxae intus-cated, hind tarsus shorter than tibia, second shorter than fifth, claws simple, divaricate. Wings hyaline, veins brown, first abscissa of radius angled, cubitus reaching basal, areolet complete, reaching about one-fifth way to basal, surface short pubescent, ciliate only on hind margin of hind wing. Abdomen smooth and polished, longer than high, somewhat compressed, second segment occupying over four-fifths and with inconspicuous patches of hair on sides, its hind margin and exposed parts of rest microscopically punctate, ventral spine in balsam about twice as long as broad, ovipositor when dissected out about same length as antenna. Using width of head as base, the length of mesonotum ratio is 1.38; antenna, 2.0; ovipositor, 2.0; wing, 3.7.

Length of six pinned specimens, 3.6–4.1 mm. Average, 3.9 mm.

Type.—Cat. No. 22571, U. S. N. M. Two cotypes.

Host.—*Quercus coccinea* Muenchhausen.

Gall.—Abrupt cushion-like swelling in the bark just at or below the surface of the ground on young sprouts which are 5–10 mm. in diameter. Single or confluent so that they may contain one to a half a dozen cells which are 4–5 mm. in diameter. They are similar to those of *Callirhytis rubida* Weld.

Type locality.—Fort Sheridan, Illinois. One cluster of these galls was found April 25, 1915, and one fly emerged in collecting box and two were cut out of galls. Three more of same species were found ovipositing in the side of the swelling buds in the same clump of sprouts at whose base the galls were found.

26. CALLIRHYTIS FULVA, new species.

Plate 34, fig. 24.

Female.—Dark red and black. Head finely rugose, broadened behind eyes, cheeks a trifle longer than half the length of eye. Mandibles two-toothed, palpi 5- and 3-segmented, antennae 13-segmented, third longest, last over twice as long as preceding and incompletely divided by a transverse groove into two whose lengths are in the ratio of 9 to 14, or 14-segmented, with no suggestion of fusion of last two. Mesoscutum rugose in front but not transversely so, with a few inconspicuous hairs from scattered punctures. Parapsidal grooves rugose, deep and broad behind, complete but less distinct in front, median line percurrent, smooth parallel lines and lines over base of wings black. Scutellum coarsely rugose, the two pits distinctly bordered laterally but opening posteriorly out on to disk and separated only by a low median ridge, with impressed pubescent areas at sides above base of hind wings. Propodeum with two straight parallel ridges inclosing a smooth but pubescent area slightly higher than wide. Mesopleura finely longitudinally striate. Legs lighter in color, tarsal claws weak, simple, divergent. Wings with yellowish veins, the second cross-vein brownish, bent at an angle and usually with a short spur, areolet incomplete or absent, surface pubescent, margin not ciliate. Abdomen black, smooth, and shining, slightly compressed, longer than deep, second segment with two lateral oval pubescent patches at base nearly touching dorsally, hind margin of all microscopically punctate. Ventral spine in balsam a little more than twice as long as broad. Ovipositor when dissected out shorter than length of antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.3; antenna, 2.5; wing, 3.7–3.8; ovipositor, 1.7.

Range in length of 50 pinned specimens, 3.0–4.0 mm. Average and median, 3.6 mm.

Related to *Callirhytis radialis* Bassett, to which the individuals with 14-segmented antennae run in Dalla Torre and Kieffer's key (1910). The pits of *radialis* do not open out behind on to scutellum,

the median area on propodeum is broader than high, and the malar space is not over half the length of eye.

Type.—Cat. No. 22572, U. S. N. M. Twenty-four cotypes.

Host.—*Quercus chrysolepis* Liebmann.

Gall.—Hemispherical when single or forming a hemispherical group with individual galls compressed laterally into angular cross-section by mutual pressure, produced on roots just under surface of ground. Single galls measure up to 22 mm. in diameter by 18 mm. high, groups of two to eight measure up to 35 mm. diameter. Tissue of gall mustard yellow, pithy distally, becoming more compact about the proximally placed larval cell.

Type locality.—San Gabriel Mountains, California.

Biology.—Collected one-half mile above Coldbrook Camp in San Gabriel River canyon above Azusa, California, August 6, 1916. The larvae change into pupae about November 1, and into adults later in the autumn, but probably do not emerge until next spring. In breeding cage out of doors at Evanston, Illinois, they issued March 10–19.

27. *CALLIRHYTIS ELLIPSOIDA*, new species.

Plate 36, fig. 30.

Agamic female.—A black and tan species. Compound eye, clypeus, tip of mandible, flagellum, broad stripe along parallel and lateral lines on mesonotum, base of scutellum, metanotum, propodeum, metapleura and upper part of mesopleura, sternum, most of second abdominal segment except a broad oblique band, black or nearly so, there being much variation in different individuals; rest of body pale yellow to fuscous. Head finely rugose, covered with white pubescence except on vertex, mandibles with two sharp teeth, maxillary palpi 4-segmented with first short and second and fourth equal, labial palpi 3-segmented with second almost as long as other two. Eyes bare. Antennae 13-segmented with the last twice as long as the preceding and incompletely divided by a groove near the middle or 14-segmented with last two subequal. Mesoscutum finely rugose but not transversely so, parapsidal furrows obliterated in front as is also the median, smooth anterior parallel lines extend back over half way and the fine ridges on each side suggest a feather, the lateral lines extend forward half way and are bordered by a pebbled area. Scutellum rugose with two rugose pits at the base separated by a narrow ridge and opening behind on to disk. Carinae on propodeum straight, converging slightly above, inclosing a reticulate area above rugose petiole. Wings transparent, veins distinct and pale yellowish, very minutely short brown pubescent, ciliate only on hind margin of hind wing, areolet reaching about one-eighth way to basal, cubitus curved and almost reaching basal. Legs with coxae and tarsi darker, hind tarsi shorter than tibiae, tarsal claws simple, divergent. Abdomen smooth

and shining, longer than high, slightly compressed, the second segment with patch of whitish hairs at base on either side, making up three-fourths the length, the third making up almost all the rest. Ventral spine twice as long as broad. Ovipositor when dissected out a trifle longer than antenna. Ovarian eggs well developed, 0.14 mm. long, and including pedicel, 0.76 mm. Using width of head in balsam mount as a base, the length of wing ratio is 3.8-4.0; antenna, 1.7-1.8; mesonotum, 1.45; ovipositor, 2.0-2.1.

Range in length of 30 pinned specimens, 3.3-4.5 mm. Average, 3.8 mm. Median, 3.75 mm.

Type.—Cat. No. 22564, U. S. N. M. Sixteen cotypes.

Host.—*Quercus bicolor* Willdenow.

Gall.—Ellipsoid, 4.5 by 5.5 mm., single or in small clusters on the small roots just below surface of ground under the tree. Surface smooth, brown. Monothalamous with a firm wall less than one-half millimeter thick when mature, exit hole at end 2 mm. in diameter. Immature galls lighter in color, fleshy, translucent white inside.

Habitat.—Type locality, Wilmette, Illinois. Collected also at Evanston and Winnetka, Illinois.

Biology.—The galls probably take two years to develop, the larvae transforming to adults the second autumn but not emerging from the galls until the following spring between April 15 and May 7. They are all females. They oviposit at once in the swelling buds of the same tree, but the alternating sexual generation is unknown.

28. *CALLIRHYTIS ELLIPTICA*, new species.

Plate 55, fig. 26.

Agamic female.—Head reddish brown, abdomen brighter red, antennae, legs, and thorax honey-yellow with the more heavily chitinized parts reddish. Head rugose, as broad as thorax, widened behind eyes, pubescent on face, clypeus almost circular with two deep impressions at insertion, malar space about 0.4 eye, interocular space about one and one-fourth times as broad as high, antennocular and ocellocular spaces equal, palpi 4- and 3-segmented, mandibles 2-toothed, antennae 13-segmented, first and third equal, fifth half as long as third, fifth to twelfth subequal, last not quite one and one-half times preceding, or 14-segmented, with last two subequal. Sides of pronotum rugose. Mesoscutum a trifle broader than long, surface pebbled with a tendency to become rugose on front and along the parapsides which are obliterated in front, anterior parallel grooves rugose extending back over half way, smoother lines over base of wings, a shallow rugose streak makes an indistinct incomplete median. Scutellum very rugose, with two rugose, sometimes communicating pits at base and impressed areas at sides, pits open behind. Propodeum with two outwardly bent ridges inclosing a reti-

culate area broader than high and narrowed gradually toward top, petiole rugose. Mesopleura pubescent except on the more finely rugose center. Hind leg with tarsus shorter than tibia, third shorter than fifth, claws simple. Wings clear, apparently bare but in balsam very short pubescent, ciliate only on margin of hind wing, veins yellowish, areolet small or incomplete. Abdomen smooth and shining, slightly compressed, longer than high, second segment with two densely pubescent patches on sides. Ventral spine tapering, in balsam twice as long as broad, ovipositor when dissected out about one and three-tenths length of antenna, ovarian eggs well developed. Using width of head as base, the length of mesonotum ratio is 1.4; antenna, 1.9; ovipositor, 1.9; wing, 3.5.

Range in length of 10 pinned specimens, 3.7–4.3 mm. Average, 3.9 mm.

This species can be separated from *Callirhytis ellipsoida* Weld only by color markings which, however, seem to be constant. The galls also are similar but on a different oak.

Type.—Cat. No. 22565, U. S. N. M. Type fly and gall. Four paratypes.

Host.—*Quercus alba* Linnaeus.

Gall.—An abrupt ellipsoidal swelling on small rootlets found an inch or two under the humus on forest floor underneath large trees. Brown, smooth, thin-walled when mature, monothalamous, and similar to galls of *Callirhytis ellipsoida* Weld on *Quercus bicolor* but the fly is different.

Type locality.—The type fly was cut out alive from a gall found at Highland Park, Illinois, October 22, 1916, on root of an undetermined oak. On May 11, 1919, five similar flies were collected at Glencoe, Illinois, ovipositing on buds of *Quercus alba*. On May 23, 1919, found similar galls on roots of white oak at Ravinia, Illinois. Some showed exit holes from which flies had recently emerged; others were full grown but contained a thick translucent nutritive layer and a barely visible larval cavity; others had a large cavity and a third of the nutritive layer left and a nearly full-grown larva which would probably transform in the fall and emerge next spring in early May. In the United States National Museum are three similar flies collected by J. G. Barlow at Cadet, Missouri, April 27 and May 5, 1883, ovipositing in buds of white oak. Also two from Nyaek, New York, collected by J. L. Zabriskie, April 21, 1885, on buds of *Quercus alba*.

These galls were also collected at Marianna, Florida, October 10, 1919, on the roots of *Quercus alba* growing in deep woods. A dead adult was cut out on December 6, and mounted in balsam. This agrees with the type material and proves the type gall to have been on white oak. Galls collected in Washington, District of Columbia, on *alba* contained living flies on October 31, 1920.

Genus EUMAYRIA Ashmead.

29. EUMAYRIA FLORIDANA Ashmead.

Plate 35, fig. 27.

Eumayria multiarticulata ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 133, gall only.

Eumayria floridana ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 147, No. 35, and p. 133.—CRESSON, Syn. Amer. Hym., 1887, p. 310.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 106.—DALLA TORRE and KIEFFER, in Wytzman Gen. Ins. Cynipidae, 1902, p. 68, No. 1.—ASHMEAD, Psyche, vol. 10, 1903, p. 153.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 277.—DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 601.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 38.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54.

Doctor Ashmead described a root gall on *Quercus laurifolia* Michaux in 1887 in Transactions American Entomological Society (vol. 14, p. 133) as *Eumayria multiarticulata*. Later in the same paper he described *Eumayria floridana*, male and female, without gall, from five specimens taken at large in March, 1887, in Florida. In the old Ashmead collection at the United States National Museum are three male flies with the label "Jacksonville, Florida," and bearing a white label with the word "type." These are evidently of the original five. The American Entomological Society probably has another one. In the Museum collection, however, probably years later, he placed a red label with "U.S.N.M. Type 2883" on a gall which answers the description of *multiarticulata* and also on a female fly and accessioned them as *Eumayria floridana*. Both bear the "U.S. D.A. No. 2647" and are from Georgiana, Florida. With these are 37 other females all bearing the same number. The emergence dates are April 12, 13, 19, 20, 25, 27, and May 3, 1882. Pinned in case with them is a slip with name "*Eumayria multiarticulata*," showing that as that name had been applied only to gall, he wished to call the species *floridana* and wished the large series of reared flies to be included in the type series for in the type book he wrote "many types." Whether there were any males in the reared series or any females in the captured series is not known. The writer has reared both males and females from galls collected at Jacksonville, Florida, and these agree with both sexes in the Museum, so that there is no doubt that the Museum material belongs to one species.

As Ashmead's description of the adults was very brief, the following notes are added from the type material in the Museum:

Female.—Dark yellowish-brown. Head coriaceous, broader than thorax, axial line 0.6 of transfacial, facial less than transfacial, interocular area 1.48 times as broad as high, antennocular and ocellocular spaces equal, malar space without groove and 0.68 length of eye, antennae with last segment two and one-fifth times as long as thir-

teenth without evidence of fusion. Mesoscutum coriaceous with scattered setigerous punctures, parapsides percurrent, lateral and parallel lines present and a broken row of large punctures forming an incomplete median. Scutellum coarsely pitted and rugose behind with smoothish spot on disk just behind the two distinctly separated pits, impressed areas on sides. Propodeum with two slightly curved ridges inclosing a smooth area broader than high. Legs with hind tarsus shorter than tibia, second and fifth subequal, claws simple. Wings with brownish veins, those beyond second cross-vein faint, first abscissa of radius arcuate, second not reaching margin, areolet small and indistinct, margin not ciliate. Abdomen compressed, longer than high, second segment occupying over four-fifths with ring of hairs at base, ventral valve in balsam twice as long as broad, ovipositor when dissected out a little longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.1; antenna, 2.2; ovipositor, 2.3-2.5; wing, 3.0.

Male.—Body darker but not black, antennae 2.8 times width of head.

Length of 38 pinned females, 2.2-2.7 mm. Average, 2.4 mm. Length of each of the three Jacksonville males, 2.2 mm.

Gall.—Photographed from galls on *Quercus catesbaei* Michaux collected at Jacksonville, Florida. In the late fall the galls contain a thick translucent nutritive layer in each cell. They should be collected in the spring for rearing.

Host.—It was described from *Quercus laurifolia* Michaux. The writer has collected galls on nine other species of oak, as shown below.

Habitat.—From *Quercus catesbaei* at Ocala and Jacksonville, Florida, galls were taken and adults of both sexes reared that agree with the types in the United States National Museum. They were collected April 21 and April 25, 1914, and the flies emerged and died in the box before August 10. Galls of this species and on this host were seen at Green Cove Springs, Ocala, Madison, and Gainesville, Florida. Galls have been taken, but no flies reared from the following oaks:

Q. rubra Linnaeus at Ravinia, Fort Sheridan, Highland Park, and Evanston, Illinois.

Q. coccinea Wangenheim at Millers, Indiana, and Evanston, Illinois.

Q. velutina Lamarck at Hot Springs, Arkansas.

Q. falcata Michaux at Gainesville, Florida.

Q. texana Buckley at Boerne and Kerrville, Texas.

Q. marilandica Muenchhausen at Mineola, Texas, and Hot Springs, Arkansas.

Q. brevifolia Sargent at Marianna and Ocala, Florida.

Q. myrtifolia Willdenow at Carrabelle and Daytona, Florida.

Genus BASSETTIA Ashmead.

In addition to the generic characters given by Ashmead, the following, taken from the genotype, may be added, and they apply as well to the other species in the genus: The margin of the front wing is not ciliate, the second segment of the antenna is as broad as the first, and both are flattened to fit the curvature of the strongly convex face when the antennae are bent backward, the eyes are almost flat, flush with the surface of the face, making the outline of head from above almost semicircular.

KEY TO DESCRIBED SPECIES.⁵

1. Head and thorax brownish-yellow.....*pallida* Ashmead.
 Head and thorax black or nearly so.....2
2. Wing with distinct brown veins. Ventral spine twice as long as broad.
 *tenuana* Weld, p. 232.
 Wing with veins pale. Ventral spine over four times as long as broad.....3
3. Mesoscutum in side view with its arch three-fourths as high as length of eye and
 with an abrupt curvature anteriorly.....*floridana* Ashmead, p. 233.
 Mesoscutum with arch six-tenths as high as length of eye and its profile without
 an abrupt curve anteriorly.....*gemmae* Ashmead.

30. BASSETTIA TENUANA, new species.

Female.—Black, with tibiae, tarsi, antennae (and in one specimen the whole head) reddish-brown. Head broader than thorax, axial line 0.65 of transfacial, widened behind eyes, coriaceous with scattered setigerous punctures, malar space without groove, at least 0.9 length of eye, interocular area nearly twice as broad as high, mandibles 2-toothed, palpi 5- and 3-segmented, antennae stout, 13-segmented, first longer than third and equal to fourth and fifth together, second as stout as first and equal to fourth, 4-12 subequal, last about twice as long as preceding and fully as stout. Pronotum coriaceous and slightly pubescent. Mesoscutum longer than broad, coarsely coriaceous, with two distinct percurrent parapsides, which, if prolonged, would meet just behind center of scutellum, parallel and lateral lines present, separated from scutellum by a distinct suture. Scutellum coarsely coriaceous, narrower behind, with two narrow, deep, smooth, distinctly separated pits at base and two impressed areas at sides. Propodeum with two straight carinae inclosing a slightly reticulate area wider than high and slightly narrower at the top, petiole rugose. Legs with hind tarsus shorter than tibia, second shorter than fifth, claws weak, simple, divergent. Wings rather broad, width 0.42 of length, transparent, with distinct yellowish-brown veins, first abscissa of radius arcuate and slightly clouded, second strongly bent, areolet distinct, cubitus reaching

⁵*Cynips tenuicornis* Bassett, which Ashmead placed in this genus (Trans. Amer. Ent. Soc., vol. 14, p. 147), is a *Diplolepis* Geoffroy. The mesoscutum is not transversely rugulose, not longer than broad, the first two segments of antenna are not flattened, tarsal claws have a distinct tooth, and the wing margin is ciliate.

basal, very short brown pubescent, ciliate only on hind margin of hind wing. Abdomen longer than thorax, longer than high, laterally compressed, smooth and shining, second segment occupying about two-thirds and with a tuft of hairs on each side at base. Ventral spine tapering, about twice as long as broad, ovipositor when dissected out nearly one and one-half times as long as antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.3; antenna, 2.1; ovipositor, 3.1; wing, 3.3.

Length of 9 pinned specimens, 2.5–3.1 mm. Average, 2.9 mm.

Type.—Cat. No. 22581, U. S. N. M. Type and 5 paratypes.

Host.—*Quercus gambelii* Nuttall.

Gall.—Similar to those of *Compsodryoxenus tenuis* Weld. The insects gnaw individual exit holes through the brown bark, which after a year or two becomes cracked and rough.

Type locality.—Las Vegas, New Mexico. Galls were collected in a patch of runner oak of an unknown species on April 4, 1918. They then contained adults, and living flies were cut out which bear Hopkins U. S. No. 15601^d. On April 19 similar galls were collected at Flagstaff, Arizona, on *Quercus gambelii*. They contained similar adults, which issued April 10–16 and bear Hopkins U. S. No. 15601^d.

31. BASSETTIA FLORIDANA Ashmead.

Plate 34, fig. 25.

Bassettia floridana ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, 1887, p. 147.—CRESSON Syn. Amer. Hym., 1887, p. 310.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 117.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Hym. Cynipidae, 1902, p. 72, No. 1; Das Tierreich, Lief. 24, 1910, p. 648.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 36.

This species was described from four females captured at large in Florida. In cutting open galls of *Compsodryoxenus humilis* Weld (p. 236) some specimens were found with much longer larval cells than is characteristic of that species, and the flies ran to the genus *Bassettia*. They agree very well with the two types of *B. floridana* Ashmead in the United States National Museum (one pinned and one in balsam), except that in these fresh specimens the abdomen is longer than head and thorax together, while in the dry pinned type it equals thorax. The eight fresh flies measure 2.75–2.95 mm. The type *floridana* measures 2.6 mm. As the original description of *floridana* was brief, some further notes from the type specimens are here added and the associated gall described for the first time.

Host.—*Quercus chapmani* Sargent.

Gall.—Spindle-shaped enlargements at base of current year's shoots occurring in patches of runner oak in fall. (Plate 34, fig. 25.) In external appearance they can not be separated from galls of *Compsodry-*

oxenus humilis Weld, but the larval cells are ellipsoidal, 3.25 mm. long by 1.25 mm. in diameter, lying lengthwise just under the bark.

Female.—Head wider than thorax, second segment of antenna as broad as first and both flattened, abdomen longer than high, ovipositor when dissected out one and one-third times as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.3; antenna, 2.0; ovipositor, 2.8; wing, 3.3.

Habitat.—Ocala, Florida. Galls collected October 30, 1919. When cut open February 23, 1920, pupae and four transformed flies were found.

Genus COMPSODRYOXENUS Ashmead.

This genus is not closely related to *Rhodites*, as indicated in the Tierreich key on page 299, for the hypopygium is not ploughshare-shaped as in that genus. It is more closely related to *Solenozopheria* Ashmead and may be recognized by the use of Ashmead's key in Psyche (vol. 10, p. 155), where it is placed close to *Bassettia* Ashmead. Only two species have been described, both from twig galls, and three more are here added, also from slight twig swellings at the base of young sprouts underground. As access was had to the types of the described species, a key to the existing species in the genus is here presented.

1. Front wing with the normal pubescent surface and ciliate margin..... 3
Front wing very *short* pubescent and without the normal ciliate margin..... 2
2. Scutellum mostly rugose, slightly coriaceous on disk. Size 2.8–4.1 mm. Average 3.6 mm. California.....*maculipennis* Ashmead.
Scutellum disk coriaceous, rugose behind and on sides. Size 2.3–3.0 mm. Average 2.5 mm. Arizona.....*brunneus* Ashmead.
3. Wings clear.....*illinoisensis* Weld, p. 234.
Wings with basal vein clouded and a more or less distinct transverse cloud or spot on second cross-vein and areolet..... 4
4. Antennae 12-segmented, postocellar line shorter than ocellular, interocular area square or higher than broad.....*tenuis* Weld, p. 235.
Antennae 13-segmented, postocellar line longer than ocellular, interocular area at least 1.1 times as broad as high.....*humilis* Weld, p. 236.

32. COMPSODRYOXENUS ILLINOISENSIS, new species.

Plate 35, fig. 28.

Female.—Black with head, except eyes, antennae and legs brownish. Head broader than thorax, widened behind eyes, coriaceous, sparsely pubescent on face, axial line 0.58 of transfacial, interocular area 1.16 times as broad as high, malar space four-tenths length of eye and with fine groove, palpi 5- and 3-segmented, antennae 13-segmented, first, third, and fourth equal, 5-12 progressively shorter, last trifle more than one and one-half times preceding. Pronotum coriaceous on sides. Mesoscutum evenly coriaceous, only little longer than wide, parapsides faint, deeper posteriorly, lateral and anterior lines present. Scutellum coriaceous on disk becoming rugose behind, with a few

scattered setigerous punctures, arcuate furrow at base on which are several longitudinal ridges. Propodeum with two straight carinae inclosing a smooth area slightly longer than wide and wider at the top and with faint median ridge. Mesoploura coriaceous becoming polished on hind margin. Legs microscopically coriaceous also, all last tarsal segments infuscated, tarsal claws simple. Wings clear with brown veins, first and second cross-veins slightly clouded, areolet present, surface pubescent and margin ciliate. Abdomen much compressed, higher than long, smooth and polished, second segment occupying about half the length and with a few scattered hairs on each side at base. Hypopygium prominent, ventral spine twice as long as broad, ventral valves protruding at an oblique angle, ovipositor when dissected out nearly one and two-thirds as long as antenna. Using width of head as a base, the length of mesonotum ratio is 1.16; antenna, 2.5; ovipositor, 4.4; wing, 3.8.

Range in length of 23 pinned specimens is 1.8–2.7 mm. Average, 2.1 mm.

Type.—Cat. No. 22580, U. S. N. M. Type and 12 paratypes.

Host.—*Quercus macrocarpa* Michaux.

Gall.—Cells in the thickened bark at the crown of small sapling causing an abrupt swelling of four to five times the normal diameter of the shoot and extending for a distance of as far as 30 cm., or in bark at base of young shoots in such numbers as to cause a noticeable swelling. Almost wholly buried under the débris on forest floor. Resembles the gall of the sexual generation of *Callirytis futilis* (Osten Sacken) on roots of large trees of *Quercus alba*, except that cells are smaller.

Type locality.—Winnetka, Illinois. One gall was found October 22, 1914, and contained living adults. Another was found November 1, with adults emerging, and they continued to come out until November 11. Another gall was found at Fort Sheridan, Illinois, on October 3, 1914, and living flies were cut out of it on October 29.

33. COMPSODRYOXENUS TENUIS, new species.

Plate 36, fig. 29.

Female.—Species nearly black, head (except eyes) and thorax being more or less brownish, antennae and tarsi still lighter brown. Head broader than thorax, axial line 0.55 of transfacial, face closely punctate, frons and cheeks coriaceous, broadened slightly behind eyes, malar space one-fifth eye with parallel striae, interocular area not as wide as high, antennocular space less than ocellular, mandibles 2-toothed, palpi 5- and 3-segmented, antennae 12-segmented, first, third, and fourth equal, 7–11 getting gradually shorter and barrel-shaped, last a little over twice as long as preceding which is a

little longer than broad, distal two-thirds stout. Pronotum coriaceous on sides. Mesoscutum slightly longer than broad, coriaceous with distinct smooth parallel and lateral lines and well-separated parapsides obsolete anteriorly and in which are a few scattered punctures visible in balsam, separated from scutellum by a distinct suture. Scutellum rugose, with arcuate reticulate furrow at base. Propodeum with two parallel carinae inclosing a smoothish area in which is a faint median ridge, spiracular areas reticulate. Legs with hind tarsus shorter than tibia, claws simple. Wings with distinct brown veins, first abscissa of radius arcuate, areolet indistinct, surface pubescent, margin ciliate, a transverse clouded area extends from origin of radius nearly across wing, first cross-vein also slightly clouded. Abdomen strongly compressed, as deep or deeper than long, smooth and shining, hypopygium prominent with ventral spine about as long as broad, ventral valves protruding obliquely, ovipositor when dissected out longer than antenna, ovarian eggs well developed. Using width of head as a base, the length of mesonotum ratio is 1.25; antenna, 2.28; ovipositor, 3.1; wing, 3.4.

Length of 8 pinned specimens 1.7–2.1 mm. Average, 1.9 mm.

Type.—Cat. No. 22579, U. S. N. M. Four cotypes.

Host.—*Quercus fendleri* Liebmann.

Gall.—A slight gradual enlargement at crown of small saplings which are 3–15 mm. in diameter. The larval cells are not scattered uniformly but occur in nests of three or four to a dozen cells under the bark in a sort of depression or pocket in the wood.

The cells are white, brittle, thin-walled, about 2–3 mm. in diameter.

Type locality.—Trinidad, Colorado. The type galls were collected July 10, 1916. They then contained pupae, and when cut open September 16 living flies were obtained. Natural emergence date unknown. Similar but larger old galls were collected at Las Vegas, New Mexico.

34. COMPSODRYOXENUS HUMILIS, new species.

Female.—Nearly black; head, thorax, base of abdomen more or less brownish. Head broader than thorax, interocular area 1.1 times as broad as high, malar space nearly 0.4 eye and with parallel striae, palpi 5- and 3-segmented, antennae 13-segmented, first, fourth and fifth subequal, third slightly longer than first, last twice as long as preceding, flagellum darker distally. Pronotum coriaceous. Mesoscutum broader than long, coriaceous, parapsides faint, broadly separated behind. Scutellum rugose, with arcuate furrow at base without septum and not limited laterally, slightly margined behind. Propodeum with usual parallel ridges and a distinct median. All last tarsal segments infuscated, claws weak, simple, divergent. Wing with distinct dark veins, first abscissa of radius arcuate and about half length of second, areolet present, first cross-vein heavily clouded, large transverse cloud in radial area, surface pubescent, mar-

gin ciliate. Abdomen broader than long, smooth and polished, second segment occupying about half the length. Hypopygium prominent, ventral spine twice as long as broad, ventral valves protruding at an oblique angle, ovipositor when dissected out longer than antenna. Using width of head as a base, the length of mesonotum ratio is 1.2-1.3; antenna, 2.4; ovipositor, 3.1-3.3; wing, 3.2.

Range in length of 15 pinned specimens 1.9-2.2 mm. Average, 2.0 mm.

Type.—Cat. No. 22831, U. S. N. M. Type and 8 paratypes.

Host.—*Quercus chapmani* Sargent and *Quercus stellata* Wangenheim.

Gall.—A slight spindle-shaped enlargement at base of one-year-old sprouts in patches of runner oak. In autumn they are on current year's growth. Maximum diameter of gall is about twice that of normal shoot. Cells are scattered, not nested, just under the bark, about 1.5 by 2.0 mm. and extending about 1.25 mm. into the wood, the deeper part narrower.

Habitat.—Type locality, Ocala, Florida. The galls were collected October 30, 1919, in a patch of *Quercus chapmani*, Hopkins U. S. No. 15634c. These galls then contained larvae and pupae. The type fly was cut out January 12, 1920. Other galls were collected on same oak at Green Cove Springs, November 23, 1919, containing adults which were cut out on December 1. One gall was taken on *Quercus stellata* October 11 at Marianna, and lighter colored flies similar in structure were cut out December 6.

Genus BELONOCNEMA Mayr.

This genus is based on a species producing a fleshy root gall on live oak in Florida. Ashmead described it as *Dryorhizoxenus floridanus* and sent material to Europe where Mayr described it also. In Transactions American Entomological Society (vol. 13, p. 63), Ashmead acknowledges that Mayr's name of *Belonocnema treatae* has precedence. In Verhandlungen der kaiserlich-königlichen zoologisch-botanischen Gesellschaft in Wien (vol. 52, p. 287), Mayr states that the correct spelling of his genus is *Belonocnema*.

In Psyche (vol. 10, p. 150) Ashmead has erroneously placed the genus in that section of the key with undeveloped wings, whereas flies of both sexes have normal wings. He also erred in considering the palpi as 6- and 4-segmented. Balsam mounts of type material show that the maxillary palpi are 5- and the labial 3-segmented. If the scutellum is considered to have an arcuate furrow at the base without pits, the genus would run in the Ashmead key to *Dryocosmus*, and if bifoveolate as Ashmead stated to *Biorhiza*. From either it is easily separated by the characteristic spur at the apex of the front tibiae and by the clouded veins about the short marginal cell.

KEY TO DESCRIBED SPECIES.⁶

1. Spur on front tibia as long as metatarsus, twice as long as furcula. Middle tibia with distinct spur. Abdomen reaching far beyond apex of radial cell. No areolet.....*fossoria* Weld, p. 240.
- Spur on front tibia one-fourth length of metatarsus, not longer than furcula, No spur or middle tibia. Abdomen reaching only to base of radial cell. Areolet present..... 2
2. Thorax clear straw yellow. Females, 3.0-4.4 mm. Average of 23, 3.7 mm. Males 3.4-3.75 mm. Average of 9, 3.6 mm.....*treatae* Mayr. p. 238.
- Thorax dark brown. Agamic females, 2.0-3.1 mm. Average of 47, 2.7 mm.
kinseyi Weld, p. 241.

35. BELONOCNEMA TREATAE Mayr.

Dryorhizoxenus floridanus ASHMEAD Trans. Amer. Ent. Soc., vol. 9, 1881, Proc. p. xxv; vol. 12, 1885, p. 293; vol. 13, 1886, p. 63.

Belonocnema treatae MAYR Genera Gallenb. Cynip., 1881, p. 17; 20 Jahresber. Com. Oberrealsch. I Bez. Wien, 1881, p. 17 note.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 131.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 278, pl. 51, fig. 1.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 5, 36.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 54, fig. 65, I.

Belonocnema treatae Mayr, ASHMEAD, Trans. Amer. Ent. Soc., vol. 14, p. 133.—CRESSON, Syn. Amer. Hym., p. 174.—ASHMEAD, in Packard 5th Rept. U. S. Ent. Comm., p. 104.—DALLA TORRE and KIEFFER, Wytzman Gen. Ins. Cynipidae, 1902, p. 80, No. 2; Das Tierreich, Lief. 24, 1910, p. 725.

Belonocnema floridanus Ashmead CRESSON, Syn. Amer. Hym., 1887, p. 174.

The type galls of this species were found while ploughing under a live oak (*Quercus virginiana* Miller) in March. They were just below the surface on the small rootlets (up to 10 mm. in diameter) and in clusters every 4 or 5 inches. They are described as irregular, somewhat wedge-shaped, soft and fleshy, easily detached, of a yellowish color, the first true root gall to be described in this country. Two hundred flies were reared. The galls are still preserved in the United States National Museum, black or brownish and very similar to the dried galls of the sexual generation of *Trigonaspis*.

The writer has never seen the fresh galls, but on two occasions has found the dried-up galls of what was probably this species on the roots of *Quercus geminata* Small, at St. Petersburg and Clearwater, Florida, in November. In each case they were on the roots of saplings whose leaves bore immense numbers of globular, tan-colored galls, described in 1861 by Osten Sacken as *Cynips q. virens*. This suggests that these pea galls on leaf might be the alternating generation of *Belonocnema treatae*, but further observations or experimental evidence will be necessary to prove it. The type galls⁷ in the United States National Museum have a label in Doctor Ashmead's hand "agamic female of *B. treatae* Mayr," showing that he had already suspected this relationship. The writer also has reared adults from these leaf-pea galls and they prove to be all females and to belong

⁶ For discussion of *Belonocnema colorado* Gillette see p. 205.

⁷ Three agamic flies from Jacksonville, Florida, also bear the same label.

to the genus *Belonocnema*, thus strengthening the supposition. The writer thus proposes to transfer the maker of this oak leaf-pea gall to *Belonocnema*, leaving the proof of the association with *treatae* to others. It appears, however, that the maker of these pea galls is still undescribed. Ashmead reared a single fly in February supposedly from over 200 of these galls and described it as *Cynips q. virens*, transferring it to *Andricus* later, but the type fly in the United States National Museum has a question mark after the genus. This type is in bad condition, but agrees with the description, and is plainly a *Disholcaspis* and agrees with *Disholcaspis ficigera*, a gall of which had evidently been mixed in with the others by mistake, and such a gall was found in the Ashmead duplicate gall collection in a box of oak leaf-pea galls which may have been his breeding cage. Thus the single fly reared was associated with the wrong gall, a mistake which would not have occurred had the species been described from adequate material. As the classification of the Cynipidae must be based upon the adults rather than upon their work, the maker of the stem gall known in literature as *ficigera* must take the oldest name applied to it, namely, *virens*, and the maker of the leaf gall needs description. However the leaf-pea gall-fly of Florida proves to be different from those from similar galls in Texas so that there are two species to describe. Although somewhat outside the scope of the present paper, these changes are here included, and the synonymy of each species follows, together with field notes on each.

DISHOLCASPIIS VIRENS (Ashmead).

Cynips q. ficus ASHMEAD, Trans. Amer. Ent. Soc., vol. 9, 1881, Proc., p. 14, gall only.

Cynips q. ficigera ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, 1885, Proc., p. 6, female and gall.

Holcaspis ficigera ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, 1885, p. 296 (*Loxaulis* is typo. error); vol. 14, 1887, p. 132.—CRESSON, Syn. Amer. Hymen., 1887, p. 179.—ASHMEAD, in Packard 5th Rept. U. S. Ent. Comm., 1890, p. 106.—DALLA TORRE, Cat. Hymen., vol. 2, 1893, p. 56.—BRIDWELL, Trans. Kansas Acad. Sci., vol. 16, 1899, p. 204.—DALLA TORRE and KIEFFER in Wytsman Gen. Ins. Hymen. Cynipidae, 1902, p. 54.—BEUTENMUELLER, Bull. Amer. Mus. Nat. Hist., vol. 26, 1909, p. 40, pl. 8, figs. 2-5.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 10, 27, 39.

Disholcaspis quercus-ficigera Ashmead, DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, 379.

Disholcaspis ficigera Ashmead, FELT, Key to Amer. Ins. Gall, N. Y. St. Mus., Bull. 200, 1918, p. 71, fig. 64, 2-5.

Host.—*Quercus virginiana* Miller and *Quercus geminata* Small.

Habitat.—The writer has collected galls on *Quercus virginiana* at Jacksonville, Gainesville, Ocala, Cottondale, Marianna, River Junction, Carrabelle, Live Oak, and Daytona, Florida; Savannah, Georgia; and Cuero, Texas. He has galls from Mobile Bay (James Hayes), Billy Island, Georgia (Dr. J. C. Bradley); and Victoria County, Texas

(J. D. Mitchell). He has collected galls on *Quercus geminata* at Carabelle, Clearwater, and Daytona Beach, Florida.

Biology.—Growing galls are found in October secreting honey-dew and frequented by flies, wasps, and yellow jackets. Galls from Texas sent to Evanston, Illinois, gave flies December 14. Others remained inside the galls and were cut out alive on December 20 and February 6. Under natural conditions emergence is probably in late fall. When attacked by quest-flies, which make cells in distal parts of the gall, the size of the gall is much reduced.

BELONOCNEMA FOSSORIA, new species.

Cynips q. virens OSTEN SACKEN, Proc. Ent. Soc. Phila., vol. 1, 1861, p. 57, No. 2, gall only.—ASHMEAD, Trans. Amer. Ent. Soc., vol. 9, 1881, Proc., p., 10.

Andricus virens ASHMEAD, Trans. Amer. Ent. Soc., vol. 12, 1885, p. 295; vol. 14, 1887, p. 127.—CRESSON, Syn. Amer. Hymen., 1887, p. 176.—ASHMEAD, in Packard 5th Rept. U. S. Ent. Comm., 1890, p. 106.—COCKERELL, Entomologist, vol. 23, 1890, p. 74.—DALLA TORRE, Cat. Hym., vol. 2, 1893, p. 103.—DALLA TORRE and KIEFFER, in Wytsman Gen. Ins. Hym. Cynipidae, 1902, p. 65.—THOMPSON, Cat. Amer. Ins. Galls, 1915, p. 16, 29, 34.—FELT, Key to Amer. Ins. Galls, N. Y. St. Mus., Bull. 200, 1918, p. 95.

Andricus quercus-virens Ashmead, DALLA TORRE and KIEFFER, Das Tierreich, Lief. 24, 1910, p. 547.

Agamic female.—Uniformly reddish. Head quadrangular, width 2.8 times length of eye. Interocular space 0.72 transfacial and area twice as broad as high. Facial line 0.82 times transfacial. Malar space 0.63 eye, groove shallow. Palpi 5 and 3. Antennae 13; lengths as 19:7:19:13:11:10:10:10:9:9:9:9:18. On same scale width from 7 to end is 8. Mesoscutum smooth and polished, grooves percurrent. Scutellum faintly margined, disk granulate. Wing longer than abdomen but reduced, veins about radial cell clouded, no areolet, pubescent and ciliate. Legs short and stout, evidently adapted for digging, furcula of fore tibia reaching beyond middle of metatarsus, spur on middle tibia as long as normal spines, claws simple. Hypopygium short, ventral spine broad, short. Ovipositor longer than antenna, stout. Using width of the head as a base the length of mesonotum ratio is 1.1, antenna, 1.8-2.0, ovipositor 1.9-2.2, wing 2.6-2.9. Range in length of 22 pinned specimens 2.3-3.1 mm. Average 2.7 mm.

Type.—Cat. No. 24099, U.S.N.M. Type and 10 paratypes.

Host.—*Quercus geminata* Small, and *Quercus virginiana* Miller.

Gall.—Globular, hard, tan-colored galls occurring in numbers on the under side of the leaf. Monothalamous, 4-6 mm. in diameter, of dense cellular tissue.

Habitat.—The type material is from galls collected at Clearwater, Florida, November 7, 1919, on *geminata* and sent in as Hopkins U. S. No. 15634¹. Flies issued December 8. Three paratypes from Jacksonville are probably from *virginiana*. The writer has seen galls at

Jacksonville, Daytona, Tallahassee, and Gainesville on *virginiana* and on *geminata* at St. Petersburg and Daytona Beach. Dr. J. C. Bradley has collected galls at St. Simon's Island, Georgia.

BELOCNEMA KINSEYI, new species.

Agamic female.—Reddish-brown, thorax darker. Head broader than thorax, width 2.4 times length of eye, finely coriaceous, malar space with groove and less than half length of eye, antennocular space two-thirds ocellular, interocular area nearly 1.6 times as broad as high, transfacial line 1.1–1.2 times facial, palpi 5- and 3-segmented, antennae 13-segmented, third one and two-thirds times fourth, 4–12 gradually shorter, last just over twice preceding. Pronotum with scattered punctures bearing white hairs. Mesonotum shining, smooth, bare except for a few setigerous punctures along the complete, deep, narrow parapsides, anterior and lateral lines very faint. Scutellum rugose behind and on sides of disk, with scattered setigerous punctures; base with two smooth distinct pits, sides with triangular rugose impressions. Propodeum with two strongly curved irregular ridges inclosing a rugose area. Front tibia prolonged on one side into a curved spine ending in a short blunt spine and almost as long as the normal forked spine on the other side. Hind tarsus shorter than tibia, second shorter than fifth, tarsal claws simple. Wings hyaline, veins brown, second cross-vein heavily clouded, second abscissa of radius strongly bent and thickened at apex, areolet small and indistinct, cubitus reaching basal, surface brown pubescent and margin ciliate. Abdomen smooth and shining, compressed, longer than high, second segment with dorsal darker area and patch of scattered hairs on sides, ventral spine about as long as broad, ovipositor three-fourths length of antenna, eggs well developed. Using the width of the head as a base, the length of antenna ratio is 2.3–2.5; length of mesonotum ratio, 1.3; wing, 3.8–3.9; ovipositor, 1.8–2.0.

Range in length of 62 pinned specimens, 2.0–3.1 mm. Average, 2.7 mm.

Mr. A. C. Kinsey was the first to call the writer's attention to the fact that adults bred from these leaf galls did not agree with the description of *Andricus virens* Ashmead. Later an examination of the type of *virens* showed it to be a *Disholcaspis*.

Type.—Cat. No. 22832, U. S. N. M. Twenty-seven cotypes. Fifteen cotypes are in collection of William Beutenmueller.

Host.—*Quercus virginiana* Miller.

Gall.—Similar to those of *Belonocnema fossoria* Weld.

Habitat.—The type material is from *Quercus virginiana* collected October 26, 1917, at Boerne, Texas. The galls then contained pupae and adults. Flies emerged in cage before November 15, and

one more was found alive in cage March 23, 1918. These galls were also seen at Houston, Wharton, Victoria, Cuero, and Austin, Texas, in October, 1917, and at Sabinal and Kerrville, Texas, in July, 1918. The galls are found full grown by the end of July, contain pupae in October, and adults emerge in November.

36. WELD 405.

Plate 37, fig. 32.

Host.—*Quercus rubra* Linnaeus and *Quercus nigra* Linnaeus.

Gall.—A polythalamous, somewhat globose, gall with a smooth brown surface, 15 mm. in diameter, attached at the crown and hidden under humus. When mature the epidermis disintegrates revealing a cluster of whitish, longitudinally ridged, relatively large woody cells.

Habitat.—Old galls were collected at Ironton, Missouri, on *Quercus rubra* October 5, 1917, and at Gainesville, Florida, October 23, 1919, on *Quercus nigra*.

37. WELD 704.

Host.—*Quercus fendleri* Leibmann.

Gall.—Cylindrical, acuminate at apex, thin-walled, smooth, 5 mm. long by 2 mm. in diameter, attached near fork at base of small sprouts at surface of ground, very easily detached.

Habitat.—Collected at Trinidad, Colorado, July 11, 1916, and one at Morley, Colorado, April 2, 1918.

38. WELD 706.

Host.—*Quercus gambelii* Nuttall and probably other Rocky Mountain oaks.

Gall.—Cluster of several dozen hairy brown cells that are probably fleshy when fresh, at end of vigorous etiolated shoots coming up under loose stone piles or under mass of humus. It is probably a spring gall. The clusters measure up to 2-3 cm. in diameter.

Habitat.—Collected old galls in July, 1916, at Trinidad, Colorado; Las Vegas, and Rito de los Frijoles near Buckman, New Mexico; Grand Canyon and Flagstaff, Arizona.

39. WELD 707.

Plate 37, fig. 35.

Host.—*Quercus emoryi* Torrey.

Gall.—Similar in size and appearance to that of *Eumayria floridana* Ashmead.

Habitat.—Old galls found at Prescott, Arizona, April 13, 1918.

40. WELD 708.

Host.—A deciduous oak.

Gall.—On under side of main root in clump of small bushes, single, or if clustered only one well developed, 5 mm. in diameter, surface brown, hairy, wall thin and cavity large.

Habitat.—Collected at Las Vegas, New Mexico, April 4, 1918.

41. WELD 1501.

Plate 37, fig. 33.

Host.—*Quercus agrifolia* Née, *Quercus wislizeni* A. de Candolle
Quercus californica Cooper.

Gall.—Abrupt oblong swellings at base of sprouts which are only a few millimeters in diameter. The gall may measure 25–35 mm. in diameter by 35–75 mm. long. It is hard and woody when dry, covered with normal brown bark which is not much thickened. Cells radially arranged in pockets in the wood. Exit holes with a characteristic smooth ring.

Habitat.—The writer has collected old galls on *Quercus wislizenii* on Mount Tamalpais, in San Gabriel and San Antonio River canyons in San Gabriel Mountains, in Ojai Valley, and at Santa Margarita, California; on *Quercus agrifolia* at Newhall, near Carpinteria, at Santa Margarita, Paso Robles, Paraiso Springs, Monterey, and Los Gatos; on *Quercus californica* at Dunsmuir and in Sequoia National Park. Fresh galls nearly full grown but too immature for rearing were seen only once at Monterey, on May 11, 1918.

42. WELD 407.

Plate 37, fig. 36.

Host.—*Quercus laceyi* Small.

Gall.—Dried-up galls, 5 mm. in diameter, were found at base of stump in the late fall. They were globular, with a slight pedicel, produced in a cluster. Probably a fleshy spring gall of the *Trigonaspis* type.

Habitat.—Boerne, Texas.

43. WELD 408.

Plate 37, fig. 34.

Host.—*Quercus laceyi* Small and *Quercus virginiana* Miller.

Gall.—Confluent, globular, dried-up galls, 4 mm. in diameter, in a small cluster, pubescent on surface. Found in fall on young shoots of live oak buried under thick bed of dead leaves and on *laceyi* attached to a large root.

Habitat.—Boerne and Cuero, Texas.

EXPLANATION OF PLATES.

Figures natural size except where otherwise noted.

PLATE 28.

- FIG. 1. Galls of *Disholcaspis acetabula* Weld.
2. Galls of *Disholcaspis lacuna* Weld.
3. Galls of *Disholcaspis terrestris* Weld on *Q. stellata*.

PLATE 29.

- FIG. 4. Galls of *Disholcaspis globosa* Weld.
5. Fresh galls of *Dryocosmus fавus* Beutenmueller on *Q. rubra*.
6. Same. Old gall on *Q. catesbaei*.
7. Same. Individual galls cut longitudinally, $\times 5$.

PLATE 30.

- FIG. 8. Galls of *Trigonaspis radicola* Ashmead.
9. Galls of *Biorhiza caepuliformis* (Beutenmueller).
10. Galls of *Xystoteras contorta* Weld on *Q. breviloba*.
11. Same. On *Q. stellata*.

PLATE 31.

- FIG. 12. Galls of *Odontocynips nebulosa* Kieffer.
13. Gall of *Andricus championi* Ashmead.

PLATE 32.

- FIG. 14. Galls of *Andricus rhizoxenus* (Ashmead) on *Q. reticulata*.
15. Galls of *Callirhytis hartmani* Weld.
16. Galls of *Callirhytis coralloso* Weld on *Q. chapmani*.
17. Same. On *Q. macrocarpa*.

PLATE 33.

- FIG. 18. Galls of *Callirhytis maxima* Weld.
19. Galls of *Callirhytis enigma* Weld on *Q. catesbaei*.
20. Same. Individual old galls, $\times 5$.
21. Galls of *Callirhytis futilis* Osten Sacken (Agamic generation).

PLATE 34.

- FIG. 22. Galls of *Callirhytis apicalis* (Ashmead).
23. Galls of *Callirhytis ovata* Weld.
24. Galls of *Callirhytis fulva* Weld.
25. Galls of *Bassettia floridana* Ashmead, $\times 2$.

PLATE 35.

- FIG. 26. Gall of *Callirhytis elliptica* Weld, $\times 5$.
27. Galls of *Eumayria floridana* Ashmead.
28. Gall of *Compsodryoxenus illinoisensis* Weld.

PLATE 36.

- FIG. 29. Galls of *Compsodryoxenus tenuis* Weld.
30. Galls of *Callirhytis ellipsoida* Weld.
31. Galls of *Callirhytis rubida* Weld.

PLATE 37.

- FIG. 32. Weld 405.
33. Weld 1501.
34. Weld 408.
35. Weld 707.
36. Weld 407.



acetabula.



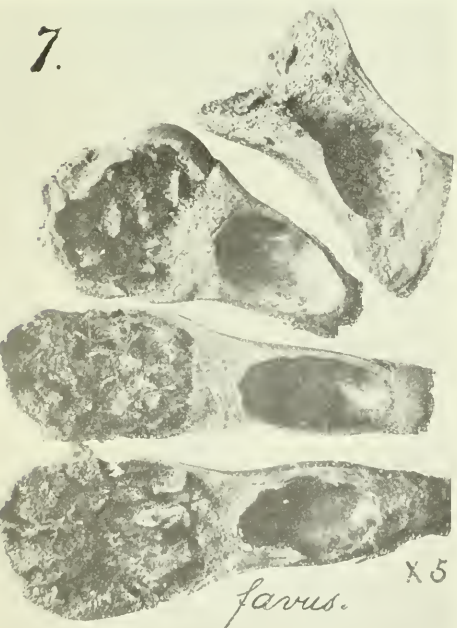
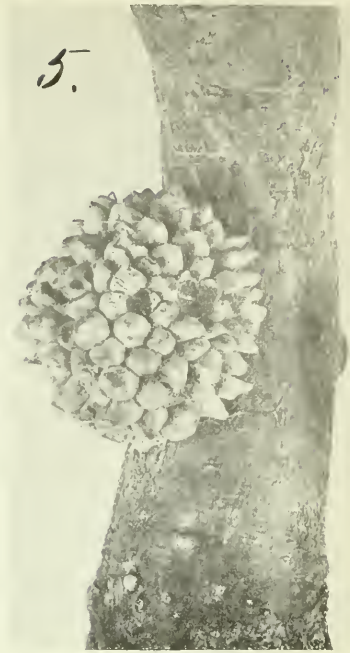
lacuna.



terrestris.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



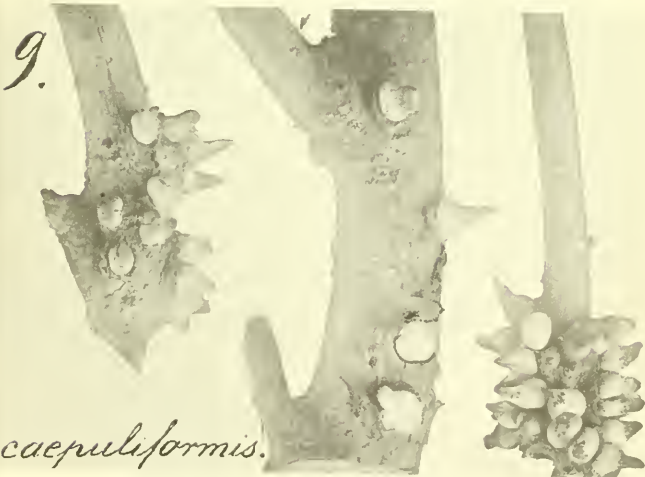
radicola.



contorta.



contorta.



caepuliformis.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.

12.



nebulosa.

neb.

13.



championi.

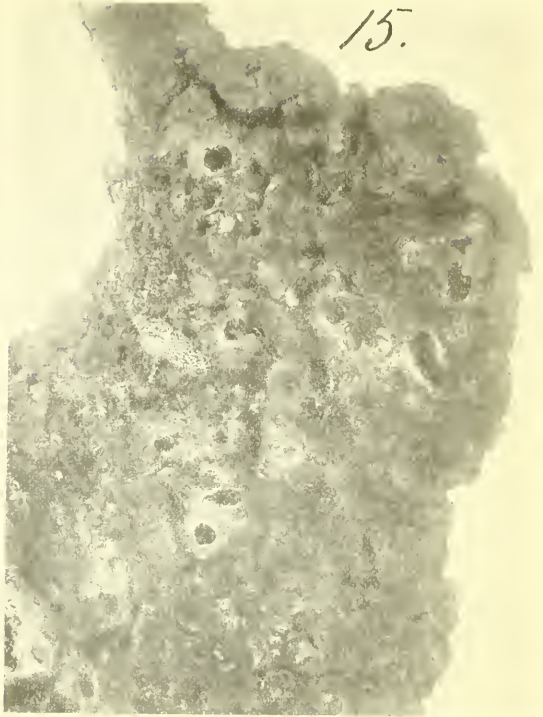
AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



16.

corallosa.



15.

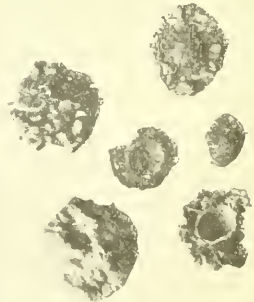
hartmani.

14.



rhinoxenus.

17.

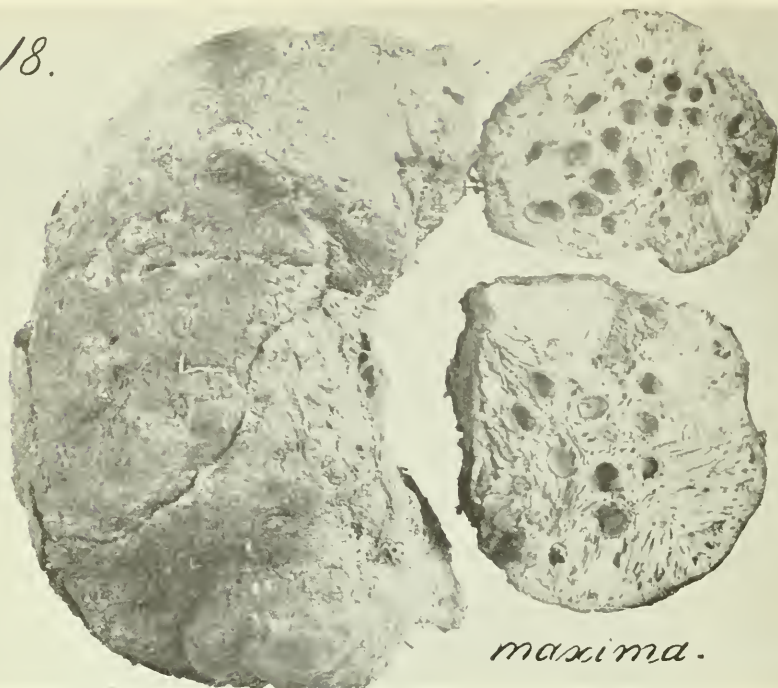


corallosa.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.

18.



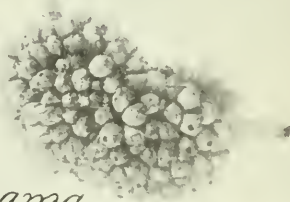
maxima.

21.



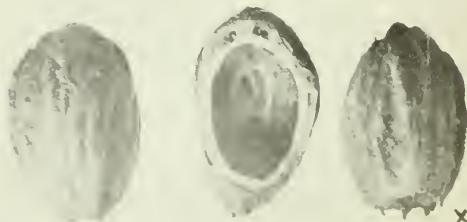
fertilis.

19.



enigma.

20.

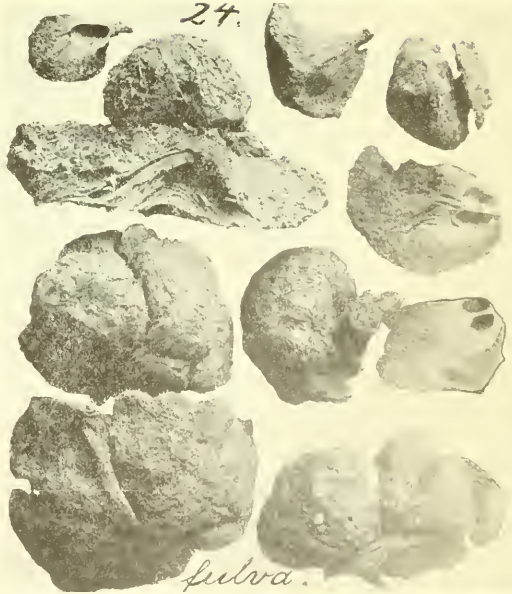
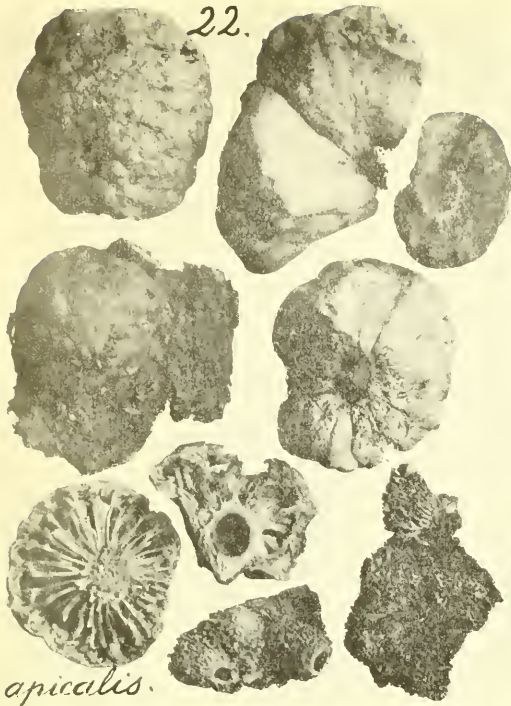


X5

enigma.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.

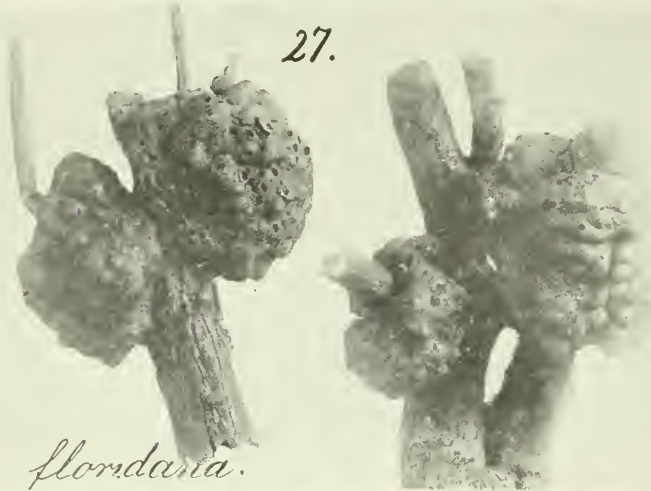
26.



X5

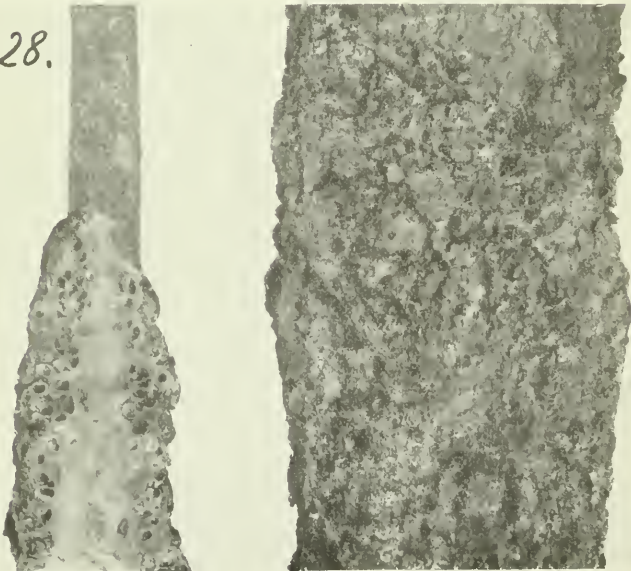
elliptica.

27.



floridana.

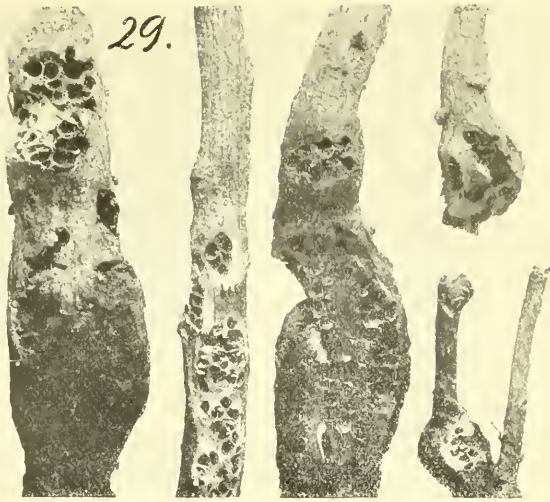
28.



illinoisensis.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.



29.

tenuis.



30.

ellipsoidea.



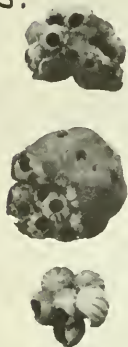
31.

resubida.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

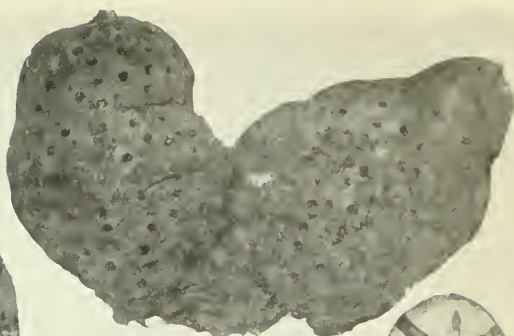
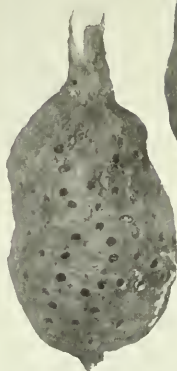
FOR EXPLANATION OF PLATE SEE PAGE 244.

32.



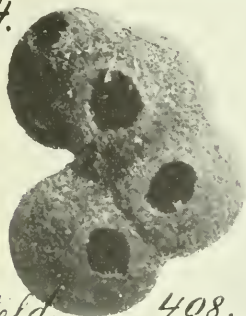
Weld 405.

33.



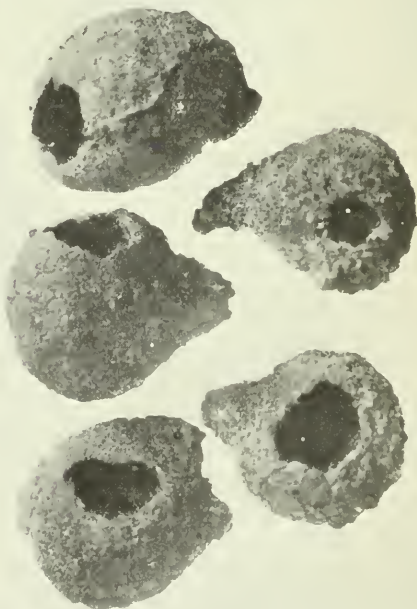
Weld 1501.

34.



Weld 408.

36.



Weld 407.

35.



Weld 707.

AMERICAN GALLFLIES OF THE FAMILY CYNIPIDAE.

FOR EXPLANATION OF PLATE SEE PAGE 244.

SPECIES INDEX.

This index includes all species referred to in this paper. Generic names are in bold face and synonyms in italics.

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<i>Q. alba</i>elliptica, coralloso, futilis (agamic), globosa, maxima, radicola.
<i>Q. arizonica</i>rhizoxenus.
<i>Q. bicolor</i>.....	.coralloso, ellipsoida, maxima.
<i>Q. brevifolia</i>.....	.caepuliformis, floridana (Eumayria), favus.
<i>Q. breviloba</i>.....	.brevinota, contorta.
<i>Q. californica</i>.....	.apicalis, See Weld 1501.
<i>Q. catesbaei</i>.....	.caepuliformis, enigma, floridana (Eumayria), favus, ovata.
<i>Q. chapmani</i>.....	.coralloso, floridana (Bassettia), humilis, ocala, radicola.
<i>Q. chrysolepis</i>.....	.fulva, hartmani.
<i>Q. coccinea</i>.....	.favus, floridana (Eumayria), marginata, rubida.
<i>Q. douglasii</i>.....	.obconica.
<i>Q. emoryi</i>.....	.See Weld 1501.
<i>Q. falcata</i>.....	.caepuliformis, floridana (Eumayria).
<i>Q. fendleri</i>.....	.tenuis, See Weld 1501.
<i>Q. gambelii</i>.....	.acetabula, fumosa, lacuna, tenuana. See Weld 706.
<i>Q. geminata</i>.....	.fossoria, treatae, virens.
<i>Q. grisea</i>.....	.See acetabula.
<i>Q. laceyi</i>.....	.See Weld 407 and Weld 408.
<i>Q. laurifolia</i>.....	.caepuliformis, floridana (Eumayria).
<i>Q. lyrata</i>.....	.See nebulosa.
<i>Q. macrocarpa</i>.....	.coralloso, illinoisensis, maxima.
<i>Q. margaretta</i>.....	.terrestris. See ocala.
<i>Q. marilandica</i>.....	.caepuliformis, favus, floridana (Eumayria).
<i>Q. myrtifolia</i>.....	.caepuliformis, enigma, favus, floridana (Eumayria), ovata.
<i>Q. nigra</i>.....	.favus. See Weld 405.
<i>Q. oblongifolia</i>.....	.rhizoxenus.
<i>Q. phellos</i>.....	.See enigma.
<i>Q. prinus</i>.....	.coralloso, futilis (agamic), maxima. See globosa.
<i>Q. reticulata</i>.....	.See acetabula, fumosa, rhizoxenus.
<i>Q. rubra</i>.....	.caepuliformis, enigma, favus, floridana (Eumayria), rubida. See Weld 405.
<i>Q. stellata</i>.....	.contorta, coralloso, humilis, nebulosa, terrestris. See radicola. Perhaps maxima.
<i>Q. texana</i>.....	.caepuliformis, enigma, favus, floridana (Eumayria), ovata.
<i>Q. toumeyii</i>.....	.rhizoxenus. See acetabula.
<i>Q. velutina</i>.....	.caepuliformis, floridana (Eumayria).
<i>Q. virginiana</i>.....	.fossoria, kinseyi, treatae, virens. See nebulosa, Weld 408.
<i>Q. wislizeni</i>.....	.apicalis. See Weld 1501.
<i>Q. species in Utah and Colorado</i>.....	.pumiliventris.
<i>Q. species in Mexico</i>.....	.championi.